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Informe de resultados de la Cuestión 3/1 del UIT-D

Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes

Periodo de estudios 2022-2025

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Las Comisiones de Estudio del Sector de Desarrollo de las Telecomunicaciones de la UIT (UIT-D) constituyen una plataforma neutral en la que expertos de gobiernos, del sector privado, de organizaciones de telecomunicaciones y de instituciones académicas de todo el mundo se reúnen para elaborar herramientas y recursos prácticos a fin de abordar problemas del desarrollo. En ese contexto, las dos Comisiones de Estudio del UIT-D se encargan de elaborar informes, directrices y recomendaciones basados en las aportaciones que reciben de los miembros. Las Cuestiones de estudio se deciden cada cuatro años en la Conferencia Mundial de Desarrollo de las Telecomunicaciones (CMDT). Los miembros de la UIT, reunidos en la CMDT-22 en Kigali en junio de 2022, acordaron que, de cara al periodo de estudios 2022-2025, la Comisión de Estudio 1 se ocuparía de siete cuestiones enmarcadas en el ámbito del "entorno habilitador para una conectividad efectiva".

El presente Informe se ha elaborado en respuesta a la Cuestión 3/1: **Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes**, bajo la dirección y coordinación generales del equipo directivo de la Comisión de Estudio 1 del UIT-D, presidida por la Sra. Regina Fleur Assoumou-Bessou (República de Côte d'Ivoire), con el apoyo de los siguientes Vicepresidentes: Sr. Ali Rasheed Hamad Al-Hamad (Estado de Kuwait), Sr. Amah Vinyo Capo (República Togolesa), Sr. George Anthony Giannoumis (Noruega), Sr. Roberto Mitsuake Hirayama (República Federativa de Brasil), Sr. Sangwon Ko (República de Corea), Sra. Umida Musaeva (República de Uzbekistán), Sra. Caecilia Nyamutswa (República de Zimbabwe), Sra. Memiko Otsuki (Japón), Sra. Khayala Pashazade (República de Azerbaiyán), Sr. Sunil Singhal (República de India) y Sr. Mehmet Alper Tekin (República de Türkiye).

El informe ha sido redactado por los Correlatores para la Cuestión 3/1, la Sra. Alison Balzer (Estados Unidos de América) y el Sr. Serigne Abdou Lahatt Sylla (República de Senegal), en colaboración con los siguientes Vicerrelatores: Sr. Hideo Imanaka (Japón), Sra. Muberra Bingol (República de Türkiye), Sra. Jingli Wang (República Popular de China), Sr. N'guessan Tchissou Jean Roger Koffi (República de Côte d'Ivoire), Sra. Ruth Kariuki (República de Kenya), Sr. Abdelwaheb Galizra (República Democrática Popular de Argelia), Sr. Edva Altemar (República de Haití), Sr. Gökhan Tok (Access Partnership Ltd, Reino Unido de Gran Bretaña e Irlanda del Norte) y Sr. Giquel Thérance Sassa (República de Camerún).

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La Comisión de Estudio 1 del Sector de Desarrollo de las Telecomunicaciones de la UIT (UIT-D) se complace en presentar el Informe final relativo la Cuestión 3/1 (Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofe), en el que prosiguen los estudios sobre situaciones de catástrofe de la antigua Cuestión 5/2 del anterior periodo de estudios (2014-2022). El informe se basa en contribuciones de los Estados Miembros y Miembros de Sector del UIT-D, así como en debates mantenidos entre los mismos a lo largo del periodo de estudios 2022-2025. En el Informe se ofrece una visión general de las telecomunicaciones y tecnologías de la información y la comunicación (TIC) para la reducción y gestión del riesgo de catástrofe y se describe una serie de tecnologías y estudios de caso sobre políticas presentados por diversas administraciones y organizaciones en relación con el uso de TIC incipientes en todas las fases de una situación de catástrofe.

El alcance y la gravedad de los peligros naturales aumentan cada año como consecuencia del cambio climático a escala mundial. Las catástrofes provocan graves daños adversos en las sociedades, y alteran el funcionamiento habitual de la vida social y económica. Habida cuenta de que las catástrofes repentinas no pueden predecirse, la resiliencia frente a las mismas, la reducción y gestión de riesgos, en particular los sistemas de alerta temprana y avisos, la realización de simulacros y ejercicios frente a catástrofes, las tecnologías de comunicación de catástrofes y la formulación políticas propicias son fundamentales para salvar vidas humanas y mitigar los efectos adversos en las sociedades.

Las telecomunicaciones y las TIC desempeñan un papel primordial en la reducción y gestión del riesgo de catástrofes. Para lograr resultados eficaces a tal efecto, es necesario que las partes interesadas compartan oportuna y eficazmente información, experiencias y conclusiones extraídas. Las TIC pueden utilizarse como apoyo en todas las fases de una situación de catástrofe en todo el mundo para reducir la pérdida de vidas y bienes.

La elaboración de normativas eficaces desempeña un papel esencial en la formulación general y la aplicación de los planes nacionales de telecomunicaciones de emergencia (PNTE). En consecuencia, el entorno político y normativo debe diseñarse para propiciar y facilitar actividades de preparación y respuesta eficaces. Es necesario contar con políticas para el despliegue de sistemas de comunicaciones de emergencia, la emisión de alertas tempranas y la continuidad de los servicios de comunicaciones, así como para facilitar la adopción de medidas de respuesta más eficaces. Deben diseñarse teniendo en cuenta la accesibilidad de las comunicaciones y, por lo tanto, deben ser inclusivas, a fin de abarcar todos los niveles sociales. Habida cuenta de ello, conviene mantenerse al día de los avances más recientes en materia de tecnologías de comunicación para hacer frente a catástrofes, aspecto que se aborda en el Capítulo 5 del presente informe.

En resumen, este informe se compone de los siguientes siete capítulos:

- En el **Capítulo 1** se esboza el alcance del informe y se ofrece una breve visión general de la función de las telecomunicaciones y las TIC en el conjunto de etapas de gestión de catástrofes.

- En el **Capítulo 2** se abordan los sistemas de alerta temprana y avisos y la utilización de las TIC en su planificación, así como el despliegue de sistemas de alerta temprana para la reducción de riesgos de catástrofe, los sistemas de radiodifusión de alertas de emergencia (EWBS) y los sistemas de información y socorro en caso de catástrofe.
- El **Capítulo 3** resume las directrices necesarias para preparar y realizar simulacros de catástrofe, ejercicios de resiliencia y pruebas de resistencia.
- El **Capítulo 4** proporciona una visión general de normativas y entornos reglamentarios propicios, incluidas las políticas para el despliegue de sistemas de comunicación de emergencias y de alerta temprana, a fin de facilitar la continuidad de los servicios de comunicaciones y la adopción de medidas de respuesta más eficaces.
- El **Capítulo 5** analiza las tecnologías de comunicación en caso de catástrofe y la resiliencia de las redes.
- El **Capítulo 6** presenta varios estudios de casos por país y sector industrial con arreglo a las contribuciones de los miembros del UIT-D.
- El **Capítulo 7** aborda las prácticas idóneas y las lecciones extraídas, así como las directrices propuestas a lo largo del periodo de estudios.

Abreviaturas y acrónimos

Abreviatura	Término
AMNT	Asamblea Mundial de Normalización de las Telecomunicaciones
ANT	aeronave no tripulada
BTK	Bilgi Teknolojileri ve İletişim Kurumu (Organismo Regulador de las Telecomunicaciones deTürkiye)
CAP	Protocolo de alerta común (*common alerting protocol*)
CB	radiodifusión celular (*cell broadcast*)
CBS	servicio de radiodifusión celular (*cellular broadcast service*)
CECE	Código Europeo de Comunicaciones Electrónicas
CMDT	Conferencia Mundial de Desarrollo de las Telecomunicaciones
CMR	Conferencia Mundial de Radiocomunicaciones
CMSI	Cumbre Mundial sobre la Sociedad de la Información
COTS	Disponibles comercialmente (*commercial off-the-shelf*)
COVID-19	Enfermedad por coronavirus-2019
CREWS	sistemas de alerta temprana de riesgos climáticos (*climate risk early warning systems*)
D2D	directo al dispositivo (*direct-to-device*)
D2H	directo al terminal portátil (*direct-to-handset*)
DCM	mapa de conectividad en caso de catástrofe (*disaster connectivity map*)
EIRD	Estrategia Internacional de las Naciones Unidas para la Reducción de los Desastres
ETC	Grupo Temático de telecomunicaciones de emergencia
ETC-PMA	Grupo Temático de Telecomunicaciones de Emergencia del Programa Mundial de Alimentos
EW4ALL	Sistemas de Alerta Temprana para Todos de las Naciones Unidas (*UN early warning systems for all*)
EWBS	Sistema de radiodifusión de alertas de emergencia (*emergency warning broadcasting system*)
EWS	Sistema de alerta temprana (*early warning system*)
FG-AI4NDM	Grupo Temático de la UIT sobre inteligencia artificial para la gestión de catástrofes naturales
GIS	Sistema de información geográfica (*geographic information system*)
GSMA	Asociación GSM

(continuación)

Abreviatura	Término
HAPS	Sistemas en plataformas a gran altitud (*high-altitude platform system*)
IA	Inteligencia artificial
IoT	Internet de las cosas
LB-SMS	SMS basados en la localización (*location-based-SMS*)
M2M	máquina a máquina
MWC	Mobile World Congress
ODS	Objetivos de Desarrollo Sostenible de las Naciones Unidas
OMM	Organización Meteorológica Mundial
ONG	organización no gubernamental
ORM	Operadores de redes móviles
PEID	pequeños Estados insulares en desarrollo
PNTE	Plan nacional de telecomunicaciones de emergencia
PPDR	Protección pública y operaciones de socorro (*public protection and disaster relief*)
QoS	calidad de servicio (*quality of service*)
RIFEN	Réseau International des Femmes Expertes du Numérique
ROI	rendimiento de la inversión (*return on investment*)
SAS	Satélite de Asia Meridional (*south asia satellite*)
SMART	supervisión científica y telecomunicaciones fiables (*science monitoring and reliable telecommunications*)
SNS	servicios de redes sociales (*social networking services*)
TIC	Tecnología de la información y la comunicación
TTX	ejercicios de simulación teórica (*tabletop simulation exercises*)
UDSEP	Estrategia y Plan de comunicación a escala nacional frente a seísmos (*national earthquake strategy and action plan*)
UIT	Unión Internacional de Telecomunicaciones
UIT-D	Sector de Desarrollo de las Telecomunicaciones de la UIT
UIT-R	Sector de Radiocomunicaciones de la UIT
UIT-T	Sector de Normalización de las Telecomunicaciones de la UIT
UNDRR	Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres
VTOL	Despegue y aterrizaje en vertical (*vertical take-off and landing*)

Capítulo 1 – Introducción

1.1 Antecedentes

En diversas resoluciones de la Conferencia de Plenipotenciarios de la UIT, la Conferencia Mundial de Desarrollo de las Telecomunicaciones (CMDT), la Asamblea Mundial de Normalización de las Telecomunicaciones (AMNT) y la Conferencia Mundial de Radiocomunicaciones (CMR), así como en varios informes de los Sectores de Desarrollo de las Telecomunicaciones (UIT-D), Normalización de las Telecomunicaciones (UIT-T) y Radiocomunicaciones (UIT-R) de la UIT, se ha hecho hincapié en la función de las telecomunicaciones y las TIC en las actividades de preparación, emisión de alertas tempranas, rescate, mitigación de riesgos, socorro y respuesta en situaciones de catástrofe. Por otro lado, las líneas de acción de la Cumbre Mundial sobre la Sociedad de la Información (CMSI), los Objetivos de Desarrollo Sostenible (ODS) de las Naciones Unidas, varias resoluciones de la Estrategia Internacional de las Naciones Unidas para la Reducción de Desastres (EIRD) y el Marco de Sendai para la Reducción del Riesgo de Desastres 2015-2030, reconocen la necesidad de reducir el riesgo de catástrofes y de poner en marcha infraestructuras sostenibles y resilientes, en particular la función primordial que las TIC pueden desempeñar a los efectos de asistencia humanitaria, protección pública y operaciones de socorro.

En sus esfuerzos por facilitar la preparación a escalas nacional y regional frente a peligros naturales y catástrofes provocadas por el hombre[1], la UIT ha abogado sistemáticamente por la utilización de las telecomunicaciones y las TIC para facilitar actividades de preparación, mitigación de riesgos, adopción de medidas de respuesta y recuperación en caso de catástrofe, y a tal efecto ha fomentado la colaboración a escalas regional y mundial y el intercambio de experiencias. En el anterior periodo de estudios (2018-2021), la Cuestión 5/2 del UIT-D examinó varios aspectos de los sistemas de alertas tempranas, las actividades de preparación frente a catástrofes, la planificación de las comunicaciones en caso de catástrofe, su gestión y las medidas de respuesta conexas [Informe final b-C5/2]. A lo largo del periodo de estudios 2022-2025, la Cuestión 3/1 hizo hincapié en la utilización de las telecomunicaciones y las TIC, incluidas las nuevas tecnologías para la reducción y gestión del riesgo de catástrofes, en particular en cuanto a aspectos de resiliencia.

1.2 Alcance del Informe

El presente informe tiene por objeto proporcionar prácticas idóneas e informar sobre conclusiones extraídas en relación con la aplicación de las telecomunicaciones y las TIC para la emisión de alertas tempranas, adopción de medidas de respuesta y socorro en caso de catástrofe, en particular en cuanto a resiliencia de la infraestructura de redes, y la elaboración de entornos normativos para facilitar su despliegue y aplicación de forma rápida. El informe abarca experiencias de países y estudios de caso sobre medidas de preparación y respuesta ante catástrofes, y mitigación de sus efectos. En cuanto al desarrollo de planes nacionales de

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1 Según la Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres (UNDRR), véase https://www.undrr.org/our-impact/campaigns/no-natural-disasters, debe evitarse la utilización del término "catástrofes naturales". Las catástrofes son el resultado de peligros naturales conjugados con vulnerabilidades. Una catástrofe es el resultado de la interacción de peligros naturales con factores humanos y medioambientales que dan lugar a sucesos catastróficos.

comunicación en caso de catástrofe, se examinan los temas habituales y prácticas idóneas. El Informe abarca cuatro amplios aspectos:

- sistemas de alerta temprana y avisos;
- simulacros y pruebas de resiliencia y resistencia;
- elaboración de entornos normativos y reglamentarios propicios;
- tecnologías de comunicación en caso de catástrofe y resiliencia de redes.

Los estudios de caso y las prácticas idóneas pertinentes se sintetizan en el Anexo 1 y se alude a los mismos en los correspondientes capítulos.

1.3 Resoluciones de la UIT y productos de otros Sectores de la UIT

A continuación, se enumeran las Resoluciones de la UIT relacionadas con la gestión de catástrofes:

Conferencia de Plenipotenciarios de la UIT

- Resolución 136: Utilización de las telecomunicaciones/tecnologías de la información y la comunicación para la asistencia humanitaria y en el control y la gestión de situaciones de emergencia y catástrofes, incluidas las situaciones de emergencia sanitaria, la alerta temprana, la prevención, la mitigación y las operaciones de socorro.
- Resolución 182: El papel de las telecomunicaciones/tecnologías de la información y la comunicación en el cambio climático y la protección del medio ambiente.

Conferencia Mundial de Desarrollo de las Telecomunicaciones (CMDT)

- Resolución 34: Función de las telecomunicaciones/tecnologías de la información y la comunicación en la preparación, alerta temprana, rescate, mitigación, socorro y respuesta en situaciones de catástrofe.
- Resolución 66: Tecnologías de la información y comunicación, medio ambiente, cambio climático y economía circular.

Conferencia Mundial de Radiocomunicaciones (CMR)

- Resolución 646: Protección pública y operaciones de socorro.
- Resolución 647: Aspectos de las radiocomunicaciones, incluidas directrices sobre gestión del espectro para la alerta temprana, la predicción, detección y mitigación de los efectos de las catástrofes y las operaciones de socorro relacionadas con emergencias y catástrofes.
- Resolución 673: Importancia de las aplicaciones de radiocomunicaciones para la observación de la Tierra.

Asamblea Mundial de Normalización de las Telecomunicaciones (AMNT)

- Resolución 73: Tecnologías de la información y la comunicación, medioambiente, cambio climático y economía circular.
- Las Recomendaciones e Informes de la UIT sobre gestión de catástrofes, resiliencia de redes y telecomunicaciones de emergencia se elaboran en el marco de las Comisiones de Estudio del UIT-T y el UIT-R. En particular, la Comisión de Estudio 2 del UIT-T (Aspectos operativos de las telecomunicaciones y las TIC), que es la Comisión de Estudio rectora en materia de normalización sobre telecomunicaciones y las TIC para operaciones de socorro en caso de catástrofe y emisión de alertas tempranas, resiliencia y recuperación de redes, mediante la coordinación de la labor de la UIT sobre elaboración de normas destinadas a

facilitar la utilización de las telecomunicaciones para operaciones de socorro en caso de catástrofe y emisión de alertas tempranas, resiliencia y recuperación de redes, elaboró la Recomendación UIT-T E.106, sobre el Plan internacional de preferencias en situaciones de emergencia para operaciones de socorro en caso de catástrofe, en el que se especifican los medios para dar prioridad a las llamadas telefónicas en dichas situaciones y garantizar la disponibilidad de las redes de telecomunicaciones para establecer comunicaciones urgentes y descartar las no urgentes.

1.4 TIC, gestión de catástrofes y operaciones de socorro

La gestión de catástrofes comprende tanto las actividades de preparación antes de que dichas catástrofes se produzcan, como las operaciones de socorro ulteriores. Como se expone en la sección siguiente, las TIC pueden utilizarse en todas las etapas de la gestión de catástrofes. Las TIC nuevas y las incipientes, en particular la inteligencia artificial (IA), evolucionan ininterrumpidamente y podrán propiciar la transformación íntegra de la gestión y las actividades de socorro en caso de catástrofe en un futuro próximo. Para salvar vidas de forma más eficaz en caso de catástrofe, es necesario seguir recopilando información sobre adopción de TIC nuevas o incipientes para su utilización en la gestión de catástrofes y las operaciones de socorro.

1.5 Utilización de las TIC en la gestión de catástrofes y desarrollo sostenible inteligente

El proceso de gestión del riesgo de catástrofes [b-NETP] abarca cuatro fases: mitigación, preparación, respuesta y recuperación. Las TIC desempeñan un papel clave en las cuatro fases de la gestión de catástrofes.

La fase de mitigación incluye todas las acciones destinadas a prevenir una situación de emergencia, reducir la probabilidad de que ésta se produzca o limitar los efectos adversos de amenazas inevitables. La Internet de las cosas (IoT) puede contribuir a supervisar el entorno y los peligros subyacentes, y los macrodatos permiten analizar la información sobre posibles catástrofes.

La fase de preparación corresponde a la planificación y los preparativos necesarios para dar respuesta a un suceso de emergencia. La IA puede utilizarse para la previsión y predicción de peligros, y la radiodifusión celular (CB) para emitir avisos y alertas a los ciudadanos.

La fase de respuesta: en esta fase de la gestión de catástrofes todas las actividades se encaminan a proporcionar ayuda de forma oportuna a los afectados. Las TIC se utilizan para recopilar y analizar información sobre el estado de la catástrofe, y permiten prestar servicios de comunicaciones de forma ininterrumpida con objeto de que las primeras instituciones y personas que presten ayuda puedan intercambiar información esencial oportunamente.

La fase de recuperación se centra en restaurar en la comunidad la situación que existía antes del suceso de emergencia, o mejorarla. Las TIC pueden contribuir a evaluar los daños y las necesidades de las zonas y la población afectadas, hacer un seguimiento de la recuperación y coordinar las actividades de reconstrucción.

El desarrollo sostenible inteligente guarda una estrecha relación con los factores humanos y la colaboración de las partes interesadas. Conlleva la superación de un conjunto de retos clave, entre ellos, desarrollar mecanismos para mejorar la coordinación entre la gran variedad de partes interesadas implicadas en las actividades de respuesta de emergencia mediante las

TIC; formular las estrategias de financiación necesarias para establecer asociaciones eficaces y garantizar una financiación predecible y versátil; garantizar la eficacia de los programas de formación de voluntarios y la expansión de las redes de intercambio de esos voluntarios; y desarrollar la capacidad de las redes regionales y aprovechar su experiencia. Por otro lado, hay que tomar medidas, entre otras cosas, para fomentar asociaciones público-privadas que permitan promover las oportunidades de colaboración a escalas regional y mundial; crear una plataforma más amplia para la gestión de catástrofes y garantizar los servicios de socorro basados en las telecomunicaciones en caso de catástrofe de forma ininterrumpida; poner en marcha soluciones planificadas de antemano a fin de evitar las soluciones improvisadas sobre el terreno; y promover el marco normativo adecuado para facilitar las tareas de socorro. Las medidas que se adopten al respecto contribuirán a alcanzar los Objetivos de Desarrollo Sostenible (ODS).

1.6 Entorno político y normativo propicio

Habida cuenta de que los enfoques de gestión de catástrofes han pasado de ser una esfera de estudio meramente técnico a tener un alcance interdisciplinar, disponer de un entorno político y normativo propicio es igualmente importante, si no más, a fin de lograr una gestión eficaz de las catástrofes. Una gestión de las catástrofes eficaz y práctica no sólo depende de los estudios técnicos y los equipos, sino también de los procedimientos y principios, normas, orientación y distribución eficiente de responsabilidades y competencias en una situación de catástrofe, así como antes y después de la misma.

1.7 Factores humanos y colaboración de las partes interesadas

Las catástrofes no tienen en cuenta los límites nacionales. Con objeto de mitigar sus daños, es necesaria la colaboración de diversas partes interesadas, a saber, gobiernos a escalas nacional, regional y local, organizaciones de ayuda y socorro de otros países, organizaciones no gubernamentales (ONG) y organizaciones de la sociedad civil, entidades del sector privado y voluntarios y grupos de acción ciudadana. Habida cuenta de que todas las catástrofes se producen a escala local, los vecinos son los primeros en adoptar medidas de respuesta y en prestarse natural y mutuamente ayuda. Las TIC contribuyen a ello al facilitar esa ayuda propia o recíproca en el marco de entornos normativos. A tal efecto, debe prepararse con antelación, con la ayuda de los ciudadanos y la administración local, mapas de riesgos y planes de prevención de catástrofes para las zonas susceptibles de verse afectadas por una catástrofe y los lugares de evacuación y refugio.

Los factores humanos y la colaboración de las partes interesadas son muy importantes para hacer frente a situaciones de catástrofe. Ese aspecto de la comunicación y la coordinación se supervisa minuciosamente en el marco de simulacros y ejercicios; siempre que se identifiquen lagunas, hay que subsanarlas y documentarlas, y elaborar procedimientos operacionales normalizados o directrices al respecto.

Un aspecto adicional es que, tras una catástrofe, las mujeres son más vulnerables y tienen más probabilidades de fallecer que los hombres. Por otro lado, la colaboración de las mujeres es primordial para fomentar la resiliencia ante situaciones de catástrofe. Los conocimientos y la experiencia de las mujeres, así como su capacidad para organizarse, convencer e informar, pueden facilitar enormemente la gestión de los riesgos de catástrofe; sin embargo, obstáculos de índole diversa limitan su capacidad para protegerse a sí mismas y participar en la toma de decisiones frente a catástrofes en todas las fases del ciclo de gestión de catástrofes.

Capítulo 2 – Sistemas de alerta temprana y emisión de avisos

Los sistemas de alerta temprana (EWS) existen desde hace mucho tiempo. Los primeros dispositivos de alerta, heredados de las civilizaciones costeras del Pacífico y los pueblos indígenas de África y las Américas, se basan en la observación visual de signos de alerta. Estos principios de observación ancestrales siguen siendo pertinentes hoy en día y una comprensión más cabal de los peligros naturales que desencadenan catástrofes, así como el despliegue de sensores y comunicaciones más eficaces para transmitir datos a observatorios de varios países, han permitido mejorar los EWS y ampliar la lista de potenciales riesgos objeto de supervisión[2, 3].

La pertinencia de los EWS ha sido reconocida por la comunidad de gestión de situaciones de catástrofe y se menciona explícitamente en el Marco de Sendai para la Reducción del Riesgo de Desastres 2015-2030 en el marco de la Prioridad 4 (Mejorar la preparación ante catástrofes para facilitar medidas de respuesta eficaces, y "Reconstruir mejor" en el marco de las actividades de recuperación, rehabilitación y reconstrucción) y de la Meta G (Mejorar sustancialmente la disponibilidad de los EWS multirriesgo y de las evaluaciones de información y riesgo de desastres para 2030, y mejorar el acceso a los mismos de la población). La comunidad internacional también ha reconocido la pertinencia de los EWS en la lucha contra el cambio climático, así como la necesidad desplegar esfuerzos al respecto en el marco del Acuerdo de París sobre el Clima[4] (Artículo 7, párrafo 7c).

La Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres (UNDRR[5]) define los EWS como "sistemas integrados de supervisión, previsión y control de riesgos, evaluación de los riesgos de catástrofe, comunicación y actividades de preparación, sistemas y procesos que facilitan a personas, comunidades, gobiernos y empresas, en particular, la toma de medidas oportunas para reducir los riesgos de catástrofe antes de que se produzcan eventos peligrosos"[6].

Como se describe en el Informe final de la Cuestión 5/2 para 2018-2021 [Informe final b-C5/2], las telecomunicaciones y las TIC desempeñan un papel primordial antes y después de una catástrofe, así como durante la misma. Brindan apoyo en todas las fases de las catástrofes, en particular en el marco de actividades de preparación, previsión, alerta, respuesta y recuperación. Se reconoce ampliamente que los sistemas de alerta constituyen una herramienta fundamental para salvar vidas en caso de inundaciones, sequías, tormentas e incendios forestales, así como en otros tipos de sucesos peligrosos (seísmos y tsunamis). Las pérdidas económicas ocasionadas por fenómenos hidrometeorológicos extremos se han multiplicado casi por 50 en los últimas cinco decenios, si bien las pérdidas humanas en todo el mundo se han reducido casi diez veces, es decir, se han salvado millones de vidas en los últimos decenios. A lo largo de este periodo se han adoptado diferentes tecnologías e iniciativas para desplegar sistemas de alerta temprana y avisos.

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2 UN-SPIDER: https://www.un-spider.org/es/riesgos-y-desastres/alerta-temprana#no-back
3 Unión Africana: https://www.undrr.org/sites/default/files/2023-10/the-africa-multi-hazard-early-warning-and-early-action-system.pdf?startDownload=true
4 Acuerdo de París: https://unfccc.int/sites/default/files/spanish_paris_agreement.pdf
5 UNDRR: https://www.undrr.org/es
6 https://www.un-spider.org/es/riesgos-y-desastres/alerta-temprana#no-back

2.1 Utilización de las TIC para la planificación de sistemas de alerta temprana

La estrategia adoptada en materia de gestión de catástrofes se basa en la constatación de que las catástrofes son inevitables, y en que la preparación de iniciativas preventivas adecuadas lo antes posible permite salvar vidas y bienes, reducir los efectos a gran escala, brindar asistencia de inmediato y contribuir a mitigar los efectos de catástrofes similares en el futuro. Conviene difundir información relevante durante una catástrofe, así como antes y después de la misma. La difusión eficaz de alertas tempranas previamente debe basarse en la capacidad y los medios necesarios para publicar información y alertas en caso de catástrofe. De ser necesario, la alerta de un peligro inminente debe llegar lo antes posible a todas las personas de la zona afectada. La utilización de tecnologías, en particular el Sistema de Información Geográfica (GIS), los sistemas de observación de la Tierra por satélite, la IA, la IoT, el análisis en tiempo real mediante macrodatos e informática avanzada, las tecnologías de comunicaciones móviles, los medios sociales, la robótica y las cadenas de bloques puede contribuir a la gestión de catástrofes y a nuevas vías de desarrollo más sostenibles, resilientes y eficaces [Informe final b-C5/2].

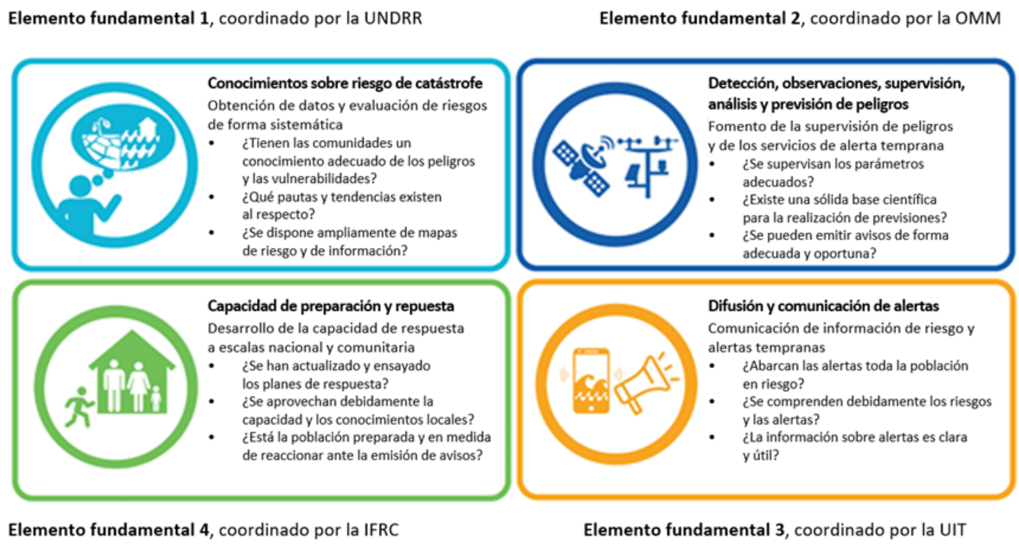
2.1.1 Iniciativa Alertas Tempranas para Todos de las Naciones Unidas

La iniciativa de las Naciones Unidas "Alertas tempranas para todos"[7] (Iniciativa EW4All), puesta en marcha por el Secretario General de las Naciones Unidas en el marco de la Conferencia de las Naciones Unidas sobre el Clima de 2022, COP-27, pone de manifiesto la manera en que las alertas permiten salvar vidas, y se prevé que sigan haciéndolo a medida que avanza el cambio climático y aumenta la incidencia de fenómenos meteorológicos extremos y peligros naturales. Los EWS constituyen una medida de adaptación al cambio climático que, según diversas estimaciones, multiplica por diez el rendimiento de la inversión.

Los cuatro elementos fundamentales de la citada iniciativa se muestran en la Figura 1:

[7] Iniciativa "Alertas Tempranas para Todos (EW4A)": https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Early-Warnings-for-All-Initiative.aspx

Figura 1: Cuatro elementos fundamentales de la iniciativa EW4ALL de las Naciones Unidas



Según manifestó el Secretario General de la ONU en su alocución ante la COP-27, "la mitad de la humanidad se encuentra en zonas de peligro". "Las comunidades vulnerables de puntos particularmente susceptibles a los efectos del clima se ven sorprendidas por desastres climáticos sucesivos, al no disponer de medios de alerta temprana". Hizo un llamamiento a todas las partes interesadas para que colaboren en la nueva iniciativa EW4ALL, en virtud de la cual se propugna que todos los habitantes del planeta estén protegidos por EWS para 2027.

La UIT coordina el elemento fundamental "Difusión y comunicación de alertas"[8] de la iniciativa EW4ALL, con apoyo de la Federación Internacional de Sociedades de la Cruz Roja y de la Media Luna Roja (IFRC), el Programa Regional de Aceleración del Emprendimiento (REAP), el Programa de las Naciones Unidas para el Desarrollo (PNUD) y la Organización Meteorológica Mundial (OMM), con objeto de estudiar la conectividad en la última milla y garantizar que las alertas lleguen a las personas en riesgo con la antelación suficiente para poder adoptar las medidas oportunas. No existe un enfoque común para difundir alertas y es preciso regirse a tal efecto por la diversidad de las comunidades en riesgo. Por ello, la UIT promueve un enfoque multicanal para emitir alertas a través de diversas vías de comunicación, en particular la radio, la televisión, las redes sociales, las sirenas, la telefonía móvil y las comunicaciones por satélite. La UIT respalda la adopción de un enfoque inclusivo centrado en las personas sobre la base de infraestructuras comunitarias existentes y mecanismos de suministro de información coordinados a nivel local para garantizar la comprensión y el procesamiento de los mensajes.

[8] Difusión y transmisión de alertas: https://www.itu.int/hub/2023/01/early-warning-systems-mobile-connectivity/#/es

Figura 2: La expansión de las redes y servicios móviles brinda nuevas oportunidades para la emisión de alertas tempranas

Las denominaciones empleadas y la forma en que se presentan los materiales en esta publicación no implican la expresión de opinión alguna por parte de la Unión Internacional de Telecomunicaciones (UIT) o de la Secretaría de la UIT sobre la situación jurídica de cualquier país, territorio, ciudad o zona, sus autoridades ni la delimitación de sus límites o fronteras.

En la actualidad, el desarrollo digital brinda nuevas oportunidades a miles de millones de personas de forma más rápida y eficaz, tanto en situaciones de catástrofe, como antes y después de las mismas. Según se desprende de la publicación de la UIT "Facts and Figures" de 2023[9], el 95 % de la población mundial tiene acceso a redes móviles de banda ancha, y el 78 % posee un teléfono móvil. Ello hace que las redes móviles constituyan un canal de comunicación muy eficaz para alertar a la población sobre un peligro inminente. El plan de acción[10] sobre la citada iniciativa, implantado en el marco de la COP-27, aboga por que se promuevan y pongan en marcha servicios de alerta temprana basados en la geolocalización a través de la telefonía móvil por CB y servicio de mensajes breves (SMS) basados en la localización, elemento esencial para la "difusión y comunicación de alertas".

Las alertas mediante radiodifusión celular o SMS basados en la localización pueden orientarse únicamente a personas situadas en una zona de riesgo determinada. Se trata de tecnologías de eficacia demostrada que ya se utilizan en varios países, y sus alertas son adaptables a requisitos específicos, en particular el idioma de cada usuario.

2.1.2 Satélites para la adopción de medidas de respuesta y recuperación ante situaciones de catástrofe y mitigación de sus efectos

Las telecomunicaciones y las TIC desempeñan un papel primordial en el aumento de la eficacia y la utilidad de los sistemas de alerta temprana y planificación. Facilitan la recopilación, el análisis y la difusión de información crucial en tiempo real, y permiten prever situaciones de crisis y

[9] Measuring digital development Facts and Figures 2023: https://www.itu.int/itu-d/reports/statistics/facts-figures-2023/

[10] Plan de acción de la iniciativa EW4ALL: https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Documents/2023/Executive_Action_Plan_en.pdf

adoptar medidas de respuesta ante las mismas de forma eficaz. Ello contribuye a salvar vidas y a mitigar el impacto de las catástrofes.

En cuanto a la recopilación y el análisis de datos, las telecomunicaciones y las TIC proporcionan:

- Sensores y redes de supervisión: las TIC permiten recabar datos en tiempo real de diversas fuentes, en particular estaciones meteorológicas, sismógrafos, sistemas de generación de imágenes por satélite, redes sociales e informes sobre el terreno. Posteriormente, esos datos se analizan para identificar riesgos potenciales y emitir alertas tempranas.
- Sistemas de Información Geográfica (GIS): los GIS permiten visualizar y analizar datos geoespaciales, lo que facilita la identificación de zonas vulnerables, la planificación de rutas de evacuación y la gestión de recursos en caso de catástrofe.

En relación con la comunicación y difusión de información, las telecomunicaciones y las TIC proporcionan:

- EWS: las TIC pueden utilizarse para difundir rápidamente alertas a la población a través de diversos canales, en particular SMS, aplicaciones móviles, sirenas, radio y televisión.
- Redes sociales y medios de comunicación en línea: las redes sociales y los medios de comunicación en línea pueden utilizarse para emitir alertas, difundir información en tiempo real sobre catástrofes, recabar testimonios y movilizar ayuda.

Ello se pone especialmente de relieve en el informe "Transformative connectivity: satellite workshop (Conectividad transformadora: taller sobre satélites)". En él se subraya el papel de la tecnología, en particular los satélites, para adoptar medidas de respuesta frente a situaciones de catástrofe. En la tercera sesión de un taller conexo se abordó el modo en que la comunicación por satélite puede ayudar en todas las etapas de la gestión de catástrofes, a saber, las fases de mitigación, respuesta y recuperación. Se destacó la resiliencia de los satélites en situaciones de catástrofe, en los casos en que otras infraestructuras de comunicación terrestres se encuentran inutilizadas, averiadas o no se dispone de las mismas. Pese a los retos existentes, la utilización de las TIC en sistemas de alerta temprana y planificación tiene un gran potencial para mejorar las actividades de preparación y respuesta frente a catástrofes mediante la recopilación y el análisis de datos, así como la difusión de información.

2.2 Despliegue de sistemas de alerta temprana para la reducción del riesgo de catástrofes

En un plazo de cinco años, todos los habitantes del planeta deberían estar protegidos por EWS. En el marco de la iniciativa EW4All, la **BDT/UIT**[11] brinda apoyo a los países a través de planes nacionales de telecomunicaciones de emergencia (PNTE[12]), en particular a través de módulos de formación en línea; actividades de capacitación en telecomunicaciones de emergencia; medidas de respuesta frente a catástrofes, como el despliegue de equipos por satélite en la utilización de mapas de conectividad en caso de catástrofe para cartografiar las infraestructuras de comunicaciones fuera de servicio tras una catástrofe, y la participación en

[11] Véase A1.7.6: Informe de la BDT sobre las actividades de telecomunicaciones de emergencia, en particular actividades, eventos y recursos al respecto. https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/NETPs.aspx

[12] https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/NETPs.aspx

reuniones intersectoriales dedicadas a la reducción del riesgo de catástrofes. Treinta países[13] se han beneficiado del apoyo de la BDT/UIT.

En **Japón**[14], el sistema L-Alert proporciona información a través de más de 900 organizaciones inscritas, en particular estaciones de televisión, organismos de radiodifusión, sitios web y aplicaciones para la prevención de catástrofes, que transmiten información a residentes locales. Se prevé desplegar el sistema L-Alert también en la República de Indonesia. Garantizar que la información relacionada con catástrofes se distribuya de forma fiable y rápida es una necesidad acuciante en todos los países.

Con objeto de mejorar la prestación de servicios y su eficacia en el **Reino de Bhután**[15] se decidió que todos los sistemas gubernamentales que contienen muy sensibles deben utilizar un centro de datos resiliente y robusto, a fin de garantizar su seguridad y protección, por lo que se creó el Centro de Datos Gubernamental.

2.3 Sistemas de radiodifusión de avisos de emergencia

Con el fin de emitir alertas de emergencia a un gran número de ciudadanos, es necesario que los servicios de radiodifusión, en particular televisiones y radios, sean eficaces y fáciles de utilizar.

JTEC[16], en Japón, implantó el sistema de radiodifusión de avisos de emergencia (EWBS), que forma parte del sistema de radiodifusión terrenal digital (ISDB-T) del servicio de información en caso de catástrofe. Se está desarrollando asimismo un sistema híbrido de transmisión EWBS-CAP que utiliza las ondas radioeléctricas del servicio de radiodifusión terrenal y se están llevando a cabo varios estudios sobre la mejor manera de implantar el sistema de radiodifusión de avisos de emergencia en los sistemas de radiodifusión de países en desarrollo.

EQ4ALL Co.Ltd[17] indicó que en la República de Corea el Ministerio de Ciencia y TIC explota en todo el país un "Sistema de alerta de emergencia para situaciones de catástrofe" inclusivo. Dicho sistema agrega toda la información sobre catástrofes y la transmite en formato del protocolo de alerta común (PAC) a un radiodifusor, que a su vez lo emite automáticamente con subtítulos.

Bhután[18] manifestó que la red de estaciones en tierra del satélite de Asia meridional (SAS) desempeña un papel primordial en la estrategia nacional de comunicación sobre situaciones de catástrofe. La doble función de la red de estaciones en tierra del SAS, para aplicaciones de radiodifusión y de comunicación en caso de catástrofe, pone de relieve la versatilidad de las infraestructuras de satélites para hacer frente a diversos retos a escala nacional.

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[13] Bangladesh, República de Maldivas, República Federal Democrática de Nepal, República Democrática Popular Lao, Reino de Camboya, República de Kiribati, Samoa, Islas Salomón, República de Fiji, Reino de Tonga, República de Djibouti, República Federal de Somalia, República de Sudán, República de Chad, Comoras, República Democrática Federal de Etiopía, República de Liberia, República de Madagascar, República de Mauricio, República de Mozambique, República de Níger, República de Sudán del Sur, República de Uganda. Guyana, República de Haití, Barbados, Antigua y Barbuda, República de Guatemala y Ecuador. Asia Central: Tayikistán.

[14] Véase A1.1.14: L-Alert en Japón (Japón).

[15] Véase A1.1.5: Telecomunicaciones y TIC para la reducción y gestión del riesgo de catástrofes (Bhután).

[16] Véase A1.1.6: Sistema de radiodifusión de alertas de emergencia (EWBS) (Japón).

[17] Véase A1.1.7: Plataforma de televisión para fomentar comunicaciones inclusivas (Corea (Rep. de)).

[18] Véase A1.1.8: Utilización del satélite de Asia meridional (SAS) para prestar servicios de televisión y radio a escala nacional en zonas rurales (Bhután).

2.4 Tecnología de sistemas de alerta temprana y emisión de avisos

Everbridge One2many[19] adopta plenamente un enfoque multicanal de en soluciones de SMS basadas en servicios de localización (LB-SMS) (en Australia, Suecia, Noruega, la República de Singapur y la República de Estonia), PAC (Reino de los Países Bajos, República de Mauricio, España, Noruega y Reino de Arabia Saudita, entre otros países) y radiodifusión celular (desplegada con 37 operadores de telefonía móvil clientes).

Aunque factibles, los proyectos de SMS basados en la localización (LB-SMS) necesitan plazos de implantación más largos debido a su complejidad y a la falta de normalización. En consecuencia, es necesario un procedimiento de integración diferente para cada operador de telefonía móvil, que requiere la integración con sondas de localización de un operador o el suministro de nuevas sondas de localización para cada red móvil, a fin de suministrar un nuevo SMSC o integrarlo con un centro del servicio de mensajes breves (SMSC) existente. Esos proyectos son complejos, ya que hay muchos proveedores de LB-SMS (al menos 40-50 proveedores diferentes) y algunas integraciones deben efectuarse mediante desarrollos propios del operador móvil, con objeto de facilitar la personalización. Muchos proveedores de LB-SMS utilizan protocolos e integraciones diferentes. En última instancia, las soluciones LB-SMS para la emisión de alertas públicas no están normalizadas, por lo que los proyectos LB-SMS son muy complejos, con plazos de entrega más largos (como mínimo de un año) y para cada despliegue es necesario un enfoque personalizado diferente.

La radiodifusión celular (CB) constituye un enfoque más sencillo para sistemas de alerta pública. La CB es una como solución normalizada 3GPP, ETSI y ATIS, plenamente respaldada en el sector de las telecomunicaciones, con plazos de entrega relativamente cortos y menos complejidad, ya que todos los proveedores de redes de acceso radioeléctgrico (RAN) soportan la norma CBC 3GPP. La radiodifusión celular es una tecnología mucho más adecuada para los países en desarrollo, a los que se dirige la iniciativa de emisión de alertas tempranas para todos, al tratarse de una aplicación plenamente normalizada y sencilla (a los efectos de implantación), con un enfoque análogo en todos los países y, en particular, con plazos de ejecución más previsibles.

Con respecto al enfoque multicanal, se propuso la norma PAC, definida por OASIS, que es otra solución normalizada. La interfaz PAC puede utilizarse como medio de integración por defecto para las alertas públicas a través de sitios web, aplicaciones móviles, radio, televisión, SMS, la OMM y tablones digitales, entre otras opciones. PAC también es una interfaz de alerta pública normalizada sencilla y fácil de desplegar a escala internacional, que puede utilizarse y/o integrarse en cualquier solución de alerta pública de forma rápida en un plazo de dos a tres meses. PAC también puede utilizarse como interfaz por defecto para la integración entre los dominios gubernamental y de compañías de telecomunicaciones (entidad de radiodifusión celular y centro de radiodifusión celular).

India[20] ha desplegado un sistema que permite la difusión de información crucial y urgente a dispositivos móviles en zonas geográficas específicas mediante radiodifusión celular, con fines de gestión de catástrofes. Constituye una mejora del sistema de difusión de alertas tempranas existente, en particular el "SAmekit CHEtavani Tantra (SACHET)", basado en el PAC.

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[19] Véase A1.1.9: Emisión de alertas mediante radiodifusión celular (RC) (Everbridge One2many, Países Bajos).

[20] Véase A1.4.8: Utilización de la radiodifusión celular para aumentar la concienciación pública a través de la plataforma del Protocolo de Alerta Común (PAC) (India).

2.5 Sistemas de alerta temprana y teledetección

La detección de catástrofes es un elemento fundamental de actividades de mitigación y gestión del riesgo de catástrofes. Para la detección de catástrofes y tsunamis en su zona oceánica, **Portugal**[21] ha introducido el sistema de cables Supervisión científica y telecomunicaciones fiables (SMART) entre Portugal y los archipiélagos de las Azores y Madeira (CAM), denominado SMART CAM. El examen de la red sísmica en Portugal pone de manifiesto que para los distritos situados en el suroeste del país la implantación de un EWS sísmico podría alertar con la antelación suficiente, con objeto de seguir las medidas de mitigación de riesgos pertinentes. Un EWS para maremotos, que también se está considerando, ofrecería una antelación de sólo decenas de minutos. Cabe señalar que la **CE 15 del UIT-T**[22] elabora la Recomendación G.smart del UIT-T.

NICT, Japón[23], desarrolló el sistema de Internet de las cosas (IoT) visual que utiliza el procesamiento de imágenes basado en IA y puede construirse a partir de componentes disponibles comercialmente (COTS). Este sistema permite detectar peligros naturales como incendios forestales por un coste relativamente bajo. Mediante cámaras de videovigilancia y computadores de procesador único de bajo coste, dicho sistema podría ser útil tanto en países desarrollados como en países en desarrollo.

India[24] implantó un sistema de observación de la Tierra para ayudar a la población a reaccionar frente a retos meteorológicos a partir de observaciones por satélite meteorológicas y de la Tierra con capacidad para observar simultáneamente todo el planeta. Se trata de una revolución menor de la ciencia meteorológica, pues se toman de manera ininterrumpida imágenes de satélite de la Tierra que permiten pronosticar de manera precisa las precipitaciones, las tormentas de viento, los ciclones, las tormentas de arena, etc. Por consiguiente, tal sistema puede considerarse un EWS y ayudar a mitigar los efectos nocivos de los riesgos meteorológicos o geológicos.

China[25] ha desarrollado varias tecnologías de detección y localización de fugas en oleoductos mediante fibra óptica, en la esfera de la detección por fibra óptica de riesgos y la emisión de alertas sobre los mismos. Dicha solución tiene una gran precisión de detección y puede ser ampliamente aplicada a oleoductos y gasoductos. Entre sus ventajas cabe destacar su fácil adquisición, características de reconocimiento preciso y rápido aprendizaje.

2.6 Sistemas de información y socorro en caso de catástrofe

Proporcionar información precisa de la forma más rápida posible en situaciones de emergencia y disponer de sistemas de información adecuados antes de que se produzca una situación de catástrofe son elementos fundamentales de toda gestión eficaz de las catástrofes.

Pese a que el carácter dinámico del sector de las telecomunicaciones y los avances tecnológicos están propiciando los cambios que la mayoría de la gente desea y espera, está claro que los gobiernos y las partes interesadas aún deben lograr los avances necesarios para predecir y

[21] Véase A1.1.10: Sistema de cables submarinos SMART CAM (Portugal).
[22] Véase A3.5: Características de los sistemas de cable submarino de fibra óptica (Comisión de Estudio 15 del UIT-T).
[23] Véase A1.1.11: Sistemas visuales basados en IoT para la detección de catástrofes (NICT, Japón).
[24] Véase A1.1.12: Observación de la Tierra: funciones y actividades de predicción y socorro en la India (India).
[25] Véase A1.1.13: Aplicación de la tecnología de detección por fibra óptica para facilitar las actividades de concienciación y emisión de alertas sobre riesgos en oleoductos (China).

prevenir mejor las catástrofes, puesto que independientemente de los avances registrados en cuanto a predicción y prevención de catástrofes aún existen deficiencias. El suministro de información lo antes posible a todas las personas que puedan verse afectadas a fin de evitar catástrofes y mitigar sus efectos reviste suma importancia. En las actividades de difusión de alertas y comunicación, un enfoque multicanal aumenta la eficacia de las alertas y permite abarcar todas las comunidades en riesgo. La transformación digital brinda numerosas oportunidades para fortalecer la labor de la iniciativa Alertas Tempranas para Todos de las naciones Unidas y permite llegar a más personas a través de las TIC, por ejemplo a través del envío de alertas por telefonía móvil[26]. Las TIC desempeñan un papel primordial en la reducción y gestión del riesgo de catástrofes, en particular en las economías en desarrollo, al ser más vulnerables a los peligros naturales. Al mejorar los sistemas de comunicación, en el marco de **RIFEN (Red Internacional de Expertas en lo Digital)**[27] las TIC facilitan los EWS, mejoran la recopilación de datos para la evaluación de riesgos y ayudan a coordinar eficazmente los esfuerzos de socorro. La tecnología IoT desempeña asimismo un papel útil en la gestión de catástrofes y la planificación de emergencias al mejorar la recopilación de datos, la comunicación en tiempo real y la concienciación sobre la situación. En una situación de catástrofe, la IoT facilita el intercambio rápido de información entre los equipos de emergencia, lo que facilita la coordinación de esfuerzos y el despliegue de recursos con eficacia. Tras la catástrofe, las tecnologías de IoT brindan asistencia en los procesos de evaluación de daños y recuperación, y en última instancia fortalecen la resiliencia y la capacidad de preparación frente a futuros sucesos.

Habida cuenta de ello, los sistemas de información deben diseñarse de forma que sean accesibles para todos y que la información que se pretende proporcionar a través de alertas sea suficientemente comprensible. A tal efecto, los servicios de alerta temprana eficaces se diseñan conjuntamente con las comunidades a las que prestan servicio y cuentan con mecanismos de suministro de información para facilitar que los mensajes lleguen a la población a través de canales de comunicación adecuados y de confianza, en formato procesable. También cabe abordar la disparidad estructural a las que a menudo se enfrentan mujeres, jóvenes, niños, personas con discapacidad, desplazados, pueblos indígenas y grupos étnicos marginados al recibir, comprender y adoptar medidas respecto de los servicios de alerta temprana[28].

En **Türkiye**[29] se elaboró la Estrategia y Plan de comunicación a escala nacional frente a seísmos para 2023 (UDSEP-2023)[30], con objeto de evitar o mitigar daños y pérdidas en los planos físico, económico, social, medioambiental y político provocados por seísmos, y establecer nuevos medios de vida sismorresistentes, seguros y sostenibles. Se tomaron medidas esenciales para aplicar las acciones del UDSEP-2023, en el marco de un ejemplar estudio que incluye enfoques estratégicos y conjuntos de medidas destinadas a minimizar las pérdidas causadas por los seísmos.

En **Côte d'Ivoire**[31], a iniciativa del Ministerio de Medio Ambiente y Desarrollo Sostenible, se prevé implantar un EWS nacional de detección y alerta temprana de riesgos diversos asociados al clima. Dicho sistema poseerá cobertura nacional para facilitar las medidas de respuesta frente a peligros en todo el país. El diseño del sistema se basará en datos e indicadores recopilados

[26] https://www.itu.int/dms_pub/itu-d/oth/07/2e/D072E0000030011PDFE.pdf (p. 5)
[27] Véase A1.1.3: El importante papel de las TIC en los sistemas de alerta temprana multirriesgo (RIFEN).
[28] https://www.itu.int/dms_pub/itu-d/oth/07/2e/D072E0000030011PDFE.pdf (p. 7)
[29] Véase A1.1.1: Sistemas de información para situaciones de emergencia (Türkiye).
[30] https://deprem.afad.gov.tr/content/75
[31] Véase A1.1.2: Fortalecimiento del marco institucional y de la utilización de las tecnologías digitales para la reducción del riesgo de catástrofes en Côte d'Ivoire (RIFEN).

por estaciones de recogida de datos hidrometeorológicos, agroclimáticos y medioambientales gestionadas por las siguientes entidades nacionales:

- Sociedad para la Explotación y el Desarrollo de Aeropuertos, Meteorología y Actividades Aeronáuticas (SODEXAM).
- Oficina Nacional de Protección Civil (ONPC).
- Oficina de Parques y Reservas (OIPR).
- Comité Nacional de Teledetección e Información Geográfica (CNTIG).

Côte d'Ivoire no dispone aún de un marco reglamentario ni de políticas generales de telecomunicaciones para facilitar el despliegue y la utilización de las TIC en situaciones de catástrofe. No obstante, las TIC están en el centro de las actividades de prevención de catástrofes y de alerta rápida:

- Diversas autoridades públicas y organizaciones de servicios de socorro han creado **páginas en redes sociales** a través de las cuales proporcionan alertas ciudadanas y avisos de catástrofe. En particular, la **página de emergencias de la Policía en Facebook** proporciona alertas a los ciudadanos, la **página de SODEXAM en Facebook** proporciona avisos meteorológicos y la **página de Facebook de ONPC-Côte d'Ivoire** facilita información y avisos sobre catástrofes asociadas a incidentes domésticos, accidentes de tráfico y sucesos industriales en todo el país.
- **Tecnologías de comunicación móvil**: emisión de avisos meteorológicos por SMS a usuarios.
- **Difusión de anuncios de servicio público y alertas a través de la radio y la televisión**: se aplican medidas sobre accesibilidad, incluidos sistemas de descripción sonora, subtitulado e interpretación en lengua de signos.

La gestión del riesgo de catástrofes en Côte d'Ivoire se rige por un marco jurídico e institucional desarrollado por el Gobierno con el fin de reforzar las capacidades de prevención y respuesta del país frente a catástrofes. Para ello se han establecido estrategias y entidades dedicadas a la reducción del riesgo de catástrofe. Pese a que aún no se ha adoptado ningún marco jurídico sobre gestión de telecomunicaciones de emergencia, Côte d'Ivoire utiliza las tecnologías de telecomunicación para emitir alertas tempranas en caso de catástrofe.

Cruz Roja de Kenya[32] aplica un enfoque integral a la gestión de catástrofes, centrado en aprovechar la tecnología para evitar y aliviar el sufrimiento humano en todo el país. Cabe destacar el uso de Mapathons para cartografiar zonas de alto riesgo, en particular zonas inundables e infraestructuras esenciales, en particular escuelas y hospitales, lo que permite adoptar decisiones basadas en evidencias y asignar recursos de forma eficaz en caso de catástrofe. La capacitación del personal gubernamental de los condados en materia de recopilación y gestión de datos de redes móviles fue fundamental para mejorar la resiliencia local. La obtención de imágenes por satélite y la tecnología de drones desempeñaron un papel crucial en la evaluación y actividades de respuesta frente a catástrofes, incluidos el posicionamiento previo de recursos en función de los efectos de las inundaciones y la supervisión de las plagas de langosta. El desarrollo de un EWS con financiación basado en objetivos pone de relieve el compromiso con la preparación proactiva ante catástrofes, con objeto de reducir sus efectos y optimizar las estrategias de respuesta. El suministro continuado de información por la comunidad y las actividades de capacitación constituyen elementos esenciales para garantizar la eficacia y la sostenibilidad de las iniciativas de transformación digital.

[32] Véase A4.2: Taller sobre gestión de catástrofes y resiliencia.

2.6.1 Mapa de conectividad en caso de catástrofe (DCM)

El Mapa de conectividad en caso de catástrofe (DCM)[33] es una iniciativa conjunta de la UIT y el Grupo de Telecomunicaciones de Emergencia (ETC), con aportaciones de la Asociación GSM (GSMA), que se puso en marcha en 2020; consiste en un mapa dinámico que proporciona información sobre el tipo, el nivel y la calidad de la conectividad sobre el terreno en situaciones de catástrofe. El equipo DCM sigue probando y evaluando fuentes de datos de conectividad suplementarias, desarrollando una plataforma de cobertura móvil de alta resolución y añadiendo filtros para aumentar aún más la precisión de los datos que se presentan.

La UIT puso en marcha el DCM a raíz del seísmo que sacudió Türkiye y la República Árabe de Siria el 6 de febrero de 2023. El DCM, que genera datos casi en directo para identificar lagunas e interrupciones en materia de conectividad tras una catástrofe, se presentó a asociados y proveedores de servicios de emergencia del ETC, y se accedió al mismo casi en 1 000 ocasiones desde 42 países durante las dos primeras semanas de febrero, principalmente desde el interior de Türkiye. Los datos del DCM pusieron de manifiesto una disminución sustancial de la cobertura de red: la conectividad justo después del seísmo se situaba en el 79 % de la cobertura celular normal, con cortes sobre todo en las zonas rurales menos pobladas. A este periodo le siguió una recuperación constante, hasta superar el 90 % de la cobertura que existía antes de la catástrofe, si bien quedaron algunas zonas específicas donde, en comparación con la situación habitual, no se había detectado conectividad.

El DCM se utilizó para brindar asistencia en las actividades de socorro en la República de Vanuatu, a raíz de los ciclones tropicales Judy y Kevin, ambos de categoría 4 de intensidad. Dichos ciclones tocaron tierra el 1 y 3 de marzo, y unas 250 000 personas se vieron afectadas. Sus fuertes vientos y precipitaciones provocaron grandes inundaciones, daños en estructuras e infraestructuras, y cortes de electricidad y averías en los sistemas de comunicaciones. Tras ambos ciclones se detectó una disminución de la conectividad celular, que alcanzó el 36 % de su nivel normal el 3 de marzo, y aumentó paulatinamente durante la semana del 6 de marzo.

2.6.2 IA para facilitar comunicaciones eficaces

La IA puede mejorar la capacidad humana para la gestión de catástrofes. Sin embargo, si se comprenden y abordan sus limitaciones pueden aprovecharse mejor sus ventajas[34]. El informe técnico del Grupo Temático de la UIT sobre inteligencia artificial para la gestión de catástrofes naturales (GT-AI4NDM), relativo a la utilización de la IA para facilitar comunicaciones eficaces, contiene resúmenes sobre prácticas idóneas y posibles casos de utilización[35]. También incluye varios ejemplos sobre cómo utilizar la IA para informar a los usuarios finales a través de documentos de grupos de trabajo estructurados, a fin de explicar prácticas idóneas sobre aplicación de la IA a la gestión de catástrofes. En particular, el SIG utiliza la IA para visualizar datos geográficos, y tras varias etapas, como se muestra a continuación, el sistema mapea los datos y crea servicios web para que los usuarios finales puedan recibir información sobre catástrofes.

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[33] Véase A1.7.6: Informe de la BDT sobre las actividades de telecomunicaciones de emergencia, en particular actividades, eventos y recursos al respecto. https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Disaster-Connectivity-Map.aspx.

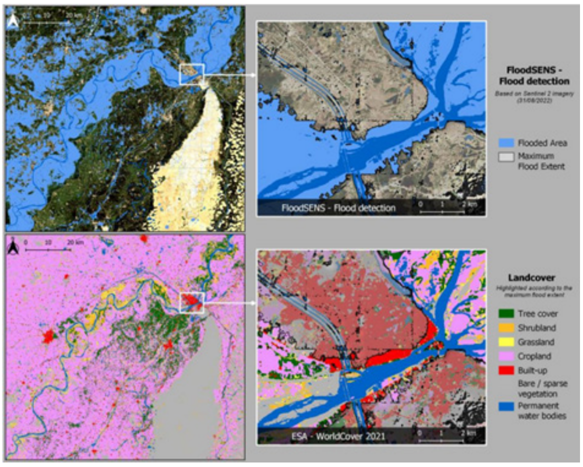
[34] https://aiforgood.itu.int/wp-content/uploads/2020/12/Nature-Communications-Facilitating-adoption-of-AI-in-natural-disaster-management-through-collaboration-Kuglitsch-et-al-24Mar2022.pdf (p. 1)

[35] https://www.itu.int/dms_pub/itu-d/oth/07/2e/D072E0000030008PDFE.pdf (p. 2)

Figura 3: Flujo de trabajo del SIG basado en la utilización de IA para visualizar datos geográficos

En el informe también se incluye un ejemplo de visualización de mapas de las inundaciones que tuvieron lugar en Pakistán en 2022. Se detectaron inundaciones mediante el algoritmo de aprendizaje automático FloodSENS y se pudo detectar el alcance geográfico de las mismas en las zonas afectadas con arreglo a los datos más recientes de la aplicación WorldCover de la ESA[36].

Figura 4: Mapa de Pakistán de 2022



2.6.3 Otros eventos y reuniones relacionados con los sistemas de avisos y alerta temprana en caso de catástrofe

La División de Telecomunicaciones de Emergencia de la BDT ha logrado avances considerables en la utilización de las TIC para la preparación ante catástrofes y las intervenciones de respuesta posteriores. La UIT ha participado activamente en grandes eventos regionales e internacionales, incluido el Mobile World Congress (MWC) de 2023, 2024 y 2025, donde se destacó el papel esencial de las tecnologías móviles en la alerta temprana y la coordinación de emergencia, y se insistió en la colaboración con los operadores de redes móviles en el marco de la iniciativa Alertas Tempranas para Todos (EW4ALL) de las Naciones Unidas.

La UIT hizo una demostración de su Mapa de conectividad en caso de catástrofe (DCM) y de cómo se ha convertido en el Mapa de conectividad de alertas tempranas, herramienta de IA desarrollada en colaboración con el laboratorio AI for Good de Microsoft, Planet y el Institute for Health Metrics and Evaluation (IHME) de la Universidad de Washington. El mapa muestra dónde y cómo numerosas personas tienen cobertura móvil y dónde los "puntos fríos" de conectividad dejan a la población fuera del alcance de las alertas móviles. Durante los últimos tres años se han cartografiado con esta herramienta 33 países. La BDT también ha estado promoviendo sistemas de alerta temprana móviles, como la CB, para reforzar la capacidad de divulgación de alertas a las poblaciones en riesgo.

Los compromisos contraídos en la Conferencia de la Red de Telecomunicaciones de Emergencia de la ASEAN, la Semana de las Redes y Asociaciones Humanitarias, el Taller sobre Telecomunicaciones para la Gestión de Catástrofes en el Caribe (con ETC y GSMA), la Cumbre Mundial sobre la Sociedad de la Información (CMSI), la Cumbre AI for Good, y el Taller sobre aplicación del PAC reforzaron las asociaciones y afianzaron el liderazgo de la UIT en la promoción de los planes nacionales de telecomunicaciones de emergencia (PNTE), la IA para las alertas tempranas y la reducción del riesgo de catástrofes gracias a las TIC. Cabe destacar que la UIT facilitó el lanzamiento y adopción del PNTE de Somalia, definido en el marco de un

36 https://www.itu.int/dms_pub/itu-d/oth/07/2e/D072E0000030008PDFE.pdf (p. 9-10)

proceso multipartito, tras lo cual se celebró un taller nacional sobre PAC a fin de aumentar las capacidades en materia de comunicaciones de emergencia.

A lo largo de 2024 la UIT ha intensificado su apoyo a los Estados Miembros mediante la definición, finalización e implementación de PNTE personalizados y hojas de ruta EW4ALL. Se completaron los PNTE de Djibouti, Namibia, Tanzanía, Zimbabwe, Rwanda, Comoras, San Vicente y las Granadinas, Georgia, Libia y Mauritania. Los PNTE de Gambia, Cabo Verde, Guinea-bissau y Tuvalu siguen en fase de elaboración. Los talleres multipartitos celebrados en Comoras, Djibouti, Mauritania, Somalia y la región SADC permitieron a los países identificar sus carencias de capacidad y establecer mecanismos de coordinación, además de avanzar en la implementación del elemento fundamental 3 de EW4ALL, Difusión y comunicación de alertas. La publicación del PNTE modelo de la SADC sirvió de marco a 16 países para intensificar sus capacidades de preparación y respuesta nacionales.

Se aumentó la capacitación gracias a una simulación teórica de formación de docentes organizada por varios organismos de TIC y celebrada en Valencia conjuntamente con la UNICEF, el PMA/ETC y la GSMA a fin de aumentar la preparación de las telecomunicaciones de emergencia. Su participación en otros eventos mundiales, incluidos el Foro de la CMSI, los talleres de aplicación del PAC y el Taller sobre la Carta de Conectividad Humanitaria de Pakistán, resalta el compromiso de la UIT para con el refuerzo de la resiliencia digital, la promoción de la colaboración regional y el fomento de asociaciones innovadoras para mejorar las telecomunicaciones de emergencia en todo el mundo.

Gracias a estos progresos, en 2025 la UIT ha ampliado su presencia en las regiones, prestando ayuda más países para que aumenten sus capacidades de refuerzo de los sistemas de telecomunicaciones de emergencia y alerta temprana. Varios talleres nacionales y regionales, celebrados en Burundi, Fiji, Malawi, el Caribe y Asia Central, se centraron en la formación práctica, el uso de equipos y la coordinación transectorial en el marco de la iniciativa EW4ALL. Estos esfuerzos reforzaron la colaboración entre gobiernos, reguladores, operadores del sector privado y organismos humanitarios, garantizando que cada vez haya más países capaces de emitir alertas tempranas de manera oportuna, fiable y antropocéntrica. Su constante implicación a lo largo de 2025 demuestra el constante compromiso de la UIT para empoderar a los países con las herramientas, conocimientos y asociaciones necesarios para crear sistemas de comunicación resilientes que salven vidas. La lista de eventos anterior no es exhaustiva y puede encontrarse más información al respecto en https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Events.aspx.

Capítulo 3 – Simulacros y ejercicios de resiliencia y pruebas de resistencia

3.1 Módulos en línea sobre conocimientos y formación en materia de telecomunicaciones de emergencia

La formación desempeña un papel fundamental en la gestión de catástrofes al dotar a profesionales y ciudadanos de las competencias necesarias para evitar, gestionar y mitigar los efectos de situaciones críticas. Facilita la preparación ante riesgos naturales (seísmos, inundaciones o incendios, etc.), al tiempo que fortalece la coordinación entre las partes clave, en particular servicios de emergencia, autoridades gubernamentales y organizaciones humanitarias. Con la formación adecuada, es posible identificar los riesgos, desarrollar planes de contingencia y aplicar estrategias de respuesta eficaces.

A raíz de la evolución de las telecomunicaciones y las TIC, la formación en línea ha pasado a ser una solución accesible y eficaz, que permite adquirir conocimientos de forma rápida y versátil y aprender a gestionar situaciones de catástrofe. Esa accesibilidad es especialmente útil para los ciudadanos y los profesionales que participan en misiones humanitarias o de gestión de riesgo, al poder formarse sin interrumpir sus actividades. Por otro lado, la formación en línea suele ser más barata o incluso gratuita, lo que permite que un mayor número de personas pueda beneficiarse de ella sin restricciones económicas.

Una de las principales ventajas de la formación a distancia radica en la exhaustividad y diversidad del material didáctico utilizado. Las nuevas tecnologías permiten a los alumnos seguir módulos interactivos mediante vídeos explicativos, estudios de caso, simulaciones y ejercicios prácticos para comprender mejor los retos de la gestión de crisis. Esos recursos se actualizan periódicamente para incorporar los últimos avances en gestión de riesgo y medidas de respuesta ante emergencias.

Türkiye[37] puso en marcha en abril de 2020 una plataforma de formación a distancia en temas variados destinada a funcionarios, incluida la gestión del riesgo de catástrofes. Dicha iniciativa promueve la igualdad de oportunidades y mejora la calidad de la formación pública, con más de 36 000 programas de formación impartidos y más de 2,7 millones de funcionarios formados hasta agosto de 2024. A raíz de recientes crisis, incluidos los seísmos de 2023, la plataforma impartió formación específica sobre gestión de catástrofes, y mejoró la preparación de los funcionarios ante situaciones de emergencia. Dichos programas de formación se organizaron con arreglo a 15 amplias categorías de formación y permitieron fomentar la concienciación y reforzar la capacidad de las instituciones y de la población.

En enero de 2021, la **UIT**[38] implantó sus Módulos de formación en línea sobre telecomunicaciones de emergencia[39]. Dichos módulos fueron desarrollados y diseñados para facilitar a la Unión

[37] Véase A1.2.2: Utilización eficaz de las TIC para la reducción y gestión del riesgo de catástrofe; formación para funcionarios en Türkiye.
[38] Véase A1.7.6: Informe de la BDT sobre las actividades de telecomunicaciones de emergencia, en particular actividades, eventos y recursos al respecto.
[39] https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/ITU-Online-Modules-on-Emergency-Telecommunications.aspx

las actividades de capacitación y el fomento de conocimientos sobre las telecomunicaciones de emergencia, así como para proseguir sus actividades de capacitación en materia de recuperación frente a catástrofes, en particular en situaciones como la provocada por la de pandemia de COVID-19. Los módulos de formación disponibles abarcan: (1) el desarrollo de planes nacionales de telecomunicaciones de emergencia (PNTE), con arreglo a las Directrices de la UIT al respecto[40]; (2) la organización de ejercicios de simulación teórica (TTX)[41], y (3) información sobre el Convenio de Tampere[42] y sus ventajas. Los tres módulos en línea son autodidácticos y están disponibles en la Plataforma de la Academia de la UIT. En total, 398 participantes siguieron los cursos durante el periodo reseñado.

3.2 Tecnologías para simulacros y ejercicios

Los ejercicios de simulación desempeñan un papel fundamental en la evaluación y comprobación de soluciones de telecomunicaciones de emergencia. Al recrear situaciones de crisis de forma realista, dichos ejercicios someten a los sistemas de comunicaciones a condiciones extremas o inusuales a fin de poner a prueba su rendimiento. Permiten verificar la resiliencia de las redes, la rapidez del despliegue de soluciones, y la eficacia de los procedimientos establecidos para garantizar una coordinación idónea entre todos los participantes. Las simulaciones proporcionan un marco práctico para evaluar la capacidad de las infraestructuras para resistir eventos perturbadores y medir la capacidad de reacción de los equipos de asistencia en situaciones en las que las comunicaciones son vitales. Al identificar vulnerabilidades y proponer mejoras, dichos ejercicios contribuyen a mejorar las estrategias de respuesta y la gestión de las telecomunicaciones de emergencia. **Malasia**[43] examinó la resiliencia de los servicios de telecomunicaciones ante inundaciones, y **Argelia**[44] diseñó una campaña para hacer frente a incendios forestales.

Al simular condiciones extremas, los citados ejercicios preparan a los equipos de asistencia para lograr una gestión más eficaz ante situaciones de crisis y permiten fortalecer los sistemas de telecomunicaciones para afrontar mejor las situaciones de emergencia.

3.3 Talleres sobre resiliencia

Los talleres que organiza el UIT-D son útiles para intercambiar información sobre gestión de catástrofes. En mayo de 2023 y abril de 2024 se celebraron los talleres relativos a la Cuestión 3/1 del UIT-D, centrados en la gestión de catástrofes y la resiliencia a través de las telecomunicaciones y las TIC, en particular el intercambio de experiencias e información sobre utilización de las telecomunicaciones y las TIC para preservar la resiliencia de las comunicaciones en situaciones de catástrofe, incluida la utilización de las tecnologías existes y las futuras para respaldar los esfuerzos de los Estados Miembros. En el Anexo A4 se proporciona información pormenorizada al respecto.

[40] https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Publications/Guidelines-for-NETPs.aspx
[41] https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Documents/Publications/2020/TTX_Guide.pdf
[42] https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/TampereConvention.aspx
[43] Véase A1.2.3: Medidas para garantizar la resiliencia de los servicios de telecomunicaciones durante tormentas monzónicas e inundaciones (Malasia).
[44] Véase A1.2.4: Prevención de incendios forestales (Argelia).

3.4 Conclusiones extraídas para aumentar la resiliencia de las TIC en todas las etapas de una situación de catástrofe

El aumento del riesgo de catástrofes extremas debido al cambio climático a escala mundial requirió una pronta mejora de la capacidad del personal encargado de las comunicaciones de emergencia y de la calidad de los equipos necesarios al respecto, así como el aumento de la eficacia y eficiencia de las comunicaciones de emergencia. A continuación de sintetizan las principales conclusiones extraídas por **China**[45] en cuanto a prácticas de comunicaciones de emergencia:

- organización de concursos de competencias para el personal de comunicaciones de emergencia para hacer frente a situaciones habituales de catástrofe, con miras a mejorar sus funciones especializadas de apoyo;
- mejora de las actividades de colaboración del personal encargado de las comunicaciones de emergencia y fomento de una cooperación eficaz entre sectores industriales y empresas;
- adopción de medidas para facilitar las labores de investigación y desarrollo sobre equipos avanzados, a tenor de las necesidades de comunicaciones en situaciones de catástrofe extrema;
- fomento de la utilización de equipos avanzados de alta tecnología para mejorar la eficacia de las comunicaciones de emergencia.

El **Estado Independiente de Samoa**[46] propuso un enfoque diverso y resiliente destinado a los pequeños Estados insulares en desarrollo (PEID) basado en el uso de las telecomunicaciones y las TIC, incluido el aprovechamiento de tecnologías de comunicaciones terrenales y por satélite para hacer frente a las vulnerabilidades de las infraestructuras tradicionales y garantizar una comunicación ininterrumpida en situaciones de emergencia. Las iniciativas de capacitación, las asociaciones y la colaboración entre gobiernos, organizaciones a escala regional e internacional y el sector privado son fundamentales para fortalecer las capacidades de gestión de catástrofes.

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[45] Véase A1.2.5: Práctica para mejorar las competencias del personal encargado de las comunicaciones de emergencia y la calidad de los equipos necesarios al respecto (China).

[46] Véase A1.2.6: Fomento de la resiliencia frente a situaciones de catástrofe mediante las telecomunicaciones y las TIC en los pequeños Estados insulares en desarrollo del océano Pacífico (Samoa).

Capítulo 4 – Entorno político y normativo propicio

La comunidad internacional reconoce la suma importancia que revisten las TIC en todas las etapas de la gestión de catástrofes (mitigación, preparación, respuesta y recuperación) y la función primordial que desempeña a tal efecto la preparación de PNTE, así como la necesidad de integrar los esfuerzos encaminados a la reducción del riesgo de catástrofes y emergencias en las normativas, los planes y los programas de desarrollo sostenible. El objetivo de las normativas jurídicas es propiciar un entorno político eficaz al establecer las responsabilidades de las personas que ocupan determinados cargos.

La cuestión de la utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes en los países en desarrollo es compleja y viene dada por factores diversos. A continuación, se enumeran algunos de las principales dificultades que afrontan esos países al respecto, así como las estrategias para superarlos:

Limitación de infraestructuras: los países en desarrollo suelen carecer de infraestructuras de telecomunicaciones de base, en particular redes eficaces de telefonía móvil y conexiones a Internet, lo que limita el acceso a la información y las comunicaciones en caso de catástrofe.

- Estrategia: invertir en el desarrollo de infraestructuras de base de telecomunicaciones, haciendo hincapié en la tecnología móvil y las redes de banda ancha, con el fin de mejorar la conectividad en las zonas rurales y aisladas.

Limitación de recursos: los países en desarrollo suelen disponer de recursos financieros, técnicos y humanos limitados para implantar soluciones tecnológicas avanzadas destinadas a la gestión de catástrofes.

- Estrategia: adoptar soluciones tecnológicas sencillas y económicas, en particular mensajería SMS, aplicaciones móviles "de fácil utilización" y sistemas de radiocomunicaciones que sean más accesibles y fáciles de desplegar en entornos con recursos limitados.

Bajos niveles de alfabetización digital: muchos habitantes de los países en desarrollo tienen un bajo nivel de alfabetización digital y poseen experiencia limitada en tecnologías de la información, lo que puede limitar su capacidad para hacer un uso eficaz de las TIC en situaciones de catástrofe.

- Estrategia: introducir programas para fomentar la concienciación y formación sobre utilización de las TIC mediante métodos didácticos acordes con el grado de alfabetización y las necesidades de la población local.

Obstáculos culturales y lingüísticos: las diferencias culturales y lingüísticas pueden dificultar la difusión eficaz de los mensajes de alerta y de la información sobre catástrofes.

- Estrategia: adaptar los mensajes de alerta y la información sobre catástrofes a las lenguas locales y a contextos culturales específicos, a través de canales de comunicación habituales y canales de medios sociales específicos de cada región.

Deficiente coordinación entre partes interesadas: la coordinación entre gobiernos, organizaciones de prestación de asistencia, organizaciones de la sociedad civil y el sector privado puede ser deficiente, lo que puede aplazar las actividades para dar respuesta a una situación de catástrofe y dar lugar a un uso ineficaz de las tecnologías de la información.

- Estrategia: fortalecer los mecanismos de coordinación y colaboración entre las partes interesadas en la gestión de catástrofes, por medio del establecimiento de asociaciones público-privadas y el fomento del intercambio de información y prácticas idóneas.

Cabe destacar varios ejemplos prácticos en relación con la **República del Congo**[47].

En la **India**[48] se ha implantado una estrategia proactiva para aumentar la eficacia de las actividades de preparación y respuesta ante catástrofes y aumentar la resiliencia de las infraestructuras de telecomunicaciones. En **Côte d'Ivoire**[49] se adoptaron diversas iniciativas para fortalecer el marco jurídico e institucional aplicable a la reducción del riesgo de catástrofes y a la mitigación de sus efectos, que hacen hincapié en la importancia que revisten las telecomunicaciones en el proceso de emisión de alertas tempranas. Con miras a mejorar la gestión de las actividades de preparación, prevención y respuesta ante catástrofes, el Gobierno de Côte d'Ivoire ha puesto en marcha políticas y marcos de reducción del riesgo de catástrofes a tal efecto, en particular:

- la Estrategia nacional para la reducción del riesgo de catástrofes (SNRRC);
- la creación de una plataforma nacional para la reducción del riesgo de catástrofes (PN-RRC);
- el proyecto de creación de un EWS multirriesgo (SAP);
- la utilización eficaz de tecnologías de la comunicación y la información para la emisión de alertas tempranas.

La **República Democrática del Congo**[50] señaló que la utilización de las tecnologías de la información y la comunicación constituye un instrumento eficaz para facilitar la transmisión de información, en particular en situaciones de crisis. A propuesta del organismo regulador (Autoridad de Reglamentación de Correos y Telecomunicaciones del Congo (ARPTC)), la República Democrática del Congo puso a disposición números gratuitos y ofertas promocionales gratuitas de servicios de telecomunicaciones y TIC para hacer frente a riesgos climáticos, incluida la erupción del volcán Nyamulagira en 2021. En **Argelia**[51], en el marco del programa de prevención de incendios forestales y de mejora de la seguridad de las instalaciones de telecomunicaciones en los parques forestales nacionales de dicho país, el Ministerio de Servicios Postales y Telecomunicaciones puso en marcha una destacada campaña de prevención en colaboración con la Dirección General de Bosques y los operadores de servicios de telefonía fija y móvil. El objetivo fue introducir medidas de prevención de incendios forestales en emplazamientos de telecomunicaciones situados en zonas boscosas. En 2022, **Australia**[52] anunció el "Plan de mejora de la conectividad para zonas regionales y rurales del país" (Plan de mejora de la conectividad), con objeto de mejorar la conectividad en diversas

[47] Véase A1.3.14: Gestión de riesgos y catástrofes (República del Congo).
[48] Véase A1.3.7: Enfoque predictivo y proactivo para actividades de preparación y respuesta eficaces frente a catástrofes y aumento de la resiliencia de infraestructuras de telecomunicaciones (India).
[49] Véase A1.1.2: Fortalecimiento del marco institucional y de la utilización de las tecnologías digitales para la reducción del riesgo de catástrofes en Côte d'Ivoire (RIFEN).
[50] Véase A1.3.5: Utilización de las telecomunicaciones para la reducción y gestión del riesgo de catástrofes en la RDC (República Democrática del Congo).
[51] Véase A1.2.4: Prevención de incendios forestales (Argelia).
[52] Véase A1.3.3: Iniciativas para mejorar la resiliencia de las redes de telecomunicaciones para la mitigación y gestión del riesgo de catástrofes (Australia).

regiones de Australia, y fomentar la productividad, la prestación de servicios en pie de igualdad y la oferta social y de seguridad pública. El Plan para fomentar la conectividad incluye la asignación de 656 millones de dólares australianos por un periodo de cinco años, a fin de mejorar la conectividad móvil y de banda ancha y la resiliencia en diversas zonas rurales y regionales del país. La financiación comprende 100 millones de dólares australianos destinados a programas de fomento de la resiliencia, en particular la Ronda 2 del Programa de Mejora de Redes Móviles y el Programa de Innovación en Telecomunicaciones para aumentar la resiliencia frente a catástrofes.

4.1 Normativa para el despliegue de sistemas de comunicaciones de emergencia

La utilización las TIC constituye una herramienta eficaz y fundamental para reducir y gestionar los riesgos provocados por peligros naturales. Las partes interesadas del sistema digital deben velar por la disponibilidad de los servicios de telecomunicaciones de emergencia y facilitar la cooperación al respecto, mediante la implantación de la estrategia del Plan de respuesta frente a riesgos de catástrofe a fin de abordar todas las etapas de la gestión de catástrofes, incluidas las actividades de emisión de alertas, respuesta, realización de operaciones de socorro y modernización de las redes de telecomunicaciones antes y después de una situación de catástrofes, y durante la misma. Se trata de aplicar una normativa de colaboración con todas las instituciones y organismos para la reducción del riesgo de catástrofes.

Los PNTE establecen estrategias claras para garantizar la disponibilidad de los servicios de comunicaciones en todas las etapas de una situación de catástrofe, fomentar la coordinación y colaboración gubernamentales a todos los niveles, así como de organismos humanitarios, proveedores de servicios y comunidades en riesgo. La normativa sobre el despliegue de sistemas de comunicaciones de emergencia se basa en regulaciones de alto nivel, legislaciones nacionales o planes nacionales de gestión del riesgo de catástrofes, que en conjunto proporcionan un marco institucional e interinstitucional para la actuación del gobierno y la sociedad civil ante situaciones de amenaza o catástrofes.

Varios países ya cuentan con un marco normativo de este tipo. En **Türkiye**[53], el Plan de respuesta ante catástrofes de Türkiye (TAMP, por sus siglas en inglés) se elaboró en 2014 para garantizar una respuesta eficaz ante situaciones de catástrofe, a tenor de la experiencia adquirida en catástrofes anteriores. El TAMP identificó las funciones y responsabilidades de los grupos de trabajo y las dependencias de coordinación que participan en estudios de medidas de respuesta ante catástrofes y emergencias, y determinó los principios básicos de la planificación de esas medidas antes y después de una catástrofe, así como durante la misma. El TAMP abarca ministerios, instituciones y organizaciones de índole diversa, así como al sector privado, ONG y particulares, que se prevé participen en las medidas de respuesta frente a posibles situaciones de catástrofe o emergencia de todo tipo o alcance que puedan producirse en Türkiye.

El 6 de febrero de 2023, dos grandes seísmos afectaron a Türkiye, cuyo epicentro se situó en los distritos de Kahramanmaraş de Pazarcık (magnitud 7,7 y 8,6 km de profundidad) y Elbistan (magnitud 7,6 y 7 km de profundidad), a las 04.17 y 13.24 horas, respectivamente, horario local. El 20 de febrero de 2023 se produjo otro seísmo de magnitud 6,4, con epicentro en Yayladağı, Hatay, a las 20.04 hora local.

53 Véase A1.7.1: Actividades de respuesta frente al seísmo en Türkiye, febrero de 2023 (Türkiye).

El "Grupo encargado de las comunicaciones en situaciones de catástrofe"[54], que incluye al Ministerio de Transportes e Infraestructuras, al Organismo regulador de las telecomunicaciones de Türkiye (BTK) y a los operadores, se reunió en el marco del TAMP y empezó a trabajar desde el comienzo del terremoto. Se pidió a los operadores que distribuyeran estaciones base móviles transportadas en remolque en la zona de la catástrofe. Se enviaron a la región 40 estaciones base de ese tipo y 500 estaciones base móviles, vehículos de comunicaciones de emergencia y casi 2 200 colaboradores, y se instalaron terminales de satélite de muy pequeña apertura (VSAT) y puntos de acceso Wi-Fi en la zona del seísmo.

Puesto que uno de los principales problemas de las comunicaciones se debió a los cortes de electricidad y a las dificultades en el suministro de combustible, se enviaron 3 500 generadores a la región. También se proporcionaron puntos de acceso inalámbrico para prestar servicios de Internet en las zonas de asentamientos provisionales.

Una de las principales tareas del BTK es velar por los derechos e intereses de los consumidores. A tal efecto, con objeto de dar una respuesta inmediata, la Junta Directiva de BTK adoptó el 14 de febrero de 2023 una decisión reglamentaria inmediatamente después del seísmo[55]. La correspondiente decisión de la Junta aconsejó a los operadores que ofrecieran a los consumidores afectados por el seísmo diversas ventajas, en particular:

- servicios y prestaciones de forma gratuita a los abonados por un periodo mínimo de un mes;
- aplazamiento de la fecha de pago de facturas al menos por un mes;
- cambio de SIM o de dirección de servicio de forma gratuita, sin cargo alguno por rescisión anticipada del contrato, entre otras medidas;
- liquidación de facturas o créditos relacionados con servicios de comunicaciones en los casos de abonados fallecidos a raíz del seísmo;
- utilización por los operadores de métodos alternativos para verificar la identidad de abonados que perdieron sus documentos de identidad en solicitudes de cambio de tarjeta SIM.

Por otro lado, la fecha de aplicación de determinados reglamentos recién promulgados se aplazó de dos a cuatro meses, con objeto de motivar a los operadores a hacer hincapié en las medidas que debían tomar a raíz del seísmo.

Además de lo anterior y con objeto de contribuir a los esfuerzos de normalización y ayuda en la región, llegó a la región afectada el Camión Tecnológico Móvil de la Academia BTK, para impartir formación a los niños en diversas materias, en particular codificación y robótica. Aproximadamente 150 niños recibieron cada día formación en las aulas móviles de la Academia BTK.

Tras el seísmo, se pidió a los operadores que revisaran sus planes de continuidad operacional y los recursos disponibles para situaciones de emergencia. Se prestó especial atención a los siguientes aspectos:

- aumento de la redundancia y de las conexiones de fibra óptica con las estaciones base, especialmente en emplazamientos mediante radioenlaces;

[54] https://www.afad.gov.tr/kurumlar/afad.gov.tr/e_Kutuphane/Planlar/TAMP.pdf

[55] https://www.btk.gov.tr/uploads/boarddecisions/deprem-felaketi-sebebiyle-alinacak-tedbirler/66-2023-web.pdf

- aumento de los recursos disponibles, en particular estaciones base móviles, generadores y baterías para casos de emergencia;
- utilización de itinerancia nacional para situaciones de emergencia;
- actualización del análisis de riesgos de infraestructuras críticas con respecto a conjuntos de datos geográficos y mapas, y utilización de esos datos para reubicar las estaciones base de zonas de alto riesgo;
- revisión de los planes de suministro energético en colaboración con empresas locales y adopción de las medidas necesarias para suministrar energía de forma ininterrumpida a infraestructuras y sistemas de comunicaciones en caso de catástrofe.

El modelo nacional de protección frente a riesgos en Türkiye mejora paulatinamente a raíz de la participación de todas las partes interesadas.

En **China**[56], la normativa adoptada al respecto incluye el establecimiento de un programa especial, la obtención y promoción de tecnologías y equipos de comunicaciones de emergencia para situaciones habituales de catástrofe, y el fomento de forma conjunta de las comunicaciones de emergencia para la prevención de inundaciones y mitigación del riesgo de catástrofes.

En la **República del Congo**[57] se prevé que los planes nacionales de emergencia incluyan propuestas sobre infraestructuras de datos. Los marcos de gobernanza de datos establecen las entidades facultadas para la supervisión de datos, incluidos los personales. También determinan la forma en que pueden utilizarse los datos y especifican qué personal, procesos y tecnologías son necesarios para su gestión y protección.

Cada país debe velar por que los datos se procesen de forma responsable mediante infraestructuras y procesos acordes con los modelos establecidos.

Flowminder proporciona un código de fuente abierta que puede instalarse en los centros de datos de los operadores de redes móviles (ORM) para facilitar el análisis de registros pormenorizados de llamadas, con el fin de identificar desplazamientos de población antes y después de una catástrofe, y facilitar operaciones de rescate específicas.

La reducción y gestión del riesgo de catástrofe no vienen determinadas únicamente por soluciones tecnológicas e infraestructuras resilientes. El grado de concienciación, preparación, participación comunitaria y colaboración de las partes interesadas, entre otros factores humanos, desempeña asimismo un papel importante para garantizar una gestión eficaz de catástrofes.

Japón[58] hace hincapié en la cooperación entre autoridades públicas y operadores de comunicaciones electrónicas a fin de mejorar la resiliencia de las redes del país a raíz del seísmo que asoló la península de Noto en enero de 2024.

En Türkiye, **Turksat**[59] ha colaborado con organismos gubernamentales (AFAD, Media Luna Roja) para establecer una infraestructura de preparación ante catástrofes. Ello incluye centros de coordinación central y móvil, vehículos de transmisión de datos y formación del personal. Turksat presta servicios de comunicaciones de forma ininterrumpida en situaciones de catástrofe.

[56] Véase A1.3.4: Normativa sobre comunicaciones de emergencia y equipos para la prevención de inundaciones y salvamento (China).
[57] Véase A1.3.6: Planes nacionales de telecomunicaciones de emergencia: catalizadores y garantías (República del Congo).
[58] Véase A1.7.2: Establecimiento de infraestructuras resilientes en Japón y medidas de respuesta y recuperación tempranas frente al seísmo que se produjo en la península de Noto (Japón).
[59] https://www.itu.int/pub/D-STG-SG01.01.03.05-2024

Ello incluye servicios de conectividad para organismos gubernamentales, emplazamientos de protección, avisos públicos y funciones de conexión a redes intermedias para operadores de telefonía móvil terrenal cuya infraestructura se haya visto dañada.

De lo anterior se desprende que las actividades de reducción y gestión del riesgo de catástrofe pueden llevarse a cabo en estrecha colaboración entre todos los actores, a saber, gobiernos, organizaciones internacionales, el sector privado y la sociedad civil. La comunicación y el intercambio de información entre las partes son esenciales para tener una comprensión más cabal de los riesgos y la probabilidad de sus efectos, compartir conclusiones extraídas y fomentar la capacitación de las partes interesadas.

La gestión eficaz del riesgo de catástrofes viene dada por la consideración de los factores humanos pertinentes y el fomento de la colaboración entre las partes interesadas. La utilización de las TIC para la reducción y gestión del riesgo de catástrofes permite fomentar la resiliencia de las comunidades y prepararse eficazmente para retos futuros, al invertir en actividades de aumento de la concienciación, preparación, participación comunitaria y colaboración de las partes interesadas.

4.2 Normativas para facilitar la emisión de alertas tempranas, comunicaciones ininterrumpidas y la adopción de medidas de respuesta eficaces

El formato PAC [b-UIT-T X.1303] permite emitir alertas de emergencia de forma sencilla y general, así como avisos públicos, frente a diversos tipos de peligros por medio de todo tipo de redes. También facilita la difusión simultánea de mensajes de alerta de forma coherente a través de diversos sistemas de alerta, a fin de aumentar la eficacia de las alertas al tiempo que se simplifica la difusión de avisos. Por otro lado, PAC facilita la identificación de pautas incipientes en alertas locales de diversa índole, en particular sobre peligros no detectados o actos hostiles. PAC también proporciona una plantilla para el envío de mensajes de alerta eficaces basada en prácticas idóneas establecidas en el marco de estudios académicos y en experiencias reales.

En marzo de 2022, las Naciones Unidas fijaron un nuevo objetivo para garantizar que todos los habitantes de la Tierra estén protegidos por EWS para 2027. Integrar un formato normalizado internacional para la emisión de alertas de emergencia que facilite la interoperabilidad y la coherencia de las alertas a través de diferentes redes de comunicación sería muy eficaz para mejorar la protección de un mayor número de personas[60].

En virtud del Artículo 110 del Código Europeo de Comunicaciones Electrónicas (CECE), todos los países de la Unión Europea (UE) deben disponer de un sistema de alerta pública que pueda enviar alertas de emergencia geolocalizadas a todos los usuarios de teléfonos móviles situados en la zona afectada durante una catástrofe natural o de origen humano. Casi todos los países europeos han adoptado un sistema de alerta temprana, o están en proceso de examen (licitación) para implantarlo. Se ha optado por una combinación de varias tecnologías: radiodifusión celular (CB) y/o transmisión de SMS basados en la localización. La eficacia de esos EWS se basa en un acceso y una cobertura adecuados de los servicios de telecomunicaciones en toda Europa, donde el 99 % de la población posee cobertura de redes 4G. La mayoría de los países de la Unión Europea abogaron en su licitación por la conformidad PAC.

60 https://www.itu.int/dms_pub/itu-d/oth/07/2e/D072E0000030011PDFE.pdf

Como en muchas partes del mundo, **Australia**[61] ha padecido diversos fenómenos meteorológicos extremos a lo largo de los últimos años. En el verano de 2019/2020 en dicho país, amplias zonas del mismo se vieron afectadas por graves incendios forestales a raíz del año más caluroso y seco registrado en Australia. Dichos incendios forestales provocaron la pérdida de vidas humanas, la muerte o el desplazamiento de unos 3 000 millones de animales y la destrucción de decenas de millones de hectáreas de terreno y miles de inmuebles. Posteriormente, una sucesión de fenómenos meteorológicos provocados por La Niña dio lugar a graves inundaciones que afectaron a muchas comunidades de Australia en 2022. Dichas inundaciones incidieron en la vida cotidiana de muchos australianos, y en muchas zonas del país se registró el año más lluvioso del que se tiene constancia. El Gobierno Federal de Australia tiene la responsabilidad general de los servicios de telecomunicaciones. Ello incluye la gestión de la normativa y reglamentación del sector, así como la concesión de subvenciones para fomentar determinadas actividades, incluida la ampliación de la cobertura móvil en zonas regionales aisladas. No obstante, la responsabilidad principal de las medidas de respuesta frente a catástrofes recae en los gobiernos estatales y territoriales (ocho en total), al tiempo que el funcionamiento directo y el mantenimiento de redes es responsabilidad de los operadores de telecomunicaciones del país. Esa división de responsabilidades conlleva que, al producirse una catástrofe, los operadores de telecomunicaciones colaboren directamente con el Gobierno del Estado o el Territorio correspondiente, de conformidad con las disposiciones en materia de gestión de situaciones de emergencia de la jurisdicción de que se trate. A tal efecto, la principal función del Gobierno australiano es contribuir a desarrollar el sector de las telecomunicaciones para responder ante catástrofes y facilitar la recuperación ante las mismas.

Por lo general, los gobiernos estatales y territoriales colaboran con el sector de las telecomunicaciones para preparar medidas que permitan hacer frente a catástrofes, lo que conlleva la participación de los operadores de telecomunicaciones en las tareas de planificación de emergencias. El Gobierno australiano proporciona asimismo asistencia eficaz a los operadores de telecomunicaciones si ello se precisa para respaldar las actividades de respuesta y recuperación. Por ejemplo, durante una grave inundación que afectó a la costa noroeste de Australia en enero de 2023, las aguas destruyeron un importante puente que sostenía cables de fibra óptica en una región lejana, lo que provocó interrupciones de servicio prolongadas al otro lado del río, e impidió a muchas comunidades contactar con los servicios de emergencia. A raíz de ello, el Gobierno de Australia proporcionó ayuda en forma de aviones militares para transportar a técnicos de una compañía de telecomunicaciones al otro lado del río. Esa ayuda permitió a los técnicos reparar rápidamente la conexión de fibra óptica y restablecer la conectividad.

Habida cuenta de la importancia que reviste la mejora de la resiliencia y la capacidad de recuperación rápida de las instalaciones de comunicaciones, **China**[62] lleva a cabo las siguientes tareas al respecto:

- revisión y mejora de los requisitos técnicos y las normas de construcción de infraestructuras de comunicaciones en función del grado de gravedad de las catástrofes;
- promoción de actividades encaminadas a la modernización y puesta en marcha conjunta de estaciones de comunicaciones móviles de gran tamaño para aumentar la resiliencia

61 Véase A1.3.2: Fortalecimiento de las telecomunicaciones frente a catástrofes naturales (STAND) (Australia).
62 Véase A1.3.4: Normativa sobre comunicaciones de emergencia y equipos para la prevención de inundaciones y salvamento (China).

frente a situaciones de catástrofe de salas de comunicaciones, mejorar los medios de transferencia y prolongar la duración de las baterías de reserva;

- desarrollo, suministro y reserva de equipos de comunicación más avanzados, incluido el despliegue de terminales de satélite que funcionen de forma independiente de las redes terrenales en zonas propensas a catástrofes;
- realización de concursos de competencias de los equipos de comunicaciones de emergencia y, con mayor frecuencia, de simulacros y ejercicios de colaboración entre empresas y organismos.

Côte d'Ivoire[63] es uno de los países más vulnerables a los riesgos naturales, principalmente como consecuencia del cambio climático. Para mejorar la gestión de las actividades de preparación, prevención y respuesta ante las catástrofes, el Gobierno de dicho país ha introducido normativas y marcos sobre reducción del riesgo de catástrofes, en particular:

- la Estrategia nacional sobre reducción del riesgo de catástrofes;
- la creación de la Plataforma nacional de reducción y gestión del riesgo de catástrofes;
- un proyecto para crear un EWS ante diversos tipos de peligros;
- utilización eficaz de las TIC para proporcionar alertas tempranas.

Los planes nacionales de telecomunicaciones de emergencia (PNTE), entre otros protocolos y normativas nacionales, son fundamentales para orientar los esfuerzos de preparación y respuesta ante situaciones de emergencia por medio de las telecomunicaciones. Dichos esfuerzos ponen de relieve la manera en que los países implantan sus PNTE y mejoran su resiliencia a escalas nacional y regional. Sin embargo, tras el desarrollo de los PNTE, los gobiernos de cada país pueden tomar muchas medidas a los efectos de planificación nacional y regional de los servicios de telecomunicaciones de emergencia y mejora de la preparación y resiliencia de las telecomunicaciones de emergencia frente a peligros naturales. Habida cuenta de la experiencia del **Grupo Temático de telecomunicaciones de emergencia del Programa Mundial (PMA-ETC)** y la **GSMA**[64], cabe destacar los siguientes puntos clave en materia de preparación frente a los peligros naturales:

- *Mejora de la coordinación a escalas nacional y regional*: es primordial identificar los organismos nacionales y regionales pertinentes, así como coordinadores, y asegurarse de que las funciones y responsabilidades queden claramente establecidas y comprendidas. Los mecanismos normativos como los PNTE y procedimientos operativos normalizados (SOP) de para telecomunicaciones de emergencia pueden desempeñar un papel fundamental para arrojar luz sobre procesos, funciones y responsabilidades. La organización de talleres o eventos puede facilitar el contacto de las partes interesadas pertinentes.
- *Fomento de las inversiones en capacitación*: la formación, el análisis de capacidades y los ejercicios de simulación pueden ayudar a garantizar que las partes interesadas gubernamentales pertinentes adquieran las competencias y los conocimientos necesarios antes de que se produzca una situación de emergencia; el aumento de las inversiones a tal efecto es primordial para formar a los responsables de la adopción de medidas de respuesta a escala nacional. El ensayo de sistemas, protocolos y capacidades mejora la preparación nacional.

63 Véase A1.1.2: Fortalecimiento del marco institucional y de la utilización de las tecnologías digitales para la reducción del riesgo de catástrofes en Côte d'Ivoire (RIFEN).

64 Véase A1.3.15: Aplicación de la planificación nacional de las telecomunicaciones de emergencia y mejora de la preparación a escalas nacional y regional (PMA-ETC de la ONU, GSMA)).

- *Mantenimiento del desarrollo de capacidades:* debe evaluarse la capacidad para valorar periódicamente la preparación frente a catástrofes, al tiempo que se fomentan enfoques de formación de formadores para preservar los conocimientos institucionales en caso de sustitución de personal.
- *Ejercicios basados en conclusiones extraídas en el marco de la colaboración Sur-Sur con objeto de intercambiar conocimientos*: a escala mundial, las partes interesadas gubernamentales también pueden aprender mutuamente mediante la documentación y difusión de conclusiones extraídas, el intercambio de conocimientos y la formación entre iguales. Las comunidades de prácticas pueden compartir conocimientos, recursos y experiencia muy importantes con el fin de coordinar mejor medidas de respuesta futuras, en particular mediante el aprovechamiento de capacidades regionales (equipos y personal de respuesta).
- *Integración de las actividades de preparación ante emergencias en la planificación nacional*: el fomento de las actividades de preparación frente a emergencias mediante provisiones financieras adecuadas en los planes nacionales es fundamental para garantizar la sostenibilidad de las intervenciones a largo plazo. Ello brinda asimismo la oportunidad de que los ciclos de planificación a escala nacional aborden de forma sostenible las intervenciones de desarrollo a largo plazo, susceptibles de incluir compromisos como la mejora de las infraestructuras de alerta temprana, entre otros.

Capítulo 5 – Tecnologías de comunicaciones para situaciones de catástrofe

5.1 TIC para la gestión de catástrofes y el desarrollo sostenible inteligente

5.1.1 Tecnologías de supervisión y detección

Utilización de la radiogoniometría para salvar vidas en situaciones de catástrofe

Las víctimas de catástrofes pueden detectarse mediante radiogoniometría a fin de localizar señales de telefonía móvil en las frecuencias de telefonía móvil en las frecuencias de enlaces de retorno (enlace ascendente). En Vila do Sahy in São Sebastião, São Paulo, in **Brasil**[65], la Agencia Nacional de Telecomunicaciones (ANATEL) recurrió a un procedimiento de salvamente consistente en emplear una antena direccional conectada a un analizador de espectro a fin de buscar manualmente la dirección del nivel máximo de señal recibida. En la Figura 5 se muestra un analizador de espectro con antena direccional.

Figura 5: Analizador de espectro con antena direccional

ANATEL utilizó un analizador de espectro provisto de una antena direccional sincronizada en las siguientes bandas de frecuencias para enlaces ascendentes de la red móvil celular: 703-748 MHz; 824-849 MHz; 890-910 MHz; 1 710-1 785 MHz; 1 895-1 900 MHz; 1 920-1 975 MHz; 2 500-2 570 MHz.

Los procedimientos resultaron eficaces al reducir las zonas de intervención para localizar a personas vivas o fallecidas en zonas remotas. Se ha documentado que el analizador de espectro utilizado por los técnicos de ANATEL desempeñó un papel crucial en la reducción de las zonas de intervención y la identificación de personas. Protección Civil señaló que el tiempo asignado a las actividades previstas en las regiones afectadas por la catástrofe de Vila do Sahy se redujo a una tercera parte del previsto. Consta que la labor realizada por Anatel formará parte de futuras actividades de rescate. Anatel constituyó una Comisión de Estudio para desarrollar una especificación técnica y un plan de acción con objeto de determinar las actividades y los procedimientos que se apliquen en São Sebastião en futuras actividades de rescate.

[65] See A1.4.1: Rescue procedures applied at Vila do Sahy in São Sebastião, São Paulo, Brazil.

5.1.2 Tecnologías de comunicación

Sistema de plataforma a gran altitud (HAPS) basado en ANT de ala fija y VTOL para comunicaciones de emergencia

Para las comunicaciones e emergencia un sistema de plataforma a gran altitud (HAPS) basadas en una plataformas de aeronaves no tripuladas (ANT) de ala fija y despegue y aterrizaje en vertical (VTOL) de tamaño medio permiten el control de la aeronave y del enlace de retorno mediante comunicaciones por satélite. Se pueden utilizar estaciones base aerotransportadas para restablecer rápidamente la comunicación a escala local en la zona de una catástrofe; también permiten la retransmisión de vídeo en tiempo real y la detección por infrarrojos. Habida cuenta de las características específicas de las HAPS, que incluyen mayor capacidad y menor latencia, así como mayor nivel de penetración con respecto a las soluciones por satélite, las HAPS no sólo soportan servicios básicos de comunicaciones, en particular de mensajería y voz, sino que también proporcionaría servicios más sofisticados como Internet móvil y entretenimiento en amplias zonas. En situaciones de catástrofe, las HAPS pueden desplegarse de inmediato en la zona afectada para restablecer las comunicaciones.

La ANT que se traslada sobre el terreno se conecta con tierra mediante cables y proporciona alimentación ininterrumpida mediante cables compuestos fotoeléctricos. Sin embargo, si las vías de comunicación se ven interrumpidas, sólo es posible alcanzar el borde de la zona siniestrada, sin poder llegarse rápidamente al núcleo de la misma para restablecer la comunicación. Las ANT de gran tamaño de ala fija precisan amplios aeropuertos y su coste es elevado, y su complejo manejo corre a cargo de profesionales muy cualificados. Las ANT VTOL de ala fija y tamaño medio resultan prácticas al no necesitar aeropuertos especiales, son más sencillas de manejar y más adecuadas para situaciones de comunicación de emergencia.

China Mobile[66] presentó una HAPS basada en una plataforma de ANT VTOL de ala fija y tamaño medio. El sistema permite el control de aeronave y del enlace de retorno mediante comunicaciones por satélite, así como utilizar una estación base aerotransportada para restablecer rápidamente la comunicación a escala local en caso de interrupción del servicio, falta de suministro energético o sistemas de transporte deficientes en la zona de una catástrofe; también permiten la retransmisión de vídeo en tiempo real y la detección por infrarrojos. Las ANT VTOL de ala fija y tamaño medio no necesitan aeropuertos especiales, son más sencillas de manejar y más adecuadas para situaciones de comunicación de emergencia.

Presentación de HAPS basada en ANT de ala fija VTOL para comunicaciones de emergencia:

- composición y características de una aeronave no tripulada de ala fija VTOL de tamaño medio;

[66] Véase A1.4.2: Estación base a gran altitud para ANT de ala fija VTOL para comunicaciones de emergencia (China Mobile).

Figura 6: Imagen de una ANT de ala fija VTOL de tamaño medio

- principio técnico de una estación base a gran altitud de ANT de ala fija VTOL de tamaño medio

Figura 7: Imagen de una HAPS que utilizan VTOL

- aumento de cobertura;
- control de vuelo de largo alcance más allá de la línea de visión;
- mejorar la cobertura de la movilidad;
- conexión del centro de mando con el emplazamiento;
- conjunto de aplicaciones.

SoftBank[67] presentó una HAPS a bordo de una ANT de rotación estacionaria en la estratosfera a una altitud de unos 20 km. A Esa altitud hay poca variación de la velocidad del viento, lo que ofrece a la HAPS gran estabilidad. Habida cuenta de su gran envergadura, la HAPS puede transportar cargas útiles de alto rendimiento y paneles solares, por lo que puede abarcar zonas de hasta 200 km de diámetro con energía suficiente por un largo periodo de tiempo.

Tras una catástrofe, las comunidades afectadas suelen padecer comunicaciones deficientes, lo que merma su capacidad para pedir ayuda, entablar contacto con su familia u obtener información primordial. Restablecer la comunicación conlleva implantar infraestructuras y tecnologías de comunicación que permitan un intercambio de información fiable y rápido entre el personal encargado de las actividades de respuesta a emergencias, las comunidades afectadas y las autoridades pertinentes. El objetivo de las HAPS es facilitar una comunicación rápida y eficaz, ofrecer información de la situación, asistir en las actividades de búsqueda y rescate y facilitar los esfuerzos de recuperación y reconstrucción tras una catástrofe. Durante el

[67] Véase A1.4.3: Sistemas de estaciones de plataformas a gran altitud (HAPS) (Softbank, Japón).

crucial periodo de las "72 horas siguientes al suceso", ofrecer un tratamiento médico preciso y entablar contacto con personas atrapadas bajo los escombros implica que el sistema debe ofrecer una calidad de servicio (QoS) que permita las videollamadas. En esas situaciones de emergencia, el restablecimiento de comunicaciones para necesidades específicas es posible gracias a la cobertura de HAPS.

Figura 8: Comparación de sistemas

Estaciones base a bordo de buques

KDDI[68] (Japón) presentó el caso de utilización de estaciones base a bordo de buques para facilitar las actividades de respuesta frente al seísmo que tuvo lugar en la península de Noto en enero de 2024. El 6 de enero de 2024 NTT Docomo y KDDI, que son los principales operadores de telecomunicaciones móviles en Japón, comenzaron a operar conjuntamente una "estación base a bordo de un buque", para ofrecer servicios de telefonía móvil desde un barco. Ese servicio forma parte del acuerdo de colaboración en el plano social que NTT y KDDI suscribieron en 2020 para abordar cuestiones sociales y que incluye colaboración en el ámbito de las telecomunicaciones, pero también para el transporte de suministros en situaciones de catástrofe.

Comunicaciones por satélite

La tecnología directa al dispositivo (D2D) es una innovación incipiente diseñada para ampliar la conectividad a zonas fuera del alcance de las redes terrenales tradicionales, en particular en situaciones de catástrofe en las que la infraestructura puede verse dañada o estar totalmente indisponible. Al facilitar la comunicación directa por satélite a través de dispositivos móviles normalizados, la tecnología D2D permite prestar servicios esenciales para preservar la vida humana en situaciones de emergencia, al tiempo que garantiza que los usuarios puedan emitir señales de socorro, recibir alertas y mantener una comunicación básica aun en regiones alejadas o afectadas por una situación de crisis. En su fase inicial, el despliegue de servicios D2D se ve limitado en gran medida a las funciones "Directo al terminal portátil" (D2H), especialmente a mensajes de emergencia. Esa implementación temprana soporta comunicaciones de base para servicios de transmisión de texto, que permiten a los usuarios solicitar ayuda o mantenerse informados en los casos en que las redes celulares no funcionen. Hasta ahora, su adopción ha tenido lugar principalmente por usuarios que ya utilizan servicios de comunicación por satélite, en particular excursionistas, montañeros, marineros y trabajadores en zonas aisladas que se encuentran con frecuencia fuera del alcance de la cobertura de las redes móviles convencionales. Esas personas utilizan desde hace tiempo teléfonos por satélite específicos, o dispositivos especializados para comunicaciones por satélite, si bien cabe esperar que la

[68] Véase A1.4.4: Estaciones base a bordo de buques (KDDI, Japón).

integración de la tecnología D2D en los teléfonos inteligentes más habituales fomente su accesibilidad.

Access Partnership[69] señaló el desarrollo de la tecnología D2H para comunicaciones en caso de catástrofe, con el objetivo de ampliar la cobertura a zonas que no abarcan las redes terrenales habituales en caso de catástrofe. En la fase inicial del servicio se han prestado principalmente servicios limitados, centrados en el envío de mensajes de emergencia.

China Mobile[70] presentó una estación base ligera por satélite integrada. El sistema contiene una batería integrada y puede activarse en todo momento o lugar. Puede transportarse en una mochila, por lo que una sola persona puede llevarla al lugar de la catástrofe.

Comunicaciones terrenales

NTT Docomo (Japón)[71] señaló la utilización de estaciones base para zonas de tamaño amplio o medio a fin de garantizar las comunicaciones en zonas densamente pobladas, en situaciones de catástrofe con interrupciones de suministro eléctrico. Estas estaciones base proporcionan una cobertura de 360 grados en un radio de siete kilómetros, más amplia que la de una estación base normalizada.

5.1.3 Tecnologías de análisis inteligentes

Modelo de rentabilidad del Grupo Temático de telecomunicaciones de emergencia (ETC)

El Grupo Temático de telecomunicaciones de emergencia del Programa Mundial de Alimentos[72], desarrolló un modelo de rentabilidad para analizar los beneficios de la inversión en actividades de preparación de las telecomunicaciones de emergencia en 2021-22, con el objetivo de generar pruebas empíricas sobre rentabilidad y, en última instancia, alentar a las partes interesadas en los ámbitos humanitario y del desarrollo a promover servicios de telecomunicaciones más resilientes frente a catástrofes.

Inteligencia artificial (IA) para la gestión de catástrofes naturales

La CE 2 del UIT-T[73] constituyó el GT-AI4NDM, con el fin de realizar un trabajo previo a la normalización sobre servicios de telecomunicaciones para actividades de socorro y emisión de alertas tempranas en caso de catástrofe, fomento de la resiliencia de redes y la recuperación mediante la utilización de IA. El Grupo de Trabajo elaboró y publicó varios productos, en particular su informe técnico sobre IA y servicios de comunicaciones para la gestión de situaciones de catástrofes naturales.

[69] Véase A1.4.5: Tecnología directa al terminal portátil para comunicaciones en situaciones de catástrofe (Access Partnership).
[70] Véase A1.4.6: Estación base por satélite 5G ligera y versátil (China).
[71] Véase A1.4.7: Estudio de caso sobre preparación ante catástrofes de los operadores de telefonía móvil en Japón (NTT Docomo, Japón).
[72] Véase A1.7.5: Modelo de rentabilidad del ETC: desarrollo de infraestructuras de telecomunicaciones resilientes frente a riesgos (PMA-ETC).
[73] Véase A3.1: IA para la gestión de catástrofes naturales (Comisión de Estudio 2 del UIT-T).

5.1.4 Otras tecnologías

Protocolo de Alerta Común (PAC)

India[74] introdujo un sistema de difusión de alertas tempranas basado en el PAC denominado SAmekit CHEtavani Tantra (SACHET), como etapa inicial de la implementación en todo el país de un proyecto de sistema de difusión de alertas tempranas basado en el PAC en agosto de 2021, que concluyó satisfactoriamente en agosto de 2023. Todos los organismos reguladores de los servicios de emisión de alertas, incluidos el Ministerio del Interior, la Autoridad Nacional de Gestión de Desastres y las Autoridades Estatales de Gestión de Catástrofes de los 36 estados, coordinaron su labor adecuadamente. Todas las Autoridades Estatales de Gestión de Catástrofes (SDMA, por sus siglas en inglés) pueden enviar directamente alertas geolocalizadas sin intervención manual a través de sus paneles de control.

La radiodifusión celular (CB), conjugada con la integración en la plataforma PAC, constituye una útil herramienta de concienciación pública integral en situaciones de catástrofe, además de la diseminación de SMS. La CB ofrece capacidades únicas para llegar a grandes poblaciones en caso de catástrofe. Su alcance universal, difusión selectiva y carácter automático permiten transmitir información crucial a todos los habitantes de las zonas afectadas, con objeto de salvar vidas y minimizar los efectos de una catástrofe. La eficacia de la CB sumada a la integración de la plataforma PAC se puso de manifiesto en India al producirse el ciclón Michaung.

5.2 Infraestructuras de comunicaciones resilientes

La utilización de las telecomunicaciones y las TIC permiten aumentar sustancialmente la resiliencia frente a catástrofes. Sin embargo, **RIFEN (Red Internacional de Expertas en lo Digital)**[75] señaló que es esencial superar retos en cuanto a accesibilidad, coordinación y resiliencia de infraestructuras.

Haití[76] proporcionó información sobre sus métodos de evaluación de la resiliencia de las redes e infraestructuras de telecomunicaciones y TIC. En términos de resiliencia, la capacidad global de recuperación o reconstrucción de los operadores de telefonía móvil y de los principales proveedores de acceso a Internet oscila entre el 60 % y el 75 %. La adopción de las medidas enumeradas a continuación es fundamental y racional, con objeto de que las redes de telecomunicaciones no padezcan daños graves y su disponibilidad no se vea afectada adversamente en una catástrofe, incluidos los días posteriores:

- evaluación de los efectos de los daños en redes e infraestructuras de telecomunicaciones;
- evaluación del plan de restauración vigente de los operadores;
- evaluación del grado de resiliencia de redes e infraestructuras existentes; y
- propuesta de soluciones para mejorar el plan de restablecimiento y el grado de resiliencia de las redes e infraestructuras de telecomunicaciones.

[74] Véase A1.4.8: Utilización de la radiodifusión celular para aumentar la concienciación pública a través de la plataforma del Protocolo de Alerta Común (PAC) (India).
[75] Véase A1.5.1: Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes (RIFEN).
[76] Véase A1.5.3: Resiliencia de las redes e infraestructuras de telecomunicaciones y TIC en Haití.

Intelsat[77] propuso un enfoque variado para mejorar la resiliencia frente a catástrofes en regiones propensas a las mismas a través de las telecomunicaciones y las TIC. Mediante la utilización de tecnologías terrenales y por satélite, los países pueden superar las vulnerabilidades de las infraestructuras tradicionales y garantizar una comunicación ininterrumpida en caso de emergencia.

5.3 Factores humanos y colaboración de las partes interesadas

Medidas de respuesta de recuperación tempranas

Japón y **KDDI, Japón**[78] proporcionaron información sobre las medidas de respuesta que adoptaron para facilitar la recuperación de las redes de telecomunicaciones a raíz del seísmo que tuvo lugar en la península de Noto el 1 de enero de 2024. El 18 de enero, los cuatro operadores de telefonía móvil, a saber, NTT Docomo, KDDI, SoftBank y Rakuten Mobile, concluyeron las actividades de recuperación en zonas de difícil acceso, y previeron una pronta recuperación del servicio en las demás zonas inaccesibles tras la apertura de las carreteras. Dichas actividades de recuperación guardan relación con las medidas adoptadas para recuperar el uso de la red en las zonas afectadas de forma provisional, por ejemplo, "el transporte de generadores a estaciones base que no pueden funcionar debido a la interrupción del suministro eléctrico", o "el transporte de equipos de comunicaciones por satélite a una estación base en la que se ha interrumpido la transmisión por conexión por fibra óptica". La plena recuperación viene dada por el estado de las infraestructuras afectadas en cada zona, en particular carreteras, electricidad y líneas de fibra óptica.

A raíz de la experiencia adquirida en esta situación de catástrofe, cabe señalar que se utilizaron ampliamente equipos de internet por satélite (terminales Starlink) como equipos de sustitución al interrumpirse la transmisión por fibra óptica de las estaciones base de telefonía móvil. También se utilizaron equipos de Internet por satélite para garantizar un medio de comunicación en los centros de evacuación. El Gobierno de Japón llevó a cabo la verificación necesaria de los motivos de la catástrofe y de las medidas de respuesta pertinentes, y tuvo en cuenta los avances logrados para utilizar nuevas tecnologías, en particular satélites y drones, así como para facilitar la colaboración público-privada. Se previó desplegar más esfuerzos para seguir fortaleciendo el entorno de comunicaciones a fin de evitar interrupciones de servicio.

Simulaciones de radiocomunicaciones

Indonesia[79] presentó una iniciativa para organizar un simulacro de radiocomunicaciones en caso de catástrofe, con la participación de varias partes interesadas. Dicho simulacro incluyó la preparación de procedimientos de radiocomunicaciones, indicativos de llamada, difusión de datos e información sobre catástrofes y establecimiento de casos hipotéticos sobre catástrofes (antes y después de una situación de catástrofe, así como durante la misma). Los simulacros de radiocomunicaciones en caso de catástrofe fomentan la competencia de las partes interesadas y las comunidades en la gestión de catástrofes y la utilización de servicios de radiocomunicaciones. La utilización de frecuencias compartidas aumenta la eficacia y eficiencia

[77] Véase A1.5.4: Aumento de la resiliencia frente a catástrofes mediante telecomunicaciones y TIC en zonas propensas a catástrofes (Intelsat, Estados Unidos)

[78] Véase A1.6.1: Establecimiento de infraestructuras resilientes en Japón y medidas de respuesta y recuperación tempranas frente al seísmo que se produjo en la península de Noto (Japón).

[79] Véase A1.6.2: Fortalecimiento de la colaboración entre las partes interesadas y las comunidades para reducir el riesgo de catástrofes mediante simulacros de radiocomunicaciones (Indonesia).

de las actividades de coordinación. Por otro lado, permite transmitir al público información fiable, válida y verificada previamente.

Mujeres, TIC y telecomunicaciones de emergencia

En la publicación de la BDT y el ETC "Mujeres, TIC y telecomunicaciones de emergencia – Oportunidades y limitaciones"[80] se esboza un conjunto de factores que ponen de relieve la brecha digital de género y la mayor vulnerabilidad de las mujeres y las niñas antes y después de una catástrofe, así como durante la misma. También se exponen prácticas idóneas y ejemplos de utilización de las TIC para promover la igualdad de género en la gestión del riesgo de catástrofes.

5.4 Otros informes relativos a la gestión de catástrofes

Informes y conclusiones extraídas a raíz de catástrofes

Türkiye[81] notificó dos grandes seísmos el 6 de febrero de 2023, y recomendó a los operadores que revisaran sus planes de continuidad operacional y sus recursos para situaciones de emergencia.

Japón[82], **KDDI**[83] y **NTT Docomo**[84] informaron del seísmo que se produjo en la península de Noto el 1 de enero de 2024, y propusieron que se desplegaran esfuerzos para movilizar todos los medios posibles, incluida la emisión de ondas radioeléctricas desde zonas costeras mediante estaciones base situadas en buques para proporcionar cobertura en la zona con estaciones base temporales por medio de tecnología de drones durante la fase de respuesta ante la catástrofe.

Prevención de pandemias

Türkiye[85] introdujo un servicio electrónico de rescisión de contratos, a fin de garantizar la protección de los consumidores en situaciones en las que el contacto físico resulte complejo, en particular durante epidemias.

Otras tecnologías de gestión de catástrofes

La **República de Rwanda**[86] introdujo la utilización de drones (ANT) para la gestión del riesgo de catástrofes, lo que facilita la realización de análisis aéreos sobre zonas propensas a inundaciones y la supervisión del nivel de los ríos en zonas inundables y de zonas propensas a desplazamientos de tierras. Habida cuenta de que el cambio climático sigue exacerbando la cadencia e intensidad de las catástrofes, Rwanda seguirá invirtiendo en soluciones tecnológicas, en particular ANT, para redoblar esfuerzos de gestión de catástrofes. Al abordar diversos retos normativos y operativos, dicho país puede desarrollar prácticas idóneas sobre utilización de ANT para lograr

[80] UIT y ETC, *Mujeres, TIC y telecomunicaciones de emergencia – Oportunidades y limitaciones* (Ginebra, 2020).
[81] Véase A1.7.1: Actividades de respuesta frente al seísmo en Türkiye, febrero de 2023 (Türkiye).
[82] Véase A1.7.2: Establecimiento de infraestructuras resilientes en Japón y medidas de respuesta y recuperación tempranas frente al seísmo que se produjo en la península de Noto (Japón).
[83] Véase A1.4.4: Estaciones base a bordo de buques (KDDI, Japón).
[84] Véase A1.4.7: Estudio de caso sobre preparación ante catástrofes de los operadores de telefonía móvil en Japón (NTT Docomo, Japón).
[85] Véase A1.7.3: Servicio electrónico de rescisión de contratos a través del Portal de la Administración Electrónica (Türkiye).
[86] Véase A1.7.4: Integración de la utilización de drones en las cuatro etapas clave de la gestión del riesgo de catástrofe: mitigación, preparación, respuesta y recuperación (Rwanda).

una gestión del riesgo de catástrofes eficaz, proteger vidas humanas y garantizar el desarrollo sostenible. Sobre la base de tecnologías avanzadas como la IA, las TIC y el análisis de datos, los drones pueden llegar a constituir herramientas muy útiles para fomentar la concienciación de la situación y mejorar los procesos de toma de decisiones en situaciones de catástrofe.

Capítulo 6 – Estudios de caso por país y sector

En la presente sección se sintetizan varios estudios de caso por país y sector presentados en el marco de la Cuestión 3/1 durante el periodo de estudios. Cabe destacar cinco categorías de estudios de caso: sistemas de alerta temprana y emisión de alarmas, simulacros y ejercicios de resiliencia y pruebas de resistencia, idoneidad del entorno normativo y reglamentario y tecnologías de comunicación en caso de catástrofe. Los estudios de caso se describen detalladamente en el **Anexo 1** de este informe. En el **Cuadro 1** figura el título de los estudios de caso, los países que los presentaron y las secciones relacionadas en el **Anexo 1** para cada tema.

Cuadro 1: Estudios de caso

Tema	País	Entidad	Título del estudio de caso	Sección
Capítulo 2: Sistemas de alerta temprana y emisión de avisos				
2.1 Utilización de las TIC para la planificación de sistemas de alerta temprana y emisión de avisos	Türkiye	Türkiye	Sistemas de información para situaciones de emergencia	A1.1.1
	Côte d'Ivoire	RIFEN	Fortalecimiento del marco institucional y de la utilización de las tecnologías digitales para la reducción del riesgo de catástrofes en Côte d'Ivoire	A1.1.2
	RIFEN		Aprovechamiento de la supervisión en tiempo real y los sistemas de alerta temprana de TIC para mejorar la preparación y la respuesta en caso de catástrofe	A1.1.16
	Kenya	Cruz Roja de Kenya	Utilización de la tecnología para la gestión de catástrofes	A4.2
2.2 Despliegue de sistemas de alerta temprana para la reducción del riesgo de catástrofes	Japón	Japón	L-Alert en Japón	A1.1.14
	Türkiye	Türkiye	Sistema nacional de alertas móviles en Türkiye	A1.1.4
	Bhután	Bhután	Telecomunicaciones y TIC para la reducción y gestión del riesgo de catástrofes	A1.1.5
	APT	ASTAP EG DRMRS	Sistemas de alerta temprana a través de sistemas de radiocomunicaciones	A3.4
	Estados Unidos	NOAA	Alertas móviles en Estados Unidos de América	A4.1

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
2.3 Sistemas de radiodifusión de avisos de emergencia	Japón	JTEC	Sistema de radiodifusión de alertas de emergencia (EWBS)	A1.1.6
	Corea (República de),	EQ4ALL Co., Ltd	Plataforma de televisión para fomentar comunicaciones inclusivas	A1.1.7
	Bhután	Bhután	Utilización del satélite de Asia meridional (SAS) para prestar servicios de televisión y radio a escala nacional en zonas rurales	A1.1.8
	ITU-R	GT 6A	Servicio de radiocomunicaciones internacionales para actividades de socorro en situaciones de catástrofe (IRDR)	A3.3
2.4 Tecnología de sistemas de alerta temprana y emisión de avisos	Países Bajos	Everbridge One2many	Emisión de alertas mediante radiodifusión celular (RC)	A1.1.9
	India	India	Utilización de la radiodifusión celular para aumentar la concienciación pública a través de la plataforma del Protocolo de Alerta Común (PAC)	A1.4.8
2.5 Sistemas de alerta temprana y teledetección	Portugal	ANACOM	Sistema de cables submarinos SMART CAM	A1.1.10
	Japón	NICT	Sistemas visuales basados en IoT para la detección de catástrofes	A1.1.11
	India	India	Observación de la Tierra	A1.1.12
	China	China	Aplicación de la tecnología de detección por fibra óptica para facilitar las actividades de concienciación y emisión de alertas sobre riesgos en oleoductos	A1.1.13

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
2.6 Sistemas de información y socorro en caso de catástrofe	Burundi (República de),	RIFEN	El importante papel de las TIC en los sistemas de alerta temprana multirriesgo	A1.1.3
	BDT	Relatores para las Cuestiones 1/1, 3/1 y 5/1	Satellites for disaster mitigation, preparedness, response and recovery of the Joint questions 1/1, 3/1 and 5/1 Paper on "Transformative Connectivity: Satellite Workshop". https://www.itu.int/md/D22-SG01-C-0346/en	A1.1.15
	Naciones Unidas		Actividad de las Naciones Unidas sobre emisión de alertas tempranas para todos (EW4all)	A4.1
Capítulo 3: Simulacros y ejercicios de resiliencia y pruebas de resistencia				
3.1 Módulos en línea sobre conocimientos y formación en materia de telecomunicaciones de emergencia	Argelia	Argelia	Comienzo del plan de rescate ORSEC	A1.2.1
	Türkiye	Oficina de Recursos Humanos	Utilización eficaz de las TIC para la reducción y gestión del riesgo de catástrofe; formación para funcionarios en Türkiye	A1.2.2
	GSMA	GSMA	Simulacro de catástrofe con operadores móviles y gobiernos	A4.2
3.2 Tecnologías para simulacros y ejercicios	Malasia	MCMC	Medidas para garantizar la resiliencia de los servicios de telecomunicaciones durante tormentas monzónicas e inundaciones	A1.2.3
	Argelia	Argelia	Prevención de incendios forestales	A1.2.4
3.3 Taller sobre resiliencia			Taller sobre catástrofes	A4
3.4 Conclusiones extraídas para aumentar la resiliencia de las TIC en todas las etapas de una situación de catástrofe	China	China	Práctica para mejorar las competencias del personal encargado de las comunicaciones de emergencia y la calidad de los equipos necesarios al respecto	A1.2.5
	Samoa	Samoa	Fomento de la resiliencia frente a situaciones de catástrofe mediante las telecomunicaciones y las TIC en los pequeños Estados insulares en desarrollo del océano Pacífico	A1.2.6

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
Capítulo 4: Entorno político y normativo propicio				
4.1 Normativa para el despliegue de sistemas de comunicaciones de emergencia	Burkina Faso	Burkina Faso	Resiliencia de las infraestructuras de telecomunicaciones en Burkina Faso	A1.3.1
	Australia	Australia	Fortalecimiento de las telecomunicaciones frente a catástrofes naturales (STAND)	A1.3.2
	Australia	Australia	Iniciativas para mejorar la resiliencia de las redes de telecomunicaciones para la mitigación y gestión del riesgo de catástrofes	A1.3.3
	China	China	Normativa sobre comunicaciones de emergencia y equipos para la prevención de inundaciones y salvamento	A1.3.4
	República Democrática del Congo	República Democrática del Congo	Utilización de las telecomunicaciones para la reducción y gestión del riesgo de catástrofes en la RDC	A1.3.5
	Congo (República del)	Congo (República del)	Planes nacionales de telecomunicaciones de emergencia: catalizadores y garantías	A1.3.6
	India	India	Enfoque predictivo y proactivo para actividades de preparación y respuesta eficaces frente a catástrofes y aumento de la resiliencia de infraestructuras de telecomunicaciones	A1.3.7
	Brasil	Intelsat	Mejora de la normativa sobre regulación y concesión de licencias para fomentar la resiliencia mediante las telecomunicaciones y las TIC en zonas propensas a catástrofes	A1.3.8
	Congo (República del)	Congo (República del)	Gestión de riesgos y catástrofes	A1.3.14
	Alianza HAPS	GT Telecom	Entorno normativo para el despliegue de HAPS (estaciones en plataformas a gran altitud)	A3.10
	Naciones Unidas	PMA	Integración de las actividades de preparación en la planificación a escala nacional	A4.2

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
	Estados Unidos	Tecnologías Lumen	Planificación avanzada para la mejora de la resiliencia	A4.2
4.2 Normativas para facilitar la emisión de alertas tempranas, comunicaciones ininterrumpidas y la adopción de medidas de respuesta más eficaces	Burundi	Burundi	Utilización de las TIC para reducir y gestionar los riesgos de catástrofe	A1.3.9
	Senegal	Senegal	Plan de acción contra la COVID-19, incluida la colaboración con las correspondientes organizaciones	A1.3.10
	Côte d'Ivoire	Côte d'Ivoire	Plan de respuesta frente a la COVID-19 en Côte d'Ivoire	A1.3.11
	Rumania	Rumania	Número único de emergencias 112	A1.3.12
	Dominicana (República),	República Dominicana	Nuevo marco reglamentario para el Sistema de información mediante alertas	A1.3.13
	Naciones Unidas GSMA	PMA-ETC GSMA	Aplicación de la planificación nacional de las telecomunicaciones de emergencia y mejora de la preparación a escalas nacional y regional	A1.3.15
	Comoras	Comoras	Aplicación del PNTE en las Comoras	A3.12
Capítulo 5: Tecnologías de comunicaciones para situaciones de catástrofe				
5.1 TIC para la gestión de catástrofes y el desarrollo sostenible inteligente	Brasil	ANATEL	Procedimientos de rescate	A1.4.1
	China	China Mobile	Estación base a gran altitud para ANT de ala fija VTOL para comunicaciones de emergencia	A1.4.2
	Japón	Softbank	Sistemas de estaciones de plataformas a gran altitud (HAPS)	A1.4.3
	Japón	KDDI	Estaciones base a bordo de buques	A1.4.4
	Reino Unido	Access Partnership Limited	Tecnología directa al terminal portátil para comunicaciones en situaciones de catástrofe	A1.4.5
	China	China Mobile	Estación base por satélite 5G ligera y versátil	A1.4.6
	Japón	NTT Docomo	Estudio de caso sobre preparación ante catástrofes de los operadores de telefonía móvil en Japón	A1.4.7

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
	India	India	Utilización de la radiodifusión celular para aumentar la concienciación pública a través de la plataforma del Protocolo de Alerta Común (PAC)	A1.4.8
	Estados Unidos	SES World Skies	El papel de las comunicaciones por satélite en las tecnologías de comunicaciones en caso de catástrofe	A1.4.9
	UIT-R	GT 6A del UIT-R	Radiocomunicaciones internacionales para operaciones de socorro en situaciones de catástrofe (IRDR)	A3.3
	APT	ASTAP EG DRMRS	Sistema de intercambio de información sobre catástrofes en los países de la APT	A3.4
	APT	ASTAP EG DRMRS	Requisitos del sistema de información y comunicación mediante vehículos en caso de catástrofe	A3.4
	APT	ASTAP EG DRMRS	Estudios de caso sobre sistemas de telecomunicaciones de emergencia portátiles o móviles en la región APT	A3.4
	UIT-T	CE 15	Topologías de red de acceso óptico para servicios de banda ancha	A3.5
	UIT-T	CE 15	Sistemas de cable para facilitar la observación científica y las telecomunicaciones fiables	A3.5
	ETSI	TC EMTEL	Especificaciones de las telecomunicaciones de emergencia	A3.7
	UIT-T	CE 21 (ex CE 16)	Servicios de emergencia	A3.8
	Alianza HAPS		Avances en el sector de las HAPS y recomendaciones normativas para fomentar un sistema estratosférico	A3.10
	UIT-T	CE 20	Medidas de respuesta frente a catástrofes mediante Internet de las cosas (IoT) y prevención de catástrofes en ciudades y comunidades inteligentes sostenibles (C+CIS)	A3.11

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
	Senegal	Universidad Cheikh Anta Diop	Sistemas de redes de comunicaciones en zonas sin cobertura	A4.2
5.2 Infraestructuras de comunicaciones resilientes	Camerún	RIFEN	Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes	A1.5.1
	Haití	Haití	Evaluación de la resiliencia de las infraestructuras y redes de TIC: enfoque sobre telecomunicaciones de emergencia	A1.5.2
	Haití	Haití	Resiliencia de las redes e infraestructuras de telecomunicaciones y TIC en Haití	A1.5.3
	Estados Unidos	Intelsat	Aumento de la resiliencia frente a catástrofes mediante telecomunicaciones y TIC en zonas propensas a catástrofes	A1.5.4
	UIT-T	CE 11	Respuesta rápida ante catástrofes súbitas naturales en redes	A3.6
	Estados Unidos	FCC	Iniciativa de respuesta ante catástrofes	A4.2
5.3 Factores humanos y colaboración de las partes interesadas	Japón	KDDI	Establecimiento de infraestructuras resilientes en Japón y medidas de respuesta y recuperación tempranas frente al seísmo que se produjo en la península de Noto	A1.6.1
	Indonesia	Indonesia	Fortalecimiento de la colaboración entre las partes interesadas y las comunidades para reducir el riesgo de catástrofes mediante simulacros de radiocomunicaciones	A1.6.2
	UIT-T	GT-AI4NDM	La IA para facilitar las comunicaciones en la gestión de catástrofes naturales	A3.1 A4.1
	UIT-R	GT 5A	Respuesta rápida ante catástrofes súbitas naturales en redes	A3.9

Cuadro 1: Estudios de caso (continuación)

Tema	País	Entidad	Título del estudio de caso	Sección
5.4 Otros aspectos	Türkiye	BTK	Continuidad de las comunicaciones y recomendaciones políticas	A1.7.1
	Japón	MIC KDDI Softbank NTT Docomo	Establecimiento de infraestructuras resilientes en Japón y medidas de respuesta y recuperación tempranas frente al seísmo que se produjo en la península de Noto	A1.7.2 A1.4.3 A1.4.7
	Türkiye		Servicio electrónico de rescisión de contratos a través del Portal de la Administración Electrónica	A1.7.3
	Rwanda		Integración de la utilización de drones en las cuatro etapas clave de la gestión del riesgo de catástrofe: mitigación, preparación, respuesta y recuperación	A1.7.4
	PMA-ETC	PMA-ETC	Modelo de rentabilidad del ETC: desarrollo de infraestructuras de telecomunicaciones resilientes frente a riesgos	A1.7.5
	UIT-D	BDT	Informe de la BDT sobre las actividades de telecomunicaciones de emergencia, en particular actividades, eventos y recursos al respecto	A1.7.6
	China	Universidad Tsinghua	Aplicación de las TIC en operaciones de rescate de emergencia	A4.2

Capítulo 7 – Buenas prácticas, directrices y conclusiones

La cuestión relativa a la utilización de las telecomunicaciones y las TIC para la mitigación y gestión del riesgo de catástrofes en los países en desarrollo es compleja y viene dada por varios factores. Los principales retos a los que se enfrentan los países en desarrollo al respecto incluyen: **limitación de infraestructuras y recursos, alfabetización digital insuficiente, obstáculos culturales y lingüísticos y coordinación deficiente entre las partes interesadas.** Estos retos se abordan en el Capítulo 4.

7.1 Análisis e identificación de directrices sobre prácticas idóneas y conclusiones extraídas

La utilización de las telecomunicaciones y las TIC para la gestión y mitigación de catástrofes puede tener un costo elevado, de ahí que deba tenerse en cuenta el análisis y la evaluación de la inversión haciendo hincapié en los países en desarrollo.

Como se describe en la sección 5.1.4, **PMA-ETC**[87] desarrolló un modelo de evaluación de rentabilidad aplicable al cálculo de la eficacia de las inversiones en actividades de preparación mediante telecomunicaciones de emergencia. En el documento se presentan diversas conclusiones extraídas y prácticas idóneas para la aplicación del modelo de rentabilidad en tres países, y se establecen orientaciones clave para medidas futuras. El modelo facilita a las partes interesadas a escala nacional y a la comunidad internacional la planificación y toma de decisiones basadas en información cuantificable que demuestre la eficacia de las inversiones en actividades de preparación mediante telecomunicaciones de emergencia. El modelo podría contribuir a fomentar las inversiones en telecomunicaciones de emergencia.

En el plano gubernamental, **Bhután**[88] ha tomado iniciativas para mejorar las actividades de reducción y gestión del riesgo de catástrofes. Quedan por resolver retos como el derecho de paso para el tendido de fibra óptica, la existencia de terrenos accidentados y la falta de coordinación entre las partes interesadas, a fin de maximizar los beneficios de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes.

En cuanto a las tecnologías por satélite, **Intelsat**[89] desplegó esfuerzos para mejorar la resiliencia ante catástrofes a través de las telecomunicaciones y las TIC en zonas propensas a catástrofes por medio de tecnologías terrenales y por satélite, y analizó las experiencias nacionales y prácticas idóneas.

El **UIT-D**[90] proporciona apoyo a los países en la esfera de las telecomunicaciones de emergencia, en particular aumento de la concienciación, actividades de planificación y formación, y elaboración de directrices y conjuntos de herramientas para facilitar los esfuerzos a escalas

[87] Véase A1.7.5: Modelo de rentabilidad del ETC: desarrollo de infraestructuras de telecomunicaciones resilientes frente a riesgos (PMA-ETC).

[88] Véase A1.1.5: Telecomunicaciones y TIC para la reducción y gestión del riesgo de catástrofes (Bhután).

[89] Véase A1.5.4: Aumento de la resiliencia frente a catástrofes mediante telecomunicaciones y TIC en zonas propensas a catástrofes (Intelsat, Estados Unidos).

[90] Véase A1.7.6: Informe de la BDT sobre las actividades de telecomunicaciones de emergencia, en particular actividades, eventos y recursos al respecto.

nacional y regional en la reducción del riesgo de catástrofes. El **PMA-ETC y GSMA**[91], en coordinación con la UIT, han brindado apoyo a organismos de TIC, autoridades de gestión de catástrofes y organismos de reglamentación de las telecomunicaciones de numerosos gobiernos para mejorar su preparación ante catástrofes.

7.2 TIC para operaciones de socorro y medidas de respuesta y recuperación en caso de catástrofe

Las telecomunicaciones y las TIC se están convirtiendo en una herramienta fundamental para facilitar las operaciones de socorro y las medidas de respuesta y recuperación en todas las fases de la gestión de catástrofes. En los capítulos 2 a 5 se describen varias directrices sobre utilización de las telecomunicaciones y las TIC, si bien es necesario tener en cuenta métodos más eficaces y necesidades específicas.

RIFEN[92] compartió información sobre la utilización de las telecomunicaciones y TIC en el ámbito de la reducción y gestión del riesgo de catástrofes. Pese a los avances tecnológicos logrados, siguen existiendo retos, en particular en lo atinente a la accesibilidad, fiabilidad y eficacia de las soluciones tecnológicas en situaciones de crisis.

Samoa[93] ha adoptado diversas iniciativas en las esferas de las telecomunicaciones y las TIC, que desempeñan un papel fundamental en las actividades de mitigación, preparación, respuesta y recuperación en caso de catástrofe, en particular en regiones propensas a peligros naturales, incluidos los PEID ribereños del océano Pacífico. Los autores compartieron los esfuerzos realizados para mejorar la resiliencia ante catástrofes a través de las telecomunicaciones y las TIC en los PEID de la zona del Pacífico, mediante tecnologías terrenales y por satélite, y debatieron sobre las experiencias a escala nacional y las correspondientes prácticas idóneas.

La **República del Congo**[94], subrayó la importancia de que los países dispongan de planes de contingencia en caso de catástrofe para facilitar las labores de gestión, a fin de evitar una gran cantidad de riesgos, tanto humanos como materiales. A tal efecto mencionó que GSMA ha formulado recomendaciones dirigidas a Estados y organismos de reglamentación para alentarles a integrar políticas sobre gestión de datos personales en relación con la utilización de las telecomunicaciones y las TIC para la gestión y mitigación de catástrofes al elaborar sus planes de contingencia a escala nacional.

7.3 Aspectos adicionales sobre accesibilidad

Se ha demostrado que la televisión es una de las plataformas más eficaces para ofrecer contenido de utilidad social a personas sordas. A medida que la tecnología evoluciona, cabe esperar que todos los contenidos de la televisión, en particular las alertas de catástrofe, se traduzcan automáticamente al lenguaje de signos de avatares. Para ello, debe contarse con sólido apoyo gubernamental en cuanto a conjuntos de datos para entrenamiento de la

91 Véase A1.3.15: Aplicación de la planificación nacional de las telecomunicaciones de emergencia y mejora de la preparación a escalas nacional y regional (PMA-ETC de la ONU, GSMA)).
92 Véase A1.5.1: Utilización de las telecomunicaciones y las TIC para la reducción y gestión del riesgo de catástrofes (RIFEN)
93 Véase A1.2.6: Fomento de la resiliencia frente a situaciones de catástrofe mediante las telecomunicaciones y las TIC en los pequeños Estados insulares en desarrollo del océano Pacífico (Samoa).
94 Véase A1.3.6: Planes nacionales de telecomunicaciones de emergencia: catalizadores y garantías (República del Congo).

inteligencia artificial (IA) (de forma simultánea con lenguaje de signos e idioma hablado) y herramientas de traducción eficaces.

La **República de Corea**[95] cuenta con dos estudios de caso sobre utilización de las plataformas de televisión más recientes para mejorar la accesibilidad a la información y la comunicación de personas sordas. El primer estudio de caso corresponde a la utilización de una plataforma de televisión Android y a tecnologías de IA para facilitar la comunicación y reducir el aislamiento de las personas sordas o con dificultades auditivas y sus familiares sin esas dificultades. El segundo estudio de caso muestra la forma de comunicar eficazmente información sobre alerta de catástrofes a ciudadanos sordos o con dificultades auditivas mediante redes inalámbricas e IP. Ambos estudios de caso, basados en la utilización de las tecnologías más recientes, facilitan la comprensión de la manera en que pueden usarse las plataformas de televisión para fomentar una sociedad más inclusiva y facilitar el cumplimiento de los ODS de las Naciones Unidas.

7.4 Conclusiones

Las telecomunicaciones y las TIC desempeñan un papel fundamental en situaciones de catástrofe y se utilizan para recabar información previa, enviar alertas a los ciudadanos para salvar vidas humanas, establecer un acceso efectivo a los servicios de telecomunicaciones, en particular en zonas catastróficas, y proporcionar soluciones de socorro después de las catástrofes, entre otros usos. En el presente informe se sintetizan estudios de caso y prácticas idóneas sobre telecomunicaciones y TIC para actividades de gestión y socorro en caso de catástrofe, en particular EWS, simulacros de catástrofe, normativas y reglamentaciones, comunicaciones en caso de catástrofe y resiliencia de red. Esta información permite elaborar planes nacionales de asistencia en caso de catástrofe para salvar vidas humanas en caso de catástrofe.

No obstante, las telecomunicaciones y TIC han evolucionado paulatinamente, y se prevé que en breve se utilicen nuevas tecnologías incipientes, en particular la IA y las IMT-2030 (6G), para la gestión de catástrofes y las operaciones de socorro, de ahí la necesidad de estudiar y comprender las soluciones de gestión de catástrofes que soportan esas nuevas tecnologías.

Se invita a los miembros del Sector UIT-D, entre otras partes interesadas, a fomentar la concienciación y a intercambiar información en su entorno profesional y con las organizaciones a escalas nacional y regional, para aprovechar los conocimientos a escalas local, nacional y regional, facilitar la aplicación de las citadas tecnologías y colaborar para alcanzar los objetivos generales de reducir el riesgo de catástrofes y salvar vidas.

[95] Véase A1.1.7: Plataforma de televisión para fomentar comunicaciones inclusivas (República de Corea).

Annexes

Annex 1 – Case studies

A1.1 Early warning and alerting systems

A1.1.1 Information systems in emergencies (Türkiye)[96]

Institutional setup in Türkiye

The Disaster and Emergency Management Agency (AFAD) in Türkiye, is an organization under the Ministry of Interior (MoI). After being restructured in 2022, the AFAD currently carries out its activities through its central organization, as well as through "Provincial Directorates of Disaster and Emergency" that are directly affiliated with governors in the provinces and "Directorates of Disaster and Emergency Search and Rescue Units" located in 16 provinces. The Ministry of Environment, Urbanization and Climate Change (MoEUCC), also has powers, duties, and responsibilities for studies to be carried out before and after disasters. These responsibilities include drafting legislation on settlement, environment, and land development; taking measures regarding urban regeneration and building inspection; ensuring the improvement of professional services; activities related to spatial planning, geological surveys, and geographic information systems; damage assessment studies; debris removal; infrastructure works; demolition of damaged buildings; prevention of environmental pollution and protection of nature; and combating climate change.

On the other hand, according to the land development legislation, it is the responsibility of metropolitan municipalities to make environmental plans that set out decisions on general land use for urban and rural settlements, development areas, and for sectors such as industry, agriculture, tourism, transportation, and energy. The metropolitan municipalities are also responsible for land development plans that envisage the general patterns for land use, the main zoning types, the population density of regions in the future, the trends, size, and principles of development for various urban and rural settlements, as well as urban, social, and technical infrastructure areas, and transportation systems. District municipalities are responsible for making implementation plans that determine land development requirements, such as building blocks, uses, building plans, building heights, floor area ratios, building coverage ratio or plot ratio, and building approach distance, as well as roads, pedestrian walkways, bicycle lanes, transportation relationships, parks, squares, and urban, social, and technical infrastructure areas. For other provinces, it is the responsibility of provincial municipalities to make development and implementation plans, while the MoEUCC is responsible for the preparation of environmental plans.

Disaster information and relief systems in Türkiye

The National Earthquake Strategy and Action Plan 2023, (UDSEP-2023), was prepared by AFAD to prevent or mitigate the physical, economic, social, environmental, and political damage and losses that may be caused by earthquakes and to establish new earthquake-resistant,

[96] ITU-D SG1 Document https://www.itu.int/md/D22-SG01.RGQ-C-0242/ from Türkiye.

safe, and sustainable living environments. Critical steps were taken to implement the actions defined in UDSEP-2023, which is an exemplary study that includes strategic approaches, and action sequences aimed at minimizing earthquake losses. The ability of the information systems developed by various public institutions to work in an integrated manner is critical in disaster management. The information systems that are considered to be directly useful in the disaster management process in Türkiye are as follows:

- Disaster Management and Decision Support System Project[97] (carried out by AFAD)
- Spatial Address Registration System[98] (carried out by MoI)
- Turkish National Geographic Information System[99] (carried out by MoEUCC)
- e-Municipality[100] (carried out by MoI and MoEUCC)
- Mobilization Resource Planning System (carried out by AFAD and National Security Council)
- Village Infrastructure Support Project[101] (carried out by MoI and MoEUCC)
- Geological Survey Information System (carried out by MoEUCC)

The Earthquake Department of AFAD shares details about earthquakes on its official website. There are multiple types of information systems provided by the AFAD earthquake department:

- earthquake reports[102]
- press releases[103]
- event web service[104]
- notification services:
  - mailing list subscriptions[105]
  - SMS list subscriptions[106]
- "This Month in History[107]"

The AFAD earthquake department also develops desktop and web-based geoscience applications and provides documents for a better understanding of the seismicity of Türkiye. Examples of such web-based geoscience applications include:

- Turkish Accelometric Database and Analysis System (TADAS)[108]
- Earthquake Data Centre System of Türkiye (TEDCS)[109]
- Türkiye Earthquake Hazard Map
- Earthquake Parameter Estimation and Analysis System (DEKAS)[110]

97 https://www.afad.gov.tr/afet-yonetim-ve-karar-destek-sistemi-projesi-aydes21
98 https://www.nvi.gov.tr/maks
99 https://cbs.csb.gov.tr/tucbs-i-86080
100 https://www.belediye.gov.tr/
101 https://koydes.csb.gov.tr/
102 https://deprem.afad.gov.tr/earthquake-reports
103 https://deprem.afad.gov.tr/press-release
104 https://deprem.afad.gov.tr/event-service
105 https://deprem.afad.gov.tr/mail-application
106 https://deprem.afad.gov.tr/sms-resignation
107 https://deprem.afad.gov.tr/this-month-history
108 https://tadas.afad.gov.tr/
109 https://tdvms.afad.gov.tr/
110 https://deprem.afad.gov.tr/content/85

- Seismo-geodetic Earthquake Analysis System (SIDAS)[111]
- Rapid Earthquake Damage and Loss Estimation Software (AFAD-RED)[112]
- 6 February 2023 Kahramanmaraş Earthquake Clearinghouse[113]

A1.1.2 Strengthening the institutional framework and the use of digital technologies for disaster risk reduction in Côte d'Ivoire (RIFEN)[114]

Côte d'Ivoire experiences regular flooding and landslides, leading to regrettable loss of human life and material damage. Moreover, more than two-thirds of the coastline is affected by coastal erosion, which has an impact on industrial facilities and on public and private investments and, in turn, weakens the national economy. The Government of Côte d'Ivoire has therefore undertaken to improve its disaster preparedness, prevention, and response plan through the adoption of a legal and institutional framework focused on emergency communications, as early warnings can be effective in reducing the risks and consequences of disasters. To this end, a regulatory framework, and a number of general telecommunication policies will be developed to support the deployment and use of ICTs in general, and during disasters, in addition to a general disaster risk reduction framework.

Development of a legal and institutional disaster risk reduction framework in Côte d'Ivoire

Owing to the country's vulnerability to climate change, Côte d'Ivoire has taken the decision to develop a legal and institutional disaster risk reduction framework. This framework includes the following policies, institutions, and warning systems dedicated to reducing disaster risks:

- **The adoption of Decree No. 2012-988 of 10 October 2012, on the creation, remit, organization and functioning of the National Disaster Risk Reduction and Management Platform**. The role of the platform is to make disaster risk reduction a priority; to identify risks; to prevent and mitigate the impact of disasters; to raise awareness and promote education about disaster risks; to reduce the vulnerabilities of populations and the environment; to maintain response readiness; and to respond to disasters. The platform was officially launched on Thursday, 24 August 2023, when the first exchange of ideas between various stakeholders was held.
- **The introduction of the National Disaster Risk Reduction Strategy**. Drawn up in 2011, this strategy is currently being reviewed pursuant to a decision of the Council of Ministers adopted on 12 December 2020, with the support of the United Nations Development Programme. This review is in line with the African Union Africa Regional Strategy for Disaster Risk Reduction. The operational framework for implementing the new National Disaster Risk Reduction Strategy should be centred around the implementation plan for the National Development Plan, the national decentralization policy and other relevant sectoral plans and policies. The actions set out in the National Disaster Risk Reduction Strategy, are founded on regional and international cooperation, and take a comprehensive and holistic all-hazards approach. The National Disaster Risk Reduction Strategy has four strategic axes:

  Strategic axis 1: Understand disaster risks: This axis is developed by the National Disaster Risk Reduction and Management Platform;

  Strategic axis 2: Improve the governance of disaster risk reduction by strengthening relevant legal and regulatory tools;

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111 https://deprem.afad.gov.tr/content/87
112 https://deprem.afad.gov.tr/content/91
113 https://deprem.afad.gov.tr/assets/pdf/deprem-bilgi-destek-sistemi.pdf
114 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0175/ from International Network of Women Digital Experts (RIFEN).

Strategic axis 3: Invest in economic, social, cultural, and environmental resilience;

Strategic axis 4: Improve post-disaster preparedness, response, and reconstruction.

Tools: EWSs in Côte d'Ivoire

EWSs can be used to warn, inform, and communicate effectively about approaching or ongoing disasters in order to reduce the risks or impact. All hazard prevention systems should be synchronized, taking into account a range of hazards and the needs of end users. In Côte d'Ivoire, at the initiative of the ministry responsible for the environment and sustainable development, a national climate-based multi-hazard detection and EWS is being developed. The system will have a geographical dimension to support hazard response throughout the country. The design of the system will draw on data and indicators gathered by hydrometeorological, agroclimatic, and environmental data-collection stations operated by the following national entities:

- **Society for the Operation and Development of Airports, Meteorology and Aeronautical Activities (SODEXAM).** SODEXAM is a national meteorological agency that operates 13 meteorology stations across the territory of Côte d'Ivoire. In the event of flooding or heavy precipitation, it supplies meteorological data to interministerial disaster management committees to enable the Government to take appropriate measures. With regard to early warning efforts, SODEXAM transmits weather forecast information to users, for example by sending SMS messages to users to warn them about weather changes and publishing alerts on its Facebook page (https://www.facebook.com/SODEXAM).
- **National Civil Protection Office (ONPC).** The ONPC is the national office responsible for implementing government policy on national protection. It provides data on previous disasters and their impact for use in compiling statistics. Within the framework of early warning efforts, the ONPC is working with SODEXAM to **raise awareness** and **provide information** about disaster risks. These activities are conducted via the ONPC website (https://www.onpc-ci.org/) and via the social media accounts of both organizations. The ONPC also provides first-aid training, including training on the provision of first-aid during disasters.
- **Office of Parks and Reserves (OIPR).** Responsible for the protection and sustainable management of biodiversity in Côte d'Ivoire, the OIPR provides information on the state of biodiversity in the country.
- **National Committee of Remote Sensing and Geographical Information (CNTIG).** The CNTIG is the country's source of expertise on geographical information systems, remote sensing and mapping applications, as well as new information technologies.

Use of ICTs in disaster risk reduction management and in EWSs

Côte d'Ivoire does not yet have a regulatory framework or any general telecommunication policies to support the deployment and use of ICTs during disasters. Nonetheless, ICTs are at the heart of disaster prevention and early warning activities:

- The public authorities and disaster relief organizations have created **social media** pages through which they provide citizen alerts and disaster warnings. For example, the **Police emergency Facebook** page provides citizen alerts, the **SODEXAM Facebook** page provides weather warnings, and the **ONPC-Côte d'Ivoire Facebook** page provides information and warnings about disasters linked to domestic incidents, traffic accidents and industrial events throughout the country.
- **Mobile communication technologies**: SMS weather warnings are sent to users.
- **The dissemination of public service announcements and alerts via radio and television**: Measures to ensure accessibility are applied, such as audio description, subtitling, and sign language interpretation.

Disaster risk management in Côte d'Ivoire is governed by a legal and institutional framework developed by the Government in order to strengthen the country's disaster prevention and response capacities. Strategies and entities dedicated to disaster risk reduction have been established to that end. Although a legal framework on emergency telecommunication management has yet to be adopted, Côte d'Ivoire is already using telecommunication technologies to provide early warnings in the event of disaster. EWSs seem to provide an effective and essential means of minimizing the risks and impact of disasters. It is therefore recommended that a legal framework should be adopted, that provides for the use of telecommunications in disaster prevention and response procedures in Côte d'Ivoire.

A1.1.3 How ICTs play an important role in multi-hazard early warning systems (RIFEN)[115]

Telecommunications and ICTs play a critical role in enhancing disaster risk reduction and management, especially in unpredictable scenarios caused by climate change.[116] Through real-time data collection, EWSs, and efficient communication networks, ICTs facilitate rapid response and coordination during disasters such as droughts and floods. However, some countries still face challenges such as limited infrastructure, high costs, and digital divides that hinder the widespread implementation of these technologies. Strengthening local capacity, investing in technology, and fostering public-private partnerships (PPPs) can help improve disaster resilience across the continent. The use of Internet of Things (IoT) EWSs can be used to rapidly detect changes that signal potential disasters, such as earthquakes, floods, or severe storms allowing authorities to issue timely alerts to citizens and emergency services.[117] This proactive approach enhances situational awareness, facilitates better resource allocation, and ultimately saves lives by enabling communities to prepare and respond more effectively to impending threats. Efforts to enhance disaster risk reduction and management in the African regions are increasingly focused on collaboration among governments, NGOs, and local communities, emphasizing the integration of ICTs. By leveraging ICTs, stakeholders improve data collection, risk assessment, and communication during emergencies, thus fostering a more resilient infrastructure. Initiatives such as workshops, training programmes, and the establishment of shared platforms aim to build capacity and enhance coordination, ensuring that communities are better prepared to respond to, and recover from natural disasters, while also addressing climate impacts.

The role of Internet of Things in disaster management and relief

IoT plays a pivotal role in disaster management and emergency planning by enhancing data collection, real-time communication, and situational awareness. Connected devices and sensors monitor critical conditions such as weather changes, infrastructure integrity, and population movements, providing valuable insights that inform decision-making. During disasters, IoT facilitates rapid information sharing among responders, enabling coordinated efforts and

[115] ITU-D Document https://www.itu.int/md/D22-SG01-C-0368/ from International Network of Women Digital Experts (RIFEN)

[116] *Dwivedi, Y. K., Hughes, L., Kar, A. K., Baabdullah, A. M., Grover, P., Abbas, R., Andreini, D., Abumoghli, I., Barlette, Y., Bunker, D., Kruse, L. C., Constantiou, I., Davison, R. M., De, R., Dubey, R., Fenby-Taylor, H., Gupta, B., He, W., Kodama, M., Wade, M. (2021). Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action. International Journal Of Information Management, 63, 102456.* https://doi.org/10.1016/j.ijinfomgt.2021.102456

[117] *Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of things: Vision, applications and research challenges. Ad Hoc Networks, 10(7), 1497-1516.* https://doi.org/10.1016/j.adhoc.2012.02.016

efficient resource deployment. Post-disaster, IoT technologies assist in damage assessment and recovery processes, ultimately strengthening resilience and preparedness for future events.[118]

Access to real-time information can dramatically improve response times and resource allocation during crises, thereby mitigating adverse impacts on health, food security, and economic stability. ICT plays a major role in disaster risk reduction and management by facilitating the development of EWSs that leverage multiple communication channels, such as radio, television, SMS, and Internet platforms. These systems enhance public awareness and preparedness by disseminating timely information about impending disasters, enabling communities to take proactive measures.

Early warning and alerting systems

EWSs leverage telecommunications/ICT to collect, analyse, and disseminate crucial information about weather and climate-related hazards, allowing communities to prepare for, and respond to potential disasters. By providing timely alerts, these systems enable individuals and organizations to take proactive measures, ultimately reducing vulnerabilities and enhancing resilience. The integration of technology in disseminating warnings through mobile alerts, social media, and community networks ensures that critical information reaches both authorities and affected populations. ICTs play a crucial role in multi-hazard[119] s EWS by facilitating timely and effective measurements of environmental parameters such as seismic activity, rainfall levels, and air quality. When predefined thresholds are exceeded, IoT devices can trigger automated alerts through various communication channels, ensuring rapid dissemination of vital information to communities at risk. Additionally, real-time data analytics enable authorities to assess potential threats quickly, leading to proactive measures and coordinated emergency responses. This integrated approach not only saves lives but also minimizes economic losses during disasters.

ICT further supports response efforts through real-time data collection, coordination among agencies, and delivery of crucial information to affected populations, ultimately reducing the overall impact of disasters and improving recovery outcomes. IoT significantly contributes to disaster risk reduction and management by offering real-time data collection and analysis through connected sensors that monitor environmental conditions, infrastructure status, and community needs. During crises, IoT facilitates improved coordination among emergency response teams, supports efficient resource allocation, and ensures continuous communication. Moreover, post-disaster, IoT aids in assessing damage and streamlining recovery efforts, thus fostering resilience and preparedness for future disasters.

A1.1.4 National mobile warning system in Türkiye[120]

Necessity of public warning systems

In situations where emergencies pose a threat to public order, national security, and cybersecurity, it is of vital importance to make necessary announcements to the public and to disseminate warnings and guidance to large audiences as quickly as possible. To achieve this

[118] Sakurai, M., & Murayama, Y. (2019). Information technologies and disaster management – Benefits and issues -. Progress In Disaster Science, 2, 100012. *https://doi.org/10.1016/j.pdisas.2019.100012*

[119] *Shi, Y., Liu, X., Kok, S., Rajarethinam, J., Liang, S., Yap, G., Chong, C., Lee, K., Tan, S. S., Chin, C. K. Y., Lo, A., Kong, W., Ng, L. C., & Cook, A. R. (2016). Three-Month Real-Time Dengue Forecast Models: An Early Warning System for Outbreak Alerts and Policy Decision Support in Singapore. Environmental Health Perspectives, 124(9), 1369-1375.* https://doi.org/10.1289/ehp.1509981

[120] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0243/ from Türkiye.

objective, it is commonly preferred for relevant public institutions to communicate the required notifications, within geographically defined areas to individuals through their mobile devices, in accordance with the tasks and responsibilities assigned to them. The public warning systems utilized within this context are systems that enable the authorities to alert the public about inevitable or ongoing emergencies and disasters.

National mobile warning system in Türkiye

The Information and Communication Technologies Authority (BTK) in Türkiye, issued a regulation on 26 February 2021, concerning the establishment and operation of a National Mobile Warning System tailored to the needs of the country. The development and implementation of the system is based on compliance with technical specifications prepared by the European Telecommunications Standards Institute (ETSI), and takes advantage of the best opportunities offered by modern technology. The National Mobile Warning System incorporates the cellular broadcast service (CBS) as one of its primary technologies in accordance with the guidelines specified in ETSI TS 123.041. With CBS, it becomes possible to reach all users with devices supporting CBS technology in a specific region. Moreover, CBS does not burden the base stations excessively, resulting in less congestion during disaster and emergency communications.

Additionally, the technical specifications for the mobile alarm system, known as the Commercial Mobile Alarm System (CMAS), have been determined according to the country's needs by adapting the guidelines provided in ETSI TS 122.268. The system will also be able to reach target audiences through short message service (SMS) texts, and pre-call announcements. The technical infrastructure of the National Mobile Warning System has been entirely developed using domestic resources, and the use of domestic resources in the systems developed, and the infrastructure established by operators is encouraged. Critical public institutions, including the Presidency of the Republic of Türkiye, the Disaster and Emergency Management Authority (AFAD), and BTK utilize this system within their mandate in accordance with the respective law. This ensures rapid and effective dissemination of information to citizens in circumstances of necessity.

Implementation of the system

Türkiye uses the National Mobile Warning System to warn citizens to take necessary precautions in advance of hazards. This is especially the case concerning floods which are more predictable, and hence suitable for early warnings. However, in situations such as earthquakes which are more sudden and unpredictable, the system can be used for crisis management tasks such as dissemination of information about the gathering zones, humanitarian aid locations, or locations of people in need. Türkiye conducts drills using the system regularly. Such a drill was held in Türkiye on the anniversary of the Düzce Earthquake of 12 November 1999. With the warning sent from the AFAD Centre via the National Mobile Warning System, a "Drop, cover and hold-on" exercise was performed throughout the country.

On 27 June 2023, a CMAS message was sent to warn the people about the risk of flooding in specific districts of the Zonguldak, Bartın, and Kastamonu provinces. The message read: *Due to the heavy rainfall in your region, which will increase its effect starting from this evening and will continue through tomorrow, it is important to be cautious to stay away from stream beds, flood plains, and risky areas. In case of emergency, it is strongly recommended to call 112 Emergency Call Centre.*

Potential use cases

- Natural disasters: The system can be used to alert citizens about imminent natural disasters such as earthquakes, tsunamis, floods, hurricanes, or wildfires. The system can provide timely warnings and safety instructions to people in the affected areas, allowing them to take necessary precautions and evacuate if needed.
- Public safety emergencies: In cases of public safety emergencies such as terrorist threats, active shooters, or chemical spills, the system can quickly inform the public about the situation, and provide guidance on how to stay safe and avoid the affected areas.
- Severe weather warnings: The system can issue alerts for severe weather conditions such as heavy storms, tornadoes, blizzards, or extreme heat waves. This way, people can be prepared for potential hazards and protect themselves accordingly.
- Public health alerts: During disease outbreaks or health emergencies, the system can be utilized to disseminate vital information about preventive measures, vaccination campaigns, and updates from health authorities to ensure public safety and containment.
- Amber alerts: The system can be used for 'amber alerts', which are issued in cases of child abductions. By sending out notifications to a wide audience, the system can increase the chances of finding missing children and apprehending abductors.
- Infrastructure failures: In the event of significant infrastructure failures such as major road closures, power outages, or water supply disruptions, the system can inform affected residents, and provide alternative routes or solutions.
- Evacuation notices: The system can efficiently communicate evacuation orders in situations where people need to leave their homes due to imminent threats such as a hazardous materials spill, or nuclear plant malfunction.

These use cases demonstrate how National Mobile Warning Systems can play a crucial role in ensuring public safety, quick response, and efficient communication during various emergencies and critical situations.

A1.1.5 Telecommunications/ICTs for disaster risk reduction and management (Bhutan)[121]

Bhutan faces a variety of natural disaster risks, including earthquakes, glacial lake outburst floods (GLOF), flash floods, forest fires, and landslides, which have previously resulted in substantial loss of life, property damage, and destruction of public infrastructure. Geographically situated in the Himalayan mountains region, Bhutan is recognized as one of the most seismically active regions in the world. The mountainous landscape of Bhutan has created remote and isolated settlements, that may become unreachable during major hazards and emergencies. Additionally, the absence of emergency communication facilities and protocols, along with the fragile road network and transportation system, exacerbates this vulnerability.

The telecommunications and information communications and technology (ICT) sector plays a number of crucial roles in disaster risk reduction and management, by enabling effective communication, coordination, EWSs, and response mechanisms. The Royal Government of Bhutan (RGoB) recognizes the importance of establishing a robust fibre-optic network infrastructure with redundancy links within the country, of having multiple international Internet gateways, and of establishing disaster communications networks to be utilized during times of disaster for emergency communications. In addition, in order to improve service delivery and efficiency through effective use of ICT, it was recognized that all government systems that

[121] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0172/ from Bhutan.

contained highly sensitive data, would require a resilient and robust data centre to ensure security and protection. Consequently, the Government Data Centre was established. However, there is no mechanism in place to ensure the continuity of business in the event of catastrophic disasters such as earthquakes, forest fires, cyber incidents, or other major natural incidents. Therefore, the establishment of active-active disaster recovery (DR) agency is being planned in the country's 13th five-year plan to ensure continuous uptime and maintain mission-critical operations in case of a disaster.

Some of the following technologies could also be explored and implemented by leveraging telecommunications and ICTs for disaster risk reduction and management (DRRM) in Bhutan.

- Climate monitoring and s EWS: Implementing robust climate monitoring and EWSs using ICTs to help alert communities about impending disasters such as earthquakes, flash floods, and GLOFs. This could include SMS alerts, mobile apps, sirens, and radio broadcasts tailored to reach remote and vulnerable populations.
- Remote sensing and geographic information system (GIS) mapping: Utilizing remote sensing technologies and GIS mapping to aid in identifying high-risk areas prone to landslides, floods, and forest fires. This data can inform land use planning, infrastructure development, and disaster preparedness efforts.
- Communication and coordination: Establishing reliable communication networks, including mobile and satellite communication systems, for facilitating coordination among emergency responders, government agencies, and communities during disaster response and recovery operations.
- Disaster recovery and reconstruction: ICTs can support post-disaster recovery and reconstruction efforts by facilitating access to financial assistance, healthcare services, and livelihood support programmes for affected communities.

A1.1.6 Emergency warning broadcasting system (EWBS) (Japan)[122]

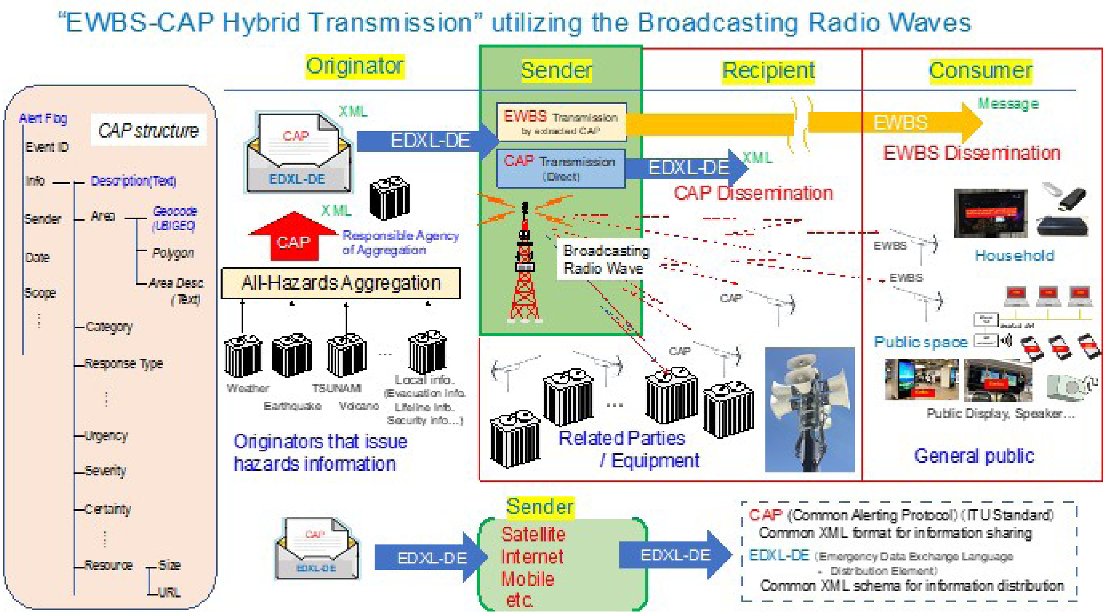
In recent years, the number of natural disasters has increased in various countries due to the effects of global warming worldwide, and some of the reports by the World Meteorological Organization (WMO) show that the number of weather-related natural disasters has increased 50 times in the last 50 years. Due to the fragility of social infrastructures especially in developing countries, even a single natural disaster could potentially lead to serious social and human damages. Effective countermeasures to not only prevent such damages, but also to promote rapid recovery from a disastrous situation are therefore of critical importance. At the same time, given a recent situation where a large-scale natural disaster occurred across borders, continuous efforts in international collaboration have become an extremely urgent issue.

[122] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0080/ from Japan.

Emergency warning broadcasting system (EWBS)

The emergency warning broadcasting system (EWBS) ensures reliable and secure one-way communication, and is a function of the disaster-information notice of the digital terrestrial broadcasting system (ISDB-T). EWBS is very highly regarded, especially in the Latin America region, due to the advantages of EWBS over other systems, and especially because the terrestrial broadcasting radio wave is robust, reliable, and the system can be introduced quickly at an optimized cost. However, in order to fully utilize such advantages, it is essential to deal with the specific needs of each country, taking into account environmental changes and technological trends in the ICT field. For example, in Peru, there is a need to distribute disaster information in a common format through not only digital terrestrial broadcasting, but also through various other media. Taking such specific circumstances into account, Japan is developing the EWBS-CAP hybrid transmission system, as a universal ICT system for disaster management, which utilizes the existing terrestrial broadcasting radio waves from upstream to downstream, and is appropriate for international cooperation across borders between developing countries. Research activities are being conducted on the ideal implementation of the system into local societies in developing countries.

Figure A-1: EWBS-CAP hybrid transmission



A1.1.7 TV platform to enable inclusive communication (Republic of Korea)[123]

More than 90 per cent of deaf children are born into hearing families. Unless the family learns sign language together, deaf children easily become isolated and may receive inadequate home education. However, a means for education in sign language in these cases does not exist in most of countries.

A disaster alerting system exists in most countries, generally also comprising captions for terrestrial and pay TV services, as well as text type messaging to mobile phones. The problem is that due to the challenges of education, more than half of deaf persons have difficulty in

[123] ITU-D Document https://www.itu.int/md/D22-SG01-C-0153/ from Republic of Korea.

understanding the text, which means that the most substantial information is not accessible by them.

TV has evolved through connectivity and whatever type of infrastructure the TV or set-top-box is based on, most TV and set-top-boxes can now have connectivity through a cable modem, direct IP communication by ISP/IPTV, or low orbit satellite constellation. Connectivity is not provided through a terrestrial frequency under the latest specifications of digital video broadcasting (DVB) and Advanced Television Systems Committee (ATSC) standards. In the United States, about 20 per cent of households have no broadband connectivity. The Government is providing e-learning contents through a datacasting feature of its next generation terrestrial specification with the aim of reducing inequality in education.

Disaster alerting information

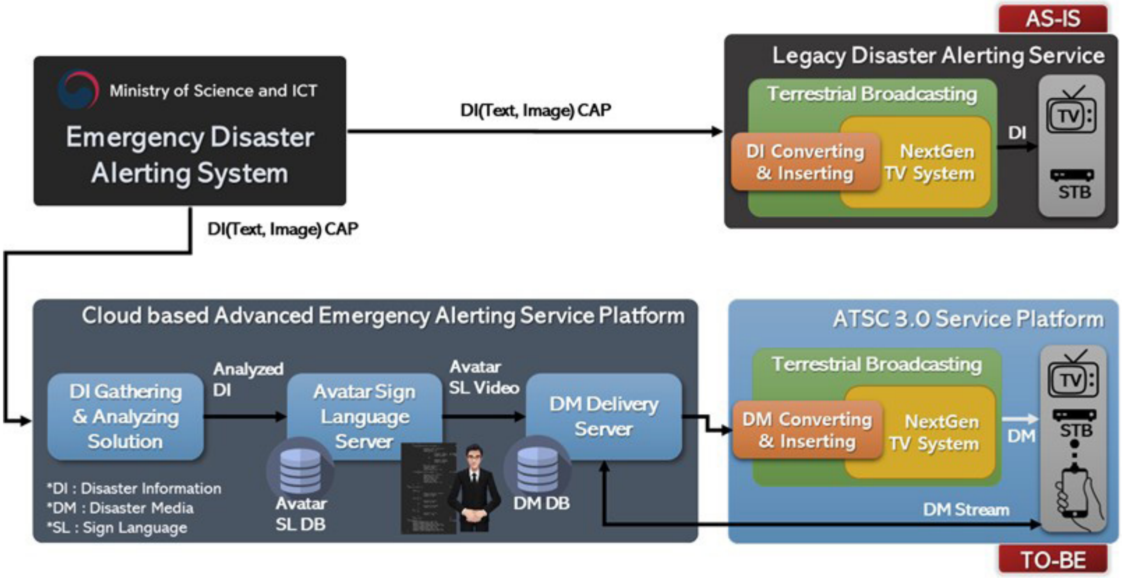
The Ministry of Science and ICT, operates a nationwide Emergency Disaster Alerting System. The system aggregates all disaster information and sends it to a broadcaster with CAP format* and the broadcaster will then automatically show the subtitle in text.

**CAP example:<identifier>KR.T7-20230416</Identifier><sender>mmdip@mictr</..><event>Flooding </..>..*

Figure A-2: Accessible disaster alerting system with avatar sign language

As the caption (text only information) is not fully accessible a by deaf person, the consortium is developing new system based on the latest terrestrial standard specification of ATSC 3.0, where IP communication for avatar signing is possible. The project also covers pay TV, set-top-boxes, and smart phones so that a deaf person can always have access to the disaster information. Figure A-2 above shows the current system where the text and image are directly delivered to terrestrial and pushed to the STB and TV. Figure A-3 shows the new system where the disaster information is converted to disaster medias formatting including avatar signing, and then transmitted with a terrestrial signal. The DM stream can be directly streamed to mobile phones with text messages and links.

Figure A-3: Accessible disaster alerting system diagram



The system is now under development not only for the Republic of Korea public broadcaster but also for some public broadcasters in the United States where the same terrestrial specification is deployed. The pilot broadcasting was scheduled the end of 2023, at Jeju Island, Republic of Korea, with nationwide deployment in 2025. As the latest European digital terrestrial standard specification also includes IP communication, the system can be implemented in more countries.

The use case shows how the latest TV platforms can contribute to inclusive society by helping to solve very basic problems using neural sign language translation technology. This will improve the accessibility of most critical information to a deaf person. It will create the "value of safety" for a deaf person while reducing inequality in information accessibility, and so contributes to achieving SDG 10 which concerns reducing inequality. As sign language translation technology is improving in many countries, it is expected that the time will soon come when all text-or-voice-only information can be automatically translated into sign language.

A1.1.8 Use of the South Asia Satellite (SAS) network to provide national TV and radio services to rural areas (Bhutan)[124]

In Bhutan, the geographical challenges of providing telecommunication and broadcasting services to rural areas have necessitated the use of innovative solutions. One such solution is the South Asia Satellite (SAS) ground station network, which has been instrumental in providing critical communication services in areas that remain unconnected by traditional infrastructure. Beyond broadcasting, the SAS network has also played a pivotal role in disaster preparedness and response, ensuring that communication systems remain operational during times of crisis.

Background and use case

The SAS ground station network is a satellite-based communication system that Bhutan has deployed to address the following key challenges:

a) **Broadcasting in rural areas**. Many remote areas in Bhutan have limited or no access to cable-based broadcasting services. The SAS network is used to broadcast national TV

[124] ITU-D Document https://www.itu.int/md/D22-SG01-C-0349/ from Bhutan.

and radio channels to these regions, ensuring that rural communities receive important information and entertainment. Recently, Bhutan have upgraded these broadcasts to high-definition (HD) quality, further ensuring that no part of the population is left behind in terms of access to high-quality content.

b) **Disaster communication**. The SAS network also plays a vital role in the disaster communication strategy of Bhutan. During emergencies, especially in remote areas where telecommunications infrastructure may be compromised, the satellite network ensures that communication lines remain open, enabling effective coordination and response. Bhutan has established very small aperture terminals (VSATs) across the country to support emergency communication via the SAS network.

Key lessons learned

Through the implementation of the SAS network, several important lessons have been learned:

a) **Satellite communication bridges the connectivity gap.** The SAS network has proven to be an effective solution for providing communication and broadcasting services in rural and remote areas where conventional infrastructure is not viable. This has helped Bhutan overcome the challenge of providing universal access to essential services.

b) **Upgrading to HD broadcasting is critical for equity.** The recent upgrade to HD broadcasting services ensures that rural populations receive the same quality of information and media content as their urban counterparts. This is crucial for bridging the digital divide, and promoting inclusivity.

c) **Dual-use infrastructure enhances resilience.** The SAS network can switch between normal broadcasting operations and emergency communication during times of crisis, which has increased the disaster resilience of Bhutan. This dual-use model ensures that resources are utilized efficiently, minimizing downtime and maximizing preparedness.

Best practices

Based on the experiences of Bhutan, the following best practices for countries considering similar satellite-based communication solutions are recommended:

a) **Establish clear operational frameworks.** It is essential to define clear frameworks that govern the use of satellite infrastructure, specifying roles for normal operations and emergency situations. This ensures quick and efficient transitions when crises arise.

b) **Collaborate with key stakeholders.** Close collaboration between government agencies, telecommunications service providers, and international satellite operators is critical for the smooth deployment and management of satellite networks. This collaboration also ensures that services are aligned with national disaster management strategies and ICT policies.

c) **Invest in upgrading rural broadcasting services.** Upgrading broadcast quality in rural areas helps ensure that populations in remote regions are not left behind. Investing in HD or other advanced services promotes inclusivity and supports national objectives for digital equity.

The use of the South Asia Satellite (SAS) in Bhutan has significantly improved the nation's ability to provide critical communication services to rural and remote areas. The network dual-use functionality for both broadcasting and disaster communication highlights the versatility of satellite infrastructure in addressing multiple national challenges.

A1.1.9 Cell-broadcast (CB) alerting (Everbridge One2many)[125]

Everbridge One2many, fully embraces a multi-channel approach as the global leader in both location-based-SMS solutions (in Australia, Sweden[126], Norway, Singapore, Estonia), CAP based solutions (in Kingdom of the Netherlands[127], Mauritius[128], Spain, Norway[129], Saudi Arabia) and CB based solutions (deployments in 37 mobile operators).

The experiences of location-based-SMS (LB-SMS) are valid projects, but they require longer implementation times due to their complexity, as they are not standardized. Therefore, a different integration is needed at every mobile operator, requiring integration with existing location probes at an operator or provision of new location probes in each mobile network, to deliver an additional Alert-SMSC or integrate with an existing SMSC. These projects are complex as there many different vendors active in the LB-SMS domain (at least 40-50 different vendors) and some of the integrations are done with mobile operator-specific developments, which makes it even more customized. Many vendors in the LB-SMS domain use different protocols and integrations. Finally, the LB-SMS solution for public warning is not standardized in any standardization body and therefore LB-SMS projects are complex, with longer lead times (at least 1 year), and for every deployment a customized and different approach is necessary.

CB is a simpler approach for a public warning system, and is a 3GPP, ETSI and ATIS standardized solution for public warning fully supported by the telecommunications industry, with relatively short delivery times, and less complexity as all radio access network (RAN) vendors support the CBC 3GPP standard. CB is a far more suitable technology to be implemented in the developing countries targeted by the 'Early warning for All' initiative, as it is a fully standardized, 'plain-vanilla' implementation (no surprises when implementing), fully supported by the telecommunications industry, having a similar approach for every country, and incurs much more predictable project timelines.

Useful references:

a) 2013 GSMA PWS in DRR (2013) – https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/01/Mobile-Network-Public-Warning-Systems-and-the-Rise-of-Cell-Broadcast.pdf

b) 5G Americas' Recommendations on Public Warning as specified by 3GPP (2018) – https://www.5gamericas.org/public-warning-systems-in-the-americas/

c) BEREC Guidelines for Art.110 (2020) implementation of EU Dir. 2018/1972 (Public warning effectiveness criteria mandated for all European Union MS) – https://www.berec.europa.eu/en/document-categories/berec/regulatory-best-practices/guidelines/berec-guidelines-on-how-to-assess-the-effectiveness-of-public-warning-systems-transmitted-by-different-means-0

For the multi-channel approach, the CAP standard was proposed, as defined by OASIS, as a solution. The CAP interface can be used as the default integration for public warning with websites, Mobile apps, Radio, TV, SMS, WMO, digital boards, etc. CAP has also proven to be a simple, easy deployable standardized public warning interface in many countries, that can be very rapidly (2-3 months) used and integrated into any public warning solution. Another

[125] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0066/ from Everbridge One2many.
[126] https://www.krisinformation.se/en/finding-help-and-services/emergency-warning
[127] https://www.nl-alert.nl/
[128] https://ndrrmc.govmu.org/Pages/nmheas.aspx
[129] https://www.emergencyalert.no/about-emergency-alert/

advantage is that CAP can also be used as the default interface to integrate between the government domain and the telecommunications company domain (CBC and LB-SMS).

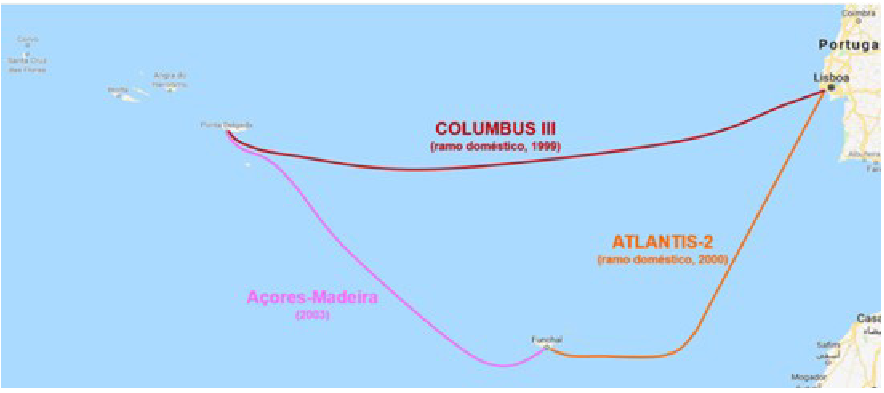
https://preparecenter.org/site/ifrcalerthubinitiative/call-to-action-on-emergency-alerting/

https://www.anticipation-hub.org/events/common-alerting-protocol-cap-implementation-workshop

A1.1.10 SMART CAM submarine cable system (Portugal)[130]

After first raising awareness for the issue in 2017, ANACOM has been actively engaged in ensuring the timely and future-proof construction of the new electronic communications interconnection between the mainland of Portugal and the Azores and the Madeira archipelagos (CAM), via the 'Science Monitoring And Reliable Telecommunications (SMART)' submarine cable system. The SMART acronym was coined by the "Joint Task Force (JTF) to investigate the use of submarine telecommunications cables for ocean and climate monitoring, and disaster warning under the auspices of ITU/WMO/UNESCO IOC"[131]. As shown in Figure A-4, the present CAM interconnection has been ensured using a domestic submarine cable connecting Madeira and Azores; a leg of the Columbus III cable for interconnecting Azores and mainland Portugal, and a leg of the Atlantis 2 cable for interconnecting Madeira and mainland Portugal. The Columbus III cable system entered in service in 1999, and the ATLANTIS 2 in 2000, and will reach the end of their useful lifetime by the end of 2024, and early 2025 respectively. However, the Columbus III and ATLANTIS 2 international cable systems were subject to 'early retirement' respectively in 2020, and 2021, as the international demand for capacity had been met by other systems that have been constructed more recently. The above-mentioned legs have nevertheless been maintained in service for CAM interconnection by Altice, the national operator that had co-invested in, and operated, these submarine cables.

Figure A-4: The CAM interconnection in 2019



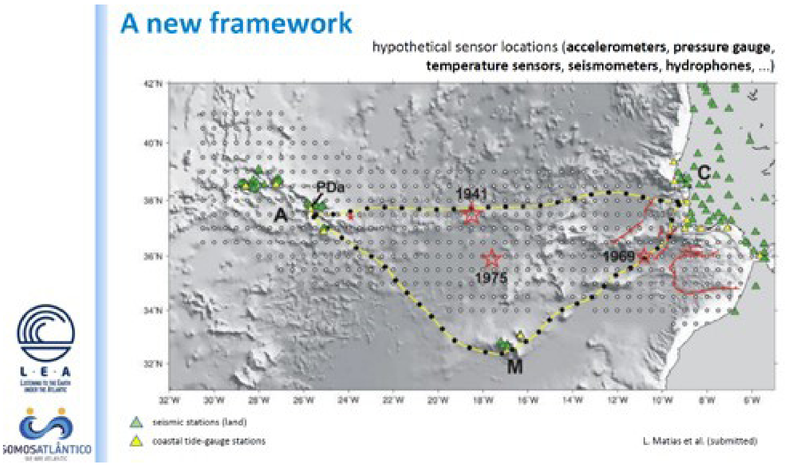
As the national operator 'Altice' had no plans to substitute these interconnections in the CAM region, in 2019, the Government of Portugal set up a working group (CAM WG)[132], chaired by ANACOM, with the Autonomous Governments of Azores and Madeira, as well as representatives of concerned ministries, to analyse the situation and propose a solution. At the same time, EMACOM, a regional public operator in Madeira, purchased capacity in a leg connecting

130 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0077/ from Portugal.
131 https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Pages/default.aspx
132 Order nr. 4805/2019, May 13th; Office of the Assistant Secretary of State and Communications https://files.dre.pt/2s/2019/05/091000000/1455814559.pdf

Madeira to mainland Portugal, which is part of the 'Ellalink,' a new cable system connecting South America to Europe.

The CAM WG heard numerous stakeholders including manufacturers, operators, investors, cable systems promotors, public institutes, and universities, and by the end of 2019, delivered a final report recommending a number of prerequisites for the CAM interconnection. Among these prerequisites was the inclusion of seismic detection and climate monitoring (SMART) functionalities, which were estimated at 10 per cent of the EUR 120M total cost of the project. The Portuguese Institute for the Sea and Atmosphere (IPMA) a LEA[133] member, presented hypothetical locations of desired submarine sensors in the CAM region to complement existing monitoring stations, see Figure A-5. IPMA considered that a SMART CAM would complement its seismic detection and climate monitoring capabilities which were based on research vessels, autonomous vehicles, and fixed observatories, and present a disruptive and innovative approach to ocean monitoring.

Figure A-5: Hypothetical locations of desired sensors in the CAM region. Source: IPMA



JTF SMART Cables, has been advocating the adoption of SMART functionalities, which would enable real time monitoring of ocean bottom temperature and pressure, from which measures of heat content and currents can be obtained. These are needed for climate monitoring, since oceans store a large fraction of the CO2 and the energy associated with its production. With such data, future temperatures around the globe can be more accurately predicted and used, to better address the impacts of climate change. SMART cable networks also have seismic and tsunami detection capabilities and will, therefore, provide early warnings. In September 2020, the government followed most of the CAM WG recommendations, including the inclusion of SMART functionalities, and mandated[134] Infraestruturas de Portugal, S. A., a public infrastructure operator, to manage the new CAM cable system project as a wholesale neutral operator.

In September 2021, the government granted the concession[135] to Infraestruturas de Portugal for the promotion of activities relevant to the conception, installation, maintenance, exploration,

[133] LEA (Listening to the Earth under the Atlantic) is a consortium with two public Institutes and one not-for-profit organization of public interest: IPMA, https://www.ipma.pt/en/index.html; IDL, http://idl.campus.ciencias.ulisboa.pt/ and IT, https://www.it.pt/

[134] Order nr. 9333/2020, September 30th; Offices of the Assistant Secretary of State and Communications and of the Secretary of State of Infrastructures https://files.dre.pt/2s/2020/09/191000000/0012900131.pdf

[135] Decree-Law nr. 63/2022, September 26th. https://dre.pt/dre/detalhe/decreto-lei/63-2022-201450532

and operation of the CAM submarine cable interconnection, and the possibility of sub-concessioning any activity. LEA (Listening to the Earth under the Atlantic), a group of public universities and institutes, assisted Infraestruturas de Portugal in procuring the seismic detection and climate monitoring functionalities for the CAM. The resulting document "Description and implementation of the 'Observer Part' of a SMART cable"[136] will be a key contribution to the Joint Task Force and SMART development. An earlier LEA document, "Management considerations to elaborate a Request for Tender for a SMART cable"[137] published in December 2021, also deserves attention. The public procedure for the acquisition through 'requests for proposal' for a SMART CAM cable system was launched 13 December 2022[138], and the received proposals were, at the time of writing April 2023, being analysed.

A recent study[139] measured the impact of an earthquake early warning system (EEWS) considering the current seismic network in Portugal, as well as the potential installation of submarine CAM sensors. The results indicated that for the districts located in the southwest of the country, an earthquake EWS might provide sufficient warning time for risk mitigation measures to be followed. In the case of a tsunami early warning system (TEWS) the lead time was estimated at tens of minutes. The collection and proper processing of the data provided by the seismic and tsunami detection capabilities implemented on SMART cable networks has, therefore, a huge potential for disaster risk reduction and management. In this context, a new draft ITU-T Recommendation G.smart, is being developed within the framework of ITU-T Q8/15 and that of PP22 Resolution 136 (Rev. Bucharest, 2022) on "The use of telecommunications/information and communication technologies for humanitarian assistance, and for monitoring and management in emergency and disaster situations, including health-related emergencies, for early warning, prevention, mitigation and relief". This document:

- considers "that oceanic sensing technologies, which may be deployed through, or by using undersea cables, can be used for early warning and disaster risk reduction, preparedness and response, including tsunami and earthquake early warning";
- considers further "the activities of the Joint Task Force to investigate the use of submarine telecommunication cables for ocean and climate monitoring and disaster warning (JTF SMART cable systems), established in late 2012, by ITU, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO/IOC), and the World Meteorological Organization (WMO);
- encourages Member States "to contribute actively to the development of oceanic sensing technologies, including the work of the JTF SMART cable systems";
- refers to ITU-D Resolution 34 (Rev. Kigali, 2022) on "The role of Telecommunications / information and communication technology in disaster preparedness, early warning, rescue, mitigation, relief and response";
- recognizes "that the concept of SMART (scientific monitoring and reliable telecommunication) cable includes scientific sensors mounted in the repeaters of submarine cables to measure ocean-bottom temperature, pressure and seismic acceleration";
- considers "the need to investigate the use of submarine telecommunication cables for ocean and climate monitoring and disaster warning", and

136 https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Documents/Observer-part-SMART-cable.pdf
137 https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Documents/LEA-contribution-to-JTF_RfT-for-a-SMART-Cable.pdf
138 https://www.portugal.gov.pt/pt/gc23/comunicacao/comunicado?i=esclarecimento-sobre-o-projeto-de-substituicao-do-sistema-de-cabos-submarinos-que-ligam-o-continente-aos-acores-e-madeira
139 "Earthquake early warning for Portugal: part 1 - Where does it matter?" in Bulletin of Earthquake Engineering, Vitor Silva, Amir Taherian and Carlos Sousa Oliveira.

- invites "BDT to consider how space-based technologies, submarine telecommunication cable networks, and associated sensor technologies can be used to help ITU Member States collect and disseminate data on the effects of climate change and support early warning, having regard to the link between climate change and natural disasters".

A1.1.11 Visual-IoT systems for disaster detection (NICT)[140]

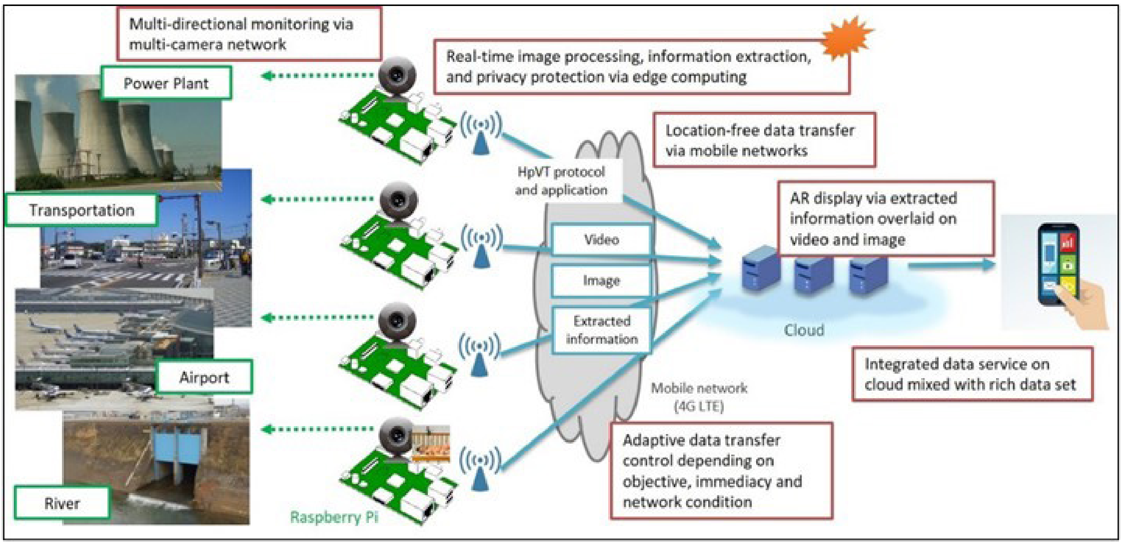
'Resilient natural environment measurement' is a concept proposed by NICT, which could be a novel technique for monitoring the environment based on a combination of broadband network and Internet of Things (IoT). One of the key issues of resilient natural environment measurement, is to monitor areas using sense of sight and sense of sound devices in association with sense of touch (legacy sensor) devices. In addition to legacy sensors, a novel technique also uses sense of sight (visual IoT) devices. As science and technology are increasingly applied to reduce uncertainty regarding environmental risks, natural environment measurement methodologies are revealing a potential for disaster risk management, primarily before, but also during and after events.

Visual IoT system for disaster detection

Visual IoT: The visual IoT concept, proposed by [Iyer et al.] in 2016, utilises image sensors or video sensors, such as closed circuit television (CCTV) cameras, as IoT sensors (Figure A-6). Visual IoT devices are deployed in society today to monitor power plants, transportation, airports, rivers, and so on. Real-time image processing and information extraction with privacy protection are required functions, and mobile networks can provide location-free data transfer. Moreover, the advanced characteristics of the visual IoT system including adaptive data transfer control depending on the objective, immediacy, and network conditions; augmented reality (AR) display via extracted information overlaid onto image and footage; and integrated data services on the cloud mixed with a rich data set such as a geographic database; all reveal something of the intelligent and multi-functional potential of visual IoT. Visual IoT systems are equipped with a video transmission device, such as an IP network camera, that is connected to the mobile network to transmit footage or images to cloud servers. Two key issues were pointed out by [Iyer et al.]: (1) problems with high-quality video transmission, and (2) information extraction from images, using image processing and image recognition techniques. To solve issue (1), NICT [Murata et al.] proposed in 2019, a new video transmission protocol, called high-performance video transmission (HpVT) protocol, to achieve high performance for monitoring a variety of outdoor phenomena over mobile networks such as 4G/LTE and 5G mobile networks, and WiFi and satellite communication networks.

[140] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0088/ from Japan.

Figure A-6: Visual IoT concept

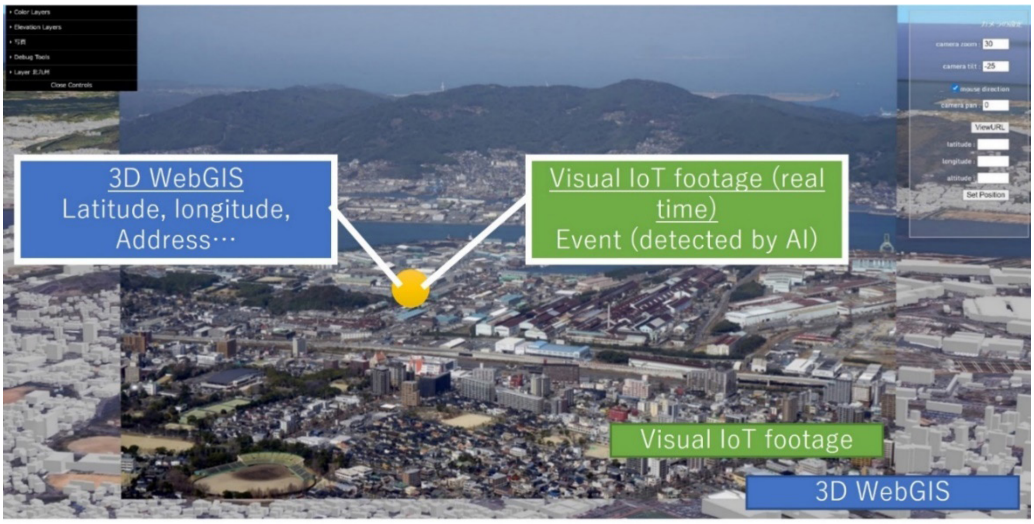


Issues for deployment: A critical issue to be overcome before the wide deployment of visual IoT systems in society can be achieved, is that of visual IoT system sensor costs. The high cost of sensors can often become a barrier to the dissemination of IoT sensors. One example is that of the water level sensors deployed by the Ministry of Land, Infrastructure, Transport and Tourism, in Japan (MLIT), where the installation costs at one site amounted to over several million USD. In order to monitor water levels for detecting river flood risks, sensors needed to be deployed every 1 km along the river. However, such a dense deployment of water level sensors on the river was difficult due to the high costs incurred. To increase the number of sensors, visual IoT systems assembled using commercial off-the-shelf (COTS) equipment could help resolve the cost issue.

Issues for disaster detection: Visual IoT systems are used to monitor fields, forestry, rivers, etc., and provide large volumes of images or footage. Information extraction of disaster events or phenomena from the images or footage, mentioned as issue (2) above, is achieved using image processing techniques. These techniques become more effective with the help of the pan-tilt-zoom (PTZ) functions of IP network cameras, which enable development of an autonomous system to detect, track, and extract disaster risk information, and to aid decision-making on required actions. To achieve disaster risk mitigation, the extracted disaster risk information from the video should be processed in real-time. Image processing techniques, especially those using artificial intelligence (AI) or machine learning (ML), need to be installed on the visual IoT system for detecting disaster events. Due to the development of single board computers equipped with a graphic processor unit (GPU) or a tensor processing unit (TPU), edge computing may be one of the options for the building visual IoT systems for disaster mitigation, that may contribute to more rapid detection of risk events.

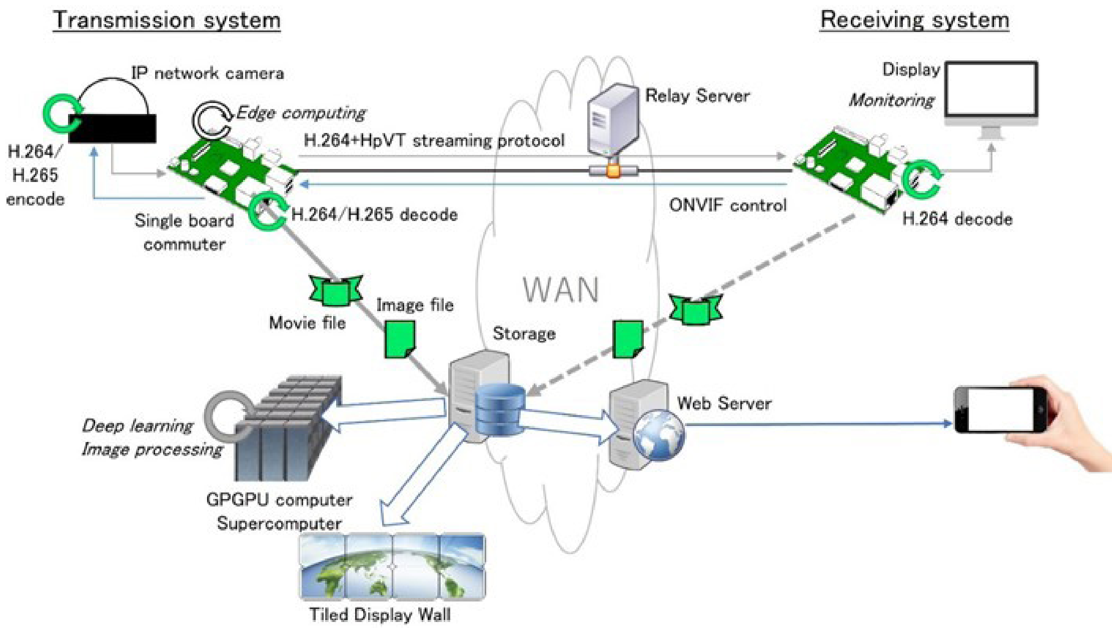
Issues for combining GIS: Considering the quick action and first responses required when a disaster occurs, a combination of geographic information system (GIS) with image processing via a visual IoT system, might shorten disaster response times. When an image processing application finds a disaster event on images or footage, it needs to identify the location of the event, as well as the scale of the disaster. Synchronization techniques of visual IoT images or footage with 3D GIS mapping have recently been developed. Figure A-7 shows an example of the synchronization; footage (inside view in the figure) by a visual IoT system at Kitakyushu city, Japan, is almost completely overlaid with a view of the 3D GIS (background view in the figure) provided by iTowns, an 3D WebGIS tool, that contains a 3D building object (PLATEAU provided by MLIT). This figure indicates that a disaster event that is detected automatically by AI from the image, is directly mapped onto the 3D WebGIS. The system can easily and quickly provide geographical information at the disaster affected area, such as the address, social facilities, traffic conditions, levels of river water, weather conditions, and so on.

Figure A-7: Overlay of visual IoT image on 3D WebGIS



Case study of a visual IoT system: NICT, Japan, developed a cost-effective visual IoT system for detecting disaster, which is also intended for easy installation. Figure A-8 shows a schematic of the visual IoT system developed for detecting disaster events. Using single board computers for edge computing units, such as Raspberry Pi (hereafter RPi) and an IP network camera with PTZ functions, NICT designed the system based on the HpVT protocol. As HpVT runs on Raspbian, which is an operating system (OS) based on generic Linux OS, edge operations are easily programmed. Combining the PTZ function and WebRTC streaming on the visual IoT system, the visual IoT system becomes an autonomous disaster detection system.

Figure A-8: Visual IoT system



NICT has been testing the developed visual IoT system in real situations. Real-time, or quasi real-time, transmission of images and footage using HpVT protocol has already been tested with success. Figure A-9 show an example of the detection of smoke on footage provided by the developed visual IoT system, in Chikuma city, Japan. In the figure, superposed texts indicate moving objects that are automatically detected on the footage, and the white texts indicate smoke caused by fire. The text in black indicates moving vehicles. The latency to event detection is less than few seconds, which provides enough time to make quick decisions and formulate a response.

Figure A-9: Smoke detection via real-time image processing [Kikuta et al.]

Useful references:

[Iyer et al.] R. Iyer and E. Ozer, Visual IoT: Architectural Challenges and Opportunities; Toward a Self-Learning and Energy-Neutral IoT, IEEE Micro, vol. 36, no. 6, pp. 45-49, 2016.

[Murata et al.] K. T. Murata, P. Pavarangkoon, S. Phon-Amnuaisuk, T. Mizuhara, K. Yamamoto, K. Muranaga and T. Aoki, "A Programming Environment for Visual IoT on Raspberry Pi," in The 5th IEEE International Conference on Cloud and Big Data Computing (CBDCom 2019), Fukuoka, Japan, Aug. 5-8, pp. 987-992, 2019, doi: 10.1109/DASC/PiCom/CBDCom/CyberSciTech.2019.00180.

[Kikuta et al.] A smoke detection method based on variances of optical flow and characteristics of HSV color, submitted to IEEE Transactions on Industrial Informatics, 2023.

A1.1.12 Earth observation: role, prediction and relief in India[141]

As India is surrounded by the Arabian Sea in the west, the Bay of Bengal in the east, and the Indian Ocean in the far south, the country has always suffered from inundations due to tropical cyclones originating over the Bay of Bengal, the Arabian Sea, and the Indian Ocean. The west coast of India is more vulnerable to tropical cyclones than the eastern coastal area, and experiences extremely severe cyclones.

Earth observation: role in climate change mitigation. Earth observation is a new frontier technology tool which is helping populations face weather challenges using satellite observation of the Earth and weather movements. The system can observe the entire Earth surface at the same time. This represents a revolution in meteorological science as satellite images are continuously collated and used to accurately forecast weather events such as rain, storms, cyclones, etc. The system is therefore used in EWSs, and helps to mitigate the harmful effects of weather or geohazards.

Cyclone Tauktae and Earth observation: case study from India. In May 2021, the Indian Meteorological Department (IMD) had forecasted the formation of a cyclonic storm over the Arabian Sea. Initially, through Earth observation satellites of the Indian Space Research Organization (ISRO) and NASA satellites, what was to develop into a cyclone appeared to be just a low-pressure area over the Arabian Sea. Tauktae developed into a full cyclonic storm with wind speeds of up to 87 km/h, and reached the Odisha-West Bengal Coast within six days. Cyclone Tauktae continued to develop into an extremely severe cyclonic storm (ESCS) with wind speeds of up to 185 km/h, and caused severe damage in a number of states on the coast of India including Goa, Karnataka, Gujarat, and Maharashtra. All of these states experienced massive damage to property, with electrical supply and infrastructural damage. The cyclone caused extreme winds, high rainfall, and massive storm surges. Even the city of Mumbai faced the impact of the cyclone. A few hours ahead of cyclone Tauktae hitting the Porbandar and Mahuva coasts, the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) Suomi National Polar-orbiting Partnership (NPP) satellites, through a visible infrared imaging radiometer suite (VIIRS) had predicted the storm using colour imaging. The United States Joint Typhoon Warning Centre also predicted extreme wind velocity from 125 miles per hour to 145 miles per hour, and declared it to be a category 3 or 4 hurricane. Though cyclone Tauktae caused great damage

[141] ITU-D Document https://www.itu.int/md/D22-SG01-C-0117/ from India.

to trees, power, telecommunications infrastructure, and rail lines, etc., due to timely prediction, the Government had time to launch alerts for citizens through various ICT means, such as repeated radio and television announcements, bulk messages directly to mobile phones by all telecommunication operators, telephone reminder messages, etc. Coastal areas and mariners at were evacuated, and people were conveyed to shelters. These measures helped greatly in reducing mortalities, even though due to the cyclone intensity a lot of damage was done to trees, crops, and infrastructure. Due to timely alerts through Earth observation, quick response, and preparedness, many lives were saved.

Role of the Department of Telecommunications and the telecommunications/ICT sector in cyclone relief and mitigation. The Department of Telecommunications (DoT) ensured that in the states affected by cyclone Tauktae, telecommunication services remained uninterrupted. Telecommunications infrastructure providers assured the Government of India that sufficient alternate energy sources such batteries, battery banks, spare parts for repairs, and diesel should be stocked in order to overcome power cuts and keep the telecommunications towers running. Restoration teams were kept on high alert. The Department, the Cellular Operators Association of India (CAOI) and the Digital Infrastructure Providers Association (DIPA) initiated roaming between circles, so that in case any service provider had lost of infrastructure, citizens would not face any communications problems. Extra cell on wheels (CoWs) were also kept as standby. All the major stakeholders including Bharti Airtel and Jio, along with Vodafone, Idea, and the state-run public sector undertaking (PSU) Bharat Sanchar Nigam Limited (BSNL), cooperated with the DoT to come together to help the affected states, and ensure there was no disruption of telecommunication services. Focused war rooms were set up by telecommunications operators to maintain infrastructure and focus on restoration work, and so avoid any kind of service disruption.

Way forward: In India, NASA and the Indian Space Research Organization (ISRO) have collaborated to develop an observatory for Earth observation employing a system of satellites. These satellites will work towards providing a 3D holistic view of the Earth. The aim of this collaboration is better climate change and disaster mitigation, prediction of fire hazards, accurate weather prediction for agriculture through Earth observation, etc. This advanced Earth observation system, which utilises ISRO radars, will further provide information to fight climate change and help in disaster mitigation efforts. ISRO has been at the forefront of Earth observation efforts in India. ISRO has launched several satellites, including the Indian National Satellite System (INSAT) series, and the Oceansat series, which are dedicated to Earth observation. These satellites provide critical data on weather patterns, atmospheric conditions, and oceanography enabling authorities to effectively monitor and manage natural disasters such as cyclones. In addition to ISRO, several other organizations and institutions are working towards the effective management of cyclones in India. The National Disaster Management Authority (NDMA) is responsible for coordinating efforts to manage natural disasters in India. The Indian Meteorological Department (IMD) provides weather forecasting services, and issues warnings for natural disasters, including cyclones.

In addition to monitoring and predicting cyclones, Earth observation can also aid in post-cyclone recovery efforts. It can provide information on the extent of damage caused by a cyclone or other events, enabling authorities to prioritise relief efforts, and allocate resources effectively. Earth observation data can also help to identify areas that are at risk of flooding or landslides, enabling authorities to take necessary measures to prevent such occurrences.

Sources

- https://www.indiatoday.in/amp/science/story/nasa-isro-disaster-management-system-climate-change-cyclone-1806655-2021-05-25
- https://m.economictimes.com/industry/telecom/telecom-news/cyclone-tauktae-dot-reviews-telecom-infrastructure/amp_articleshow/82663626.cms
- https://m.economictimes.com/industry/telecom/telecom-news/telcos-working-with-dot-infra-firms-to-mitigate-impact-of-cyclone-tauktae/amp_articleshow/82736920.cms

A1.1.13 Application of fibre-optic sensing technology in pipeline risk awareness and warning (China)[142]

Petroleum is one of the most important economic resources in the world today. However, uneven geographical distribution, and the physical properties of petroleum mean that transporting the resource to where it is needed presents a tough challenge. Oil and gas are typically transported by rail, road, water, air, or pipelines. Of these, pipelines are the least restrictive and most suitable transportation method for oil and gas products. According to statistics, 50 per cent of the world's oil and gas pipelines have been operating for more than 30 years, and oil and gas pipelines are facing serious operational safety issues. There are many reasons for pipeline failure, including external force, corrosion, and material and construction defects. According to statistics from the National Energy Administration of China, by the first half of 2021, China's oil and gas pipelines had exceeded 175 000 kilometres. In the past two decades, the number of accidents caused by leakage, accounted for a large proportion of the accident rate. In addition to soil pollution, serious leakage accidents can cause explosions, which poses a serious threat to the productivity and lives of the surrounding people. Therefore, more and more attention has been paid to the development of intelligent detection and location technology for pipeline leakage.

Figure A-10: Heavy losses and the difficulty of prevention, represent huge challenges for the safe operation of oil and gas pipelines

Solution

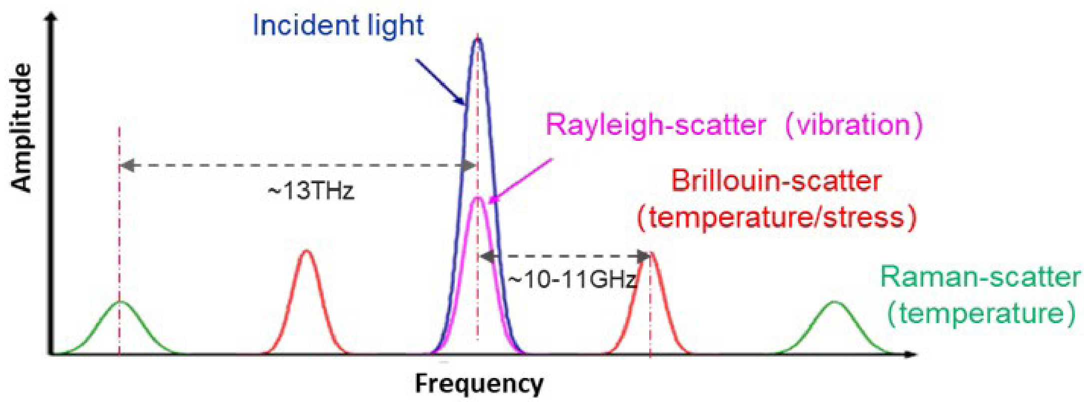
Current status of oil and gas pipeline risk awareness and warning: A number of digital technologies, such as sensor technologies, have already been applied to pipeline inspections. However, problems remain such as those caused by false negatives where damage goes undetected, damage is detected where there is none, or misidentification occurs where construction is mistakenly categorized. Some technologies, such as aerial drones used for inspecting power grids, are ill-suited to oil and gas pipeline scenarios, because most pipelines are built underground. Therefore, oil and gas pipeline risk awareness and warning, urgently

[142] ITU-D Document https://www.itu.int/md/D22-SG01-C-0216/ from China.

need an automatic remote risk awareness product with high precision identification capability, and easy deployment. Leading optical technologies have been applied to the fibre-optic sensing field and a fibre-optic sensing risk awareness and warning solution has been developed. This solution comprises industry-leading identification accuracy, and can be widely used in oil and gas pipeline risk awareness and warning scenarios. Advantages of this solution include comprehensive acquisition, accurate recognition, and fast learning.

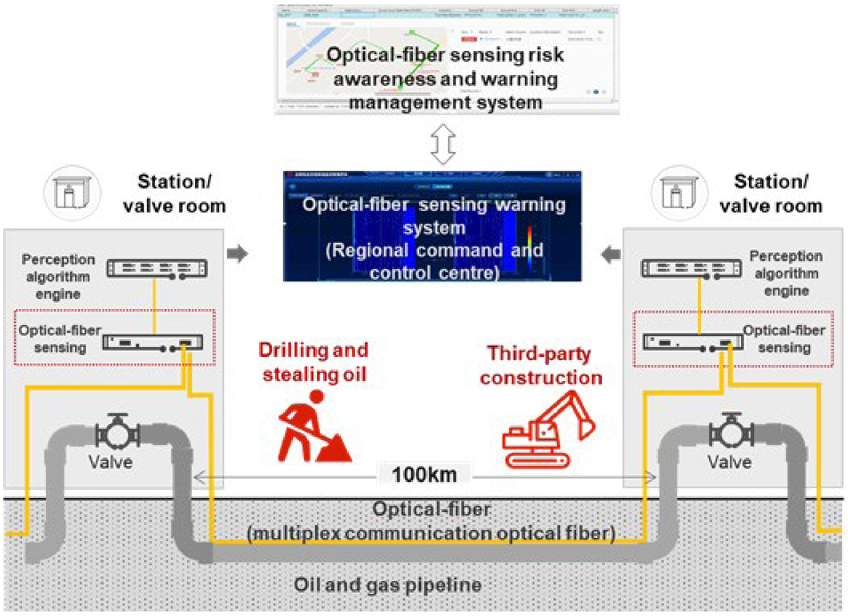
Technical principle of distributed fibre-optic **sensing.** Scattering occurs when light travels through optical-fibre. Fibre-optic sensing technology mainly uses Rayleigh-scatter, Brillouin-scatter, and Raman-scatter techniques. When vibration (Rayleigh-scatter), temperature changes (Brillouin-scatter and Raman-scatter), and stress changes (Brillouin-scatter) occur, the scattered signal of light changes synchronously. Each point on optical-fibre can be used as a sensing unit to be register environment changes, and measure, analyse, and locate physical parameters (vibration, stress, and temperature) around the optical-fibre.

Figure A-11: Rayleigh-scatter, Brillouin-scatter, and Raman-scatter



Fibre-optic **sensing risk awareness and warning solution**: Fibre-optic sensing devices are based on traditional communication optical fibre and use Rayleigh-scatter technology to detect vibration. The fibre-optic sensing device transmits pulse light to the detection optical-fibre, and collects backscattered signals returned by the optical-fibre. The collected data can form the intensity and phase baseline of scattered light at each point on the optical-fibre. When vibration occurs at any point along the optical-fibre, the intensity and phase of the backscattered light transmitted back to the fibre-optic sensing equipment change synchronously. Through the perception algorithm engine, these signals are modelled with multi-dimensional information by an intelligent recognition algorithm, and model recognition is carried out according to the model library, so that the event type and location can be accurately identified. The generated alarm information can be transmitted to the fibre-optic sensing and warning system, of the regional command and control centre, which is managed by the fibre-optic sensing risk awareness and warning management system.

Figure A-12: Fibre-optic sensing risk awareness and warning solution



Advantages of the fibre-optic sensing risk awareness and warning solution:

Signal collection: The enhanced optical digital signal processing (oDSP) module has a strong, built in correction algorithm for blind spots, which can correct and shape the phase of weak signals and raise the effective signal acquisition rate to 99.9 per cent.

Accurate identification of incidents: The exclusive vibration ripple identification engine can analyse construction incidents across multiple dimensions. For each construction vibration point, a minimum of 32 pieces of phase information are collected. Multiple features can be extracted, including voiceprint, frequency, space, time sequence, and duration. Samples are identified and compared through multi-dimensional deep convolution, raising incident identification accuracy to 97 per cent.

Fast learning: The fibre-optic sensing risk awareness and warning solution can perform iterations based on new construction behaviour data, and various geological environment scenarios in the database. Working with universities that provide large amounts of geological data, (up to 1 000 new incident samples each day) this data can be used to improve the sensing and warning accuracy of the solution.

Application cases. Shandong Jihua Gas was one of the first companies to adopt the fibre-optic sensing risk awareness and warning solution. The company operates gas pipeline networks at various levels, comprising more than 3 000 km of pipeline that supplies gas to 920 000 households and more than 3 000 industrial, boiler, and public welfare users in Jinan city.

China have worked with Shandong Jihua Gas, to deploy a 20-km underground pipeline that traverses complex environments including suburbs, national highways, and rural areas. Construction samples from excavators, rammers, ditchers, and manual excavations were collected onsite for training and model creation. Based on these, 56 tests were conducted on different road segments. The initial phase of technical verification has been completed, proving the efficacy of the intelligent optical sensing product. Shandong Jihua Gas used intelligent optical sensing products and video management systems to build an optical-visual linkage solution, improve the awareness accuracy of the oil and gas pipeline network, and reduce costs.

Fibre-optic vibration is used to complete the first round of risk awareness. When an exception is detected, nearby cameras are automatically triggered to obtain onsite video information for secondary confirmation. After confirming that the exception is true, alarms are generated, and personnel are automatically arranged to attend the site and rectify any faults and risks.

Future study. China plans to develop additional optical technologies, such as the distributed fibre-optic sensing of vibration, temperature, stress, and water quality for many more industries, including the electrical power, transportation, government, and sanitation sectors. In conjunction with big data and GIS mapping, these technologies will support differentiated, multi-dimensional, and intelligent detection and warning solutions.

A1.1.14 L-Alert in Japan (Japan)[143]

In areas with weak social infrastructure, even a single natural disaster can cause serious social and human damage, and it is extremely important to minimize such damage. At the same time, given the current situation of large-scale natural disasters occurring across borders, disaster risk reduction is a very important issue that should be addressed through international cooperation.

L-Alert system: Japan introduced the L-Alert system, a type of disaster prevention ICT, over 10 years ago. When local government offices and other information providers send evacuation orders, and other disaster-related information to the L-Alert system, the information is automatically distributed simultaneously to various media outlets through L-Alert, which is operated by the Foundation for MultiMedia Communications (FMMC).[144]

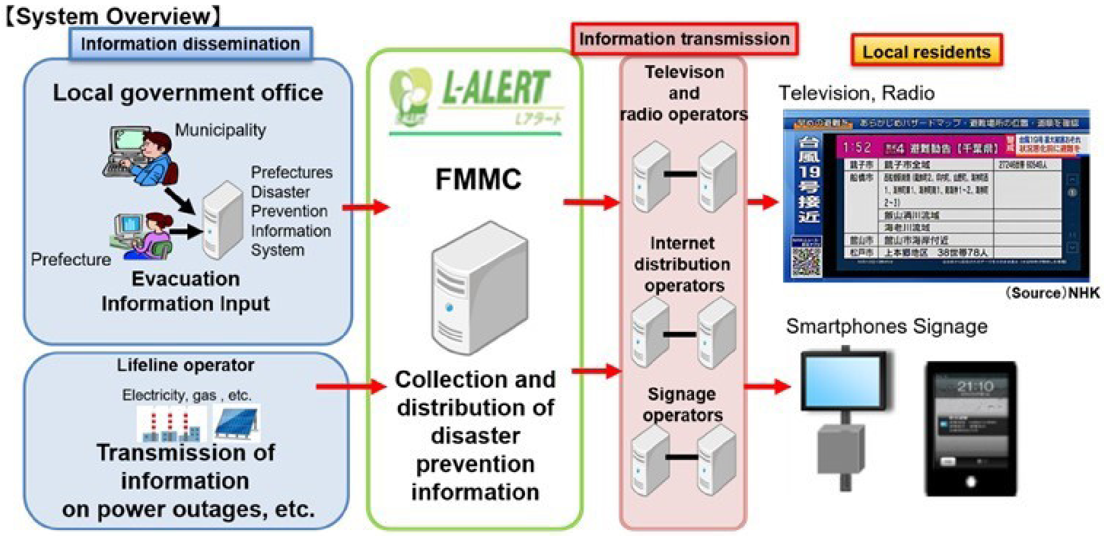
This makes it possible for all local residents, regardless of their disability or age, to reliably and quickly obtain emergency information on disasters, in an easy-to-understand 'anytime, anywhere' format through a wide range of media, including television, radio, mobile phones, and the Internet. The system has great benefits not only for local residents, but also for information providers. Only by inputting the L-Alert, it is possible to reliably and quickly transmit information to various media, etc., and by reducing the burden of transmitting information such as through individual input work, it is possible to concentrate on other essential tasks. In addition, information transmitters such as TV stations can automatically obtain wide-area and detailed disaster information in a list as electronic data. This has the advantage of being able to efficiently and effectively provide information tailored to local circumstances. In Japan, it is possible to provide information for an L-Alert in all prefectures. More than 900 registered organizations, including TV stations, radio broadcasters, websites, and disaster prevention apps, transmit information to local residents.

When a typhoon struck in September 2022, over 1 000 items of information (evacuation information, shelter information, blackout information, etc.) were provided from 137 organizations over a four-day period. Disaster-prevention ICT technologies will also be deployed in the Republic of Indonesia, a country that faces similar disaster hazards to those of Japan. The development of a system for processing and transmission of disaster prevention information, utilizing the expertise of L-Alert will lead to an increase in the number of disaster prevention information transmission destinations, to disaster prevention administrative agencies and telecommunications carriers, an increase in transmission data capacity, a reduction in

143 ITU-D Document https://www.itu.int/md/D22-SG01-C-0188/ from Japan.
144 See the figure below for an overview of the system https://www.fmmc.or.jp/english.

transmission time, and a reduction in congestion, leading to a reduction in the risk to human life due to earthquake and tsunami disasters.

Figure A-13: System overview of L-Alert system



Conclusion: L-Alert, a representative of disaster prevention systems, has been successfully introduced in Japan. Ensuring that disaster-related information can be distributed reliably and quickly is an urgent issue common to all countries. Japan, which as a country has had experience with a number of disasters, can be expected to contribute to the SDGs by strengthening efforts against natural disasters, and providing the technology, and disaster prevention ICT know-how that it has cultivated over time, to countries that are also fighting against disaster hazards.

A1.1.15 Satellites for use in disaster mitigation, response, and recovery (GSOA, Access Partnership, Viasat, Turksat, SES, Japan)

Effective disaster response relies on coordination and communication. Satellites bring essential connectivity to disaster responders when other communications options are incapacitated[145]. This is particularly critical in the first 48 hours, the most crucial timeframe after a disaster for managing relief efforts, and ensuring the safety of affected populations. When terrestrial networks are affected, satellite communications provide essential connectivity for public officials, responders, and communities to share information and coordinate efforts. This connectivity ensures that even those without access to other communication channels can stay informed and connected with their loved ones, and with authorities. Beyond the immediate aftermath, satellite communications are instrumental in continuing recovery efforts, by maintaining open communication lines throughout the rebuilding process. They enhance all phases of disaster management including disaster mitigation, preparedness, response, and recovery. Satellite data that is conveyed in real-time helps identify high-risk areas and monitor environmental changes, while satellite connectivity facilitates quick and accurate communication among emergency services, ensuring efficient relief efforts and real-time updates.

The number of recorded natural disasters has more than doubled between the periods 1980-1984 and 2015-2019, a trend likely to continue in the next decade.[146] Over the past 60 years,

145 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0110/ from GSOA.
146 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0103/ from Access Partnership.

satellite communications have contributed to disaster response efforts, providing critical connectivity when terrestrial networks fail. However, these contributions were provided by overcoming many technological and administrative barriers, such as difficulties in the importation of the satellite terminal equipment to the disaster-hit area, training of personnel, interoperability of different devices and networks, or limited spectrum resources. Today, changing satellite communication technologies promise to open a new chapter in disaster communications where more robust and well-integrated systems might provide safer and faster connectivity for disaster responders. Such a shift in connectivity during response and recovery periods after a disaster can exponentially increase the number of saved lives.[147]

Recent advances in satellite communications have focused on the significant potential of new space-based connectivity technologies to transform disaster response and recovery. Medium Earth orbit (MEO) and low Earth orbit (LEO) constellations that offer enhanced speeds and reduced latency, allow for more efficient and reliable communication during emergencies, and ensure that first responders and coordination centres can exchange real-time information seamlessly. This technology enables the provision of better connectivity for responders, as well as communications for everyone through unified networks. Satellite technology is also employed in disaster prediction and in EWSs allowing measures to be taken in time as well as infrastructure assessments to be carried out before and after a disaster. Satellites that provide real-time data and imagery of earth, that can be used to predict and monitor disasters[148] might help to save lives and goods to a very significant extent. In 2022, the United Nations launched an ambitious international initiative called 'Early Warning for All'[149] with the goal of achieving comprehensive global EWS coverage by 2027. This initiative underscores the importance of a people-centred approach to disaster management, ensuring that communities are at the heart of all efforts. The initiative is structured around four key pillars:

Disaster risk knowledge: This involves understanding the various risks that different regions face, including natural disasters such as earthquakes, floods, and hurricanes. By gathering and analysing data, communities can better prepare for potential threats.

Observation and monitoring: Continuous monitoring of environmental conditions is crucial. This includes using advanced technologies such as satellite imagery and remote sensing to track weather patterns and other indicators of impending disasters.

Warning dissemination and communication: Effective communication channels are vital for disseminating warnings to the public. This pillar focuses on ensuring that alerts reach people in a timely manner, utilizing various platforms including mobile networks, social media, and traditional media outlets.

Preparedness and response capabilities: Building the capacity of communities to respond to disasters is essential. This includes training, drills, and the development of emergency response plans to ensure that people know what to do when a disaster strikes.

A connectivity revolution in disaster management could significantly reduce losses globally by up to USD 148 billion in 2025-2029.[150]

[147] Presentation from Viasat at the Transformative Connectivity Satellite Workshop.
[148] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0110/ from GSOA.
[149] Presentation from BDT, ITU at the Transformative Connectivity Satellite Workshop.
[150] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0103/ from Access Partnership.

As discussed in the previous section, device-to-device (D2D) satellite communications eliminate the need for bulky satellite terminals, which offers a more efficient and accessible solution for disaster response and recovery. D2D simplifies logistics, reduces costs, and speeds up the deployment of communication networks in disaster-stricken areas. Hybrid constellations have also significantly enhanced disaster communications. By integrating different satellite orbits, hybrid constellations enable real-time data exchange and continuous monitoring, which are crucial for effective disaster response and recovery. This technology ensures that first responders and coordination centres can communicate efficiently, even in remote or underserved areas.

Internet of Things (IoT) can power a resilient network of sensors to provide real-time data and situational awareness after a disaster. Sensors can be deployed on main transportation roads, bridges, and on other critical infrastructure to gather immediate information about the extent of damage during a disaster. These sensors monitor structural integrity, traffic flow, and environmental conditions, transmitting data directly to crisis centres via satellite. This capability allows crisis centres to obtain a comprehensive picture of the damage within minutes, enabling quicker and more informed decision-making. Instead of relying on manual assessments, which can be time-consuming and dangerous, satellite-enabled IoT provides accurate, real-time insights. This technology enhances the efficiency of emergency response, and ensures that resources are allocated effectively, ultimately saving lives and reducing the impact of disasters.

Regulators and policymakers should ensure meeting the spectrum requirements in a harmonized way so that seamless communication can be provided without interference. The February 2023, earthquake disaster in Türkiye highlighted the importance of such harmonization. Turksat's swift response in re-establishing communication networks was made possible through the central coordination and support of regulators and policymakers.[151]

Examples of restoring communications networks and reconnecting after service disruptions

Kingdom of Tonga connectivity restoration in 2022 and 2019: In Tonga the urgency for connectivity reached a peak in January 2022, when the catastrophic eruption of the Hunga Tonga-Ha'apai volcano, was followed by a tsunami. The damage was profound, severing the Tonga cable system and cutting off international calls. However, SES stepped in, utilizing their geostationary Earth orbit (GEO) satellite technology to restore international calls, bringing a vital lifeline to the isolated nation amidst chaos. This was not the first time Tonga faced such challenges, as in January 2019, connectivity issues arose when the Tonga cable system was cut in two places. SES demonstrated its commitment to restoring communication in times of crisis, and ensured that the people of Tonga could connect with the outside world.

Papua New Guinea earthquakes and cable cut: In May 2019, a powerful 7.2 magnitude earthquake struck Papua New Guinea, causing significant damage to essential terrestrial and subsea infrastructure. This left many areas without connectivity, but SES quickly responded by deploying their O3b medium Earth orbit (MEO) beam. This strategic move provided an additional 1.5 Gbit/s of low-latency IP transit service, alleviating network congestion, and allowing vital communication to resume. As if nature had not already tested their resilience, a further earthquake shook Papua New Guinea in September 2022. Understanding the urgency of the situation, SES and its partners rapidly increased the O3b MEO capacity to support disaster recovery efforts, reinforcing their commitment to ensuring that even in the face of adversity,

[151] Presentation from Turksat at the Transformative Connectivity Satellite Workshop.

connectivity would not be lost. Through these efforts, SES not only restored communication, but also helped communities stay connected during their most challenging moments.[152]

Noto Peninsula, Japan earthquake[153]: At 4:10 p.m. on 1 January 2024, a powerful earthquake struck the Noto Peninsula in Ishikawa Prefecture, Japan, registering a maximum intensity of seven on the Japanese seismic scale. The quake and subsequent tsunami caused significant destruction, resulting in 241 confirmed deaths, 12 missing, and nearly 1 300 injured across eight prefectures, making it the deadliest earthquake in Japan since 2016. In response, KDDI partnered with local government and agencies, including the Self-Defence Forces, to prioritize evacuation centre support, and restore communication networks. Mobile base stations and satellite antennas were installed, providing free Wi-Fi at evacuation centres and facilitating online classes in schools serving as shelters.

A1.1.16 Harnessing real-time monitoring and ICT-driven early warning systems for strengthening disaster preparedness and response (RIFEN)[154]

Considering the increasing frequency, complexity, and magnitude of both natural and human-induced disasters worldwide which pose significant threats to human lives, infrastructure, and economic stability, it is imperative to integrate ICTs into national and regional disaster risk reduction frameworks. Real-time monitoring systems and EWS have a transformative potential in hazard forecasting, rapid information dissemination, emergency coordination, and community empowerment through inclusive and timely communication.

Real-time tools such as IoT sensors, satellite imagery, remote sensing technologies, and unmanned aerial vehicles (UAVs) facilitate continuous environmental data collection and predictive analytics. These technologies significantly enhance situational awareness, and enable data-driven emergency responses. Evidence from the United Nations Office for Disaster Risk Reduction (UNDRR) suggests that countries with robust early warning infrastructure witness up to 60 per cent fewer fatalities during disasters.

Japan serves as a global benchmark in this regard. The Japan Meteorological Agency (JMA) operates a sophisticated earthquake early warning (EEW) system utilizing over 1 000 seismometers to detect seismic activity and issue alerts within seconds across multiple communication platforms including television, radio, mobile phones, and sirens. Tsunami warnings are similarly issued through integrated oceanic sensors, satellite feeds, and hierarchical governance structures with clearly defined evacuation protocols. This illustrates how institutional coordination, real-time ICT infrastructure, multi-platform alert dissemination, and community awareness can significantly mitigate disaster impacts.

India has also taken proactive measures in this direction. Initiatives such as the National Disaster Management Authority (NDMA) Integrated Alert System, the CAP-based mobile alerts by the Department of Telecommunications using cell broadcast services (CBS), deployment of Doppler weather radars by the India Meteorological Department (IMD), and the use of AI for cyclone prediction models are notable examples. Additionally, the use in India of SMS/USSD-based alerts in rural areas, executed in collaboration with telecommunications service providers and

[152] Presentation from SES at the Transformative Connectivity Satellite Workshop.
[153] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0192/ from Japan.
[154] ITU-D Document https://www.itu.int/md/D22-SG01-C-0536/ from Réseau International Femmes Expertes du Numérique (RIFEN)

state disaster management authorities, exemplifies scalable, low-cost ICT solutions aimed at bridging the last-mile communication gap.

Other countries in the region have taken similar steps. **People's Republic of Bangladesh**, for instance, leverages community radio and mobile messaging platforms to disseminate early warnings, while some countries in Africa use solar-powered early warning loudspeakers and mobile alerts to reach vulnerable, low-connectivity areas. These examples highlight how ICTs can be adapted to local contexts to improve community preparedness and disaster response.

Case studies from around the world provide further evidence of the critical role ICT plays in disaster risk reduction. During the 2011, Great East Japan Earthquake and Tsunami, the earthquake early warning (EEW) system gave Tokyo residents a 10-second lead before tremors struck, helping shut down trains and industrial operations and reducing further casualties. In India, Cyclone Phailin in 2013, saw extensive use of Doppler radar, satellite data, and early warnings, resulting in fewer than 50 deaths, compared to over 10 000 deaths suffered in the Odisha cyclone of 1999. Cyclone Amphan 2020, involved coordinated alerts via mobile networks, social media, and community radio, enabling the evacuation of over four million people in India and Bangladesh.

Similarly, the Indian Ocean Tsunami of 2004, serves as a major failure case, where the absence of a regional EWS and coordinated ICT infrastructure, contributed to over 230 000 fatalities. This tragedy led to the establishment of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS), which now includes satellite sensors, ocean buoys, and regional alert networks.

Even slow-onset disasters like the COVID-19 pandemic can showcase the significance of ICTs. Real-time dashboards, such as the Johns Hopkins COVID-19 tracker, AI-based modelling tools, and contact tracing apps played a central role in prevention, mitigation, and recovery. In India, the Aarogya Setu app offered localized alerts, health advice, and contact tracing data to over 100 million users, underscoring how ICT is equally critical for biological and public health emergencies.

Despite these advancements, several global challenges persist. The digital divide, limited ICT infrastructure in least developed countries (LDCs) and small island developing states (SIDS), lack of interoperability due to non-standard systems, ethical concerns regarding data privacy and surveillance, and inadequate local capacity for ICT deployment all hinder progress. Bridging these gaps requires inclusive ICT policies with universal service obligations, stronger public-private partnerships, and the promotion of open-source, interoperable platforms.

Furthermore, integrating indigenous knowledge systems (IKS) with modern EWS designs, and conducting regular community-based simulation drills are essential to improving grassroots disaster preparedness. Building local capacity, and fostering inclusive participation will be key to creating resilient communities.

In conclusion, the integration of ICTs into disaster risk reduction frameworks is essential for enhancing EWSs, improving situational awareness, and ensuring timely communication, particularly in vulnerable regions. While India has made notable progress in leveraging ICT for disaster management, continued efforts are needed to bridge infrastructure gaps, address the digital divide, and promote inclusive, sustainable solutions. Strengthening public-private partnerships (PPPs) and fostering regional cooperation will be vital in building long-term resilience and safeguarding lives during disasters.

References

- **United Nations Office for Disaster Risk Reduction (UNDRR)**. (2019). *Global Assessment Report on Disaster Risk Reduction*. https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019
- **International Telecommunication Union (ITU)**. (2020). *Using ICTs for Climate Change Adaptation and Mitigation*. https://www.itu.int/en/action/climate/pages/adaptation.aspx
- **Japan Meteorological Agency (JMA)**. *Earthquake Early Warning (EEW)*. https://www.jma.go.jp/jma/en/Activities/eew.html
- **National Disaster Management Authority (NDMA), India**. *National Disaster Management Plan (NDMP), 2019*. https://ndma.gov.in
- **India Meteorological Department (IMD)**. *Doppler Weather Radar Network and Cyclone Prediction Models*. https://mausam.imd.gov.in
- **Department of Telecommunications (DoT), India**. *Cell Broadcast Service for Disaster Alerts*. https://dot.gov.in
- **National Remote Sensing Centre (NRSC), ISRO**. *Applications in Disaster Management*. https://www.nrsc.gov.in
- **Asian Disaster Preparedness Center (ADPC)**. *Integrating Indigenous Knowledge in Early Warning Systems*. https://www.adpc.net
- **UNESCO**. (2023). *Community Media for Disaster Risk Reduction*. https://en.unesco.org/themes/community-media/disaster-risk-reduction
- **International Federation of Red Cross and Red Crescent Societies (IFRC)**. *World Disasters Report 2020: Come Heat or High Water*. https://www.ifrc.org/document/world-disasters- report-2020-come-heat-or-high-water
- **UNDP India**. (2021). *Building Resilience through Technology in Disaster Management*. https://www.in.undp.org

A1.2 Drills and exercises for resilience and stress tests

A1.2.1 ORSEC rescue plan initiation (Algeria)[155]

The telecommunication sector of Algeria participates in the various simulations performed by the relevant authorities pursuant to Executive Decree No. 19-59 of 2 February 2019, which, under Article 47, defines the methods for the preparation and management of rescue organization plans, involving all disaster management stakeholders.

Rescue organization plan: The ORSEC rescue organization plan is part of the State's emergency planning and organization measures to facilitate management of natural disasters and other major incidents that cause harm to human life and infrastructure losses. Pursuant to Article 3 of Executive Decree No. 19-59, the purpose of the plan is to deal with any serious incident that threatens property, persons and the environment. The rescue organization plan identifies all the human and material resources that can be mobilized in the event of disaster. It also allows for the organizing, taking, and coordinating of required actions and is organized as follows, depending on the nature and magnitude of the disaster or the resources mobilized:

- national rescue organization plan and interprovince rescue organization plan;
- province rescue organization plan and municipal rescue organization plan;

155 ITU-D Document https://www.itu.int/md/D22-SG01-C-0130/ from Algeria.

- rescue organization plan for sensitive sites.

The rescue organization plans comprise fourteen components cutting across all sectors, the most important being the connectivity and telecommunication component, for which the posts and telecommunication sector assumes responsibility. The officials responsible for this component are to provide means to ensure continuity of telecommunication services for disaster management bodies and the public, as well as the preparation and restoration of telecommunication networks for normal operations as quickly as possible.

Purpose of simulations: The primary purpose of simulations is to assess the preparedness of human and material capacities identified under the rescue organization plan, and to raise awareness of all stakeholders involved in plan components, of associated risks and of how best to deal with them, and how to respond to a disaster and manage its consequences. For the telecommunication sector, the objectives are to:

- test the connection speed of disaster-management command posts for the different satellite and terrestrial telecommunication networks, with a view to providing services necessary to coordinate interventions and crisis management;
- test the continuity of telecommunication service operation and provision to the public in affected areas;
- enhance coordination among the different sector players, such as administrative bodies, public and private operators, including ensuring their preparedness and effectiveness for disaster response;
- train telecommunication workers and relevant teams in disaster management;
- evaluate the efficiency of telecommunication technologies and ensure that they operate properly in emergency situations.

Telecommunication sector participation in simulations: In Algeria, simulations of rescue plan initiation are run annually by the Ministry of the Interior, Local Authorities and National Planning for the 58 provinces, with participation cutting across all sectors, and according to field of expertise. The telecommunication sector participates in these exercises under the supervision of the Ministry of Posts and Telecommunications, and through the involvement of the three mobile operators, the fixed telephone operator, the space telecommunication operator, and the postal operator, as well as in coordination with other public bodies. The simulations in which the telecommunication sector participated during 2022-2023 included in particular:

- an earthquake simulation in the M'Sila province on 29 May 2022;
- a fire simulation in the Bordj Bou Arréridj province on 22 June 2022;
- an earthquake simulation in the Bouïra province on 29 May 2022.

Human and material resources: The effectiveness of telecommunication sector participation in the above simulations owed much to the involvement of all mobile phone operators, the fixed telephone operator, satellite communication operators, and Algérie Poste, as well as the participation of the National Telecommunication Directorate (DTN) in the connectivity and telecommunication component.

With respect to management of sector participation and inter-operator coordination, the Ministry of Posts and Telecommunications dealt with all technical and practical aspects, in cooperation with province directorates, with a view to harnessing the material resources of the various operators as summarized below:

- ATS satellite communication operator: provision of fast-setup fixed very small aperture terminal (VSAT) stations in order to ensure telecommunication services for disaster management centres and command posts, and provision of a mobile VSAT station providing transmission links to mobile phone operators, as well as IP phones;
- Algérie Télécom (AT) fixed telecommunication operator: provision of mobile 4G eNodeB station with built-in power supply and radio relay and fibre-optic links with a Microcell mobile base station;
- ATM Mobilis mobile operator: mobile base station providing 2G, 3G and 4G service with built-in power supply and VSAT antenna, radio relay link with accessories, and portable electric generator;
- WTA Ooredoo mobile operator: mobile base station providing 2G, 3G and 4G services equipped with VSAT station with built-in power supply and radio relay link, and portable electric generator;
- OTA Djezzy mobile operator: mini fixed base station, radio relay link with accessories, and 02 portable generator;
- Algérie Poste: mobile post office offering services to the public to provide liquidity and, in particular, the ability to communicate with relatives by sending messages via the Telegram Web application;
- National Telecommunication Directorate (DTN): VHF radios and Thuraya mobile devices.

In terms of human resources, some 80 people participated in each simulation from different sector players, including representatives of executive, control and regulatory bodies.

Conduct of simulations. Once the rescue organization plan has been put into effect, a fixed command post for all plan components is installed at the province headquarters, and the Director of Civil Protection is instructed to install an operational command post near the disaster site to manage field operations. Subsequently, the Director of Posts and Telecommunications for the province shall intervene, as the official responsible for the connectivity and telecommunication component, in coordination with the parent ministry, and DTN in the following stages:

1) Establish telephone service between the fixed and operational command posts through the use of DTN radios and Thuraya phones.
2) Establish communication via Thuraya phone with the regional directorate of Algérie Télécom Satellite for the installation of VSAT stations at the fixed and operational command points.
3) Establish direct communication with the different operators at the local level for an initial assessment of the condition of the telecommunication network, and to inform them of the rescue organization plan initiation for immediate intervention to provide phone and Internet services, and for immediate damage repair and network restoration.
4) After the initial evaluation, immediately contact via Thuraya phone representatives of the Ministry of Posts and Telecommunications responsible for the rescue organization plan in order to pass on relevant information, and to request their intervention with operators for the provision of all mobile equipment not available at the local level.
5) The province director, as the official responsible for the connectivity and telecommunication component, shall coordinate with local authorities and operators, and oversee all resources made available by them to ensure their use in affected areas.

6) Preparation of a telephone directory by the province directorate, in coordination with the various operators, in order to ensure links with the different components at both the fixed and operational command posts.

7) Prepare a detailed final report on the conduct and various stages of the intervention and any established shortcomings in order to prevent their recurrence.

Conclusion. The participation of the postal and telecommunication sector in the simulations was highly effective and interesting, as it allowed for different tests to be carried out on the day of the simulation, enhanced understanding of the organization and management of the rescue plan, and the gaining of more experience in various aspects, in particular:

- understanding operators' available resources and their preparedness for intervention and installation of equipment;
- enhancing coordination and establishing a complementary relationship between public and private telecommunication operators in disasters;
- strengthening coordination for the provision and exploitation of telecommunication facilities available to various public bodies.

A1.2.2 Effective use of ICT in disaster risk reduction and management training for public employees in Türkiye[156]

The Presidency of the Republic of Türkiye Human Resources Office, responsible for overseeing the training and development of the workforce in Türkiye, coordinates numerous training activities and ensures extensive coordination among institutions. In addition to coordinating face-to-face training and development activities, the Office also offers training and development activities to all public institutions through the Distance Learning Gate (DLG) digital training platform, established on 22 April 2020. DLG has been structured to provide employees with the necessary knowledge, skills, and competencies in order to develop, and is offered free of charge to all employees in public institutions. The platform aims to provide equal opportunity in employee training, foster a learning culture, make employee training more inclusive, improve alignment to emerging skill needs, and increase the quality of training and development activities in public institutions and organizations. The platform offers public employees in both asynchronous (videos, presentations, and interactive content) and synchronous (virtual classrooms or webinars) training options. Public employees can access training activities prepared by experts in institutions that will contribute to their professional development as well as personal development. By the end of August 2024, more than 36 000 trainings were carried out, and 2.7 million public employees participated in these activities. Employees completed over 62 million trainings and earned certifications, with videos viewing adding up to 530 million views. The platform also hosted approximately 10 000 live sessions involving virtual classrooms and webinars. In addition, greenhouse gas mitigation calculation was conducted in cooperation with the Human Resources Office, the Ministry of Environment, Urbanization and Climate Change, and the Turkish Standards Institute. The objective of this study was to identify initiatives aimed at reducing greenhouse gas emissions and assess their contribution on climate change. It was determined that there was a reduction of 280 000 tons of greenhouse gases, which is equivalent to the greenhouse gas reduction provided by 12 278 854 red pine trees in one year when compared with the equivalent in face-to-face training activities.

[156] ITU-D Document https://www.itu.int/md/D22-SG01-C-0344/ from Türkiye.

Training and development activities at DLG were implemented after considering the professional and personal development needs of public employees in various fields. The activities are mainly in 15 training categories in order to enable public employees to keep up with innovations in various fields, generate ideas in the areas of information technologies that will facilitate their work, and acquire knowledge about the legislation they need to know while performing their work. One of these categories specifically focuses on disaster risk reduction and management training to meet the needs of public employees in that field. This focus on disaster training became especially pertinent in 2023, when Türkiye was struck by three major earthquakes centred on the Kahramanmaraş and Hatay districts on 06 February and again on 20 February 2023. The initial earthquakes, with magnitudes of Mw 7.7 in Pazarcık and Mw 7.6 in Elbistan, were followed by a Mw 6.4 earthquake in the Hatay's Yayladağı district. These earthquakes caused extensive damage across 11 provinces, resulting in over 50 000 deaths, the destruction of more than 500 000 buildings, and significant damage to communication and energy infrastructure. Affecting over 14 million people, 16.4 per cent of the total population of Türkiye, these events were among the most severe natural disasters in the country's history, with profound social and economic repercussions. Training for disaster risk reduction and management plays a crucial role in increasing individuals', institutions', and communities' resilience to disasters. Disaster training: i) increases awareness of disaster risks by providing information on potential hazards in their area and the possible impacts of these hazards, ii) offers practical knowledge on how to act in different disaster situations such as fires, earthquakes, and floods, how to reach safety zones, and how to provide first aid, iii) raises awareness on various topics from simple preventive measures to be taken in homes and workplaces before a disaster, to correct interventions during and after a disaster, iv) makes communities more resistant and prepared for disasters, and so speeding up the recovery process after a disaster, and v) provides guidance on how authorities and volunteer organizations can coordinate, ensure information flow, and communicate with the community during disaster situations. Additionally, the trainings to be conducted for public employees aim to contribute to their more effective, conscious, and coordinated performance of tasks such as search and rescue, evacuation, first aid, sheltering, and security in emergency situations. The in-service training programmes structured in this context focus on preparing workers for their role and response in disaster situations. Various organizations offer both face-to-face, and online training sessions to support these efforts and enable public servants to contribute effectively during rescue and relief operations.

Pre-earthquake training activities. In the context of disaster risk reduction and management, a range of disaster preparedness trainings were available on the distance learning gate (DLG) prior to the earthquakes of 6 and 20 February 2023. These trainings, provided in asynchronous video format, allowed public employees to access them at any time and from any location. Table A-1 shows the training titles, the providing institutions, the number of personnel trained, and the number of views.

Table A-1: Summary of Disaster Preparedness Trainings Offered on DLG before the Earthquake

Training title	Providing institution	Number of unique users (up to 6 February 2023)	Total repeated niews (up to 6 February 2023)
Disaster awareness training	Ministry of Interior Disaster and Emergency Management Presidency	482 282	898 672

Table A-1: Summary of Disaster Preparedness Trainings Offered on DLG before the Earthquake (continuación)

Training title	Providing institution	Number of unique users (up to 6 February 2023)	Total repeated niews (up to 6 February 2023)
Disaster awareness training for individuals and families	Ministry of Interior Disaster and Emergency Management Presidency	139 569	228 809
AFAD emergency mobile application	Ministry of Interior Disaster and Emergency Management Presidency	36 476	82 973
Earthquake preparedness and urban transformation awareness training	Ministry of Environment, Urbanisation and Climate Change	4 735	11 850
Total		**537 524**	**1 222 543**

As can be seen in Table A-1, over 500 000 public employees have participated in at least one of the disaster awareness courses offered through the platform.

Post-earthquake training activities. Immediately following the earthquake of 6 February 2023, the Ministry of Family and Social Services responded to requests from personnel working in the field by offering psychosocial support to disaster victims. The Ministry provided both synchronous and asynchronous training through DLG to approximately 15 000 employees scheduled to work on-site. A webinar programme was organized on 22 and 24 February, with 5 223 personnel attending the session on 22 February and 4 879 personnel participating in the session on 24 February.

Webinar content

- Preparation for the disaster zone
- Services in the disaster zone and referral mechanisms
- Psychological first aid
- Ethics and code of conduct in the field

In addition to the webinar programme, the trainings detailed in Table A-2 were provided asynchronously in video format through the DLG.

Table A-2: Summary of psychosocial support trainings offered on DLG after the earthquake

Training title	Date added	Number of unique users	Total repeated views
Supporting employees in disasters and emergencies	15 March 2023	82 232	246 860

Table A-2: Summary of psychosocial support trainings offered on DLG after the earthquake (continuación)

Training title	Date added	Number of unique users	Total repeated views
Reactions in Children after Disasters and Emergencies and Recommendations for Families	15 March 2023	65 909	183 194
Reactions in Adults after Disasters and Emergencies	15 March 2023	95 639	286 672
Grief Reactions in Children and Recommendations for Families	15 March 2023	62 996	201 535
Privacy in Children: Important Considerations During Disaster Periods	18 April 2023	65 837	185 292
Period of Loss and Grief in Adults	15 March 2023	77 086	222 610
Total		**173 399**	**1 326 164**

Table A-2 shows that more than 170 000 public employees have taken part in at least one of the psychosocial support courses available on the platform.

In the context of disaster risk reduction and management efforts, a "Disaster awareness training programme" was developed to target all public employees, and not just a specific group of employees. Initially, a coordination meeting was held with the units responsible for training and development in 17 ministries to discuss the framework and content. Subsequently, a workshop was conducted with designated personnel from each unit to finalize the programme outline. As a result of extensive coordination and efforts, a training programme of an approximately 4-hour duration, consisting of five modules and 61 videos, was made available to all public employees (see Table A-3). This training programme was developed with contributions from seven institutions, including the Ministry of Interior Disaster and Emergency Management Presidency, four ministries, a relevant non-governmental organization, and a university (see the advertisement of the programme: Option 1: Dubbed in English[157], Option 2: Original with English subtitles[158]).

157 https://cbiko.gov.tr/uploads/u/EarthquakeAwarenessProgram_DubbedVersionwithSubtitles.mp4
158 https://cbiko.gov.tr/uploads/u/EarthquakeAwarenessProgram_OriginalwithSubtitles.mp4

Table A-3: Summary of the 'Earthquake awareness' training programme

Training title	Number of unique users	Total repeated views
Module 1: Introduction to earthquake awareness training programme	1 511 581	5 421 630
Module 2: Basic information about earthquakes and the seismicity of Türkiye	1 423 553	4 259 287
Module 3: Preparing for an earthquake	1 341 202	3 689 371
Module 4: What to do during and after an earthquake	1 282 497	3 493 715
Module 5: Guidelines for personnel in earthquake zones	1 260 941	3 318 411
Total	**1 517 844**	**20 182 414**

Each module within the training programme includes assessment tests at the end to evaluate understanding. At the end of the training programme, a survey was completed by 247 611 participants, and the overall satisfaction rate for the training programme was determined to be 96 per cent.

In conclusion, ICT has been used effectively and efficiently in disaster risk reduction and management, achieving satisfactory outcomes. Both synchronous and asynchronous communication technologies have been utilized appropriately in training and development activities according to the needs. As a result of these training and development activities, the public employees who participated in activities in the disaster zone were able to carry out post-disaster processes in a more effective, efficient, and coordinated manner, and the level of awareness of all public employees was increased.

A1.2.3 Measures to ensure the resilience of telecommunications services during monsoon storms and floods (Malaysia)[159]

Malaysia experienced massive floods from 15 December 2014 to 3 January 2015, which many locals described as the worst the country had experienced in decades. More than 500 000 people in the east coast area of Malaysia were affected. States in Kelantan, Terengganu, and Pahang were hit hardest. Tragically, 21 people were killed by the floods. Communication services in the affected areas were inaccessible as telecommunication towers were destroyed or severely damaged. The 2014 floods led the Government of Malaysia, through its agencies, to take urgent steps to ensure communication services remain accessible during disasters in future. Today, early flood warnings are now disseminated via 'SMS blast', a tool for sending bulk messages, to urge people to relocate to safer areas based on weather warnings. Telecommunication infrastructures are considered as critical assets that remain in operation during the floods. The Malaysian Communications and Multimedia Commission (MCMC) and telecommunications

[159] ITU-D Document https://www.itu.int/md/D22-SG01-C-0342/ from Malaysia.

industry players have jointly invested to ensure that communications towers in flood prone areas are flood-proof, through a 'site-hardening' programme.

SMS blast: To increase access to information regarding early flood warnings to the affected public, the Department of Irrigation and Drainage (DID), through the National Flood Prediction and Warning Centre (PRABN), and the National Disaster Management Agency (NADMA) have collaborated with MCMC in disseminating warning announcements through the SMS blast system. As of March 2024, a total of 11 031 430 disaster early warning SMS messages have been sent by mobile network operators (MNOs) and mobile virtual network operators (MVNOs) to the public.

Figure A-14: Image of SMS blast (1)

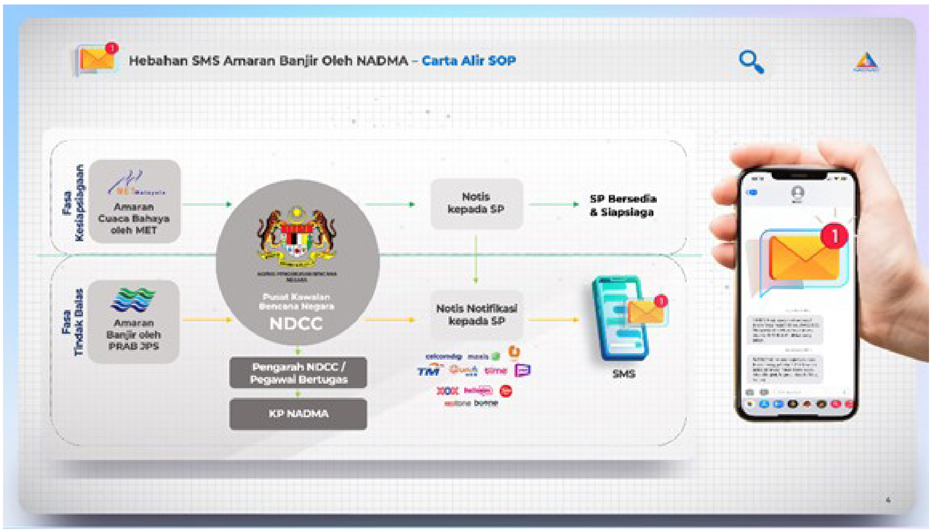
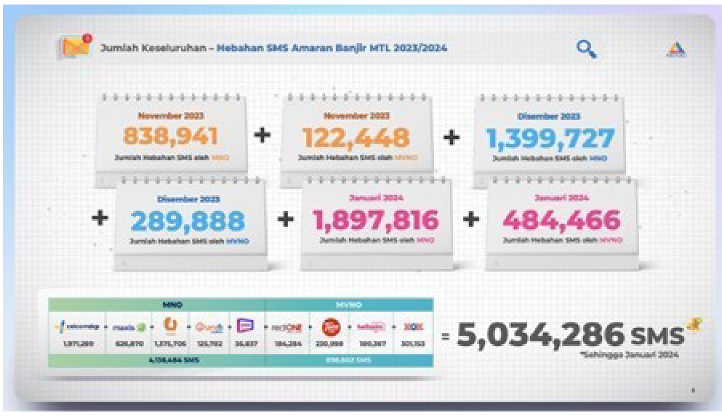


Figure A-15: Image of SMS blast (2)



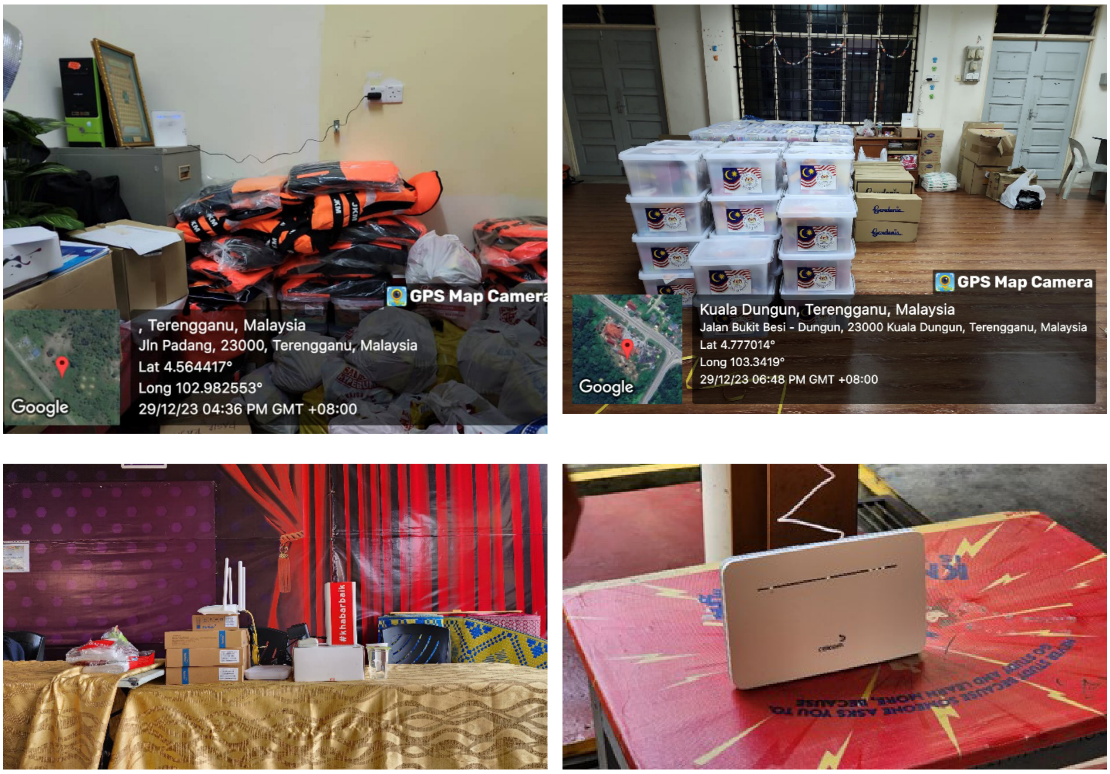
Site hardening: During the major flood of 2014, communications in flooded areas were disrupted by flood damage to telecommunication transmitter structures. As a result, MCMC collaborated with the telecommunications industry to re-design the sites to be more resilient to disasters. A total of 429 telecommunications transmitter structures (towers, etc.) were completed and strengthened by service providers between 2021 to 2024, and this 'site hardening' resulted in a significant reduction in service outages.

Figure A-16: Site hardening

Coverage at temporary placement centres. MCMC monitors complaints from the public on poor quality of service at temporary placement centres for disaster victims. Officers from MCMC State Offices carry out desktop analysis and quality of service (QoS) testing at the centres. In an effort to comfort the victims affected by the flood, the telecommunications company installed free Wi-Fi service at these selected centres to enable flood victims, who have taken shelter, to obtain decent quality Internet and telecommunication access.

From December 2022 to March 2024, a total of 70 temporary placement centres nationwide have benefitted from the free Wi-Fi service provided by the service providers. This initiative shall continue for the coming monsoon season. Some of the criteria for selecting the free Wi-Fi installation initiative were based on the assessment of the quality of service at the relief centres, whether the number of flood victims involved exceeding 200 people, and those relief centres that have a record of being open for more than 72 hours.

Figure A-17: Pictures of a temporary placement centre



A1.2.4 Forest fire prevention (Algeria)[160]

Forest fires are a recurring threat, in particular during summer. They can cause significant damage to biodiversity, the environment, infrastructure and homes. Prevention is therefore necessary to reduce risks and mitigate the impact of forest fires. In this context and in order to promote forest fire prevention, the Ministry of Posts and Telecommunications has launched a national prevention campaign in collaboration with the General Directorate of Forestry and the three national mobile operators and the fixed operator.

Objective of the prevention campaign. The main objective of this initiative is to:

- enhance the security and protection of telecommunication infrastructure in forested areas, and forest fire prevention and protection;
- reduce the risk of, and mitigate damage to telecommunication infrastructure caused by forest fires;
- ensure continuity of telecommunication services in forested areas, even in the event of fires;
- develop a detailed list of GPS coordinates for the various operators' telecommunication infrastructure in forested areas.

Implementation of the prevention campaign. Following the roadmap developed by the Ministry of Posts and Telecommunications, in collaboration with the General Directorate of Forestry, and telecommunication operators, the forest fire prevention campaign was implemented in two phases as follows:

[160] ITU-D Document https://www.itu.int/md/D22-SG01-C-0131/ from Algeria.

Phase I – Organization of field visits. During this phase, field visits were organized in the 39 provinces with forested areas in order to examine all telecommunication facilities located in national forest estates and to:

- verify compliance of telecommunication sites with applicable standards and regulations for forest fire prevention;
- assess the risks of forest fires at these sites and develop appropriate preventive measures to reduce them;
- obtain recommendations and directives from the forestry services on preventive actions to be carried out at each site;
- develop a detailed database listing the telecommunication facilities in forested areas with their geographical coordinates.

In this context, some 780 sites were examined across the various operators, with 586 requiring preventive action to mitigate the risk of forest fires and protect telecommunication infrastructure.

Phase II – Completion of necessary preventive action by telecommunication operators. Following completion of the inspections, which allowed each site to be assessed individually, a list of reservations and directives established by the forestry services was sent to the telecommunication operators concerned, which proceeded to demonstrate a strong commitment in addressing the reservations raised. The work was completed at the beginning of June 2023, and focused for the most part on the following actions:

- establishing a safeguarding bare strip of land between 2 and 25 metres wide that is devoid of any vegetation;
- remove weeds and small shrubbery surrounding telecommunication towers and within and outside sites;
- cut down trees located too close to telecommunication sites in the presence of representatives of the forestry services;
- trim trees surrounding telecommunication site fences and enclosures.

Assessment of the prevention campaign. The campaign proved successful and Figure A-18 and Figure A-19 show the scope of the prevention campaign process, which was carried out at national level and implemented in record time.

Figure A-18: Number of telecom sites

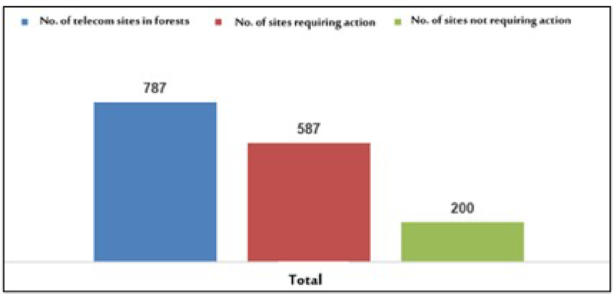
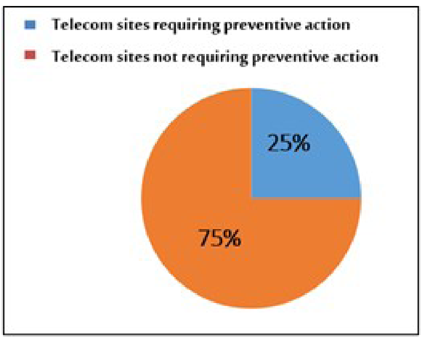


Figure A-19: Number of telecom sites requiring action



Conclusion: The campaign that was launched by the Ministry of Posts and Telecommunications, and implemented by telecommunication operators to prevent fires in areas surrounding telecommunication facilities, was highly successful thanks to the close cooperation with the General Directorate of Forestry. All those that participated in the campaign demonstrated great commitment through persistent efforts to implement the preventive measures identified by the forestry services. For their part, the forestry services expressed great satisfaction with, and appreciation for, the campaign to prevent fires in the vicinity of telecommunication facilities. Furthermore, they acknowledged the efforts of the telecommunication sector and stressed the importance of taking such a proactive approach. Such an approach contributes significantly to reducing the risk of fires, and to enhancing the security of telecommunication infrastructure.

A1.2.5 Practices for enhancing the ability of emergency communication teams, and the level of emergency communication equipment (China)[161]

Background: The occurrence of extreme natural disasters often results in the destruction of telecommunication facilities, leading to regional communication interruption. So, while rapid repair of communication networks is necessary, it is also critical for emergency communication teams to be able to use advanced technology and equipment to temporarily and quickly establish a communications connection. The professional skills and equipment level of emergency communication support personnel, directly affect the quality and efficiency of efforts to rapidly repair and re-establish communications. Over the past few years, the Ministry of Industry and Information Technology (MIIT) of China, have organized various practical activities to improve the skills and equipment capabilities of emergency communication teams. Their purpose was to promote mutual learning and joint improvement among teams, to explore suitable technology and equipment, and to promote their application, and in this way enhance emergency communication support capabilities of emergency communication teams for extreme disaster scenarios.

Practices for improving the capability of emergency communication teams and equipment. China managed to achieve an effective integration of team capability enhancement, and equipment capability improvement, through use of methods such as skills competitions for emergency communication teams, research, and application demonstrations of specialized equipment. These practices involved assessing the theoretical knowledge and operational skills of the national emergency communication support teams, as well as exploring and promoting advanced and applicable technology and equipment for extreme scenarios.

a) Team capability enhancement practices

In 2023, the first nationwide emergency communication skills competition was held, with the aim of comprehensively examining the theoretical knowledge and practical operation proficiency of the support teams. In the long run, it can promote the consolidation of foundational skills, foster mutual learning, enhance collaboration among teams and groups, establish a talent pool for emergency communication support, and improve the national emergency communication support capabilities for extreme events. The skills competition consists of two stages, which are a theoretical examination and a practical operation assessment. The theoretical examination is conducted in a closed-book format on-site, and covers knowledge of management systems, emergency communication, safe operation, and wilderness survival. The practical operation assessment involves on-site timed operations and includes three examination subjects. Subject one involves the activating of public network base station services based on satellite communication, which is used to be rapidly deployed to the scene and provide

[161] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0223/ from China.

public communication services in response to sudden disaster scenarios. The purpose of this subject is to assess the level of proficiency in operating satellite communication equipment, the capability to quickly activate 4G base station services, and the team's emergency response capabilities. Subject two involves the activating of 5G portable base station services based on the bridging capabilities of portable microwave stations, which are used to enhance network coverage in complex geographical environments. The purpose of this subject is to assess the team's capability for on-site equipment assembling and debugging, the capability to quickly activate 5G portable base station services, and the team's physical fitness and resilience to pressure. Subject three involves troubleshooting fibre-optic cable, throwing, and laying fibre-optic cable, crossing an obstacle zone, and fusing optical-fibre, which is used to rapidly build fibre-optic cable connections when ground transmission lines are damaged. The purpose is to assess the team's capabilities for on-site laying of cable while overcoming obstacles, fusing fibre-optic cable, and operating with precision. The skills competition effectively stimulated the enthusiasm of the team members to study and learn professional skills, it examined and helped to cultivate a group of highly skilled and qualified professionals, and served to optimize and improve the talent pool. At the same time, it evaluated the application and level of capabilities of emergency communication equipment, contributing to identifying any shortcomings and issues with the equipment.

b) Equipment capability enhancement practice

Starting in 2021, the MIIT has organized a number of specialized research and development initiatives for emergency communication technology and equipment. To address the specific communication needs of extreme disaster scenarios and address the inadequacies of equipment exposed during typical event responses, specialized engineering directions have been established, such as integrated satellite communication, UAV-based mobile communication, etc. These specialized engineering directions focused on core elements such as equipment communication capabilities, and the environmental adaptability of equipment. This initiative guides collaborative research, development, testing and the application of efforts among industry and university research. The goal is to enhance the consistency and reliability of equipment, and address issues related to engineering transformation and promotion. In 2022, China Academy of Information and Communications Technology (CAICT) carried out an initiative to obtain advanced equipment. To address the communication support needs in scenarios such as earthquakes, floods, forest fires, maritime search and rescue, and nuclear accidents, an open solicitation was conducted to collect both proven mature equipment and prototypes, that focus on solving practical problems in specific environments, that demonstrate advanced technical indicators, significant application effectiveness, and considerable potential for widespread adoption. A comprehensive evaluation of the shortlisted equipment was carried out, leading to the discovery and promotion of a collection of technologically advanced and practically useful emergency equipment. In 2023, MIIT organized an exhibition to display advanced emergency communication technology and equipment. Physical exhibition areas combined with desktop sand tables were utilized. The exhibition areas were set up for different stages of disaster management, including monitoring and early warning, centralized resettlement support, communication support in the case of power and network outage, and support for scenarios of simultaneous road, power, and network disruptions. The exhibition highlighted the integrated application of various support means, including satellite communication equipment, cluster base stations, broadband microwave technology, drones, 'robot dogs', and all-terrain vehicles. The exhibition provided a visual representation of communication support measures and equipment applications in the event of major disasters through static explanations, dynamic demonstrations, case displays, interactive discussions, etc.

Summary. The professional competence and equipment level of emergency communication support teams directly affect the effectiveness and quality of support. It is therefore necessary for teams to conduct regular skill competitions, improve talent pool development, enhance team collaboration, and effectively strengthen the practical comprehensive capabilities. Efforts should also be made to explore advanced and applicable technology and equipment, tackle issues in industrial engineering applications, promote high-end practical equipment, and effectively drive the improvement of emergency communication equipment capabilities.

A1.2.6 Enhancing disaster resilience through telecommunications and ICTs in the small island developing states of the Pacific Ocean (Samoa)[162]

About SAMOA: Samoa is situated in the central South Pacific Ocean, among the westernmost of the island countries of Polynesia. It has nine volcanic islands in its archipelago, four of which, Savai'I, Upolu, Manono and Apolima make up more than 99 per cent of the land. Almost a quarter million people live in the principal capital and villages across the coastal areas. Society in Samoa is centred around the extended family, headed by an elected chief who directs the family's social, economic, and political affairs, and the church, which is a focus of recreational and social life. The economy revolves around fishing and agriculture, and it is vulnerable to cyclones, earthquakes, floods, and disease. Attempts at diversification have met with success. Tourism is growing, thanks to the numerous scenic attractions and fine beaches. Offshore banking spearheads an expanding services sector. Light manufacturing is expanding and has attracted foreign investment. Samoa has a national airline as well as inter-island maritime services. Despite its natural resources and potential for economic growth, Samoa faces several challenges, including vulnerability to natural disasters, climate change, limited market access, and high dependence on imports. The Government is working to address these challenges through policy reforms, diversification strategies, and international cooperation. Regarding telecommunications infrastructure, Samoa is served by fixed lines, mobile cellular services, and satellite services with gateway connectivity.

Statement of the situation or problem: Telecommunications and ICTs are crucial in disaster mitigation, preparedness, response, and recovery. Samoa and other countries bordering the Pacific Ocean witness significant disaster events annually, demonstrating the critical need for resilient disaster communications and management systems in this vulnerable region. These countries, especially SIDS can bolster their preparedness, response, and recovery efforts by harnessing technological advancements. Resilient communication infrastructure, including satellite networks, ensures continuous connectivity during emergencies, and facilitates coordinated response efforts. Strengthening the capacity of local institutions through training programmes and fostering partnerships with regional and international stakeholders further enhances disaster resilience in the Pacific region. By integrating telecommunications and ICTs into comprehensive disaster management strategies, Samoa and Pacific SIDS that are vulnerable to disasters can better protect infrastructure and livelihoods from the impacts of natural disasters. The present report addresses efforts that can be undertaken to enhance disaster resilience through telecommunications and ICTs in Samoa and Pacific SIDS.

[162] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0217/ from Samoa.

Leverage terrestrial and satellite technologies for disaster resilience: Terrestrial and cable technologies are vulnerable to exposure to natural hazards prevalent in the Pacific region. Events such as cyclones, earthquakes, and volcanic eruptions pose significant risks to these infrastructure components, leading to disruptions in communication networks. Moreover, the Pacific island SIDS and territories' remote and dispersed nature presents challenges to the deployment of terrestrial fibre-optic networks across the entire region. Financial constraints further limit the ability of telecommunications service providers to invest in fibre-optic technology, particularly in rural and remote areas. In response to these challenges, there is a growing reliance on satellite networks as vital components of disaster-resilient communication systems in this region. Satellites offer resilience to physical damage, making them ideal for providing crucial connectivity in remote and disaster-prone areas. Satellite broadband networks offer several advantages in disaster scenarios. Portable very small aperture terminals (VSAT) antennas, hand-held terminals, and temporary installations can be rapidly deployed post-disaster to bolster communication efforts. Additionally, satellites equipped with software-defined (SDS) technology enable dynamic capacity allocation in areas of higher need, enhancing network resilience, and supporting emergency response activities. Lastly, satellite backhaul solutions play a critical role in ensuring connectivity in remote regions and serving as backups for critical terrestrial infrastructure. Many Pacific SIDS, territories and other countries already possess significant satellite antenna infrastructure, which can be recommissioned with minimal investment to enhance disaster resilience. By leveraging terrestrial and satellite technologies, Samoa and other Pacific SIDS can strengthen and improve their disaster resilience and ensure continuity of communication during emergencies.

Analysing national experiences and best practices

Capacity building: Governments need to prioritize capacity-building initiatives to enhance disaster management capabilities. One way to do this is to provide training programmes for local institutions and stakeholders involved in disaster response and recovery efforts.

Partnerships and collaboration: Collaborative efforts among governments, regional and international organizations, NGOs, and the private sector are essential. By fostering partnerships and sharing experiences, best practices, and lessons learned, SIDS and countries in the Pacific region can strengthen their disaster resilience. This collaborative approach also facilitates the exchange of resources, expertise, and technologies to enhance disaster preparedness and response. The role of ITU is essential in this collaboration through capacity building and its Partner2Connect (P2C) initiative, which fosters partnerships and resources mobilization for implementing critical telecommunications infrastructure projects.

Regulatory and policy initiatives

Exemptions and streamlined procedures: Regulatory constraints often hinder the rapid deployment of telecommunications infrastructure during emergencies. Governments should implement exemptions from licensing and customs clearance procedures during disaster situations to expedite the deployment of critical telecommunications equipment and technologies. Regulators should consider amending the Telecommunication Acts to provide exemptions from licensing, and type approval requirements to ensure fast deployment of telecommunications infrastructure during emergencies. Streamlined regulatory processes ensure that telecommunications providers can quickly establish or restore connectivity in affected areas without bureaucratic delays.

Investment incentives: Encouraging investment in resilient telecommunications infrastructure requires creating favourable regulatory environments and offering investment incentives. Governments can provide tax breaks, subsidies, or other financial incentives to telecommunications operators and infrastructure providers willing to invest in disaster-resilient networks. Removing regulatory barriers and offering investment incentives in times of disasters can attract private sector investment in disaster-resilient telecommunications infrastructure.

Desired outcomes: In conclusion, the submission proposes a multi-faceted approach to enhancing disaster resilience in Samoa and other SIDS of the Pacific Ocean region, through telecommunications and ICTs. By leveraging terrestrial and satellite technologies, countries can overcome the vulnerabilities of traditional infrastructure and ensure continuous communications during emergencies. Capacity-building initiatives, partnerships, and collaboration among governments, regional and international organizations, and the private sector are crucial for strengthening disaster management capabilities. Regulatory and policy initiatives, including exemptions, streamlined procedures, and investment incentives, are essential for encouraging investment in resilient telecommunication infrastructure.

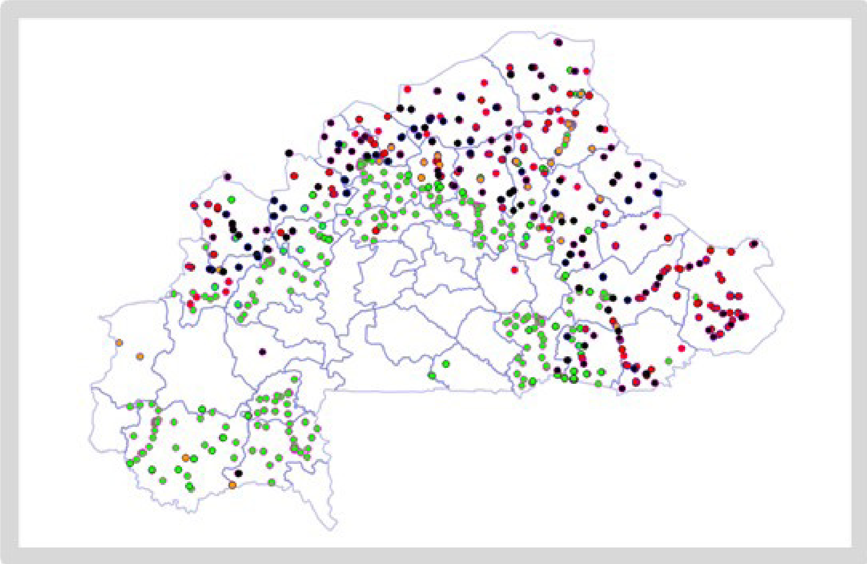
A1.3 Enabling policy and regulatory environment

A1.3.1 Resilience of telecommunication infrastructure in Burkina Faso (Burkina Faso)[163]

Telecommunications infrastructure has become a prime target for armed terrorist groups operating in certain parts of the country. Attacks and acts of vandalism against physical installations and radio sites by armed groups are aimed at isolating people from the affected areas. These attacks are on the rise and pose a challenge to the provision of electronic communications services. Indeed, an inventory of telecommunications services established on 30 June 2022, shows that among the 812 sites identified in insecure areas, 418 were out of service or vandalized. This inventory shows that 11 regions out of 13 were impacted, with strong pressure in the sites of the North, East, North Central, and East Central areas and increasingly the West.

[163] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0052/ from Burkina Faso.

Figure A-20: Situation of sites in insecure areas as at 30 June 2022



This situation has a strong impact on the digital sector and presents many challenges for consumers in the affected areas, but also for public authorities and telephone operators. Consumers in insecure communities no longer have much access to digital services, nor to emergency and security services. Similarly, they face interruptions of financial transactions with mobile money and inaccessibility to social networks. For the State and the public authorities (notably the Regulatory Authority), the consequences of the damage to radio sites and other electronic communications facilities are reflected in the dysfunction of the intelligence services in the affected localities, and in the difficulties in obtaining the cooperation of the population in the fight against all forms of violence. It should also be noted that the efforts of telephone operators to ensure the maintenance of radio sites, and to re-establish radio sites are greatly hampered by the difficulties of access to these infrastructures. Finally, public initiatives to ensure the coverage of white areas through, for example, the universal service fund (USF), are finding it difficult to implement them, further accentuating the digital divide in the country and the isolation of the populations of the localities under the influence of terrorist groups. Aware that the physical isolation and digital isolation of populations in insecure areas constitutes an additional challenge in the fight against armed groups, and with the aim of ensuring the resilience of populations in the face of terrorism, the Government of Burkina Faso has adopted a series of measures, one of which is the re-establishment of electronic communications infrastructure in areas experiencing a high security challenge. The ultimate objective of this measure is to ensure the availability and accessibility of electronic communications to consumers throughout the country. Beyond this objective, it is above all a question of ensuring the continuity of the State throughout the territory. The implementation of this measure is entrusted to a multidisciplinary working group composed of public administrations (Ministry, Regulatory Authority, Defence, and Security Force) and telephone operators established under the auspices of the Ministry of Digital Transition, Posts and Electronic Communications.

Inventory of radio sites destroyed or vandalized

<u>Overview and mapping of non-functional telecommunication sites</u>

The approach consists initially in drawing up an exhaustive and precise inventory of radio sites and telecommunication infrastructures destroyed or vandalized, by mapping for each operator the vandalized sites or non-functional sites. Thus, on the basis of the data collected from the three national telecommunication operators, the total of unavailable sites was estimated at 418 sites on 31 December 2022, as shown in Figure A-21 and Figure A-22.

Figure A-21: Evolution of the number of telecommunication sites out of service due to the security situation 2019-2022

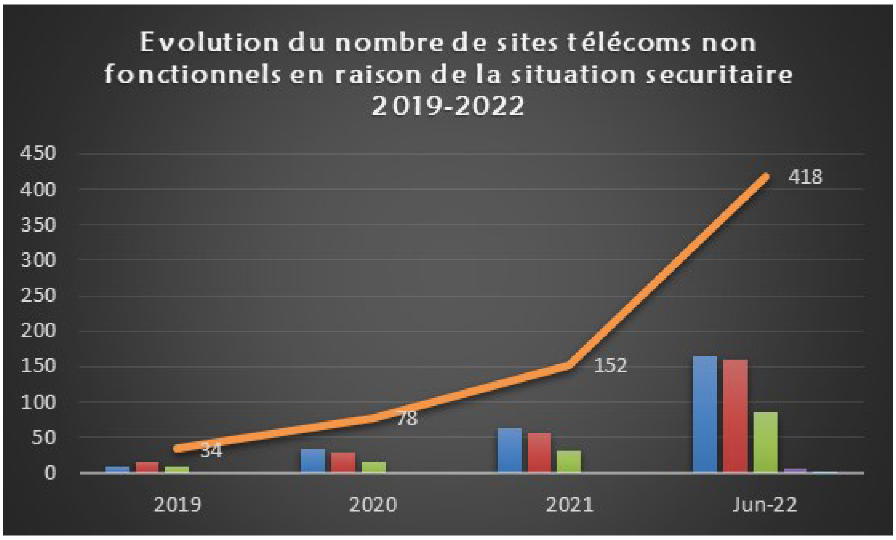
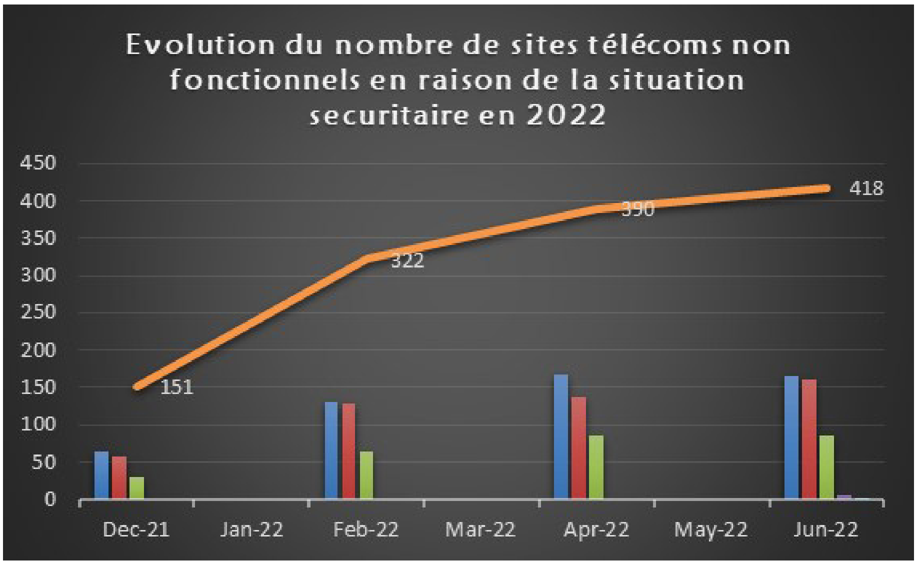


Figure A-22: Evolution of the number of telecommunication sites out of service due to the security situation in 2022



These trends and data lead to the conclusion that the armed groups have a good knowledge of the operators' transport networks and exert strong pressure to isolate the population in the northern and eastern parts of the country.

Identification of criteria for selection of sites for restoration. On the basis of a realistic approach taking into account the constraints on the ground, the Working Group identified criteria for selecting the telecommunication sites to be restored. These criteria are as follows:

- Sites that can be secured during and after service is restored;
- Sites in the vicinity of military camps;

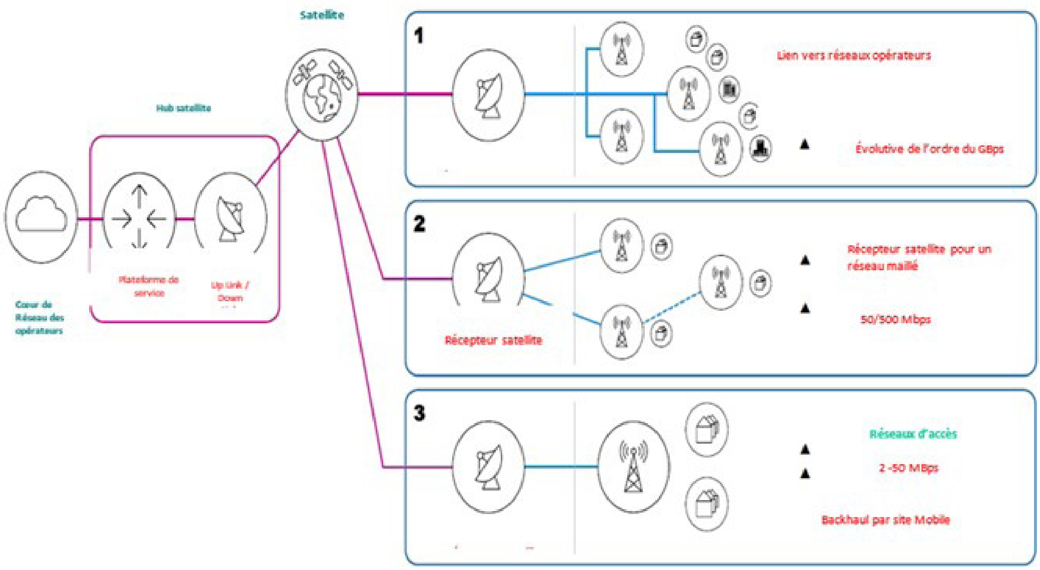
- Sites located in large agglomerations.

In accordance with the above criteria, 50 sites were selected, of which 25 were considered priority sites.

Recovery of selected telecommunication sites

Technology choice: Starting from the security constraints on the ground and the need to ensure the safety of the sites after their recovery, several technical and technological solutions were explored for this purpose. After analysis, satellite solutions were deemed to be the most appropriate in view of the current security situation, and of the network architecture of the telecommunication operators. Specifically, it is a question of creating a satellite hub in the capital at which operators will interconnect their networks. From this hub, each of the 25 sites can be interconnected via satellite links.

Figure A-23: Architecture



Technology solution financial assessment and support details: The estimates collected from operators indicate that the implementation of such a project requires a period of at least 4 months from the choice of the selected service provider outside the time limits linked to the procurement procedures. For financing, a co-investment approach was considered. The costs of repairing all the components of the impacted sites will be borne by the operators involved, while the Government will cover the costs of establishing satellite transmission links through the 'Support Fund for the Implementation of Exceptional Measures in the Electronic Communications Sector.' This Fund is a legal and financial mechanism established by Act n°061-2008/AN of 27 November 2008, regulating electronic communications networks and services. The terms for the use of the Fund were set out in Decree n°2020-536/PRES/PM/MDENP/MINEFID of 30 June 2020, defining the terms for the use of the Fund for the implementation of exceptional measures in the electronic communications sector. According to Article 2, the Government may use the Fund to finance three types of measures, including "measures for the restoration of emergency communications in the event of disasters or crises".

A1.3.2 Strengthening telecommunications against natural disasters (STAND) (Australia)[164]

As in many parts of the world, Australia has experienced a number of extreme weather events in recent years. In the 2019/2020 summer, large parts of the country were affected by severe bushfires following hottest and driest year on record in Australia. These bushfires resulted in loss of human lives; the death or displacement of an estimated 3 billion animals; and the destruction of tens of millions of hectares of land and thousands of properties. Since then, a succession of La Nina weather events has caused significant flooding impacting many communities across Australia over 2022. The flooding has affected the everyday lives of many Australians, with many areas of the country experiencing their wettest year on record. Disasters such as these represent an increasingly significant challenge for the resilience of Australia's telecommunications networks. For example, approximately 1 400 telecommunications facilities were impacted across Australia during the 2019/2020 bushfires, either directly or indirectly. Likewise, during a particularly extreme flooding event in March 2022, along the eastern coast of Australia, approximately 900 telecommunications facilities were impacted. As a result of these major outages, many communities in both instances were left isolated and without any ability to:

- contact their friends, family or emergency services;
- receive emergency warnings from Government;
- access emergency information such as the location of evacuation centres; and
- use payment systems (such as EFTPOS) to purchase essential supplies such as food, water or fuel, or access government financial assistance.

These impacts, especially during an active disaster, can delay response and recovery efforts, put lives at risk, and compound the devastating impact and subsequent trauma experienced by communities.

Australian emergency management arrangements. The Australian Federal Government (the Government of Australia) has an overall responsibility for telecommunications. This includes managing policy and regulatory settings for the sector, as well as providing grant funding to encourage certain activities such as expanding mobile coverage in regional and remote areas. However, the primary responsibility for disaster response sits with State and Territory Governments (eight in total), while the direct operation and maintenance of networks is the responsibility of the telecommunications carriers in Australia. This division of responsibilities means that when a disaster occurs, telecommunications carriers will work directly with the relevant State or Territory Government, in accordance with the emergency management arrangements within that jurisdiction. In this context, the main role of the Government is to help prepare the telecommunications sector to respond to and recover from disasters. In practice, the State and Territory Governments often work with the telecommunications sector to prepare for disasters, and this includes involving telecommunications carriers in emergency planning. Meanwhile, the Government provides broad assistance to telecommunications carriers where necessary to support response and recovery efforts.

For example, during a severe flooding event impacting the northwest coast of Australia in January 2023, floodwaters destroyed a major arterial bridge which held fibre-optic cables in a very remote region, causing major outages on the other side of the river, with many communities being unable to contact emergency services. In response, the Australian Government provided

[164] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0065/ from Australia.

assistance in the form of military aircraft to transport technicians from a telecommunications carrier to the other side of the river. This support enabled the technicians to rapidly repair the fibre-optic connection and restore connectivity.

Figure A-24: Division of responsibilities

Case study: Strengthening telecommunications against natural disasters (STAND) package. The Government of Australia has been strengthening the telecommunications sector against disasters through a range of actions over the past three years. Recognising the serious impact of the 2019/2020 bushfires on telecommunications networks in Australia, the Government has been implementing the 'Strengthening Telecommunications Against Natural Disasters' (STAND) package. The STAND package comprises four key measures:

a) **Mobile Network Hardening Programme**: Upgraded the battery back-up power to a minimum of 12 hours at 461 mobile base stations across Australia to date;

b) **Sky Muster Satellite Service Deployment Programme**: Installed fixed satellite services at 1 086 evacuation centres and emergency service depots across Australia, which can provide free backup connectivity via satellite;

c) **Temporary Infrastructure Deployment Programme**: Expanded the availability of portable assets such as 'cells on wheels', and portable satellite kits which can provide temporary coverage following a disaster; and

d) **Communications Programme**: Developed communications material and other resources for stakeholders to use in an effort to improve general community awareness and preparedness for telecommunications outages during disasters.

The STAND package has had a real impact in improving the availability of telecommunications during natural disasters to date. For example, during the March 2022 floods along the eastern coast of Australia, temporary facilities funded under STAND were deployed to evacuation centres in flood-affected areas across the state of New South Wales, providing critical connectivity for evacuated residents in time of need. Lessons learned through implementation of measures 2 to 4 of STAND (item 1 is still being delivered):

- It is critical to work with emergency services stakeholders to deliver this type of programme. The stakeholders know what services they require and where they need them.
- When deploying multiple services over the entire country, the local (state level) engagement and interest in the programme makes all the difference to a successful programme delivery.
- If possible, co-design the programme with the intended recipients. If co-design is possible then the solutions have the best chance of being useful to the recipients and communities that receive them.

- The Sky Muster satellite service deployment programme has had unanticipated benefits for remote communities who are able to utilise broadband connections at community buildings outside of emergencies.
- Research in the context of Australia has shown there is a clear divide between rural and urban communities in being prepared for telecommunications outages. Rural communities have a greater understanding of and preparedness for telecommunications outages.

Case study: 'Better Connectivity Plan for Regional and Rural Australia': The Government of Australia announced the 'Better Connectivity Plan for Regional and Rural Australia' in October 2022. The Plan includes AUD 100 million in funding for additional measures to strengthen telecommunications resilience against disasters. These measures include:

- Additional funding for further mobile network hardening, such as upgrades to back-up power capacity, transmission diversity, and the physical security of regional mobile network infrastructure;
- New funding for hardening broadcasting infrastructure against natural disasters, to improve the resilience of broadcasting tower sites and ensure that critical emergency information can be relayed to communities in a disaster; and
- Funding for a new 'Telecommunications Disaster Resilience Innovation[165]' Programme, which will fund new, innovative solutions to address disaster resiliency challenges in line with a number of key themes, such as power resiliency, and making greater use of emerging technologies such as satellite, public Wi-Fi and hybrid power generators.

These initiatives will build on the successes of STAND and further improve the resilience of communications networks in Australia against the impacts of power outages and damage during natural disasters.

A1.3.3 Initiatives to improve telecommunications network resilience for disaster risk mitigation and management (Australia)[166]

In 2022, the Australian Government announced the 'Better Connectivity Plan for Regional and Rural Australia', intended to to improve connectivity in regional Australia, and targeting productivity, equity of services, and social and public safety outcomes. The Better Connectivity Plan includes AUD 656 million over five years to improve mobile and broadband connectivity and resilience in rural and regional Australia. This funding includes AUD 100 million for resilience development programmes, such as the **Mobile Network Hardening Programme Round 2** (Case study 1) and the **Telecommunications Disaster Resilience Innovation Programme** (Case study 2).

The Australian Bureau of Meteorology notes in its State of the Climate 2022 Report that climate of Australia has warmed by approximately 1.47°C in the period between 1910 and 2021, which is leading to more heat extremes and fewer cold extremes. It also notes the potential for an increase in the number of dangerous fire weather days, and a longer fire season for southern and eastern Australia[167]. Additionally, the September 2023 Climate Driver Update forecasted warmer and drier conditions across most of Australia from October to November 2023. These findings highlight the importance of a proactive approach to supporting vulnerable and at-risk communities to meet the challenges of a warming climate. A resilient telecommunications

165 https://www.infrastructure.gov.au/media-communications-arts/phone/telecommunications-disaster-resilience-innovation-program
166 ITU-D Document https://www.itu.int/md/D22-SG01-C-0208/ from Australia.
167 State of the Climate 2022, page 25.

network allows for continuity of service during and after a disaster, supporting emergency service responses and economic recovery. The following details two initiatives delivered by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) that are designed to improve the resiliency of Australia's telecommunications infrastructure, and support vulnerable regional communities.

Case study 1: The Mobile Network Hardening Programme: The Mobile Network Hardening Programme (the Programme) was established in response to the 2019/2020 'Black Summer' bushfires in Australia. It provides grant funding for upgrades to mobile network telecommunications infrastructure in regional, rural and remote Australia to build resilience to, and support recovery from, natural disasters. Potential projects are identified by telecommunication industry applicants, based on type of infrastructure, location and threat from natural disaster. The Programme funds upgrades to mobile network telecommunications infrastructure to:

- prevent outages in the event of a natural disaster;
- strengthen the resilience of telecommunications facilities to allow them to operate for longer during bushfires and other natural disasters; and
- enable the rapid restoration of services following an outage.

Resilience upgrades eligible for grant funding under the programme include:

- upgrading power capacity to a minimum of 12 hours at a telecommunications site;
- elevating infrastructure to protect it from floods;
- delivering emergency power solutions to rapidly restore services during or after a natural disaster;
- the installation of redundant backhaul; and
- expanding a protection zone around a site to increase protection from bushfires.

The first round of the Programme (Round 1) was delivered in two stages:

- Stage 1 provided AUD 13.2 million for upgraded battery backup power at 467 mobile base stations.
- Stage 2 provided AUD 10.9 million for 532 general resilience upgrades at mobile base station sites across Australia.
- 60 per cent of the 999 Round 1 projects have been completed (September 2023).

One example of a resilience improvement funded under Stage 2 is a fleet of 29 portable generators spread across depots in the state of New South Wales. This fleet, which is managed by a telecommunications provider, can be quickly deployed from a depot within a radius of 150 kilometres, as circumstances demand.

The second round of the Programme (Round 2) is intended to build upon the outcomes of Round 1. Round 2 is open to telecommunications industry applicants, with up to AUD 16.5 million available in grant funding. For applicants from the telecommunications industry, community input in the identification of suitable projects is facilitated by a 'noticeboard' on the DITRDCA website. The noticeboard allows communities to identify potential areas of risk, or potential projects. In bringing the communications and telecommunications providers together, communities can inform projects included in the telecommunication industry members' applications for funding. Funding for the programme is assessed on a competitive basis according to guidelines developed by DITRDCA after robust public consultation.

Case study 2: Telecommunications Disaster Resilience Innovation Programme: The Telecommunications Disaster Resilience Innovation Programme (TDRI) provides AUD 50 million towards projects that improve the preparedness of telecommunications networks in Australia against rising climate risks, including against an anticipated increase in the frequency and severity of natural hazards in Australia. This is done by:

- supporting and accelerating the development and deployment of innovative, new or emerging technologies that will improve the resilience of telecommunications, particularly in rural, regional, remote or Australian indigenous persons (First Nations) communities;
- demonstrating the benefits of emerging telecommunications technologies in improving disaster resilience outcomes; and
- encouraging greater collaboration and partnerships between industry and government stakeholders on telecommunications disaster resilience matters.

The intended outcomes of the programme are:

- expedited adoption of emerging telecommunications technologies in Australia that will improve disaster resilience outcomes for Australian communities (including through preventing outages and/or supporting the rapid restoration of services following an outage); and
- reduced instances of telecommunications outages during natural disaster events, including reduced instances of communities being isolated and unable to contact emergency services or access other critical services/supports such as disaster financial assistance.

Two rounds are currently open to applications under the Telecommunications Disaster Resilience Innovation Programme: the 'Power Resilience Round', and the 'Innovation Round'.

Power Resilience Round: This round (AUD 30 million) will fund solutions that strengthen the resilience of telecommunications against the impacts of power outages. It concentrates on three focus areas:

1) Stand-alone, off-grid power solutions:
   - Proposals that involve the development or deployment of innovative, place-based power solutions at existing telecommunications infrastructure sites or facilities that will remove (or substantially reduce) the exposure and dependence of these sites or facilities to the energy network/mains power supply.
   - This may, for example, include stand-alone or hybrid power systems that combine a mix of renewable and non-renewable energy generation sources with energy storage to provide additional power resilience than could otherwise be provided by a standard battery or generator alone.
2) Deployable power solutions:
   - The development or acquisition of new, innovative portable power solutions that can be rapidly deployed to restore power to at-risk telecommunications infrastructure sites or facilities following a disaster-induced disruption to the mains power supply.
   - This may, for example, include solutions that provide a greater, longer lasting power supply, are more rapidly deployable, and/or are more readily able to access hard-to-reach telecommunications infrastructure sites or facilities relative to existing solutions.
3) Energy efficient telecommunications infrastructure:

- The development or deployment of innovative, place-based solutions that will reduce the energy consumption of telecommunications infrastructure sites or facilities, for the purpose of reducing power draw to increase the effective operational longevity of the backup power supply during natural disasters.
- This may, for example, include installing energy efficient equipment such as cooling and transmission equipment or other equipment, to optimise network load and reduce overall energy consumption in a natural disaster.

The Innovation Round: This round (AUD 20 million) will fund innovative technologies to improve the resiliency, redundancy, and availability of telecommunications during and after a natural disaster. The three focus areas targeted in the Innovation Round are:

1) Deployable telecommunications solutions:
   - The development or acquisition of new, innovative and portable telecommunications facilities that can be rapidly deployed to restore connectivity for disaster-impacted communities.
   - This may, for example, include new solutions that address or overcome existing barriers to deployment of portable telecommunications facilities such as by being more rapidly deployable and/or readily able to access hard-to-reach locations or offer greater coverage relative to existing solutions.
2) Satellite connectivity:
   - The development or deployment of new or innovative satellite-based technologies, or using existing satellite technologies, such as geo-stationary satellites, in an innovative way, to provide critical telecommunications resilience and/or redundancy.
   - This may, for example, include place-based solutions that involve the installation of long-range public Wi-Fi with satellite backhaul at emergency locations such as evacuation centres to provide additional redundancy, or portable solutions that make use of satellite connectivity for a similar purpose.
3) Enhanced situational awareness:
   - This focus area is seeking to support projects aimed at improving situational awareness of telecommunications and power outages for emergency management purposes. These projects may involve improved monitoring, data collection and sharing between relevant entities to improve visibility of outages and restoration priorities.
   - This may, for example, include the development of automated and real-time monitoring and reporting solutions to seamlessly collect and share outage data with relevant entities to inform emergency response and recovery efforts.

Conclusion: These initiatives will build on the successes of current programmes and further improve the resilience of communities in Australia against the impacts of power outages and damage during natural disasters. The Government is committed to developing a resilient telecommunications network. Feedback is sought through various channels, which allows for continuous improvement of these services, particularly as new technologies enter the market.

A1.3.4 Policy for emergency communication and equipment used in flood prevention and rescue (China)[168]

Extreme natural disasters and their impacts: Many kinds of natural disasters occur in China, including floods, hailstorms, droughts, typhoons, earthquakes, geological disasters, low

[168] ITU-D Document https://www.itu.int/md/D22-SG01-C-0215/ from China.

temperature freezing and snow disasters, sandstorms, forest and grassland fires, and marine disasters, etc. Disasters in 2021 and 2022, respectively affected 107 million and 112 million people respectively, resulting in direct economic losses of CYN 334.02 billion and CYN 238.65 billion[169, 170]. Henan province in July of 2021, and Beijing and Hebei province in August of 2023, suffered extreme rainstorm disasters, which caused traffic, communications and power problems. These extreme conditions resulted in difficulties for the communications force to get into the disaster area. At the same time, poor natural conditions, large numbers of rescue teams, and intensive temporary public settlements meant that transferring information was difficult, communications among agencies were blocked, and communication requirements in some areas were suddenly increased.

Requirements for emergency communications are described as follows:

- Supervising risks and releasing early warning information, which are carried out before the disaster.
- Understanding how disasters impact command organizations and requesting rescue operations for the public.
- Emergency communications, including utilizing emergent mobile communication means to set up communication channels quickly.
- Supporting emergency response, including providing smooth communications for command organizations on site, emergency rescue teams, mass resettlement sites, and important agencies.

Policy for emergency communications. In China, the Ministry of Industry and Information Technology (MIIT) organized and coordinated China Telecom, China Mobile, China Unicom, China Satcom, China Tower, and other agencies to carry out communications support operations. There were a number of tasks to be carried out, and these included recovering public communications networks, and providing emergency communications in the event of a disaster. 32 national emergency communications teams with emergency communications equipment were created with the telecommunications enterprises. In recent years, the emergency communications ability of China has been enhanced by establishing special projects to enhance the level of emergency communication technology and equipment. This task was supported through the policy imposed by the fourteenth five-year plan for scientific and technological innovation in the field of public safety and disaster risk prevention and reduction[171]. Tasks included researching and developing equipment suitable for investigating disaster situations and decision-making, and of researching and developing integrated modular, lightweight, highly integrated, and easily built emergency communication technology equipment. Another task involved collecting and popularizing disaster response emergency communication technology and equipment. Solutions and advanced equipment for emergency communication were embraced, creating the necessary bridge between the supply side and demand side. By mobilizing social forces to solve key and difficult communications problems, and disseminating tasks among the various telecommunications agencies, national communications capabilities in extreme conditions were improved. A target of the initiative was to enhance the capability of collaboratively carrying out

[169] Basic situation of natural disasters in China in 2021 https://www.mem.gov.cn/xw/yjglbgzdt/202201/t20220123_407204.shtml.

[170] Basic situation of natural disasters in China in 2022 https://www.mem.gov.cn/xw/yjglbgzdt/202301/t20230113_440478.shtml.

[171] The 14th five-year plan for scientific and technological innovation in the field of public safety and disaster risk prevention and reduction https://www.most.gov.cn/xxgk/xinxifenlei/fdzdgknr/fgzc/gfxwj/gfxwj2022/202211/t20221110_183375.html.

emergency communication support for flood prevention and disaster risk relief. To this end MIIT organized and stimulated cross-enterprise collaboration, which included sharing transfer lines among operators, recovering network connectivity based on regional divisions among operators, dispatching emergency communications teams and equipment across provinces, sending warning messages and safety tips to the public, providing mobile phone maintenance services, and delaying shutdowns due to arrears for the affected public.

Communication technology and equipment used. The following technology and equipment were used in flood prevention and disaster relief actions in recent years, and remarkable success were achieved. In the stage of reporting the disaster situation, and especially when the public network connectivity was down, Tiantong satellite mobile phones were used to call or send messages to the command centre. This helped the public to report the disaster situation and helped command to clarify the rescue goals. In the early stages of repair and recovery of the public network, UAV based mobile stations were used to cover the disaster areas from the air. During the rainstorm disaster in Henan in 2021, large fixed-wing UAVs equipped with mobile communication base stations and private network communication base stations, flew for 4.5 hours to the disaster area, and served customers in areas extending to 50 square kilometres. During the rainstorm disaster in Beijing and Hebei in 2023, middle hybrid-wing UAVs equipped with mobile communication base stations, took off vertically and hovered for eight hours at altitude, covering 30 square kilometre areas. In addition, portable backpack base stations were taken into the disaster site and activated, serving tens of customers. In the emergency response stage, portable satellite terminals worked with mobile communication base stations, and vehicle-borne emergency communication systems, and provided connectivity for large numbers of customers, including the public in settlement shelters, commanders, rescue teams, and vital agencies.

Measures for the future: Faced with the risk of increasingly frequent disasters brought about by global climate deterioration, the Government of China is promoting the following agenda to improve the resilience and rapid recovery ability of communication facilities.

- Revising and improving the technical requirements and constructional standards of communication infrastructures according to the disaster grade.
- Promoting operators to upgrade and co-construct mobile communications superstations by improving the disaster resistance level of communication rooms, increasing the means of transfer, and extending backup battery support time.
- Developing, equipping, and reserving more advanced communication equipment, and especially deploying satellite terminals independent of ground networks in areas prone to frequent disasters.
- Conducting skills competitions among emergency communications teams, and more frequent collaborative drills and exercises across enterprises and agencies, to promote the skills and collaborative capabilities to respond effectively to extreme disasters.

A1.3.5 Use of telecommunications for disaster risk reduction and management in the Democratic Republic of the Congo[172]

Natural disasters such as floods, landslides, and volcanic eruptions exacerbate fragilities in the Democratic Republic of the Congo by degrading the already insufficient infrastructure and poor living conditions of the population. The events of recent years, caused by climatic hazards

[172] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0198/ from Democratic Republic of the Congo.

creating major floods and landslides, as well as the eruption of the Nyamulagira volcano, have resulted in significant loss of life and livelihoods. It is therefore imperative to limit the damage caused by such natural disasters by fully involving the local community in all disaster prevention processes. It is at this level that ICTs play an indispensable role in informing the public of the risks of impending disasters, before and during the disaster, and in enabling the continuation of economic and social activities after the disaster. Thus, in the interests of reducing the risk of natural disasters, the Democratic Republic of the Congo has set up:

- The Congolese Environment Agency (ACE), which is responsible for the environmental and social assessment of activities which may comprise environmental risks prior to the submission of a project, and for monitoring of their implementation.
- The National Disaster Risk Reduction Platform "PFN-RRC" is responsible for preventing new risks, reducing risks and finally managing residual risks.

Best practice: The use of ICTs is an effective tool for ensuring the transmission of information especially in times of crisis.

Overview of disasters in the Democratic Republic of the Congo: Natural disasters due to climate change and poorly planned urbanization have impacted a number of towns in the Democratic Republic of the Congo. Such natural disasters include river erosion and landslides in Bukavu, repetitive flooding in some parts of South Kivu, the volcano in North Kivu, earthquakes and house fires, resulting in loss of life and livelihoods. In the Democratic Republic of the Congo, floods have become common events in recent years, often resulting in landslides. Between 2020 and 2021, the country experienced 21 episodes of catastrophic flooding with severe consequences for the population and the economy. Poor urbanization, inadequate water drainage systems, and poorly constructed housing located on floodplains increase the country's vulnerability to climate-related shocks. Floods often spread diseases through contaminated drinking water and by creating mosquito breeding sites, which in turn lead to epidemic outbreaks of cholera and malaria. Floods also cause damage to already severely inadequate infrastructure and further increase the cost of transportation which accounts for 11 per cent of the consumer price index (CPI). Below is a list of just some of the disasters recorded from 2021 to date in the Democratic Republic of the Congo:

- In 2021, in the Kalehe territory of South Kivu, rivers flooding and exiting their beds, led to floods, mudslides and rockslides in a number of villages, causing 411 deaths, 54 people injured, over 3 000 houses and 6 schools destroyed, 30 unaccompanied children identified, and nearly 5 000 missing people.
- Also in 2021, the flank of Mount Nyiragongo erupted, causing lava flows towards Goma about 20 km south to Goma International Airport. This catastrophic eruption, similar to the eruption in 2002, led to 8 000 refugees in Rwanda, 15 people dead, 117 missing children; and 150 children separated from their families, as well as several hundred destroyed houses.
- In 2023, at least 15 people died, as well as 2 missing, and 9 seriously injured while 5 houses were completely destroyed in the city of Bukavu as a result of a landslide caused by heavy rains and unplanned urbanization.
- Also in 2023, more than 300 people died, and nearly 4 500 people disappeared in the villages of Nyamukubi and Bushushu in South Kivu as a result of erosion.
- In February 2024, devastating floods impacted the Democratic Republic of the Congo by overflowing the Congo River to a level not seen in 60 years. More than 2 million people, 60 per cent of them children, are in need of humanitarian aid.

It should be noted that, almost every year, the Democratic Republic of the Congo experiences deaths, subsistence losses, infrastructure destruction, floods, landslides, erosions, and volcanic eruptions.

Government involvement in disaster risk management: The role of the Government of the Democratic Republic of the Congo in reducing and managing the risks of natural disasters is to establish a regulatory framework to enable the evaluation of the various projects or activities that may have an impact on the environment, and also to monitor their implementation. These include:

- Article 22 of Ordinance-Law No. 23/007 of 03/03/2023 amending and supplementing Law No. 11/009 of 0907/2011 on fundamental principles relating to the protection of the environment stipulating that any project shall be certified after the assessment and approval of the environmental and social impact study, monitoring its implementation as well as environmental monitoring by the public establishment, – Congolese Environment Agency, ACE in acronym;
- Decree No. 14/019 of 02/08/2014 establishing the rules for the operation of environmental protection mechanisms as defined in Chapter 3 of the above-mentioned law;
- In accordance with ITU Resolution 71 on national disaster risk reduction strategies, SADC member countries have adopted a model of the national strategy for the implementation of a national emergency telecommunication plan in each State;
- The Democratic Republic of the Congo through the Ministry of PTNTIC and the regulator (ARPTC) is working on the road map for the implementation of the national emergency telecommunications plan based on the SADC national strategy model;
- From the use of ICTs in disaster risk management, the regulator "ARPTC" issues green numbers to the police and approves free promotional offers (voice, SMS and Data) to ensure the availability of communications during the mitigation, response and recovery phase of disaster risk management.

The Democratic Republic of the Congo perspective on disaster risk reduction and management: According to the IMF 2022 p4 report, the Democratic Republic of the Congo is the second most likely country to receive climate shocks and the eight most vulnerable country to the effects of climate change. Therefore, in view of the risks of disasters caused by heavy rains, poor urbanization, volcano eruptions, etc., the regulator (ARPTC) and the Ministry of Posts, Telecommunications, and New Information and Communication Technologies "PTNTIC" needs to put in place a plan to respond to these disaster risks, comprising:

- A multisectoral steering committee consisting of the regulator (ARPTC), ministries and other actors involved in disaster risk reduction and management;
- A national emergency telecommunications plan with accompanying measures;
- An alerting system including the Ministry of PTNTIC, the regulator (ARPTC) and other actors involved in disaster management;
- Green numbers that can be used make emergency calls in the event of a disaster;
- ARPTC should facilitate agreements that allow customers to use other people's networks in case of emergencies, ensuring that people can always communicate in the event of network disruption or overload during the period of risk;
- ARPTC should develop guidelines on the temporary location of antennas and faster approvals to replace sites damaged during crises; and
- Conduct a study to assess and analyse the contribution of ICTs in disaster management.

Conclusion: The use of ICTs is an effective and essential tool in reducing and managing the risks caused by natural disasters. Stakeholders in the digital ecosystem should ensure the availability of emergency telecommunications and support cooperation in this area, by implementing the strategy of the natural disaster risk response plan described above, in order to address all stages of disaster management, such as alerting, response, relief operations, and the updating of telecommunication networks before, during, and after disasters.

The purpose outlined here is to apply collaborative regulation with all institutions and agencies involved in the field of natural disasters.

A1.3.6 National emergency telecommunication plans: Catalysts and guarantees (Republic of the Congo)[173]

The following are policy proposals that integrate the management of personal data into the use of ICTs for mitigating and managing disaster risks:

- Protection of data and privacy: Put in place strict rules to ensure that personal data collected as part of disaster management operations are protected against all forms of unauthorized access, disclosure and misuse.
- Educated consent: Ensure that citizens give educated and explicit consent for the collection and use of their personal data in disaster management, by providing them with clear information about how their data will be used and protected.
- Data anonymization: Promote the use of data anonymization techniques to minimize the risk of personal data disclosure while simultaneously enabling the authorities to access the data gathered so that they can make educated decisions on disaster management.
- Limited retention period: Limit the retention period for personal data collected as part of disaster management operations, and ensure that all such data are deleted or anonymized once no longer required for operational purposes.
- Transparency and rendering of accounts: Require full transparency regarding the manner in which personal data are collected, used and shared as part of disaster management activities, and require the rendering of accounts in the event of any violation of privacy or data security.

The following are examples of policy proposals that States and telecommunication regulators could consider adopting to facilitate the use of telecommunications/ICTs in disaster risk reduction and management:

1) Development of emergency and business continuity plans: Draw up detailed plans to ensure the continued availability of telecommunication services during disasters, including the allocation of additional resources and the adoption of rescue procedures.
2) Investment in resilient infrastructure: Encourage telecommunication operators to invest in robust infrastructure with built-in redundancy, such as disaster-resilient telecommunication towers and secure data centres.
3) Promotion of network interoperability: Develop rules and protocols allowing for efficient interoperability between telecommunication networks to facilitate communication and coordination between different government agencies and disaster relief organizations.
4) Use of emergency communication technologies: Encourage the adoption of technologies, such as SMS alerts, disaster warning applications for mobile telephones, survival radios and social networks, for disseminating key information and safety instructions to affected populations.

[173] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0145/ from Republic of the Congo.

5) Training and awareness-raising: Put in place training programmes for telecommunication operators and local authorities on the use of communication technologies in the event of disaster, and conduct public awareness-raising campaigns to inform citizens about the methods of emergency communication available.
6) Regular tests and simulations: Hold regular simulation exercises involving telecommunication operators, government agencies and disaster relief organizations to evaluate the efficacy of emergency plans and identify areas for improvement.
7) Integration of ICTs in disaster management systems: Use ICTs to improve the collection, analysis, and dissemination of disaster-related data to support educated real-time decision-making.
8) International coordination: Reinforce international cooperation and coordination in the area of disaster management by exchanging best practices, information, and resources with other countries and with international organizations.
9) Put in place strict rules to ensure that personal data collected as part of disaster management operations are protected against all forms of unauthorized access, disclosure, and misuse.
10) Data anonymization: Promote the use of data anonymization techniques to minimize the risk of personal data disclosure while simultaneously enabling the authorities to access the data gathered so that they can make educated decisions on disaster management.

These policies are designed to enhance the resilience of telecommunications infrastructure and improve the ability of governments and populations to cope with disasters through the efficient use of ICTs.

A1.3.7 Predictive and proactive approach for efficient preparedness and response to disasters and developing resilience of telecommunication infrastructure (India)[174]

Background. Telecommunications play a very important role during disasters, starting from the alerting of populations likely to be affected prior to a disaster, through to rescue and relief activities post disaster. India has shifted its approach to dealing with the disasters, from reactive to predictive. In recent times, the Government of India through the Department of Telecommunications, has proactively played a role both prior to, and during disasters to support relief activities pre- and post-disaster. Proactive disaster preparation and effective disaster response strategies were showcased during a number of major disasters over the last decade, such as Cyclone Fani (April, 2019), Amphan (May, 2020), Tauktae (May, 2021), Cyclone Biparjoy (June, 2023), and Michaung (December, 2023), etc.

Enabling policy and regulatory environment

- The Government of India has setup an institutional framework for ensuring a proactive approach towards disaster management, and to ensure a collaborative approach among different Government departments at both local and State level. The National Executive Committee (NEC) was created, and is responsible for the coordination and monitoring of the disaster management process. In addition to the Union Home Secretary, members of the committee include a Secretary from each of the Ministries and Departments with responsibility for agriculture, atomic energy, defence, drinking water, environment and forests, finance (expenditure), health, power and rural development, science and technology, space, telecommunications, urban development, water resources, and the Chief of the Integrated Defence Staff.

[174] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0208/ from India.

- The National Telecom Disaster Co-ordination Committee (NTDCC) and the Digital Communication Commission were created in 2017, and members include telecommunication service providers, and officials from the Ministry of Home Affairs and the National Disaster Management Authority.
- Collaborative partnerships were established in all States. The State Telecom Disaster Coordination Committee (STDCC) was constituted in 2017, and in all the States comprises officials of the Department of Telecommunications (DoT) and of State Government to ensure better coordination pre-disaster and post disaster.
- Collaborative partnerships with various agencies, power distribution companies, and port authorities were established. Field war rooms and restoration teams were formed in each district, along with implementation of the intra circle roaming (ICR) system, ensuring uninterrupted communication. ICR provides connectivity to the public through latching onto the best signal available of any telecommunications service provider (TSP), even if the signal of an individual's telecommunications service provider is not available.
- To enable ICR during a disaster all TSPs have guaranteed roaming arrangements and there is a memorandum of understanding (MoU) among the TSPs to facilitate roaming within the 'State/Circle' during disaster events. Orders are issued by Government, to enable roaming for certain number of days and to ensure the continuity of telecommunication services during disasters.
- In the response and recovery phase, real-time assessments, and coordination with local authorities and the National Disaster Response Force (NDRF) facilitated prompt repairs. Critical success factors included early alerts, ICR implementation, coordinated efforts with the State Government, and an effective EWS (EWS). Challenges, such as restoring power supply amid logistical difficulties, were addressed through a comprehensive approach.
- Standard operating procedures (SOP) outlining actions for all six elements of disaster management (prevention, mitigation, preparedness, response, rehabilitation, and reconstruction) have been issued. The following is the link of SOP issued by the Department of Telecommunication (DoT): (https://dot.gov.in/sites/default/files/2021_01_06%20SOP-2020%20DM.pdf?download=1)
- Field war rooms and restoration teams were formed in each district. In the response and recovery phase, real-time assessments and coordination with local authorities and the National Disaster Response Force (NDRF) facilitated prompt repairs of telecommunications infrastructure.

Recent success stories

- The swift and effective response to the Silkyara Tunnel collapse demonstrated a successful coordination with telecommunications service providers (TSPs) to enhance network connectivity through the deployment of 'small cells', that ensure communication in challenging environments. A telephone exchange was established at the site and a line was extended inside the tunnel, through which trapped workers could communicate with their relatives. Despite encountering difficulties, cell sites were installed at 'Hill Top' and provided connectivity to the various agencies involved in rescue operations.
- In October 2023, a lake burst resulted in extensive damage to the telecommunications network in Sikkim. The 'cell on wheels' (CoWs) system was mobilized, and intra-circle roaming was activated immediately. In addition, very small aperture terminals (VSAT) terminals were mobilized to provide immediate connectivity in the areas where the terrestrial network was down due to a fibre-optic cable cut.
- During sudden floods in Himachal Pradesh, major routes to a number of districts were flooded and the fibre-optic network of almost all TSPs was down in the districts of Kullu and Manali. Intra-circle roaming (ICR) was activated immediately to support the general public, relief and rescue operations, and restoration activities. Taking stock of the situation, large-scale restoration was initiated to restore telecommunications connectivity. A communication group was formed in which officials of licensed service areas (LSAs), TSPs,

State Government, NDMA were present. Drones were also used to restore fibre-optic connectivity where roads were damaged.

- Coordinated and special efforts have been made to ensure the continuity of telecommunication services and the maintenance of additional load during a number of train accidents in the remote locations.

Success story of the recent Cyclone "Biparjoy" June 2023

- During Cyclone Biparjoy, a proactive approach was adopted to predict the impact of the cyclone on telecommunication services in selected districts of Gujarat. In anticipation, intra circle roaming (ICR) was activated based on the predicted path of the cyclone.
- Preparations encompassed early alerts, meetings, and the establishment of a communication group for coordinated efforts. Collaborative partnerships were forged with telecommunications service providers (TSPs), district management, and power distribution companies.
- The support extended by the State Government, coupled with leadership from licensed service areas (LSAs), significantly fortified overall response efforts. Mobile network availability was sustained for both disaster response agencies (DRAs) and the public during Cyclone Biparjoy.
- Gujarat LSA played a proactive role in fostering collaboration and coordination with District Management officials. This included facilitating the smooth movement of TSPs and arranging for fuel supplies in case of power failures. Coordination with the Gujarat State Disaster Management Authority and other state government authorities, including power distribution companies, ensured priority power supply restoration at critical sites for TSPs.
- Meetings were conducted with State authorities, and direct communication was established with the managing director of PGVCL, a power distribution company, in order to fully convey the gravity of the situation and so obtain the necessary support.
- Gujarat LSA maintained coordination with government agencies responsible for disaster response, ensuring seamless information sharing and mutual support during and after the cyclone. The proactive measures and collaborative efforts undertaken by the authorities were crucial in mitigating the impact of Cyclone Biparjoy and ensuring the uninterrupted functioning of telecommunication services.
- The efforts of the Department of Telecommunications (DoT) and telecommunication service providers (TSPs) were appreciated by the State Government of Gujarat.

Conclusion: Previously, the focus was primarily on response and rehabilitation post-disaster, however a significant paradigm shift has occurred with India now channelling its efforts towards mainstreaming disaster management of telecommunication infrastructure. This shift includes the adoption of a proactive, predictive approach to ensure the continuity of telecommunication services for both rescue and relief forces, and the general population. This strategic shift has led to a more effective handling of disasters, contributing to the preservation of lives.

During Cyclone "Biparjoy", despite the fact that it was of great intensity and lasted for two days even after landfall, zero causalities were reported, and the telecommunications network was restored within in a short span of time. Key factors in managing the cyclone efficiently included:

- Sensitizing field units beforehand.
- Activation of roaming among telecommunications service providers (TSPs) beforehand, ensuring continuous telecommunications coverage despite network disruptions.
- Timely and targeted early warning messages to keep the public informed and prepared.

- The State Telecom Unit of the Department of Telecommunications, led in active collaboration and coordination with State Government and district officials.
- Identification of district nodal officials from various agencies, ensured a seamless coordination in disaster response efforts.
- Proactive support was provided by the State Government in facilitating the activities of TSPs, arranging fuel supplies, and prioritizing power restoration at critical sites.

A1.3.8 Enhancing regulatory and licensing policy to ensure resilience through telecommunications and ICTs in disaster prone areas (Brazil)[175]

Statement of the situation or problem: In the face of natural and man-made disasters, terrestrial communications networks are often severely damaged and their services disrupted. Land-lines, mobile towers and antennas are often destroyed and cannot be used by for emergency services. Satellite networks, being unaffected by conditions on the ground, have the capability of restoring connectivity in an immediate manner wherever the need arises, and thus play an essential role in disaster response. Satellite communications rely on limited ground-based communications systems and are therefore almost independent of terrestrial infrastructure. Their global coverage can ensure full network functionality, performance, and service within the entire area affected by a natural disaster, whatever the scale, increasing the effectiveness of emergency services. The rapid deployment of satellite networks is an additional key factor that enables the restoration of communications within record time. Another important feature of satellite systems that contributes to resilience, is their redundancy. Satellite networks can comprise overlapping coverage so that if one satellite fails, another can takeover. For example, multi-orbit solutions allow low Earth orbit (LEO), medium Earth orbit (MEO), and geostationary Earth orbit (GEO) satellites to combine their respective strengths and so increase the capacity, reliability and speed of the satellite network.

Satellite broadband networks are not susceptible to damage from disasters, because the primary repeaters are on spacecraft and not part of the ground infrastructure. Hand-held terminals, portable very small aperture terminal (VSAT) antennas, and temporary fixed installations can all be introduced into a post-disaster environment to provide support to relief and recovery efforts. For example, satellite telecommunications equipment was deployed very quickly, due to relaxations in type approval and marketing access licensing, in Republic of Mozambique and Republic of Zimbabwe after the severe devastation caused by Hurricane Ida in 2019. The hurricane hit Mozambique, and the city of Beira, before striking Zimbabwe and Malawi. Hurricane Ida caused devastating floods, killed or injured thousands of people, and damaged crops, houses and roads. Over 2.6 million people were affected across the three countries, with most of the districts being almost completely cut off. All terrestrial communications infrastructure was destroyed. Satellite telecommunications equipment was sent to the devastated areas where telecommunications were most needed for the coordination of response efforts on the ground. By harnessing such technological advancements, disaster prone countries can bolster their preparedness, response, and recovery efforts. Resilient communication infrastructure, including satellite networks, ensures continuous connectivity during emergencies, facilitating coordinated response efforts. Strengthening the capacity of local institutions through training programmes, and fostering partnerships with regional stakeholders further enhances disaster resilience. By integrating telecommunications/ICTs into comprehensive disaster management strategies,

[175] ITU-D Document https://www.itu.int/md/D22-SG01-C-0361/ from Intelsat US LLC, Brazil.

disaster prone countries can better protect infrastructure and livelihoods from the impacts of natural disasters.

Analysing national experiences and best practices. Regulators should take into account the general objectives of their telecommunications regulatory framework which will always include "connectivity and emergency assistance." Policy needs to be developed that encourages investment in infrastructure and the promotion of innovation and of regulatory predictability in times of disasters and emergencies. Major steps are as follows:

- Abolish satellite landing rights in times of emergencies. This means that an authorized satellite Earth station network operator can deploy space segment services without restrictions as to where that supplier might be authorized or licensed.
- Make changes to the way authorizing the provision of communication networks and services, during times of disaster or emergencies, is carried out. This allows authorization requirements for individual licences to be wavered in order to obtain a general temporary authorization by notifying the authorities.
- Provide clear conditions for type approval of radio equipment, and its market placement, in order to facilitate quick access to markets in times of emergencies and natural disasters. This would enable predictability of the application review timeframe, and so help operators plan for deployment (adoption of a default approval of the application if the regulator does not respond within certain timeframe, could be considered).
- Ease the processes of doing business. The licensing and authorization processes could be streamlined and simplified, and where possible provide a single window for the licence application and the entire set of approvals requirements.
- Enable an online licence application process. Allow online licence applications, this will the ease the workload, provide easy tracking, and save time.

Desired outcome: A multi-faceted approach is required for enhancing disaster resilience in disaster prone regions through telecommunications and ICTs. By leveraging both terrestrial and satellite technologies, countries can overcome the vulnerabilities of traditional infrastructure, and ensure continuous communication during emergencies. The aim of this multi-faceted approach is to embrace equipment blanket licensing, and where possible, exemptions from licensing and free circulation in times of emergency, and also remove the need of service licensing to embrace "registration" and so reduce costs to end users. As new satellite systems begin to provide service, blanket licensing also allows for scaled solutions that should aim to streamline licensing of satellite Earth stations as much as possible.

A1.3.9 Using telecommunication/ICT to reduce and manage disaster risks (Burundi)[176]

As science and technology are increasingly being applied to reduce uncertainty regarding health and environmental risks, ICTs have come to be used in disaster risk management primarily before, during and after events. Today, ICTs play a significant role in communications both by helping to prevent dangers and also by facilitating requests for assistance in the event of a disaster risk linked to climate change.

History of disaster risks in Burundi between 2014 and 2021: Burundi is no stranger to the effects of climate change, having experienced a lasting drought in the northern and central provinces, widespread desertification following environmental degradation (caused by deforestation and

[176] ITU-D Document https://www.itu.int/md/D22-SG01-C-0029/ from Burundi.

a population explosion), riverbank erosion in Bujumbura, repeated flooding in some areas, landslides, earthquakes, forest fires (also affecting residential and other infrastructure), and epidemics. On the night of 9 January 2014, floods which occurred to the north of Bujumbura, in the Gatunguru district resulted in a number of fatalities, with 182 people injured, 1 100 homes destroyed and a further 900 homes damaged. On 20 December 2019, in Uwinterekwa, the Cari and Nyabagere rivers broke their banks, and the resultant flooding caused considerable damage, including deaths, injuries and the destruction of homes. The same area was again hit by flooding in March 2020.

Role of stakeholders in disaster risk management. The Government of Burundi assists in the coordination and implementation of material support, including the provision of food, medicines, and drinking water. Burundi Red Cross has launched and implemented programmes aimed of preventing and alleviating suffering in communities throughout the country. The organization uses the "model household" approach to community development, in which emergency care is one of the pillars that contributes to the transformation and changing of household behaviour. The Ministry of Solidarity, Social Affairs, Human Rights and Gender, oversees the distribution of food and other forms of support.

Other State actors and non-governmental organizations, such as the World Food Programme, the International Organization for Migration, the United Nations Children's Fund, etc., have made significant contributions to support disaster-related risk management. ICTs are the primary means of communication, making use of, among other things, mobile telephony, the Internet, social networks such as WhatsApp and Viber, Freephone numbers, and radio broadcasts, in addition to weather reports broadcast on television.

Study findings. The findings of the study are as follows:

- The integration of ICTs into disaster risk management in Burundi has two main benefits: it facilitates a speedier response through the use of EWSs at each stage of crisis management (communications, decision-making, resource dispatch), while at the same time minimizing damage (human and material), saving as many lives as possible, and making it easier for victims to call for help. Thanks to ICTs, information can be communicated rapidly, and responders can ensure that they are prepared to act immediately when required.
- ICTs enable victims to request help from various services.
- ICTs enable individuals to use social networks to share information with public and private media, thereby facilitating rescue operations.
- Lastly, the use of numbering resources (freephone numbers) and emergency call centres to request emergency assistance from the police, the Red Cross, or the local authorities helps to limit the damage caused as much as possible.

Conclusion: When used correctly to share information, ICTs can help reduce the risks and impact of natural disasters. While challenges remain, ICTs are an essential tool for improving the efficiency of disaster and climate change management.

A1.3.10 Action plan for COVID-19 including cooperation with related organizations (Senegal)[177]

DAANCOVID 19: a citizens' initiative that puts digital at the heart of the fight against the pandemic

[177] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0053/ from Senegal.

When the first case of COVID-19 appeared in Senegal on 2 March 2020, the President of the Republic assessed the potentially disastrous consequences of the virus and adopted strong measures to protect citizens and limit the spread of the disease in Senegal. The population was committed behind the Head of State to participate in the response against COVID-19. Beyond the immediate health emergency, COVID-19 was having a negative impact on people. In this context, digital technology, the main growth lever for the national economy, and the third presidential initiative of the 5-3-5 five-year programme, played a key role in managing the crisis. The private sector led by the Organisation of Information and Communication Technology Professionals (OPTIC), and the Ministry of Digital Economy and Telecommunications, jointly implemented a digital response plan, called DAANCOVID 19, to support the Ministry of Health and Social Welfare in its fight against the COVID-19 outbreak. Under the co-chairmanship of the Ministry of Health and Social Welfare (MSAS), the Ministry of Digital Economy and Telecommunications, and the DAANCOVID 19 citizens' initiatives committee, the project supported any digital solution that would enable efficient and effective management of the fight against COVID-19. The Senegalese private sector formed part of the national solidarity movement to support the actions of the President of the Republic in the fight against the COVID-19 pandemic, and also in the accompanying measures to support the economy.

The aim of DAANCOVID 19, which brought together the best digital resources in the country on a voluntary basis, was to contain the COVID-19 pandemic in Senegal through the employment of digital technology. The initiative was organized around five sub-committees, which were coordinated by a technical committee, which in turn was led by a steering committee. These sub-committees, led by working groups, were composed of experts from various companies and industry sectors, working in unison, and applying their expertise to achieve the following:

- Communications: to ensure continuous, engaging, reliable and proactive communication with the public, the medical profession, patients and the DAANCOVID 19 team;
- Management, steering, and decision support: to ensure optimal management of patients and medical resources;
- Analysis, follow-up, and research: to provide information for decision-making and prediction in the case management;
- Legal expertise: to ensure legal compliance with regard to processing, and declaration of data and information;
- Digital solutions: to federate, pool, organize and standardize the most relevant digital solutions in the fight against COVID-19.

To achieve the ambitious goal of "zero cases of COVID-19 in Senegal", an action plan composed of six key points representing the major issues defined in collaboration with the Ministries of Digital Economy and Telecommunications and that of Health and Social Action, was implemented:

- Inform, by sensitizing the population through all possible digital channels;
- Manage and optimize, making optimal use of the country's health resources;
- Be proactive, anticipate the control of the spread of the COVID-19 pandemic;
- Harmonize and rationalize by centrally controlling the digital response in order to make it more effective;
- Respect the laws and regulations concerning personal data and digital sovereignty;
- Address non-health aspects.

After almost three months of activities, DAANCOVID 19 had presented a very satisfactory first assessment with a number of major achievements, and concrete results:

- The establishment of a single, free 1919 number for the rapid handling of calls by the alert unit.
- The reinforcement of awareness through massive use of digital messaging through all information channels.
- Management and optimization of health resources through the deployment of applications that automate the management of healthcare records, stocks of personal protective equipment (PPE) products, etc.
- The deployment of tools to help control the spread of the pandemic through the implementation of advanced analysis solutions such as a consumer mobile application.

The initiative counted more than 450 active professional volunteers, from Senegal and elsewhere, engaged 24/7 in the fight against COVID-19, the common enemy.

Other digital platforms to fight or mitigate the COVID-19 pandemic:

- The establishment of the official website of the Republic of Senegal, which enables taking a number of steps online regarding the COVID-19 vaccine: Citizens can apply for a vaccination certificate, register to be vaccinated, or request a conversion from the old vaccination certificate to the new Smart Health Card (SHC) certificate.
- The establishment of a platform called "Together against COVID-19" to provide answers to citizens' questions about the COVID-19 coronavirus.
- The diaspora registration support platform, called "FORCE COVID-19 - DIASPORA", this digital system complements the previous paper system which remains valid. The service is accessible on any type of terminal through a browser. It has been designed for ease of use by people with disabilities.

A1.3.11 COVID-19 Response Plan in Côte d'Ivoire (Côte d'Ivoire)[178]

The first case of COVID-19 was detected in Côte d'Ivoire on 11 March, 2020, but the Government had already convened a crisis committee to manage the risk of contagion and the spread of the disease. The Ministry of Health and Public Hygiene set up a vast programme called the **"COVID-19 RESPONSE PLAN"** encompassing all aspects for limiting the spread of the disease, ranging from prevention, and medical care to post-medical follow-up.

A1.3.11.1 Elements of the National Response Plan

The implementation of this programme was, among other things, focused on a major media campaign, and screening for COVID-19. These two actions were based on the use of digital content, and the means of communications used by populations, health professionals, and parties involved in the fight against the pandemic.

The awareness campaign: An awareness campaign consisting of advertising inserts but also of digital communications was initiated. Social networks and a number of websites disseminated information about the COVID-19 pandemic. The government information and COVID-19 prevention website http://info-covid19.gouv.ci/ provided real-time information such as the

[178] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0116/ from Côte d'Ivoire.

number of new cases, recoveries and deaths, government news updates during the crisis, and global statistics on the pandemic, etc.

Figure A-25: Information website for COVID-19

Awareness was also raised through television and radio broadcasting, which was used because it remains more accessible to populations in the country. The awareness campaign aimed to inform people about the best actions to take, the symptoms of the disease, the locations of screening centres, and also the commissioned toll-free contact numbers to call in case of suspicion of infection.

The toll-free numbers: Toll-free numbers 101, 125, and 143 were made available to the public for COVID-19 pandemic-related information and rapid support. The same was also true for the numbers 113 and 1366, which could only be used for short messages (SMS) but which, on the other hand, incurred some costs.

All these toll-free numbers were made accessible regardless of the network of the national telecommunications operator used.

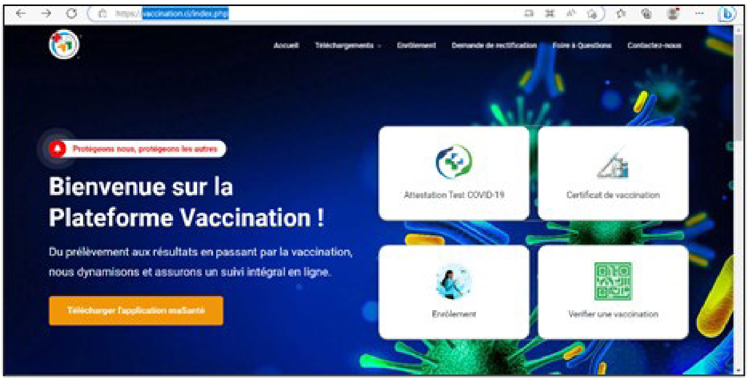
The use of digital tablets by health workers for COVID-19 screening: The COVID-19 screening teams of the National Institute of Public Hygiene (INHP) were made up of teams based in screening centres, and of others belonging to mobile units that could go directly to individuals to perform nasopharyngeal swabs. In terms of logistics, the entire district of Abidjan, and the towns throughout the country, had screening centres and medical treatment cells. These amounted to 14 screening and collection centres and sites, 116 rapid intervention teams (RRT) carrying out nasopharyngeal swabs, and approximately 6 000 teams of 5 people (30 000 people) forming mobile units. All of these resources were equipped with connected tablets for recording the data collected.

The digital tablets were connected either to the Wi-Fi of the screening centre or medical centre, or using to pocket Wi-Fi obtained from the mobile telecommunications operators. In addition, the application used by the tablets to collect digital data was set up by the Ministry of Health and Public Hygiene.

All collected information was transmitted to a data centre for processing. Data processing was entrusted to SAH Analytics International, an external service provider acting under the supervision of the State (Prime Minister's office and Ministry of Health). It should also be noted that this structure had its own cloud, thus guaranteeing the protection and confidentiality of the personal data of all persons sampled.

The MA SANTÉ.CI website and application

Figure A-26: Website of MA SANTÉ.CI



The website is quite complete and gives access to several platforms allowing the results of the COVID-19 tests, the vaccination certificate, the follow-up of the vaccination process, as well as the verification of the validity of a vaccination to be obtained. In addition, there is the "MASANTE. CI" (*MY HEALTH*) application which has the same functionalities as the website, and which can also be downloaded on the mobile phone. Access to this platform is only possible from a code communicated to the person during the COVID-19 screening or vaccination process.

A1.3.11.2 A practical case: COVID-19 screening

The physical screening: The Pasteur Institute of Côte d'Ivoire (IPCI) operates as the reference laboratory. All nasopharyngeal samples taken by the National Institute of Public Hygiene (INHP), and all samples taken in the screening centres were sent to the Pasteur Institute. From 2020 to 2022, approximately 2 000 000 tests were carried out with processing times of 48 to 72 hours. Apart from the sampling and laboratory analysis which are done physically, the rest of the process, from registration, to the transmission of the results of the people tested, can be carried out by means of ICTs (online or on personal mobile phones).

The process until the results are obtained: Conveniently, nasopharyngeal samples could be taken anywhere in the territory, and the data was then instantly recorded in the system using a connected tablet, which generated an enrolment code at the end of the enrolment process. This code was noted on the sample, along with the patient's name. From this moment, a health worker with a batch of pre-printed neutral codes in the form of "QR codes", and an encrypted (8 to 10 digits) code, matches the patient's data to one of these codes, which then becomes the code of the person tested, and this code is physically given to him in the form of a sticker. The process is the same for the mobile units that come directly to people's homes to take samples.

Figure A-27: Screenshot of a sticker

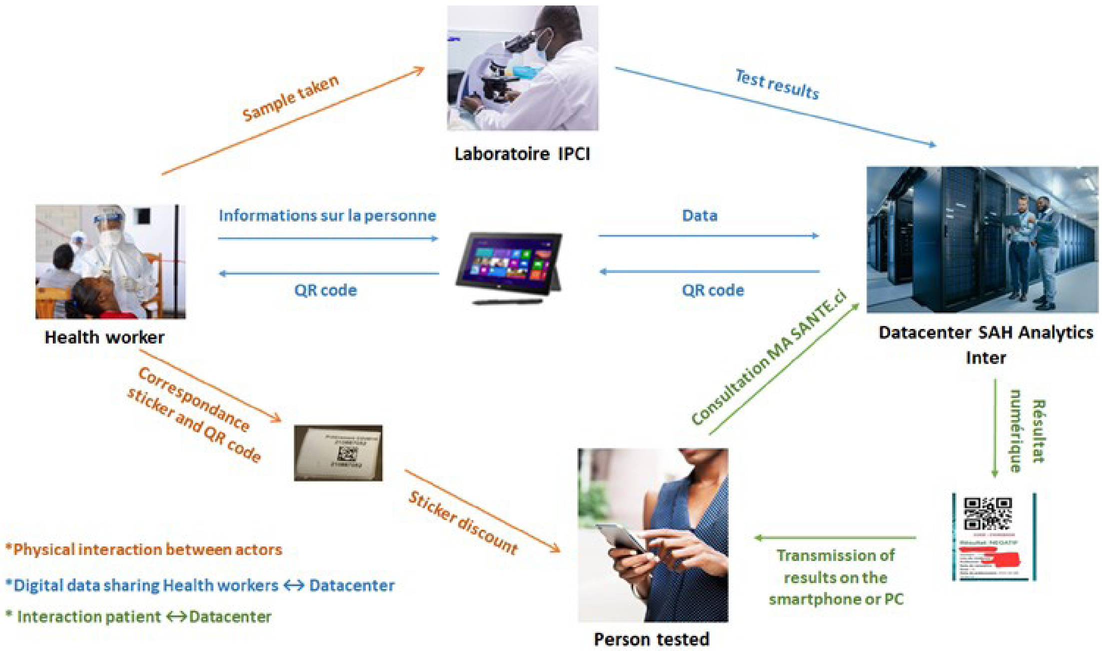
The sticker comprises the encrypted QR code, so that the person tested can consult his results on the platform and scan or print the test result. The person tested can also check the test result on his/her smartphone using the MA SANTÉ.ci application.

Figure A-28: Screenshot of a test result

The person tested also receives on their communicated mobile number, an SMS informing them when the results of the COVID-19 test are available.

Conclusion: The use of telecommunications/ICTs for disaster risk mitigation and management played a significant role in helping people to avoid risk of exposure to contagion through otherwise repeated physical attendances at COVID-19 testing centres and health centres. Such initiatives could serve as a textbook case for the management of other types of disasters. However, such initiatives require good coverage and easy access to telecommunications services.

Figure A-29: Scheme of the process



A1.3.12 Single emergency number 112 (Romania)[179]

112 is the European emergency number, available free of charge, 24/7, anywhere in the European Union. Citizens can dial 112 to reach emergency services, including the police, emergency medical services, and the fire brigade. While you can still use your country's individual emergency numbers, 112 works in all European Union Member States, as well as in Republic of Albania, Georgia, Republic of Moldova, Iceland, Republic of North Macedonia, Montenegro, Principality of Liechtenstein, Norway, Republic of Serbia, Confederation of Switzerland, Türkiye, and the United Kingdom. 112 became the single European emergency number in 1991[180]. The European Electronic Communications Code ensures that in Europe, you can contact 112 from any phone, wherever you are, for free. In Romania, two decades ago, 112 replaced the individual numbers 955, 961, and 981 that could be called to reach the specialized response agencies, contributing to the efficient, coordinated, and collaborative management of dangerous situations nationwide and saving lives. 112 has been for 20 years the single emergency number in Romania, during which time over 300 million calls have been handled by the Special Telecommunications Service (STS) call-takers. Since 2004, the 'Single National Emergency Call System' has proved to be a simple, efficient, and fast method for alerting the emergency services. 112 is now the unique number for emergency calls, which can be called from all public telephone networks in Romania. Calls are answered 24/7 by operators and, depending on the type of emergency, callers are then transferred to specialist response agency dispatchers, who conduct a competency-based interview, and assign and alert responders. Calls can be answered and handled in several international and national minority languages.

Legal framework and the functioning of the 112 emergency service in Romania: The establishment of the 112 system in Romania involved developing normative acts[181] and inclusion in government strategies and policies. The system introduced the single emergency number 112 across public fixed and mobile networks[182]. The Ministry of Research, Innovation and Digitalization oversees its coordination, while the Special Telecommunications Service (STS) manages its operation and maintenance. The Romania National Authority for Management and Regulation in Communications (ANCOM), establishes obligations for fixed and mobile operators and assesses contraventions. According to data provided by the Special Telecommunications

[179] ITU-D Document https://www.itu.int/md/D22-SG01-C-0321/ from Romania.

[180] Additionally, European Union legislation (the 2018 European Electronic Communications Code, 2019 Accessibility Act) requires equivalent access to emergency services for people with disabilities. Several solutions are currently in use in different European countries, including total conversation, relay services, SMS, Real-time Text (RTT), smartphone applications etc.

[181] Law no.398 of June 14, 2002, for the approval of the Romanian Government Ordinance no.18/2002 on the functioning of the Single National Emergency Call System (SNUAU); Romanian Government Decision no. 227/2003 on the approval of the conditions for the installation, operation, maintenance of the Single National System for Emergency Calls (SNUAU), as well as for the establishment of an activity besides the Special Telecommunications Service, financed entirely from own revenues. Romanian Government Ordinance no. 81 of July 14, 2005, for the amendment of para. (2) of art. 7 of Government Ordinance no. 18/2002 on the functioning of the Single National System for Emergency Calls; Romanian Government Decision no. 1.118 of 22 September 2005 on the designation of the specialized structures of the Romanian Gendarmerie and of the specialized unit of the Romanian Information Service as specialized intervention services; Order on the implementation of the Single National System for Emergency Calls, no. 112/07.04.2005 (Official Gazette of Romania, Part I, No. 312/13.04.2005).

[182] There are four location methods implemented in Romania (AML, APEL 112 mobile application, Geolocation and Cell ID/Sector ID) all of which are complementary to each other, but none of them is infallible. For this reason, when a user calls 112, he must provide as many details as possible regarding the emergency location. Cooperation with the STS operator and emergency agency dispatchers is especially important to determine the place where intervention is required. https://sts.ro/en/noi-reglementari-pentru-imbunatatirea-localizarii-apelurilor-la-112/.

Service (STS)[183], from 2004 until the present day, the percentage of non-emergency calls has dropped from over 90 per cent to under 50 per cent. By integrating new technologies and standards, including advanced location methods, the 112 system in Romania has become a model of best practices for other European countries. In 2023, of the 10 489 979 calls to 112, 53.82 per cent were emergencies, while 46.18 per cent did not require intervention from emergency agencies such as the ambulance service, police, Emergency Situations Inspectorate (ISU-SMURD), or the Gendarmerie[184].

Table A-4: Statistics of 112 calls

Statistics regarding 112 calls in Romania[185]			
Year	Total number of calls	Emergency calls	Non-emergency calls[186] (Calls that did not require the interven-tion of agencies such as Ambulance, Police, Emergency Situations Inspecto-rate (SMURD)
2023	10 489 979	53.82 per cent	46.18 per cent
2022	10 248 377	57.82 per cent	42.18 per cent
2021	10 337 426	59.27 per cent	40.73 per cent

Most calls were forwarded to ambulance services (49.29 per cent), with police (24.01 per cent) and Emergency Situations Inspectorate ISU-SMURD (18.76 per cent) also receiving significant portions. The distribution of calls, by responsible institutions, including other response agencies involved in managing such cases, is presented in Table A-5:

Table A-5: Distribution of 112 calls

The distribution of 112 calls in Romania according to the responsible institutions[187]	
Specialized response agencies	Transferred calls percentage
Ambulance	49.29 per cent
Police	24.01 per cent
ISU-SMURD (Emergency Situations Inspecto-rate)	18.76 per cent
Gendarmerie	5.85 per cent
Other agencies	2.10 per cent

The Call 112 app, available for free, automatically transmits a caller's location to the 112 system. If offline, users can manually provide their coordinates. Another solution, Geolocation 112, involves receiving an SMS link to send location coordinates to the system. Most of the calls

[183] 112, 20 years in Romania, February 11, 2024, https://sts.ro/ro/112-de-20-de-ani-in-romania/.
[184] 112, for 20 years in Romania, February 11, 2024, https://sts.ro/en/112-de-20-de-ani-in-romania/.
[185] Official data taken from the Special Telecommunications Service (STS) in Romania.
[186] In Romania, falsely informing the authorities is punishable by the legislation in force (OG 34/2008) by imposing fines between 400 EUR and 800 EUR, or by performing 200 to 400 hours of community service.
[187] *112, for 20 years in Romania*, February 11, 2024, https://sts.ro/en/112-de-20-de-ani-in-romania/.

under the responsibility of the 112 service, received throughout last year, were forwarded to the ambulance service.

New innovative tools for 112 caller location identification in Romania: In Romania, 112 call location information is currently determined through radio cell coverage and, where possible, global navigation satellite system (GNSS) functionality on smartphones. Cell-ID based location data is available for most calls but is often imprecise, covering large areas, while advanced mobile location (AML) is used for about half of the calls to improve accuracy, depending on the handset and technology. In 2023, the Government of Romania introduced an emergency ordinance[188] to improve location accuracy for 112 calls. This measure, developed by the Ministry of Research, Innovation and Digitalization (MCID), in collaboration with the Special Telecommunications Service (STS), and the National Authority for Management and Regulation in Communications (ANCOM), introduces new localization methods. The normative act follows the steps initiated by the Emergency Ordinance no. 48/2023[189] regarding some measures in the field of the 'single national system for emergency calls', which for the first time requires the implementation of several technical solutions at the level of European emergency services, in order to improve the localization of calls to the emergency number 112. Additionally, the ANCOM decision revises regulations to support multimedia emergency communications via IP-based services. After 2027, disabled end-users' access to emergency services will be available using voice, text, video, and other media in real time, improving communication during emergencies.

Expected changes in the context of the 2G and 3G switch-off: The technical changes take place in the context of the 3G and 2G networks switch-off, complementary to the development of 4G and 5G networks, which use IP technology to transmit data. These technical changes will facilitate the use of new technology to retrieve 112 calls and the corresponding location information, for calls initiated from new generation networks. Improvements in terms of the interconnection provided by the ANCOM decision, will be felt as soon as the new location solutions, established last year through primary legislation, for mobile calls initiated from 2G/3G/4G networks, are implemented at national level and also through the use of IP-based IMS technology. To obtain the most accurate location information, the user should have a smartphone type device with access to Internet services. Access of persons with disabilities to emergency services will also be ensured under conditions equivalent to those enjoyed by other users. Interconnection based on circuit-switching will be used as a backup solution for a time, until at least the full migration of emergency call transmission to the new technologies is completed.

New legal requirements: The decision revising the regulations on communications to the Single National System for Emergency Calls (SNUAU) also establishes a new obligation for mobile operators. Mobile operators must twice a year, transmit to ANCOM, a statistical situation appraisal of the terminals connected to the network, the first by 30 June, and the second by 31 December. The mobile operators should transmit each statistical situation appraisal specifying the names of the manufacturers, the names of the terminals, and the versions of the operating systems of the terminals (to the extent that the provider has access to the version information), as well as certain capabilities of the terminals. This statistical information will be used for analysing the dynamics of the types of terminals on the market that are capable of handling specific

188 *New measures to improve the 112-caller location information*, May 26, 2023, https://sts.ro/en/noi-reglementari-pentru-imbunatatirea-localizarii-apelurilor-la-112/.

189 GOVERNMENT OF ROMANIA, EMERGENCY ORDINANCE no. 48 of May 26, 2023, regarding some measures in the field of the single national system for emergency calls, https://sts.ro/fodidin/uploads/2023/10/81fc86cb4bfa8700.pdf.

location methods, which are generally advanced mobile location (AML), or assisted global navigation satellite system (A-GNSS).

Challenges: The challenges associated with these upgraded technical requirements for emergency services stem from the very context of an important change, namely that of the phasing out of 3G and subsequently of 2G networks, while spurring the development of 4G and 5G networks. This change to new generation networks incurs among others, a complex series of social and economic adjustments, and users should be prepared to move on to new devices and services, and to associated new opportunities, including greater accuracy in emergency location information. Information campaigns tailored to reduce user reluctance concerning new technologies should be initiated, as well as education programmes aiming to help people overcome the digital literacy gap when migrating to the new terminals. Of course, as a prerequisite, the connectivity of new generation networks should be at least as widespread as that of the old networks, and handsets with the new functionalities should be available at an affordable price. From the experience of Romania, user reluctance can be mitigated by comprehensive information campaigns. Such information campaigns should highlight the benefits of measures to improve the 112 service, given its primary objective of saving lives.

Conclusion: The decision to have mobile operators implementing new technical measures to improve location information for emergency calls to 112 is beneficial from several perspectives:

- It enables precise location information, crucial for quickly locating people in distress and saving lives.
- Leveraging IP technology and advanced smartphone features enhances localization and multimedia service use.
- Transitioning from 2G/3G to 4G/5G networks is essential for maintaining and improving emergency services.
- Ensures access for end-users with disabilities to emergency services under equivalent conditions to those enjoyed by the other end-users, promoting fairness in emergency services.
- The decision by ANCOM adapts services to new technologies and user needs, improving overall emergency response efficiency and public safety.

A1.3.13 New regulatory framework for the Alert Information System (Dominican Republic)[190]

A new regulatory framework for the Alert Information System in Dominican Rep., aims at ensuring the dissemination of alerts, messages, and warnings in emergency or disaster situations, through public telecommunication service providers for the protection of human life and property, before, during, and after a crisis. The main body for coordinating operations and issuing emergency alerts in Dominican Rep. is the Emergency Operations Centre (COE). The texts of the alert messages are received at the COE, through specialized agencies, such as the National Meteorological Office or the Institute of Seismology, for dissemination and distribution to the entire population through social networks, and radio and television stations, etc. The system is activated by imminent natural or man-made disaster threats. Among the specific objectives of this standard are to guarantee the immediate dispatch and dissemination of messages in specific urban and rural areas, at no cost to the end user. Telecommunication providers should guarantee the necessary infrastructure for the transmission of alerts, including the use

[190] ITU-D Document https://www.itu.int/md/D22-SG01-C-0386/ from Dominican Republic.

of technologies such as the cell broadcast service (CBS) for the mass sending of messages. The standard also states that in the event of officially declared disasters, guidelines for the transmission of alerts shall be written in plain and precise language. The type of information will be transmitted according to the event classification defined by the COE, in accordance with the protocols and procedures established in the National Emergency Plan and in the established Alert Declaration Process, or by a competent body duly authorized to issue an alert message.

A1.3.14 Management of risks and disasters (Republic of the Congo)[191]

The question of how to use telecommunications/ICTs for disaster risk reduction and management in developing countries is complex and multifaceted. The following are some of the key issues faced by developing countries in this area, as well as strategies for overcoming them:

Limited infrastructure: Developing countries often lack basic telecommunication infrastructure, such as reliable mobile telephone networks and Internet connections, which limits access to information and communications in the event of a disaster.

- Strategy: Invest in the development of basic telecommunication infrastructure, with emphasis on mobile technology and broadband networks, in order to improve connectivity in rural and isolated areas.

Limited resources: Developing countries often have limited financial, technical and human resources for implementing sophisticated technological solutions for disaster management.

- Strategy: Adopt simple, economical technological solutions, such as SMS messaging, "lite" mobile applications and radio communication systems, which are more accessible and easier to deploy in limited-resource environments.

Low levels of digital literacy: Many inhabitants of developing countries have a low level of digital literacy and limited experience with information technology, which can limit their capacity to make effective use of ICTs during disasters.

- Strategy: Introduce awareness-raising and training programmes on the use of ICTs, using teaching methods adapted to the literacy level and needs of local populations.

Cultural and linguistic barriers: Cultural and linguistic differences can hinder the effective dissemination of warning messages and information regarding disasters.

- Strategy: Adapt warning messages and information about disasters to local languages and cultural contexts, using widely used communication channels and region-specific social media channels.

Weak coordination between actors: Coordination between governments, aid organizations, civil society organizations, and the private sector can be weak, which can lead to a delayed disaster response and to the inefficient use of information technology.

- Strategy: Reinforce mechanisms of coordination and collaboration between the various actors involved in disaster management, by establishing public-private partnerships and encouraging the exchange of information and best practices.

Some practical examples are outlined in the table below:

191 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0162/ from Republic of the Congo.

Country	Law	Action
France	Law No. 2004-811 of 13 August 2004, on the modernization of civil security: The aim of this law is to modernize civil security, primarily by improving the use of ICTs for disaster prevention, preparedness and management.	Introduction of ICT-based surveillance and early warning systems; integration of digital technologies into disaster management plans; development of emergency communication platforms for authorities and citizens; and strengthening of coordination between actors involved in crisis management.
	https://www.pyrenees-atlantiques.gouv.fr/Actions-de-l-Etat/Securite/Protection-civile/La-planification/Le-systeme-de-planification-en-France	
United States	Post-Katrina Emergency Management Reform Act, 2006: The aim of this law is to improve the planning and coordination of relief efforts in the event of disaster, including through the use of ICTs.	Expansion of high-speed Internet access in high-risk zones; development of early warning and emergency communication systems; use of social media platforms to disseminate information and instructions in real time; and introduction of emergency operation coordination centres to facilitate disaster response.
	https://crsreports.congress.gov/product/pdf/IN/IN12277	
China	Law on disaster management of the People's Republic of China, 2007: This law provides for the use of ICTs for the prevention, prediction and management of natural and industrial disasters.	Strengthening of telecommunication infrastructure to improve resistance to natural disasters; development of surveillance and early alert systems; and improvement of coordination between government bodies, disaster relief agencies, and private businesses to facilitate an effective disaster response.
	http://www.npc.gov.cn/zgrdw/englishnpc/Law/2009-02/20/content_1471589.htm#:~:text=Article%201%20This%20Law%20is,the%20people%2C%20and%20maintaining%20national	
Australia	National Disaster Risk Reduction Framework, 2018: This law sets out provisions on the use of ICTs for disaster management, including the introduction of communication and early warning systems.	Development of emergency communication and early warning systems; integration of ICTs into disaster management plans; training of citizens on the use of digital safety tools; and introduction of follow-up and evaluation mechanisms to continually improve disaster preparedness and response efforts.
	https://www.lemonde.fr/idees/article/2020/01/03/incendies-en-australie-un-coup-de-semonce-politique_6024693_3232.html	

(continuación)

Country	Law	Action
Republic of South Africa	Disaster Management Act, 2002: This law provides for the use of ICTs for disaster prevention, prediction, and management and for the rapid dissemination of information to affected populations.	Integration of ICTs in national emergency plans; development of emergency communication and early warning systems; provision of training on digital technology for responders to improve the coordination of relief activities; and public awareness-raising about digital tools for use in crisis management.
	https://www.gov.za/documents/disaster-management-act	
Ghana	National Disaster Management Organization Act, 1996: This law sets out provisions on the use of ICTs for disaster management and for the rapid dissemination of information to the competent authorities.	Awareness-raising and training on the use of ICTs for disaster management; development of emergency communication and early warning systems; strengthening of local capacities to ensure a swift and effective response to disasters; and introduction of mechanisms of coordination between government bodies and civil society organizations.
	https://www.preventionweb.net/publication/ghana-national-disaster-management-organisation-act-1996#:~:text=This%20act%20establishes%20a%20National,of%20persons%20affected%20by%20disasters	
Mauritius	National Disaster Risk Reduction and Management Act, 2006: This law provides for the use of ICTs for disaster prevention, prediction and management, including the introduction of early warning systems.	Strengthening of telecommunication infrastructure to ensure full coverage of national territory; development of emergency communication and early warning systems; integration of digital technologies into disaster management plans; and public awareness-raising about relevant tools.
	https://disasterlaw.ifrc.org/media/3021	

More references

https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/12/NETP_Report_R_Digital.pdf

https://www.connectingbusiness.org/publications/gender-disaster-management-and-private-sector

https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/03/Mobile-for-Development-Utilities-Digital-Solutions-for-the-Urban-Poor.pdf

A1.3.15 Implementing national emergency telecommunications planning and building greater national and regional preparedness (UN WFP-ETC, GSMA))[192]

In times of crisis, connectivity is a lifeline. In a crisis situation the ability to call for help, find information online, or contact friends and family can be the difference between life and death. However, natural hazards, disasters, and conflicts often damage telecommunications infrastructure, leaving responders and affected populations stranded. National emergency telecommunications preparedness is a critical priority that, spurred by capacity development, has been gaining primacy in recent years. Coordinated by ITU, the Emergency Telecommunications Cluster (ETC), and GSMA have been putting in place National Emergency Telecommunications Plans (NETP) for countries across the world. The need for national emergency telecommunications preparedness was underlined by the United Nations Secretary-General's call for inclusive EWSs under the 'Early Warnings for All' initiative[193]. Both national governments and intergovernmental bodies have been ramping up their implementation efforts not just in emergency telecommunication protocols, procedures and policies, but also in enhancing national capacities, and by sharing lessons and knowledge across borders. The ETC and the GSMA are playing a crucial role in complementing these efforts, by enabling national and regional implementation and ownership. The principal areas where these efforts have been made are outlined, with some key areas identified below:

- **National coordination mechanisms**: One of the most important aspects of preparedness is coordination. Identifying which agencies are responsible for what, ahead of time is critical, as is identifying how various agencies collaborate, so that when an emergency arises, roles and responsibilities are clearly laid out, and the competencies and expertise of each actor is maximized. In the spirit of enhancing coordination, the GSMA brings together government agencies and private sector partners at 'Humanitarian Connectivity Charter' workshops to enable a more coordinated and predictable response to disasters. In 2024, regional workshops in Kenya (targeting the wider African region), Barbados (targeting the Caribbean region) and the Republic of the Philippines (targeting the Asia-Pacific region) brought together representatives from telecommunications regulators, national disaster management authorities, humanitarian organizations, and the private sector. Sessions focused on EWSs, anticipatory action, and creating specific action plans with key stakeholders. Other discussions identified gaps in communications preparedness and coordination and needs within the region. These sessions helped stakeholders clarify roles and coordinate response strategies, ensuring preparedness for emergencies.
- **Strengthening NETP Implementation**: Since 2021, the WFP-led ETC has been providing technical support and advice in establishing and strengthening national emergency ICT coordination mechanisms in high-disaster-risk countries. This includes support to national disaster management authorities and regulatory bodies in Dominican Rep., Mozambique, Rwanda, Republic of Madagascar, Zimbabwe, Mongolia, Ghana, and Malawi. In six of these countries, NETPs had either been ratified or were in development. These national coordination structures play a key role in implementing the priority areas and action points outlined in the NETPs, offering an inclusive and cohesive platform for stakeholders to collaborate on capacity development, preparedness, response efforts, and infrastructure improvement.
- **Building regional NETPs**: Additionally, the ETC has provided sub-regional coordination assistance in three crucial regions: 1) the Pacific region, also engaging the Secretariat of the Pacific Community (SPC); 2) the Caribbean region, working closely with the Caribbean

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192 ITU-D Document https://www.itu.int/md/D22-SG01-C-0472/ from UN World Food Programme (WFP)-led, Emergency Telecommunications Cluster (ETC), GSM Association (GSMA).

193 https://www.un.org/en/climatechange/early-warnings-for-all.

Disaster Emergency Management Agency (CDEMA); and 3) Southern Africa region, collaborating closely with the Southern African Development Community (SADC). The ETC and the GSMA actively collaborated with SADC, under ITU-led processes, in reviewing and developing the 'Regional Model NETP' in May 2023, resulting in a model NETP created by SADC and experts, for customization by Southern African Member States.

Case studies in strengthening national disaster ICT response capacity. The ETC and the GSMA, in collaboration with key partners such as ITU and relevant WFP country offices and Regional Bureaus, have actively strengthened national capacities to respond to disasters. Some country cases are detailed as follows:

- **Rwanda**: After national validation in March 2024, the ETC contributed to validation of the NETP for Rwanda, under ITU coordinated processes. At the request of the Government, the ETC and WFP Rwanda conducted national emergency preparedness workshops in August 2024 and January 2025, strengthening the skills and coordination of three ministries, five agencies, and three United Nations and civil society entities. This led to the creation of a national ICT emergency coordination body, tasked with implementing the NETP. As part of the workshop in 2024, the ETC designed a 'flood and landslide desktop simulation' for 32 participants, testing national disaster management policies and emergency telecommunications protocols. The lessons are now guiding the work of the telecommunications coordination body, starting with the development of a standard operating procedure (SOP) for emergency preparedness. A follow-up workshop in 2025, saw the development of a draft standard operating procedure for guiding the work of a future telecommunications cluster.
- **Malawi**: Following the development of an NETP in May 2023, the ETC responded to a national request to assess capacities, and identify collaboration opportunities among stakeholders, in the emergency telecommunications sector. This was completed in June 2023, leading to the formation of a national ICT working group with representatives from the Government, private sector, and United Nations system. A key priority was practical training, and in January 2024, the ETC organized a cyclone-based desktop simulation for 41 national participants in Malawi, using the NETP as a reference. The simulation highlighted coordination and capacity gaps, guiding the future efforts of the groups, including developing a standard operating procedure (SOP) for emergency telecommunications coordination, inspired by practices from the 'Global South'. Between 2024 and 2025, the working group also prepared an SOP for emergency telecommunications preparedness.
- **Dominican Rep.**: The ETC and WFP Country Office have worked closely with the Government of Dominican Rep., to strengthen disaster risk management and emergency telecommunications capacities. In 2021, they co-hosted a national capacity-building workshop that laid the groundwork for forming a national ETC coordination mechanism. This followed the 2018 NETP, which stressed the need for improved national coordination and capacity development in telecommunications for emergency preparedness. During the response to Hurricane Fiona in September 2022, WFP contributed to drone-based damage assessments and provided telecommunications equipment, enabling local technicians to restore communications. As part of the response, the ITU-ETC-GSMA Disaster Connectivity Map was activated, which helped identify connectivity blackspots, guiding the prioritization of communication restoration efforts in 'high-damage areas'.
- **Islamic Republic of Pakistan**: The GSMA hosted a Humanitarian Connectivity Charter (HCC) National Convening on 11-12 December 2024, which included a disaster simulation desktop exercise, jointly run with UNICEF. The primary objective of the Convening in Pakistan, was to bring together stakeholders from across the mobile ecosystem, government, and the humanitarian sector to discuss and strategize on improving mobile-enabled disaster resilience in the country. Crucially, this included the development and implementation of a mobile-enabled EWS.

Facilitating regional support and collaboration

Southern African Development Community (SADC) region: Building regional connections and facilitating 'lessons learned' exchanges, the ETC convened national project focal points, and government representatives from three SADC countries, Mozambique, Madagascar, and Malawi from 21-23 June 2023, in Maputo. Realizing the severe vulnerability of all the countries in the SADC region, the ETC subsequently worked with SADC through the WFP Liaison Office in Republic of Botswana, to develop a proof-of-concept and workplan outlining high-impact cooperation activities, including activities on capacity development, knowledge exchange, and equipment advisory. A major milestone was the participation of ETC as a faculty advisor under the UNDAC-convened 'Emergency Response Training' in Botswana in July 2024, where 30 participants from 15 Member States were trained in emergency preparedness and response essentials, including a module on telecommunications, and a field simulation which tested communications vulnerabilities in a cyclone scenario.

Caribbean region: Recalling the extensive preparedness and response support provided for the Caribbean region, including response operations in Haiti, Dominican Rep., and the Commonwealth of the Bahamas, the ETC joined hands with ITU and the GSMA to run an emergency preparedness workshop for 49 participants from regional bodies and governments from Caribbean states at the end of 2023. The main outcomes were knowledge exchange and peer-to-peer learning across islands, culminating in a desk-top simulation testing readiness and response efficiency in a hurricane context. A follow-up workshop in October 2024, included an 'after-action review' of the Hurricane Beryl response, and agreement to form a regional community of practice in emergency telecommunications preparedness across the island states.

Facilitating Government-to-Government collaboration: In Ghana, following establishment of the national ICT working group with a technical advisory provided by the ETC and WFP Ghana in May 2023, priority was accorded to peer-to-peer learning and EWS development. Officials of the Government of Ghana went to India in 2023 on a study visit to learn more about national practices in ICT and disaster risk management. These findings have inspired national preparedness efforts in ICT readiness in the country.

Lessons learned: A final area of preparedness where the GSMA and the ETC have supported national and regional governments is compiling the lessons learned across numerous interventions and sharing these. This has primarily been achieved through both technical support, as well as documentation of lessons learned. The GSMA, for example, has published several reports highlighting best practices and lessons learned around the topics of inclusivity in EWSs in South Africa[194], the use of CB in EWS[195], and the role of the mobile industry in supporting resilience. These reports have been used to share lessons learned with national disaster management agencies[196] and telecommunications regulators. Some of the lessons learned are outlined below:

- **Enhancing national and regional coordination**: Identifying relevant national/regional agencies, and focal points, and ensuring roles and responsibilities are clearly articulated and understood is key. Policy mechanisms such as NETPs and emergency telecommunications standard operating procedures (SOPs) can play a key role in clarifying

194 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/enhancing-inclusion-in-mobile-enabled-risk-communications-lessons-from-south-africa/

195 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/cell-broadcast-for-early-warning-systems-a-review-of-the-technology-and-how-to-implement-it/

196 https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/building-a-resilient-industry-how-mobile-network-operators-prepare-for-and-respond-to-natural-disasters/

processes, roles, and responsibilities. Workshops or events can help connect relevant stakeholders.

- **Investing further in capacity development**: Trainings, capacity mapping, and simulation exercises can help to ensure that relevant government stakeholders have the requisite skills and knowledge ahead of an emergency, while enhancing investments in these engagements is crucial for developing national responders. Testing systems, protocols, and capacities also enhances national preparedness.
- **Sustaining capacity development**: There should be capacity assessment interventions undertaken to assess readiness for disasters at intervals, and proliferating training-of-trainer learning approaches to retain institutional knowledge in case of staff movements.
- **South-South lessons learned exercises to share knowledge**: Globally, government stakeholders can also learn from one another through the documentation and dissemination of lessons learned, knowledge exchange and peer-to-peer learning. Communities of practice can pool critical knowledge, resources, and expertise to deliver a more coordinated response in the future, including leveraging regional capacities (equipment and responders).
- **Mainstreaming emergency preparedness in national planning**: Backing emergency preparedness interventions with adequate financial provisions in national plans, is crucial to ensure the sustainability of the interventions over time. It also provides an opportunity for national planning cycles to sustainably tackle long-range development interventions which could include commitments such as enhancing early warning infrastructure, amongst others.

Conclusion: NETPs and other national protocols and policies are foundational for guiding emergency telecommunications preparedness and response efforts. These efforts highlight how countries are operationalizing their NETPs and enhancing resilience nationally and regionally. However, following the development of an NETP, there are many measures national governments can take to implement national and regional emergency telecommunications planning, and to improve emergency telecommunications preparedness and resilience to natural hazards. As climate change continues to increase the frequency and severity of disasters, effective preparedness and resilience is, and will, continue to be critical. Preparedness is key.

A1.4 Disaster communication technologies

A1.4.1 Rescue procedures applied at Vila do Sahy in São Sebastião, São Paulo, Brazil[197]

The use of radiogoniometry in order to save lives in disasters: The 683 millimetres of rain that fell in Vila do Sahy region between 18 and 19 February 2023, were the highest recorded rainfall during a 24 hour span in the history of Brazil, according to data from the National Centre for Monitoring and Alerts of Natural Disasters (Cemaden, http://www2.cemaden.gov.br) and the National Institute of Meteorology (Inmet, https://portal.inmet.gov.br). The following day, 20 February 2023, Anatel, the Brazilian Telecommunication Regulatory Agency, provided technicians and equipment to help Civil Defence and the Fire Department rescue personnel. Anatel technicians operated spectrum analysers, tuned on through cellular mobile networks reverse links, with coupled directive antennas to locate people buried in the mud and rubble.

[197] ITU-D Document https://www.itu.int/md/D22-SG01-C-0144/ from Brazil.

Procedures applied to rescuing people: The technique applied by Anatel in Vila do Sahy, was to use a directive antenna connected to a spectrum analyser, in order to manually search for the direction of the maximum level of received signal, as shown in Figure A-30 and Figure A-31.

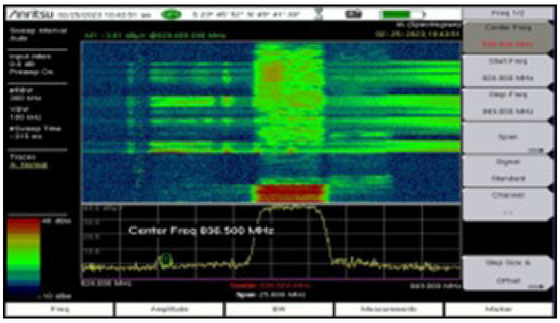
Figure A-30: Spectrum analyser with directive antenna

The spectrum analyser was tuned in the following frequencies bands, used in the cellular mobile network uplinks: 703-748 MHz; 824-849 MHz; 890-910 MHz; 1 710-1 785 MHz; 1 895-1 900 MHz; 1 920-1 975 MHz; and 2 500-2 570 MHz.

Figure A-31: Spectrum analyser operation

Radio frequency analysis: For this rescue operation procedure Anatel technicians first set-up and stored uplink frequencies on a spectrum analyser, in order to reduce the scanning time for signals. Everybody present in the rescue area then turned off their mobile phones. Analysis of the signals transmitted by the reverse links of the mobile phones of buried victims helped in mapping of areas where signals indicated the possible presence of victims. Figure A-32 shows the presence of signals in the 824-849 MHz band.

Figure A-32: Analysis of uplink frequencies



Georeferencing areas: After locating radio frequency (RF) signals transmitted by the reverse links of victims' mobile phones, the area was georeferenced (latitude and longitude) to optimize the excavations to find people. Civil Defence personnel then used sniffer dogs to locate both living and deceased people. The use of sniffer dogs helped in confirming the areas demarcated by the Anatel technicians.

Excavation: Locating signals transmitted by the mobile phones of buried people, and confirming the presence of bodies reduced the area of excavations to be carried out by Civil Defence personnel. Figure A-33 shows the locating and digging operations in the rescue areas.

Figure A-33: Locating and digging operations in the rescue areas

Conclusion: The use of a spectrum analyser by Anatel technicians was important in defining rescue excavation areas and finding people. The Civil Defence reported that the estimated time required for the planned excavation activities in the areas affected by the natural disaster at Vila do Sahy was reduced to a third of the originally planned intervention. The Civil Defence also reported that the procedure carried out by Anatel technicians will form a part of future rescue operations. Anatel formed a Study Group to develop a Technical Specification and action plan to detail the activities and procedures applied in São Sebastião for future rescue operations.

A1.4.2 A high-altitude base station for vertical take-off and landing (VTOL) fixed-wing UAVs for emergency communications (China Mobile)[198]

Due to the impact of climate change, the frequency and intensity of natural disasters has been gradually increasing around the world. There is now an increased probability of weather induced events such as floods, droughts, low temperatures, extreme rainfall, freezing temperatures, and forest and grassland fires. The disaster risk situation is severe and complex, as disasters are increasingly being experienced with a widening distribution, rising frequency, and often heavy losses. Disaster recovery communication has gradually become a key step in rescue operations, and emergency communication is an important support for post-disaster relief. In areas with poor transport and power supply infrastructure, the ability to cope with disasters such as flash floods, or earthquakes is reduced. Communications can also be interrupted due to damage to fibre-optic cables and base stations, but real-time transmission of post-disaster information is crucial for successful emergency rescue operations. Today 70 per cent of the world, comprised mainly the high seas regions, deserts, forests, plateaus, and other remote areas, remain without adequate ground communication network coverage. In such areas, and the same applies to low-income areas, the construction of base stations can be a difficult and costly undertaking. The result is that many areas remain virtual islands cut-off from communication, and in such areas when a disaster occurs, the post-disaster situation cannot be quickly transmitted back to a rescue operations team. In summary, in the case of power failures, limited or severely damaged

[198] ITU-D Document https://www.itu.int/md/D22-SG01-C-0217/ from China Mobile Communications Corporation.

networks, or network disconnections, a system that can quickly arrive at the disaster scene to provide emergency communication within the "golden rescue period" timeframe is needed. A high-altitude base station system based on a medium-size vertical take-off and landing (VTOL) fixed-wing unmanned aerial vehicle (UAV) platform can realize aircraft control and link returns through satellite communication, and can use the airborne base station to quickly restore local communication in the case of disconnection, or power or transmission failure in the disaster area, and can even carry a micro-pod to send real-time video and infrared detection data. Such systems also have the advantages of wide coverage, flexible deployment, and low line-of-sight propagation attenuation. The above advantages can be deployed in remote areas and post-disaster areas to ensure smooth communication.

Composition and characteristics of a medium VTOL fixed wing UAV: Common solutions employed for high-altitude base station lift-off are large UAVs or unmanned airships. Negative aspects of these solutions include their high cost, difficulties concerning aircraft control and deployment, the requirement for a suitable airport, low security issues, and consequently difficulties in meeting the urgent and real-time communication requirements of emergency situations. UAV high-altitude base stations are more suitable for post-disaster deployment. The UAVs commonly used for emergency communication include tethered UAVs, large fixed-wing UAVs, and medium-sized fixed-wing vertical take-off and landing (VTOL) UAVs.

Figure A-34: Image of UAV

In towed UAV systems, a UAV tows a secondary aerial platform that is connected to the ground and provides continuous power supply through photoelectric composite cables. However, if roads are disrupted or non-existent, such systems may only reach the edge rather than the centre of the disaster area to restore communication. Large fixed-wing UAVs require large airports, are expensive, require high-end professional operators, and are difficult to use. Medium VTOL fixed-wing UAVs do not need a special airport, are simpler to operate, and are more suitable for emergency communication scenarios.

Technical principle of high-altitude base station of medium VTOL fixed wing UAV. Medium-size VTOL fixed wing UAVs adopt a technology combination of "VTOL fixed wing UAV + airborne satellite communication system + base station + micro-pod + data fusion module". Medium VTOL fixed wing UAVs use a hybrid mode of fuel and electric power, allowing such systems to remain at altitude for extended periods. Requirements for take-off and landing sites are minimal, and they do not require the extensive runway required by large fixed-wing UAVs. The airborne satellite communication system is used to realize the 'data return and control link' mechanisms for controlling and managing the flow of data, and they have sufficient space aboard for the installation of a base station. The 48V power supply required by the base station to realize the communications application of air base stations, is provided by the aircraft power supply system.

A micro-pod can be installed to send images of the mission back to the flight control centre and the user interface in real time, providing a basis for decision-making and support. These aircraft also comprise an emergency safety protection mechanism which causes the aircraft return to base in the event of data link signal loss, an abnormal drop in altitude, low voltage, or GPS signal loss.

Figure A-35: Image of telecommunication networks using UAVs

Improved coverage breadth: Traditional emergency communication operations after a disaster usually employ emergency vehicles to deploy emergency base stations, but the height of these emergency base stations is generally limited to a height of approximately 15 metres, and consequently coverage is limited. High-altitude base stations use the advantages of high-altitude to build line-of-sight propagation links, which can effectively overcome the propagation loss of electromagnetic waves. With the launch of a UAV base station platform, the coverage radius of high-altitude base stations expands rapidly. High-altitude base stations employing UAVs as lift-off platforms are therefore more suited for deployment in post-disaster areas. The independent broadband satellite communication UAV system greatly improves the signal breadth and depth and solves the problem of over-the-horizon communication. A network equipped with an FDD900 standard base station can cover about 30 square kilometres, and the coverage area can be adjusted at any time.

Beyond line-of-sight long range flight control: Common systems used for UAV control and data return link include ground stations, Wi-Fi, mobile communication network, and satellite communication. The wireless communication environment in disaster areas is usually complex and rarely meets the conditions required for line-of-sight propagation. In order to overcome signal instability factors such as the Earth curvature, and mountain terrain occlusion, and to ensure ultra-long distance control, high-throughput satellite communication is used as the main return link. UAV control can be achieved anywhere within the coverage of the satellite, with a wide range of long-range, low-altitude, controllable and visual flight capabilities. Safety control features include low-orbit narrowband satellites, digital radio, and remote control three-fold control insurance.

Improving coverage mobility: While roads in post-disaster areas are often disrupted and communication is difficult, UAVs can enter the disaster area before roads have been restored by using the air route. Medium fixed wing UAVs with vertical take-off and landing do not need airports and runways, and can be transported to the take-off site in a single van or truck. When fully fuelled, UAVs can maintain flight for up to eight hours while flying as close to the ground as possible, while hover height can be as low as 100 metres. This system then combines the characteristics of flexibility and long endurance. Medium fixed wing UAVs with VTOL can be used to provide temporary emergency communication coverage, and network support for emergency command and disaster transmission, in areas that are otherwise cut-off from communications.

Connecting the command centre to the site: The command centre and the disaster site are often in a state of information asymmetry and asynchronicity, making it difficult to formulate an overall strategic and timely plan. Being able to realize intelligent monitoring and management of flight tasks, responds to demands for real-time supervision and command, and promotes industry applications. After using high-throughput satellites to transmit information in real time, an AI platform can be used to carry out image recognition on the UAV return video, automatically identifying people and hazards. Infrared sensors and wind speed measuring instruments can be added to the UAV to accurately locate fire sources and direction of fire propagation.

Application case: In 2023, a typhoon and heavy rain in Hebei and Heilongjiang caused widespread damage, and vertical take-off and landing fixed-wing UAVs were used to quickly restore communication and real-time video back to a control centre from the disaster area. In Heilongjiang, a medium-sized VTOL fixed-wing high-altitude base station UAV was used to perform three flight missions (including a night flight, and a flight in force 6 wind speeds), with an average flight time of 1.5 hours, a distance covered of 135 kilometres, and all of this at the maximum flight control distance of 15 kilometres from the take-off point. A total of 427 emergency personnel in the disaster zone were connected, helping the last four villages in the province to restore communication. In Hebei Province, a medium-size VTOL fixed-wing high-altitude base station was used to carry out three flight missions, with an average flight time of two hours. The actual maximum flight control distance was 20 kilometres from the take-off point and a flight altitude of 800 metres was maintained. A total of 1 428 connected emergency personnel helped resolve the regional communication isolation problem.

Recommendation. This paper introduces a high-altitude base station used for emergency communication. Its flexible and mobile features such as wide coverage capability, etc., can help ensure the rapid recovery of communications in disaster areas. The system can be widely used in emergency communication and promises multiple solutions and application areas. The high-altitude base station is an important part of the space-based network of the future 6G air-earth integrated communication network. The high-altitude base station with a medium UAV as the lift-off platform combines the characteristics of fast mobility, flexibility, and wide coverage. Capable of realizing beyond line-of-sight flight control and data retrieval through high-throughput satellite communication systems, it can also be used as an innovative solution for large-scale network interruptions of mobile communication caused by sudden disasters or events.

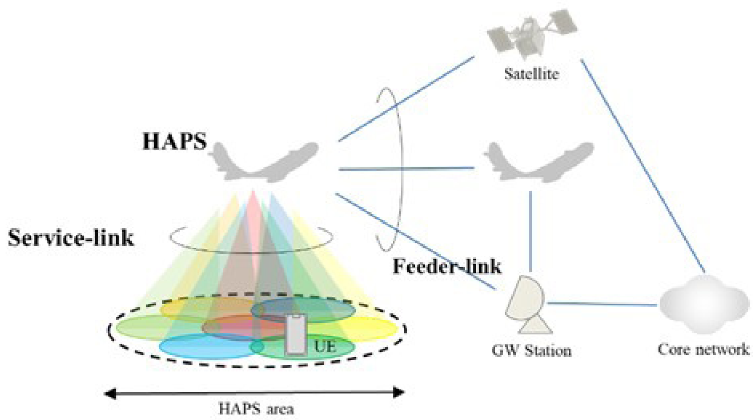
A1.4.3 High altitude platform station (HAPS) systems (Softbank)[199]

Overview of the HAPS system: High altitude platform station (HAPS) systems are located on uncrewed aircraft at an altitude of approximately 20 km, in stationary rotation in the stratosphere. Operating in the stratosphere, where atmospheric conditions throughout the year are stable

[199] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0205/ from Softbank, Japan.

with little change in wind speeds, allows HAPS to fly with stability. Comprising a large wingspan, HAPS can carry high-performance payloads and solar panels, and can cover a communication area of up to 200 km in diameter while relying on a self-sufficient power source for extended flight periods. HAPS offers a suitable solution for areas where ground networks are not available, such as in the air, on remote islands or mountainous areas, and in developing countries or regions that are difficult to cover with ground base stations. In the event of a disaster, HAPS can also be rushed to the disaster area immediately to recover the communication. As shown in Figure A-36, two types of communication service, "service link" and "feeder link" are required for HAPS operation. The feeder link is a one-to-one communication between the HAPS and a gateway station, while the service link provides one-to-many communication directly to regular user equipment.

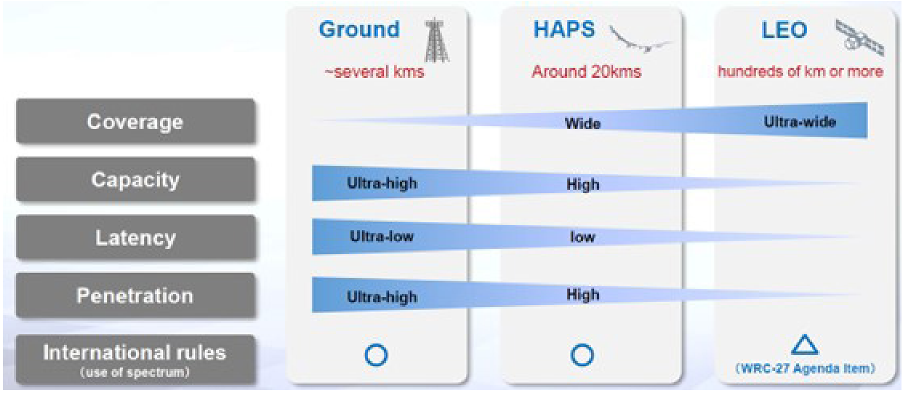
Figure A-36: Different types of links for HAPS communication



Under previous ITU-R Radio Regulations (RR), it was possible to operate HAPS service link using the 2 GHz mobile spectrum band, but the usage of other global mobile spectrum bands was prohibited. At the World Radiocommunication Conference 2023 (WRC-23), held in Dubai, United Arab Emirates, from 20 November to 15 December 2023, the expansion of HAPS spectrum to add three additional mobile spectrum bands, namely 700-900 MHz, 1.7 GHz, and 2.5 GHz, was formally agreed upon. It is to be expected that the revision of RR, approved during the conference, will be implemented in the national regulations of each country, in order to utilize these new frequency bands for use of HAPS service link. As the result, when introducing HAPS-based mobile broadband communication services, the spectrum can be chosen with greater flexibility in different countries and regions, thereby enabling seamless usage with existing smartphones and other devices.

Figure A-37 shows a comparison of NTN direct to device (D2D) communication services in the stratosphere and the space.

Figure A-37: Comparison of NTN D2D communications



As they orbit at distances of hundreds of kilometres or more from the earth's surface, low Earth orbit (LEO) satellites can provide wide coverage. However, HAPS, among other NTN solutions, has the advantages of higher capacity, lower latency, and better penetration, similar to terrestrial networks. HAPS therefore, would not only provide basic communication services such as messaging and voice services, but would also provide richer services such as mobile Internet and entertainment services across wide areas.

Emergency communications and disaster recovery. Following a disaster, affected communities frequently encounter communication breakdowns, impeding their capacity to seek aid, connect with family, or obtain crucial information. Restoring communication entails implementing communication infrastructure and technologies to facilitate dependable and prompt information exchange among emergency responders, affected communities, and pertinent authorities. The aim is to facilitate rapid and effective communication, bolster situational awareness, assist in search and rescue operations, and facilitate the recovery and reconstruction efforts in the aftermath of a disaster. On 11 March, 2011, Japan experienced a catastrophic event when a magnitude 9.0 earthquake struck off the Sanriku coast, triggering strong tremors and generating massive tsunami waves along the Pacific coastline. This disaster, famously known as the Great East Japan Earthquake, inflicted severe damage from the Tohoku to Kanto regions. The earthquake and ensuing tsunami wreaked havoc on telecommunication infrastructure, leading to the collapse or washing away of numerous cell phone base stations. Within a day, communication services were suspended due to widespread power outages, causing battery depletion. Approximately 29 000 cell phone base stations went offline initially. While restoration efforts and the return of electricity helped reduce outages, aftershocks prolonged the restoration process, and almost two months passed before telecommunication companies could fully restore services[200].

On New Year's Day 2024, a 7.6 magnitude earthquake struck the remote Noto peninsula. After two weeks of emergency mobile network restoration operations, using portable equipment and wired power feed drones etc., communication services were still unavailable in areas made inaccessible due to road infrastructure damage. The Nankai Trough recurring megathrust earthquake (M8 class) poses a significant threat to the future for Japan, with a predicted probability of occurrence at some point over the next 30 years of 70 to 80 per cent. This escalating probability adds a heightened urgency to preparation measures as time

200 White paper Information and Communications in Japan Year 2011 (https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h23/pdf/n0010000.pdf, in Japanese).

progresses[201]. In the event of a major disaster in the Tokai region, where up to 40 per cent of ground base stations may be incapacitated in affected areas, it could take several days to restore communications[202]. The "golden 72 hours" principle underscores the need for a quality of service (QoS) capable of facilitating video call services for precise medical interventions and communication with people trapped in enclosed spaces, or under the rubble of collapsed buildings. In such cases, and when considering the emergency and specific penetration needs, only HAPS could provide timely solution for the restoration of communication.

Industry developments and achievements in HAPS: HAPS industries have achieved a number of remarkable developments HAPS technologies. HAPS Alliance, is well known as the consortium targeting the construction a cooperative HAPS ecosystem, and has released serval publications, including whitepapers, introducing the latest achievements[203] and stratosphere flight test results[204].

A1.4.4 Shipboard base station (KDDI)[205]

On 6 January 2024, in response to the Noto Peninsula earthquake, two major mobile telecommunication carriers in Japan, NTT Docomo and KDDI, jointly began operating a "shipboard base station", which is a mobile phone base station installed on a ship. NTT Docomo and KDDI mobile phone base station equipment was installed on the "Kizuna", a submarine cable-laying ship operated by NTT World Engineering Marine, of the NTT Docomo Group. By transmitting radio waves received by satellite antennas to end users from the ship, they aimed to restore communications to some coastal areas of Wajima City, Ishikawa Prefecture, where recovery operations were proving difficult because land routes had been cut off by the earthquake. This operation was part of the social contribution collaboration agreement that NTT and KDDI signed in 2020, and that also includes other mutual cooperation operations, such as the transportation of supplies during disasters.

Figure A-38: Shipboard base station

201 Long-term evaluation on Active faults and trench earthquakes published on January 15, 2024 (https://www.jishin.go.jp/main/choukihyoka/ichiran.pdf, in Japanese).
202 Damage Assumption for a Nankai Trough Earthquake (Damage to Facilities, etc.) (https://www.bousai.go.jp/jishin/nankai/taisaku_wg/pdf/1_sanko.pdf, in Japanese).
203 HAPS Alliance Member Achievements (https://hapsalliance.org/wp-content/uploads/formidable/16/HAPSAlliance_MemberAchievements__Q3_2023.pdf).
204 White paper Bridging the Digital Divide with Aviation in the Stratosphere (https://hapsalliance.org/wp-content/uploads/formidable/12/SpA_Flight_Communication_Tests_White_Paper_English_Final_2021.pdf).
205 ITU-D Document https://www.itu.int/md/D22-SG02.RGQ-C-0148/ from KDDI, Japan.

A1.4.5 Direct-to-handset (D2H) technology in disaster communications (Access Partnership)[206]

Introduction to D2H technology: Not so long ago, terminal devices required large power supply modules and sizable, deployable antennas to communicate with satellites, a service known as 'mobile satellite service' (MSS). However, recent technological advancements in design and manufacturing have substantially reduced the size, weight, power, and cost of electronic communication equipment. Consequently, smaller phone forms can now accommodate the necessary power supply and antenna, leading to several industry players announcing their intentions to enter the emerging direct-to-handset (D2H) market. Emergency services, and disaster risk reduction and management provide a clear viable example of the D2H use case. Expanded coverage to areas not reached by traditional terrestrial networks, or if terrestrial networks are offline due to a national disaster, provides governments and emergency service operators with a viable communication technology that can help to save lives and mitigate further disaster. While the advent of D2H services represents an exciting and unprecedented technological milestone, the lack of coherent global regulations combined with other challenges, such as spectrum coordination, interference, and resource allocation, require broad encompassing solutions.

Disaster frequency on the rise: The frequency of disasters is rising at an alarming rate, even surpassing the most pessimistic forecasts, and especially so given the onslaught of climate change. While various weather-related disasters will impact countries of all development stages, low-income nations are especially vulnerable to the effects of climate change. Due to limited technical and human resources, and inadequate investment in infrastructure and equipment, such countries are often ill-equipped to handle the fallout and associated costs of disaster. The economic impact of natural disasters is also expected to increase significantly. Consistent with the trend of the rising frequency of natural disasters, the average economic impact of natural disasters has increased by more than three times from an annual average of USD 56 billion per annum between 1980 to 1984, to an annual average of USD 199 billion between 2015 to 2019.

Impact of D2H on disaster risk management: The emergence of D2H services as a viable means to expand coverage has the potential to transform both government and service provider approaches to disaster risk reduction and management. This is because the benefits of D2H satellite services are not limited to reaching areas that are otherwise difficult or impossible to reach through traditional networks, but they are also crucial in providing backup connectivity in the wake of a natural disaster, where terrestrial communication infrastructure is temporarily damaged and unavailable. The initial phase of the service, as is the case currently, has been dominated by the provision of limited D2H services, with a focus mainly on emergency messaging. Already, 'handhelds' such as the 'Reach' (Garmin) and 'Spot X' (GlobalStar) have implemented satellite connectivity, with early adoption among users of satellite phones and satellite-powered gadgets, such as hikers and mountaineers who are not otherwise able to access cellular connectivity through their mobile devices. However, D2H, through its utilization of satellite technology, has the greatest potential impact in remote communities, which traditionally face disproportionate challenges in receiving updates related to natural disasters.[207] With D2H services offering these underserved locations a cheaper alternative access to mobile broadband, such 'handheld' tools can be used to facilitate faster and timelier responses to natural disasters.

[206] ITU-D Document https://www.itu.int/md/D22-SG01-C-0240/ from Access Partnership Limited.
[207] https://www.sciencedirect.com/science/article/pii/S2212420920314333

Reliable communication systems during times of disasters are critical in ensuring effective access to response and relief activities. For example, during the 2020 Cyclone Harold in the Solomon Islands, Vanuatu, Republic of Fiji, and Tonga, the communications equipment provided by ITU and Kacific meant locals affected by the disaster were able to access the community Wi-Fi service and quickly deploy disaster relief assistance, even after local network coverage was wiped out. This technology has become increasingly pertinent with the frequency of natural disasters expected to rise due to climate change.[208] Analysis by Access Partnership, estimates that under a 'business-as-usual' scenario, the global cost of natural disasters could reach approximately USD 320 million per year from 2023 onwards, constituting infrastructure damage, loss of life, and increased morbidity. However, improvements to communication systems facilitated by D2H services could reduce the impact of natural disasters by up to 38 per cent, meaning approximately USD 120 million worth of economic impact could be mitigated per year from 2023.

Direct-to-handset satellite services: When terrestrial networks are damaged or destroyed by disaster, one of the greatest challenges for responders is often the transportation and setting up of telecommunication equipment such as satellite terminals in the disaster site. In some cases, this may also involve bureaucratic and administrative processes in addition to purely logistical hardships. The 'Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations' specifically touched upon this problem with a dedicated article titled 'Regulatory Barriers'. With D2H technology, both logistical and administrative problems and delays can be overcome very quickly by using resilient satellite networks with smartphones.

Direct-to-handset satellite services can also enable remote medical consultations and telemedicine services, which can be especially beneficial for patients in remote or underserved areas.

Additional benefits of promoting widespread connectivity: As of 2023, nearly a quarter of the world's population still lack access to modern communications.[209] While the value of investments required to set up D2H infrastructure will be significant, the potential economic impact that D2H technologies offer to broader society mean such investments could be necessary. With around a quarter of the population across the globe living outside the reach of modern communication systems, there is a significant proportion of economic potential yet to be captured due to this lost connectivity. A study by ITU in 2018, covering 139 economies across the globe revealed that every percentage point increase in mobile broadband penetration increases GDP by 0.15 per cent.[210] Connecting the more than two billion individuals who do not regularly use the Internet today, could add an estimated USD 1.2 trillion to global GDP through various cost savings and productivity improvements.

Road ahead: The coming years of transition to a new era in D2H satellite communications, promise a number of transformative developments in the sector. There have been calls for greater multistakeholder action to ensure a robust, effective, and harmonized communication plan and strategy to face the increasing number of natural disasters that are likely to impact

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208 Intergovernmental Panel on Climate Change (2021), "Climate change widespread, rapid, and intensifying – IPCC." Available at: https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/.

209 With Almost Half of World's Population Still Offline, Digital Divide Risks Becoming 'New Face of Inequality', Deputy Secretary-General Warns General Assembly | UN Press.

210 https://www.itu.int/en/ITU-D/Regulatory-Market/Documents/FINAL_1d_18-00513_Broadband-and-Digital-Transformation-E.pdf

countries. Policy and regulation play a critical role in ensuring timely and effective disaster responses by enabling the rapid deployment of essential emergency communication technology. Additionally, disaster response speed can be further increased by facilitating emergency response capabilities, developing expedited licensing for emergency communications, and enabling good-faith partnerships with international private network operators. There is a need for regulating future technologies, prioritizing user-centred and widely accessible solutions, and for partnering with the private sector to deliver activation protocols and promote national and international coordination. Finally, the role of low Earth orbit (LEO) constellations, and moderating competition concerns in order to enable network complementarity and redundancy should be considered.

A1.4.6 A lightweight and flexible 5G satellite base station (China)[211]

In the first half of 2024, the total loss caused by natural disasters worldwide reached USD 120 billion[212], significantly exceeding the average level of the past ten years. In the future, as the global climate environment deteriorates, the frequency of extreme weather and disasters will continue to increase year by year. Emergency communications have become an important element in the entire process of disaster relief. Traditional emergency communication equipment, such as emergency communication vehicles, are often limited by road conditions, and it can be difficult to ensure emergency support under extreme "no road, no network, no electricity" conditions. In such cases, emergency communication vehicles may be unable enter the target area and base stations cannot be connected. Traditional satellite stations usually rely on traditional geostationary Earth orbit (GEO) satellites, and most of these systems only support Wi-Fi services. In addition, the overall weight of associated traditional devices often attains 50 kg and only external power supply sources are supported. Consequently, two separate enclosures may be required for an installation, making transportation and complex logistics impractical.

Lightweight integrated 4G/5G satellite base station: Lightweight integrated satellite base stations can realize not only Wi-Fi, but also 4G and 5G base stations, through high-throughput satellites. Because the system comprises a built-in battery, the built-in base station can be activated anytime and anywhere. It can also be packed into a backpack, and a single person can carry it to the disaster site. The system can support extreme conditions, and its base station supports up to 400 concurrent users via satellite back transmission. The wide coverage of the base station can provide a convenient and fast access service. Figure A-39 shows the lightweight integrated satellite base station.

[211] ITU-D Document https://www.itu.int/md/D22-SG01-C-0413/ from China Mobile Communications.

[212] https://www.munichre.com/content/dam/munichre/mrwebsitespressreleases/MunichRe-NatCat-HY-2024-Factsheet.pdf/_jcr_content/renditions/original./MunichRe-NatCat-HY-2024-Factsheet.pdf

Figure A-39: Image of lightweight integrated satellite base station

Key features of the system include:

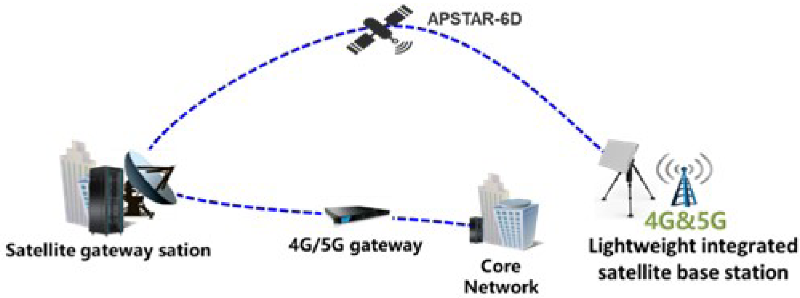
- Reduced weight: 13 kg, with a volume reduction of one-third.
- Enhanced intelligence: designed as a single unit that eliminates assembly requirements (the system previously comprised six separate components).
- Broader compatibility: supports both 4G and 5G networks (previously limited to only 4G).
- Increased transmission power: delivering 1W per channel.
- Extended battery life: high-density batteries provide up to four hours of service.

Other essential performance metrics include:

- Capacity for mobile phone users: 400 users.
- Coverage radius of the base station: 500 metres.
- Operating frequencies for the base station: FDD LTE at 1800 MHz for 4G and 2.6 GHz for 5G.
- Satellite transmission rate: uplink rate of 20 Mbit/s (12 MHz bandwidth), downlink rate of 40 Mbit/s (20 MHz bandwidth).

Technical principle of lightweight integrated 4G/5G satellite base station: The lightweight integrated satellite base station is transmitted using the APSTAR-6D high throughput satellite. After the transmission data is connected to the satellite gateway station, it is connected to the operator network through a transmission line or 4G/5G Internet gateway, thus realizing the operational deployment of the base station. Unlike traditional satellites, high-throughput satellites (HTS) use multi-point beam technology and frequency multiplexing, to significantly increase the overall communication capacity with the same spectrum resources. This system achieves several times the capacity of traditional fixed communications satellites and is tailored for broadband applications such as consumer Internet access. Consequently, this satellite solution increases the connectivity capacity of 4G and 5G base stations while ensuring high-speed Internet connectivity.

Figure A-40: Connection between lightweight integrated satellite base station and core network through HTS



Optimization of satellite transmission for 4G/5G base station. Compared with ground transmission, disadvantages of satellite link include large delay, relatively high channel error rate, and limited transmission capacity which has a greater impact on 4G/5G base stations and user experience. Satellite transmission systems need targeted optimization.

Current satellite transmission systems are unable to provide higher capacity than optical transmission networks, and so they are unable to reach the peak transmission rates of 4G/5G base stations. 4G/5G based on satellite transmission will inevitably encounter the problem of limited transmission capacity. Transmission data includes signalling, various service data, and base station network management data. In order to ensure efficient network operation when the 4G/5G network is overloaded or congested, a quality of service (QoS) mechanism must be used to ensure that important traffic is not delayed or discarded. The QoS mechanism is based on the protocol, virtual local area network identification (VLAN ID), TOS value, source IP address (or subnet), destination IP address (or subnet), port, and differentiated services code point (DSCP), and is independent of the 4G/5G system as an auxiliary QoS mode, which can be combined with the satellite bandwidth allocation mode. The satellite system can know various service priority labels in advance according to QoS rules. On the other hand, the satellite system can also conduct in-depth detection of data in general packet radio service tunnelling protocol (GTP) packets through optimization equipment.

Application case: In August 2023, the north of China experienced unprecedented heavy rainfall due to 'Super Typhoon Doksur,' which had a profound impact on remote mountainous regions as well as in extensive plains areas. Access to the affected zones was severely hindered for vehicles, leading to significant communication disruptions across most locations. To address the urgent communication challenges, 27 portable satellite stations, transported by emergency telecommunications personnel to the site were deployed, and connectivity was successfully restored in ten towns[213]. The lightweight integrated satellite base station effectively mitigated the transport and communication barriers caused by the disaster.

A1.4.7 A case study of disaster preparedness by mobile operators in Japan (NTT Docomo)[214]

Japanese mobile communication carriers have established policies for implementing disaster prevention operations to ensure communication services even in the event of a disaster, and

213 https://mp.weixin.qq.com/s/wEdiyoyzRyfxoXQUxjNJbQ
214 ITU-D Document https://www.itu.int/md/D22-SG01-C-0412/ from NTT DOCOMO, Japan.

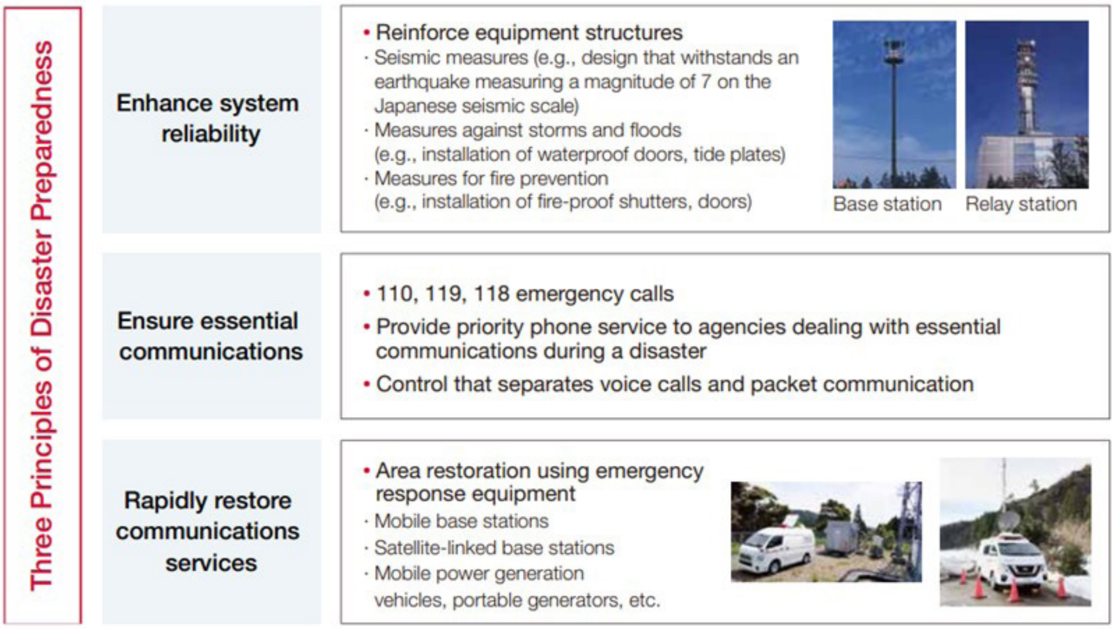
have taken measures to prepare for disasters. This section outlines the disaster preparedness of NTT DOCOMO, one of the major mobile operators in Japan.

Applying the three principles of disaster preparedness to secure communications in times of disaster: Since its founding, NTT DOCOMO has been continuously working to secure communications during disasters in accordance with its three principles of disaster preparedness:

- enhance system reliability,
- ensure essential communications, and
- rapidly restore communications services.

Applying lessons learned from the Great East Japan Earthquake, NTT DOCOMO formulated new measures for disaster preparedness and had implemented these new measures by the end of February 2012. NTT DOCOMO is strengthening its disaster preparedness in order to be better able to respond to the increasingly diverse natural disasters anticipated in the future.

Figure A-41: Three principles of disaster preparedness



Use of emergency base stations in response to the magnitude of a disaster: NTT DOCOMO maintains emergency base stations to secure its networks in the event of a disaster. Depending on the level of damage, NTT DOCOMO implements measures such as setting up temporary base stations and remotely adjusting the transmission angle of radio waves from base stations.

Large-zone base stations: Large-zone base stations are specialized for emergencies to secure communications in heavily populated areas during widespread disasters and power outages. Large-zone base stations provide 360-degree coverage across a seven-kilometre radius, which is wider than that of a standard base station. Since 2011, NTT DOCOMO has installed large-zone base stations at 106 locations around Japan, and all are compatible with long term evolution (LTE) technology, which can enable an approximately three-fold boost in capacity. During the Hokkaido Eastern Iburi Earthquake, which struck in September 2018, NTT DOCOMO activated a large-zone base station for the first time, helping to restore communications to a wide area at Kushiro City.

Figure A-42: Large-zone base station

Medium-zone base station: Medium-zone base stations are built with foundations that are more robust than those of standard base stations and are used as standard base stations under normal circumstances. They are able to cover adjacent areas by remotely expanding their service areas in the event of a disaster-related service interruption at neighbouring base stations. NTT DOCOMO has installed more than 2 000 medium-zone base stations in Japan to cover areas expected to suffer damage based on hazard maps. NTT DOCOMO also promotes the nationwide deployment of medium-zone base stations to secure a means of communication in the suburbs of medium-size cities, disaster base hospitals, and coastal and mountainous regions. 62 base stations were activated during the torrential rains of July 2020.

Covering areas that are difficult to access rapidly. To diversify emergency recovery options in times of disaster, NTT DOCOMO is building shipboard base stations and fixed-line drone base stations that can be used to rescue people living in areas that are difficult to access rapidly from maintenance sites. Following the Noto Peninsula Earthquake on New Year's Day 2024, NTT DOCOMO became the first company to operate a shipboard base station. In cooperation with KDDI Corporation, NTT DOCOMO provided relief to two areas in Wajima City that were severely damaged. In cooperation with related organizations, NTT DOCOMO implemented a sea route approach with the cooperation of the Self-Defence Forces to restore communication in areas where land routes were closed. Drone relay stations also authorized to secure communication areas by amplifying radio waves in airspace and so strengthening the emergency recovery system.

Response to the Noto Peninsula Earthquake. When the Noto Peninsula Earthquake struck on New Year's Day 2024, up to 260 base stations experienced service interruptions due to power outages and transmission line disruptions. Service coverage dropped to 30 per cent of the normal coverage of the six affected municipalities (Nanao City, Suzu City, Wajima City, Shiga-cho, Anamizu-cho, and Noto-cho). NTT DOCOMO established an internal system immediately after the disaster, and began recovery activities the following day. A total of 10 000 staff members engaged in emergency response activities. In addition to road traffic congestion and the long-distance travel imposed by the limited transportation routes on the peninsula, other obstacles to local access included aftershocks and snowfall. In total, more than 200 sites were temporarily restored through restoration work carried out by employees from all over the country. With the help of shipboard base stations, emergency restoration was completed, excluding some areas that were difficult to access, by 17 January, and the area restoration, excluding Hegura Island in Wajima City, was completed on 21 March. NTT DOCOMO also made direct visits to almost all of the designated and undesignated evacuation centres, in approximately 300 locations, and provided free battery charging, free Wi-Fi, and free rental of NTT DOCOMO public mobile phones to evacuees. It also provided mental and physical care by providing online medical care and video services as support for prolonged evacuation centres. This was the first attempt by

NTT DOCOMO to provide support for NTT DOCOMO public mobile phones, online medical care, and video services.

A1.4.8 Leveraging CB for public awareness via a CAP platform (India)[215]

SAmekit CHEtavani Tantra (SACHET) CAP based early warning dissemination system

- The Pan-India implementation of the CAP-based early warning dissemination system project commenced in August 2021, successfully concluding in August 2023. The primary focus was on developing an indigenous system for early warning dissemination.
- This system plays a crucial role in saving lives and minimizing property damage during disasters.
- Involves the integration of all alert generating agencies, including the Indian Meteorological Department (IMD), the Central Water Commission (CWC), the Indian National Centre for Ocean Information Services (INCOIS), and the Forest Survey of India (FSI).
- Major alert disseminating agencies, such as telecommunications service providers (TSPs), television and radio stations, railways station announcement systems, and coastal alert systems, are being consolidated onto a single platform. TSPs are already connected on CAP-SACHET, and proof of concept (POC) has been completed for all other modes.
- All alert authorizing agencies, including the Ministry of Home Affairs, the National Disaster Management Authority, and the State disaster management authorities (SDMAs) of all 36 States, have been seamlessly integrated. All SDMAs can send geo-targeted alerts directly without manual intervention through their dashboards.
- To date, over 13.50 billion targeted SMSs have been sent by SDMAs using this platform during various emergencies, including the COVID-19 pandemic, and other disasters.

Leveraging cell broadcast (CB) for public awareness via the CAP platform: Following on from the successful implementation of a system for alert dissemination through SMS, the decision was taken to further improve disaster awareness through the development of a CB based emergency alerting system, for sending alerts for disasters that have no, or a very sudden or short lead time. This system allows the dissemination of critical and time-sensitive disaster management information to mobile devices within specified geographical areas. This system was designed in India, and is currently undergoing comprehensive testing. During Cyclone Michaung, alongside SMS dissemination, CB through the CAP platform, emerged as another powerful tool for public awareness. While both systems offer significant advantages, CB presents unique capabilities for reaching larger audiences during disaster situations.

Strengths of cell broadcast via CAP

- Universal reach: CB bypasses individual phone subscriptions, directly addressing all phones within a targeted cell tower coverage area. This ensures that even those without an active phone plan receive critical information.
- Targeted dissemination: Similar to SMS via CAP, CB allows geo-targeting based on cell tower locations, ensuring relevant alerts reach only those in the path of the disaster event.
- High penetration: CB messages automatically appear on phone screens, regardless of the user's activity or currently opened app, reaching them even if they are not actively using their phone.
- No action required: Unlike SMS, receiving CB messages requires no user action, reducing the risk of missed information due to unread messages.

[215] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0207/ from India.

- Cost-effectiveness: The cost of CB for emergency alerts is typically borne by mobile network operators, making it a resource-efficient option for large-scale communications.
- Fastest medium: CB can deliver warnings to users within ten seconds.

Steps taken for implementation of alert dissemination through CB

- CB has been implemented among all TSPs and large-scale testing exercises have been conducted in various regions of the country.
- A gazette notification was issued on 6 April 2023, mandating the inclusion of essential features for receiving CB alerts on mobile handsets, encompassing distinct sounds, and storage capabilities, effective six months from the date of gazette publication. Furthermore, the same gazette notification also prescribed the introduction of automatic readouts in both English and Hindi.
- Comprehensive large-scale testing of CB, covering the entire State, was successfully conducted by Pan-India, and was completed by 31 October 2023.

Guidelines on utilizing CB for effective disaster awareness

- Timely warnings: Leverage CAP integration to trigger immediate CB alerts based on real-time storm data and evacuation orders.
- Clear and concise messages: Use simple language and actionable instructions such as information on evacuation zones, shelter locations, and emergency contact details.
- Repetitive broadcasts: Repeat crucial information at regular intervals to ensure it reaches even those initially unavailable or distracted.
- Post-disaster updates: Utilize CB for post-disaster communications, providing essential information on restoration efforts, safety protocols, and recovery resources.

Existing CAP-compliant platforms can be integrated with CB infrastructure, enabling:

- Automated CB activation: Pre-defined triggers based on cyclone severity and location automatically activate CB broadcasts in affected areas.
- Dynamic content management: Updating of message content in real-time based on evolving weather conditions and disaster response needs.

Additional considerations

- Testing and training: Regularly test CB functionality and train emergency personnel on its effective use during disaster situations.
- Public awareness and education: Educate the public about CB functionalities and how to respond to disaster alerts received through CB.
- Collaboration with mobile network operators (MNOs): Ensure close collaboration with mobile network operators for smooth integration and efficient CB delivery during emergencies.
- By effectively utilizing CB alongside SMS dissemination via CAP platforms, disaster response efforts can be significantly enhanced, empowering communities to be better prepared and respond effectively during disaster events.

Conclusion: CB, paired with CAP platform integration, offers a powerful tool for comprehensive public warning awareness during disaster events with a relatively short alert window. The universal reach, targeted dissemination, and automatic nature of CB via CAP can ensure critical information reaches everyone in affected areas, potentially saving lives and minimizing disaster impact. The effectiveness of CB via CAP was successfully demonstrated during Cyclone Michaung.

A1.4.9 The role of satellite communications in disaster communications technologies (SES World Skies)[216]

Natural and man-made threats to communication networks. Natural disasters driven by climate change are intensifying in frequency and severity. For instance, in 2023 alone, Asia experienced 79 hydro-meteorological hazard events, making it the most disaster-hit region in the world.[217] As seen in natural disasters of the past, profound disruptions can spread across any industry or government sector, not to mention the difficulty natural disasters can present when disseminating life-saving information, coordinating relief efforts, and maintaining public safety. The possibility that terrestrial networks and undersea cables might be affected by natural disasters needs to be taken into consideration. This consideration is even more pronounced for geographically challenging regions such as island and mountainous areas. Amid unpredictable climate conditions, the bolstering of network infrastructure and implementation of reliable fail-safe systems have become indispensable to network planning.

Apart from intense weather, human activities such as dragged ship anchors and fishing-net trawling incidents continue to jeopardise undersea fibre-optic cables that carry 90 per cent of the world's global data.[218] Very recently, 25 per cent of data flowing between Asia and Europe was disrupted after undersea cables in the Red Sea were severed.[219] The vastness of oceans and frequently harsh conditions may often obscure the exact causes of disruption, making preventative measures difficult to implement. Untimely disruptions can greatly impact critical sectors such as finance, commerce, transportation, and healthcare that rely on constant connectivity. In 2017, heavy tropical storms between Singapore and Perth cut the SEA-ME-WE3 cable linking Europe, the Middle East region, and Asia disrupting communications for over a month.[220] In 2022, an underwater volcano severed Tonga's international and domestic cables, and took 18 months to be fully repaired.[221] In the face of such natural or man-made disasters, the ability to sustain communication saves lives and supports mission-critical disaster recovery efforts. This is where satellites play a crucial role.

Resilient networks - How communications satellites mitigate the impact of disasters on connectivity: Communication network solutions must be adaptable and reliable in order to mitigate unpredictable threats. Powered by SES geostationary (GEO) and medium Earth orbit (MEO) high-throughput satellites, the end-to-end network acts as a life-saving conduit during times of disaster. The uninterrupted support of satellites, both MEO and GEO, enables emergency responders to carry out their jobs expeditiously and reliably, especially when terrestrial networks are damaged or out of service. Positioned 8 000 km above sea level, MEO satellite constellations such as SES O3b and O3b mPOWER provide low-latency and high-throughput connectivity across vast regions. This allows businesses to reroute traffic and keep essential services running even when terrestrial infrastructure is compromised. GEO satellites,

216 ITU-D Document https://www.itu.int/md/D22-SG01-C-0421/ from SES World Skies.
217 Climate change and extreme weather impacts hit Asia hard. (2024, April 23). World Meteorological Organization. https://wmo.int/news/media-centre/climate-change-and-extreme-weather-impacts-hit-asia-hard.
218 Tratos Group. (n.d.). What are submarine cables used for? Tratos Cable Academy. https://tratosgroup.com/tratos-cable-academy/what-are-submarine-cables-used-for/.
219 BBC News. (2023, October 2). Internet outages: Undersea cables damaged in Middle East region https://www.bbc.com/news/world-middle-east-68478828.
220 DatacenterDynamics. (2017, August 31). SEA-ME-WE 3 cable cut by storms. DatacenterDynamics. https://www.datacenterdynamics.com/en/news/sea-me-we-3-cable-cut-by-storms/.
221 Paul Lipscombe. (2024, July 11). Tonga's only domestic subsea cable suffers another outage, could take weeks to repair. DatacenterDynamics. https://www.datacenterdynamics.com/en/news/tongas-only-domestic-subsea-suffers-another-outage-could-take-weeks-to-repair/.

positioned 36 000 km above sea level, provide a critical layer of redundancy, enabling broad, dependable coverage for essential services such as weather monitoring, broadcasting, and emergency communications. The O3b satellite service was deployed in Tonga in 2024, after SES extended its Digicel Partnership in a bid to enhance disaster network resiliency of the Pacific nation. The MEO satellite powered network enabled rapid recovery of voice, SMS, and data services just six hours after Tonga's only subsea cable was severed. Tonga had also suffered from a previous major connectivity disruption after the Hunga Tonga-Hunga Ha'apai volcanic eruption in 2022, and relied on GEO satellites to maintain island connectivity as undersea cables were restored. In another instance in Taiwan, a private 5G network platform deployed on a mobile truck along with SES O3b MEO terminal technology allowed the delivery of 5G services to enable emergency response teams to coordinate rescue efforts.[222] When terrestrial networks are down O3b mPOWER can also support live mobile video capture and video surveillance, which are critical capabilities that enable rescuers to successfully facilitate response efforts. Together with the Government of Luxembourg, and through the emergency.lu solution, a provider of end-to-end solutions for rapid emergency telecommunication service recovery, SES World skies has delivered vital connectivity services in the aftermath of disasters when telecommunication infrastructure and terrestrial wireless systems have been disrupted or destroyed.

Hurricane Beryl, was the strongest hurricane in history to form in the month of June in the Atlantic Ocean, and wreaked havoc as it swept through Grenada, Saint Vincent and the Grenadines, and Jamaica. Initially a tropical depression, Beryl rapidly intensified into a Category 4 hurricane and briefly reached Category 5 status, with winds up to 240 km/h (150 mph). 'Emergency.lu solution' along with a humanitarian intervention team were sent to assist the populations in need on the islands of Grenada, and Saint Vincent and the Grenadines. The Beryl mission involved a Ku-band satellite terminal, which was initially deployed on Carriacou Island and that was subsequently moved to Union Island. The Ku-band satellite terminal used the SES-14 satellite for communication, to establish and maintain contact with the affected country, the humanitarian community, and the media, as well as to access vital information and coordinate the emergency response.

Conclusion: Network deployment, maintenance, and recovery operators can further bolster network redundancy and resilience by incorporating multi-orbit satellite communications systems. With MEO and GEO, maintaining reliable communications becomes possible for urban centres, remote rural regions, and everywhere in between. The efforts of SES in restoring connectivity after several natural disasters showcase how satellite systems can effectively restore services quickly.

A1.5 Network resilience

A1.5.1 Use of telecommunications/ICTs for disaster risk reduction and management (RIFEN)[223]

Telecommunications and ICT have become essential tools in disaster management. These technologies enable the rapid collection, transmission, and analysis of critical data, facilitating real-time decision-making. However, despite their potential, challenges persist. Access to

[222] Taiwan Taps Private 5G for Disaster Recovery, SES, 14 September 2022.

[223] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0197/ from Réseau International des Femmes Expertes du Numérique (RIFEN).

technologies remains uneven, especially in regions most vulnerable to disasters. In addition, coordination between different stakeholders, including governments, NGOs, and the private sector can be difficult to establish in emergency situations. Finally, the resilience of telecommunications infrastructures to disasters is a major concern. A number of solutions and improvements are outlined in this section.

Integration of emerging technologies: This improvement involves including the use of emerging technologies such as artificial intelligence (AI) and the Internet of Things (IoT) in data analysis and real-time decision-making during disaster situations. AI can be used to analyse large quantities of data from a variety of sources, such as social networks, environmental sensors and surveillance systems, to quickly detect emerging trends and risks. Similarly, IoT enables real-time data collection from connected sensors and devices, providing greater visibility into conditions on the ground.

Development of robust communication platforms: This enhancement aims to develop robust and accessible communication platforms to facilitate coordination between the various stakeholders involved in disaster management. Robust communication platforms could include centralized emergency information management systems that enable the secure sharing of data between government agencies, humanitarian organizations, businesses, and citizens. In addition, user-friendly mobile applications could be developed to provide real-time alerts, information on emergency shelters, evacuation routes, and available rescue services.

Enhancing the resilience of telecommunications infrastructures: This improvement involves investing in innovative solutions to strengthen the resilience of telecommunications infrastructures in the face of disasters. This could include the deployment of deployable mobile networks, such as base stations on wheels or drones equipped with communication relays, which can be rapidly deployed in disaster-affected areas to restore communications. In addition, low-energy wireless communication technologies, such as long range wide area networks (LoRaWAN), could be deployed to provide backup connectivity in areas where traditional infrastructure has been damaged.

Conclusion: In conclusion, the use of telecommunications and ICT offers considerable potential for building resilience to disasters. However, to fully exploit this potential, it is essential to overcome the challenges of accessibility, coordination, and infrastructure resilience. The recommendations set out in this report offer ways of overcoming these challenges and improving communities' ability to deal with disaster risk proactively and effectively. By implementing these recommendations, stakeholders will be able to make better use of information and communication technologies to save lives, reduce economic losses, and foster community resilience to disasters.

A1.5.2 ICT infrastructure and network resilience assessment: An approach for emergency telecommunications (Haiti)[224]

Following the earthquake on 14 August 2021, that devastated southern Haiti, ITU again volunteered, as it had done on 12 January 2010, and following the hurricane of 4 October 2016, to assist in the provision of personnel and equipment to facilitate communication for the management of rescue and relief operations and recovery. Initiated in October 2020, in response to the COVID-19 pandemic, to help countries to strengthen digital infrastructure

224 ITU-D Document https://www.itu.int/md/D22-SG01-C-0129/ from Haiti.

and ecosystems and to remain resilient in the event of natural disasters, the Connect2Recover initiative was implemented in the country and served as a precursor to the contribution of ITU in assessing the resilience of telecommunication networks and infrastructure of Haiti.

Why assess the resilience of telecommunication networks and infrastructure: Telecommunication/ICT infrastructure is essential to the functioning of society today. Services provided by these networks and infrastructure are essential to almost all vital sectors: education, economy, healthcare, finance, commerce, and transport, etc. Failure in the provision of such services can bring the operation of those sectors to a halt, resulting in huge losses in both time and money. Another important point is that, in the event of disasters, a natural reflex is to use telecommunication/ICT services to enquire about the survival, health or mental well-being of loved ones. Determining whether networks and infrastructure can withstand a disaster is crucial.

The assessment and its implications: Conducted by a local expert, the assessment took into account the existing situation to verify resilience according to a restoration plan. Monitoring will involve the collection of relevant data from telephone network operators and Internet access providers via an appropriate questionnaire. Further information on the needs and challenges of operators and suppliers was gathered in separate interviews. In addition, there was an analysis of available broadcasting data collected during interviews with station chief engineers, and connectivity measurements for rural populations carried out in the field.

The results of the assessment, based on the acquisition, collection, analysis and interpretation of data are as follows:

- 60-75 per cent variation in the overall recovery or rebuilding capacity for mobile phone operators and the main Internet access provider;
- 60-80 per cent variation in overall market resilience;
- Low level of connectivity in rural areas (reliance on −90 dBm signal);
- Predominance of 2G in rural areas and very low broadband penetration;
- Means of repairing infrastructure damaged by a disaster for broadcasting stations is generally low (less than 10 per cent), thus very low overall resilience.

Resilience implies the ability of networks and infrastructure to react or adapt to sustain services in the event of disasters. This depends on the quality of the equipment and architecture that make up the networks and infrastructure, which requires a distinction to be made between active resilience (capacity to react or adapt) and passive resilience (relating to equipment and architecture). The assessment carried out by the local expert calls for operators and service providers to have a redundancy strategy in improving their existing architecture.

The results of the assessment will guide decision-makers and stakeholders in taking measures to consolidate recovery capacity and the existing resilience level. These measures must include, in particular, resilience to future disasters. Working to mitigate damage and ensure adequate infrastructure and network availability before, during and after disasters is essential.

Consideration of assessment by stakeholders: As a follow-up to the telecommunication network and infrastructure resilience assessment, a feedback workshop was held with stakeholders (ITU and CONATEL), the Government of Haiti, operators and service providers, the university, and other telecommunication sector actors. This led to recommendations for network and infrastructure resilience. The Government has written to CONATEL congratulating it and asking it to express its thanks to ITU for this noble initiative. To this end, the Minister of Public Works, Transport and Communications required the formation of a follow-up group to take into account the recommendations of the workshop. This follow-up group will consist of two commissions, one working on resilience, taking into account the expert's recommendations, and the other on emergency telecommunications.

Conclusion: As discussed previously the use of telecommunications/ICTs for disaster risk mitigation and management went some way to avoiding exposing people to risk of infection through their repeated attendance at COVID-19 testing centres and healthcare centres, and also because the use of telecommunications/ICTs also helps in management before, during and after natural disasters, ensuring network and infrastructure resilience is vital for protecting property and saving lives.

A1.5.3 Resilience of telecommunication/ICT networks and infrastructure in Haiti[225]

Any failure in the provision of services can disrupt the continuity of services offered to communities, consumers, government and the private sector, resulting in, at the very least, substantial losses in time and money. Today, disruptions in the provision of telecommunication/ICT services can have just as much impact as a power outage, interrupting the provision of essential services to citizens and impacting their lives and livelihoods. When a disaster strikes, the first reaction of individuals everywhere is to use any available means of electronic communication to connect with loved ones. In a broader perspective, telecommunications are the means of communication that can be mobilized before, during and after natural disasters to save lives and ensure a rapid return to normal life. The consequences when the telecommunication networks themselves are affected and users are left without service in an emergency can be extremely serious. In view of the essential role that telecommunication networks play for users in both normal and disaster situations, there is a clear need to protect these networks and their infrastructure so as to ensure their continuous, uninterrupted availability at all times. Like any system, telecommunication networks are exposed to a variety of threats:

- **Malicious attacks**: cable theft, signal jammers, cable damage and anti-satellite weapons;
- **Non-deliberate threats**: system failures, power failures, and cable damage;
- **Natural hazards**: hurricanes, earthquakes, flooding, and tsunamis.

When a disaster occurs, telecommunication networks and infrastructure may suffer the physical destruction of network components, disrupting the support infrastructure, and causing network congestion. In order to be able to withstand damage and to continue to ensure an acceptable level of service, telecommunication systems need to be resilient against all kinds of threats.

Natural disasters in Haiti: Haiti is no stranger to natural disasters: tropical storms, tropical waves, and hurricanes are all common occurrences. The country is also vulnerable to droughts, torrential rains, flooding, landslides and occasional earthquakes. On 12 January 2010, a major earthquake resulted in some 220 000 deaths and 300 000 people injured, and destroyed much of the country's infrastructures. On 4 October 2016, a category 4 hurricane, hurricane Matthew, struck Haiti with high winds, flooding in coastal regions, and heavy rains. The southern part of the country was particularly afflicted by the resulting massive floods and landslides. There was widespread damage to infrastructure, agricultural crops and natural ecosystems, and the death toll reached 546. Another earthquake, this one of magnitude 5.9, struck on 6 October

[225] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0165/ from Haiti.

2018, in the zone 20 km north of Port-de-Paix in the northwest of the country. It affected several departments, and resulted in 12 deaths and 151 injured. On 14 August 2021, an earthquake struck southern Haiti, leaving 2 248 dead, 12 763 injured and 329 missing, according to the National Emergency Operations Centre. The economic damage has been estimated at USD 1.5 billion. The earthquake directly or indirectly affected 690 000 people, or 40 per cent of the population of the departments of Nippes, Grand'Anse and Sud. In addition to the loss of life, 83 770 houses were damaged, and a further 53 815 were completely destroyed.

Figure A-43: Region affected by the 14 August 2021 earthquake

The designations employed and presentation of material in this publication, including maps, do not imply the expression of any opinion whatsoever on the part of ITU concerning the legal status of any country, territory, city or area, or concerning the delimitations of its frontiers or boundaries.

Department	Nippes	South	Grand'Anse
Population	342 325	774 976	468 301
Area (km²)	1 268	2 654	1 912
Municipa-lities	11	18	14
Density (inhabitants/km²)	246	266	245

Source: 2023 study of telecommunication network resilience in Haiti.

Telecommunications in Haiti. The telecommunication sector of Haiti is organized on three distinct levels: policy, regulation, and the market. The public policy of the Government with its plans and vision for the sector, falls within the responsibility of the Ministry of Public Works, Transport and Communications (*Ministère des Travaux Publics Transports et Communications*, MTPTC). Regulatory matters are the responsibility of the National Telecommunication Council (*Conseil National des Télécommunications*, CONATEL), which was founded on 27 September 1969, and reporting is the responsibility of the MTPTC. The regulatory remit of the MTPTC is set out in the 12 October 1977 decree, covering licences, concessions, authorizations, and so on. As for the communications market, it is dominated by two mobile telephony operators, four Internet access providers, some 347 FM radio broadcasting stations, 131 terrestrial television stations, and four satellite broadcasters.

The telecommunication infrastructure and market in Haiti. With a penetration rate of 65 per cent, cellular telephony dominates the Haitian telecommunication market, and the Internet penetration rate is also growing, despite the challenges posed by the risk of natural disasters in the country. Fixed connections lag far behind wireless. In terms of infrastructure, the country uses:

- radio relay links (in cooperation with Dominican Rep.);
- satellite links; and
- submarine cables (the Haiti-Bahamas cable, the Columbus cable from the United States, and the Claro cable from Dominican Rep.).

Currently international access is diversified in the telecommunications market of Haiti, and consists of submarine cables (BaTelCo and Columbus); an underground cable (with Dominican

Rep.); several radio relay links (with Dominican Rep.); and several satellite links, mainly used by satellite television operators. The market is served by about ten international gateways, while international organizations and private companies use their own satellite gateways for Internet connections. Accordingly, it is not possible to establish accurately the total number of international gateways.

Evaluation of damage to telecommunication networks: failures during disasters. In general terms, a telecommunication network becomes dysfunctional when one or more components are in total or partial failure due to a breakdown caused by a disaster of natural or human origins. The affected key part or component of the network or infrastructure causes a technical malfunction in the system. The failed component may affect one part of the system or the entire system, with the undesired result that service becomes unavailable. The failures of a telecommunication network or infrastructure caused by a disaster vary depending on the cause. The failure of a telecommunication system can be caused by any of three primary causes:

- physical destruction of network components;
- disruption in the supporting network infrastructure; and/or
- network congestion.

Information on network damage is obtained from reports to the regulator. An assessment of the existing network restoration plan and the current level of network resilience was conducted by ITU and CONATEL on the basis of data collected from mobile network operators (MNOs) and Internet access providers (IAPs) through a questionnaire. The additional information received, and the identified challenges and needs of the MNOs and IAPs provides an idea of their post-disaster recovery capabilities. An assessment of the broadcasting subsector through analysis of the available data, also provided information on the state of the subsector and its capabilities. Field visits were carried out to help assess the level of connectivity of rural populations. In terms of resilience, it was determined that the overall recovery or reconstruction capability of the mobile telephone operators and the main Internet access provider in Haiti, is between 60 and 75 per cent. Other findings from the assessment of network resilience in Haiti included the following:

- the overall resilience of the Haiti telecommunication market is between 60 and 80 per cent;
- in rural areas, the level of connectivity is low, and most connections depend on a signal having a strength of −90 dBm;
- 2G is still predominant in rural areas, so the penetration of high-speed Internet remains very low;
- less than 10 per cent of radio and television stations have the means to repair infrastructure damaged in a disaster;
- the overall resilience of radio and television stations is very low.

The passive resilience of telecommunication networks and infrastructures depends on equipment and architecture, while active resilience depends on an ability of the operator to react or adapt. It is important to emphasize that the quality and type of equipment must be guaranteed by manufacturers. While the network redundancy strategy is mainly the responsibility of the service providers/operators, there is also a need to improve the existing network architecture, especially in terms of route diversity. In the first instance, the results of this assessment will help decisionmakers and stakeholders in the actions they undertake to reinforce the existing recovery capabilities, and the level of resilience. They should also take appropriate measures to increase their recovery capabilities, and in particular strengthen their resilience to future disasters. The ongoing network recovery and resilience building projects of the regulator and the telecommunication operators should give a significant boost to the development of the sector in Haiti. In this context, it is fundamental and rational to take the following steps to ensure that telecommunication networks do not suffer excessive damage, and that availability is not unduly impaired in a disaster and its aftermath:

- assessment of the impact of damage incurred by telecommunication networks and infrastructure;
- assessment of the existing restoration plan of the operators;
- assessment of the level of resilience of existing networks and infrastructures; and
- proposal of solutions to improve both the restoration plan, and the current level of resilience of the telecommunication networks and infrastructure.

A1.5.4 Enhancing disaster resilience through telecommunications and ICTs in disaster prone areas (Intelsat)[226]

Statement of the situation or problem: Telecommunications and ICTs play a crucial role in disaster mitigation, preparedness, response, and recovery. For instance, countries bordering the Pacific Ocean, in the Southeast Asia or Caribbean regions, witness significant disaster events annually, demonstrating the critical need for resilient disaster communications and management systems in these vulnerable regions. By harnessing technological advancements, disaster prone countries can bolster their preparedness, response, and recovery efforts. Resilient communication infrastructure, including satellite networks, ensures continuous connectivity during emergencies, facilitating coordinated response efforts. Strengthening the capacity of local institutions through training programmes and fostering partnerships with regional stakeholders further enhances disaster resilience. By integrating telecommunications and ICTs into comprehensive disaster management strategies, disaster prone countries can better protect infrastructure and livelihoods from the impacts of natural disasters. This section addresses efforts that can be undertaken to enhance disaster resilience through telecommunications and ICTs globally, and more specifically in disaster prone regions.

Leverage terrestrial and satellite technologies for disaster resilience: Terrestrial and cable technologies are vulnerable to exposure to natural hazards prevalent in disaster prone regions. Events such as cyclones, earthquakes, and volcanic eruptions pose significant risks to infrastructure components, leading to disruptions in communication networks. Moreover, the remote and dispersed nature of Pacific Island territories poses challenges to the deployment of terrestrial fibre-optic networks across the entire region. Financial constraints further limit the ability of telecommunication service providers to invest in fibre-optic technology, particularly in rural and remote areas. In response to these challenges, there is a growing reliance on satellite networks as vital components of disaster-resilient communication systems. Satellites offer resilience to physical damage, making them ideal for providing crucial connectivity in remote and disaster-prone areas. Satellite broadband networks offer several advantages in disaster scenarios. Portable very small aperture terminal (VSAT) antennas, hand-held terminals, and temporary installations can be rapidly deployed post-disaster to bolster communication efforts. Additionally, satellites equipped with software-defined technology enable dynamic capacity allocation in areas of higher need, enhancing network resilience and supporting emergency

[226] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0252/ from Intelsat US LLC.

response activities. Finally, satellite backhaul solutions play a critical role in ensuring connectivity in remote regions and in serving as backups for critical terrestrial infrastructure. Moreover, in any jurisdiction, such as those in the Pacific region countries that already possess significant satellite antenna infrastructure, this satellite antenna infrastructure can be recommissioned following a disaster with minimal investment to enhance disaster resilience. By leveraging both terrestrial and satellite technologies, disaster resilience and continuity of communication during emergencies can be ensured.

Analysing national experiences and best practices

Capacity building: Governments need to prioritize capacity building initiatives to enhance disaster management capabilities. This involves providing training programmes for local institutions and stakeholders involved in disaster response and recovery efforts.

Partnerships and collaborations: Collaborative efforts among governments, regional organizations, NGOs, and the private sector are essential. By fostering partnerships and sharing experiences, best practices, and lessons learned, countries in disaster-prone regions can strengthen their disaster resilience. This collaborative approach also facilitates the exchange of resources, expertise, and technologies to enhance disaster preparedness and disaster response. The role of ITU is also important in this collaboration, not only through capacity building, but also through the ITU Partner2Connect (P2C) initiative, that fosters partnerships and resource mobilization for implementing critical telecommunications infrastructure projects.

Regulatory and policy initiatives

Exemptions and streamlined procedures: Regulatory constraints often hinder the rapid deployment of telecommunications infrastructure during emergencies. Governments should implement exemptions from licensing and customs clearance procedures during disaster situations to expedite the deployment of critical telecommunications equipment and technologies. For instance, exemptions from a local entity requirement or from type approval requirements should be encouraged to ensure a fast deployment of telecommunications infrastructure during emergency situations. Streamlined regulatory processes ensure that telecommunications providers can quickly establish or restore connectivity in affected areas without bureaucratic delays.

Investment incentives: Encouraging investment in resilient telecommunications infrastructure requires creating favourable regulatory environments and offering investment incentives. Governments can provide tax breaks, subsidies, or other financial incentives to telecommunications operators and infrastructure providers willing to invest in disaster-resilient networks. Removing regulatory barriers and offering investment incentives can attract private sector investment in disaster resilient telecommunications infrastructure.

Desired outcome

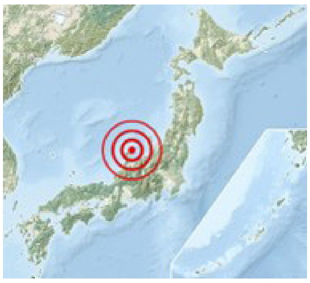
In conclusion, the submission proposes a multi-faceted approach to enhancing disaster resilience in disaster prone regions through telecommunications and ICTs. By leveraging both terrestrial and satellite technologies, countries can overcome the vulnerabilities of traditional infrastructure and ensure continuous communication during emergencies. Capacity-building initiatives, partnerships, and collaboration among governments, regional organizations, and the private sector are crucial for strengthening disaster management capabilities. Regulatory and policy initiatives, including exemptions and streamlined procedures, and investment incentives are essential for encouraging investment in resilient telecommunications infrastructure.

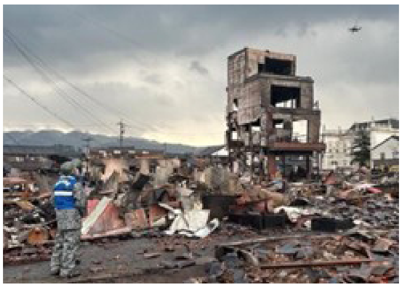
A1.6 Human factors and stakeholder collaboration

A1.6.1 Building resilient infrastructure in Japan - Early recovery response to the Noto Peninsula earthquake (Japan)[227]

Noto Peninsula earthquake: At around 4:10 p.m. on 1 January 2024, a powerful earthquake hit the Noto Peninsula area of Ishikawa Prefecture, Japan. The earthquake was registered 7, the highest level on the Japanese seismic intensity scale. The shaking and accompanying tsunami caused widespread destruction on the Noto Peninsula. As of 28 February 2024, there were 241 deaths confirmed and 12 people remaining missing, while nearly 1 300 were injured across eight prefectures, making it the deadliest earthquake in Japan since the 2016 Kumamoto earthquakes.

Figure A-44: Noto Peninsula earthquake





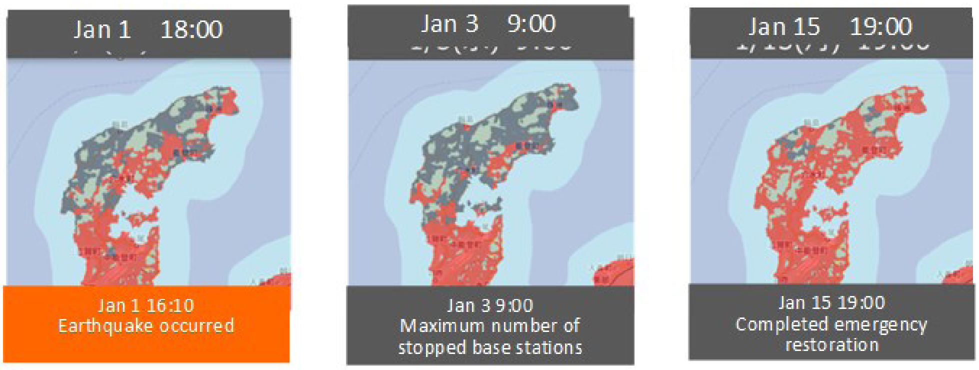
Network recovery status[228] **(18 January 2024)**: Approximately two weeks after the Noto Peninsula Earthquake disaster, on 18 January, the four mobile carriers NTT Docomo, KDDI, SoftBank, and Rakuten Mobile held a joint press conference on the network recovery status in the disaster area. Executives in charge of each mobile carrier network gathered at the conference and explained the recovery status of mobile phone lines in the local area. All four companies had completed 'emergency restoration,' except in some difficult to access areas, and aimed for prompt restoration in the remaining inaccessible areas as soon as roads could be opened. 'Emergency restoration' refers to measures undertaken to temporarily restore network operations, such as "bringing a generator to a base station that cannot operate due to a power outage" or "bringing satellite communication equipment to a base station where the optical-fibre of the transmission line has been cut". The prospect of full recovery depends on the recovery status of related infrastructure in each area, such as roads, electricity, and fibre-optic transmission lines. In areas where the network went down due to the disaster, the majority of the causes were "transmission line breaks due to landslides" and "prolonged power outages". Both issues depend on the restoration status of other infrastructure, so even though emergency restoration had been largely completed, it was difficult to predict when full restoration would be achieved, but it was expected to take a considerable time.

[227] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0192/ from KDDI.

[228] Network recovery status in the disaster area https://news-mynavi-jp.translate.goog/article/20240118-2865619/?_x_tr_sl=ja&_x_tr_tl=en&_x_tr_hl=ja&_x_tr_pto=wapp

KDDI communication network recovery progress[229] **(15 January 2024)**: As of 15 January 2024, KDDI, with the exception of sites that were difficult to access due to earthquake-related landslides, had completed emergency restoration in areas where communication services were unavailable or difficult to operate, by bringing in mobile base stations (vehicle-mounted or portable base stations) and by installing antennas for satellite broadband at the base stations. In areas with inaccessible locations, KDDI worked in collaboration with local government and related agencies, including the Self-Defence Forces, to prioritize responses to evacuation centres. In addition to the early restoration of communication networks through the installation of mobile base stations and satellite antennas, KDDI also provided communication support such as in the setting-up of satellite communications for free Wi-Fi (also made available to non-KDDI customers) at evacuation centres until the completion of recovery operations. Schools that were used as evacuation centres were also equipped for online classes by satellite.

Figure A-45: Communication network recovery



There were a great number of transmission line failures, and due to road closures and landslides, it was not always possible in these places, to carry out transmission line recovery work, or even to bring in mobile base stations (vehicle-mounted or portable). Such conditions added to the time required to restore base stations and connectivity. KDDI worked to achieve a quick recovery of the communication network by using its own disaster response system to visualize the damage situation of the base stations, quickly assess the situation, and formulate a recovery plan. In addition, KDDI worked on recovery activities such as the restoring of communications using a shipboard base station, collaborating with local government to facilitate early road opening, transporting recovery response items to isolated areas in collaboration with the Self-Defence Forces, and installing mobile base stations and satellite antennas for evacuation centres.

Table A-6: Recovery equipment in use (as of January 15, 2024)

Equipment	Number of units
Vehicle-mounted/portable base station	84
Satellite antenna for backhaul lines	159
Portable generators	228
Shipboard base station	1 vessel (NTT Docomo joint)

[229] KDDI communication network recovery progress https://news-kddi-com.translate.goog/kddi/corporate/newsrelease/2024/01/16/7186.html?_x_tr_sl=ja&_x_tr_tl=en&_x_tr_hl=ja&_x_tr_pto=wapp

Figure A-46: Recovery activities

Vehicle-mounted base station | Satellite antenna for backhaul lines | Base station restoration work | Refuelling emergency generator

Figure A-47: Support at evacuation centres

Satellite antenna | Wi-Fi and charger

Strengthening measures in preparation for large-scale disasters: Given the importance of mobile communications, and especially of mobile phones, which often serve a lifeline during disaster events, it is extremely important to strengthen the disaster resistance of communications infrastructure. In Japan, and particularly since the Great East Japan Earthquake of 2011, mobile phone carriers have been working to strengthen measures against transmission line interruptions, power outages, and equipment failures. Additionally, the Ministry of Internal Affairs and Communications (MIC) has:

- amended relevant ministerial ordinances requiring businesses to strengthen disaster countermeasures,
- deployed mobile power supply vehicles,
- created a response team (MIC-TEAM) that provides disaster response support to secure means of information and communication in the event of a disaster, and
- made it mandatory for mobile phone base stations that cover important locations, such as municipal government offices, to implement preventive measures against power outages, for at least the first 24 hours following a disaster event, to ensure communication during disasters.

In addition, as it is vital to secure a means of communication that enables administrative agencies to operate smoothly even when normal communication services, such as mobile phones, have been interrupted, the MIC has established a satellite mobile phone network. By stockpiling rental radio equipment and deploying it in each region, MIC have established a system to enable lending of satellite mobile phones, etc., to local government during disaster events. Furthermore, in order to secure electricity and fuel, which are important for the early restoration of communication services, MIC are cooperating with related ministries and agencies, in establishing liaison systems and conducting joint training exercises. Telecommunications carriers, the Ministry of Defence, and the Self-Defence Forces have also concluded agreements regarding mutual cooperation in securing communications during disasters, including the implementation of training exercises, the sharing of information important for recovery activities during disasters, and the provision of disaster recovery equipment and supplies. Efforts are also being made to strengthen cooperation regarding the transportation of disaster recovery personnel.

Some examples of disaster preparation activities

- Mobile phone carriers have installed over 800 satellite entrance lines that connect mobile base stations via satellite in the event that terrestrial lines go down. The four mobile phone carriers have over 11 400 time-based base stations (as of the end of March 2023) and over 4 300 mobile power supply vehicles and portable generators for 24-hour backup power.
- The Business Telecommunications Equipment Regulations (Ministerial Ordinance) were revised in 2012, and comprise provisions for strengthening the disaster resistance of transmission line equipment, strengthening power outage countermeasures, and strengthening large-scale disaster countermeasures.
- In response to the widespread and long-term disruption of mobile phone base stations in the Kanto region of Japan due to a power outage caused by a typhoon in 2019, the information and communication network safety and reliability standards (notifications) were revised in 2020. The revised standards require 24-hour backup power for mobile phone base stations that cover municipal offices and recommend 72-hour backup power for prefectural offices, remote islands, and other offices that are difficult to reach.

Early recovery response to the Noto Peninsula Earthquake. In response to the 2024 Noto Peninsula Earthquake, the MIC collaborated with telecommunications carriers, etc., to immediately collect damage information, and dispatched the MIC-TEAM to Ishikawa Prefecture to quickly restore telecommunications services. Regarding mobile phone services, due commercial power outages, equipment failures or damage to base stations, and disconnection of transmission lines, the service coverage area in six cities and towns in the northern part of the Noto Peninsula had been reduced to less than a third of the pre-disaster service coverage area. There were also problems encountered in 70 to 80 per cent of coverage areas. To quickly restore mobile phone services in the face of such damage, the telecommunications carriers installed emergency recovery equipment, such as mobile power supply vehicles and portable base stations. As a result of mutually coordinated efforts, which included coordinating with related organizations for the transportation of fuel and personnel, and in the of clearing roads, the emergency restoration work was largely completed by mid-January, just two weeks after the earthquake. In addition, to ensure a working communications environment at evacuation centres and other locations, the four mobile phone carriers lent approximately 660 satellite Internet devices (Starlink terminals) free of charge, and provided mobile terminals, etc. MIC also provided mobile power supply vehicles and mobile terminals. MIC have also been working on collaborative efforts, such as renting out communication equipment, such as satellite mobile phones. While major roads were cut off by landslides and restoration work was difficult, the preparations and countermeasures that were undertaken by the public and private sectors were put to good use.

Notes

- Approximately 330 power supply vehicles and generators are available for both the public and private sectors. Additionally, each carrier operates approximately 100 in-vehicle/ portable base stations.

- Coordination with the Japan Maritime Self-Defence Force enabled the use of transport ships to refuel and transport recovery equipment to difficult-to-reach areas, and coordination with the Ministry of Land, Infrastructure, Transport and Tourism facilitated the road clearance necessary for base station restoration operations.

Prospects for securing communications in the event of future disasters: In response to this disaster, all possible means were mobilized, including emitting radio waves from coastal areas using a ship-based base station, and covering the area with temporary base stations using drone technology. In addition, satellite Internet equipment (Starlink terminals) was widely used as a replacement when the fibre-optic lines to mobile phone base stations were cut off. Satellite Internet equipment was also used to secure a means of communication at evacuation centres. The MIC conducted a study of the causes of the disaster and of its response and took into account the progress made in efforts to utilize new technologies, such as satellite and drone technologies, as well as the progress made in public-private collaboration. Efforts will be made to further strengthen the communication environment so that communication will not be disrupted during future disaster events. MIC aim to introduce "inter-operator roaming" by the end of 2025, which allows mobile phone users to temporarily use another carrier network in the event of an emergency, such as a natural disaster or communication failure. In recent years in particular, related businesses have also been working towards the commercialization of services that allow smartphones to make calls, and send and receive emails, using satellites and unmanned aerial vehicles in the stratosphere. Utilizing new technology, MIC will also proceed with efforts to ensure that mobile phone services can be used even if base stations are damaged and the terrestrial network is interrupted.

A1.6.2 Strengthening stakeholders and communities' collaboration in disaster risk reduction through radio communication simulations (Indonesia)[230]

Indonesia, as part of the so-called Pacific "Ring of Fire", comprises very complex geological conditions and is prone to natural disasters. With more than 130 active volcanoes, Indonesia experiences frequent volcanic eruptions, earthquakes, and tsunamis. In addition, the presence of colliding tectonic plates around Indonesia is also the main cause of seismic activity, which often results in heavy losses in terms of both physical damage and fatalities. Natural disasters often cause deaths and injuries, extensive infrastructure damage, and can severely impact social, economic, and environmental life. Therefore, a thorough understanding of the situation is critical for effective disaster risk management and for building community resilience to natural disasters. Currently, Indonesia has a number of communication channels for disaster management and dissemination, such as SMS Blast, EWS, website, mobile apps, social media, Emergency Service 112, and disaster radio communications.

Telecommunications infrastructure is often damaged and rendered non-functional during disasters, making coordination and rescue difficult. Therefore, it is important to have reliable communication alternatives when the telecommunications network is down. One effective solution is the use of radio frequency (RF) for disaster radio communications. Disaster response agencies often have their own frequency channels for internal coordination that are used when a disaster occurs. This situation can make communication between the various disaster response agencies difficult. MCI[231] (DG-SDPPI[232]) has developed an initiative to organize disaster

[230] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0218/ from Indonesia.
[231] MCI: Ministry of Communication and Informatics (https://www.komdigi.go.id/).
[232] DG-SDPPI: Directorate General of Resources Management and Equipment of Posts and Informatics (https://sdppi.kominfo.go.id).

radio communication simulation exercises involving disaster response agencies (BNPB[233], Basarnas[234], BMKG[235], BPBD, BRIN[236]), community radio organizations (ORARI[237], RAPI[238]) and disaster community activists or volunteers. The simulation exercise includes preparing radio communication procedures and call signs, dissemination of disaster data and information, and simulation of disaster scenarios (pre-disaster, disaster, and post-disaster). These simulations use shared radio frequencies assigned by DG-SDPPI, and include the use of radio communications via satellite.

Disaster radio communications framework and simulation: In accordance with the provisions of Article 20 of Law No. 36 (1999), concerning telecommunications, every telecommunications operator is obliged to give priority to the sending, distribution, and delivery of important information relating to state security, safety of human life and property, natural disasters, distress, and disease outbreaks. Law No. 24 2007, provides guidelines for disaster management. In order to support the implementation of these provisions, DG-SDPPI has prepared instructions for the management of disaster radio communications, to be used as guidelines for the "radio frequency monitoring offices" that support the communication and dissemination of disaster information, in order to accelerate the recovery of telecommunication infrastructure and broadcasting capability. Disaster radio communication is employed in the pre-disaster, disaster, and post-disaster stages.

a) **Pre-disaster stage**: Under normal conditions 'pre-disaster' involves activities to ensure the readiness of telecommunications and broadcasting infrastructure to support disaster management.

b) **Disaster phase**: When a disaster occurs this phase comprises activities to ensure the availability of radio communications during the disaster response, including:

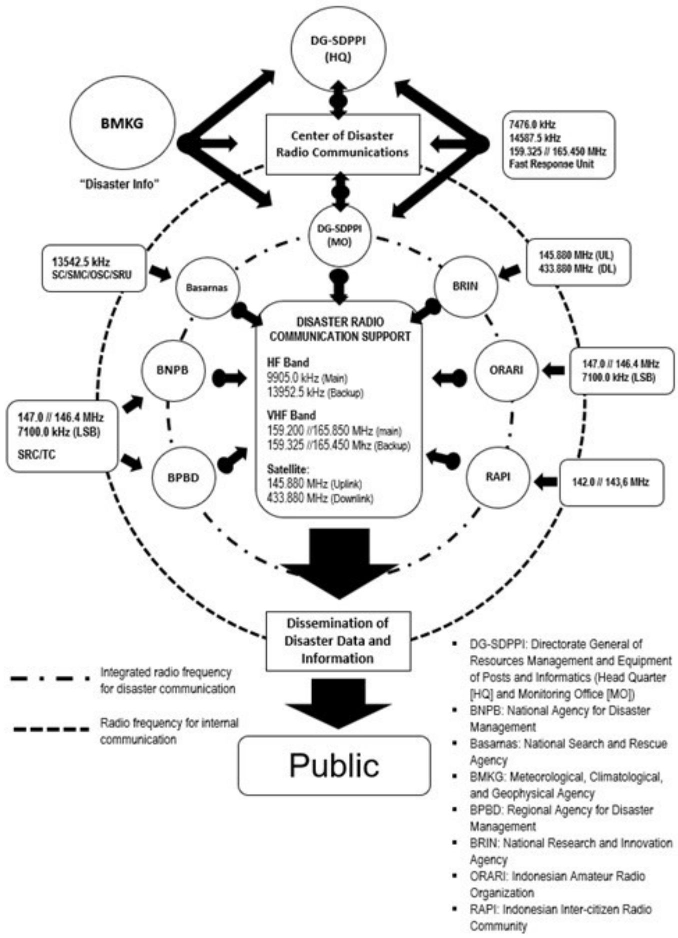
   - Disaster incident reports, containing information on disaster situations, the availability of radio communication and monitoring equipment, the condition of telecommunication infrastructure, and information on broadcasting affected by the disaster.
   - Collaboration with stakeholders and communities.
   - Utilizing the Centre for Disaster Radio Communication.
   - Providing disaster radio communication.

c) **Post-disaster phase**: The recovery period this phase is carried out through activities to support the provision of radio communication networks in affected disaster areas and accelerate the recovery of telecommunications infrastructure and broadcasting capabilities.

The DG-SDPPI has developed disaster radio simulation procedures involving stakeholders and communities. These procedures include the flow of disaster communication coordination, call signs, and procedures for conveying information via available communication channels. A mapping of the roles of disaster response agencies and radio communities, etc. in disaster radio communication is shown in Figure A-48.

233 BNPB: National Agency for Disaster Management (https://bnpb.go.id/).
234 Basarnas: National Search and Rescue Agency (https://basarnas.go.id/).
235 BMKG: Meteorological, Climatological, and Geophysical Agency (https://www.bmkg.go.id/).
236 BRIN: National Research and Innovation Agency (https://brin.go.id/orpa).
237 ORARI: Indonesian Amateur Radio Organization (https://orari.or.id/).
238 RAPI: Indonesian Inter-citizen Radio Community (https://brin.go.id/orpa).

Figure A-48: Disaster radio communication simulation scheme



- BNPB as coordinator for national disaster
- BPBD as coordinator for regional disaster
- Basarnas as coordinator for national search and rescue
- SAR Office for search and rescue of disaster-affected victims
- ORARI, RAPI, and communities are to support radio communication equipment and its human resources
- DG-SDPPI is coordinator of the disaster radio communication centre to support disaster radio communication infrastructure, provide radio frequency allocation, and collaborate with communities

The radio frequencies used for disaster radio communications and for sharing with stakeholders and the community are as follows:

- Band HF: Main: 9 905.0 kHz; Backup: 13 952.5 kHz
- Band VHF: Main: 159.200 MHz (Tx) and 165.850 MHz (Rx); Backup: 159.325 MHz (Tx) and 165.450 MHz (Rx)

Disaster radio communication support simulations are carried out at the pre-disaster, disaster, and post-disaster phases. Persons engaging in the disaster radio communication simulation scheme are shown in Figure A-49.

Figure A-49: Disaster radio communication simulations

The role of DG-SDPPI in disaster management: DG-SDPPI comprises 35 monitoring offices spread across all provinces in Indonesia, that are equipped with radio communications and radio frequency monitoring equipment. The nearest monitoring office will engage with the disaster area to support radio communication. Other monitoring offices will provide support. Dissemination of data and information to combat hoaxes or fake news can be achieved through collaboration with stakeholder disaster response agencies and communities. Provision of a shared frequency that can be used by the "incident commander" to coordinate with stakeholder disaster response agencies and communities results in reliable and valid information for the public. The role of DG-SDPPI in disaster management is as follows:

- Mapping the roles of stakeholder disaster response agencies and communities in disaster radio communications.
- Providing maps of telecommunication infrastructure and broadcasting as well as existing disaster radio communications, both national and regional.
- Providing technical guidance and workshops to stakeholder disaster response agencies and communities to increase competency in disaster radio communications.
- Providing radio frequency allocation for disaster radio communications that stakeholder disaster response agencies and communities can use.
- Building the Centre of Disaster Radio Communication.
- Collaboration with stakeholder disaster response agencies and communities for disaster preparedness.
- Providing radio communication and monitoring equipment belonging to the monitoring offices to be used when a disaster occurs.
- Disaster radio communication simulations and periodic radio check-ins to ensure disaster preparedness involving stakeholder disaster response agencies and communities. In addition, the radio frequencies provided for satellite communications are 145.880 MHz (uplink) and 433.880 MHz (downlink).

Conclusion: Collaboration between stakeholder disaster response agencies and communities in providing integrated disaster radio communication supports the Government of Indonesia in reducing disaster risks and increasing public awareness of disasters. Disaster radio communication simulations increase the competency of stakeholder disaster response agencies and communities in disaster management and in the use of radio communication. Using shared frequencies makes coordination more effective and efficient. In addition, reliable and valid information can be conveyed to the public without suffering the effects of hoaxes and fake news. This programme aligns with sustainable development goals (SDGs) in terms of making cities inclusive, safe, resilient, and sustainable, especially in disaster risk reduction and management.

A1.7 Other cases of disaster preparation, response, and recovery

A1.7.1 Earthquake response in Türkiye February 2023 (Türkiye)[239]

Overview of the earthquake-affected region: On 6 February 2023, two major earthquakes hit Türkiye, with the epicentres in the Pazarcık (Mw 7.7; focal depth: 8.6 km) and Elbistan (Mw 7.6; focal depth: 7 km) districts of Kahramanmaraş, at 04:17 and 13:24 local time, respectively. On 20 February 2023, another earthquake with a magnitude of Mw 6.4 occurred, with the epicentre at Yayladağı, Hatay, at 20:04 local time. These earthquakes, all of which were unprecedented in recent history in terms of magnitude and coverage, caused major devastation in a total of 11 provinces. The earthquakes claimed the lives of more than 48 000 people, wreaked damage to over half a million buildings, as well as communication and energy structures, and led to

[239] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0090/ from Türkiye.

significant financial losses. The total population of the 11 provinces affected by the earthquake was registered as 14 013 196 persons in 2022, accounting for 16.4 per cent of the national demographic.[240]

A1.7.1.1 Communication status

The Information and Communication Technologies Authority (BTK) in Türkiye, is the regulatory authority for the electronic communication and posts sector. Operators providing services in the electronic communication sector are obliged to make business continuity plans to ensure the continuity of services, and to take necessary measures to ensure the operation of critical systems in the event of a disaster. As of the third quarter 2022[241], there were 464 authorized operators 840 authorizations were granted to these operators. There are 11.5 million fixed telephone subscribers and approximately 91 million mobile subscribers, with 91.4 million broadband Internet subscribers in Türkiye. The length of fibre-optic infrastructure was approximately 500 000 km. Prior to 6 February, the number of mobile subscribers in 11 provinces exceeded 15 million, while the total number of mobile subscribers in these provinces constituted approximately 16.7 per cent of the mobile subscribers in all of Türkiye. In other words, the great disaster affected one of every six mobile phone subscribers in the country. The key indicators for 2022, for the electronic communications sector in the earthquake-affected region are presented in Table A-7.[242]

Table A-7: Key Indicators for electronic communications sector, by Province (2022)

	Population	Number of fixed telephone access lines	Number of mobile phone subscribers	Number of fixed broadband Internet subscribers	Number of mobile broadband subscribers	Fibre-optic cable length
Adana	2 274 106	201 059	2 353 513	459 130	2 019 392	10 980
Adıyaman	635 169	50 099	658 680	78 530	597 103	3 165
Batman	634 491	42 618	455 759	64 662	422 037	2 361
Diyarbakır	1 804 880	92 667	1 515 599	192 953	1 117 182	6 764
Elazığ	591 497	72 125	535 605	96 409	449 384	4 818
Gaziantep	2 154 051	161 904	1 941 159	387 578	1 693 922	8 128
Hatay	1 686 043	148 862	1 529 763	294 313	1 333 527	6 078
Kahramanmaraş	1 177 436	105 904	1 004 781	180 849	872 654	6 729
Kilis	147 919	13 308	169 317	25 617	143 953	1 114
Malatya	812 580	100 650	715 683	143 209	631 164	5 676
Mardin	870 374	53 645	619 924	97 017	568 454	4 113
Mersin (İçel)	1 916 432	182 243	1 639 320	428 456	1 349 009	9 849

240 https://www.sbb.gov.tr/wp-content/uploads/2023/03/2023-Kahramanmaras-and-Hatay-Earthquakes-Report.pdf.
241 https://www.btk.gov.tr/uploads/pages/pazar-verileri/2022-3-k-disi-3ocak-63f71da4999a3.pdf
242 https://www.btk.gov.tr/uploads/pages/yillik-il-istatistikleri/2023.pdf

Table A-7: Key Indicators for electronic communications sector, by Province (2022) (continuación)

	Population	Number of fixed telephone access lines	Number of mobile phone subs-cribers	Number of fixed broadband Internet subscribers	Number of mobile broadband subscribers	Fibre-optic cable length
Osmaniye	559 405	47 026	458 436	85 382	419 502	2 874
Şanlıurfa	2 170 110	95 291	1 520 795	159 234	1 415 637	6 268
Regional Total	**17 434 493**	**1 367 401**	**15 118 334**	**2 693 339**	**13 032 920**	**78 917**
Türkiye	**85 279 553**	**11 197 928**	**90 297 565**	**18 998 803**	**71 651 056**	**517 325**

The physical collapse of buildings and the heavy damage to some of the base stations on the buildings affected mobile communication in the region. In mobile services there was no loss of service in the core network, and there was no problem at the interconnection points. The main problems in communication were due to the power outages, difficulties in fuel supply, and the bad weather conditions.

A1.7.1.2 Post-earthquake actions

After the earthquake, under the coordination of the Disaster and Emergency Management Agency (AFAD), a Disaster Emergency Relief Coordination Group consisting of government ministries, relevant institutions and stakeholders carried out their duties. The Türkiye Disaster Response Plan (TAMP) was prepared in 2014, to ensure effective response to disasters in line with the experiences gained from previous disasters. The TAMP ensured identification of the roles and responsibilities of the working groups and coordination units, and determined the basic principles of response planning before, during, and after disasters. The TAMP includes government ministries, institutions, and organizations, as well as the private sector, non-governmental organizations, and the people, that would take part in responding to potential disasters and emergencies of all types and scales that could occur in Türkiye. The "Communications Disaster Group"[243] which includes the Ministry of Transport and Infrastructure, BTK, and the operators, came together within the framework of the TAMP and started to work from the first moment the earthquake occurred. Operators were instructed to deliver all trailer mobile base stations to the disaster area. 40 trailer-type mobile base stations and 500 mobile base stations, and emergency communication vehicles, and nearly 2 200 personnel were dispatched to the region. VSAT satellite terminals and Wi-Fi access points were installed in the earthquake area. As one of the main problems in communication was due to the power outages and difficulties in fuel supply, 3 500 generators were sent to the region. Wireless access points were provided for Internet needs in the temporary settlement areas. One of the main tasks of BTK is to protect consumer rights and interests. In this context, to give an immediate response, a regulatory decision was taken after the earthquake by the BTK Board on 14 February 2023.[244]

[243] https://www.afad.gov.tr/kurumlar/afad.gov.tr/e_Kutuphane/Planlar/TAMP.pdf
[244] https://www.btk.gov.tr/uploads/boarddecisions/deprem-felaketi-sebebiyle-alinacak-tedbirler/66-2023-web.pdf

The Board decision advised operators to provide various facilities to consumers affected by the earthquake, such as:

- Providing free services and benefits to subscribers for a minimum of one month.
- Postponing the payment date of bills for at least one month.
- No fees for SIM changes or changes of service address, no charge for early terminations of committed term contracts, etc.
- Clearing of bills and waiving of receivables related to communication services for the subscribers who lost their lives in the earthquake.
- For subscribers who cannot reach their identity documents, operators will use alternative methods for verifying their identity for SIM changes and SIM card requests.

Implementation dates of some newly enacted regulations were also postponed by 2-4 months to encourage the operators to focus on the measures they needed take due to the earthquake. Apart from all above, to contribute to the normalization and relief effort in the region, A BTK Academy mobile technology truck arrived in the region and provided training for children on various subjects such as coding and robotics. Approximately 150 children per day received training in the mobile classrooms of BTK Academy.

A1.7.1.3 Recovery period, business continuity and risk assessment

Following the earthquake, operators were instructed to review their business continuity plans and the resources for use in emergency situations. Special attention was drawn to the following issues and requirements:

- To increase redundancy and fibre-optic connections to the base stations especially for radio link connected sites.
- To increase resources such as mobile base stations, generators, and batteries to be used in the emergency.
- To use national roaming in case of emergencies.
- To update the risk analysis for critical infrastructure based on the geographical data sets and maps and relocate the base stations that are in the high-risk areas.
- To review supply plans in collaboration with local energy supply companies and take necessary measures to provide continuous energy for communication infrastructure and systems in the event of disasters.

In addition, the national risk shield model of Türkiye is currently being developed with the participation of all stakeholders.

A1.7.2 Building resilient infrastructure in Japan - Early recovery response to the Noto Peninsula Earthquake (Japan)[245]

Strengthening measures in preparation for large-scale disasters: Given the importance of mobile communications, and especially of mobile phones, which often serve a lifeline during disaster events, it is extremely important to strengthen the disaster resistance of communications infrastructure. In Japan, and particularly since the Great East Japan Earthquake of 2011, mobile phone carriers have been working to strengthen measures against transmission line interruptions, power outages, and equipment failures. *1 Additionally, the Ministry of Internal Affairs and

[245] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0220/ from Japan.

Communications (MIC) has amended relevant ministerial ordinances requiring businesses to strengthen countermeasures, *2 deployed mobile power supply vehicles, and created a response team (MIC-TEAM) that provides disaster response support to secure means of information and communication in the event of a disaster. MIC also made it mandatory for mobile phone base stations that cover important locations, such as municipal offices, to take measures against power outages for at least 24 hours *3 to ensure communication during disasters. In addition, since it is important to secure a means of communication so that administrative agencies can operate smoothly even when communication services, such as mobile phones, have stopped, MIC has established a satellite mobile phone network. By stockpiling rental radio equipment and deploying it in each region, MIC have established a system that will enable efficient lending of satellite mobile phones, etc. to local government authorities. Furthermore, in order to secure electricity and fuel, MIC cooperates with related ministries and agencies, through liaison systems and by conducting joint training exercises. Telecommunications carriers, the Ministry of Defence, and the Self-Defence Forces have concluded agreements regarding mutual cooperation in securing communications during disasters, including the implementation of training exercises, the sharing of information important for recovery activities during disasters, and the provision of recovery materials and supplies. Efforts are being made to strengthen cooperation regarding the transportation of disaster recovery personnel.

*1 Mobile phone carriers have installed over 800 satellite entrance lines that connect mobile base stations via satellite. As of March 2023, the four mobile carriers have over 4 300 mobile power supply vehicles and portable generators, and 24-hour backup power, to cover problems with terrestrial lines, as well as over 11 400 time-based base stations.

*2 The Business Telecommunications Equipment Regulations (Ministerial Ordinance) were revised in 2012. The revised regulations include provisions for strengthening the disaster resistance of transmission line equipment, strengthening power outage countermeasures, and strengthening large-scale disaster countermeasures.

*3 In response to the widespread and long-term outage of mobile base stations in the Kanto region due to the power outages caused by a typhoon in 2019, the information and communication network safety and reliability standards (notifications) were revised in 2020. The revised standards require 24-hour backup power for mobile phone base stations that cover municipal offices and recommend 72-hour backup power for prefectural offices, remote islands, and other offices that are difficult to reach.

Early recovery response to the Noto Peninsula Earthquake. In response to the Noto Peninsula Earthquake in January 2024, MIC collaborated with telecommunications carriers to immediately collect damage information, and dispatched the MIC-TEAM to quickly restore telecommunications services to Ishikawa Prefecture. For mobile services, the service coverage area in six cities and towns in the northern part of the Noto Peninsula had decreased to less than a third of the pre-disaster service coverage area, due to commercial power outages, equipment failures, collapse or damage to base stations, and disconnection of transmission lines. Problems occurred in 70 to 80 per cent of areas. To restore mobile phone services quickly, telecommunications carriers installed emergency recovery equipment, such as mobile power supply vehicles and portable base stations.

*4 As a result of mutually coordinated efforts, which included coordinating with related organizations for the transportation of fuel and personnel, and in the of clearing roads, the emergency restoration work was largely completed by mid-January, just two weeks after the earthquake.

*5 for transporting fuel and personnel and clearing roads, emergency restoration work was largely completed in mid-January, except for difficult-to-access areas.

In addition, to ensure a communication environment at evacuation centres and other locations, mobile phone carriers lent approximately 660 satellite Internet devices (Starlink terminals) free of charge and provided mobile terminals, etc. MIC also provided mobile power supply vehicles and mobile terminals. MIC had been working on collaborative efforts, such as the renting out of communication equipment such as satellite mobile phones. While major roads were cut off by landslides and restoration work was difficult, the preparations and countermeasures that had been undertaken by the public and private sectors were put to good use.

*6 A maximum of approximately 330 power supply vehicles and generators are available for both the public and private sectors. Additionally, each carrier operates up to approximately 100 in-vehicle/portable base stations.

*7 Some examples are that the Japan Maritime Self-Defense Force provided transport ships to refuel and transport recovery equipment to difficult-to-reach areas, and the Ministry of Land, Infrastructure, Transport and Tourism made road clearance necessary for base station restoration work.

Prospects for securing communications in the event of future disasters. During this disaster response phase, efforts were made by mobilizing all possible means, including emitting radio waves from coastal areas using ship-based base stations and covering the area with temporary base stations using drone technology. In addition, satellite internet equipment (Starlink terminals) was widely used as a replacement when the optical fiber to mobile base stations was cut off, and to secure a means of communication at evacuation centers. The MIC conducted the necessary verification of the causes of the disaster and its response and took into account the progress made in efforts to utilize new technologies, such as satellites and drones, as well as the progress made in public-private collaboration. Efforts will be made to further strengthen the communication environment so that communication will not be disrupted from time to time. In addition, Japan will introduce "inter-operator roaming" by the end of fiscal 2025, which allows mobile phone users to temporarily use another carrier network in the event of an emergency.

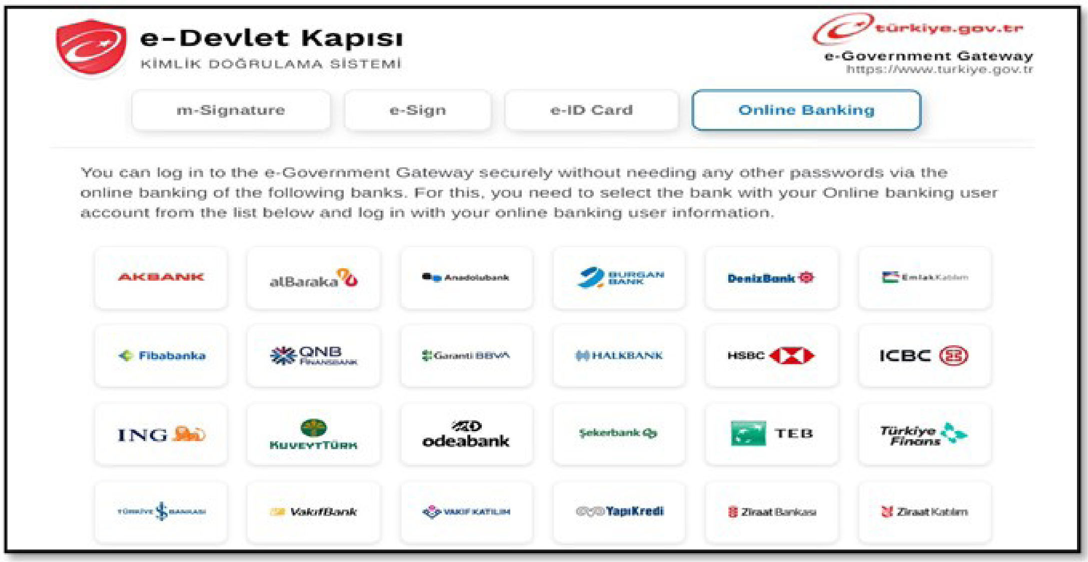
A1.7.3 Electronic contract termination service through the e-Government gateway (Türkiye)[246]

Necessity for an electronic contract termination service: Consumers receiving services from operators in Türkiye were only able to apply for termination of their subscription contracts in written form in accordance with the legal regulations in the electronic communications sector. In order to facilitate the termination of contracts by consumers, the Law on Electronic Communications was amended in 2020 to remove the written form requirement.

Implementation of the Regulation. With the aforementioned regulation, secure login methods, as shown in Figure A-50, have been developed in order to ensure that applications for termination of subscription contracts can be made safely through eDK.

[246] ITU-D Document https://www.itu.int/md/D22-SG01-C-0345/ from Türkiye.

Figure A-50: Image of eDK



The electronic contract termination service has been welcomed by consumers and especially by disadvantaged groups (such as the elderly, persons with disabilities, etc.) and those living in rural areas, as it ensures the protection of consumers in situations where physical contact is difficult, such as during epidemics. It also allows subscription contracts to be easily terminated without the need to go to operators' dealerships or shops. The electronic contract termination service received an award in the e-Government category at the World Summit on the Information Society 2022, (WSIS Prizes)[247].

A1.7.4 Integration of drones across the four key phases of DRM - mitigation, preparedness, response, and recovery (Rwanda)[248]

Rwanda, is vulnerable to various natural disasters, including floods, landslides, earthquakes, and droughts. With the increasing frequency of these disasters due to climate change, there is a growing need to integrate technology in disaster risk management (DRM). The United Nations Office for Disaster Risk Reduction (UNDRR) highlights the importance of adopting technologies to enhance disaster preparedness, reduce risks, and ensure effective response and recovery (UNDRR, 2020). This focuses on the role of drones in the four key phases of DRM: mitigation, preparedness, response, and recovery, and provides a detailed analysis of their application in the context of Rwanda.

Disaster risk management (DRM) phases. Disaster risk management consists of four phases: mitigation, preparedness, response, and recovery. Each phase is crucial in minimizing the impact of disasters on human lives, infrastructure, and the environment.

[247] https://www.itu.int/net4/wsis/stocktaking/Prizes/2024/Details/16427478805122477
[248] ITU-D Document https://www.itu.int/md/D22-SG01-C-0434/ from Rwanda.

Figure A-51: Four phases of disaster risk management

Source: ITU 2020

Mitigation: Mitigation refers to efforts to reduce the potential impact of disasters before they occur. Mitigation involves the implementation of long-term measures aimed at reducing risks posed by natural hazards. Drones can play a critical role in this phase by conducting aerial surveys to identify areas prone to flooding, landslides, or other hazards. These surveys provide accurate data for mapping and monitoring risk-prone areas in Rwanda, which can help in planning infrastructure development and enforcing land-use regulations. For instance, drones equipped with geographic information systems (GIS) technology can produce detailed maps of flood-prone areas along the Nyabarongo River, which is essential for designing effective flood mitigation strategies (Johansen et al., 2019).

Preparedness: Preparedness focuses on equipping individuals, communities, and governments with the tools and knowledge necessary to manage potential disasters. In this phase, drones can be used to simulate disaster scenarios and assess vulnerabilities. Their ability to capture real-time data enables the generation of risk models, which can be used to design EWSs. Drones can also be employed to inspect critical infrastructure such as dams and bridges in Rwanda, ensuring they are resilient to potential hazards. Rwanda's National Risk Atlas already highlights vulnerable regions, and integrating drone technology into national preparedness strategies could enhance these assessments *(National Risk Atlas of Rwanda published by the ministry in 2015)*.

Response: The response phase deals with immediate actions taken during or after a disaster to save lives and minimize damage. In disaster-stricken areas, drones can be deployed to assess the situation and provide real-time images of affected zones. This allows rescue teams to prioritize resources and deploy personnel more effectively. Drones can also deliver medical supplies, food, and water to hard-to-reach areas, as demonstrated during the flood crisis in 2018, in the Western Province of Rwanda, where roads were inaccessible (Moore et al., 2021). In Rwanda, drones could be especially valuable in mountainous regions, where traditional access can be challenging.

Recovery: Recovery involves rebuilding affected communities and restoring normalcy after a disaster. In this phase, drones can be used to monitor the progress of reconstruction efforts and ensure that rebuilding projects comply with safety and sustainability standards. Aerial surveys conducted by drones can also help identify areas where rehabilitation efforts are still needed. In the aftermath of the 2020 floods in Musanze District, for example, drones could have facilitated a quicker assessment of damaged infrastructure, expediting the recovery process (Johnson et al., 2021).

The role of drones in disaster management in Rwanda: The Vision 2050 plan outlines the importance of integrating modern technologies into national development efforts, including disaster management. The Government of Rwanda has already shown a commitment to using drones in various sectors, such as healthcare (e.g., delivering blood supplies via Zipline drones). Expanding the use of drones in disaster management is a logical next step. The National Disaster Management Policy (NDMP) of Rwanda highlights the need for EWSs, risk assessment, and efficient response strategies, all of which can be enhanced through drone technology (NDMP, 2018).

Cost-effective and accessibility: One of the key advantages of drones is their cost-effectiveness compared to traditional methods of monitoring and assessment. For example, conducting a manned aerial survey over a flood-prone area is significantly more expensive and time-consuming than deploying a drone. Drones can quickly gather data from remote areas that would otherwise be difficult or dangerous to access, particularly in regions like the Northern Province, which is prone to landslides.

Environmental monitoring and EWSs: Drones equipped with sensors and cameras can be used to monitor environmental changes and provide early warnings of potential disasters. For instance, a drone monitoring river levels in flood-prone areas could alert authorities to rising water levels, triggering evacuation plans. This technology can also be used to monitor landslide-prone areas such as the slopes of the Virunga Mountains, providing crucial data that can inform mitigation measures.

Challenges and opportunities: While drones present numerous benefits, there are also challenges to their widespread adoption in the disaster management efforts of Rwanda. Regulatory frameworks governing the use of drones need to be strengthened to ensure safe and effective deployment during disasters. Additionally, there is a need for financial investment and capacity building in terms of training of personnel to operate drones and interpret the data they collect. On the other hand, the opportunities are immense. Rwanda's investment in ICT infrastructure provides a strong foundation for the integration of drones into DRM. By collaborating with international organizations and the private sector, Rwanda can continue to enhance its disaster management capabilities using drones.

Conclusion: In conclusion, the use of drones in disaster risk management in Rwanda can significantly improve the ability of the country to mitigate, prepare for, respond to, and recover from disasters. As climate change continues to exacerbate the frequency and intensity of natural disasters, it is imperative that Rwanda continues to invest in technology-driven solutions such as drones to enhance its disaster management efforts. By addressing the regulatory and operational challenges, Rwanda can lead the way in using drones for effective DRM, protecting lives and ensuring sustainable development. By utilizing advanced technologies such as AI, ICT, and data analytics, drones can become invaluable tools in improving situational awareness and decision-making processes during disasters. The choice between establishing an in-house drone fleet, and leveraging drone-as-a-service models depends on various factors, including cost, control, and operational needs. Regardless of the approach, the strategic deployment of drones will play a crucial role in building a resilient disaster management framework in Rwanda, ultimately contributing to the safety and well-being of its citizens.

References

Johansen, K., Tiede, D., & Blaschke, T. (2019). Drones for urban and environmental monitoring. Journal of Geographic Information Science, 12(3), 123-145.

Moore, J., et al. (2021). Disaster response and UAVs: A case study in East Africa. Disaster Management and Prevention, 22(4), 231-245.

Rwanda Ministry of Disaster Management and Refugee Affairs. (2015). National Risk Atlas. Kigali: Government of Rwanda.

Johnson, L., et al. (2021). Post-disaster recovery and infrastructure: The role of drones in Rwanda's flood response. Urban Disaster Studies, 9(2), 98-109.

National Disaster Management Policy (NDMP). (2018). Kigali: Government of Rwanda.

United Nations Office for Disaster Risk Reduction (UNDRR). (2020). The Role of Technology in Disaster Management. Geneva: UNDRR.

A1.7.5 The ETC return on investment (ROI) model: Informing risk-resilient telecommunications infrastructural development (WFP-ETC)[249]

Introduction and background: Successful disaster management relies on resilient infrastructure, including resilient telecommunications infrastructure. In 2021-22, the Emergency Telecommunications Cluster (ETC), led by the World Food Programme (WFP), developed a rate of return on investment (ROI) model for assessing the benefits of investment in emergency telecommunication preparedness, with the aim of generating empirical evidence of cost effectiveness, and ultimately of encouraging humanitarian-development stakeholders to build more disaster-resilient telecommunications. This model quantifies and qualifies the benefits of investments in emergency telecommunications preparedness, particularly in terms of:

- Providing decision-makers with insights that make a case for greater and more sustained investments in disaster-resilient emergency telecommunications which, in turn, can further reduce devastating impacts of disasters.
- Improving the qualitative and quantitative analyses that support pre- and post-disaster assessments of telecommunications infrastructure.
- Encouraging resilient, redundant, and interoperable communications in support of disaster response and recovery efforts.

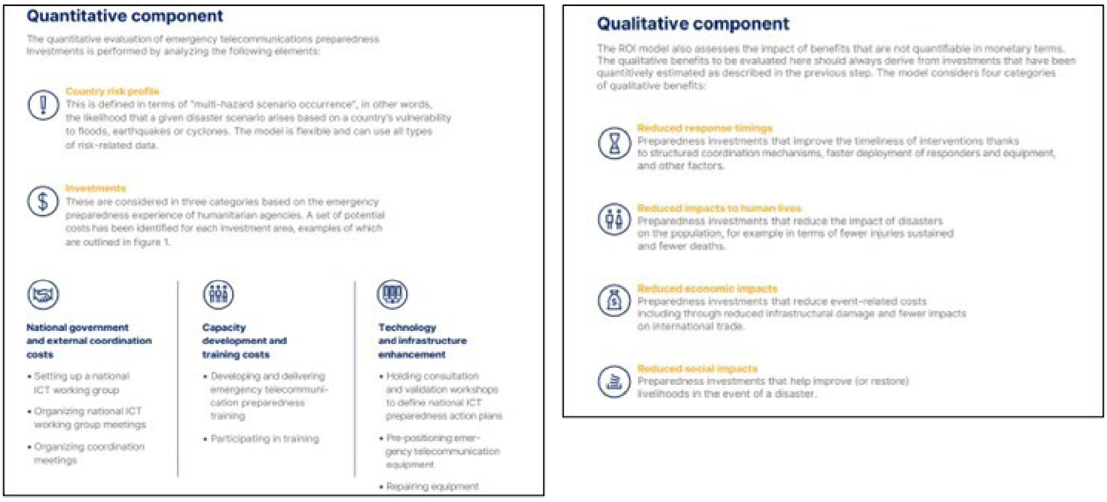
Challenges the ROI model addresses: As disasters become more frequent and severe, a growing number of telecommunications, regulatory, and disaster management authorities have expressed a keen interest in enhancing preparedness and communications network resilience. However, the desire alone to enhance national telecommunications preparedness and ICT network resilience is not in itself sufficient. Investment-benefit numbers drive decision-making, informing national budgeting and planning efforts. These insights gave rise to development by the ETC of this first-of-its-kind ROI model to quantify and qualify emergency telecommunications preparedness and investment efficacy, which is reflected in an investment-benefit ratio. Since this model was first presented at the ITU-D Question 3/1 workshop in spring 2023, it has been applied to three country contexts by the WFP-led ETC in Mozambique (2021-22), Madagascar

[249] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0202/ from World Food Programme-led Emergency Telecommunications Cluster (WFP-ETC).

(2022-23), and Dominican Rep. (2023-2024). This contribution will discuss the following high-level findings and recommendations, with reference to application of this model:

Problem statement and ROI model considerations: This evidence-based model seeks to inform the decision-making of donors, government, and other humanitarian actors, by identifying priority pre-emptive emergency telecommunication investments. The results of the model will indicate whether sustained investment in enhanced stakeholder coordination, national-level capacitation, and infrastructural readiness could improve the efficiency of disaster response, and what forms such investment could take. The ROI model is designed to be used by all development-humanitarian partners engaged in emergency telecommunications preparedness, including WFP. It is based on the practical emergency preparedness expertise and experiences of the ETC in different countries. All humanitarian partners involved in emergency preparedness, particularly within the emergency telecommunications sector, can readily apply the model using their own data. The model consists of two dimensions, the qualitative and quantitative, whose constituents are shown in Figure A-52 below.

Figure A-52: Qualitative and quantitative components of the ROI model



Underlying assumptions in the quantitative and qualitative application of the ROI model include:

- The quantitative ROI model focuses only on investments and benefits that are quantifiable from an economic standpoint. All other benefits stemming from investments in emergency telecommunications preparedness are evaluated using a qualitative approach.
- The model only considers risks related to three types of rapid onset high-impact disasters (cyclones, earthquakes, and floods).
- The model also reflects a discount rate to reflect the depreciation of infrastructural assets over time, that is consonant with the life-cycle of physical infrastructure.
- When evaluating the risk of a particular scenario occurring (while creating the country risk profile component), the assumption is that each disaster event (be it cyclone, flood, or earthquake) is independent of the others, with the Emergency Events Database (EM-DAT) as the principal data source.
- Different global warming scenarios alter the likelihood of an event occurring considerably, introducing a high degree of volatility in the overall model. Therefore future-facing climate data is not directly factored into the model.

Brief ROI application case in Mozambique, Madagascar, and Dominican Rep.: The ROI model was launched by the ETC after a nearly a year-long development process, devised in collaboration with Deloitte Italy. The approach was initially shared with Cluster partners for feedback and validation and ultimately was published online in early 2022. Based on advocacy efforts by the ETC, complemented by country interest post-disaster, the model was initially applied in Mozambique as a pilot following Cyclones Kenneth and Idai, then applied subsequently in Madagascar post-Cyclone Batsirai, and most recently in Dominican Rep. following Hurricane Fiona. The application of the ROI model following emergency communications responses sought to demonstrate the efficacy of preparedness investments in the aftermath of a disaster. WFP country offices, in collaboration with the ETC team collaborated to collect the data. Data-entry was undertaken by the ETC in two cases, and by a WFP Country Office in one case. National government focal points from the ICT authority and/or disaster management agency were involved, to ascertain more granular insights, both quantitatively and qualitatively. The investment-benefit data drew principally on WFP and ETC investments made in emergency preparedness, and the benefits were derived based on an avoidance cost premise. The flexibility of the model in terms of reflecting context-specificities enabled data entry for these three country contexts without modifying the core structure of the model. A snapshot of the results for the three application cases is available at Annex 3 of the full ROI study, and is available at https://www.etcluster.org/document/return-investment-roi-model. As per Annex 3, the final ROI numbers range from 2.96 to 2.47, reflecting that for all three country cases, for every 1 USD invested in emergency telecommunications preparedness, the returns in terms of quantifiable savings in times of disaster response are more than double. For Madagascar and Mozambique, the ROI is just under triple. These results were presented in each country to the national emergency telecommunications preparedness stakeholders and WFP country teams to inform decision-making, as well as for identifying planning and budgeting opportunities. Briefings were also conducted for the ETC Cluster partners who engage in coordination and provision of communications in emergencies, and the model was shared at different humanitarian-development forums including the Humanitarian Networks and Partnerships Weeks 2022.

Good practices and lessons learned in ROI application. In each country where the ROI model has been applied, it has proven, in quantifiable terms, that investing in emergency communications preparedness capacity development and coordination pays off ahead of a disaster, with an ROI at least double that of the initial investments made in emergency preparedness.

- ROI model results can be used to advocate for increased preparedness and resilience awareness. The results can then be leveraged to encourage donor finance for emergency communications preparedness efforts. One application country cited the ROI in a successful proposal for increased emergency preparedness in capacity building and infrastructure enhancement terms.
- In one case, a government used the ROI findings to report against progress on UN parameters covering resilience and disaster readiness, when reporting to the Sendai Framework.
- Investments in more resilient communications infrastructure must consider capacity and maintenance efforts that enable communications networks to remain functional over time and during disasters or other disruptions. This includes maintenance schedules and regular inspections, testing and refurbishment of communications network equipment.
- Ensuring redundant back-up power capabilities is crucial for maintaining and restoring communications in emergencies.
- Multi-hazard risk profiling is a crucial layer informing the overall ROI analysis that contextualizes the investment-benefits information in a multi-risk context.

- Knowing the "spread of investments", or simply the investments made by category across coordination, capacity development and infrastructure, helps in strategizing national planning and budgeting decisions. Understanding how these investments are distributed has helped both national partners and the ETC to consider supporting, or enabling, specific operational and capacity development support activities in-country.
- The highest returns on investments do not always lie in the sector that receives the highest investment. In all three country cases, though investments in infrastructure were among the highest expenditures, the financial returns for increased coordination and capacity development terms were highest (refer to Annex 3).
- Infrastructure-focused solutions alone are insufficient. Equally important are investments in people. Augmenting infrastructure should ideally be accompanied by investments to increase coordination and capacity development, for example setting up a national ICT emergency coordination mechanism, simulations to test existing standard operating procedures, and targeted trainings to meet national ICT needs.
- Partnerships, communications, and resource mobilisation efforts leveraging ROI findings need to be undertaken simultaneously to be able to truly create opportunities for increasing emergency telecommunications investments.

Next steps and opportunities: Following the successful application of the ROI model in three countries, the key next steps are listed as follows:

- National governments and humanitarian partners are encouraged to contact the ETC for information on the ROI model, and how they might apply it to determine their ROI in emergency telecommunications on their own initiative, with the ETC providing technical/advisory support.
- Applying the model in regional contexts is a point of interest being explored, and if it is feasible to create an aggregated ROI based on multi-country data.
- Trickle-down effects of national to local telecommunications resilience is a challenge and needs particular attention when national investment plans and budgeting activities are undertaken for augmenting coordination, capacity development, and improving infrastructural provisions. In this respect, ensuring investment efforts are distributed to local levels is crucial to build resilience at every level.
- The ETC is currently developing a social rate of return-on-investment model, which will examine the community resilience benefits of investment in emergency telecommunications preparedness.

A1.7.6 BDT report on the emergency telecommunications work including activities, events, and resources[250, 251, 252, 253, 254]

Disaster preparedness

ITU support to the United Nations initiative on 'Early Warning Systems for all': ITU is supporting the United Nations initiative on 'Early Warning Systems for all'. This climate change adaptation measure, announced by the United Nations Secretary-General in March 2022, stipulates that by 2027 every person in the world should be protected by an EWS. To achieve this goal, ITU will highlight the opportunities brought by the growth in digital services to effectively reach and deliver alerts to people at risk; especially over mobile cellular networks, which reach a very large

250 ITU-D Document https://www.itu.int/md/D22-SG01-C-0030/ from BDT.
251 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0062/ from BDT.
252 ITU-D Document https://www.itu.int/md/D22-SG01-C-0169/ from BDT.
253 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0158/ from BDT.
254 ITU-D Document https://www.itu.int/md/D22-SG01-C-0317/ from BDT.

percentage of the population. ITU will work closely with WMO, and other partners, in supporting the United Nations Global Early Warning Initiative by engaging mobile network operators and regulators, as well as identifying and sharing best practices and expertise. WMO, which has been designated to lead on this initiative, presented an 'action plan' on the initiative during COP27, in Egypt in November 2022. On 22 October 2022, ITU presented on the Technical Conference "The UN Global Early Warning Initiative For Climate Adaptation: Early Warnings For All", organized by WMO, to highlight the importance of ICTs, and in particular mobile network and services, in developing effective EWSs. The purpose of the conference is to explore the global EWS value cycle and to develop strategic partnerships in support of a coordinated action plan for this initiative. On 14 Feb 2023, the ITU Regional Office for Africa presented at the WMO Regional Conference on digital technologies on mobile EWSs and the United Nations Early Warnings for All initiative. The presentation highlighted the opportunity to reach more people at risk, presented by the increasing coverage of mobile network and services, shared best practices in Europe on the regulatory approach, and the ITU roles in the overall initiative. ITU participated in a panel session on 'Disaster Risk Reduction and Climate Change: Sustainable Early Warning – Early Action' during the second edition of the European Humanitarian Forum, which took place on 10 March 2023. The session brought together a panel of humanitarian actors and academic experts and discussed opportunities for building efficient multi-hazard EWSs. ITU highlighted the UN Early Warning for All initiative and the opportunities that a growing digital world has for reaching communities at risk. On 21 April 2023, ITU presented the Early Warning for All initiative (EW4All), and the mobile EWSs in the EENA Conference & Exhibition, organized by the European Emergency Number Association (EENA). This event brought together professionals across the public safety field including governments, emergency services, researchers, solution providers, and mobile network operators. ITU BDT is working closely with EENA in the context of the UN Early Warning for All initiative (EW4All), where ITU is leading on the 'Warning Dissemination, and Communication' pillar, to promote mobile EWSs (CB and location-based SMS) as critical technologies to reach people at risk.

During May to October 2023, ITU was actively engaged in the EW4All workshops and events. ITU presented the ITU-led pillar 3 on warning dissemination and communication, including high-level events aimed at raising awareness of EWS, driving the initiative forward, and gaining momentum. These events included the WMO Congress in May 2023, workshops, and the launch of the Africa EW4All initiative, as well as the University College London Warning Research Centre 'Creating Effective Warnings For All' conference. ITU was also represented at the Climate Ambition Summit in September 2023, and the EW4All advisory meeting in October 2023. As part of its work to support the EW4All warning dissemination and communication pillar, ITU released a detailed background paper on "Digital Transformation and EWSs for Saving Lives" in October 2023, to point to the opportunities offered by the growing availability and reach of mobile networks and services to alert communities at risk. The paper also delves into the legislative approach adopted by 33 countries to speed up the implementation of mobile EWS. ITU participated in the Water at the Heart (which is coordinating closely with the EW4All initiative) workshop in Uganda, to present the pillar 3 discussions and activities with key stakeholders in the country, from 15-17 November 2023. ITU participated in the Barbados National Consultative Workshop on Early Warning Systems (EW4ALL) convened on 1 and 2 November 2023, by the United Nations EW4ALL Pillar leaders (UNDRR, WMO, ITU, IFRC), in collaboration with the Department of Emergency Management (DEM) of Barbados. ITU presented the pillar 3 discussions and activities with key stakeholders in the country. ITU participated in the Antigua and Barbuda National Consultative Workshop on Early Warning Systems (EW4ALL) convened on 12 December 2023, by the United Nations EW4ALL Pillar leaders (UNDRR, WMO, ITU, IFRC) in collaboration with the National Office of Disaster Services of Antigua and Barbuda. ITU presented the pillar 3 discussions and activities with key stakeholders in the country.

ITU, together with IFRC, released a video on mobile EWS for saving lives in December 2023, to feature the use cases of CB and highlight the potential of reaching populations at risk through mobile networks. During COP-28, on 1 December, ITU, together with WMO, UNDRR and IFRC, organized a session featuring the potential of AI to accelerate processes and address gaps to achieve the Early Warnings for All initiative. The session 'Early Warnings for All: Artificial Intelligence to unlock the potential of Early Warning Systems', presented recent relevant best practices in the application 'Artificial Intelligence to make early warnings more accessible, efficient, and actionable'. Also during COP-28, commitments and pledges from the mobile and satellite community to support multi-channel alert dissemination under EW4All were featured in a side event on 4 December 2023 titled 'Digital connectivity and technologies for the Early Warning for All initiative'. This side-event was part of the ITU-led Green Digital Action track. ITU participated the EW4All kick-off workshop in Fiji on from 29 February to 1 March 2024, to present the approach on warning dissemination and communication and lead the gap analysis to identify gaps and priorities. There were National Launch & Consultation Workshops on Early Warnings for All (EW4All) initiative, in countries such as Comoros (15-19 April 2024), Republic of Djibouti (7-8 May 2024), Ecuador (2-3 July 2024), Republic of Liberia (22-23 July 2024), and Republic of Seychelles (30-31 July 2024).

ITU is spearheading the development of an AI-powered advanced visualization tool that will improve the assessment of subnational connectivity levels during and after disasters, facilitating more effective communication in high-risk areas. Launched in 2020, with the United Nations Emergency Telecommunications Cluster and GSMA, the Disaster Connectivity Map has been activated over 50 times in more than 30 countries, aiding first responders, United Nations agencies and governments by providing near real-time information on communication network status. The tool developed in partnership with Microsoft AI for Good Lab, IHME at the University of Washington, and Planet utilizes AI to rapidly analyse satellite imagery and generate high-resolution, time-enabled population density maps. It also processes and visualizes connectivity data, offering both historical baselines and real-time performance maps. The tool plays a key role supporting EW4All by identifying gaps in telecommunication coverage and assessing which messaging channels (fixed broadband, 2G SMS, 3G+, etc.) are available for disseminating early warning notifications. By quantifying the offline population, meaning those unable to receive emergency alerts due to lack of network coverage, the tool helps determine the reach and effectiveness of EWSs before and after disasters. Initial piloting is underway in Fiji, Tonga and Vanuatu, with plans to expand to additional countries involved in EW4All to enhance disaster response and connectivity resilience globally. A sub-working group on AI for EW4All has been formed to specifically show how AI can support the attainment of the EW4All Initiative objectives. The key partners and organizations of the AI sub-group are: UNDRR, ITU, WMO, IFRC, UNDP, UNFCCC, ITU/WMO/UNEP Focus Group on AI for Natural Disaster Management, Google, Microsoft, GSMA, and Group on Earth Observations (GEO). A workshop on 'Forecasting the future: AI in early warning systems' (attended by 160 people) was organized on 31 May 2024, as part of the ITU AI for Good Global Summit, to foster dialogue and collaboration among stakeholders including donors, present gaps for the achievement of EW4All, encourage new partners to join, and make commitments to innovative AI solutions that could contribute to the advancement of the initiative. ITU participated in a virtual side event of the G20 DRR Working Group in support of the Brazilian Presidency, focusing on the use of bell broadcast (CB) under the context of Early Warnings for All, on 8 May 2024. ITU Asia and the Pacific Regional Office organized a Masterclass on inclusive and resilient Broadcasting development on 1 and 2 September 2024. The event was organized as a pre-event during 19th Asia Media Summit (AMS) 2024, which was organized by the Asia-Pacific Institute for Broadcasting Development (AIBD) in Kuala Lumpur, Malaysia. The event highlighted the role of broadcasting as an indispensable component of EWSs while focussing on the strengths of traditional and modern broadcasting technologies which can enhance community preparedness and response in saving lives and in reducing the impact of disasters. The event was supported by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) of Australia. ITU provided technical assistance and advice to both Georgia and Moldova on mobile EWSs.

In collaboration with other pillar leads, ITU BDT is working on the technical implementation of EW4All, including the design of implementation plans, roadmaps, development of the toolkits, and coordination of the initiative. ITU is also collaborating with various stakeholders, including regulatory authorities, the committee for radio and TV, GSMA, mobile network operators, satellite industries, big tech companies, and community actors, to design and roll out the EW4All country programmes. This effort includes country workshops such as the Tajikistan EW4All launch workshop. Additionally, ITU BDT is working to develop guidelines on mobile EWSs to support countries in adopting CB and/or location-based SMS, including, regulatory information and guidance, as well as technical specifications to support the bidding process. ITU BDT also continues to raise funds for the initiative, with the support of ITU Member States and ITU-D Sector members, and in close coordination with its EW4All partners WMO, UNDRR, and IFRC.

National Emergency Telecommunication Plans (NETPs): ITU BDT continues to support countries in the development of their National Emergency Telecommunication Plans. Currently these countries are: Afghanistan, Solomon Islands, Ecuador, Fiji, Malawi, Kiribati, Tonga, Mongolia, Federation of Saint Kitts and Nevis, and Peru. Countries that have requested assistance include Nepal, Republic of Paraguay, Republic of Iraq, and State of Palestine. To further support countries in developing NETPs, ITU undertook baseline assessments to identify the availability of national laws, regulations, and policies governing emergency telecommunications within the Arab and Americas Member States, and the Pacific Islands. The assessments help to track ITU Strategic Goals and in particular the Target 3.5, and shows that 29 per cent of countries assessed have an NETP. ITU BDT is supporting Zimbabwe, United Republic of Tanzania, and Republic of Namibia with the implementation of a tailored NETP. Furthermore, ITU started to support the African Anglophone countries with a similar NETP model that will benefit them. In the same line, ITU is finalizing the NETP for Saint Vincent and the Grenadines, as well as for Georgia, which has a special focus on the implementation of CB. In 2023, following the request from Southern African Development Community (SADC), EET developed an emergency telecommunication assessment of, and prepared a SADC model NETP for, the SADC region, focusing on disaster risk analysis and the use of ICTs for disaster risk reduction and management. This model is intended to assist the 16 Member States of SADC in identifying key priorities in terms of their NETP. ITU and the SADC Secretariat co-organized the SADC Model NETP Situational Analysis Validation Workshop on 22-24 March 2023. The workshop focused on the topic of ICTs and disaster management and highlighted topics including NETP, the Tampere Convention, disaster preparedness and investment, EWSs and the UN Early warnings for all initiatives, ITU capacity building opportunities (presented by the ITU Academy team), and regulation. The workshop also validated the SADC NETP situational analysis, an assessment carried out by ITU to identify key priorities and gaps in terms of emergency telecommunication of the SADC Member States. This model will assist the 16 Member States of SADC in identifying key priorities in terms of their NETP.

ITU conducted a stakeholder consultation meeting on 9 March 2023, to draft a NETP as a part of continued assistance to Tonga following the loss of connectivity in the wake of the volcanic eruption in January 2022. Following the formal consultation process, the Tonga Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change, and Communications (MEIDECC) adopted the NETP ahead of the cyclone season that usually starts in the Pacific in October. Technical assistance is supported through an ongoing partnership with the Ministry of Internal Affairs and Communications (MIC) of Japan. To further support countries in developing NETPs, ITU undertook baseline assessments to identify the availability of national laws, regulations and policies governing emergency telecommunications within the Member States of the Arab and Americas , and Pacific Islands regions. ITU has started to support the African Anglophone countries with a similar NETP model that will benefit them. In the same line, ITU is also supporting Saint Vincent and the Grenadines, as well as Georgia with the development of a NETP with a focus on the implementation of EWS. ITU BDT is also supporting the Government of Moldova in the technical, economic and regulatory analysis for the implementation of an EWS based on CB and other means of alert diffusion, such as radio and television broadcasting. This support is provided to Moldova in response to their request made during the Regional Development Forum 2023, and in line with the ITU role as lead on Pillar 3 on 'Warning Dissemination and Communication' of the Early Warning for All Initiative. As part of this support, the implementation of a tailored NETP for Namibia, and the NETPs for Saint Vincent and the Grenadines, and for Georgia were finalized. Furthermore, the implementation of tailored NETPs for Tanzania, Zimbabwe, and Comoros are being finalized, along with the NETPs for State of Libya and Islamic Republic of Mauritania. A NETP for Djibouti has been finalized and is in the process of validation by the national stakeholders. The development of NETPs for Republic of the Gambia, and Republic of Cabo Verde were expected to be finalized by the end of 2024. ITU BDT is also supporting the governments of Somalia, Republic of Zambia, Seychelles, and Botswana in a technical, economic and regulatory assessment for the implementation of an EWS based on CB and other means of alert diffusion, such as radio and television broadcasting as well as sirens. This support is being provided in line with the ITU role as lead on Pillar 3 on 'Warning Dissemination and Communication' of the EW4All Initiative.

Common alerting protocol (CAP): CAP is the international (ITU Recommendation ITU-T X.1303) standard format for exchanging all-hazard emergency alerts and warnings over all kinds of networks, including digital media. The adoption of CAP is an important step for better disaster management and for setting up EWSs. Since April 2021, during the Humanitarian Networks and Partnerships Week, ITU together with International Federation of Red Cross and Red Crescent Societies and WMO announced the 'Call to Action on Emergency Alerting'. The goal is that by 2025, all countries are able to enhance their emergency alerting by leveraging the. A CAP HelpDesk is being established, with the aim of supporting country level implementation of CAP through information, methods, and tools to promote coordination and build a community of support to scale CAP implementation worldwide. ITU participated in the 2022 CAP Implementation workshop, which took place in Amsterdam. A major focus of the workshop was the new UN Secretary-General's goal on protecting every person on Earth with an EWS. ITU met with several countries and experts to discuss how it can support countries and provide technical expertise to ensure that more developing countries adopt a CAP-based EWS, taking advantage of ICTs. ITU BDT participated the CAP Editor Design workshop, 11-12 July, organized by IFRC, and presented how ITU is promoting CAP, the key standard for emergency alerting, to expand the reach of reliable, fast, and actionable early warning messages to people at risk.

Online modules on emergency telecommunications: In January 2021, the ITU launched the ITU Online Training Modules on Emergency Telecommunications. The online training modules have been developed and designed to allow ITU to build capacity and increase knowledge on the topic of emergency telecommunications, and to continue to build disaster resilience, even in times such as the COVID-19 pandemic. The available training modules cover (1) the development of National Emergency Telecommunication Plans (NETPs), which are based on the ITU Guidelines on NETPs, (2) the organization of tabletop simulation exercises (TTX), and (3) information on the Tampere Convention and its benefits. All three online modules are self-paced and are available in the ITU Academy Platform. Since January 2022, the numbers of participants that have taken the courses were: TTX = 79; 10 had earned the badge. Tampere =46; 7 had earned the badge. NETPs = 122; 18 had earned the badge.

ARCO framework – Arab States region. In March 2021, ITU BDT and the Arab Red Crescent and Red Cross Organization (ARCO) signed the Framework Cooperation Agreement (FCA) to reinforce cooperation to leverage the power of ICTs for disaster risk reduction and management in the Arab region. The objective of the FCA was to further strengthen the partnership between ITU and ARCO to identify the best ICT technologies to be used to interconnect the emergency centres of the national societies and authorities in all Arab countries. Within the framework of this collaboration with ARCO, in November 2021, BDT started an ICT technical assessment to interconnect the ARCO Arab Disaster Preparedness Centre (ADPC) with Arab Red Crescent and Red Cross National Societies, and to be better prepared to respond to disasters and pandemics. The outcome of this assessment will serve as a first step towards developing a regional project to be implemented in cooperation with ARCO and other partners, and to connect the ADPC with Arab disaster authorities and emergency centres of national societies and authorities in all Arab States. The study is now under review by the regional office.

Disaster response

Disaster response: On 16 December 2021, the Philippines was hit by Typhoon Rai/Odette, which brought torrential rains, violent winds, landslides, and storm surges affecting eight million people, and caused extensive damage to infrastructure, including communication services. Following the request from the country, and in cooperation with the WFP Emergency Telecommunication Cluster (ETC), ITU is providing support through the Disaster Connectivity Map (DCM), which tracks connectivity gaps and outages. ITU BDT continues to support Tonga since it was hit by disaster in January 2022. In Tonga, a small island developing state (SIDS) in the Pacific, the eruption of the Hunga-Tonga-HungaHa-apai underwater volcano and subsequent tsunami, caused significant damage across the Tongatapu and Ha'apai Islands, impacting more than 80 per cent of the population of Tonga. The connectivity situation was particularly critical in Tonga as it was cut off from almost all Internet services because the submarine cable that it relies on was damaged and took weeks to be repaired. The situation highlights the importance of connectivity, but also of resilient infrastructure, including through satellite technology. ITU provided satellite equipment and airtime, and continues to track connectivity through the DCM. Response efforts were complicated by COVID-19, and national regulations, as well as a commercial dispute. Following a request from Nicaragua, ITU deployed 10 Iridium satellite phones and 10 Inmarsat broadband global area networks (BGANs) to support the country in their relief efforts following Hurricane Julia. Two experts from the ITU Emergency Telecommunications Roster were deployed to deliver equipment and train local teams on how to use it. The experts also visited the affected area and supported the response on the field. Following requests from Malawi and Mozambique, the emergency telecommunications team deployed 25 Thuraya satellite phones to Malawi and 10 Iridium satellite phones to Mozambique in support of the disaster response to Cyclone Freddy. Cyclone Freddy broke the record as the longest-lasting tropical cyclone on record. The heavy rainfall brought floods and mudslides, resulting in loss of life and damage to property and infrastructure. More than 200 people died and over 1 million people were affected. Following a request from Papua New Guinea, on 7 August 2023, ITU deployed satellite telecommunications equipment to support the country in the aftermath of the volcanic eruption of Mount Bagana, in Bougainville. This equipment was used to coordinate evacuation activities of all at risk communities, that lived near the volcano, to evacuation/care centres located in Central and South Bougainville. The evacuation was undertaken in coordination with the Autonomous Bougainville Government. The satellite equipment deployed was composed of 10 Iridium satellite phones and 5 Inmarsat BGAN terminals.

A new initiative for pre-positioning ITU satellite equipment was launched in 2023. The aim is to reduce response times in the aftermath of disasters so that countries can restore communication links and provide a fast response to affected communities. At the end of 2023, and the beginning of 2024, equipment was pre-positioned in the WFP ETC warehouse in Dubai to assist Arab States, Africa, and Asia and Pacific regions. Equipment is also pre-positioned in Barbados, which serves as the hub for the Americas region, including the Caribbean Islands, and more equipment is pre-positioned in Zimbabwe to serve the SADC countries. All of these regions have strengthened their preparedness measures and increased capacity to respond to disaster events. In the aftermath of disasters, ITU deploys telecommunications equipment to affected countries to help in restoring telecommunications links which are vital for coordination of the disaster response activities at ground level. The latest deployment was made in Jamaica, Grenada and Saint Vincent and the Grenadines, in July 2024, to support the disaster response to Hurricane Beryl. Also, as part of the preparedness actions, BDT launched a new initiative for pre-positioning ITU satellite equipment. The aim is to reduce response times in the aftermath of disasters so that countries can restore communication links and provide a fast response to affected communities. Equipment has been pre-positioned at WFP ETC warehouse in Dubai to assist countries in the Arab States Asia-Pacific, and Africa regions; in Zimbabwe, at POTRAZ, where equipment will serve the SADC Member States, and in Barbados to assist the Caribbean countries, as well as the Americas region. In July 2024, the ITU satellite equipment was pre-positioned.

ITU Emergency Telecommunication Roster: The ITU Emergency Telecommunication Roster, is a group of ITU expert staff, established in March 2022, that are on-standby to be deployed in times of disasters to deliver emergency telecommunication equipment to countries, and provide training on how to use the Hughes BGAN terminals that were part of the Inmarsat/Hughes donation that ITU BDT recently received. The donation includes 30 broadband global area network terminals (BGANs) and over USD 1.2 million in airtime and training. The BGANs are the size of a laptop and provide Internet and phone services to users. In September 2022, the ITU Emergency Telecommunication team and one member of the Emergency Telecommunication Roster participated the 'Gear.UP' training course in Neuhausen, Federal Republic of Germany. Gear.Up is a large-scale inter-agency operational exercise and functional training event designed to advance the emergency response capabilities of the global ICT and logistics humanitarian community, organized by a key partner of ITU, the Emergency Telecommunication Cluster (ETC).

Disaster Connectivity Map (DCM): The Disaster Connectivity Map is a joint initiative between ITU and the Emergency Telecommunications Cluster (ETC) with input from GSMA, which was initiated in 2020, and consists of a live map that can provide information on the type, level, and quality of connectivity available on the ground during times of disasters. The DCM team continues testing and evaluating additional connectivity data sources, developing a high-resolution mobile coverage platform and adding filters to further refine the accuracy of the data that is displayed. In February 2022, ITU and ETC held a webinar on the latest developments in the Disaster Connectivity Maps (DCMs) to Global ETC partners. ITU activated the DCM in response to the earthquake that hit Türkiye and Syrian Arab Republic on 6 February 2023. The DCM, which produces near-live data to identify connectivity gaps and outages following disasters, was presented to partners and first responders of the Emergency Telecommunications Cluster (ETC) and was accessed almost 1 000 times from 42 countries during the first two weeks of February 2023, mainly from inside Türkiye. The DCM data showed a significant decrease in network coverage where connectivity immediately after the earthquake stood at 79 per cent of the normal cellular coverage, with outages mostly in less populated rural areas. This period was followed by a steady recovery to over 90 per cent of pre-disaster coverage, with some pockets remaining where connectivity was not detected when compared to normal operation. The DCM was activated to support the disaster relief effort in Vanuatu, that was impacted by tropical Cyclones Judy and Kevin, both of category 4 intensity. The cyclones made landfall on 1 and 3 March and approximately 250 000 people were affected. The strong winds and substantial amounts of rain caused major flooding, damage to buildings and infrastructure, and power outages and communication system breakdowns. A decrease in cellular connectivity coverage area was detected after both cyclones, reaching 36 per cent of the normal level on 3 March, followed by an overall increase during the week from 6 March. ITU activated the DCM in response to the earthquake that hit Morocco on 8 September 2023, to find out which were the areas where mobile networks and services were most affected.

On 26 October 2023, a presentation on DCM was delivered to the NetHope Global Summit in Bridgetown, Barbados, highlighting the new features, data sources, and activations added to the DCM. A 'ground truth exercise' was undertaken with colleagues and partners from ITU, GSMA, ETC and Ericsson, to include measurements taken using the Speedchecker mobile app during the Caribbean multi-stakeholder workshop on the 'Role of Telecommunications in disaster preparedness, response and recovery', which was jointly organized by the ITU, GSMA and WFP/ETC from 21 - 23 November 2023. In 2024 the DCM was activated in:

- Mozambique | 3 – 24 Mar 2024
- Madagascar | 26 Mar – 9 Apr
- Grenada and Saint Vincent and the Grenadines to support the response to Hurricane Beryl | June 2024
- In 2024, the DCM was showcased or demonstrated on various events, including:
  - ITU Study Group 12 Mozambique workshop (27 Feb 2024).
  - EW4All Fiji workshop (28 Feb 2024).
  - ITU Study Group 12 Geneva workshop (23 Apr 2024).
  - ITU AI4Good Summit.

Annex 2 – Related work of other sectors

A2.1 Collaboration with other Questions in ITU-D Study Groups 1 and 2

This section provides a list matching ITU-D Question 3/1 to other Questions being examined by ITU-D Study Groups 1 and 2. The list was reviewed and discussed at Question 3/1 meetings, after which the table below was agreed without any further comments.

Table A-8: Matrix of ITU-D Study Group 1 and 2 intra-sector coordination

	Q1/1	Q2/1	Q4/1	Q5/1	Q6/1	Q7/1	Q1/2	Q2/2	Q3/2	Q4/2	Q5/2	Q6/2	Q7/2
Q3/1	X	X	X	X			X	X	X		X	X	

A2.2 Mapping of ITU-T and ITU-D Questions

An updated mapping is provided below, based on ITU Study groups activities, and existing mapping table provided Inter-Sector Coordination Group (ISCG)[255].

A2.3 Mapping of ITU-R Working Parties and ITU-D Questions[256]

[255] https://www.itu.int/en/general-secretariat/ties/ISCGDocumentLibrary/Liaisons%20Statements%20on%20Inter-Sectoral%20Coordination%20Activities/Table%203.pdf

[256] https://www.itu.int/en/general-secretariat/ties/ISCGDocumentLibrary/Liaisons%20Statements%20on%20Inter-Sectoral%20Coordination%20Activities/Table%201.pdf

Annex 3 – Information from ITU-T, ITU-R and other organizations

A3.1 AI for natural disaster management (ITU-T Study Group 2)[257]

ITU-T Study Group 2 reported on the progress of our activities on disaster risk reduction and management. ITU-T SG2 is the lead study group on telecommunications for disaster relief/early warning, network resilience, and recovery, and presently parents the Focus Group on AI for Natural Disaster Management (FG-AI4NDM). FG-AI4NDM completed the following deliverables which were approved by the focus group:

- SG2-TD192/PLEN[258] is a Technical Report for AI for Communications Towards Natural Disaster Management
- SG2-TD191/PLEN[259] is a Technical Report for Standardization Roadmap on Natural Disaster Management Trends and Gaps in Standardization
- SG2-TD193/PLEN[260] Glossary for Artificial Intelligence for Natural Disaster Management

The ITU Telecommunication Standardization Bureau (TSB) will add the above documents to the focus group page for deliverables, alongside the previous deliverables from the Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR): https://www.itu.int/pub/T-FG.

FG-AI4NDM has the following working groups:

Table A-9: Working Groups in FG-AI4NDM

Working Group on Data for AI (WG-Data)	WG-Data looks at best practices for data collection, handling, and monitoring. It is responsible for producing the technical report on this topic.
Working Group on AI for Modelling (WG-Modelling)	WG-Modelling explores the application of AI to support modelling across spatiotemporal scales through extracting complex patterns (and gaining insights) from a growing volume of geospatial data as well as aspects such as data preparation for training, AI development, and AI evaluation. It is responsible for producing the technical report on this topic.
Working Group on AI for Communications (WG-Comms)	WG-Comms addresses the role of AI in facilitating effective communications before and during natural disasters. It looks at technical as well as sociological/demographical aspects. It is responsible for producing the technical report on this topic.

[257] ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0050/ from ITU-T SG2.
[258] https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG02-230313-TD-PLEN-0192
[259] https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG02-230313-TD-PLEN-0191
[260] https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-SG02-230313-TD-PLEN-0193

Table A-9: Working Groups in FG-AI4NDM (continuación)

Working Group for Mapping AI-related Activities in Natural Disaster Management (WG-Roadmap)	WG-Roadmap compiles information about pre-standardization and standardization activities in the field of AI for natural disaster management (focusing on standard developing organizations and UN bodies). It is responsible for producing the roadmap.
Working Group on Educational Materials to Support Capacity Building (WG-EduMat)	WG-EduMat looks at the activities of the working groups and work streams, extracts components that are deemed relevant for different target stakeholders (with a focus on least developed countries and small island developing states), and produces educational materials using various formats that can transfer this knowledge. It is responsible for producing the educational materials.

Additional information about FG-AI4NDM can be found at: https://www.itu.int/en/ITU-T/focusgroups/ai4ndm/Pages/default.aspx

A3.2 Informative update in the area of disaster communications (ITU-R Disaster Relief Liaison Rapporteur)[261]

The ITU-R Disaster Relief Liaison Rapporteur frequently provided updated information related to disaster communications in ITU-R and other organizations.

Telecommunication is critical at all phases of disaster management. Aspects of radiocommunication services associated with disasters include, inter alia, disaster prediction, detection, alerting and relief. In certain cases, when the "wired" telecommunication infrastructure is significantly or completely destroyed by a disaster, only radiocommunication services may be employed for disaster relief operation.

Two major tasks of the ITU-R - ensuring the effective use of the radio-frequency spectrum, and studies concerning development of radiocommunication systems - concern all radiocommunication services. Moreover, the ITU-R SGs carry out studies related to the continuing development of radiocommunication systems used in disaster mitigation/relief operations and these can be found within their work programmes. ITU-R SG 5 Webpage Emergency Radiocommunications indicates the diverse ITU-R SGs activities on Prediction & Detection at SG 7, Alerting at SG 4, SG 5 and SG 6, Relief at SG 4, SG 5 SG 6 and SG 7.

ITU Radio Regulations Resolution 646 (Rev.WRC-19) 'Public protection and disaster relief' encourages membership to use harmonized frequency ranges for public protection and disaster relief (PPDR) to the maximum extent possible when undertaking their national planning for their PPDR applications. Recommendation ITU-R M.2015 'Frequency arrangements for public protection and disaster relief radiocommunication systems in accordance with Resolution 646 (Rev.WRC-15)' is most relevant to the Q3/1 Report. It promotes and provides guidance on global

[261] ITU-D Document https://www.itu.int/md/D22-SG01-C-0176 from ITU-R WP5A and ITU-D Documents https://www.itu.int/md/D22-SG01-C-0007/, https://www.itu.int/md/D22-SG01-C-0021/, https://www.itu.int/md/D22-SG01-C-0062/, https://www.itu.int/md/D22-SG01-C-0171 and https://www.itu.int/md/D22-SG01-C-0548 from ITU-R Disaster Relief Liaison Rapporteur.

and regional harmonization of frequency bands for PPDR. The combination of Resolution 646 (Rev.WRC-19) and other relevant ITU-R Recommendations and Reports serve as a package in relation to the provision of PPDR services and applications.

A3.3 Terrestrial broadcasting delivery for disaster relief (ITU-R Working Party 6A)[262] [263]

1) HF broadcasting bands

ITU-R WP6A informed that it has developed a draft revision of Recommendation ITU-R BS.2107, "Use of International Radio for Disaster Relief (IRDR) frequencies for emergency broadcasts in the High Frequency (HF) bands," and lists the HF frequencies reserved in the HF broadcasting bands for emergency broadcasts.

2) Satellite and terrestrial broadcasting systems

ITU-R WP6A informed Recommendation BT/BO.1774[264] "Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief". The Recommendation provides characteristics of satellite and terrestrial broadcasting systems used for disaster mitigation and relief operations. Detailed descriptions of these systems are given in Annex 1 of the Recommendation as guidance.

3) Joint ITU-R SG 6 – EBU Workshop

ITU-R WP6A provided information on Joint ITU-R SG 6 – EBU Workshop[265] "Broadcasting in times of crisis - 2023". The main objectives of this workshop were to remind about the role of broadcasting in times of crisis, through real-life examples; to inform about available emergency warning technologies in broadcasting and their synergy with other radiocommunication systems, and to identify high-level requirements to improve the role of broadcasting in this context.

4) Broadcasting for public warning, disaster mitigation, and relief

ITU-R WP6A also provided reference to ITU-R Report BT.2299[266] "Broadcasting for public warning, disaster mitigation and relief". The Report explains the criticality of radio and television broadcasting media for information dissemination to the public in times of emergencies. Indeed, fixed, mobile and portable terrestrial broadcast receivers are readily available, inexpensive, and virtually ubiquitous in most societies. The case studies in this Report represent only a few of countless examples that attest to the global importance of terrestrial broadcasting, helping to protect and save lives during local, national and international emergencies.

A3.4 Early warning systems using radiocommunication systems (APT ASTAP)[267]

APT Standardization Programme (ASTAP) Expert Group Disaster Risk Management and Relief Systems (EG DRMRS) has already published an APT Recommendation, APT/ASTAP/REC-01

[262] ITU-D Document https://www.itu.int/md/D22-SG01-C-0037/ from ITU-R WP6A.
[263] ITU-D Document https://www.itu.int/md/D22-SG01-C-0496/ from ITU-R WP6A.
[264] https://www.itu.int/rec/R-REC-BT/recommendation.asp?lang=en&parent=R-REC-BT.1774
[265] https://1f8a81b9b0707b63-19211.webchannel-proxy.scarabresearch.com/en/ITU-R/study-groups/workshops/sg6-itu-ebu-btc-2023/Pages/default.aspx
[266] https://www.itu.int/pub/publications.aspx?lang=en&parent=R-REP-BT.2299-3-2022
[267] ITU-D SG1 Document https://www.itu.int/md/D22-SG01.RGQ-C-0120/ from APT.

(Rev.1), and an APT report, APT/ASTAP/REPT-02, which relate to EWSs using radiocommunication systems. EG DRMRS believes these APT documents help to develop a work plan, especially for EWSs.

In addition, ASTAP has already published the following APT reports on the disaster management area:

- APT Report on a Cost-Effective Disaster Management System.
- APT Report on a Disaster Information Sharing System in APT Countries.
- APT Report on Requirements of an Information and Communication System Using Vehicle during Disaster.
- APT Report on case studies for portable/movable emergency telecommunication systems in APT region.
- APT report on local-area resilient information sharing and communication systems.

A3.5 Characteristics of fibre-optic submarine cable systems (ITU-T Study Group 15)[268, 269]

The following work items related to the use of telecommunications/ICTs for disaster risk reduction and management are currently under study within Questions of ITU-T SG15.

- Question 7/15: The revised version of Recommendation ITU-T L.250[270] (01/2024): Topologies for optical access network – has been published. Descriptions of the topology reliability have been added in the revision work. In clause 9, the physical network topology that can withstand disaster using redundant architecture at the optical fibre /cable level were mentioned in the revised version.

  Recommendation ITU-T L.391/L.81[271] (11/2009): Monitoring systems for outside plant facilities – is currently under revision. In clause 6.3, descriptions of the additional emergency management programme for "freezing" will be added in this revision work. The revised version will also describe the distributed fibre-optic sensing technique as a useful technique for detecting the disaster.

- Question 8/15: The new Recommendation ITU-T G.9730.1[272] (08/2024): Dedicated scientific sensing submarine cable system – has been published. The new Recommendation addresses the dedicated submarine cable system for scientific sensing applications for climate monitoring and disaster risk reduction.

  The new Recommendation ITU-T G.9730.2[273] (08/2024): Scientific monitoring and reliable telecommunication submarine cable systems – has been published. The new Recommendation describes the qualitative high-level characteristics and requirements of scientific monitoring and reliable telecommunication cables using fibre-optic submarine cables to enable both telecommunication and sensing functionalities for ocean and climate monitoring as well as disaster warning. The implementation of seismic, accelerometer, absolute pressure gauge sensors as well as distributed acoustic sensing (DAS) within a submarine cable system could be used for early tsunami warning.

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268 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0123 from ITU-T SG15.
269 ITU-D SG1 Document https://www.itu.int/md/D22-SG01-C-0509/ from ITU-T SG15.
270 https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15808
271 https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=10435
272 https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=16050
273 https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=16051

A3.6 Rapid response to sudden natural disasters in network (ITU-T Study Group 11)[274]

The following work items related to the use of telecommunications/ICTs for disaster risk reduction and management are currently under study within Questions of ITU-T SG11.

ITU-T Q.Req_Frame_RRDN specifies the requirements and framework for rapid response to sudden natural disasters. The scope of the draft Recommendation includes:

1) The requirements for the network capability to realize rapid response to sudden natural disasters, which reduce rescue time and increase rescue effectiveness and success.
2) The framework of the network enables the rapid response system to achieve a series of functions.
3) Security considerations.

The draft ITU-T Q.Req_Frame_RRDN is available in SG11-TD1102/GEN[275].

A3.7 Emergency telecommunication specifications (ETSI TC EMTEL)[276]

The following work items related to the use of telecommunications/ICTs for disaster risk reduction and management are currently under study within ETSI TC EMTEL.

The Table A-10 lists the specifications and report published by TC EMTEL on these topics.

Table A-10: The specifications and report of TC EMTEL

Category title	Explanation
Acronym	– ETSI TR 102 445 v1.2.1 – ETSI TS 102 181 v1.3.1 – ETSI TS 102 182 v1.5.1 – ETSI TS 102 900 v1.4.1
ETSI	ETSI/Technical Committee EMTEL (Emergency Communications)
Title	– Emergency Communications (EMTEL); Overview of emergency communications network resilience and preparedness – Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies – Emergency Communications (EMTEL); Requirements for communications from authorities/organizations to individuals, groups or the general public during emergencies – Emergency Communications (EMTEL); European public warning system (EU-ALERT) using the cell broadcast service

[274] ITU-D Documents https://www.itu.int/md/D22-SG01-C-0113/, https://www.itu.int/md/D22-SG01-C-0276/ and https://www.itu.int/md/D22-SG01.RGQ-C-0144/ from ITU-T SG11.

[275] https://www.itu.int/md/T22-SG11-240501-TD-GEN-1102/en

[276] ITU-D Documents https://www.itu.int/md/D22-SG01-C-0114/ and https://www.itu.int/md/D22-SG01-C-0277/ from ETSI TC EMTEL.

Table A-10: The specifications and report of TC EMTEL (continuación)

Category title	Explanation
Description	TS 102 900 and TS 102 182 cover communication from authorities to citizens, e.g. Public Warning System. TS 102 181 defines the requirements for communication between authorities/organizations during emergencies. The last version published in June 2020 includes activities on mission critical services (MCX), satellite and IoT for emergency communication. TR 102 445 focuses on the concepts of resilience and preparedness including more recent communication network technologies used by emergency services. TS 102 900 covers communication from authorities to citizens, e.g. Public Warning System. The changes are to add support for device-based geo-fencing to EU-Alert, and may support alerts with the default device audio attention signal and default device vibration cadence, and support of alerts that are silent (no audio attention signal and no vibration cadence).
Main disaster group	The work done by ETSI TC EMTEL does not differentiate between disaster groups.
Disaster management phase	These ETSI EMTEL published documents cover the mitigation, preparedness and response phases of the disaster management cycle.
Relevant technologies	Early warning system
Status	Published.
Link	https://www.etsi.org/deliver/etsi_ts/102900_102999/102900/01.04.01_60/ts_102900v010401p.pdf https://www.etsi.org/deliver/etsi_ts/102100_102199/102182/01.05.01_60/ts_102182v010501p.pdf https://www.etsi.org/deliver/etsi_ts/102100_102199/102181/01.03.01_60/ts_102181v010301p.pdf https://www.etsi.org/deliver/etsi_tr/102400_102499/102445/01.02.01_60/tr_102445v010201p.pdf
Contact	Cristina Lumbreras (cl@eena.org), TC EMTEL Chair. Peter Sanders (peter.sanders@everbridge.com), TC EMTEL Vice Chair and Rapporteur for early warning system.

A3.8 Emergency services (ITU-T Study Group 16[277] and ITU-T Study Group 21[278] [279])

The following work items related to the use of telecommunications/ICTs for disaster risk reduction and management are currently under study within Questions of ITU-T SG21.

277 ITU-D Document https://www.itu.int/md/D22-SG01-C-0120/ from ITU-T SG16.

278 ITU-T Study Group 21 (SG21) was established by World Telecommunication Standard Assembly held in October 2024 (WTSA-24), and merged ITU-T SG16 and SG9. All work in previous SGs9 and 16 were continued in SG21.

279 ITU-D Document https://www.itu.int/md/D22-SG01-C-0473/ from ITU-T SG21 (Technologies for multimedia, content delivery and cable television).

Table A-11: Newly developing work items related to disaster management in ITU-T SG16

Work item	Question	Subject / Title	Timing	Reference(s)
H.430.3 (V2)	Q8/21 (ex Q8/16)	Live streaming service in inaccessible areas scenarios	*	SG16-TD138/Plen
H.ILE-AR	Q8/21 (ex Q8/16)	Augmented reality assisted immersive live experience, including ILE-AR for disaster response (ILE-AR4DR)	2026	SG21-TD11/WP4
F.CUAV-ES	Q9/21 (ex Q21/16)	Framework and requirements for emergency services using civilian unmanned aircraft vehicles	2024	SG16-TD160/WP1 (2023-07)
F.760.2 (ex F.FR-ERSS)	Q4/21 (ex Q24/16)	Requirements for user interface of first responders in emergency response support systems	**	SG16-TD175-R2/Plen (2023-07)
F.MDI	Q4/16 (ex Q24/16)	Metadata for disaster information presentation with human factors	2023	SG16-TD68/WP2 (2023-07)
F.760.1 (ex F.EMRES-CUE)	Q2/21 (ex Q28/16)	Requirements and reference framework for emergency rescue systems	2022	Published

A3.9 International mobile telecommunications (IMT) for broadband public protection and disaster relief (PPDR)(ITU-R Working Party 5D)[280] [281]

WP 5D suggests that Report ITU-R M.2291 on the use of international mobile telecommunications (IMT) for broadband public protection and disaster relief (PPDR) applications, should be considered while working on the new Report on the use of telecommunications/ICTs for disaster risk reduction and management.

Report ITU-R M.2291 on use of IMT for broadband PPDR applications, addresses how IMT-based technologies could play a vital role by enabling broadband PPDR applications. PPDR communications are predominantly mission critical because they aid in ensuring the protection and safety of life or property on a day-to-day basis, as well as in response, rescue, and recovery efforts before, during, and after emergencies and disasters. The ability of PPDR agencies to react quickly, to inter-communicate, and to work together in close coordination with each other, as well as their ability to communicate with resources that are farther away, will heavily influence the outcome of an emergency, whether it be a forest fire, a traffic accident, or a terrorist threat. With the ever-increasing scale of responses to emergency situations, and increased numbers of responding agencies and authorities, administrations have increasingly recognized how new PPDR applications based on IMT systems may be able to serve or support broadband PPDR communications. The use of IMT for broadband PPDR applications could open up new ways

280 ITU-D Document https://www.itu.int/md/D22-SG01.RGQ-C-0146/ from ITU-R WP5D.
281 ITU-D Document https://www.itu.int/md/D22-SG01-C-0477/ from ITU-R WP5D.

of working, increase the effectiveness of emergency management, and improve interaction within and across PPDR organizations. Section 3 of Report ITU-R M.2291, details the existing and planned capabilities of IMT that support broadband PPDR applications, and Section 4 of the Report introduces some of the planned capabilities of IMT-2020 to support broadband PPDR applications.

PPDR applications could be supported on commercial IMT networks to either complement the dedicated PPDR networks in certain areas where dedicated networks may not be economically viable, or to directly integrate PPDR applications, so as to reduce the overall cost of deploying a dedicated PPDR network. Section 5 of the Report details some approaches for supporting broadband PPDR applications using IMT.

A3.10 Development in the HAPS industry and regulatory recommendations to enable the stratospheric ecosystem (HAPS Alliance)[282] [283]

High altitude platform stations (HAPS) as one of the non-terrestrial network (NTN) solutions, constitute an important layer in modern 3D telecommunication infrastructure, together with satellite constellations, and terrestrial networks. HAPS can help telecommunication services providers and government agencies overcome cost and geographic challenges, by expanding coverage to unserved and underserved areas, as well as in rapid response to natural disasters. Due to their lower altitudes compared to satellite systems, faster connection speeds with lower latency, better indoor penetration, and higher network capacity can be achieved.

HAPS Alliance Telecom WG (https://hapsalliance.org/) produces deliverables which provide useful information for governments that are planning, or are interested in implementation of HAPS within their national frameworks:

- Unlocking the Potential of the Stratosphere[284] (Q2 2024) - Introduces the HAPS Alliance mission and vision, membership, and technological progress, and considers the fundamental technologies and stratospheric platforms progressed by member companies towards commercialization.
- Creating an Enabling Regulatory Environment for HAPS Deployment[285] (May 2024) - Regulatory recommendations for HAPS to support the stratospheric ecosystem are provided, including the latest information, such as for example information on the expansion of HAPS service-link following WRC-23 for flexible use of HAPS frequency bands, to assist governments in implementing appropriate HAPS regulations within their national frameworks.

Additionally, the HAPS Alliance recently published a new White Paper titled "HAPS Reference Architecture Series: Cell Towers in the Sky[286]", which provides an overview of the aviation and service systems. HAPS Alliance is also in the process of drafting some use cases and technical white papers.

[282] ITU-D Document https://www.itu.int/md/D22-SG01-C-0402/ from SoftBank.
[283] ITU-D Document https://www.itu.int/md/D22-SG01-C-0499/ from HAPS Alliance.
[284] https://hapsalliance.org/pitch-deck/
[285] https://hapsalliance.org/publications/
[286] https://hapsalliance.org/wp-content/uploads/formidable/12/2024_HAPS_Reference_Architecture_Cell_Towers_In_The_Sky_White_Paper.pdf

A3.11 Disaster response by Internet of Things (IoT) and disaster prevention for smart sustainable cities and communities (SSC&C) (ITU-T Study Group 20)[287]

ITU T Study Group 20 (SG20) is responsible for the development of innovative standards (ITU-T Recommendations), guidelines, reports, methodologies and best practices for the Internet of Things (IoT), digital twins, and smart sustainable cities and communities (SSC&C), with the goal of accelerating digital transformation in urban and rural areas.

SG20 provided the following information on published and ongoing specifications related to disaster risk reduction and management:

Table A-12: SG20 work items on disaster risk reduction and management

Work item	Question	Subject / Title	Timing	Reference(s)
ITU-T Y.4705 (ex Y.nmm-isms)	Q1/20	Metadata model of sensing capability for disaster monitoring systems	2024-08	ITU-T Y.4705
ITU-T Y.4226 (ex Y.isms)	Q1/20	Functional framework and requirements for disaster monitoring systems	2024-08	ITU-T Y.4226
ITU-T Y.4222 (ex Y.smart-evacuation)	Q2/20	Framework of smart evacuation in a disaster or emergency in smart cities and communities	2025-01	ITU-T Y.4222
ITU-T Y.4601 (ex Y.dt-smartfirefighting)	Q2/20	Requirements and capability framework of a digital twin for smart firefighting	2023-Q1	ITU-T Y.4601
ITU-T Y.4229 (ex Y.IoT-SFFS)	Q2/20	Requirements and reference functional model for an Internet of things-based smart forest firefighting system	2025-Q1	ITU-T Y.4229
ITU-T Y.Fram-ssdp	Q3/20	Requirements and framework of metaverse simulation service for disaster prevention in electric power facilities	2026-Q4	SG20-TD255
ITU-T Y.4507 (ex Y.arc-psfws)	Q3/20	A functional architecture of Internet of things-based warning system for power supply facilities	2025-Q1	ITU-T Y.4507
ITU-T Y.Supp-AI-WF	Q4/20	Analysis of AI models and datasets for Cerrado Savana Biome wildfire detection	2026-Q3	SG20-TD352-R2 SG20-TD353-R2

[287] ITU-D Document https://www.itu.int/md/D22-SG01-C-0466/ from ITU-T Study Group 20.

Table A-12: SG20 work items on disaster risk reduction and management (continuación)

Work item	Question	Subject / Title	Timing	Reference(s)
ITU-T Y.4911 (ex Y.KPI-Flood) (determined)	Q7/20	Key performance indicators of ICT based urban flood disaster prevention and mitigation capability	2025-Q4	TD174-R4

A3.12 Implementation of NEPT in Comoros (ITU-T Study Group 2)[288]

ITU-T Study Group 2 (SG2) informed a related contribution from Comoros, which highlights how telecommunications and ICT technologies have been effectively utilized in Comoros to enhance disaster preparedness, response, and resilience, particularly in the context of natural disasters. The Comoros experience offers valuable insights into the role of ICT in improving disaster management, and these lessons can be of significant value to other regions facing similar challenges.

[288] ITU-D Document https://www.itu.int/md/D22-SG01-C-0469/ from ITU-T Study Group 2.

Annex 4 – Information on workshops and panel sessions

A4.1 Emergency preparedness for disaster management[289]

A4.1.1 Introduction

As part of the work of **ITU-D Study Group 1 Question 3/1**, a workshop on 'Emergency preparedness for disaster management', took place on 11 May 2023. This workshop aimed to present and exchange information on disaster prediction and detection, emergency alerting, and the use of emerging ICTs for disaster preparedness. The discussion focused on identifying lessons learned based on the experiences of a diverse group of stakeholders. The discussion results will be considered for further study as the Question focuses on EWSs and disaster preparedness, with key findings incorporated into the final report of Question 3/2. All presentations for this session are available on the event website at: https://www.itu.int/en/ITU-D/Study-Groups/2022-2025/Pages/meetings/session-Q3-1-may23.aspx.

A4.1.2 Session details

A4.1.2.1 Opening

The workshop was opened by **Ms Alison Balzer (United States), Co-Rapporteur for Question 3/1**, who welcomed participants, then briefly explained the background and objectives of this workshop. **Mr Cosmas L. Zavazava**, BDT Director, had some opening remarks delivered by Ms Vanessa Gray. The BDT director had been involved in the area of disaster management and relief activities in ITU for many years, and so thoroughly recognized the significance of the Q3/1 subject matter as a means of protection for human life in natural disaster events. ITU has continually provided emergency telecommunications support to ITU Member States in the event of disaster, and recently provided satellite phones to Mozambique. As connectivity during disasters is critical, a National Telecommunication Plan (NTP) should be a priority for all countries. All presenters and participants received sincere thanks for their contributions.

A4.1.2.2 Early warning systems for disaster preparedness

This session was moderated by **Ms Alison Balzer. Ms Vanessa Gray (Head of Environment and Emergency Telecommunications division, ITU BDT)**, presented the United Nations Early Warning for All (EW4All) initiative. Established in March 2022, the aim of the EW4All initiative is for all people, everywhere to benefit from an EWS by 2027. ITU plays an important role in communication which is the one of the four pillars of the EW4All initiative. It was informed that mobile phones, owned by roughly 75 per cent of people worldwide, could serve as suitable terminals for early warning messages. EW4All selected 30 countries in which to implement strategies for national EWSs, including training and tools. Due to other business, questions were postponed to Q3/1 rapporteur meeting sessions. **Mr Tom Ward (IBM, United States), vice-chairman of ITU-T Focus Group on AI for Natural Disaster Management (FG-AI4NDM)**, presented remotely an 'Introduction of activities and outcomes of FG-AI4NDM', providing an overview of deliverables made by FG-AI4NDM. This presentation was made in collaboration with **Ms Ivanka Pelivan (Fraunhofer HHI, Germany), vice-chairman of FG-AI4NDM**. An important

[289] For further information, see the workshop webpage.

deliverable titled "AI for effective communication" was published in March, as a deliverable of FG-AI4NDM. He also introduced the management structure and the current status of FG-AI4NDM. Since the FG was extended to 2024, it was suggested to maintain close collaboration between Q3/1 and the FG. **Mr Mike Gerber (NOAA, United States)**, presented "Mobile alerting in the United States of America", which introduced the meteorological messaging system called 'Wireless emergency alert (WEA)'. Over 1 600 organizations joined the WEA activities, which provides emergency meteorological information, such as hurricane and tornado information in English and Spanish. The system follows the national regulations for wireless systems from by ATIS and 3GPP. **Dr Ken T. Murata (National Institute of Information and Communications Technology (NICT), Japan)**, presented "Visual IoT techniques for resilient natural disaster mitigation", which introduced a disaster detection system using AI and visual surveillance cameras. This system can detect not only wildfires and flooding but also volcanic eruptions. This information including use cases was proposed to the Q3/1 Rapporteur Group meeting.

A4.1.2.3 Q&A session

Mr Serigne Abdou Lahatt Sylla (Senegal), Co-Rapporteur Question 3/1, moderated this Q&A session. In the session, the following questions, mainly concerning the NOAA presentation, were raised and answered:

- The question was raised as to whether the scope of the AI model for meteorological forecasting needed to be clarified. The AI model did not depend on the message types, and over 1 000 systems in several organizations were connected to WEA.
- A United States representative pointed out that implementing WEA was not easy, because several organizations had several different systems. Collaboration with organizations, especially telecommunication providers is necessary.
- A Côte d'Ivoire representative suggested the need to consider accessibility for WEA, especially for blind persons.
- Concerning the NICT presentation, a representative for Kenya suggested that the implementation costs of the visual IoT system needed to be considered. The response was that utilizing commercial off the shelf (COTS) equipment reduced costs, and that users can use their own ICT devices.

A4.1.3 Closing remarks

Mr Serigne Abdou Lahatt Sylla (Senegal), Co-Rapporteur Question 3/1, thanked all the speakers, moderators, participants, and BDT staff and interpreters for their active support and contributions to making the workshop a real success.

A4.2 Disaster management and resilience workshop[290]

The Q3/1 management team organized a workshop on **'Disaster management and resilience through telecommunications/ICT**', which took place at ITU Headquarters in **Geneva, Switzerland, on 25 April 2024,** in conjunction with the Question meeting 3/1 of ITU-D Study Group 1 on "The use of telecommunications/ICT for disaster risk reduction and management". The workshop report is accessible for ITU-D Sector members at: https://www.itu.int/md/D22-SG01-C-0390/.

[290] For further information, see the workshop webpage and contribution 1/390E.

A4.2.1 Presentation of speakers and discussions

The first session, entitled "ICT infrastructure in times of crisis: Strengthening telecommunications networks for disaster resilience," focused on the critical importance of telecommunications infrastructure in disaster management and strategies, to strengthen the resilience of these networks in times of crisis. Speakers and participants took a close look at the specific challenges faced by telecommunications networks during disasters such as earthquakes, storms, floods and wildfires, as well as solutions and best practices to address them.

In this session, the presentations were summarized in the following points:

- Overview of the challenges facing telecommunications and ICT infrastructures in the event of a disaster.
- Exploring network preparedness and hardening strategies, including telecommunications and ICT infrastructure resilience, diversification of communication channels, and emergency response plans.
- Case studies in disaster communication network management.

The second session, entitled "Technological innovation and cooperation: Information and communication technologies as key tools in emergency management and post-disaster reconstruction", examined the crucial role of ICTs in emergency management and post-disaster reconstruction. During the discussions, speakers highlighted the latest technological innovations and best practices in the use of ICTs to effectively respond to crises, and facilitate the sustainable reconstruction of affected communities.

The points discussed in this second session mainly revolved around:

- The introduction of innovative technologies such as artificial intelligence (AI), Internet of Things (IoT), and big data analytics for disaster management.
- Discussion on the importance of collaboration between governments, humanitarian organizations, the private sector, and civil society in the use of ICT for disaster prevention, emergency response, and reconstruction.
- Presentation of innovative applications and platforms using ICT for real-time data collection, mapping of affected areas, and coordination of relief operations.

A4.2.2 Conclusions of the workshop

In conclusion, the ITU-D Question 3/1 team reiterated its thanks to the speakers, participants and the BDT team. Participants expressed their appreciation for the informative experiences shared. The need for good collaboration and effective coordination between governments, humanitarian organizations, the private sector, and civil society in the use of Telecommunications/ICTs for disaster risk reduction and management, was highlighted in the various interventions. The importance of continuing to introduce innovative technologies such as artificial intelligence, Internet of Things (IoT), and big data analytics in disaster management is encouraged in disaster prevention and resilience initiatives.

A4.2.3 Detailed report of the workshop

Report of the workshop organized by ITU-D Question 3/1 on 25 April 2024, in Geneva.

Welcome and setting the scene

The workshop commenced with an opening address by Mr Serigne Abdou Lahatt Sylla (Senegal), Co-Rapporteur of ITU-D Study Group 1 Question 3/1. He highlighted the negative impact of disasters on populations and the disruption to social and economic life caused by such events. He also emphasised the central role that telecommunications and ICTs play in disaster prevention, mitigation, and management. He indicated that the main objective of the workshop is to exchange experiences and knowledge on disaster resilience mechanisms using telecommunications/ICTs (5G, the Internet of Things, megadata and artificial intelligence) with ITU-D Sector members. Finally, he reiterated that the outcomes of the discussions could be valuable for the preparation of the annual report on Question 3/1. He also expressed his gratitude to the speakers, focal points, and BDT team for their contributions to the success of the workshop. These thanks were echoed by Ms Alison Balzer (United States), Co-rapporteur for ITU-D Question 3/1, to the speakers, the focal points, and the BDT team.

SESSION 1 – ICT infrastructure in times of crisis: Strengthening telecommunication networks for disaster resilience

Session 1 began with introductory remarks by the moderators, Mr Serigne Abdou Lahatt SYLLA (Senegal) and Ms Alison Balzer (United States) co-rapporteurs for ITU-D Question 3/1.

Ms Zoe Hamilton from GSMA highlighted three key areas that past communication networks focused on to increase resilience: internal organization, external coordination, and collaboration with humanitarian entities. Internally, businesses developed continuity management plans, ensured staff safety, and conducted drills. They secured access to key sites, maintained infrastructure, and prepared backup power systems. Externally, operators supported customers with services such as free credit and Wi-Fi, coordinated with suppliers, and worked with governments to remove regulatory barriers. Finally, collaboration with the humanitarian community, including coordination with responders and other mobile network operators, proved essential for national resilience. Mobile network operators collaborate with governments to develop national emergency telecommunication plans, identifying potential roadblocks in advance. These include issues such as the importing of necessary equipment, power, and generators, and establishing roaming agreements. By addressing these pain points early, both government and industry can ensure swift network restoration during crises, benefiting responders and the public. The GSMA representative also emphasized three main barriers to enhancing communication network resilience: cost, coordination, and geographic challenges. The GSMA representative highlighted the financial burden of setting up and maintaining resilient infrastructure and stressed the need for broader funding sources beyond traditional government budgets. The GSMA also sees positive trends in increased focus on resilience initiatives and coordination efforts across sectors and organizations, despite challenges in cultural and operational alignment. GSMA advocates for proactive planning and innovative solutions, such as mobile base stations on ships and cloud-based EWSs, to address remote and vulnerable areas effectively. The GSMA representative also touched upon the Humanitarian Connectivity Charter, an initiative in the mobile industry, focused on enhancing disaster preparedness and resilience among mobile network operators. GSMA facilitates knowledge sharing and coordination among operators, governments, and humanitarian actors through workshops and country-specific collaborations. Their efforts include conducting research to document best practices and protocols for setting up communication mechanisms in crisis situations. Recently expanding into crisis and conflict settings, GSMA addresses challenges such as intentional infrastructure targeting and network shutdowns, emphasizing the critical need for coordinated efforts to maintain connectivity during emergencies.

Mr Justin Cain from the Federal Communications Commission (FCC) explained that preparedness and resilience are closely linked. Effective response relies on understanding infrastructure availability, particularly in underserved areas, and ensuring network redundancy. This involves planning for disaster scenarios, learning from past events such as hurricanes and 9/11, and collaborating with agencies and the industry to enhance communication capabilities during disasters. A key point in disaster management is maintaining communication through mutual aid among industry players. Initiatives such as the Emergency Cooperative Communication Network, started in 2016, and the mandatory Disaster Response Initiative, require carriers to enable roaming on each other's networks during disasters. The FCC mandates carriers to report outages and establishes pre-agreements to ensure technical feasibility. This collaboration ensures communication consistency and resource sharing during disasters, recognizing that communication providers are also impacted. The FCC also grants waivers and special authorizations, to facilitate mobile solutions during such events. He also explained that the FCC had taken actions to ensure service prioritization when most needed. The FCC implemented telecommunication service prioritization, identifying critical nodes across the United States that, if impacted, could affect the public significantly. By registering these nodes with the Cybersecurity and Infrastructure Security Agency, the industry focused on restoring them first during disasters. Additionally, the wireless priority service (WPS) gave disaster management, national security, and law enforcement personnel priority access in congested or degraded environments, ensuring essential communications were maintained for the country's stability and security. Finally, he highlighted the crucial role of regulators in all facets of disaster planning and preparedness, ensuring they understand technical challenges faced by telecommunications carriers and enabling informed policy decisions to support effective communication and response efforts for residents, first responders, and law enforcement.

Ms Ria Sen from World Food Programme shared findings from a study[291] indicating that for every USD dollar invested in disaster preparedness, there is a threefold saving in response costs. This was evident in cases such as those of Mozambique and Madagascar, which benefited significantly from pre-investment. The study underscores the importance of integrating preparedness into national planning, emphasizing that preparedness should be a multisectoral effort involving all areas of emergency planning and management. Ms Sen highlighted that clear cost-benefit analysis helps governments prioritize and strategically allocate budgets for emergency preparedness, making it a crucial aspect of national resilience strategies. She also emphasized the importance of regulatory bodies in emergency communication, within a broader framework of preparedness. She highlighted the role of national working groups, where regulators are crucial participants in emergency preparedness discussions, especially in small island states like Dominican Republic. Their tripartite engagement with disaster management and emergency authorities improved resilience, as evidenced during Hurricane Fiona. Ms Sen also noted that in many countries and regional blocks, regulatory involvement has been increasingly emphasized to ensure swift decision-making during evolving crises, underscoring the critical role of regulators in preparedness and response coordination. She reminded all that the previous year, ITU had collaborated with the Southern African Development Community to develop a model emergency telecommunications plan, benefiting countries prone to disasters and varied development situation countries in the region. Regulatory engagement was crucial in preparing this model and operationalizing its aspects. Similar efforts were undertaken in the Caribbean region, where ITU supported emergency telecommunication simulations to enhance disaster resilience, and test regulatory, policy, and procedural readiness. These initiatives highlighted

291 https://www.itu.int/dms_pub/itu-d/oth/07/31/D07310000050010PDFE.pdf

the pivotal role of regulators in emergency response, underscoring their importance, despite initial involvement levels in decision-making processes. Ms Ria also highlighted significant challenges faced by landlocked developing countries (LLDCs) and small island developing states (SIDS), emphasizing their struggle against natural imbalances, and limited resources for disaster resilience. She stressed the complexities of decision-making involving investments in emergency telecommunications versus other urgent developmental needs such as food security or healthcare. Ms Ria shared proactive examples from their work, such as earthquake preparedness initiatives and cyclone simulation exercises, which demonstrated the importance of national coordination, and regional cooperation in enhancing disaster preparedness across diverse environments and developmental stages. She also discussed the role of the Emergency Telecommunications Cluster (ETC) as an emergency coordination mechanism, emphasizing proactive engagement in both crisis response, and preparedness. The Cluster collaborated closely with national ICT Working Groups, advising and supporting them in setting priorities and implementing emergency communication strategies. For instance, in Madagascar, the Cluster conducted capacity assessments, and recommended interventions to establish a robust national Working Group ahead of the annual cyclone season and other potential crises, highlighting the multifunctional nature of these efforts in responding to disasters such as cyclones, the COVID-19 pandemic, and famines. The approach involved tailored responses to specific national needs, deploying equipment and response coordinators to assist in early recovery, and reconstruction phases post-disaster, while maintaining close collaboration with national authorities for sustainable service provision.

Ms Kathryn Condello, from Lumen Technologies, emphasized the role of Lumen Technologies in minimizing disruptions and speeding up recovery in various crises such as hurricanes, fires, or cyberattacks. Working closely with operational teams, their focus was on advanced planning, derived from past events, to develop effective protocols and strategies. This proactive approach aimed to enhance resilience across all circumstances and situations, by anticipating challenges and implementing coordinated plans, programmes, and regulations. In challenging environments, whether in developing countries or difficult-to-reach areas, it is recognized that financial resources are always insufficient. Planning becomes crucial to acknowledge and work within the constraints, focusing on local or regional collaborations, to establish safety nets for communication. These efforts, though not ideal, foster innovative solutions tailored to specific risks such as hurricanes, emphasizing local engagement to build resilience and explore alternative communication methods such as satellite, or two-way radios when primary services falter. The goal is to create scalable solutions through community understanding and cross-regional support in crisis scenarios. Advanced planning is crucial as it allows for strategic investment in developing relationships, protocols, and processes without requiring substantial financial resources. Planning enhances resilience by refining investments in physical infrastructure and communication protocols, and fosters collaboration across local, regional, and national levels. This proactive approach aims to mitigate the impact and duration of threats, including in contested environments impacted by evolving cyber challenges.

During the **Question-Answer part of the session**, Internet Society (ISOC) thanked the panellists for their insights and posed two questions. The first question asked the panellists for examples of Internet service providers (ISPs) performing effectively during crises. The second question, concerning top infrastructure data points to assess network resilience, could the panellists select three ideal metrics they would wish to have publicly available. In response, Mr Justin Cain highlighted that ISPs are resilient in crises, despite facing challenges, as they dedicate resources to maintain communications. He emphasized the ongoing difficulty in identifying infrastructure choke points, underscoring the need for comprehensive risk assessments to understand interdependencies and bolster infrastructure resilience, and particularly critical infrastructure resilience. Mr Cain advocated for a collaborative approach involving communication companies, stakeholders, and agencies, to enhance redundancy planning and mitigate downstream impacts of disruptions. Regarding the top three infrastructure data points, Mr Cain emphasized the importance of understanding **network architecture**, **core locations**, and **choke points** to improve long-term preparedness and response strategies tailored to different disaster scenarios and vulnerable regions. His insights underscored the necessity for continual risk evaluation and community cooperation to strengthen infrastructure resilience in the face of crises.

Ms Katheryn Condello underscored the significant collaboration among ISPs during the COVID-19 pandemic, highlighting how they adapted to shifting traffic patterns globally. She emphasized proactive engagement of Lumen with fellow carriers, Internet exchange points, and content delivery networks to manage traffic flows effectively. This included balancing demands such as coordinating the release schedules of major video games and movies to optimize network performance. Ms Condello noted that this period offers a pivotal opportunity for unprecedented collaboration, extending beyond the usual partnerships like AT&T and BT, to collectively address global traffic challenges, and ensure uninterrupted service delivery worldwide. This would demonstrate enhanced resilience in a crisis scenario on a global scale. The representative from Côte d'Ivoire asked whether regional Working Groups should be established to discuss risk reduction in the case of disasters, considering that over 40 per cent of countries do not have emergency plans, as highlighted by the panellists. In response, Ms Condello emphasized the importance of evolving as a cluster to address region-specific hazards and vulnerabilities, highlighting the need for cooperation to develop model plans that can enhance preparedness.

Ms Sen acknowledged that while some regions have successfully developed model plans, there are challenges in certain subregional blocs where this may not be prioritized. She underscored the role of Member States in advocating for these issues within subregional bodies, emphasizing that United Nations entities can only support such initiatives upon receiving national requests. Ms Ria stressed the importance of national engagement to bolster regional plans and encouraged countries to seek technical support and assistance from the United Nations Secretariat and the Emergency Telecommunications Cluster (ETC) for coordination and capacity development. The representative from Dominican Rep. emphasized the ongoing and evolving nature of climate change, stressing the need for constant improvement in protocols and preparedness efforts by leveraging new available technologies. They underscored the necessity of international agency support and collaboration between the private and public sectors to effectively address these challenges.

Ms Ria highlighted the close collaboration with the Dominican Rep. and underscored that climate change, with its increasing frequency and severity of hazards, emphasizes the critical need for effective emergency telecommunications coordination mechanisms. She emphasized the pivotal role of regulators, disaster management authorities, and ICT agencies in driving interventions to enhance resilience. Ms Ria acknowledged that while coordination is crucial, there is still significant work needed in capacity development and supporting vulnerable communities. She viewed these efforts as a positive starting point toward improving overall resilience.

SESSION 2 – Technological innovation and cooperation: Information and communication technologies as key tools in emergency management and post-disaster reconstruction

Session 2 began with introductory remarks by the moderator, Mr Serigne Abdou Lahatt SYLLA (Senegal), co-rapporteur for ITU-D Question 3/1.

Professor Cheikh Ahmadou Bamba Gueye, University Cheikh Anta Diop from Senegal presented a study[292] on unconnected areas during the session. He defined "white spot areas" as regions lacking cellular network coverage, which exacerbates vulnerabilities during disasters when infrastructure is destroyed. Prof. Gueye introduced the COWSHED project, which employs long-range communication technology to cover distances of up to 15 kilometres in interconnected areas. Highlighting that 70 per cent of the population in developing countries like Senegal remains unconnected, mostly in rural areas with low incomes. He emphasized how limited operator investment exacerbates the prevalence of white spot areas, hindering both basic communication and Internet access. Gueye proposed utilizing open frequency bands for meshed networks to enhance connectivity in pastoral regions, which is crucial for herders navigating climate change impacts including diminishing grazing areas, and water sources, and enables them to share vital information efficiently. He continued his presentation by illustrating the evolution of 2G coverage in Senegal from 2017 to 2021, highlighting persistent white spot areas where no cellular network exists. He emphasized the significance of these white spots in regions such as the Sahel, and how they are impacting livestock herders' ability to sell livestock, and fishermen's access to communication while at sea. The COWSHED project utilizes low-cost solutions such as LoRa technology which operates efficiently over distances of 15 to 25 kilometres without high energy consumption. He explained how this technology facilitates communication between livestock herders, and mitigates conflicts over grazing areas, utilizing gateways and smartphones to extend network reach within the community. Prof. Gueye emphasized ongoing research to enhance the COWSHED technology to better support rural communities in Senegal and other developing regions. He then proceeded to present the results of tests conducted in the Ferlo region, where infrastructure is absent, demonstrating the capability of their system to cover distances up of to 15 kilometres effectively. He then showcased the setup of the gateway mobile unit, which livestock herders can carry in a backpack along with a solar panel to ensure continuous power supply. This setup allows herders to remain independent as they move across fields, ensuring the device remains charged throughout their journey. Prof. Gueye emphasized the performance of the system in various environments, including at sea, where it can cover up to a 25-kilometres radius, due to better wave propagation over water compared to land. He highlighted the use of digital terrain models (DTMs) to extend network coverage, enabling nodes within the 15-kilometre radius to relay information, and discussed ongoing research using satellite technology for uplink connections to enhance communication capabilities in remote areas.

Professor Chen Tao, Tsinghua University[293]; highlighted several major disasters and their impacts. The presentation underscored challenges during mass casualty incidents (MCI), such as insufficient resources, transportation limitations, and the critical importance of timely treatment within the "golden hour." It is very difficult to implement fast and accurate on-site triage with the current processes and technology. The speaker advocated for improved triage processes using AI and machine learning (ML) to enhance accuracy and speed in assessing injuries and prioritizing treatment. The need to focus primarily on patients who need immediate treatment was acknowledged, and technology is expected to have a significant effect by collecting and analysing face video data, voice data and physiological data. They concluded with a proposal

292 https://www.itu.int/dms_pub/itu-d/oth/07/31/D07310000050008PDFE.pdf
293 https://www.itu.int/dms_pub/itu-d/oth/07/31/D07310000050014PDFE.pdf

for a comprehensive emergency medical system integrating advanced technologies such as AI, mobile field hospitals, and coordinated command systems, to optimize disaster response and minimize casualties and disabilities.

Ms Naomi Ng'ang'a from Kenya Red Cross; presented[294] a comprehensive approach to disaster management, focusing on leveraging technology to prevent and alleviate human suffering across the country. Ms Ng'ang'a highlighted the use of Mapathons to map high-risk areas such as flood zones and critical infrastructures such as schools and hospitals, enabling evidence-based decision-making, and efficient resource allocation during disasters. Capacity-building trainings for local government personnel in mobile data collection and management, were pivotal in enhancing local resilience efforts. Satellite imagery and drone technology played crucial roles in disaster assessment and response, from prepositioning resources based on flood impacts, to monitoring locust infestations. The development of a focused-based financing EWS underscored their commitment to proactive disaster preparedness, aiming to reduce impacts and optimize response strategies. Continuous community feedback and capacity building were emphasized as essential components in ensuring the effectiveness and sustainability of digital transformation initiatives.

Ms Monique Kuglitsch from Fraunhofer HHI, Germany; spoke about the global initiative that emerged from the Focus Group on AI For Natural Disaster Management, aiming to advance standards in this critical field. Hosted within the ITU Telecommunication Standardization Sector, the initiative focuses on establishing guidelines for AI applications in disaster management, addressing gaps identified in existing international standards. Over three years, the initiative engaged experts globally through 12 topic groups, developing 27 use cases to illustrate the role of AI across various natural hazards. Key outputs include reports on data management, AI modelling, and operational integration, emphasizing transparency, ethical considerations, and user-centric design. Educational initiatives, hackathons, and workshops have facilitated widespread capacity-building efforts, fostering collaboration among stakeholders to enhance disaster resilience worldwide. Concluding its three-year term, there is strong interest from participants and United Nations partners to extend the efforts of the initiative. A recent meeting co-hosted by NASA and the University of Maryland, Baltimore County marked this transition, attended by representatives from key United Nations agencies. The initiative aims to build on past achievements, expand use cases, and integrate emerging technologies such as digital twins. The initiative plans to update technical reports, delve into new topics, and prioritize implementation to ensure proposed best practices are effectively applied. The first major project of the initiative, a three-year effort funded by the European Commission Horizon programme, focuses on developing a multi-hazard EWS across the Mediterranean region to Sweden, testing AI and related technologies for decision support, forecasting, risk assessment, and community outreach. For access to documents and involvement in upcoming activities, visit the initiative website via the provided QR code.

During the **Question-Answer part of the session**; the moderator posed a question to Ms. Naomie Ng'ang'a focused on the importance of cooperation among governments, humanitarian centres, private companies, and civil populations in disaster preparedness and relief efforts. The question also touched on the challenges related to illegal migration and its impact on safety, poverty, and community resilience. Ms. Ng'ang'a highlighted advancements in preparedness through collaborative efforts, emphasizing the need to leverage strengths of different stakeholders,

[294] https://www.itu.int/dms_pub/itu-d/oth/07/31/D07310000050011PDFE.pdf

including private sectors, for information and cash transfers. She underscored the importance of building community resilience proactively, rather than solely focusing on response, and of integrating local knowledge with scientific information, to effectively address disaster risks and community needs. Ms Monique Kuglitsch emphasized several approaches to engage with countries in the context of standardization activities related to AI. She highlighted the importance of considering regional differences, capabilities, feasibility of AI use, data availability, and infrastructure when developing standards. Insights are gathered from ITU Member States' engagements, and from ongoing research studies such as those in Mozambique and Ethiopia, which provide valuable regional perspectives. Collaboration with organizations such as the African Union, and engagement with small island developing states (SIDS) in the Caribbean region further enrich the standardization process. Ms Kuglitsch encouraged further engagement and sharing of experiences to enhance their focus group activities.

By presenting innovative applications and platforms using ICTs for real-time data collection, mapping of disaster areas, and coordination of relief efforts, the speakers demonstrated the importance of coordination for more successful actions and interventions during disasters. To achieve this, it was recommended that a community of committed stakeholders and experts be created, building on the progress already made by the ITU in this area. In essence, the session examined the critical role of ICTs in emergency management and post-disaster reconstruction, and highlighted technological innovations, and best practices in the use of ICTs to respond effectively to crises and facilitate the sustainable reconstruction of disaster-affected populations. The necessity for collaboration and coordination between governments, humanitarian organizations, the private sector, and civil society in the use of ICTs for disaster prevention, emergency response, and reconstruction was emphasised, as was the importance of continuing to introduce innovative technologies such as artificial intelligence, the Internet of Things (IoT), and megadata analysis into disaster management.

Conclusions of the Workshop

Ms Alison Balzer (United States), Co-Rapporteur for ITU-D Question 3/1, expressed her delight at the experiences shared. She then reiterated her thanks to the speakers, participants and BDT team.

A4.3 Transformative connectivity: Satellite workshop[295]

The joint Q1/1, Q3/1, and Q5/1 workshop informed administrations of the unprecedented innovation in the satellite industry in terms of coverage, capacity, and integration with terrestrial technologies. The workshop focused on how developing countries, particularly unserved or underserved, and rural and remote areas, can benefit from these developments. The goal was to support administrations in building their national digital strategies to advance the connectivity goals of each country by identifying challenges, and potential collaborations to achieve meaningful connectivity with the objectives of providing connectivity to all, and providing regulatory and business best practices. The workshop, structured into four sessions, brought together stakeholders from ITU, various industries, and administrations to discuss the current state of the satellite industry, its impact on developing countries, its role in disaster response, and its potential for future convergence with traditional network infrastructure.

[295] For further information, see the workshop webpage and workshop report document 1/346-E.

The third session **"Satellites to support disaster mitigation, preparedness, response and recovery"** was on the following items:

- Satellite applications for disaster prediction, detection, monitoring, early warning, response, relief, and recovery – EW4ALL (Early Warning for All).
- Ensuring a favourable regulatory environment to enable rapid deployment and implementation of satellite technologies in support of disaster mitigation, preparedness, response, and recovery.
- Public/private partnerships for disaster preparedness and recovery.
- Building an enabling environment for resilient networks including satellite, for emergency communication systems.

The third session shifted to the critical role of satellites in strengthening disaster resilience. Speakers emphasized the irreplaceable nature of satellite communication during emergencies when traditional infrastructure may be damaged or overwhelmed. The session also discussed the 'Early Warnings for All' initiative, highlighting the importance of collaboration in disaster preparedness efforts.

In conclusion, the workshop underscored the growing significance of satellites in bridging the digital divide, especially in remote areas, and also other areas such as the use of satellites and Wi-Fi as complementary technologies for Wi-Fi connectivity *in-flight*. The workshop has also focused on the implementation of satellite technologies in support of disaster mitigation, preparedness, response, and recovery. Collaboration between stakeholders, effective spectrum management, and user-centric approaches are crucial for success. The promising potential of non-terrestrial networks (NTNs) suggests a future where satellite and terrestrial networks work together as complementary technologies to create a more connected world. The workshop outcomes were summarized in the interim report.

Detail report of session 3 of the joint workshop

Session 3 – "Satellites to support disaster mitigation, preparedness, response, and recovery"

Session 3 began with opening remarks from Mr. Gokhan Tok, Access Partnership Ltd, vice-rapporteur for ITU-D Question 3/1. This session focused on how satellite communication strengthens disaster resilience. It highlighted the importance of this technology when other communication fails during disasters.

Ms. Maritza Delgado, Programme Officer, EET Division, BDT, ITU7 elaborated on the Early Warnings For All initiative. This initiative launched by United Nations Secretary-General in 2022, with the ambitious goal of ensuring that every person on Earth is covered by an EWS by 2027. The key highlights of this initiative centred around the four pillars of the initiative: (1) Disaster Risk Knowledge (UNDRR): Educating communities about hazards and risks, (2) Observation and Forecasting (WMO): Collecting, analysing, and predicting hazards, (3) Warning Dissemination (ITU): Using technology to deliver early warnings, and (4) Preparedness and Response (Red Cross): Helping communities understand warnings and take action. Representatives from Türkiye, India, and multiple organizations sought further information on the implementation of the Early Warnings for All initiative. This United Nations-led effort aims to provide everyone with EWSs for disasters by 2027. Technology is crucial, with satellites seen as a good option for reaching remote areas. ITU, which is a United Nations agency, works with governments, telecommunications companies, and at-risk communities to establish warning systems. This includes creating regulations, training exercises, and emergency plans. India suggested using mobile Internet for alerts, but the Speaker recommended a multi-channel approach considering factors such as a country's infrastructure and population.

Mr. Tare Brisibe, Senior Legal & Regulatory Counsel, APAC, SES8, talked about the SES Humanitarian Solutions initiative, referring to SES which is a global satellite operator offering communication solutions. The Speaker focused on how SES supports disaster relief and recovery. SES offers rapid response solutions using existing satellite infrastructure, such as geostationary (GEO) and medium Earth orbit (MEO) satellite constellations, for immediate communication needs following disasters, such as was the case following the Tonga volcanic eruption. During disaster recovery, SES provides solutions for scaling communication capacity, as was the case post-Tonga eruption and post Hurricane Ian. This can even transition into long-term network resiliency (Tonga). SES is part of 'Emergency.LU,' a public-private partnership offering free, mobile satellite communication to first responders during disasters. Emergency.LU has completed dozens of missions globally in the past year. The Speaker highlighted the importance of spectrum availability for disaster response, existing satellite infrastructure vs. deploying new equipment after disasters, interoperability between satellite operators for broader communication access, and integrating satellite connectivity into existing broadband networks. The Speaker recommended for the development of a coordinated plan for disaster response, involving all stakeholders (businesses, institutions, local operators). This facilitates resource pooling and improves response efficiency. In response to the enquiries about the challenges a satellite operator faces when providing connectivity in a new disaster zone, SES highlighted several challenges including difficulties in importing terminals and ground stations, and difficulties in obtaining spectrum access. He also noted that a surge in communication needs after a disaster can strain satellite network capacity, damaged infrastructure can hinder equipment movement to affected areas, satellite infrastructure might rely on other (potentially damaged) infrastructure for functionality, disasters often cause power outages, requiring alternative power solutions such as solar or generators for terminals, that high winds, floods, etc. can make installing terminals difficult, and that security issues, and other unforeseen issues might arise after the initial crisis.

Ms. Donna Bethea-Murphy Policy Spectrum, Senior Vice President Global Regulatory and Technology Policy, Viasat9 talked about the Satellites in Disaster Relief initiative. The Speaker highlighted the importance of satellites in disaster preparedness, warning, and response. The Speaker focused on the crucial role of satellites in the first 48 hours after a disaster. Prepositioning satellite equipment and training for usage is crucial for preparedness. Public awareness campaigns are needed to encourage proactive disaster planning. Viasat advocates for integrating satellite redundancy into existing communication infrastructure. All types of satellites (meteorological, GPS, mobile, and broadcasting satellites) play a role in disaster management. EWSs such as dam monitoring devices, and tsunameters utilise satellites for communication. The Speaker shared some examples, in which satellite phones were used to coordinate aid deliveries after a hurricane destroyed airplane runways on an island. Portable telemedicine equipment allows first responders to consult with medical professionals via satellite. The representative from United States raised the issue of preparedness for network congestion during disasters, focusing on policies, agreements, and relationships. The Speaker highlighted two key areas for preparedness. The first area for improving preparedness is the use of 'Continuing Operation Plans (COPs)' whereby regulators need a COP to quickly grant access to alternative communication providers (e.g., satellite companies) during disasters. Here the COP plan should define clear communication channels – who to contact and how, even if displaced. The United State example demonstrates the importance of practicing these plans.

The second area for improving preparedness is 'User Preparedness', whereby users should be familiar with backup communication methods (e.g., VHF radios) to avoid confusion when primary networks are congested. Viasat suggests exploring direct-to-device (D2D) satellite communication, potentially built into mobile phones, as an emerging solution for disaster situations. This technology is still under development but could be a future policy consideration.

Mr. Veli Yanıkgönül, Director Spectrum Management, Turksat10 presented on the role of Turksat in disaster management. The Speaker emphasised the importance of satellite communication in disaster preparedness, response, and recovery. The Speaker focused on the experience of Turksat, a Turkish satellite communication company. Turksat collaborates with the Government of Türkiye agencies (AFAD, Red Crescent) to build infrastructure for disaster preparedness. This includes central/mobile coordination centres, data transfer vehicles, and staff training. Turksat prioritises providing uninterrupted communication during disasters. They offer services such as connectivity for government agencies, shelters, and public announcements and backhaul capacity for terrestrial mobile operators whose infrastructure is damaged. The Speaker recommended that the regulatory efforts focus on the national and international regulations for disaster response, as well as sufficient, globally harmonised satellite spectrum, protection of satellite spectrum from harmful interference, national frequency allocations that prioritise disaster response needs, and streamlined licensing and authorisation procedures for satellite operators. The Turksat response to a recent major earthquake in Türkiye affecting 11 cities, faced challenges in providing a huge amount of data capacity, over an extensive area, within the first 48 hours following the disaster. Turksat provided connectivity for government agencies, shelters, public announcements, as well as backhaul for mobile operators. Effective disaster management requires coordinated efforts across various stakeholders, including regulatory bodies, and satellite operators. In response to the concern raised on the biggest challenges they faced (technological, logistical, or regulatory) in their past disaster response experience, the Speaker emphasised that all three aspects (regulatory, technical, logistical) are crucial for effective disaster response. They need to work together to ensure a healthy satellite industry that can handle emergencies, to have sufficient satellite capacity available in the affected country, and to respond quickly and reach all affected areas.

Ms. Astrid Bonté, Director of International and Institutional Affairs, Eutelsat Group, presented on 'Satellite communication for disaster recovery, and how satellite communication can improve disaster response'. Satellite communication is crucial for EWS and for resilient communication networks in disaster situations. Eutelsat Group has extensive experience providing connectivity during disasters such as hurricanes, earthquakes, and fires. They offer high-throughput, easily deployable antennas and user terminals, along with solar energy kits for independent operation. Eutelsat provides a unique combination of geostationary (GEO) and low Earth orbit (LEO) services, offering high capacity, global coverage, and low latency. Eutelsat works with organizations including Telecom Without Frontiers, and the United Nations Crisis Connectivity Charter to equip responders and governments with satellite connectivity during disasters. Regulatory hurdles, such as import licences and customs restrictions, often delay deployment of satellite services. The Speaker recommended for the development of pre-approved temporary licence templates for disaster-prone regions to expedite service activation, the conducting of training sessions for disaster responders on using satellite equipment and services, and for the creation of a central map of pre-identified resources and solutions for faster disaster response. The Speaker emphasised the critical role of satellite communication in disaster recovery, and proposed solutions to overcome current obstacles for faster and more effective response.

In conclusion for session 3, the Chairperson highlighted key takeaways from the session in terms of challenges in which familiar issues persist, such as power outages, equipment importation difficulties, and lack of trained personnel after disasters. New technological solutions such as multi-orbit satellites, and advanced device technology offer promise. Pre-disaster coordination with response authorities and NGOs is crucial, and supportive regulations and streamlined import processes are essential. The session concludes with a call for a harmonised global spectrum for disaster response communication, including lite licensing and import regimes. These discussions will continue to be a focus area for future sessions.

Annex 5 – Bibliography

[b-Q5/2 final report] ITU-D Question 5/2: Utilizing telecommunications/ICTs for disaster risk reduction and management, 2018-2021 study period: https://www.itu.int/hub/ publication/d-stg-sg02-05-2-2021/

[b-NETP] ITU Guidelines for national emergency telecommunication plans: https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Publications/Guidelines-for-NETPs.aspx

[b-ITU-T X.1303] ITU-T Recommendations X.1303: Common alerting protocol (CAP 1.1) https://www.itu.int/rec/T-REC-X.1303-200709-I

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