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利用电信/信息通信技术降低和管理灾害风险




ITU-D第5/2号课题输出成果报告

利用电信/信息通信技术降低和管理灾害风险

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利用电信/信息通信技术降低和管理灾害风险：2018-2021年研究期ITU-D第5/2号课题输出成果报告

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鸣谢

国际电联电信发展部门（ITU-D）研究组提供了一个中立性平台，来自世界各地的政府、业界、电信组织和学术界的专家可汇聚一起，制定解决发展问题的实用工具和资源。为此，ITU-D的两个研究组负责在成员所提出输入意见基础上制定报告、导则和建议。研究课题每四年在世界电信发展大会（WTDC）上决定。国际电联成员于2017年10月在布宜诺斯艾利斯举行的WTDC-17上商定，在2018-2021年期间，第2研究组将在“信息通信技术服务和应用促进可持续发展”的总体范围内处理七项课题。

本报告是针对**第5/2号课题 – 利用电信/信息通信技术降低和管理灾害风险** – 编写的，由ITU-D第2研究组的管理班子进行全面指导和协调。该研究组由主席Ahmad Reza Sharafat先生（伊朗伊斯兰共和国）领导，并得到以下副主席的支持：Nasser Al Marzouqi先生（阿拉伯联合酋长国）（2018年辞职）；Abdelaziz Alzarooni先生（阿拉伯联合酋长国）；Filipe Miguel Antunes Batista先生（葡萄牙）（2019年辞职）；Nora Abdalla Hassan Basher女士（苏丹）；Maria Bolshakova女士（俄罗斯联邦）；Celina Delgado Castellón女士（尼加拉瓜）；Yakov Gass先生（俄罗斯联邦）（2020年辞职）；Ananda Raj Khanal先生（尼泊尔共和国）；Roland Yaw Kudozia先生（加纳）；Tolibjon Oltinovich Mirzakulov先生（乌兹别克斯坦）；Alina Modan女士（罗马尼亚）；Henry Chukwudumeme Nkemadu先生（尼日利亚）；王珂女士（中国）；和Dominique Würges先生（法国）。

本报告由第5/2号课题共同报告人Sanjeev Banzal先生（印度）；Joseph Burton先生（美国）（2020年辞职）和Ms Kelly O'Keefe女士（美国）和下列共同报告人协作撰写：Parag Agrawal先生（印度）；Hideo Imanaka先生（日本）；Joses Jean-Baptiste先生（海地）和Abdulkarim Ayopo Oloyede先生（尼日利亚）。

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本导则是在电信发展局研究组联系人、编辑以及出版物制作团队和ITU-D研究组秘书处的支持下编写的。

目录

图和表列表

图目录

表目录

内容提要

国际电联电信发展部门（ITU-D）第2研究组高兴地分享关于第5/2号课题“利用电信/ICT降低和管理灾害风险”的最后报告。本报告以成员国和部门成员在2018-2021年研究期内的文稿和互动式讨论为基础，提供了利用电信/信息通信技术（ICT）降低和管理灾害风险的概览，并介绍了针对ICT在灾害所有阶段的使用，主管部门和各组织提到的一系列技术和政策案例研究。

无论是自然灾害还是人为灾害，均可对社会带来极为负面的影响，打乱社会和经济生活的正常运行。当局和人民必须立刻应对，帮助受影响的人并重建可接受的福祉和生活基础。危害、脆弱性再加上无法降低风险的潜在负面影响可谓是灾害性的。由于许多灾害无法预测，因此备灾和灾害风险管理对拯救生命和保护财产至关重要。在未发生灾害时，对风险管理（如减轻损害、损害防备和早期预警/预测）有所思考亦非常重要。有效的规划和准备能够也的确会拯救生命。

电信和ICT在灾害预防、减缓和管理方面发挥着核心作用。有效的灾害管理需要不同利益攸关方之间及时、有效地共享信息，而ICT对达到此目的不可或缺。它们是灾害所有阶段的支持来源，包括预测和早期预警阶段。的确，已在世界各地观察到有效的降低风险技术使灾害发生时的生命和财产损失大幅减少。

在2018-2021年研究期内，对第5/2号课题的探讨主要围绕利用电信/ICT降低和管理灾害风险。有效的政策在国家应急通信计划（NETP）的总体设计和实施中发挥着至关重要的作用。因此，政策和监管环境构想应帮助实现和促进有效备灾和应对。应存在针对应急通信系统部署、早期预警、通信连续性和更有效应对的政策。在制定时应顾及通信无障碍获取，因此应具有包容性，涵盖社会所有阶层。新技术，特别是物联网（IoT）、机器到机器（M2M）通信和人工智能（AI），得益于快速的发展，一直在促进灾害所有阶段的工作并将继续如此。这使得知悉救灾通信技术的最新发展非常重要，本报告之中一章对此进行了探讨。

早期预警系统在通知人们即将发生的灾害方面发挥着关键作用，因此应在灾害频发地区部署。在灾害发生之前、期间和之后，有效的信息传输和传播非常重要。在研究期内举办的关于早期预警系统的讲习班收到许多关于该议题的好的输入意见，因此也是本报告其中一章的主题。

备灾涉及演练和演习，范围从桌上推演到全方位演练不等。此类演练和演习暴露的差距需要分析和纠正行动，以便在实际灾害发生时，每个人都能按照预期、协调一致地行动。学习其他国家采用的最佳做法很重要，尤其是那些灾害频发且已吸取经验教训的国家。因此，本报告载有多个不同国家的案例研究，介绍了他们吸取的经验。在研究期内举办关于演练和演习的专门讲习班之后，专家们的探讨经汇总形成一套面向小岛屿国家和内陆国家的指导原则并纳入本报告。

有利的政策环境对于任何灾害的管理都必不可少。此类政策应为部署应急通信设备提供灵活性，并确保成功利用电信和ICT备灾和应对灾害。明确有利政策环境的构成很重要，这样的环境可加强应急通信备灾能力、网络复原力、灾害风险降低和灾害管理。

当前世界正面临新冠肺炎疫情大流行的严峻挑战，疫情已导致数百万人死亡，对世界经济的影响高达数万亿美元。没有一个国家幸免于难。关于灾害管理（包括应对大流行病）的有利政策环境网络研讨会探讨了对疫情的有效、可行应对，并提供机会让许多国家分享在人们开始居家办公和各国引入封锁限制导致互联网流量显着增加时，加强和扩充ICT基础设施的经验。收到的关于第5/2号课题的文稿还描述了针对新冠肺炎疫情大流行的国家应对措施。相关详细信息载于本报告第2章 – 有利的政策和监管环境。

简而言之，本报告共分为七章，如下：

- **第1章** – 引言说明本报告的范围并简要概述电信/ICT在整个灾害管理周期中的作用；
- **第2章** – 有利的政策和监管环境全面概述了有利的政策和监管环境，包括关于应急通信和早期预警系统部署、支持通信连续性和促进更有效应对的政策；
- **第3章** – 救灾通信技术探讨救灾通信技术；
- **第4章** – 早期预警和告警系统讨论早期预警和告警系统，以及利用ICT进行规划；还讨论了部署用于降低灾害风险的早期预警系统、广播应急预警系统、灾害信息和救灾系统以及适应性网络技术；
- **第5章** – 演练和演习总结了筹备和开展救灾通信演习和演练的指导原则；
- **第6章** – 国家和行业案例研究基于ITU-D成员的文稿，介绍不同国家和行业案例研究；
- **第7章** – 好的做法、指导原则和结论探讨已确定的最佳做法和经验教训，以及研究期内提出的指导原则。

缩写与首字母缩略词

2G/3G/4G/5G	第二/三/四/五代移动网络
AI	人工智能
BDT	国际电联电信发展局
BGAN	宽带全球局域网
CAP	公共告警协议
COVID-19	2019新型冠状病毒
ETC	联合国应急通信集群（ETC）
FEMA	美国联邦应急管理署
GIS	地理信息系统
GSMA	GSM协会
ICT	信息通信技术
IoT	物联网
ITU	国际电信联盟
ITU-D	国际电联电信发展部门
ITU-R	国际电联无线电通信部门
ITU-T	国际电联电信标准化部门
IPAWS	公共告警和预警综合系统
IPAWS-OPEN	IPAWS应急网络开放式平台
LDC	最不发达国家
M2M	机器对机器
MDRU	可移动且可部署的信通技术资源单位
MHEWS	多灾种早期预警系统（MHEWS）
ML	机器学习
NETP	国家应急通信计划
NGO	非政府组织
NOAA	美国国家海洋和大气管理局
OSCAR	世界气象组织观测系统能力分析与评审工具
PPDR	公众保护和救灾

（续）

SDGs	联合国可持续发展目标
SIDS	小岛屿发展中国家
SNS	社交网络服务
UAV	无人机
UNISDR	联合国国际减灾战略
UNITAR	联合国训练研究所
UNOSAT	联合国培训研究所业务卫星应用方案
UN-SPIDER	联合国灾害管理和应急响应天基信息平台
VoLTE	（长期演进）技术语音通话
VSAT	甚小孔径终端
WFP	世界粮食署
WHO	世界卫生组织
WMO	世界气象组织

第1章 – 引言

1.1 背景

国际电联全权代表大会、世界电信发展大会（WTDC）和世界无线电通信大会（WRC）的不同决议，以及国际电联电信发展部门（ITU-D）、国际电联电信标准化部门（ITU-T）和国际电联无线电通信部门（ITU-R）报告均已强调电信/信息通信技术（ICT）在备灾、早期预警、救援、减灾、赈灾和应对方面的作用。此外，信息社会世界高峰会议（WSIS）各行动方面、联合国可持续发展目标（SDG）、若干联合国国际减灾战略（UNISDR）决议和《2015-2030年仙台减少灾害风险框架》均认识到需要降低灾害风险并建立可持续、有抵御能力的基础设施。ICT在人道主义援助以及公众保护和救灾中也发挥着作用。

在促进自然和人为灾害国家和区域备灾的工作中，国际电联一直倡导将电信/ICT用于备灾、减灾、应对和恢复之目的，并为此鼓励区域性和全球协作及经验分享。在上一个研究期内（2014-2017年），ITU-D第5/2号课题研究了灾时通信规划、管理和应对的多个方面。2018-2021年研究期的重点是利用电信/ICT降低和管理灾害风险。

1.2 报告的目标

本报告的目标是继续审查电信/ICT在灾害预测、探测、监测、早期预警、应对和救灾中的应用，包括考虑实施和确保实现快速部署和落实的监管环境方面的最佳做法/指导原则。报告含有在备灾、减灾和应对以及制定国家灾时通信规划方面的国家经验和案例研究；探讨了其中的共同主题和最佳做法。报告涵盖四个广泛领域：

– 有利的政策和监管环境；
– 救灾通信技术；
– 早期预警和告警系统；
– 演练和演习。

相关案例研究和最佳做法参见相应章节。

1.3 电信/ICT以及灾害管理和救灾

众所周知，电信/ICT在灾害管理和降低灾害风险方面发挥着至关重要的作用。为在灾害期间和之后挽救生命和财产，设计国家应急通信计划（NETP）非常重要，利用ICT建立早期预警和监控系统，并确保应急通信设备可用。电信/ICT在灾害探测、降低风险、早期预警、监控和救援以及灾后救济工作的所有阶段均可发挥作用。获取信息和及时通信是控制灾害影响的关键。不同的ICT和网络（包括卫星、无线电和移动网络、互联网、

地理信息系统（GIS）软件、卫星地球观测系统、物联网（IoT）、使用大数据和先进计算的实时分析、移动通信技术和社交媒体）均有助于增强灾害管理能力，降低人们的脆弱性。当地社区、政府、私营部门、灾害管理机构、气象组织、民间团体、人道主义机构和国际组织均可为灾害管理活动的协调做出贡献，使所有重要利益攸关方参与合作伙伴关系、预先规划和备灾工作。

1.4 将电信/ICT用于灾害的所有阶段

电信/ICT是灾害所有阶段必不可少的工具，有效的灾害管理会利用一系列不同的电信/ICT手段。实例包括通过卫星、雷达、遥测和气象系统的遥感以及卫星M2M感应技术发出早期预警；广播和移动技术（无线电和电视广播、业余无线电、卫星、移动电话和互联网）散布告警；以及临时基站、便携式应急系统等，帮助评估损害，向搜索、营救、救灾和重建小组传达指令，并通过使用卫星电话等设备恢复通信和其它基础设施。因此，利用ICT的灾害综合管理需要稳健、可靠的电信基础设施，能够确保灾害发生之前、期间和之后的有效通信，从而将生命和财产损失降至最低。

此外，在每次灾害过后吸取经验教训非常必要，更好地为下一次做准备。因此，电信/ICT也用于在重大灾害之后收集数据，包括出于对自身使用和性能进行分析之目的。吸取经验教训还有助于技术发展，帮助改进救灾规划和流程。

1.5 有利的政策和监管环境

有利的政策和监管环境是灾害通信管理的重要组成部分。此类环境由两方面构成：ICT总体部署和使用的一般性电信监管和政策框架；以及专门针对灾害事件的框架和政策。公共政策考量包括减少ICT部署的监管障碍，促进稳健、具有抵御能力的ICT基础设施发展，简化许可程序和频谱管理。救灾通信框架和政策帮助指导整个灾害期间的活动和职责，并且确保恢复期间ICT运营的连续性。灾害应对框架的具体ICT政策和监管措施包括灾害期间的快速许可程序，解决应急通信设备入境可能遇到的海关壁垒，以及实施《关于向减灾和救灾行动提供电信资源的坦佩雷公约》。2014-2017年研究期内收到的多份文稿探讨了政府和机构政策及规划。

1.6 救灾通信技术

如前文所述，电信/ICT可以在灾害的所有阶段使用：传感技术为即将发生的灾害（如气旋或飓风）提供早期预警，并且得益于ICT，重要信息能够在受灾人员（包括公众）与参与短期和长期应对的人员之间交换。了解通信技术和需要共享的信息类型也非常重要。例如，用于向公民提供早期预警信息的通信技术包括移动电话、甚小孔径终端（VSAT）、卫星电话、交互式语音应答系统、互联网（包括网络媒体）、电视、广播、新闻、数字标牌音响和国家知识网络。社交媒体平台可用于收集数据和共享信息，使救灾和应对机构能够回应求助请求，并在群体内部和不同群体之间建立联系，以便共享信息、态势感知和报告。用于灾害管理的ICT工具有很多，但本报告仅探讨其中一些。专家们应认真考虑基于标准的方法，避免局限于一种或多种特定设计解决方案或技术。

1.7 救灾通信技术

当一个国家经历灾害并失去其通常的电信能力时，它可以选择宣布紧急状况，这样就会使联合国应急通信集群（ETC）能够触发一种机制，快速识别并在灾区免费部署至关重要的通信技术。各国应该了解这种机制确实存在并可供其使用。该机制旨在避免一种临时方法，即，不同的非政府组织（NGO）可能参与其中，但每个非政府组织均携带重复且可能造成浪费的设备和解决方案抵达现场。此外，此机制为人道主义团体与各国政府都提供了更可预测的响应。[1]

1.8 早期预警和告警系统

早期预警系统对于控制生命丧失和财产损失至关重要。它们可以探测或预测灾害，然后及时向民众提供信息，同时使用电信/ICT网络监控情况并发出告警。早期预警系统促进了基于历史经验和脆弱性的风险评估，帮助监控和预测灾害，并且向灾害频发地区的人提供明确信息。它们在预警发出之后的应急响应活动中也非常有用。

通用警报协议（CAP）是一种数字化协议，用于通过多种通信路径交换紧急情况警报：移动电话、电视、广播、扬声器/警报鸣笛、计算机弹出窗口、电子邮件和短信。CAP格式的告警消息便于机器和人类使用。《国际电联国家应急通信计划指南》[2]建议，应设计和部署早期预警系统，尽可能连接所有基于危害的系统，利用规模经济的优势，并且通过考虑多种潜在危害和最终用户需求的多用途框架增强可持续性和效率。此类系统的清单应纳入国家应急通信计划，定期审查和更新。

1.9 演练和演习

演练和演习在应急管理准备中有着重要作用，因为有助于增强能力和培训，以便在实际灾害发生时，人们按预期应对。演练和演习的主要目的是发现并随后解决既定程序与实际实施之间的差距。这类能力建设的另一个优势是提高应急准备和应对的速度、质量和有效性，改进问责制和对结果的衡量，并且尽可能降低灾害风险。

1.10 良好做法与指导原则

协同研究的理念是交流从彼此的经历中吸取的共同经验，随后确定并遵循最佳做法。除研究组会议期间开展的讨论外，在研究期内举办的四个讲习班和本最后报告附件所载的信息也有助于确定面向所有国家的指导原则，特别是小岛屿发展中国家（SIDS）和内陆国家，并确定早期预警、演练和演习以及政策制定方面的最佳做法。

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[1] EMEA欧洲卫星运营商协会（ESOA）。服务。《应急通信》。

[2] 国际电联。主题报告。《国际电联国家应急通信计划指南》（2020年，日内瓦）。

1.11 人为因素和利益攸关方的协作

灾害不分国界。为减轻损害，各利益攸关方–国家、区域和地方政府、海外援助和救灾组织、非政府组织和民间团体组织、私营部门实体以及志愿和公民行动团体，都必须贡献出自己的力量。若要有效应对灾害带来的挑战，他们必须紧密协作，并为此进行有效沟通。另一个要考虑的因素是，灾害可能对应对小组成员的家庭有何影响，以及该成员是否能够为应对工作出力。在这种情况下，备用计划至关重要。此外，所有灾害都具有局部性，即灾害发生时邻近的人是最早响应者，人们会首先寻求自救。ICT有助于处理这一现状，使人们能够自助或互相帮助。为此，应在公民和地方政府的协助下，提前编制易受灾的地区或疏散和收容安置地点的灾害地图。

在处理灾害情况时，人为因素和利益攸关方协作非常重要。在演练和演习期间，这一方面的通信和协调会得到仔细监控；一旦发现缺陷，就需要予以纠正并记录在案，并起草关于该问题的标准操作规程或指导原则。

另一个附加考虑因素是，灾害发生后，女性比男性更脆弱，更容易死亡。新冠疫情（COVID-19）大流行给女性和年轻女性带来毁灭性的社会和经济后果，因为她们在医疗保健人员中约占70%，在非正规经济中占比过多并承担了大部分家务劳动–已经存在不平等的三个领域。与此同时，女性是抗灾重建中的重要伙伴。女性的观点和经验，以及她们的组织、游说和通报能力，可以极大地推进灾害风险管理议程。然而，现有的一系列障碍限制了她们在整个灾害管理周期阶段保护自己和参与灾害决策的能力。

国际电联电信发展局（BDT）与ETC关于“妇女、ICT与应急通信：机遇与限制”[3]的一本出版物概述了一系列突出强调性别数字鸿沟以及造成妇女和年轻女性在灾前、灾中和灾后日益脆弱的因素。该出版物还展示了可以如何利用ICT来推进灾害风险管理中性别平等的良好做法和示例。

1.12 ICT用于灾害管理和智慧可持续发展

智慧可持续发展与人为因素和利益攸关方协作相互关联。其中涉及应对多项重要挑战：建立机制改进参与应急ICT响应的广泛利益攸关方之间的协调；制定建立有效合作伙伴关系和确保可预测的、灵活资金所需的融资策略；确保志愿者培训计划的有效性并扩大志愿者交流网络；以及增强区域性网络的能力并利用其专业知识。此外，必须采取措施，发展能够促进区域和全球协作机会的公共私营伙伴关系；创建更广的灾害管理平台，从而确保全天候的救灾电信业务；安排预先规划的解决方案到位，避免在实地使用临时解决方案而浪费时间；以及建立适当的监管框架为救灾工作提供便利等。在这些方面采取的行动将有助于实现SDG。国际电联关于灾害管理和智慧可持续发展的一份报告[4]对这一主题进行了全面探讨，该报告以全球快速响应应急基金（GEF）、应急通信志愿者以及监管工具包和指南三个工作组的审议为基础。

[3] ITU-D与ETC，《妇女、ICT与应急通信：机遇与限制》，国际电联，日内瓦，2020年。

[4] 国际电联。智慧可持续发展模式咨询委员会。《智慧可持续发展模式（SSDM）报告》，2018年。《用于加速应急反应和可持续发展的工具》。国际电联，日内瓦，2018年。

1.13 无障碍获取方面的考量

灾害尤其对弱势群体而言是毁灭性的，其中包括残疾人、儿童、老年人、外地务工人员、失业人员以及因之前的灾害流离失所的人。灾害管理必须具有包容性，回应他们的需求。ICT在帮助获取灾害应对服务存在障碍的边缘化群体方面可发挥作用，有关的全面信息可参见相关ITU-D报告[5]，其中对灾害管理每个阶段的利益攸关方提供了具体建议。跨领域建议包括：

– 直接向弱势群体人员了解需求并为他们参与灾害管理进程的所有阶段提供便利；

– 确保基于ICT的灾害管理流程或基于ICT的发展项目均考虑到ICT的无障碍获取和易用性；

– 使用不同类型的战略和机制促进可无障碍获取的ICT，包括立法、政策、规定、许可要求、行为准则以及货币或其它激励措施；

– 通过提高认识、培训和技能培养项目，提高弱势群体在受灾情况下使用ICT的能力；

– 使用多种通信方式在灾害之前、期间和之后提供信息，包括：

  - 按照当前互联网内容无障碍获取指南设计的无障碍网站和移动应用；
  - 广播和电视公共服务通知（使用音频、文本、字幕和手语翻译等无障碍获取措施）；
  - 政府当局、援助和救灾机构等通过短信、彩信或群发邮件向公民发送通知和提示；
  - 可无障碍获取的电子情况简报、手册和指南；
  - 多媒体演示内容（网络研讨会、网播和视频，包括在YouTube等热门网站上的视频）；
  - 政府和灾害应对组织创建的Facebook网页和推特等社交媒体的专门账户。

得益于人工智能领域的进步，技术可用于开发聊天机器人系统，以收集和散布灾害相关信息。此类应用将对包括残疾人在内的弱势群体有所助益。

[5] 国际电联，印度互联网与社会中心（CIS）和全球包容性信息通信技术举措（G3ict）。《残疾人无障碍获取ICT：准备工作》。国际电联，2016年。

第2章 – 有利的政策和监管环境

国际社会认识到ICT在灾害所有阶段发挥的重要作用，以及制定国家应急通信计划的重要性，认可降低灾害风险的努力必须系统地纳入可持续发展政策、规划和项目中。ICT的成功部署和使用，以及国家应急通信计划的制定和实施需要有效、有利的政策环境。《2005-2015年兵库行动框架》突出了这一必要性："易发生灾害的国家在可持续发展政策、规划和方案以及灾后和冲突后救济、重建和恢复活动中应考虑针对减少灾害风险的兼顾诸多危害的综合办法"[6]。其中强调，立法框架是将降低灾害风险纳入发展政策和规划的关键："各国，凡制定减少灾害的政策、立法和体制框架，并能够通过可测量的具体指标推行发展和推动进展情况的，均有较强的能力管理风险，并在社会各阶层就减少灾害风险措施达成普遍共识、实现共同参与和按照这些措施的要求行事"[7]。立法和正式的书面规定很重要，因为它们定义了身居特定职位人员的职责。法律和规定可以决定协调机制、通信渠道和运作程序的框架，并明确相关机构的决策者。此外，立法和书面规定有助于灾害风险管理流程的可持续性，从而使灾害管理政策比单个政府行政部门更长久，并且确保预算独立于党派政治活动等。在许多情况下，降低灾害风险的国家立法有助于形成相关国家战略，并在国家以下各级有相对应的结构。这使得作用和职责下放到下级政府，并提供能够在行业和政府层面移动的整体协调结构。[8]

救灾通信框架和政策帮助指导整个灾害期间的活动和职责，并且确保在恢复期间ICT运行的持续性。灾害应对框架的具体ICT政策和监管措施包括灾害期间的快速许可程序、解决应急通信设备入境可能遇到的海关壁垒以及落实《坦佩雷公约》。

正如第1章所述，第5/2号课题的目的之一是研究有利的政策和监管环境。因此，2020年7月14日举办了题为"有效灾害管理（包括应对新冠肺炎疫情）的有利政策环境"的公开网络研讨会（见**附件4**，A4.4段），汇集专家共同探讨能够加强应急通信备灾、网络复原力、灾害风险降低和灾害管理的政策环境组成部分。他们还讨论了为部署应急通信设备实现灵活性的政策，电信和ICT方面的成功备灾和灾害应对，以及制定和实施有利政策和国家应急通信计划方面的经验教训。

2.1 应急通信系统部署政策

国家应急通信计划列出了确保通信在灾害所有阶段均可用的明确战略，促进各级政府、人道主义机构、服务提供商和面临风险社区之间的协调和参与。

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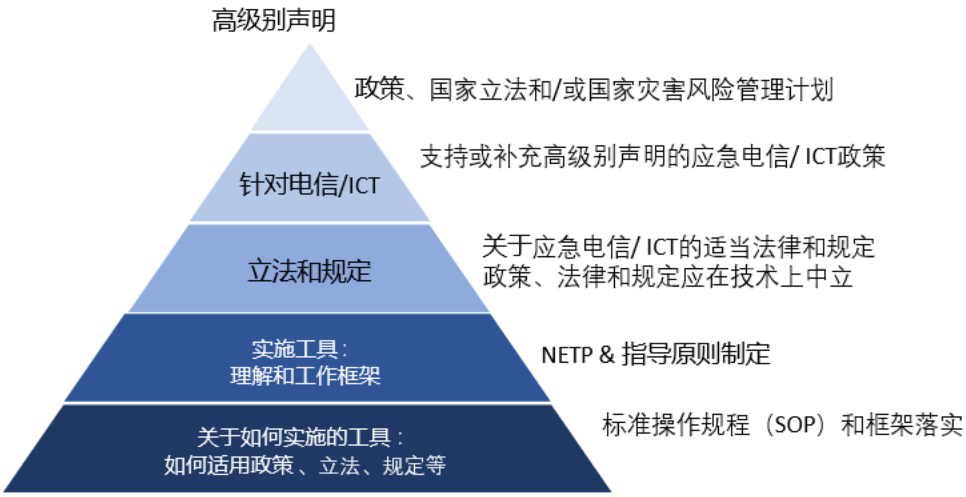
[6] 国际减灾战略系统（ISDR）《2005 – 2015年兵库行动框架：加强国家和社区的抗灾能力》。摘自世界减灾大会最后报告（A/CONF.206/6），第三部分A，第13(c)段。

[7] 同上，第三部分B.1，第16段。

[8] 国际电联，同上（注释2）。

图1：应急通信系统部署政策：构成要素



来源：国际电联[9]

应急通信系统部署政策源自高级别政策声明、国家立法和/或国家灾害风险管理计划（见**图1**），它们共同为政府和民间团体应对威胁或灾害的行动提供机构和机构间框架。

计划应拥有最高层政府的承诺，政府反过来必须提供组织和领导支持，分配资源，并致力于实现和保持预期成果。应出台关于应急通信的一套专门政策，对国家立法予以支持或补充。必须注意确保政策旨在建设、发展或增强国家互操作电信能力。

多个国家已有这样的政策框架。在印度，最高层认为救灾通信非常重要。《2012年国家电信政策》强调建立稳健、有抵御能力的电信网络的重要性，以满足对减轻自然和人为灾害提供积极支持的需求。其中规定了部门标准操作规程，促进灾害和紧急情况的有效、尽早缓解，并鼓励将ICT用于灾害预测、监测和预警以及传播信息。印度政府已通过一系列措施制定灾害政策、计划和指南：2005年《灾害管理法》；2009年《灾害管理政策》；《2012年救灾通信指南》；以及《2019年灾害管理计划》。在应对新冠肺炎疫情大流行期间，根据《灾害管理法》出台了有关封锁/重新开放、安全和保障措施的指令。印度的电信监管机构印度电信监管局也开展了应急通信方面的工作。该局已就单一应急服务号码（112）、针对参与救灾和营救行动人员的优先呼叫路由以及电信服务提供商允许签约用户在灾害期间漫游到其它网络而不产生额外费用的必要性向政府提出建议。它还建议在印度建立公共保护和救灾（PPDR）网络。

海地没有统一的应急通信系统，但已成立部门应急通信委员会（Comité sectoriel sur les télécommunications d’urgence，或COSTU），负责根据国家灾害和风险管理计划协调部门应对措施。该委员会的设立旨在利用电信和ICT加强灾害预防、备灾和应对方面的协调。政府以此表明加强防灾、备灾和应对措施的决心。

世界粮食计划署（粮食署，WFP）和ITU-D编写了一份“应急通信准备核对清单”，审查可纳入国家应急通信计划的重要主题领域，并提供一个简单计分方式，来评估随时间推移每个决策点或行动的进展情况。该核对清单主要为国家应急通信计划的制定和完

[9] 同上。

善提供支持，侧重了解国家在灾时启用应对通信的准备情况，同时确定可能需要关注的目标领域。

2.2 有利于早期预警、通信连续性和更有效应对的政策

自然危害早期预警系统的目标是降低此类危害对可能受影响的人造成的损害。如果受影响人员无法应对，则自然危害可能变成灾害。因此，预警系统的主要目标是赋予个人和社区以及时、适当方式应对的能力，以降低死亡、受伤、财产损失和损害的风险并减轻灾害影响。没有早期预警的社区面对危害将毫无准备并承受更多痛苦。

在《2005-2015年兵库行动框架》所列的五点清单中，第二个行动重点是“确定、评估和监测灾害风险并加强预警”[10]。减灾决策机构要求越来越精确的早期预警，以确保制定有效措施。其中包括增长预警的提前准备时间，提高准确性，回应对概率预测、更好的通信和预警传播的更高需求，使用新技术向公众告警，使预警服务针对相关和特定用户，以及发送清楚、准确无误且易于理解的预警消息，以便采取适当的应对行动。最好有较长的预警准备时间和概率预测，以减少误报次数。研究期内收到的成员国文稿显示，许多国家已采取措施建立健全、有效的早期预警系统。例如，印度已指定主要的结点机构对该国的灾害进行监测并提供早期预警：印度气象局负责气旋、洪水、干旱和地震；中央水资源委员会负责洪水；印度地质调查局负责滑坡；印度国家海洋信息服务中心负责海啸；以及降雪和雪崩研究机构负责雪崩。

印度早期预警机构还向邻国以及印度洋和亚太区域的多个同类机构发送重要信息。得益于各个机构的协调努力，以及利用电子媒体、固定/移动电话和CAP等技术在社区传播信息，印度已能够增加例如气旋的预警准备时间，使得相关救援和恢复机构有足够时间营救人员并将他们带往更安全的地点。因此，当几乎每年都登录该国沿海区域的气旋侵袭时，人类和动物生命损失以及财产损坏得以大幅减少。

在布隆迪，多个机构负责灾害应对。公共机构布隆迪地理研究所负责为人民福祉促进国家气象活动。布隆迪红十字会确保迅速应对，在气候变化相关的灾害期间帮助受害者。当地政府发挥领导作用，在其他抗灾利益攸关方的帮助下保护民众。布隆迪已建立国家风险管理平台，负责灾害相关风险的防范和管理，提高认识并在灾害发生时开展切实行动。上述所有实体协调合作，降低灾害风险并予以应对。

巴西、日本、新西兰和美国也有早期预警系统，并使用各种媒体，最近则通过CAP发出告警。

灾害预防、复原力和应急服务能力均能够通过使用最新卫星通信网络、公共移动通信网络和应急通信专用网络，以及整合空间和地面应急通信网络资源得到提高。其他救灾通信技术在**第3章 – 救灾通信技术**中介绍（例如，中国在应急响应和救灾中使用KA频段高通量卫星与4G业务（见**附件1， A1.2.8段**）。存在许多不同的应用，并且可以通过利用卫星通信和图像探测和传输灾害相关信息部署解决方案。卫星能够实现全球任何地方的实时通信。

[10] 《2005-2015年兵库行动框架》，同上（注释6）。第三部分B.2。

研究组于2018年5月8日组织了关于早期预警系统（包括安全确认）的嘉宾讨论会，作为工作的一部分。讨论会指出早期预警政策、通信连续性和有效应对方面的若干最佳做法（更多详情见**附件4，A4.1段**），尤其是有关监管和总体灵活性、不断演进的技术和应急告警系统、有利政策的必要性、连通性、能力建设、应急程序的持续改进和核对清单的最佳做法。

2.3 有关新冠肺炎疫情大流行的政策干预

世界卫生组织（WHO，世卫组织）于2020年3月11日宣布新冠肺炎疫情为大流行。疫情在全球迅速蔓延，造成数百万人死亡和数万亿美元的经济损失。借助ICT，各国对所面对的问题采取了多样化的应对：例如采取措施满足增加的宽带需求；免除或降低电信费用/收费；对于封锁期间无法充值的签约用户推出预付费移动电话免费充值；使用移动应用帮助追踪已感染者和与其有过接触的人员；以及开发显示住院病床和相关医疗卫生基础设施可用情况的移动应用。

在“为（包括应对新冠疫情在内的）灾害管理创造有利的政策环境”网络研讨会上，讨论了许多从疫情大流行中吸取的经验教训，其中一项是，所有人都认识到，全球电信网络和数字化基础设施必须稳健、有抵御能力、模块化、可扩展并对处理所有类型的灾害准备更充分。

第3章 – 救灾通信技术

本章介绍能够用于支持灾害管理的不同新兴救灾通信技术。

3.1 通信技术

电信/ICT的使用能够对防灾、备灾、早期预警、应对和救灾大有助益。大多数ICT与电信网络相连接，因此确保拥有合适的电信基础设施非常重要。不同的电信网络可有助于灾害管理。

– **卫星通信网络：**通过卫星进行通信的优势在于它们不会在自然灾害中受损。许多卫星服务，包括固定卫星设备、诸如事故响应车辆或救护车等移动车辆上的设备和便携式设备（如卫星电话或宽带全球区域网（BGAN））目前均用于应急通信。此外，卫星通信在预测、减灾、预警和应对灾害方面发挥着有价值的作用，并且通常是在陆基技术受到影响时首先部署的技术。它们还可以协助数据聚合以及具有复原力的可恢复式通信，并已为此集成到地面网络中，例如，已纳入英国应急服务网络之中。

– **飞行器：**与卫星通信网络类似，从装载于飞行器（包括无人机（UAV））上的转发器到中继站的无线电波传输没有地面障碍，因此在自然灾害中很有用。

– **自组网技术：**尽管自组网不具备大规模的网络连接功能，但有独特的网状网能力，可用作在荒野、临时地下室和高楼出口通道开展应急救援的一种补充技术。

– **5G移动网络：**5G应用的三个主要情境 – 增强型移动宽带、超可靠和低时延通信以及大规模机器类通信，满足大部分应急通信业务对大带宽、低时延和高可靠性的需求。5G有潜力增强应急通信救援和综合应急支持能力，有望达到应急管理的新高度。预计专用网络和5G公共网络今后将共同为应急管理提供具有抵御能力的通信服务。公共和专用网络相结合将带来三重保障的应急通信网络，涉及空间 – 地球整合和互操作，并且将适应和匹配应急保障通信系统。

3.2 救灾通信中的新兴技术

3.2.1 移动应用

随着智能手机的普及，人们大量使用互联网业务，如社交网络、信息检索和电子商务，同时互联网移动应用正在成为灾害情况下的重要解决方案。以Fisher Friend（渔夫之友）移动应用为例，这是一款早期预警移动应用，是针对渔民社区整体岸对岸需求的独特单一窗口解决方案，使脆弱的渔民能够立刻获取有关天气、潜在捕捞区、海洋状况预测的重要、近实时知识和信息服务以及市场相关信息。如今，渔民会定期收到海洋气象预报、恶劣天气情况的早期预警和潜在捕捞区的公告。

另一个例子是脸书（Facebook）灾害地图。使用Facebook应用时启用位置服务的人会定期收到关于自己所在位置经纬度的信息。此类地理定位数据经收集并去身份识别后，可作为灾后信息的来源。Facebook数据集类型包括人员流动、人群密度和灾后收集的Facebook安全检查信息。

3.2.2 利用社交网络服务

社交媒体是使用户能够参与、评论和创建内容，同时与其他用户和公众交流的平台。在线社交网络服务（SNS）以及Facebook、推特、YouTube和Google+等社交媒体可用于在灾害期间告警所涉地区之外的人，招募志愿者和/或捐助者，联系流离失所的家人和朋友，并提供有关无人认领的财产和尸体或援助中心和其他资源的信息。可以利用它们提供有关封路、停电、火灾、事故和其他事件的最新信息。还能够帮助人们更好地为灾害做准备，了解哪些组织可以提供帮助。在灾害期间，它们使用户能够直接与家人、记者、志愿者组织和其他居民交流，并即时共享信息。在灾害之后，还有助于将社区汇聚在一起，探讨事件、共享信息、协调重建工作、获取援助信息等。

举例而言，在日本发生重大灾害后，社交媒体在救援行动中得到广泛使用并用于筹集资金。与传统通信渠道相比，社交媒体能够更快速、准确和可靠地传播关于灾害恢复设施和材料的信息。

在2015年的印度金奈洪水期间，人们广泛使用社交媒体与外界联系。金奈居民通过社交媒体向寻求躲避雨水和洪水的陌生人提供自己的房屋。受灾者和帮助者均使用了#ChennaiFloods和#ChennaiRainHelps的标签。

对于灾害导致电信业务，尤其是互联网业务中断的情况，日本开发出一种便携式本地联网系统，名为“本地无障碍接入云系统”。该系统由Wi-Fi接入点、小型计算机服务器、电池和其它外围设备构成。这些组件组装在一个便携式手提箱中，易于运送至受灾地区。服务器可作为网络服务器，提供灾害情况下所需的基本通信功能。

日本还开发出一个聊天机器人系统，名为SOCDA（用于灾害管理的社交动态观察和受害者支持对话代理平台）。该系统使用人工智能技术，通过SNS向人们收集灾害相关信息，采用灾害信息分析和总结技术将内容汇总（见下文**第3.6节**），绘制在地图上并及时传播疏散人员所需的信息。市民和最早响应者只需在SNS上“发送朋友（friending）”即可使用该系统。预计这个系统将得到发达国家和发展中国家的国家和地方政府、最早响应者（包括医护人员）和受灾地区的人使用。

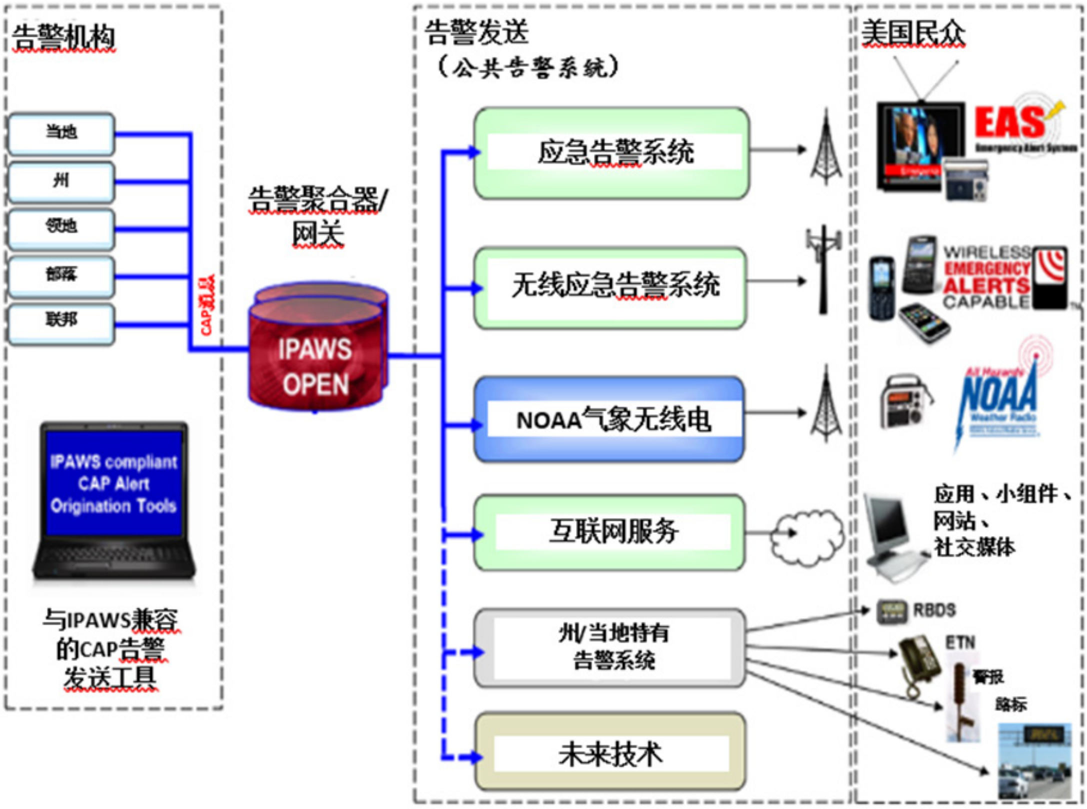
3.2.3 综合公共告警

在开发告警和预警系统时，拥有适当的权限、政策和治理以确定人员和资金的优先次序至关重要。

在美国，美国联邦应急管理署（FEMA）的公共告警和预警综合系统（IPAWS）是一种独特、多灾种、多用户的全国范围告警和预警系统，全国各地的联邦、州、地方、部落和领地实体都在使用。该系统利用技术和信息标准使多个私营部门通信技术基础设施参与，能够通过多个公共传播途径（广播、电视、移动设备和联网系统、网站和应用）传递同一条应急消息。

IPAWS架构（见**图2**）旨在支持该国采用相同标准的任何告警和预警系统之间的互操作性。公共告警和预警综合系统应急网络开放平台（IPAWS-OPEN）是用于向公众路由经认证的告警和预警消息的基础设施，它利用了应急告警系统中的广播和电视系统、针对手机的无线应急告警、国家海洋和大气管理局（NOAA）气象无线电及其他通信系统。

图2：IPAWS架构



来源：美国[11]

3.2.4 载人航空器或无人机的使用

政府、消费者和企业对无人机的使用日益增加。无人机对范围广泛的行业解决方案提供支持，在公用事业、农业、快递、应急响应、能源领域等广泛使用。

使用无人机救火

无人机经证明在救火时非常管用。它们可以追踪火势的蔓延和来源，帮助指导消防工作。包括热图像在内的火势及其蔓延图像可用于决定如何将火扑灭。2019年4月，两架民用无人机参与了巴黎圣母院的火灾扑救。如今，4G网络能够支持一些无人机情境下的通信需求，但在带宽、时延、干扰协调方面还面临许多挑战。随着无人机行业的高速发展，对无人机通信链路和与蜂窝移动通信技术的紧密结合也提出了新要求。一旦5G技术广泛使用，这些问题能够得到解决。

[11] ITU-D第2研究组SG2RGQ/152号文件+附件，来自美国

通过高空基站的应急通信

当自然灾害发生时，无人机能够迅速搭建高空基站，恢复通信功能（语音和数据）。

传统上，当地震、洪水、泥石流和其他自然灾害造成大规模破坏时，会临时使用应急通信车辆确保通信。但是，此类车辆提供的服务覆盖范围相对有限且信号稳定性弱；如果道路坍塌或阻塞，甚至可能无法抵达中心受灾区域。因此，这种建立应急通信站和恢复基站的传统方式效率低、成本高、难度大且费时。无人机技术的成熟以及与应急通信系统的融合使之成为运营商恢复灾区通信更快、更便捷的新方式。

系留式无人机+高空基站

系留式无人机系统从地面供电，通过系留电缆连接至无人机升空平台，能够实现不间断飞行。无人机空中基站工作时，地面发电设备向系留系统和机载远端无线电单元供电。机载单元利用系留系统的光纤线路经地面基带单元设备与应急通信车辆进行通信，应急通信车辆可以通过微波设备、光纤或卫星通信车与附近基站塔进行连接，进而将信号中继至核心网，实现移动信号的覆盖。地形对电磁波的影响从而得到有效解决，保证一定区域内的连续覆盖。

无人机应急高空基站的覆盖范围可达50平方公里左右，同时为数千个手机用户提供即时消息业务。它们可以快速升空50到200米，为灾区提供24小时不间断的长期演进技术语音通话（VoLTE）及其他数据业务。系留式无人机与空中基站结合使用能够快速恢复现场通信，解决应急情况下的信号覆盖问题，有效提升政府及运营商应对自然灾害的应急通信支持能力。

固定翼无人机+高空基站

搭载移动通信基站和卫星通信系统的大型固定翼无人机飞至目标区域后，可为超过30平方公里的地区提供长时间（不低于24小时）稳定、连续的移动信号覆盖，从而立刻恢复灾区通信并减少生命和财产损失。

联网固定翼无人机配备正交相机和光电吊舱可用于获取快速数据传输和高效生成地震地区三维地图所需的地理信息系统（GIS）数据，为救援决策提供基础。

在单兵系统演练过程中，地面先遣队能够基于GIS数据报告关键救援信息，传回实时视频和图像，迅速调派救援人员和设备，有效提高应急救援行动的及时性和准确性。

无人机应急通信：下一步

标准制定是无人机应急通信面临的挑战之一。中国正在制定配备系留式无人机的高空基站应急通信的技术要求。此外，由于普通基站主要提供地面覆盖，无人机需要特殊基站实现空中覆盖。5G无人机目前依靠通用5G用户驻地设备进行通信，该设备用于将5G信号转换为WiFi信号；未来将需要专门的终端和5G通信模块来提高融合度。

3.3 灾害应对和救灾方面的新兴技术

新兴技术和工具，例如遥感数据分析和世界气象组织（WMO）观测系统能力分析与评审工具（OSCAR）[12]，对灾害相关信息进行分析并帮助制定合适的灾害应对和救灾措施。多个联合国机构正在开发和使用这些工具，以下介绍其中的几个。

为从遥感数据中获得最大效益，需要地方应急管理机构将适当的信息传达给在实地的人。联合国灾害管理和应急天基信息平台（UN-SPIDER）注重帮助各国发展灾害管理能力。UN-SPIDER帮助组建救灾组织并培训其人员，而其他组织更以数据为导向。

WMO的观测系统能力分析与评审工具包括一个表格，其中列出了所有过去已知、现在和将来用于气象和地球观测目的的卫星。该工具可用于找到其它数据源。

另一个经过分析的遥感数据来源是联合国培训研究所业务卫星应用方案（UNOSAT），这是为加强国际社会和发展中国家获取卫星图像和GIS服务创建的一个联合国项目。

3.4 管理自然灾害的地面和卫星遥感技术

管理自然灾害需要大量多时相空间数据。卫星遥感是灾害管理的理想工具，因为它在很短的时间间隔内提供大面积区域的信息。尽管它能够在灾害管理的所有阶段使用，但截至目前在实际中主要用于预警和监测。近几十年来，卫星/空间技术已用于气旋、干旱和洪水的备灾和预警阶段。

气象辅助、气象卫星以及地球探测卫星业务，在以下活动中发挥重要作用：

- 识别面临风险的地区；
- 天气预报和预测气候变化；
- 探测和跟踪地震、海啸、飓风、森林火灾、石油泄漏等；
- 提供此类灾害的告警/预警；
- 评估此类灾害造成的损害；
- 提供用于规划救灾行动的信息；和
- 监控灾害的恢复情况。

这些业务对保持和提高天气预报准确性、监控和预测气候变化以及收集有关自然资源的信息提供了虽不是不可或缺但有用的数据。**表1**归纳了卫星技术的目标和相关联应用。

[12] 见：WMO观测系统能力分析与评审工具（OSCAR）。

表1：目标和相关卫星技术

目标　　技术	合成孔径雷达图像	干涉测量合成孔径雷达图像	有源微波成像	雷达高度测量	雷达散射测量	测雨雷达	GPS无线电掩星	无源微波成像	无源微波探测器	地理可见光和红外成像	光学成像	多光谱光学成像	红外图像
沿海灾害	x										x		
干旱	x		x	x	x			x		x	x	x	
地震	x	x					x				x		
极端天气					x	x	x	x	x	x	x		
洪水	x		x		x	x	x	x	x		x		
滑坡	x	x									x	x	
海洋 污染	x											x	
污染											x	x	
海冰/湖冰	x							x			x		
火山	x	x						x			x	x	x
荒原火灾								x			x	x	x

3.5 卫星通信

数十年来，卫星通信向国际救援组织和受灾地区及民众提供支持，是全球备灾和救援行动的重要组成部分。卫星通信可以提供宽带通信，通常不受地面环境的影响。已有50多年历史的星基灾害通信生态系统现在更具可负担性及实效。

星基通信还独立于本地电信基础设施运行，而且当本地电源在灾害期间受到损坏时，小型电池和独立电源有助于提供连续性。卫星通信终端自给自足，并且通过各种部署表明，它们可以在到达现场几分钟内立即投入使用。

救灾通信设备可以是小巧、轻便和手提式的，方便救援团队与他们的基地的通信，执行从上传详细的损坏报告到下达供货订单等紧急任务。

表2总结了卫星通信特别适用于减少和管理灾害风险的一些关键特性。

表2：星基通信的主要特征

灵活性	– 快速部署的理想选择 – 灾害发生后可立即在现场设置 – 可以控制和限制对服务的访问
便携性	– 适合独自旅行以及站点到站点移动的任何人员的紧凑型终端
使用方便	– 只需简单培训即可提供设置和使用大多数卫星设备所需的专业技术知识
全球覆盖	– 远程站点的互联互通 – 拓展团队覆盖
可靠性	– 关键数据的可靠性 – 独立于地面基础设施
提供基本互联互通	– 为地面基础设施提供回程 – 以无需依赖于部署密度的成本提供宽带连接

3.6 大数据分析用于灾害管理

当今世界严重依赖信息技术，大数据的到来使基于数据分析做出决策成为可能。大数据分析正在允许社会调整灾害管理策略，以降低人类痛苦和经济损失。计算机专家和政策制定者的主要目标是使用大数据从各种格式中提取信息并存储，以便在灾害管理中有效使用。

社交媒体分析是从社交媒体网站收集大量数据并分析的过程，其中大部分数据为半结构化或非结构化。这一过程使用了各种机器学习算法，例如决策树形图、支持向量机、随机森林、朴素贝叶斯分类器、逻辑回归和灾害响应人工智能平台。算法对数据进行分析，从中得出结果，并从预期角度将结果精确地可视化。得出的信息可用于搜索和救援行动以及灾后分流、救济和重建。许多人工智能和机器学习工具重点关注社交媒体的更新内容如何提供事件迹象并促进态势感知。

每当有灾害发生，都有大量短消息和推文发布在社交网络软件（SNS）上；其中有的信息可能非常有用，但也可能微不足道。这些消息和推文可以使用大数据分析技术进行分析。在日本，国家信息通信技术研究所（NICT）开发出两个数据分析系统：灾害信息汇总软件（D-SUMM）和灾害信息分析软件（DISAANA）系统。前者从SNS中自动提取出灾情报告，组织、汇总并以用户友好的方式提供。后者原样输出提取的灾情报告（例如，“有地震！”或“我们这儿仍有余震！”）。D-SUMM通过汇总每个次区域的灾情报告，使用户能够迅速了解在哪里发生了什么。还可以指明多个类别并在地图上显示，同时显示一个事件的报告次数，使灾情概况能够轻易获得。

3.7　人工智能用于灾害管理

人工智能是指通过机器，尤其是计算机系统来模拟人类的智能过程。这些过程包括学习（获取信息并以算法的形式接受规则，以便使用信息）、推理（使用规则得出近似或确定的结论）和自我纠正。多款最新的智能手机还有针对人工智能（AI）优化的硬件。

机器学习（ML）被定义为机器通过人工智能自动学习的能力。其中涉及算法创建，这些算法无需人工干预或明确编程即可自行调整，得出学习输出成果。这通过分析馈送给机器算法的结构化数据实现。因此，学习过程涉及观察、处理和分析数据，并采取相应行动。灾害响应人工智能平台借助ML和人工智能的潜在机会和益处，使用ML对收集自推文的自然和人为灾害数据自动进行实时分析。参与灾害响应的所有各方均可使用。

AI和ML已发展到能熟练地做出预测以及识别和分类的程度。借助数据分析，通过众包数据共享生成的实时信息对于应对和救灾工作以及减轻痛苦大有助益。

3.8　物联网用于灾害管理

物联网（IoT）是"物"（即电子传感器、软件和其它设备等实物）的网络，通过互联网相互连接并与其它设备和系统交换信息。云计算、宽带无线网络、传感器本身和数据分析的发展催生出功能强大、综合且实时的物联网系统。如今，物联网应用已在各个领域中使用：医疗卫生、教育、交通、农业、工业等。在灾害管理中，物联网可用于监测突发自然危害，如地震和泥石流，发出应急告警并将数据近实时传送至应急管理和指挥中心，以此增强防灾和减灾能力。第三代合作伙伴项目（3GPP）已提出一组基于LTE的窄带物联网技术（即，窄带IoT和增强型机器类通信），扩大了LTE技术组合，支持更节能物联网服务的更广泛应用。此外，他们正在研究通过卫星与其他非地面网络（NTN NB-IOT）进行的通信。

3.9　智慧城市灾害管理

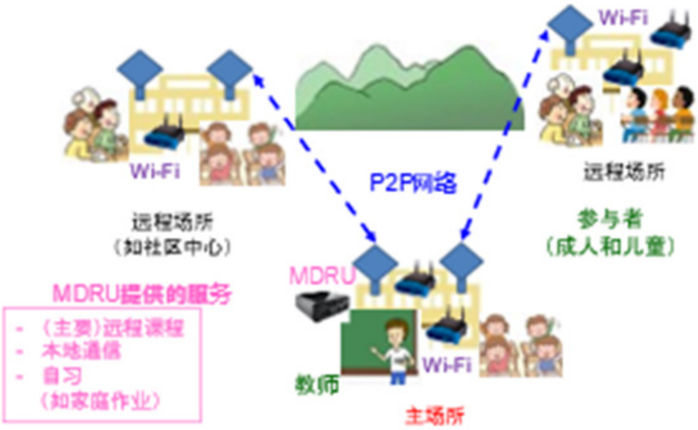
除通过常规电信行业将新的几代ICT引入应急通信外，世界各国对将ICT应用于他们正在努力打造的智慧城市应急管理表现出极大热情。建设智慧城市的一个关键方面是使用数字化技术改善应急通信。借助更全面、实时和动态的数据，迅速且经济高效地实施应急响应计划成为可能。能够与智慧城市的发展相关联的应急技术系统和应急工作包括：灾害早期预警系统；应急响应优化（即后台呼叫处理和应急车辆的战略部署等现场调度）；个人告警应用（向应急响应服务或亲人传送定位和语音数据）；以及行动区域的智能监控。

3.10　应急通信系统在平时的使用

应在灾害发生之前组装足够数量的应急通信系统，如MDRU（用于紧急情况的移动式即时部署ICT资源设备）。但是，总体而言，任何提前安装的此类系统均可能待命多年，因为很难判定灾害何时发生。为此，它们可能届时因操作技术或电池寿命等相关问题无法使用。因此，在正常情况下予以使用是一个好办法，例如用作基础设施不足的农

村地区的临时电信基础设施。**图3**就显示了MDRU实现小学与附近两个村庄之间连接的实例。儿童和农民将因此接受使用系统的培训，这一事实意味着他们将具备应对灾害时操作该系统所需的技术。

图3：电信基础设施平时在农村地区的使用



来源：日本[13]

3.11 自主分布式ICT系统

在灾害发生时，地方政府扮演着多个重要角色，例如，第一时间对受灾地区作出响应、向受灾民众提供急救、进行消防救援处理。这些角色均要求政府的ICT系统通过互联网或电信网络连接到本地服务器或云服务器。因此，电信中断可能会导致政府服务中断。在电信网络出现故障时，使用作为业务连续性计划的自主分布式ICT系统是一种解决方案，可以帮助确保政府服务的连续性。日本的NICT开发了“难憾动网络（Die-Hard Network）”作为自主分布式ICT系统，拥有由车辆支撑的存储 – 携带网络，用于应对灾害。Die-Hard Network由多个边缘服务器组成，分别置于地方政府市政厅之类的总部、城市医院等分布式办公室以及车辆之内，还有Wi-Fi和存储结转网络等通信网络中。[14]

[13] ITU-D第2研究组SG2RGQ/188(Rev.1)号文件，来自日本

[14] ITU-D第2研究组2/401号文件，来自日本国家信息通信技术研究所（NICT）

第4章 – 早期预警和告警系统

电信/ICT在任何灾害之前、期间和之后都发挥着至关重要的作用。它们是灾害所有阶段的支持来源，包括备灾、预测、早期预警、应对和恢复。技术进步使增强复原力和确保备用，从而在灾害发生后迅速恢复连接成为可能。但是，有效的灾害管理取决于备灾情况，包括落实早期预警系统以及定期演练和演习。早期预警系统已得到普遍认可，是在洪水、干旱、暴风雨、森林火灾和其他危害（地震、海啸）中拯救生命的重要工具。已记录在案的、与极端水文气象事件相关联的经济损失在过去50年里增加了近50倍，然而全球范围内的死亡人数显著降低，约减少10倍，意味着在此期间数百万条生命得到拯救。[15]

4.1 利用ICT规划早期预警和告警系统

灾害管理路线图基于一个前提，即灾害无法避免，因此得到早期预警的适当举措将拯救生命和财产，减少大规模影响，促进立刻开展救灾并帮助减轻今后类似灾害的影响。

灾害之前、期间和之后的信息传播非常重要。灾前有效早期预警需要发布灾害预警信息的能力和手段。必要时，紧迫危险的预警应尽快传达给指定区域的每个人。

GIS软件、卫星地球观测系统、物联网、使用大数据和先进计算的实时分析、移动通信技术、社交媒体网络、机器人和区块链等技术可用于灾害管理，并且为更可持续且更具复原力的发展前景提供信息。

4.2 部署早期预警系统以降低灾害风险

4.2.1 公共告警协议及其在早期预警系统中的使用

公共告警协议（CAP）是基于XML的数据格式，用于告警技术之间交换公共预警和应急信息。它使预警消息能够同时统一通过多个预警系统发送至众多应用。它提高了预警有效性并简化激活预警的任务。标准化告警可从多个来源接收并设置，以便应用能够按照预期处理和响应。由于CAP将涉及不同威胁、管辖区和预警系统的告警数据标准化，因此还可用于探测预警活动中的趋势和模式。印度已开展案例研究和试验，在早期预警系统中使用CAP传播地震、山洪暴发等情况的信息。新西兰也使用CAP信息提要获取有关地震、恶劣天气和民防紧急情况的告警。

4.2.2 地震和海啸的早期预警系统

当发生地震和海啸时，早期预警系统有助于控制人员死亡和财产损坏。当前技术可以迅速探测到中等至大型地震，以致预警可在破坏性地震波到达前向震中以外的地方发

[15] 见世界气象组织（WMO）。减灾风险（DRR）方案。多灾种早期预警系统（MHEWS）。

送。来自单个站点或站点网络的数据构成地震早期预警的基础。结合单一站点和区域地震网络的告警，可提高准确性和预警时间。在中等到大型地震期间，现场和区域告警会在地震告警演示系统中合并。今后，地震早期预警系统可能嵌入智能手机和车辆、“智能”应用以及越来越多含有传感器和通信芯片的日常物品中，将它们与全球网络相连。

在印度，喜马拉雅地区部署了超过100个传感器，为印度北部城市提供地震早期预警，探测事件、确定位置、预估震级并发出告警。在2004年海啸之后，印度政府采取措施建立稳健的早期预警系统：地球科学部在安得拉邦海得拉巴的印度国家海洋信息中心设立了国家海啸早期预警系统；科学部下属的气象局开发了基于ICT的系统，向所有主要灾害管理机构发出准确的预警并生成实时天气报告。

4.2.3 气旋早期预警系统

气旋、飓风和台风均为大气扰动导致的风暴，其中空气绕着名为“风眼”的低气压中心循环旋转。在北半球，风呈逆时针旋转，而在南半球，则为顺时针。在印度周围的海域，几乎每年的六月和七月都会出现不同强度的气旋。得益于建立的强有力早期预警系统，印度能够有效应对气旋，如费林（2013年）和法尼（2019年），它们以超过200公里/小时的风速登陆并伴有大量降雨。通过早期预警系统发送的告警消息经证明简明、准确，还指出预计在何处对居所和基础设施造成何种损坏。因而，人畜死亡大幅降低。

4.2.4 暴雨早期预警系统

雷暴云和暴雨/强降雨等现象会导致灾害。日本开发出相控阵气象雷达来探测暴雨，从而避免造成损失。该雷达能够每30秒观察一次三维降雨信息（雷达反射率和多普勒速度），在早期阶段发现当地正在快速形成的积雨云。

4.2.5 洪水、滑坡和泥石流早期预警系统

早期预警系统可在洪水、滑坡和泥石流等灾害中使用。配备传感器/物联网的最新开发技术可用于探测土壤运动、水分含量等，并及时生成告警。在日本盐尻市，土壤湿度使用物联网传感器检测，当土壤湿度超过特定数值时，告警会自动向该市风险管理人发送。

在赞比亚，国际电联和赞比亚信息通信技术管理局共同资助了一个项目，即为Mbeta岛和Kasaya村两个社区建立早期预警系统。该系统向紧邻赞比西河的这两个社区传播洪水和即将发生的灾害告警。它们还将用于公共安全，促进当地社区和政府机构之间的信息交流。

4.3 广播应急预警系统

告警消息还可以通过广播和电视、有线电视和卫星直播系统进行广播。中国、新西兰、美国和许多其他国家均使用了广播应急预警系统。在美国，应急告警系统通过广播电台和电视、有线电视和卫星直播来传送告警消息。另一个系统，无线应急告警可以向目标区域的移动电话发送告警消息（还可以传输儿童绑架警报）。在中国，4G网络正在得到不断改善，以确保移动签约用户能够及时收到重要的应急告警消息。中国开发出广播系统“推必达”，一个实时推送的移动互联网基础设施。

4.4 早期预警和告警系统技术

4.4.1 多灾种早期预警系统

《2015-2030年仙台减少灾害风险框架》认识到多灾种早期预警系统（MHEWS）的益处，并将其纳入七项全球目标之一（目标 (g)：“到2030年大幅增加人民获得和利用多灾种预警系统以及灾害风险信息和评估结果的几率”）。

该框架敦促在MHEWS、减少灾害风险战略和政府政策中转变风险信息的编写、评估和利用方式。在2018年5月第5/2号课题关于早期预警系统的嘉宾讨论会上，WMO专家阐释了有利于国家早期预警和告警活动的WMO工具，如MHEWS核对清单（可在WMO网站获取）以及气候风险和早期预警系统举措。WMO还采用了公共告警协议（CAP）（ITU-T X.1303）和名为告警中心的平台。全球多灾种告警系统的目标是为联合国机构和人道主义界的运营和长期决策制定过程提供权威信息和建议。

4.4.2 公共告警和预警综合系统

美国联邦应急管理署（FEMA）的公共告警和预警综合系统（IPAWS）使用技术和信息标准将多个私营部门通信技术基础设施相联系，使它们能够同时向多个公共传播途径（如广播、电视、移动设备以及联网系统、网站和应用）传送单一应急消息。

启动这一设计解决方案的首要关键步骤是利用CAP和其他技术标准。当告警和预警服务符合CAP并纳入IPAWS时，平台作为媒介，验证来自授权用户的消息，迅速通过多个传播途径向特定地理区域的人们传播确凿的应急信息。来自单一来源关于单个事件的信息因此可以通过广播、电视、无线电话、互联网服务和未来符合CAP的IPAWS连接技术送达公众。基于标准的方法使国家告警和预警架构能够适应和利用未来技术。使用多个传播途径进行公共告警大幅提高了消息送达目标的可能性。此外，通过多个途径同时传播一条CAP告警消息缩短了发送告警所需的时间并减少应急管理人的工作量，否则管理人不得不分别编写并发送多个渠道特定格式的告警。IPAWS基于标准的方法加快了关键生命救援信息的传递。

4.5 早期预警和遥感系统

如前文所述，ICT是灾害所有阶段的支持来源，包括预测、脆弱性分析和风险评估、早期预警和灾后恢复。早期预警信息使用遥感系统（卫星、雷达、遥测和气象系统、卫星M2M传感技术等）收集，并通过各种媒体传播。这需要当地应急管理机构将适当信息传达给在实地的合适人员。关于UN-SPIDER、WMO和UNOSAT作用的详细信息已在**第3.3节**提供。ITU-R RS.1859建议书涵盖了在灾害事件中使用国家遥感系统收集数据。

在国家层面，日本开发出相控阵气象雷达，探测暴雨并防止其造成的损坏（见**第4.2.4节**）。

在印度，印度空间研究组织（ISRO）的国家遥感中心与诸如印度地质调查局、印度标准局和禁止化学武器组织（OPCW）等其他组织，利用遥感数据共同制作了基于危害脆弱性的印度分区地图。这些地图对于灾前计划、预防和减灾活动非常有用。ISRO的地理信息平台BHUVAN基于地质调查局地图提供广泛服务。

印度早期预警机构将从卫星遥感数据中获取的重要信息发送给邻国以及印度洋和亚太区域的多个同类机构。印度早期预警系统也是WMO世界天气监视网（WWW）全球电信系统（GTS）的一部分。

同样，气象辅助、卫星气象和卫星地球探测业务在美国的早期预警和遥感活动中也发挥着重要作用（相关介绍见**第3.4节**）。

4.6 灾害信息和救灾系统

处理自然灾害对政府和私营公司而言均是一个挑战。他们对快速、准确处理信息的需求使得通信至关重要。信息系统可用于建立适当流程，定义职责以及做出决策，提高灾害管理的效率和有效性。信息系统支持政府和企业努力重新获得信任，重建声誉并维持运营能力。

例如在印度，得益于程序和协议的制定、职责定义和决策制定结构的制度，关于气旋费林（2013年）和法尼（2019年）路径的准确数据在国家、各邦和地方一级共享，大幅降低造成的死亡数量。此外，印度气象局发布的早期预警得到邦政府备灾和减灾活动的支持：提供收容安置和食物，设立志愿者系统，定期开展演练并为邦和乡村一级的灾害管理制定标准操作规程。

社交媒体的使用

社交媒体在救灾行动中可能极为有用，不仅对于个人通信，还可为最早响应者收集损害信息。例如，在日本，社交媒体在近期严重风暴和暴雨造成的洪水期间不停地得到使用。国家信息和通信技术研究所的灾害信息和SUMMarizer系统从SNS自动提取灾害报告，并以用户友好的方式组织、汇总和提供内容。该系统检索的不仅有灾害相关信息，还包括矛盾数据，以对用户提供告警。

在印度，喀拉拉邦政府利用社交媒体分享有关向首席部长赈灾基金捐款的信息[16]。随着灾害范围变得清晰，喀拉拉邦政府联系了世界各地的软件工程师，邀请他们加入邦政府运营的信息技术小组，创建网站。网站允许在喀拉拉邦许多受洪灾影响地区帮忙救灾的志愿者分享被困人员的需求，以便当局能够及时给与回应。同样，喀拉拉邦一所政府运营工程学院的一群机械工程专业学生创建了名为Inspire的群。这个群制作了100多个临时移动电源，分发给那些在受洪灾影响地区和赈灾营中无法与家人取得联系的人。移动电源可在几分钟内将手机电量提高20%，这对用不上电的人来说至关重要。另一个例子，在2015年金奈洪水期间，人们广泛使用社交媒体与外界建立联系。在这场灾害中，数千人伸出援助之手。金奈居民利用社交媒体为寻求躲避雨水和洪水的陌生人提供家中的房屋。受害者和志愿者均使用#ChennaiFloods和#ChennaiRainHelps标签查找/提供收容安置场所、食物、交通甚至移动手机充电、分享政府求助热线、提供有关提供帮助的非政府组织的信息等。

灾害信息和数据，救灾和救援行动的有效组织，使用社交媒体以及社区参与救灾行动能够大幅降低人畜丧生并推动经济快速复苏。

16 “喀拉拉邦对抗洪水时，社交媒体帮助联系焦急的亲人、协调救援工作”，2018年8月17日，Scroll.in。

第5章 – 演练和演习

演练和演习在应急管理准备中有着重要作用，因为它们有助于增强能力和培训，以便在实际灾害发生时，人们按预期应对。其目的有多个，包括以下各项。

– *评估备灾方案并发现计划和程序上的缺陷：*备灾方案可能未经测试，未更新或无法适应新情况。应急通信演练能够暴露方案的不足之处，检查其对意外情况的适应性，并判断是否需要调整和改进。

– *加强应对实际事件的能力：*应急通信演练能够帮助检验新技术应用和信息通信资源，评估新设备的能力并加强应急通信支持能力。它们可以说明现有资源的能力并发现资源缺口。

– *改善内部和外部小组、组织和实体之间的协调，并且提高跨区域支持水平：*演练旨在增强多部门和快速响应行动的协调能力，并改善应急组织和人员之间的沟通与协调。

– *训练应急通信团队：*应急演练有助于提高团队负责人的分析、决策、组织和协调能力。帮助电信工作人员了解现场角色和职责。还可以帮助提高对危害及其潜在影响的认识和理解，减少恐慌并促进与政府及其部门的合作，从而提高社会整体应急响应能力。

在研究期内，第2研究组编写了指导原则草案[17]，含有发展中国家、小岛屿发展中国家（SIDS）和最不发达国家（LDC）的政府和组织可用于开展国家应急通信演习和演练的可调整或可扩展指导。下文**第5.1节**归纳了关键要素。定期开展演练和演习可提供明显的益处并帮助参与备灾的组织：

– 测试在紧急情况下维持和恢复通信的准备情况；

– 评估应急通信程序、政策和系统是否充分；

– 根据演习结果对国家应急通信计划做出改进；

– 提高利益攸关方对电信覆盖范围和连续性计划潜在优势和差距的认识；

– 实现安全环境中的实务学习；

– 评估利益攸关方之间的资源和人力分配，注意潜在的差距和重叠之处；

– 发展团队并建立强有力的工作关系；

– 发展和测试跨部门合作；

– 吸引并激励利益攸关方就准备行动开展更加紧密的协调；

– 确保应急响应专业人员的通信能力；

[17] ITU-D第2研究组2/TD/32号文件，来自5/2课题共同报告人

- 评估各个利益攸关方之间的通信并提高互操作性；
- 形成不断改进的文化；
- 提高通信复原力。

5.1 筹备和开展救灾通信演习和演练的指导原则

第2研究组指导原则草案向计划和开展演练或演习的人提供了全面指导。这些指导原则可根据演练或演习的规模或类型以及所涉国家或组织的具体需求进行调整。计划和开展演练或演习的关键要素或步骤总结如下。

- 从强调目标的概念说明开始。
- 确保最高管理层支持开展演练。
- 组建一个计划/推进小组，全面计划演习。
- 编写情境。
- 创建评估计划。
- 开展演习。
- 详细记录演习，为后续工作和吸取经验教训提供便利。
- 向参加者做汇报，帮助发现备灾工作中的差距，加强可取之处，并确定经验教训、优势和缺陷。
- 开展事后回顾，确保以结构化方式开展下一步工作。
- 确定并分配纠正行动的目标。
- 视需要更新应对计划、政策、程序和设备，并将结果纳入考虑。
- 监控正在取得的进展，并且继续致力于通过定期举办演练/演习支持方案不断改进。

5.2 评估和更新计划

事后回顾和汇报中记录的演练或演习结果，应用于对国家应急通信计划或相关政策和程序中需改进或调整的方面制定行动计划，以及确定优势领域。为确保管理层对定期和持续演练和演习计划的支持，展示计划的影响至关重要。

此外，为发展不断改进的文化，应通过促使确定的改进点成为最佳做法来增强事后回顾创造的势头。通过采用记录、跟踪和结束行动的原则（对备灾规划、分配所有者和定期召开改进会议有积极影响），组织可推动改进措施纳入下一轮应急备灾计划，包括下一次演习。这一过程应在每次演练或演习间隔期以及期间持续进行，因为这有助于为持续改进国家应急通信计划的方法建立势头。

第6章 – 国家和行业案例研究

本节总结了研究期内针对第5/2号课题提交的国家和行业案例研究。案例研究有五个类型：有利的政策和监管环境；救灾通信技术；早期预警和告警系统；演练和演习；及其他。本报告**附件1**载有对案例研究的详细介绍；**表3**列出了每个主题案例研究的标题、提交国家和在**附件1**中的相关小节。

表3：案例研究

主题	国家	实体	案例研究标题	小节
有利的政策和监管环境	印度		关于ICT和灾害管理的政策框架	A1.1.1
	印度		ICT在灾害管理中的重要性	A1.1.2
	海地		海地部门工作组下的应急通信	A1.1.4
	全球	粮食署	应急通信准备核对清单	A1.1.4
	新西兰		基于CAP的早期预警	A1.1.5
	布隆迪		利用ICT管理洪水的影响	A1.1.6
	多个国家		关于灾害管理（包括应对新冠肺炎疫情）的有利政策环境公开网络研讨会	A4.4
救灾通信技术	中国	中国电信	空间和地面应急通信网络资源的整合	A1.2.1
	印度		关于ICT和灾害管理的政策框架（Fisher Friend移动应用）	A1.1.1
	中国		智能应急通信管理	A1.2.2
	中国		应急通信服务和网络	A1.2.3
	印度		社交媒体平台的作用	A1.2.4
	中国		向灾区提供通信服务	A1.2.5
	日本		本地无障碍接入云系统	A1.2.6
	美国	Loon LLC	利用气球实现的备灾和应急通信解决方案	A1.2.7
	中国		应急响应和救灾中的Ka+4G模式	A1.2.8
	欧洲	欧洲、中东和非洲（EMEA）卫星运营商协会（ESOA）	卫星连接用于早期预警（扑灭野火、尾矿坝监控）	A1.2.9
	日本	NICT	用于灾害管理的“SOCDA”聊天机器人系统	A1.2.10

（续）

主题	国家	实体	案例研究标题	小节
	日本	NICT	自主分布式ICT系统	A1.2.11
	全球	ITU-T第11研究组	用于快速部署发生自然灾害时应急通信网络的信令架构	A3.8
	全球	ITU-R 4A工作组	通过卫星固定业务系统接入全球宽带互联网	A3.7
	全球	ITU-T第11研究组	快速部署应急通信网络	A3.8
	全球	ITU-R第5研究组	用于减灾和救灾行动的固定无线系统	A3.9
	全球	ITU-R 4B工作组	卫星系统	A3.10
	全球	ITU-R 5A工作组	公众保护和救灾	A3.11
	全球	ITU-R 5D工作组	IMT公众保护和救灾	A3.12
	多个国家		关于灾害演练和灾害管理新兴技术的会议	A4.2
早期预警和告警系统	印度		印度北部基于CAP的地震早期预警系统	A1.3.1
	印度		关于ICT和灾害管理的政策框架	A1.1.1
	欧洲	ESOA	卫星连接用于早期预警 （早期洪水预警、地震和海啸探测）	A1.2.9
	印度		实施CAP试验	A1.3.2
	中国	中国电信	ICT备灾	A1.3.2
	巴西		应急告警的实施	A1.3.4
	日本	NICT	早期预警和灾害信息收集	A1.3.5
	日本		先进早期预警技术	A1.3.6
	中国		使用推必达服务提供应急告警	A1.3.7
	美国		遥感活动的状况	A1.3.8
	印度		监控并准确预测气旋路径	A1.3.9
	美国		告警和预警系统	A1.3.10
	全球	ITU-T第2研究组	救灾系统的灾害管理框架	A3.6
	多个国家		关于早期预警系统的嘉宾讨论会	A4.1
演练和演习	中国		应急通信演练	A1.4.1

（续）

主题	国家	实体	案例研究标题	小节
	阿尔及利亚		模拟实施电信民用安全计划的演练	A1.4.2
	中国	中国电信	空间和地面应急通信网络资源的整合	A1.2.1
	日本	NICT	用于灾害管理的“SOCDA”聊天机器人系统	A1.2.10
	日本	NICT	自主分布式ICT系统	A1.2.11
	多个国家		关于灾害演练和灾害管理新兴技术的会议	A4.2
	多个国家		关于开展国家应急通信演练和演习的会议：针对小岛屿发展中国家（SIDS）和最不发达国家（LCD）的指导原则	A4.3
其他	日本		全球灾害统计数据	A1.5.1
	日本		预置应急通信系统	A1.5.2
	刚果民主共和国		对抗埃博拉病毒病	A1.5.3
	美国	Facebook	灾害地图计划	A1.5.4
	中国		ICT用于对抗新冠肺炎疫情大流行	A1.5.5
	美国		应对新冠肺炎疫情	A1.5.6
	全球	ITU-T第15研究组	网络适应性和恢复的灾害管理框架	A3.1
	全球	ITU-R 7C工作组	遥感系统	A3.3
	全球	ITU-T第2研究组	救灾系统、网络适应性和恢复的术语和定义	A3.5
	多个国家		关于灾害管理（包括应对新冠肺炎疫情）的有利政策环境公开网络研讨会	A4.4

第7章 – 好的做法、指导原则和结论

在研究期内，第5/2号课题组围绕四个议题举办了讲习班/会议：早期预警系统；灾害演练和新兴灾害管理技术；SIDS和LDC的国家应急ICT演练和演习；和灾害管理（包括应对新冠肺炎疫情）的有利政策环境。

7.1 分析和确定最佳做法指导原则和经验教训

讲习班/会议讨论、审议、文稿和专家意见得出以下最佳做法和指导原则。

(A) 早期预警系统

– **顾及发展中国家的需求：**告警系统必须满足发展中国家需求，并考虑到正在使用的技术水平。

– **确保灵活性：**采用灵活的方法设计、定制和测试对发展中国家所经历多种危害的告警至关重要。

– **确保监管灵活性：**在灾害未发生时制定实现监管灵活性的政策很关键。例如，可以授予监管机构特殊临时权限，缩短应急通信部署的批准期限。

– **调整应急告警系统：**各国必须考虑到人们的通信方式。例如，在灾害发生时，广播媒体（广播、电视等）对于向公民发布信息仍至关重要，然而，必须认识到人们越来越依赖通过移动设备获取信息。

– **确保连通性：**缺乏连通性既是保障问题也是发展问题。可能使人们无法收到救生告警和预警，延迟或阻碍灾害应对和恢复。通信发展政策必须顾及潜在的应急通信需求和网络复原力。

– **能力建设：**电信发展局有潜在机会加强LDC和SIDS的能力，使其生成并传播有效、基于影响、多灾种且考虑到性别差异的早期预警和风险信息。加强告警、探测和应对的能力建设很重要。

– **制定有利的政策：**《坦佩雷公约》是各国可用于增强备灾和应对能力的宝贵工具，但已签署该公约的国家往往没有出台必要的有利政策和程序。

– **不断改进应急程序：**试点项目、灾害管理演练和演习很重要，可对程序进行测试并根据需要做出调整，更好地为特定类型的紧急情况做准备。还需要利益攸关方之间的不断协调。

– **关注技术进步：**不断演进的技术在更有效、高效地传播多灾种早期预警方面发挥着重要作用。例如，除探测海啸和洪水等自然灾害外，基于物连网的技术还可以帮助收集数据，这些数据可使用大数据分析技术进行处理，以探测或减轻灾害或模拟潜在的灾害影响。必须持续评估和更新程序和技术，确保告警和预警及时、有针对性、并得到接收社区的采用。

– **需考虑的其他方面：**

- 关于可用于早期预警和响应的卫星系统及其他系统的高级培训；
- 当地政府向公民发送的最后一英里预警消息，以及卫星系统的能力；
- 对灾害风险知识的不断追求，可通过系统化地收集数据和评估灾害风险（探测、监控、分析和预测危害及可能的后果）得到扩充，从而实现及时、准确、有针对性且具有可操作性的预警通信，并包含关于可能性、影响和建议行动的信息。

(B) 灾害演练和新兴灾害管理技术

– 卫星图像对于评估受灾地区的范围和造成的损害非常重要。

– 利用演习（如Triplex[18]）并确保当地现场与控制中心之间的有效协调很重要。

– 演练和演习应基于过去灾害的实际数据，帮助建立更实际的灾害情境并使培训更“真实”。

– MDRU可作为快速恢复ICT网络的重要工具。

– 必须制定有关网络复原力的计划，包括容量和供电方面的考虑，因为在灾害期间即使未被损坏的网络也往往变得拥塞，网络电池可能耗尽，传输线断开连接，并且还可能存在对有形基础设施的直接损坏。

– 鉴于技术并非独立存在，因此关键是关注计划、协调、演习和演练，以不断修订政策和程序；设备必须定期测试。

– 演习应测试卫星电话等灾害设备的可及性和使用情况，以确保至少有基本的最低数量的响应者可以访问并知道它们如何使用。

– 低技术解决方案可能必不可少。响应者应做好技术不可用的准备，并在连接断开或断电的情况下有备用通信手段。

– 计划至关重要，演习的目标必须事先确定并传达给参与者和利益攸关方。

– 演习情境很重要，并且应根据当地危害和情况进行调整。不过，每个人都应始终准备好适应和调整，灵活性是关键。为使参与者更好地为复杂、不断变化的情境做准备，应计划多个“小插曲”，使情境升级并测试应对越来越复杂的情况的能力。

– 操练！操练！操练！频繁的培训，再培训和灾害应对模拟是找到差距并完善政策和程序的关键。

– 灾害发生后，通信需求将立刻激增，因为人们试图联系亲人，响应者则努力在拥塞、损坏的网络上协调应对措施。需求将随时间在整个恢复期内下降。

– 演练应根据优先需求和应用（如医疗信息）具有针对性。

[18] TRIPLEX是由国际人道主义伙伴关系运营的定期、全面模拟演习，使不同人道主义实体能够在突发自然灾害情境中实践自己的应对机制。

- 演练和计划应包括对残疾人和有具体需求人群的考虑。应采取措施，确保此类人员能够获取信息，并使用所有可用的方式，包括手语和字幕满足他们的通信需求。
- 尽早疏散是残疾人幸存的关键。
- 各国应鼓励业余无线电的使用，作为所有其他网络基础设施故障时的备用通信方式。
- 推进者和参与者分享经验，讨论挑战和提供反馈时的汇报（或事后回顾）是演习最重要的部分。应肯定备灾方案的优势并针对需要改进或调整的方面制定行动计划。该行动计划应决定后续活动的优先次序，从演习中确定的“立竿见影措施”开始。
- 桌上演练可作为非常有效的第一步工作，旨在找到差距并完善计划和程序。随后应依次进行模拟演练、职能演练和全面演习。演练期间的团队建设将在实际情况的协调中看到回报。
- 在通信演练中纳入各类不同的参与者很重要，例如通信官员、应急频率操作者以及公共安全和区域官员。
- 演练和演习还应考虑提高监管灵活性的方法，例如特殊临时授权，以实现ICT基础设施的快速进口和部署。
- 各国应就能力建设援助和有关灾害/应急通信准备的信息与电信发展局联系。
- 应在需要时，寻求外部援助。
- 必须在国家、州和地区/社区各级制定标准操作规程，并考虑如何提高相关实体之间的互操作性。

(C) 针对SIDS和LDC的国家应急ICT演练和演习

建议的计划制定步骤/里程碑

- **从概念说明开始，**列出目标和预期演习结果、所需的资源和时间范围。概念说明将向各利益攸关方介绍演习情况。
- **组建计划制定小组，**规划演习情境、时间范围、参与者、所需资源等每一个细节。
- **编写情境：**从桌上推演到全面演练的所有演习均需要情境。情境是搭建演习舞台的剧本。确保情境与演习目标挂钩！
- **创建评估计划，**这是使演习成为宝贵学习经历的主要元素。
- **开展演习：**检查所有设备和其他资源是否到位，接着推进小组向参与者做简要介绍，并开展基于情境的演习。
- **监控：**评价参与者对关键事件如何应对。目标是否实现？结果如何？
- **记录**所有主要决策点和结果。
- 向参与者**做汇报**。

– **开展**事后回顾/趁热打铁。

– 基于对演习的观察，**确定并分配纠正行动**。

– 根据需要**更新**计划、政策、流程和设备。

计划演习的最佳做法

– **确保计划较长的提前准备时间：**在演习规划周期中留出足够的提前准备时间，向参与者发出通知（如果计划如此）。例如，如果演习或演练包括电信行业参与者，他们需要充分的通知时间，以安排应对所需的资源。

– **情境范围的充分规划和起草，**然后制定时间表并确定内部和外部小组达成预期结果所需的资源。

– **定期开展演习或演练**（如有可能，每年），以增强效果。

– **起草具有两个时标的演习时间表：**真实的时间顺序和演习时长。例如，演习从实际时间星期一9时开始，但在情境中为星期日凌晨3时，应以两个时标均可理解的时段开展（例如开始：3时相当于9时；演习1：开始时间+1小时=10时；演习2：开始时间+ 2小时= 11时）。

– **延展演习时间表，**以探讨在模拟事件之前或之后会开展的行动。例如，飓风/气旋情境应涵盖从事件发生日期“-5天”到事件发生日期“+3天”之间的准备、减缓和恢复/响应行动，囊括资产的预先部署、燃料、补给、待命应急小组、网络封锁、人员配备和防洪措施，如装沙袋。将小插曲嵌入演习时间表。

– **考虑情境的时机：**旅游旺季或一年中不太繁忙的时段？假日或年末或月末？这将测试资源的可用性，尤其是模拟旨在确保对即将发生的重要事件的准备情况。

– **包括**针对内部和外部小组实现预期结果所需的时间和资源的**详细时间安排**。

– **让行业参与：**设计情境，以便行业运营商能够就是否实际提供输入意见并且能够看到参与的潜在益处。其中包括跨部门协调、与监管机构和政府机构更有力的联系，以及测试自己的通信的可能性。

– **演习以现有计划（如可用）为基础：**了解将适用于演练的国家计划和政策范围及规模（不建议设计绕过当前所有监管程序的测试）。有哪些恢复时间目标？恢复目标是什么（如有）？随后设计评价/测试，以评估达成这些目标的能力以及在整个过程中投入的资源。是否已在计划中确定含有相关恢复时间目标的关键响应/业务流程？如否，则已经有一个演习可关注的发现结果。

– **统一语言和词汇：**确保所有参与者熟悉所用的术语。如有必要，事先发布术语表。

– **保持情境实际：**设计使所有参与者均受益的情境。这将帮助利益攸关方更好地发挥他们的作用。还应考虑演习的地理范围。人们是否必须移动更长的距离？情境是否会涉及普通公众（疏散、建立应急医疗设施、小区广播等）？

– **情境和小插曲应灵活机动，**推动组织和个人处理串联的事件。自然灾害不会遵循预定的计划，因此为多重情境做好准备至关重要。

– **获得关键利益攸关方的认可：**起草一份必须参与的关键参与者清单，和另一份自选参与的人员清单。确定参与者的优先次序。如果利益攸关方在直接控制和组织范围之外，确保他们允许将自己的工作人员纳入，因为可能会占用他们较长时间。如果有意让他们参与数天，确保他们的上下级和领导层知晓。

– **资源影响：**如果实际成果需要大量工作（如数据收集），认识到资源的影响。

– **知道何时终止：**如果情况致使演习无法实施或者结果无用或不切实际，则应准备好叫停。这一经历将有助于改进下一次演习。

– **增加"压力"：**考虑从演习中去除技术平台，退回到通信可能性有限的人工操作流程。这将给流程增加"压力"，并测试小组的预规划能力、对计划的了解程度及在没有指导的情况下行动的能力。

– **利用现实世界的流程和系统：**避免创立"仅用于演习"的小组、电子邮件地址和通信路径，这无法真正验证使用的系统在真实事件中是否有效。

开展演练和演习

– **推进基于情境的演习：**推进者应向参与者提前发送组织的应急计划（如有）。推进者还可以联系当地的和区域应急管理人员和社区响应者，事先获取输入意见，例如关于可能影响组织计划的当地现有应急管理问题[19]。推进者的作用是搭建一个框架，鼓励对话和引导讨论，以期实现演习目标、为组织的应急计划提供信息、推动团队合作并对参与者进行培训。其中可包括：

  - 向参与者提供演习的概况，包括范围、情境、时间表、参与者角色和后续步骤；
  - 让参与者自我介绍；
  - 让参与者作为小组共同合作（或分为多个小组）；
  - 向参与者介绍事件，如真实发生一般；
  - 通过以灾害各个阶段（备灾、响应、恢复和减灾）为基础的互动模块对小组进行指导，并讨论每个阶段需采取的具体行动；
  - 鼓励深入探讨适当的备灾、减灾和应对行动，以增强未来灾害发生时的通信能力；
  - 在关键时刻引入"小插曲"。
  - 推进"汇报"或"趁热打铁"讨论，参与者借此总结观察和发现，最好为国家应急计划提供信息并进行修正；
  - 全面参与事后进程。

[19] 亦见《实施业务连续性计划应对自然灾害：移动网络运营商的快速指南》（全球移动通信系统协会，2017年）。

开展演习的最佳做法

- **记录事件：**指派报告记录员捕捉时间线和关键决策。

- **提供一份时间表，**并从解释演习将如何开展开始。纳入参与者的呼叫频率。制定何时进行何种呼叫的时间表。指明结束时间。

- **保持日程紧凑，**无论是面对面还是电话会议。力求将行政管理任务降至最低。

- **小插曲**应旨在激发行动、活动和直接或间接参与演习的小组、机构和个人之间的对话。例如，如果情境涉及检查设施对飓风的应急响应，则第一个小插曲可以是媒体称热带低气压正在演变成一场飓风的天气报道。下一个插曲将是飓风向该地区移动的后续报告。

- **小插曲应将模拟的事件与希望人们采取的行动联系起来**。它们为演习提供了统一性，并由控制者提供用于推动情境。小插曲通常都会发生，无论参与者的行动如何。例如，模拟的道路紧急情况可影响通过关键道路进行疏散的能力。这是一个插曲，因为演习控制者会在预先设定的时间告知参与者该模拟事件已经发生，无论他们采取什么行动。其他例子包括发电机故障、燃料短缺（接下来3小时没有燃料）、必须由危险物质小组清理的化学泄漏或医院附近的公民骚乱。在计划插曲时，将模拟的影响与人们应采取的行动相联系。

- **开发挑战应对结构、测试应对计划灵活性并推动优先领域讨论的小插曲：**例子包括对通信的影响（重要地区的蜂窝塔遭到破坏或损坏、互联网或固定电话线路故障、海底电缆被破坏、无法接入云恢复）和影响应对的基础设施问题（如机场封闭、道路损坏）。

- **确定实际成果有哪些、达成时间和详细程度**（完全或部分）。

- **制定演习期间通信的基本规则：**在开始时使用“仅用于演习”，并明确演习相关的所有通信何时结束。

- **制定事件期间的报告条款：**正在进行哪些监控以及由谁进行？他们可以提供哪些信息？正在传送的报告状态？需要运营商报告哪些内容以及将如何报告？

- **确立汇报关系：**哪些内容？向谁？频率如何？对这些沟通关系的理解如何？

(D) 经验教训

- 接入世界各地稳健、有抵御能力且安全的ICT基础设施在大流行病和任何类型的灾害中都至关重要。

- ICT有助于全球紧急情况下的基本服务。但是，为履行其职能，ICT需要有利的政策环境，支持具有抵御能力的网络的发展，以及当灾害发生时ICT的快速恢复和部署。例如，可以做出规定，允许对附加频谱使用临时授权，或为应急呼叫划拨免费充值余额。

- 世界电信网络和数字化基础设施必须为所有类型的灾害做更充分的准备。需要合作行动帮助确保演练开展且快速响应措施到位，因为灾害，包括瘟疫流行随时随地可能发生，很少或没有预警。

– 如果早已提前拥有稳健、具有抵御能力的网络以及灾害管理工具和做法，灾害的任何负面后果均可减少。

7.2 结论

在整个研究期内，ITU-D第2研究组研究了发达国家和发展中国家在灾害和紧急情况下利用电信/ICT方面的大量活动（第5/2号课题）。注意到越来越多的国家和组织正在采取措施建立早期预警系统，部署最新技术并提高电信/ICT网络抵御灾害风险的能力，这令人振奋。研究期内吸取的经验教训和编写的指导原则将有助于改进早期预警、演练和演习以及及时、有效的政策制定方面的准备工作。话虽如此，从讨论中可以看出，发展中国家需要更多的支持来实施救灾通信，因此当前重点应转为将电信/ICT用于灾害应对和恢复行动，以及落实救灾通信计划。不过，各国仍应继续分享在灾害管理的所有领域使用电信/ICT的经验和文稿，尤其是在应对新冠肺炎疫情大流行方面。发展中国家还可以投入更多时间交流经验，包括通过互动讲习班，以期确定共同的挑战，突出成功做法，并支持救灾通信框架、技术和计划的不断发展和落实。

Annexes

Annex 1: Detailed use cases

A1.1 Enabling policy and regulatory environment

A1.1.1 Policy frameworks on ICT and disaster management (India)[20]

(1) India's policy framework – Role of ICTs in disaster situations

The National Telecom Policy 2012 emphasizes the importance of disaster management and contains various provisions relating thereto, including with regard to:

– the creation of robust and resilient telecommunication networks to address the need for proactive support to mitigate natural and man-made disasters;

– sectoral standard operating procedures to promote effective and early mitigation during disasters and emergencies;

– the creation of an appropriate regulatory framework for the provision of reliable means of public communication by telecommunication service providers during disasters;

– encouraging use of ICTs to predict, monitor and issue early warnings of disasters, and to spread information;

– facilitating an institutional framework to establish a nationwide unified emergency response mechanism by providing a nationwide single access number for emergency services.

(2) India's standard operating procedures for the use of telecommunication services in disasters

The Department of Telecommunications, which is part of India's Ministry of Communications, prepared standard operating procedures for disaster-response and emergency communications in 2015. A crisis management plan for disaster communications was also released in 2015, and the standard operating procedures were last updated in March 2017. The update covers detailed procedures for communication services during all kinds of disasters, including the following:

- the organization of telecom services at all levels (central, state and district) for implementing and monitoring disaster-management plans;
- the constitution of committees at national, state and district level that meet once every six months to review disaster-management plans and activities;
- robust and preventive measures for telecommunication systems;

[20] ITU-D SG2 Document 2/70 from India

- the obligation for telecommunication service providers to make provision for physical infrastructure safety and redundancy in traffic management;
- the obligation for telecommunication service providers to identify the vulnerabilities of their respective telecommunication infrastructure and prepare emergency plans accordingly, including back-up components (e.g. engine alternator, batteries);
- an overload protection mechanism for traffic overload and congestion management;
- the provision of control room management/activities during and after the disaster;
- periodic training to promote ongoing awareness and drills to check preparedness.

Details are available at the Department of Telecommunications website.

(3) Telecom Regulatory Authority of India initiatives

The recommendations of the Telecom Regulatory Authority of India (TRAI) regarding a single emergency number in India provide a framework for implementation of an integrated emergency communication and response system. The recommendations were accepted by the Government of India and the number "112" was allocated to this service. The Department of Telecommunications subsequently issued the necessary instructions to telecommunication service providers for implementation. In 2013, TRAI also issued recommendations on priority call routing for persons involved in rescue and relief operations, which were also largely accepted. Telecommunication service providers were asked to provide Intra Circle Roaming for their subscribers so that, should mobile services be interrupted because of infrastructure failure during a disaster, subscribers can obtain roaming service for 15 days on the network of another telecommunication service provider whose network is in working condition. TRAI is currently consulting on next-generation PPDR communication networks. Detailed information is available on its website.

(4) Early-warning systems

India has a very robust early-warning system, comprising the following primary nodal agencies:

- the India Meteorological Department (cyclones, floods, drought, earthquakes);
- the Central Water Commission of the Ministry of Water Resources (floods);
- the Indian Space Research Organisation (ISRO) National Remote Sensing Centre, which provides all manner of space navigation services;
- the Geological Survey of India (landslides);
- the Ministry of Earth Sciences, via the Indian Tsunami Early-Warning Centre at the Indian National Centre for Ocean Information Services, Hyderabad (tsunamis);
- the Snow and Avalanche Study Establishment (avalanches).

Indian early-warning agencies send important information derived from satellite-based sensing data to neighbouring countries and to several similar agencies in the Indian Ocean and Asia Pacific region. The Indian early-warning system is also part of the WMO World Weather Watch Global Telecommunication System.

The ISRO National Remote Sensing Centre, together with other organizations such as the Geological Survey of India, the Bureau of Indian Standards and OPCW, has produced maps dividing India into zones on the basis of hazard vulnerability using sensing data. These maps are very useful for pre-disaster planning, prevention and mitigation activities. Bhuvan is the ISRO geoplatform providing an extensive range of services based on Geological Survey maps.

(5) Disaster management: an integrated approach using ICT applications to enable efficacious disaster prediction

In the wake of the 2004 tsunami, the Government of India took steps to build robust early-warning systems: the Ministry of Earth Sciences established the National Tsunami Early-Warning System at the Indian National Centre for Ocean Information Services in Hyderabad, Andhra Pradesh; and the Ministry's Meteorological Department developed ICT-based systems that issue accurate warnings and generate real-time weather reports for all major disaster-management agencies.

The benefits of early warnings and preparedness became apparent when Cyclone Phailin, the strongest storm to hit India in more than a decade, swept across the Bay of Bengal to the eastern coast states of Andhra Pradesh and Odisha on Saturday, 12 October 2013, making landfall with winds over 200 km/h and bringing heavy rainfall. The red message, the highest alert message from the Indian Meteorology Department in New Delhi, was concise, accurate and to the point. It also indicated where and what type of damages were expected to shelter and infrastructure.

The Orissa State Disaster Management Authority team and the National Disaster Management Authority managed the largest-ever evacuation exercise in the state. Nearly 500 000 people were evacuated in time and moved to higher ground and safer cyclone shelters. State, federal and local administration officials, international and national NGOs, and community leaders joined hands in a well-planned large-scale relief operation. Control rooms were set up in ten districts, mobile phone numbers were updated and verified, leaves were cancelled to ensure that all staff members were on stand-by, and food and relief stocks were kept in readiness. The National Disaster Management Authority facilitated local efforts in Odisha, mobilizing rescue teams and sending equipment to possible hot spots. It deployed nearly 2 000 personnel of the National Disaster Response Force in Andhra Pradesh, Odisha and West Bengal. The teams were equipped with satellite phones and wireless sets to maintain smooth communications.

Thanks to the efficient early-warning system and the rapid evacuation measures deployed, a very low death toll was reported: only 21 people died (12 million lived in the storm's path). By contrast, a 1999 cyclone in the same area had a much more devastating impact, killing 10 000 people. Similarly, the 2004 tsunami took the lives of about 10 000 people in coastal states of India.

The early warning issued by the India Meteorological Department was also effective thanks to the state government disaster preparedness and mitigation activities for communities at risk carried out previously: shelters and food had been made available, a volunteer system established, drills regularly conducted and standard operating procedures drawn up for disaster management at state and village level.

(6) The Fisher Friend Mobile Application

The Indian National Centre for Ocean Information Services has collaborated with a very renowned research institution, the M.S. Swaminathan Research Foundation, to develop the Fisher Friend Network, which ensures safety at sea and improves the livelihoods of fishermen. The Fisher Friend Mobile Application is a unique, single-window solution for the holistic shore-to-shore needs of the fishing community, providing vulnerable fishermen immediate access to critical, near real-time knowledge and information services on weather, potential fishing zones, ocean state forecasts and market-related information. Fishermen now receive regular ocean weather forecasts, early warnings about adverse weather conditions and advisories on potential fishing zones. The application is an efficient and effective decision-making tool enabling the fisher community to make informed decisions about their personal safety and the safety of their boats, and to make smart choices about fishing and marketing their catches.

The application was developed on an android platform in partnership with Wireless Reach Qualcomm and Tata Consultancy Services. It is currently available in Tamil, Telugu and English. Fishermen have been trained to recognize warning signs to ensure their own safety and that of their communities.

A1.1.2 The importance of ICTs in disaster management (India)[21]

(1) Disaster-management governance and law

Major disasters, such as the earthquakes in Uttarkashi (1991), Latur (1993) and Chamoli (1999), the Assam floods (1998) and the Orissa super cyclone (1999), led to serious brainstorming on the state of disaster management in India and on the actions required to improve the situation. A key step in that direction was the establishment by India, which was a party to the 1994 Yokohama Strategy for a Safer World, of the High-Power Committee under the chairmanship of Mr J.C. Pant, former secretary of the Indian Government. The Committee produced a detailed report and a set of fundamental and practical recommendations. The Gujarat Bhuj earthquake in 2001 triggered the proposed Disaster Management Bill, which was enacted after the 2004 Indian Ocean tsunami as the Disaster Management Act 2005. The Act enshrines the paradigm shift to "prevention-mitigation based holistic disaster management". Interestingly, in 2005 India also participated in the Kobe World Conference on Disaster Reduction, which adopted the Hyogo Framework for Action 2005–2015. Although India's pioneering legislation on systemic disaster planning and preparedness, the Emergency Planning, Preparedness and Response Rules 1996, was adopted as part of the Environmental Protection Act 1996, the mechanism for holistic planning for disaster management and a tiered approach involving national, state, district and local authorities was introduced by the Disaster Management Act 2005.

The Disaster Management Act 2005 clearly spells out the institutional structures and corresponding functional responsibilities needed to bring about the paradigm shift, leading to the establishment of the National Disaster Management Authority, the National Institute of Disaster Management (the National Authority's capacity-building arm) and the National Disaster Response Force. Similar responsibilities at state and local level resulted in the establishment of the respective institutions at state and district level. This institutional framework ensures that, in post-disaster situations, the communities concerned have assured sustainable livelihoods and reduced vulnerability to future disasters. India is also a party to all international disaster risk reduction strategies and a signatory of the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Agenda for Sustainable Development and the 2015 Paris Climate Agreement.

The National Disaster Management Authority has drawn up the National Policy on Disaster Management, which defines India's disaster-management vision. The policy aims to promote a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education. It encourages mitigation measures based on technology, traditional wisdom and environmental sustainability, and promotes mainstreaming of disaster management into the development planning process. The policy envisions the use of science and technology in all aspects of disaster management in India and is available on the website of the National Disaster Management Authority.

(2) National telecom policy and emergency telecommunication initiatives

India's National Telecom Policy 2012 emphasizes the importance of disaster management and contains various provisions relating thereto, including with regard to:

- the creation of robust and resilient telecommunication networks to address the need for proactive support to mitigate natural and man-made disasters;

[21] ITU-D SG2 Document 2/70 from India

- sectoral standard operating procedures to promote effective and early mitigation during disasters and emergencies;
- the creation of an appropriate regulatory framework for the provision of reliable means of public communication by telecommunication service providers during disasters;
- encouraging use of ICTs to predict, monitor and issue early warnings of disasters, and to spread information;
- facilitating an institutional framework to establish a nationwide unified emergency response mechanism by providing a single access number for emergency services valid throughout the country.

Pursuant to the National Telecom Policy 2012, the Department of Telecommunications, which is part of India's Ministry of Communications, prepared standard operating procedures for disaster response and emergency communications in 2015. A crisis management plan for disaster communications was also released in 2015, and the standard operating procedures were last updated in March 2017. The update covers detailed procedures for communication services during all kinds of disasters.

Going further, the Department of Telecommunications has now created an organizational structure at each Telecom Licensed Service Area (which normally corresponds to India's states), a functional role specific to disaster management empowered to implement the standard operating procedures in all Telecom Licensed Service Areas and drive emergency telecommunications at federal and state government level.

The Telecommunication Engineering Centre, the Department of Telecommunications' telecom research and standardization arm, produced a paper on disaster communications in 2008. The paper's recommendations were adopted as the department's standard operating procedures. The Centre has recently released a testing procedure for enhanced Multi-Level Precedence and Pre-Emption priority services for emergency communications.

The Telecom Regulatory Authority of India has already issued recommendations on priority call routing, the single emergency number and next-generation PPDR communication networks.

(3) ICT-based forecasting and warning networks

In line with the ongoing paradigm shift in disaster management, and with the priorities and action points of the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Agenda for Sustainable Development and the 2015 Paris Climate Agreement, disaster risk reduction, climate change adaptation and sustainable development are now interrelated. In India, the emphasis is now on disaster risk reduction through prevention, mitigation and preparedness. India has built up a very strong early-warning system. The country's meteorological service, the India Meteorological Department (IMD), was established in 1875. It is the principal government agency in all matters relating to meteorology, seismology and allied subjects. The IMD offers observation, data collection, monitoring and forecasting services across various sectors: monsoons, hydrology, agriculture, health, aviation, transport, shipping, cyclones, climatology, mountaineering, disaster management, etc. It offers many web-based forecast services. For example, weather forecasts, meteorological information, nowcasts and warnings are provided from IMD headquarters in New Delhi and various IMD offices. The IMD's meteorological telecommunications consist of an integrated network of point-to-point and point-to-multipoint links with meteorological centres in the country and worldwide for receiving data and relaying it selectively. The IMD also has a VSAT-based network. It has a two-tier organization:

- the Meteorological Telecommunication Network, which is part of the WMO World Weather Watch Global Telecommunication System;

- the National Meteorological Telecommunication Network.

The Global Telecommunication System, the main part of the WMO National Meteorological Telecommunication Centre, in Mausam Bhavan, New Delhi, acts as a WMO regional telecommunication hub.

The IMD is mandated:

– to take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities such as agriculture, irrigation, shipping, aviation and offshore oil exploration;

– to warn against severe weather phenomena such as tropical cyclones, northwesters, dust storms, heavy rains and snow, and cold and heat waves, which cause destruction of life and property;

– to provide the meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities;

– to conduct and promote research in meteorology and allied disciplines;

– to detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects.

Apart from the IMD, other Indian agencies monitor and provide early warnings of disasters:

- the Central Water Commission of the Ministry of Water Resources (floods);
- the ISRO National Remote Sensing Centre, which provides all manner of space navigation services;
- the Geological Survey of India (landslides);
- the Ministry of Earth Sciences, via the Indian Tsunami Early-Warning Centre at the Indian National Centre for Ocean Information Services, Hyderabad (tsunamis);
- the Snow and Avalanche Study Establishment (avalanches).

Indian early-warning agencies send important information derived from satellite-based sensing data to neighbouring countries and to several similar agencies in the Indian Ocean and Asia Pacific region. The Indian early-warning system is also part of the WMO World Weather Watch Global Telecommunication System.

(4) Mapping and hazard zones

The ISRO National Remote Sensing Centre, together with other organizations such as the Geological Survey of India, the Bureau of Indian Standards and OPCW, has produced maps dividing India into zones on the basis of hazard vulnerability. The maps are specific to an area's hazard profile. The maps are very useful for pre-disaster planning, prevention and mitigation, and mainstreaming of disaster risk reduction and development planning activities. They are also used to implement building by-laws.

(5) Bhuvan data discovery and metadata portal

Bhuvan is the ISRO geoplatform providing an extensive range of services based on Geological Survey maps. The portal, which was developed by the ISRO National Remote Sensing Centre, is meant to:

- improve access to and integrated use of spatial data and information;
- support decision-making;
- promote multidisciplinary approaches to sustainable development;
- enhance understanding of the benefits of geographic information.

It is being extensively used for disaster risk reduction. It also helps pinpoint the location of events. For example, forest fires can be quickly located and remedial action taken thanks to this geo-portal. Details of the various disaster services on offer are available here.

A1.1.3 Emergency telecommunications under Haiti's Sectoral Working Group (Haiti)[22]

(1) Disaster management in Haiti

In Haiti, disaster management is entrusted to the Civil Defence Directorate (Direction de la Protection Civile, or DPC), which is under the authority of the Ministry of the Interior and Local Government Authorities. The DPC receives support for natural disaster management from many other State bodies and private and international institutions.

In addition to planning and coordinating relief activities, the DPC also manages a UHF telecommunication network to facilitate communication between the different bodies involved in the disaster-management process. For field telecommunications, the DPC relies on the support of the National Telecommunication Council (CONATEL) to mobilize all telecommunication/Internet operators and broadcasters. CONATEL's responsibilities in terms of emergency telecommunications are as follows:

- coordinate with telecommunication operators with a view to ensuring availability of telecommunication networks for relief operations;
- issue alerts via radio and television stations;
- activate and distribute satellite telephones to government officials for the coordination of relief operations;
- coordinate the deployment of telecommunication systems with ITU.

(2) Regulator's emergency telecommunication plan of action

The regulator's emergency telecommunication plan of action involves the following:

[22] ITU-D Document SG2RGQ/121 from Haiti

- coordination with the DPC, mobile operators, Internet access providers, and radio and television stations for emergency alerts to the public;
- ensuring the resilience of mobile operator, Internet access provider and radio and television station networks;
- coordination of assistance from ITU and other international organizations for emergency telecommunications;
- advocacy for the adoption and implementation of a national plan for emergency telecommunications;
- introduction of a mechanism for the efficient and optimal use of telecommunication resources during emergencies.

(3) Role of telecommunication/Internet operators and broadcasters

Telecommunication operators and Internet access providers have the following responsibilities:

- provide telecommunication services in disaster-affected areas;
- issue emergency alerts at the DPC's request;
- offer calls free of charge to persons living in disaster-affected areas.

Radio and television stations are supposed to broadcast alerts to disaster-affected populations.

(4) Support from international organizations

ITU provides appropriate support to Haiti during emergencies. Its interventions take two forms:

– deployment of emergency telecommunication equipment to facilitate communication among relief teams;

– distribution of satellite telephones to government officials for the coordination of relief activities.

Several other international NGOs, either established in Haiti or arriving specifically for emergencies, deploy their telecommunication equipment to support DPC activities.

(5) Projects under way

There are currently two emergency telecommunication projects under way.

Haiti does not yet have an integrated emergency telecommunication system. It has therefore been decided to establish a sectoral committee on emergency telecommunications (Comité sectoriel sur les télécommunications d'urgence, or COSTU), charged with coordinating sectoral responses, in accordance with the national disaster and risk management plan. COSTU was set up with a view to using telecommunications and ICTs to enhance the coordination of disaster prevention, preparedness and response.

COSTU reflects an ongoing commitment bringing together the Ministry of Public Works, Transport and Communications, through the participation of CONATEL, and the Ministry of the Interior and Local Government Authorities, through the participation of the DPC. It demonstrates the Government's determination to strengthen disaster prevention, preparedness and response measures through joint planning and to take advantage of the essential role of telecommunications in this regard.

COSTU's terms of reference include the following elements:

- mission and functions
- composition
- operating mechanisms
- task descriptions
- financing arrangements
- expected outcomes
- follow-up and assessment mechanisms.

WFP and the GSMA contributed to work leading to the establishment of the sectoral working group on emergency telecommunications.

The second project concerns the introduction of an early-warning system to issue public alerts in the event of a disaster. The system is designed to operate on mobile telephone operator networks. Arrangements are being made for it to be installed on the networks of the country's two mobile operators. The system, which will be provided by Microimage, receives assistance from the GSMA and is financed by the World Bank.

A1.1.4 Emergency Telecommunications Preparedness Checklist (WFP)[23]

As disasters continue to increase in frequency and scope across the world, and ITU-D Question 5/2 considers the critical role of how communication policy-makers can help enable emergency telecommunications in disaster preparedness, mitigation, response and relief, the WFP-led Emergency Telecommunications Cluster and ITU-D have jointly developed the Emergency Telecommunications Preparedness Checklist. The checklist examines key thematic areas that could be considered for inclusion in an NETP and provides a simple scoring approach to assess the state of progress on each decision point or action over time. It primarily supports the establishment and refinement of NETPs, with a focus on understanding national readiness to enable response communications in a disaster. It also identifies targeted areas that may require attention. For a more detailed listing of potential questions that communications authorities may ask when drafting an NETP, please refer to the Emergency Communications Checklist.[24]

A1.1.5 CAP-based early warning (New Zealand)[25]

(1) Governance

The New Zealand CAP Working Group is chaired by the Ministry of Civil Defence & Emergency Management (MCDEM) and is open to anyone with an interest in promoting the general uptake of CAP, using CAP for registered alerting authority alerts and developing software or supplying hardware to support the dissemination of alerts in New Zealand.

Owing to the CAP's flexible definition of hazard levels and nomenclature, the Working Group maintains a technical standard, Common Alerting Protocol (CAP-NZ) Technical Standard [TS 04/18], to assist

[23] ITU-D Document SG2RGQ/182+Annexes from the World Food Programme

[24] ITU, op. cit. (note 2), Annex A

[25] ITU-D SG2 Document SG2RGQ/145 from New Zealand

with CAP implementation in the New Zealand alerting context. The standard aims to provide clarity for alerting authorities on the formatting and categorization of alerts and how those alerts should then reach the public via various alerting end-points. It encompasses the Working Group's decisions, recommendations and lexicons to ensure consistency within New Zealand's alerting environment. It is reviewed annually.

The MCDEM coordinates associated task groups and working groups, which implement information systems and alerting end-points utilizing CAP concepts such as its schema, its alert gradings of certainty, severity or urgency, its distribution through alerting end-points, and the New Zealand-specific lexicons to provide common understanding of the message contents. It also coordinates the development of best-practice messaging in New Zealand for the various end-point technologies.

The Working Group does not have any decision-making capacity; instead it makes recommendations to the Public Alerting Governance Committee, which considers and approves the specification documents produced by the Working Group.

The Public Alerting Governance Committee was established by the Hazard Risk Board, one of the governance boards of the Officials' Committee for Domestic and External Security Coordination[26]. It comprises senior officials responsible for public alerting and representatives of New Zealand mobile operators and the scientific organizations that monitor natural hazards.

(2) New Zealand CAP feeds

New Zealand currently has three public live feeds of alerting information in CAP format; a fourth is under development.

Earthquakes

GNS Science uses the GeoNet system to maintain a CAP feed of Modified Mercalli intensity "moderate" (MM5) or higher earthquakes occurring in the last seven days in the New Zealand region and of a suitable quality for alerting.

Severe weather

The Meteorological Service of New Zealand Limited (MetService) maintains a CAP feed of severe weather warnings and watches for rain, wind, snow and thunderstorms.

Civil defence emergencies

New Zealand has sixteen regional Civil Defence Emergency Management Groups. They have adopted the Red Cross Hazard App as their preferred mobile device application for notifying multiple hazards in their region. The Storm CMS is used to prepare these alert messages and their impact zones, and these are published as a CAP feed.

Emergency Mobile Alert

New Zealand's public alerting technology is cell broadcasting. A CAP feed is currently being developed by system provider One2many BV to publish these alerts and allow their uptake by multiple other channels, such as apps, websites and digital signage. It is expected to go live by the end of 2019.

(3) High-priority alerts

New Zealand's registered alerting authorities have agreed to use the CAP to share and disseminate their alerts and warnings. But the CAP is not just a data protocol, it is also a way of classifying alerts. Its classification criteria were used to define the scenarios acceptable for use by New Zealand's

[26] ODESC is a committee of Chief Executives that manages national security in New Zealand. It is chaired by the Chief Executive of the Department of the Prime Minister and Cabinet.

Emergency Mobile Alert (EMA) system. The cornerstone attributes of urgency, certainty and severity enable agencies to grade their alerts and make them comparable.

New Zealand has also adopted the unofficial, but widely accepted, definition of high-priority alerts. These are defined to be at level (a) or (b) within each of the following three CAP criteria:

Certainty

a. Observed: determined to have occurred or to be ongoing

b. Likely: probability of occurrence greater than 50%

Severity

a. Extreme: extraordinary threat to life, health or property

b. Severe: significant threat to life, health or property

Urgency

a. Immediate: responsive action should be taken immediately

b. Expected: responsive action should be taken soon

(4) Interpretations of "certainty", "severity" and "urgency"

When designing the protocol for use of the EMA system, decision-makers responsible for issuing EMA messages requested further guidance on the CAP definitions of certainty, severity and urgency in order for them to be more useful in an operational environment.

Certainty

Likely should consider that a qualitative estimate of probability may vary by up to 30 per cent, and erring on the side of caution may be preferable in some circumstances. The desire to wait for certainty is a trade-off against allowing sufficient time for action.

Severity

Extreme applies to an emergency affecting a town, city or region:

- **life**: widespread deaths are possible; or
- **health**: widespread permanently incapacitating injuries or illness are possible; or
- **property**: widespread destruction (or rendering uninhabitable) of buildings is possible.

Severe applies to an emergency affecting rural dwellers or a small part of a suburb in an urban area:

- **life**: limited deaths (i.e. individuals or small groups) are possible; or
- **health**: limited permanently incapacitating injuries or illness are possible; or
- **property**: limited (i.e. few or very localized) destruction (or rendering uninhabitable) of buildings is possible.

Urgency

Expected: soon must include time for action – the minimum amount of time people could reasonably be expected to carry out the instructions in the alert. For example:

- 5 minutes: "Do not take personal belongings other than critical medication and personal documents";
- 30 minutes: "Bring in outdoor objects such as lawn furniture, toys and garden tools, and anchor objects that cannot be brought inside".

(5) Optimal warning and guidance messages

The Working Group considers the social science around public messaging to be a logical extension of its terms of reference.

A consequence of the EMA system was the need for short warning messages of 90 characters or less, in effect the CAP **headline** element. A report[27] was commissioned that provides best practice for writing short warning messages for the public to achieve a desired behavioural response. It was based on an international literature review and some preliminary results from primary New Zealand research. It focused on warnings for regional tsunamis, with additional examples for a volcanic eruption and a flood event.

In order to permit a future relaxation of the 90-character limit, and for other channels featuring short messages, the guidance is useful for up to 930 characters, the technical limit for EMA messages in New Zealand under the most favourable conditions. This upper limit typically also covers social media, short emails and electronic billboards.

Another messaging initiative has been to support the Red Cross "What Now" service. This involves adapting standard multi-hazard key action messages to a New Zealand setting, to ensure consistency, clarity and safety. For each hazard, and for up to six stages of an emergency, several short, clear action messages are promoted as being the key ones for dealing with the hazard.

(6) Trigger levels matrix

New Zealand has been using the concept of a Hazard Intensity Metric (HIM). This is one or more measures that can be calibrated against their potential impacts, including causing death, injury or illness, or property damage.

The Working Group aims to set thresholds for the three critical CAP elements (certainty, severity and urgency) that work across a variety of hazards and their HIM metrics in the setting of the broadcasting and messaging end-points through which they should be distributed. For each hazard, the responsible alerting authority is consulted on the intensities that might trigger different alerting end-point behaviours.[28] For example, an EMA is only issued for high-priority alerts.

(7) New Zealand events and event codes lexicon

Like other nations, and in line with the current OASIS (Organization for the Advancement of Structured Information Standards) CAP initiative to provide a consistent set of event codes, New Zealand is creating a table of event codes that provide more specificity to the nature of the emergency. At

[27] Sally Potter. Recommendations for New Zealand agencies in writing effective short warning messages. GNS Science report 2018/2.Lower Hutt, New Zealand, 2018.

[28] For weather, wind speed can be measured in km/h, or rainfall in mm/hour. For tsunamis, it could be wave height in metres, and for earthquakes, Modified Mercalli intensity. Intensity levels are less clear for perils such as pandemics.

this time, the table is restricted to those alerts available on public feeds, primarily weather and earthquakes.

With the EMA system soon to be providing its alerts as a CAP feed, further event descriptions and event codes have to be agreed, to cover situations such as boil water notices, flooding, biotoxins, hazardous substances and criminal activities. New Zealand has looked to previous work by Australia[29] and Canada[30] for guidance, but with this topic being considered at a global level, it is pausing now to ensure that it is aligned with the future direction for these elements. At this time, the **event code** element is not used in New Zealand.

(8) Package names

Although work has not commenced, the Working Group has identified a need to work on the standardization of "package names" describing alerts (e.g. watch, warning, bulletin, outlook). Many of these terms have long been used by the alerting authorities that issue them, and there may even be legislative implications should change be deemed desirable.

Nevertheless, it is the sentiment of the Working Group that the use of these terms should be defined more clearly and align more consistently across the impacts of hazards they describe.

(9) Conclusion

Since 2015, New Zealand's CAP Working Group has been an active committee of approximately 60 member national and local agencies, industry members from the geospatial community, and alerting app and warning system hardware manufacturers. It has provided technical guidance and an opportunity for networking and collaboration, and enjoys official government recognition of the importance of the CAP to the alerting environment.

The Working Group remains committed to supporting the worldwide CAP community and following the initiatives being spearheaded by other nations in order to ensure that the CAP is a truly global, trusted and consistent alerting protocol.

A1.1.6 ICTs in managing the effects of floods (Burundi)[31]

(1) Management of the floods in March 2019 and 2020

In March 2019 and March 2020, successive torrential rains fell in the region of Imbo and the surrounding area. The rivers which flow into Lake Tanganyika via the town of Bujumbura burst their banks, causing material damage, including the destruction of homes, loss of life and the massive displacement of the inhabitants of Cibitoke, Bubanza and the Bujumbura districts of Buterere in 2019 and Gabtumba in March 2020.

During rescue operations, the use of mobile communications saved the lives of people in danger as a result of the floods. The use of short numbers assigned to the Burundi Red Cross and the police enabled the sick to be swiftly evacuated to hospitals in Bujumbura to receive treatment.

To assess the contribution of the telecommunication/ICT sector to disaster management, the Telecommunication Regulation and Control Agency (ARCT) carried out a survey on the use of ICTs in disaster management in Burundi. The data collected revealed that the floods and landslides in Cibitoke, Bujumbura and Bubanza resulted in casualties, displaced persons and the destruction of

[29] For Australia event codes, see: Australian Government. CAP-AU-STD version 3.0: Australian Government Standard for the Common Alerting Protocol (CAP-AU-STD) and in particular Annex 2 to CAP-AP.

[30] For Canada event codes, see: Government of Canada. Public Safety Canada. CAP-CP Event References 1.0.

[31] ITU-D SG2 Document SG2RGQ/222 from Burundi

property and personal possessions. Flooding, strong winds and landslides had also occurred in the last five years elsewhere in the country, and ICTs played a significant role in their management.

Social media were used to involve the general public, facilitate communication between population groups, raise awareness of the situation and concerns in the event of an emergency, and facilitate the response at the local level.

(2) The role of stakeholders

Geographic Institute of Burundi

The Geographic Institute of Burundi is a public agency responsible for promoting national meteorological activities for the well-being of the population. Its mission is to provide high-quality, reliable and affordable meteorological services in line with its partners' expectations. It thus plays a part in protecting property, people and the environment in general, in line with the national objective of prosperous socio-economic development.

Burundi Red Cross

The Burundi Red Cross is a key player in the population's social development. It provides a rapid response in the event of climate change-related disasters. It has been assigned a toll-free short number so that victims of natural disasters and people in need of emergency aid can call its services free of charge.

Territorial administration

Local government plays a leading role in the protection of the population and is obliged to collaborate with stakeholders involved in fighting disasters. It has a duty to carry out awareness-raising campaigns on disaster prevention and management methods, and facilitates activities on the ground in the event of a disaster within the area administered.

National risk management platform

Burundi set up a national platform to focus on disaster management in the country by Decree No. 100/016 of 8 February 2019, on the appointment of the members of the National Platform for Disaster Risk Reduction and Management. This multi-party team is responsible for disaster-related risk prevention and management, raising awareness and taking concrete action in the event of disasters.

The media

The national radio and television service of Burundi (RTNB) is a public media outlet that contributes considerably to public information. It broadcasts weather reports for the purposes of prevention and airs information and awareness-raising campaigns during and after disasters.

Telecommunication operators

Telecommunication operators play a major role, ensuring communication and interconnection in order to relay and transmit information to users. Toll-free numbers are operational and mobile telephony, operating mainly through social media, is increasingly used to transmit information before, during and after disasters.

A1.1.7 Case studies of satellites in disaster risk reduction and management[32]

(1) Case studies of satellites

There are many examples or case studies demonstrating the vital role of satellite communications in disaster risk reduction and management. The following provide a few examples:

– In October 2016, when Hurricane Matthew struck Haiti, nine days before mobile networks were restored, satellite phones helped 2 461 people across 19 communities restore family links. VSAT equipment deployed to departmental emergency operations centres (COUDs) to replace local Internet connection stayed in place for months after the event.[33]

– In 2017, Inmarsat's high-speed solution was used by Télécoms Sans Frontières (TSF) for the first time in the wake of Hurricanes Irma and Maria in the Caribbean.[34]

– In September 2018, Inmarsat satellite connectivity supported the emergency response in three regions of the Philippines battered by Typhoon Mangkhut.[35]

– In September 2018, TSF deployed a team of technicians just hours after Sulawesi Island in Indonesia was hit by a 7.5-magnitude earthquake, triggering a deadly tsunami on 28 September 2018. With medical and food supplies in danger of running out and terrestrial communications down, it was essential to establish satellite connectivity to coordinate emergency response.[36]

– In September 2019, the Bahamas was in the path of Hurricane Dorian, the most powerful storm to hit the region since records began. The Category 5 tropical cyclone destroyed entire communities and left 70 000 people in need of food and shelter. TSF used Inmarsat's satellite connectivity to set up fast, reliable communication links for aid agencies and national governments coordinating relief efforts, as well as offering victims free satellite phone calls.[37]

(2) Policy considerations: the need for reduction of regulatory barriers

Although the previous section simply serves to highlight the role played by satellites in disaster risk reduction and management with practical examples, it is worth mentioning some of the lessons learned from disasters and some of the key policy considerations to be taken into account in order to be able to fully utilize satellite communications for disaster risk reduction and management.

Some of the lessons learned from disasters include the following:

– Disaster preparedness planning is essential.

– The business of disaster response is conducted before a disaster strikes.

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32 ITU-D SG2 Document 2/410 from Inmarsat (United Kingdom)

33 Inmarsat. Latest News. TSF on the ground in the wake of hurricane Matthew. 5 October 2016.

34 Inmarsat. Disaster Response. Reliable connectivity when seconds count; Inmarsat. Latest News. TSF deploys to West Indies as hurricane Irma batters islands. 6 September 2017; and Inmarsat. Latest News. Over 1,000 hurricane victims helped by TSF. 26 October 2017.

35 Inmarsat. Latest News. Typhoon relief efforts aided by satcoms. 28 September 2018.

36 Inmarsat. Latest News. TSF deploys to Indonesia in aftermath of devastating tsunami. 1 October 2018.

37 Inmarsat. Latest News. Hurricane Dorian victims offered satellite call lifeline. 12 September 2019.

- Efficient coordination and network sharing by NGOs and other end users is needed.
- Frameworks for customs clearance are required.
- Well-trained first responders and media are key.
- Prepared users drive satellite usage.
- Social networking and mobility-based applications are revolutionizing disaster response.
- Data requirements on the ground are growing dramatically.
- Responders need a mix of connectivity solutions (satellite, terrestrial, hybrid, fixed, mobile) in their daily toolkit.

Some of the key policy considerations to allow satellite communications to be most effectively used for disaster risk reduction and management include the following:

- Exemption from/temporary waiver of regulations that might restrict the use of telecommunication equipment/radio frequencies during the use of such resources for disaster mitigation and relief.
- Recognition of foreign type approval of telecommunication equipment and/or operating licences.
- Exemption from regulations that might restrict the import/export of telecommunication equipment.
- Facilitating the transit of personnel, equipment, materials and information involved in the use of telecommunication resources for disaster mitigation and relief into, out of and through the disaster area.

A1.2 Disaster communication technologies

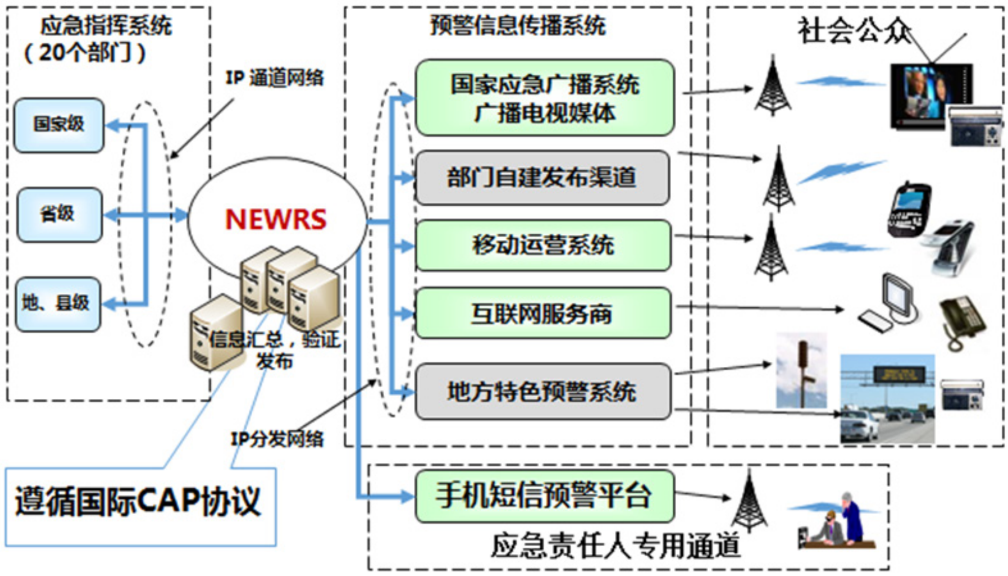
A1.2.1 Integration of space and terrestrial emergency communication network resources (China Telecom, China)[38]

(1) Introduction

Many governments around the world have recognized that cell broadcast technology can be used to deliver emergency alert notifications. China has developed public emergency alert notifications standards based on that technology that support global roaming and are compatible with standards in Europe and the United States. The emergency alert system in China is depicted in **Figure 1A**.

[38] ITU-D SG2 Document 2/158 from China

Figure 1A: Emergency alert system in China



Legend:

应急指挥系统（20个部门: Emergency command system (20 departments)

国家级: National level

省级: Provincial level

地、县级: Prefecture and county level

IP通道网络: IP-based channel network

信息汇总、验证、发布: Information summary, verification and distribution

IP分发网络: IP-based delivery network

遵循国际CAP协议: Compliance with the CAP

预警信息传播系统: Emergency alerting system

国家应急广播系统广播电视媒体: National public alerting system

Broadcast and TV media

部门自建发布渠道: Self-built departmental dissemination channels

移动运营系统: Mobile operation system

互联网服务商: Internet service providers

地方特色预警系统: Local specialty emergency alert system

手机短信预警平台: Mobile phone SMS alerts platform

应急责任人专用通道: Dedicated channel for emergency management chief

社会公众: The general public

4G networks are being continuously improved, and it is particularly important that they be used efficiently, to ensure that mobile subscribers can receive vital emergency alert messages in time. It is strongly recommended that, for the benefit of the general public, efforts be made to develop emergency cell broadcast alerting systems based on 4G networks for use in major natural disasters and other public safety incidents such as earthquakes, typhoons and mudslides, and to ensure that 4G emergency alerting management platforms can interconnect with the existing interfaces of emergency alert management organizations.

To meet disaster mitigation and prevention needs, China Telecom has researched and developed the LTE cell broadcast technology-based multi-channel emergency alerting system. It has used the system to send emergency alert messages by concurrent mode in the shortest possible time, rendering it a vital component of the national emergency communication assurance plan. The system will be widely used in various scenarios and applications, including disaster prevention and emergency alerting.

China Telecom will further optimize its emergency alerting strategies to facilitate the inclusion of next-generation cell broadcasting in network entry standards for telecommunication equipment and will support the use of social media, including mobile Internet, to issue alerts, with a view to increasing emergency alerting capabilities.

(2) Detection and monitoring of natural disasters and other emergencies

In disaster management, IoT can be used to monitor sudden-onset natural hazards such as earthquakes and mudslides, to issue emergency alerts, and to transmit data in near real time to emergency management and command centres, thereby boosting disaster prevention and mitigation capabilities. The 3rd Generation Partnership Project has already launched a set of LTE-based narrowband IoT technologies (i.e. narrowband IOT and enhanced machine-type communication), which have expanded the LTE technology portfolio to support broader application of more energy-efficient IoT services.

To operate, conventional IoT devices rely on terrestrial communication networks, which can be easily damaged or destroyed in a severe natural disaster. Satellite IoT can compensate for that weakness. Extensive coverage, resistance to destruction and flexible network construction have together made satellite IoT irreplaceable for real-time monitoring of large areas impacted by a natural hazard.

China Telecom already has the ability to monitor and report on various natural hazards in real time using 4G IoT. It can provide end-to-end solutions, from data collection in earthquake zones to 4G-network coverage and transmission, and then to back-office processing and analysis. In 2017, in partnership with the China Earthquake Administration, China Telecom uploaded seismic data from an earthquake-affected region to a cloud platform via its IoT Link card. The monitoring data were mainly obtained from measurements of earthquake intensity, which are then used to analyse the earthquake's vibration process and real-time scenarios. Such data supplement those collected by professional seismic stations and provide a basis for decision-making and prediction.

In addition, China Telecom has used its exclusively operated satellite mobile communication system platform to provide satellite IoT applications and services, and expanded coverage of IoT monitoring applications thanks to satellite IoT terminal devices. Monitoring and detection operations focus on river water levels and discharge; sediment concentrations; environmental and atmospheric conditions; cereal pests and diseases; forest fires; seismic data; natural gas production and operations; water leakages; mudslides; avalanches; wind speed and direction; and rain and snowfall.

(3) Emergency communication exercises

It is recommended that more efforts be made to conduct cross-sector and -regional emergency communication exercises by various means, including table-top exercises, full-scale exercises and functional exercises, so as to increase synergy and interconnection, operability and continuity, and to build a specialized emergency communication support team characterized by professionalism, dedication and supportiveness.

China Telecom has conducted a number of special emergency communication exercises covering various disaster recovery scenarios. The exercises feature a national specialized emergency communication support team, include programmes such as "Building a Front-line Command System", "Emergency Relief Communications Support" and "Public Network Communications Support", and demonstrate China Telecom's integrated air/ground ICT applications and cross-sector emergency communication capabilities in times of natural disaster or other emergency. Apart from deploying conventional services related to emergency communications (e.g. Tianyi (Skywings) Walkie-Talkies, satellite phones, 4G individual communications and a variety of emergency vehicles), the exercises also involve new services, such as the new generation of narrowband IoT, big-data and visual dispatch systems, and new equipment, including helicopters, mooring UAV and airborne balloons.

(4) Emergency communication command and control capabilities

An emergency communication command and control system is an integrated emergency command and control platform that integrates such functions as presentation, dispatch, deployment, dial testing and intelligent analysis.

(5) Building airborne emergency communication platforms

Built to meet the needs of three-dimensional wireless coverage, airborne emergency communication platforms consist of mooring UAVs, wireless broadband access systems, 3G/4G trunked emergency communication systems, air safety protection systems, high-definition video live broadcast systems, airborne lighting and call systems, etc.

Airborne emergency communication platforms are used in emergency zones to facilitate disaster recovery and assistance in major public safety incidents and other important events. They serve to set up wireless broadband access and 4G mobile communication and trunked communication service networks, provide users in the field with mobile and data communication services, and transmit dynamic information to back-end command and control centres. China Telecom has already developed its airborne emergency communication platform specifications and can provide the relevant solutions and services, the application scenarios of which include the following:

- Emergency communications in isolated areas without access to communications: In areas devastated by natural hazards such as earthquakes, typhoons, floods or fires and in which emergency operations are ongoing, satellite communication access systems, ad hoc mesh networks and portable 2G/4G mobile communication access systems are set up and speedily activated, in order to provide government, corporate customers and the general public with emergency mobile communication and natural disaster surveillance services.

- Emergency communications at hotspots: At communication hotspots such as cultural, sports or business events at which emergency operations are ongoing, satellite communication access systems or optical transmission access systems, ad hoc mesh networks and portable 2G/4G mobile communication access systems are set up and speedily activated to provide the media, government, business customers and the general public with emergency mobile communications and data communication services.

- Emergency communications for emergency command and control: At cultural, sports or business events and at major public safety incidents at which emergency operations are ongoing, satellite communication access systems, ad hoc mesh networks and portable 800 MHz digital trunked communication access systems are set up and speedily activated to provide police forces and public safety agencies with critical digital trunked communication services.

A1.2.2 Intelligent emergency telecommunication management (China)[39]

(1) Upgrading emergency telecommunication command and control systems utilizing Internet+ cloud computing and big data

[39] ITU-D SG2 Document 2/159 from China

In many parts of China, attempts have been made to apply the Internet+ to the development of emergency telecommunication command and control systems. For instance, the Shanghai communication industry has used the Internet+ to reinforce its development of the command and control system covering emergency communication vehicles, emergency support supplies and response teams. In combination with digital maps, emergency-related data such as emergency support mission statistics, emergency telecommunication vehicle utilization rates, emergency service statistics, emergency response teams and emergency support equipment have been included in the command and control system. The system enables closed-loop management of satellite resource applications and allocation and approval of material reserves. It can be easily and speedily operated via mobile apps, significantly increasing emergency response efficiency.

(2) Using big data to analyse people flows and network traffic in hotspots

Through the integrated use of Internet and big-data processing technologies, valuable information can be drawn from massive, scattered, unstructured and constantly changing data relevant to the emergency, so that the associated macro environment can be analysed and understood, and the incident's development profile can be obtained in a timely and efficient manner to support scientific decision-making.

In public safety incidents, emergency alerts can be issued using data analytics and the Internet. Big data can be used to analyse the network access and transportation modes of mobile subscribers during major conferences and exhibitions, on holidays and during festivals, in order to predict and identify areas with high-moving crowd densities or large people flows during peak hours. Data on large crowds and flow trends are used as reference information by organizers, who can then notify people in areas at high risk of a safety-related incident via mobile Internet and avoid human stampedes and crushes.

In Shanghai, where mobile Internet is flourishing, people-flow monitoring, mobile Internet perception in key areas and an analytical platform were built based on big-data analytics of 2G/3G/4G cell service statistics. The relevant analytical results are displayed in such a way as to make it easy for emergency command centres to allocate resources, dispatch personnel and troubleshoot. In abnormal field situations, the platform can identify problems before mobile subscribers perceive them, enhancing safety in mass gatherings. Similar systems developed to analyse mobile service data targeting in key areas and hotspots provide information on the total number of people (mobile subscribers), popular apps, people flow, etc.

(3) Using Internet communication tools to support emergency responses

In recent years, Internet instant messaging tools such as Wechat and QQ have also been widely used in China. They are highly efficient, fast and convenient to use for assigning emergency tasks, reporting and delivering information, etc.

In the aftermath of a major disaster in Japan, social media such as Twitter and Facebook were widely used for rescue operations and to attract donors. According to a survey conducted after the disaster, social media had an outstanding impact on the transmission of information, spreading news of disaster recovery facilities and materials much more quickly, accurately and reliably than traditional channels of communication. Widely distributed cell broadcasts and dedicated message recordings played a significant role in providing locally generated information, including on the location of emergency food and water supplies, delivery time and location of disaster recovery supplies, and psychological counseling services.

Another example is Facebook Disaster Maps. People using the Facebook app with the location service enabled receive regular information on the longitude and latitude of their position. When gathered and de-identified, such geological location data can be a source of post-disaster information. Facebook data-set types include movements of people, crowd density and Facebook Safety Check information collected after the disaster.

(4) Increased smart-city capabilities facilitate the development of intelligent emergency telecommunications

Apart from introducing new generations of ICTs to emergency telecommunications via the conventional telecommunication industry, countries around the world have shown great enthusiasm about the application of ICTs in the emergency management sector. In a 2018 report,[40] consulting firm McKinsey and Company noted that one key aspect of building smart cities is using digital technologies to improve emergency telecommunications. With more comprehensive, real-time and dynamic data, emergency response services are able to monitor emergency incidents closely and understand the changing models of needs. They are therefore able to implement emergency response plans more speedily and more cost-effectively. Emergency technological systems and emergency efforts that can be linked to the development of smart cities include at least the following: disaster early-warning systems; emergency response optimization (i.e. back-office call processing and field operations such as the strategic deployment of emergency vehicles); personal alert applications (transmitting emergency alerts such as location and voice data to emergency response services or loved ones) and smart monitoring of the operation zone. According to McKinsey and Company's analysis of research data on a large number of cities around the world,[41] cities can cut emergency response times by 20 to 35 per cent on average by deploying new types of smart applications (e.g. smart systems to optimize call centres and field operations; traffic signal pre-emption to clear lanes for emergency vehicles). More mature cities with an already low response time of eight minutes can shave almost two more minutes off by doing smart-city upgrades and retrofits. Less-developed cities starting with an average response time of 50 minutes might be able to trim that by at least 17 minutes by introducing new types of smart applications.

(5) Accelerated integration and development of next-generation ICTs and emergency telecommunications

The future will see an accelerated integration of next-generation ICTs such as big data and AI into emergency telecommunication systems. With the expedited restructuring and rapid iterations of core technological systems, including new generations of hardware, software and services, future emergency telecommunication technological applications will experience an increasingly manifest trend of integration and innovation. Thanks to the accelerated convergence of emergency telecommunication networks and edge computing technologies that promote and support self-perception, self-decision-making, self-optimization and self-execution, the blockchain technology that supports multiple party and reliable data storage and exchange capabilities, and virtual/enhanced reality technologies that support three-dimensional intuitive display, new types of emergency telecommunications featuring such newly emerged key elements as emergency status perception, data processing and immersive telepresence will expedite the realization of smart command and control, network control and maintenance, smart dispatch of work order tasks and smart reserves, and will help deliver opportunities for a new industrial ecosystem.

In the new development stage, with new features including physical integration of information, ubiquitous intelligence and computing, resilient platform components, data-centered operations, emergency telecommunications will enter a completely new track of smart development, embracing a historic turning point marked by capability upgrades in all dimensions. An integral part of emergency management, emergency telecommunications provide important tools for disaster mitigation and prevention. In the past, people tended to be concerned about the response times and capabilities of emergency telecommunications in the aftermath of a disaster. To a great extent, however, emergency telecommunication services should focus more on emergency preparedness. Turning

[40] McKinsey Global Institute. Smart Cities: Digital Solutions for a More Livable Future. McKinsey and Company, June 2018.

[41] The sample comprised 50 cities around the world that had already developed or announced ambitious smart-city development plans and were selected for their overall representativeness in terms of geographical coverage, differences in income levels, population density and infrastructure quality.

disadvantages into strengths, building highly efficient emergency alert systems, delivering emergency alert messages to the public in a timely and effective manner, enhancing disaster prevention and mitigation capabilities, and improving emergency response capabilities at all levels of emergency management agencies – these are the future trends in emergency telecommunications.

A1.2.3 Emergency communication services and networks (China)[42]

(1) Overview

China suffers frequent natural disasters and therefore has a highly developed form of natural disaster prevention and response. On the other hand, state-level super-large-scale activities, sports events and so on make the task of emergency communication increasingly onerous. Whether for natural disasters or public incidents, emergency communication support has become increasingly important and urgent, raising the bar for the development of emergency communication services and networks.

(2) Current networks for emergency management in China

At present, the existing emergency communication network includes public communication networks, private networks, satellite networks, and so on.

1) Public communication networks: The existing public fixed telephone and mobile networks play an important role in emergency communication support, but find it difficult to meet all needs in emergency situations. For example, it is difficult to ensure call priority for voice communications amid the sharp increase in the number of calls during an emergency, resulting in network congestion. In the special circumstances of emergencies, it is difficult for public networks to guarantee that the need for efficient cluster scheduling capabilities will be met.

2) Private networks: Emergency communication has strict and special requirements. During a critical emergency response, when the public network cannot meet emergency communication requirements, emergency communication capability must be boosted through the private wireless communication network.

   The international community has reached a consensus that government emergency response command and dispatch communications should essentially rely on dedicated wireless systems. Currently, private wireless network technologies include:

   - analogue narrowband technology: analogue voice technology, providing only voice services;
   - digital narrowband technology: digital speech coding and channel coding can provide voice services and narrowband data services, but not real-time video or integrated data query services;
   - B-TrunC technology: LTE-based wireless broadband trunking technology can provide broadband data services such as voice services, real-time video and positioning;
   - in the long run, digital narrowband networks and wireless broadband B-TrunC networks will coexist and interconnect.

42 ITU-D SG2 Document SG2RGQ/183 from China

3) Satellite communication networks: Communication via radio waves from satellites to relay stations has the advantage that it is not damaged during natural disasters. Satellite systems such as Tiantong and BeiDou are currently used in emergency communications.

4) Ad hoc network technology: Although ad hoc networks do not have large-scale networking capabilities, they have unique mesh capabilities that can be used as a supplementary technology for emergency rescues in wilderness areas, temporary basements and high-rise egress routes.

In addition, although China's telecommunication network has matured, its coverage is still relatively limited. Many areas prone to natural disasters and emergencies, such as oceans, mountains and deserts, have not yet achieved ground network coverage. Therefore, other communication modes, such as satellite and private communication networks, also play a very important role in emergency communication and support.

(3) Analysis of key service requirements for future emergency communications

Future emergency communication services have the following key service requirements:

1) key voice: The business that the emergency communications must guarantee;

2) real-time video: Real-time video from cameras or through UAV transmission can show the scene in real time;

3) multimedia messaging: Transmission of drawings, maps, etc., of the scene, fire, etc.;

4) remote database access: To query emergency materials information, vehicle information, personnel information, plans and so on, remotely;

5) indoor and outdoor positioning and flow tracking: Realizing real-time situational awareness of personnel, vehicles and materials;

6) interconnection: Interconnection with broadband trunking, narrowband trunking and other networks.

In order to meet the above requirements, emergency communication networks must have broadband, security/isolation, an ad hoc network, priority guarantees, fast trunking communication capabilities, high reliability, portability, and unified dispatch and command characteristics.

(4) Research on the development of new emergency communication technologies

In the future, emergency communication systems will be comprehensive information systems integrating network technologies such as private networks, public mobile networks and satellite networks, able to unify dispatch and command, and to coordinate various departments to play an effective emergency role. Development support is moving in that direction, as described below.

- In order to meet the growing demand for mobile broadband for emergency personnel, advantage should be taken of mature LTE technology in public networks and user scale efficiency to reduce costs, encourage standard research and development of key LTE technology supporting tasks and promote support for LTE-based technology.

  1) Emergency communications can be delayed by damage to public infrastructure on the ground. In order to solve that problem, and to meet the need for large-capacity

critical mission communication support in the incident area, regional emergency communication systems based on low-altitude platforms positioned near the ground are being studied and developed.

2) In order to provide priority services for key tasks in the public network after the IP architecture network has been fully developed, standards and solutions are being studied and developed for emergency priority services in next-generation networks.

3) Emergency communication scenarios are being studied to take advantage of 5G broadband, low latency and high reliability.

The 5G standard is constantly improving. There are still many key technologies that need to be urgently improved with a view to ensuring reliable access to emergency communications at any time, anywhere: multimedia multicast broadcasting service, enhanced security capability, end-to-end network visualization, integrated emergency command and dispatch capability, and base station non-core network working mode in emergencies.

5G plays a very important role in promoting the development of emergency communication towards broadband and intelligence. The three main 5G application scenarios – enhanced mobile broadband, ultra-reliable and low-latency communications, and massive machine-type communications – meet most emergency communication business needs for large bandwidth, low latency and high reliability. They have the potential to enhance emergency communication rescue and comprehensive emergency support capabilities, with a view to achieving a new level of emergency management.

Research is currently being carried out on the potential demand for 5G, the relevant business model and the technical support required for its use in emergency response. Various characteristic 5G+ emergency applications have been deeply excavated and incubated, including 5G+ monitoring and early warning, 5G+ safety production, 5G+ fire prevention and 5G+ emergency dispatch. In addition, some operators have 5G-equipped emergency communication vehicles.

It is anticipated that private networks and 5G public networks will work together in the future to provide guaranteed communication services for emergency management. Combinations of public and private networks will result in three-dimensional guaranteed emergency communication networks featuring space-Earth integration and interoperability, and will adapt and match emergency guaranteed communication systems.

A1.2.4 The role of social media platforms (India)[43]

(1) Artificial intelligence for disaster response

The huge volumes of real-time information generated through crowdsourced data sharing can be used, with the help of AI-based data analytics, to predict important outcomes required for response and relief. AI is the simulation of human intelligence processes by machines, especially computer systems. The processes include learning (the acquisition of information and rules imbibed in the form of algorithms for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction. Several new and recent smartphones also have hardware optimized for AI. Machine learning is defined as the ability of machines to learn automatically by using AI. It involves the creation of algorithms that can modify themselves without human intervention or without being explicitly programmed to produce learning output. This is achieved by analysing structured data fed to a machine's algorithms. The learning process thus involves observing, processing and analysing data, and acting accordingly.

43 ITU-D SG2 Document 2/269 from India

The potential opportunities and benefits of machine learning and AI have been leveraged by the Artificial Intelligence for Disaster Response platform, which uses machine learning to analyse data on natural and man-made disasters collected from tweets in real time and automatically. It is accessible to all those involved in disaster response.

(2) Social media platforms and disaster management

Social media analysis is the process by which huge volumes of data, for the most part semi-structured or non-structured, are collected from social media sites and analysed. The process uses various machine-learning algorithms, such as decision trees, support vector machines, random forests, Naive Bayes classifiers, logistic regression and the Artificial Intelligence for Disaster Response platform. These algorithms analyse the data, generate outcomes therefrom and help visualize the outcomes precisely and as desired. The resulting information can be used for search-and-rescue operations and for post-disaster triage, relief and rehabilitation. Many AI and machine-learning tools focus on how social media updates provide incident indications and contribute to situational awareness.

(3) Utilization of social media platforms for managing disasters in India

Case 1: Kerala floods

The southern Indian state of Kerala was hit by the worst floods in a century on 16 August 2018, the result of unusually high rainfall during the monsoon season. All 14 of the state's districts were placed on red alert. Around one million people were evacuated, mainly from Chengannur, Pandanad Edanad, Aranmula, Kozhencherry, Ayiroor, Ranni, Pandalam, Kuttanad, Malappuram, Aluva, Chalakudy, Thrissur, Thiruvalla, Eraviperoor, Vallamkulam, North Paravur, Chellanam and Palakkad. The National Disaster Relief Force was deployed alongside the Indian Army and Navy to conduct intensive search-and-rescue operations. During the floods, thousands of people took to social media platforms via mobile phones to coordinate search, rescue and food distribution efforts, and to reach out to people who needed help.[44]The National Disaster Management Authority and the state government, for their part, used a CAP-based warning system to send alerts to mobile users. Social media were extensively used to provide information about those stranded in different parts of Kerala who needed access to relief.

As part of its coordinating efforts, the state government took to social media to share information about donations to the Chief Minister's Distress Relief Fund.[45] As the scope of the disaster became clear, it reached out to software engineers from around the world, asking them to join the state government-run Information Technology Cell to create a website. The website allowed volunteers who were helping with disaster relief in Kerala's many flood-affected districts to share the needs of stranded people so that the authorities could provide a timely response. The volunteers comforted the victims in emergency operation centres. People joined social media groups with hundreds of members who were coordinating rescue and relief efforts. They were able to reach people marooned at home and faced with medical emergencies. A team of volunteers called the Kerala Designers Collaborative compiled vital information in the form of infographics on anything from post-flood car maintenance (check for lizards and venomous snakes, and remove moisture content from the lights) to burying animal bodies to prevent the spread of disease. The infographics were very useful and were translated into five Indian languages.[46]

Similarly, a fraternity of mechanical engineering students at a government-run engineering college at Barton Hill in Kerala created a group called Inspire. The group built over 100 temporary power

[44] Nikita Mandhani. How Indians are using social media to help flood-hit Kerala. BBC.com. BBC News Delhi, 20 August 2018.

[45] Scroll.in. As Kerala battles flood, social media helps connect anxious relatives, coordinate relief efforts. 17 August 2018.

[46] Kamala Thiagarajan. How Social Media Came to the Rescue after Kerala's Floods. npr.org, 22 August 2018.

banks and distributed them among those unable to contact their families in flood-affected areas and relief camps. A power bank could boost a mobile phone's charge by 20 per cent in minutes – a critical feature for people without access to electricity. The authorities agreed to distribute the power banks, wrapping them in bubble wrap and airdropping them into areas where people were marooned. As the waters receded, ordinary citizens tweeted about where to go for free medical care and other services.[47] Charity organizations used their websites to collect donations for relief kits.

Case 2: Use of social media during the Chennai flood

Between October and December 2015, the southern Indian state of Tamil Nadu received 90 per cent more rainfall than during a normal monsoon season, because of El Niño. The state capital, Chennai, received more rainfall than at any other time in this century. The flood caused severe damages, made even worse by poor urban planning and drainage systems. An estimated 500 or more people were killed and 1.8 million displaced, with huge economic losses ranging in the thousands of millions of rupees. The Indian Army and Navy were deployed in the city for search-and-rescue operations, Chennai airport was closed and several other transport facilities in the city came to a standstill. During this testing time, people used social media extensively to connect to the outside world.[48]The calamity brought out thousands of helping hands. Chennai residents took to social media to offer their homes to strangers seeking shelter from the rain and floods. #ChennaiFloods and #ChennaiRainHelps were used by victims and volunteers alike to find/offer shelter, food, transport and even mobile phone recharges, share government helpline numbers, provide information on NGOs offering help, etc.

Case 3: Fighting drought with the help of the Internet of Things

A Hyderabad-based start-up has offered technology-based solutions in crucial sectors such as agriculture, water management, education and smart-city planning.[49] It has built a water resources information and management system for India's southern states. Its website enables the public to view information on rainfall, ground water, reservoirs – major, medium and minor – soil moisture, rivers and streams, irrigation canals and environmental factors like temperature, humidity, sunshine and wind speed. The technological solutions offered are powered by IoT devices such as automatic weather stations, ground water sensors, and reservoir and canal level sensors, backed up by satellite-based imagery and manual data. As a result, all data relevant to water are available on one platform and presented in real time for all the water-related assets of a large state, county, district or block. Information on water stress mitigation is also available. The AI-based system is being trained to learn and produce effective results. The application uses the same data to produce village water budgets on the basis of village water supply and demand. The water budgets make villagers aware of their water sources, impending water crises and water stress mitigation possibilities, helping to fight droughts.

Case 4: Using AI to enhance crop yield

The International Crop Research Institute for the Semi-Arid Tropics, a non-profit, non-political agricultural research organization for development in Asia and sub-Saharan Africa, has developed a sowing app that uses AI, cloud machine learning, satellite imagery and advanced analytics to help smallholder farmers increase their incomes through higher crop yields and greater price control.[50] The app helps farmers gauge the right time to sow their crops, using an AI-based study of climate data collected over 30 years in the Devanakonda area of Andhra Pradesh. The Moisture Adequacy Index (MAI) is the standardized measure used to assess whether rainfall and soil moisture will be adequate to meet the water requirement of crops. The real-time MAI is calculated from the daily

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47 Ibid.

48 Scroll.in. #ChennaiRainsHelp: How a flooded city is using Twitter to lend a hand to strangers. 2 December 2015.

49 See The Economic Times website

50 Microsoft. Microsoft Stories India. Digital Agriculture: Farmers in India are using AI to increase crop yields. Microsoft News Center, India, 7 November 2017.

rainfall recorded and reported by the Andhra Pradesh State Development Planning Society. The future MAI is calculated from weather forecasting models. Sowing advisories are issued accordingly; they indicate an optimal sowing date, the need for soil test-based fertilizer and farmyard manure, seed treatment, optimum sowing depth, etc. This AI-based sowing advisory leads to 30 per cent higher yields and helps farmers exercise better price control.

A1.2.5 Delivering communication services to disaster zones (China)[51]

(1) Integrating UAV and wireless communication technology

In recent decades, wireless communication migrated rapidly from voice-dominated 2G to data-dominated 3G and 4G. It is now entering the 5G era, which is characterized by the Internet of Everything. In the past, wireless signals mainly covered people and objects on the ground, without aerial coverage specifically designed for UAVs. Low-altitude digitization is therefore a treasure to be explored. UAVs have been partially networked in 4G networks.

Mobile networks continue to offer people greater choices in terms of means of communication and daily life; they also enable the digital transformation of all industries, improving operational efficiency and service quality. The brand-new 5G network architecture represents another leap in network performance, providing over 10 Gbit/s of bandwidth, millisecond latency and ultra-high density connection. ITU proposes three 5G scenarios: enhanced Mobile Broadband, ultra-reliable and low-latency communications, and massive machine-type communications. Compared with 4G networks, 5G networks are better able to meet the communication needs of most UAV application scenarios. Networked UAV will drive the application upgrade of multiple scenarios.

The integration of 5G cellular mobile technology and UAVs makes what was once inconceivable possible. To satisfy future needs for more automated and intelligent UAV applications, such as autonomous flight and flight in formation, greater demands will be made of mobile communication network capabilities.

(2) Demand analysis of UAV emergency scenarios

1) In the event of a natural disaster, UAVs can quickly put high-altitude base stations in place to restore communication functions (voice and data).

Traditionally, emergency communication vehicles are used temporarily to ensure communications when earthquakes, floods, mudslides and other natural disasters cause large-scale disruptions. However, such vehicles provide relatively limited service coverage and have weak signal stability, owing to limitations in technology, hardware and other factors; it may even be impossible to transport them to the central disaster area if roads collapse or are congested. This traditional way of setting up emergency communication stations and restoring base stations is therefore inefficient, costly, difficult and time-consuming. The maturity of UAV technology and its integration into emergency communication systems make it a new, faster and more convenient way for operators to restore communications in disaster areas.

2) During major sports events when traffic increases sharply, UAVs help ensure uninterrupted communication, build networks and provide aerial video footage.

(3) UAV emergency communication mode

1) Tethered UAV + high-altitude base station

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[51] ITU-D SG2 Document 2/277 from China

Tethered UAV systems are powered from the ground and raised to a UAV take-off platform by a tethering cable capable of uninterrupted flight. Once the UAV aerial base station is working, ground power-generating devices supply power to the tethered system and the onboard remote radio units. The onboard units communicate with the emergency communication vehicles via ground baseband unit devices using the fibre-optic line of the tethered system, and the emergency communication vehicles can connect to the nearby base station tower via microwave devices, optical fibre or satellite communication vehicles, and then relay the signal to the core network to achieve mobile signal coverage. The impact of terrain on the electromagnetic wave is thus effectively dealt with and continuous coverage guaranteed in a certain area.

UAV emergency high-altitude base stations can cover up to about 50 square kilometres and provide instant messaging service to thousands of mobile phone users simultaneously. Capable of climbing quickly to between 50 and 200 metres, they can provide 24-hour uninterrupted VoLTE and other data services to disaster areas.

In a natural disaster, tethered UAVs used in combination with aerial base stations can quickly restore onsite communications, address the problem of signal coverage in emergency situations and effectively improve the emergency communication support capability of the government and operators in response to natural disasters.

Tethered UAVs, which can stay in the air for long periods and carry large payloads, can be used in conjunction with high-altitude searchlights and loudspeakers to provide high-altitude illumination over large areas to support rescue operations at night. Loudspeakers facilitate command and coordination of people onsite, message broadcasting and other similar tasks, and improve the level of hardware support onsite. Using a mount-and-drop mechanism, UAVs can carry rescue items into areas too difficult and dangerous to access at short notice and with a heavy load.

The mobile phones of people trapped in an area covered by a UAV base station will be automatically connected to the onboard base station, which will send the user's international mobile subscriber identity number and current geographic information in graphical form to the search-and-rescue teams in real time.

This all-new emergency communication method aims to solve the problems of slow device deployment, high cost and poor environmental adaptability. It features quick response capabilities, is easy to operate, provides flexible coverage, can be airborne for long periods and is readily scalable.

2) Fixed-wing UAV + high-altitude base station

Large fixed-wing UAVs carrying mobile communication base stations and satellite communication systems, when flown to a target area, can provide stable continuous mobile signal coverage over a long period (not less than 24 hours) in an area of more than 30 square kilometres, thus restoring communications in no time and reducing loss of life and property in the disaster area.

A networked fixed-wing UAV equipped with an orthographic camera and a photoelectric pod can be used to obtain the GIS data needed for rapid data transmission and efficient generation of a three-dimensional map of an earthquake area, providing a basis for rescue decisions.

During single-soldier system drills, ground advance teams can report key rescue information, send back real-time video and images, and quickly dispatch rescue personnel and equipment based on the GIS data, effectively improving the timeliness and accuracy of emergency rescue operations.

(4) UAV emergency communication: next steps

Standard-setting is one of the challenges facing UAV emergency communications. China is developing technical requirements for the emergency communications of high-altitude base stations with tethered UAVs. In addition, since ordinary base stations provide mainly ground coverage, UAVs need special base stations for aerial coverage. 5G UAVs currently rely on the general 5G Customer Premises

Equipment used to convert 5G signals to Wi-Fi signals for communication; in the future, dedicated terminals and 5G communication modules will be needed to improve integration.

Meanwhile, China has issued successive series of regulations on UAV production, sales and flight. Regulations concerning the transaction process include the Regulations on the Management of Real-name Registration of Civil Unmanned Aircraft and the Interim Regulations on the Management of Unmanned Aircraft Flight (Draft for Comments). The difficulties related to flight plan applications, the complicated procedures involved and other issues are expected to be resolved following the establishment of a comprehensive UAV regulatory platform. In terms of corporate operations, the Management Measures for the Operational Flight Activities of Civilian Unmanned Aircraft (Interim) have greatly simplified the entry requirements for unmanned aircraft operating licenses, retaining only basic licensing requirements such as corporate legal persons, real-name registered unmanned aircraft, certified training capabilities (for enterprises in the training category) and ground third-party liability insurance.

A1.2.6 Locally Accessible Cloud System (Japan)[52]

(1) Background

Every year, the global community faces numerous disasters, including earthquakes, typhoons and floods. Such disasters often damage social infrastructure like telecommunication networks, electric power distribution networks and transportation systems, severely disrupting the lives of people.

When disasters occur, telecommunication networks may be damaged. Base stations for mobile communication services, access network cables, communication equipment and even communication buildings can be damaged in large-scale disasters. The damages cause outages of telecommunication services including not only fixed/mobile telephone services, but also Internet services and any other services delivered over the Internet. To address this issue, movable and deployable ICT resource units have been proposed and standardized. Their chief objective is to restore fixed/mobile telephone services. With the growing use of smartphones, people have come to rely heavily on Internet-based services for social networking, information searches and e-commerce. Restoring Internet-based services is becoming a key aspect in disaster situations.

The Japanese Government endorsed research and development projects on disaster-management technologies after the Great East Japan Earthquake in 2011. In one of the projects, the Cabinet Office's Strategic Innovation Programme conducted several disaster-management exercises involving movable and deployable ICT resource units (MDRUs); it aims to implement the results throughout society. MDRUs can provide telephone and file-exchange services using Wi-Fi and IP-PBX when telecommunication infrastructure is damaged. Similar to the MDRU, one of the Programme's solutions is the Locally Accessible Cloud System (LACS), which instantly provides Internet-based service in local disaster areas.

A LACS feasibility study carried out in the Philippines in December 2019 examined the use of LACS for e-education and e-health in island areas.

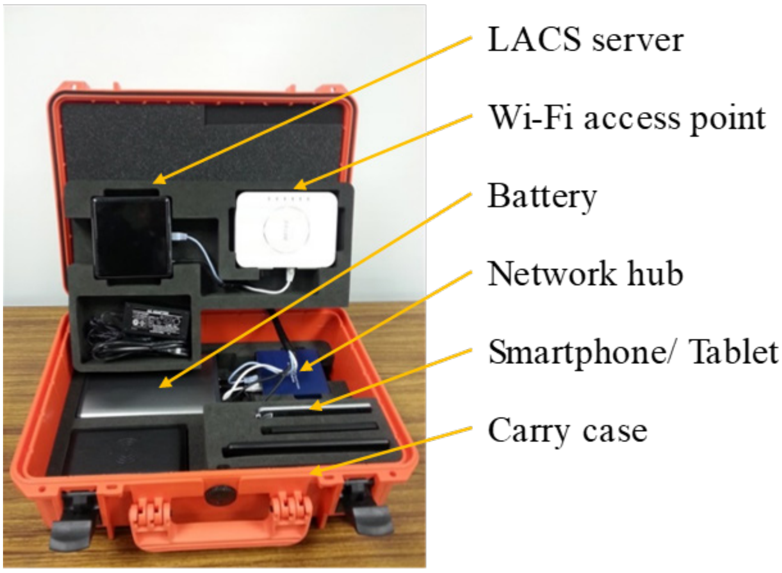
(2) Introducing the Locally Accessible Cloud System

The LACS comprises a Wi-Fi access point, a small PC server, a battery and other peripheral devices assembled in a portable carrying case (see **Figure 2A**) for easy transport to disaster-affected areas. The server acts as a web server and offers the basic communication functions required in disaster situations. The LACS offers basic communication functions, including information broadcasting, information sharing and bi-directional communication between users, although service delivery is restricted to small areas, namely, the area around the LACS. The LACS handles demands for local

[52] ITU-D SG2 Document 2/309 from Japan

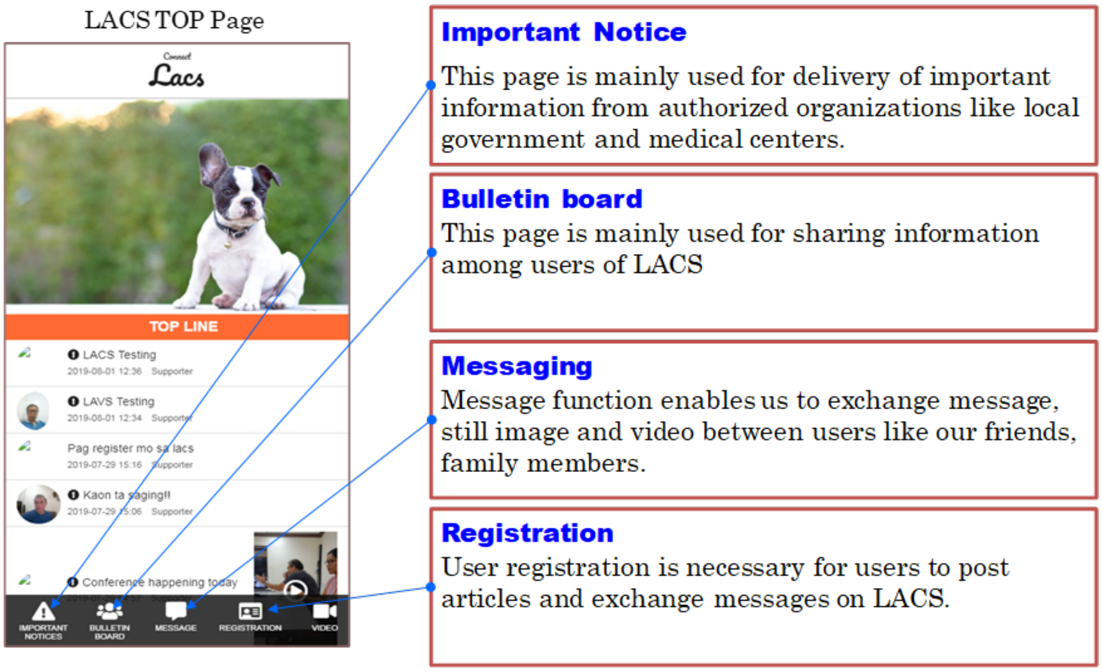
communications, which is generally where most demand is. Users access the service using a Wi-Fi-enabled network device like a smartphone to deliver and collect information and to communicate locally with people like family members, friends and neighbours. They can send and receive large-size content in the form of text, voice, videos and still images. The LACS is able to collaborate with other systems (e.g. Internet disaster-management systems) once its access to the Internet has been restored.

Figure 2A: LACS pilot product



Users can access the top page of the LACS server over the web browser, as shown in **Figure 3A**. By clicking on the icons at the bottom of the top page, they can access the functions the system offers. The pilot product offers three basic functions: the "Important notices" function delivers important information from authorized organizations like local governments and hospitals; the "Bulletin board" function enables users to share information; and the "Messaging" function enables them to exchange messages, still images and videos. "Registration" is a management function for user registration. Users who upload information via the important notice and/or bulletin board function or who use the messaging function are required to register so that they can be identified in the system.

Figure 3A: LACS basic functions



(3) Case study in the Philippines

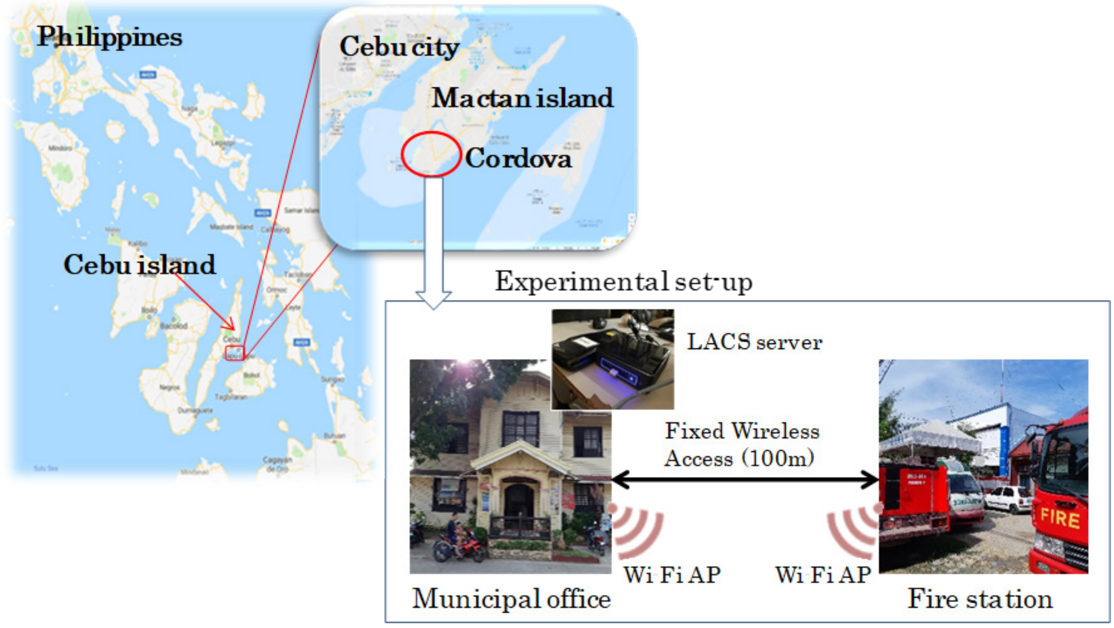
The LACS is not only an answer to communication difficulties in disaster situations; it can also be used in ordinary, non-disaster situations. Its anticipated users are disaster relief workers (including government, police and hospital staff), people in disaster areas and residents in developing countries. The LACS is expected to play an important role in developing countries with insufficient networking infrastructure.

In order to confirm the feasibility of the LACS concept, an experiment was conducted in the Philippines with the cooperation of Cordova municipality in Cebu, in the central Philippines. **Figure 4A** shows the location and setup. A LACS server and Wi-Fi access point equipment were installed in the Cordova municipal office to form a locally accessible cloud environment. The local area was extended to the fire station, located 100 metres from the municipal office, using point-to-point fixed wireless access equipment and a Wi-Fi access point installed in the fire station.

The experiment was conducted for both the residents of Barangay Poblacion, a part of Cordova municipality, and students of Cordova Public College. In the first experiment, to test LACS e-education possibilities, students used the LACS file-sharing function to download an educational video to their smartphones, then watched the video on their smartphones and uploaded their comments to the LACS bulletin board for their teacher. In the second experiment, a disaster simulation, residents of Barangay Poblacion were asked to use the LACS bulletin board to take pictures of supposed disaster areas and upload them to the LACS server, so that officials in municipal offices could confirm the status of disaster areas. To demonstrate the system's e-health possibilities, selected residents consulted medical professionals using the LACS video communication function.

The experiment's 32 participants were asked to evaluate the LACS. All the participants said that the LACS was useful during disasters and in ordinary times; 99 per cent found the LACS easy to use.

Figure 4A: Experimental set-up in Cordova, Cebu

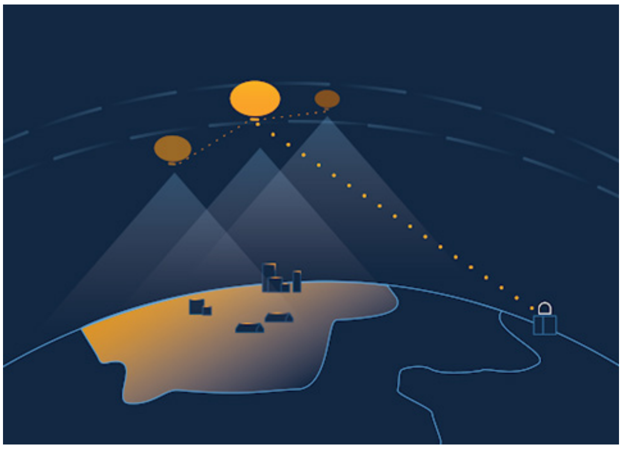


A1.2.7 Balloon-enabled preparedness and emergency telecommunication solutions (Loon LLC, United States)[53]

(1) Overview

Loon is a network of high-altitude balloons designed to deliver stratospheric Internet connectivity to unserved and underserved communities around the world (see **Figure 5A**). The network aims to connect people everywhere by inventing and integrating new and emerging technologies and concepts.

Figure 5A: Illustration of stratospheric Internet delivery



Each balloon carries a payload with an LTE base station connecting users to the network of the local mobile operator. With the advantage of height, one balloon can transmit service over an area 20 to 30 times greater than a traditional ground-based system. Unlike cell-on-wheels or satellite technologies, each balloon can connect directly to LTE/4G smartphones, including in remote and hard-to-serve

[53] ITU-D SG2 Document 2/327 from Loon LLC (United States)

areas (islands, mountains, jungles). The network (including mesh links between balloons) operates above the ground and is therefore weather resilient, with independent solar power for each balloon and minimal ground logistics. It can be deployed quickly if infrastructure and network integration are prepared ahead of a crisis and the vehicles are properly positioned.

The most effective communication system is one that can expediently provide basic Internet connectivity to the public and emergency response providers after natural disasters, and offer disaster preparedness service to mobile network operators to quickly reconnect people on the ground. Therefore, preparedness and related training activities are the most effective ways to be ready for disasters, whether natural or man-made.

It is imperative to work in close partnership with local aviation and telecommunication authorities, and to partner with local mobile network operators, to ensure integration with existing network equipment before disaster strikes. On regulatory matters, Loon LLC works with local partners to obtain all necessary approvals for spectrum use, aviation overflights and other operating requirements. With the local carrier partner, it pre-installs ground equipment in the country or region, prepositions fleet resources, and performs network integration and testing with the telecom partner.

(2) Disaster preparedness service description

Loon LLC has extensive experience of preparedness planning and recovery communication operations, and has developed a robust set of tools for non-disaster communications. In collaboration with local mobile network operators, regulators and other stakeholders, it offers a three-phase service: initial set-up and integration; ongoing "stand-by" operations; and emergency service activation.

Phase 1: Set-up

In the initial integration phase, Loon LLC works to:

- coordinate regional ground station certification with regulators;
- complete an assessment of installation, operation and maintenance considering geographic diversity;
- secure reliable, high-speed IP connectivity from ground station locations to the Loon-evolved packet core (EPC), in collaboration with local cable operators;
- integrate the balloon-based network and Loon EPC components with a local mobile operator, IP exchange provider, or Telecom Roaming Sponsor;
- to secure authorization for Loon-compatible LTE spectrum bands (e.g. Band 28) and for millimetre wave (mmWave) spectrum for backhaul and balloon-to-balloon links (E band, 71-76 GHz and 81-86 GHz);
- conduct end-to-end ground-to-balloon-to-LTE user testing;
- secure overflight approvals from local aviation authorities to operate the balloons over each country.

Phase 2: Stand-by

After integration, Loon LLC prepares the fleet and network for expedient emergency response by performing the following activities:

- monitor weather patterns, providing guidance for locations where telecom networks may be impacted by weather;
- pre-position a balloon fleet to expediently navigate to impacted areas, with expected time-to-destination 24/7 air traffic and radio coordination.

Phase 3: Service activation

In the event of an emergency, Loon LLC:

- makes reasonable best efforts to provide a balloon-based LTE radio access network for local operator subscribers at designated locations and times (this may be affected by the severity of the disaster, other location factors, weather and coordination with the local carrier partner);
- customizes each coverage area's network availability capacity by monitoring demand levels and areas of determined need;
- coordinates with carrier partners to provide network outage reporting as required or needed to regulatory agencies.

(3) Regulatory requirements to enable the stratospheric Internet

Meeting regulatory mandates is critical for successful deployment of stratospheric Internet for preparedness and emergency communications.

Equipment homologation: The ground station equipment is certified to national regulatory requirements before use. This includes equipment type approval, electromagnetic compatibility, safety and demonstrating that the equipment has met national radio spectrum requirements.

Streamlined import process: Ground stations, which are compact systems measuring 1.3 m across by 1.6 m high, connect the mmWave backhaul service to the LTE service. Typically, two ground stations are deployed to cover a service area, with options for both roof and tower mounting. The number of ground stations depends on the geography, the local carrier partner's network and the area needing to be covered.

Spectrum authorizations, for both mmWave and LTE: Two spectrum bands are used to enable Loon technology. The first is mmWave spectrum in the E band (71-76 GHz/81-86 GHz), which is used between the balloons and with the ground station, to provide backhaul service. The second is the local operator partner's LTE spectrum, to provide connectivity between the balloons and the user equipment.

Authorization to use the E band for backhaul is critical for providing the stratospheric Internet. The E band is a 71-76 GHz uplink paired with an 81-86 GHz downlink. A channel bandwidth of 750 MHz is used to ensure sufficient system capacity. Two frequency pairs are used per site, with centre frequencies of 71 500 MHz / 81 500 MHz and 74 000 MHz / 84 000 MHz. The backhaul service is integrated into the local carrier partner's network.

To transmit the LTE spectrum, the local carrier partner identifies spectrum bands between 700 and 900 MHz. Loon LLC ensures that its technology meets any national licensing requirements. It works with local agencies and does testing with the local carrier to ensure that there are no interference issues that could disrupt other services within the country.

Cross-border coordination: The technology can geofence areas to mitigate interference. The Loon carrier partner has also done previous work and achieved regulatory approvals to operate in an area under its licensing terms.

Other non-telecommunication regulatory considerations

- Overflight authorizations: The balloons require overflight authorization from the civil aviation authority of every country that they may fly over.
- Business registration: Loon LLC is not a direct customer-facing entity; the local mobile operator still represents the service and handles all billing and related customer-facing operations.

(4) Recommendations/lessons learned

The following recommendations should be considered to allow innovative solutions like stratospheric Internet to occur.

Consider an overall spectrum strategy, including mmWave and 5G applications

- Members States are encouraged to consider spectrum licensing in the larger context of technological developments and what applications they would like to enable. Loon LLC uses E-band spectrum for backhaul services because it has wide channels that enable long range, narrowly targeted communications between directional antennas. Member States have different ways of licensing E band, from licence exempt to self-coordinated and flexible licensing. In the United States, there is a "flexible licensing" scheme for the E band that allows for innovative uses of mmWave spectrum but nonetheless requires that users seek licensing from the Federal Communications Commission. That entails coordination across the Government and registering individual links in a third-party database. This transparency also allows for efficient and innovative use of the spectrum to spur competition in the industry.
- In countries like the United States, having a database of spectrum licence holders has enhanced understanding of the market potential and ways to use spectrum more efficiently. Member States should also consider ways to assess their spectrum assets and make spectrum holdings and usage transparent, to enable future thinking about how to use spectrum more efficiently, particularly as new technologies are developed and deployed.
- A complementary strategy to enable innovation is to consider how experimental licences would allow for proof-of-concept ideas to move to commercialization. In many cases, companies apply for an experimental licence to test technologies over the airwaves, but after the licence expires, there is no clear regulatory path for transitioning to a commercial licence.

Streamline homologation procedures and timeframes

- Support innovative technologies by developing streamlined national or regional processes to certify equipment that can be used to supply preparedness or emergency communication services. These requirements should be made publicly available, for example, on the regulator's website.

– In most cases, it might be possible to utilize the supplier's declaration of conformity to show that equipment meets a country's technical specifications. If a country does not allow such declarations, countries and regions should consider developing a common set of homologation requirements for emergency communication equipment, to facilitate speed and availability.

Streamline equipment import processes

Countries can support innovative technologies by making it easier for local providers to partner with companies like Loon to deliver services. While a country may have emergency procedures to allow the import of equipment to provide communications in times of disaster, the focus on preparedness means that equipment procedures should be predictable and timely.

Encourage cross-border coordination for innovative services

Serious consideration must be given to the ability to protect communication services from interference. Countries can encourage all carriers to coordinate in a timely and effective manner to effectively operate systems that serve communities in time of need. This may include network management opportunities like using facilities across borders, as long as this is compliant with related telecommunication regulations.

Partner with civil aviation authorities to approve overflight authorizations

In most countries, overflight authorization is approved by the national civil aviation authority. To ensure that aerial connectivity solutions are available during and after emergencies, telecommunication regulators should work collaboratively with civil aviation authorities in support of the necessary overflight authorizations.

A1.2.8 Ka + 4G model in emergency response and disaster relief (China)[54]

(1) Overview

In order to meet the requirements for the activation of 4G base stations at emergency disaster sites, satellite communication is usually used as the means of relay and backhaul for emergency base stations. However, because of transmission capacity and cost factors, traditional satellite communication can only provide satellite relay capability up to about 2 Mbit/s, and can therefore meet the application requirements of basic voice and low-speed data services only below 2Mbit/s; it is difficult to meet the requirements for relay and backhaul of 4G base stations.

The new-generation Ka high-throughput satellites (HTS) have technical features such as multi-spot beams, frequency reuse and high beam gains. Compared with a traditional communication satellite, Ka HTS have advantages in terms of capacity and unit bandwidth cost, which can help address the bottleneck created when traditional satellites are used for 4G base station backhaul.

Chinasat-16 is the first geostationary HTS in China. It has 26 spot beams and provides Ka frequency band HTS communication services, with a total system capacity of 20 Gbit/s. It provides the end users with an access speed of up to 150 Mbit/s in downlink and 12 Mbit/s in uplink, delivering satellite broadband Internet in the true sense.

China Telecom is actively conducting studies on the application of Ka HTS in the field of emergency communication to explore how to implement the Ka + 4G application model and improve the application capability of emergency satellite broadband services. It has also applied relevant study results to actual emergency communication guarantee tasks and achieved excellent results. Depending

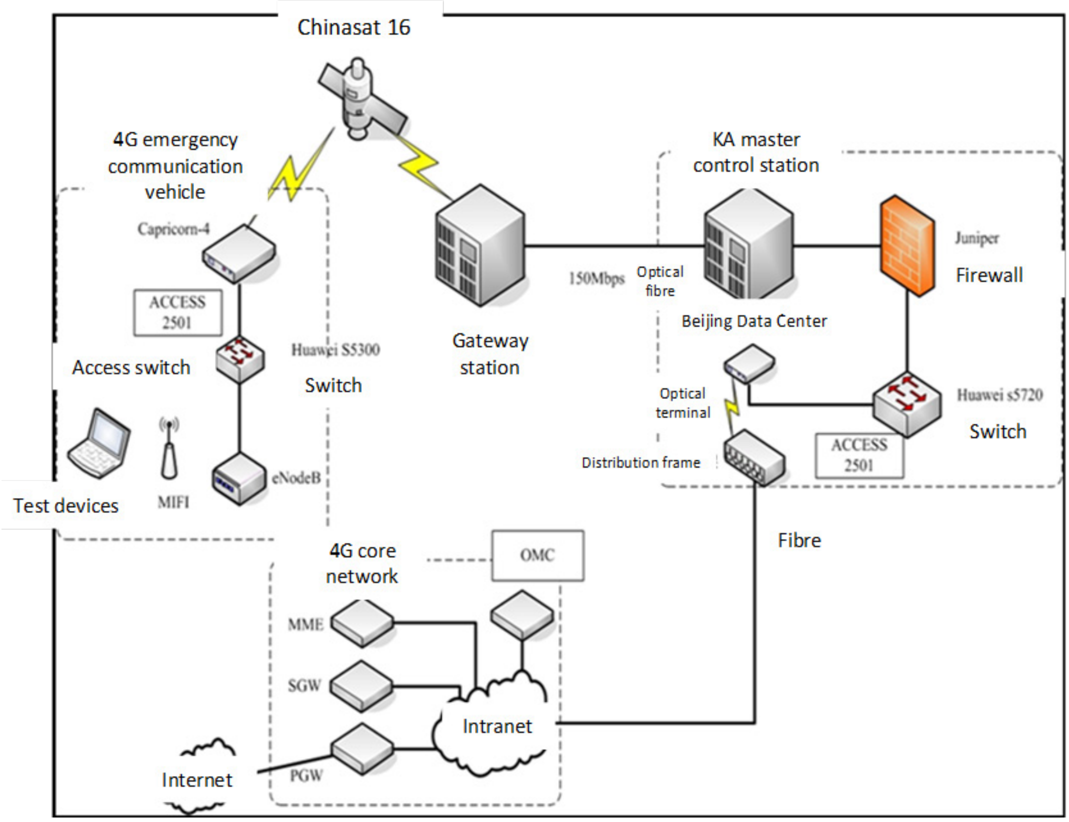
[54] ITU-D SG2 Document SG2RGQ/228 from China

on the characteristics and business requirements of different emergency scenarios, there are two different satellite backhaul models for 4G emergency base stations.

Two-layer private line model

The two-layer private line model connects the Ka HTS network to the bearer network on the ground; from there, the satellite network is connected to the mobile core network (see **Figure 6A**). As it extends the wide-area wireless coverage of the existing 4G network, this model can meet the access requirements of most base stations in the public network. It has the advantages of stable transmission quality and strong 4G service capability, and is therefore widely used in various emergency communication guarantee scenarios.

Figure 6A: Topology of a two-layer private line model



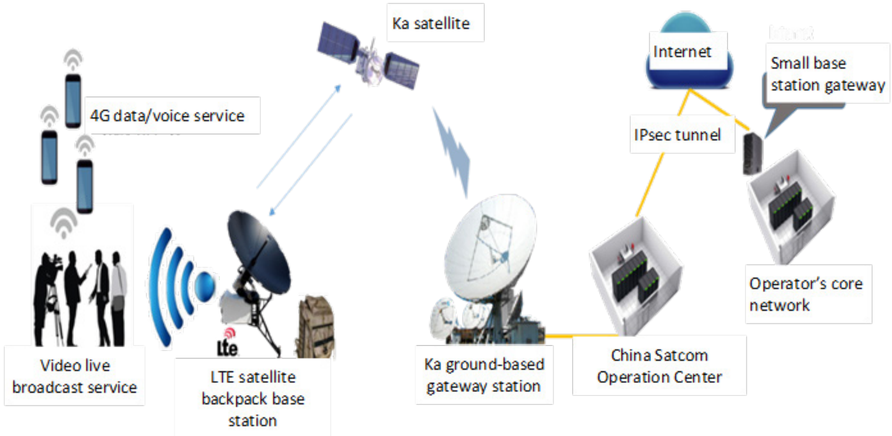
In order to be simultaneously activated in different regions within the same network architecture, different types of service need to be segregated and isolated. Two-layer services mainly rely on virtual local area network tagging and related IP addresses for service segregation and isolation.

Three-layer Internet model

The three-layer Internet model, which is based on the public Internet through a secure encrypted IPsec tunnel and a dedicated service gateway, connects the satellite communication to the bearer network on the ground; from there, satellite communication is connected to the mobile core network (See **Figure 7A**).

This model is mainly suitable for access by small base stations. It can quickly activate emergency base stations through public interconnection when there is a lack of private line transmission on the ground. It can provide various emergency broadband value-added services through innovative technologies such as multi-access edge computing and software-defined networking.

Figure 7A: Topology of a three-layer Internet model

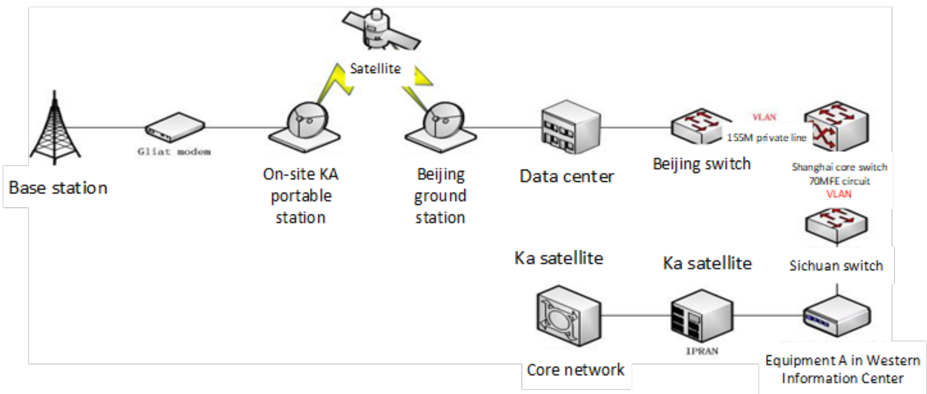


(2) Application promotion

Having completed its study of the innovative application of Ka HTS for emergency communication, China Telecom has gained a comprehensive and systematic understanding of the functional characteristics and business capabilities of HTS, and obtained a huge amount of first-hand test data, laying the technical foundation for the applications of Ka HTS in actual situations of emergency response and disaster relief. The technology has also been tested in an actual situation.

On 20 August 2019, torrential rainfall and heavy mudslides occurred in Wenchuan, Aba, and communications in many towns and villages in Wenchuan County were interrupted. At the disaster relief site, the mobile communication bureau of China Telecom in Sichuan activated the 4G backpack base station through the Ka portable station based on the two-layer private line model to guarantee 4G services for the staff in the emergency response command and control office. The overall system topology is shown in **Figure 8A**.

Figure 8A: Topology for the application of Ka + 4G when mudslides struck Wenchuan, Aba, on 20 August 2019



The onsite service testing data are shown in **Figure 9A**.

Figure 9A: Screenshot of service testing data of the 4G backpack base station

- Download rate: 57.2 Mbit/s (the Ka satellite station downlink speed limit is 60 Mbit/s)
- Upload rate: 4.28 Mbit/s (the Ka satellite station uplink speed limit is 10 Mbit/s)
- Latency: 700 ms
- Jitter: 11 ms
- Coverage distance: 200-300 metres
- Test environment: moderate to heavy rain, thick clouds, and a Ka satellite receive level of about 11 dB.

A1.2.9 Satellite connectivity for early warning (ESOA)[55]

Early warning is as much about satellite communications as it is about satellite imagery. Imagery is necessary but so is communication. Satellite communications play an important role because they enable real-time data for real-time action. Specifically, they provide solutions for areas where it is often difficult to send people and in response to large threats and risks, and they enable data delivery for an unlimited number of users, often using small, low-power, portable terminals.

Below are some examples that show how satellite plays an important role for early-warning systems and monitoring of earthquakes; tsunamis; floods; wildfires; and mining.

Fighting wildfires

The destructiveness of a fire can be devastating. Emergency workers may not have the manpower to manage a growing fire or must evacuate for safety reasons before a fire is out. The solution includes a mobile trailer containing hoses and sprinklers carried on a mobile platform that can be remote-controlled from a laptop or mobile phone relying on satellite/cellular terminals depending on the location and network coverage.[56]

Tailings dam monitoring

The mining industry increasingly stores often toxic or radioactive by-products in so-called 'tailings dams'. A failure of the dam can have disastrous consequences for the environment and so constant monitoring is essential. The solution collects data from sensors distributed along the dam which are then transferred across a satellite network to a single cloud dashboard. This enables mining

[55] ITU-D SG2 Document SG2RGQ/237 from the EMEA Satellite Operators Association (ESOA)

[56] W.A.S.P. Manufacturing Ltd. https://waspwildfire.com/

companies and other stakeholders to gain a comprehensive view of the status of their dams with detailed metrics such as pond elevation, piezometric pressures, inclinometer readings and weather conditions displayed in one place, no matter where the mine is located, minimizing environmental risks and achieving high levels of safety.[57]

Early flood warning

Water levels are on the rise in many places for various reasons, and require constant monitoring. The solution consists of several water-level monitoring sites with stream gauges connected to a satellite messaging terminal frequently powered by solar panels. Changes in water levels are transmitted via satellite to a central monitoring site. Since many of the monitoring stations are in mountains, canyons and other remote areas, satellite messaging terminals provide a cost-effective means to install a communication link where other services providing real-time data and guaranteeing data delivery are not available.[58]

Earthquake and tsunami detection

The increasing disasters in the world include earthquakes and tsunamis, and several solutions that rely on satellite communications are implemented in some parts of the world. These range from sensors along coastlines measuring minute changes in tides or currents, to broadband stations deployed across a territory measuring seismic movements, or deep-ocean tsunami detectors. The solutions rely on satellite to transmit real-time data for international coordination and early warning – often through WMO's Global Telecom System.[59],[60],[61]

Safety systems are often seen as a cost and only considered once a disaster has happened. Solutions to increase our preparedness for climate change and other disasters are available today.

A1.2.10 "SOCDA" chatbot system for disaster management (NICT, Japan)

(1) Background

Every year, the global community faces numerous disasters, including earthquakes, typhoons and floods. Such disasters often damage social infrastructure like telecommunication networks, electric power distribution networks and transportation systems, severely disrupting the lives of people.

SNS are known to be useful not only for individual communications but also for collecting information on damages for first responders. They have been used in recent floods caused by severe storms and heavy rains in Japan. However, it is also well known that SNS can cause confusion, because the information they are used to spread is not always true; it may be misleading or even fake. The NICT has been developing an SNS disaster information analysis system called DISAANA, which compiles useful disaster-related information from huge volumes of SNS data, and a disaster information summarizing system called D-SUMM. An overview of the systems was provided in an NICT contribution in 2018. DISAANA and D-SUMM retrieves both disaster-related and contradictory information. When disaster strikes, information can help save lives. The type of information sought by the victims varies widely, depending on their situations, so it needs to be collected from as many sources as possible. However, postings on SNS are currently voluntary, and this means that much important disaster-related information is not reported. SNS chatbots are a useful means of collecting disaster-related information effectively. When operated on smartphones/tablets, chatbots can reach many victims

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57 Inmarsat. Solutions and Services. Tailings insight: Award-winning tailings dam monitoring solutions, enabling smarter and faster decision-making, safer operations and enhanced regulatory compliance.

58 Skywave.com. Application Profile: satellite for Early Flood Warning.

59 Australian Government. Bureau of Meteorology. Deep Ocean Tsunami Detection Buoys.

60 Inmarsat. Solutions and Services. BGAN 2M.

61 Inmarsat. Solutions and Services. Connectivity you can rely on.

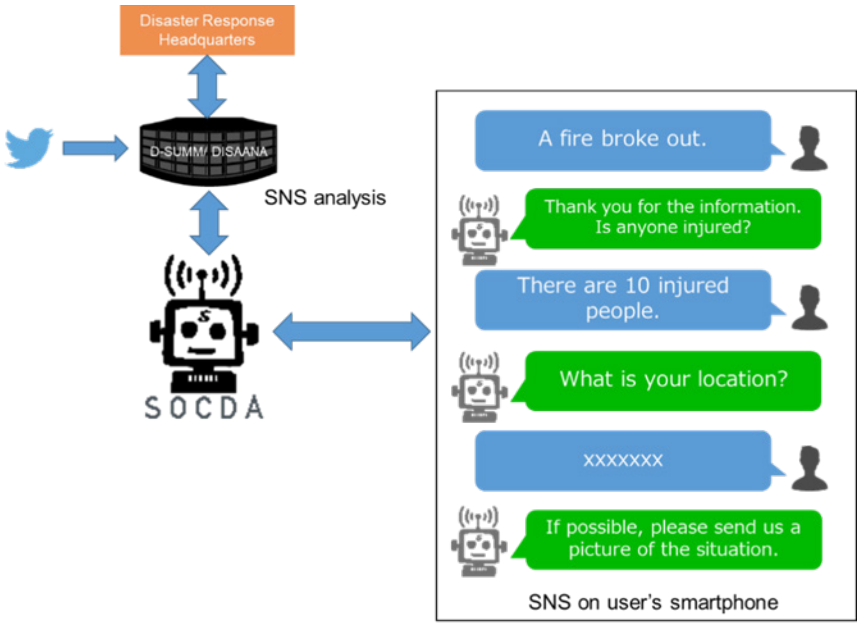
and facilitate two-way communication. They can survey and deliver disaster-related information proactively.

(2) Overview

As part of the Cabinet Office's Strategic Innovation Programme, a chatbot called SOCDA (SOCial dynamics observation and victims support Dialogue Agent platform for disaster management) has been jointly developed by the NICT and other organizations. Since the Programme aims to implement research results throughout society, feasibility studies employing SOCDA have been conducted involving several local governments in Japan. Expected users of SOCDA are the national government, local governments, first responders (including medical staff) and ordinary citizens in disaster-affected areas in both developed and developing countries. They have been involved in several emergency drills and exercises simulating a natural and/or pandemic situation.

SOCDA uses AI to collect disaster-related information via SNS. It aggregates the contents by applying DISAANA and D-SUMM technologies, plots them on a map and distributes the information needed for people's timely evacuation. Citizens and first responders can use SOCDA simply by "friending" it on SNS. **Figure 10A** shows an example of interactive information collection using SOCDA, which answers users automatically and collects information on their situation and damages.

Figure 10A: Interactive information collection by SOCDA



SOCDA has three main functions.

1) Disaster-related information-sharing function: When a disaster occurs, users can submit a wide variety of information via SNS after friending SOCDA's account.

2) Inquiry function: A huge inquiry operation can be automated thanks to FAQ written beforehand.

3) Evacuation support function: Appropriate evacuation support information is provided for individual users in the light of their attributes and location.

(3) Case study: safety confirmation training for people requiring evacuation support

In January 2020, the Council on Artificial Intelligence for Disaster Resilience conducted a demonstration of a new safety confirmation model, using the SNS app "LINE" to confirm that around 300 people in Itami, Hyogo prefecture, were safe. The demonstration aimed to confirm that SOCDA could be used by elderly and other people who needed evacuation support. This was the first safety confirmation project employing SNS for people requiring evacuation support, including elderly persons. The demonstration was based on the assumption that Itami had been hit by a heavy earthquake at 10 a.m. After the demonstration started, SOCDA sent safety confirmation messages to all participants, who answered questions such as "Please tell me where you are now" and "Is the health of the person requiring nursing care okay?" By 4 p.m., replies had been received from nine people in need of evacuation assistance and 32 people had heard from relatives.

The demonstration also aimed to collect disaster-related information, including reports on the disaster situation sent by city officials. The information was aggregated by SOCDA and used at the city disaster-response headquarters.

(4) Case study: training in disaster information sharing (heavy rainfall)

In June 2020, the Council on Artificial Intelligence for Disaster Resilience conducted a demonstration in Kurashiki, Okayama prefecture, where many people had been affected by heavy rainfall in June 2018. People had observed how difficult it was to know what was happening at the time of evacuation, so the purpose of the demonstration was to share information throughout the region.

The training involved local residents using an SNS account on a smartphone/tablet on which SOCDA had been installed. Information on rising water levels in the Takahashi and Oda rivers that could trigger floods was posted on SNS, mapped by SOCDA and sent throughout the region. The 398 participants, including local residents, posted about 270 reports. It was concluded that SOCDA is able to collect information over a wide area across multiple local governments.

(5) Case study: evacuation assistance during the COVID-19 pandemic

In a pandemic situation such as COVID-19, appropriate arrangements must be made to avoid the "Three Cs": closed spaces with poor ventilation; crowded places; and close contacts (e.g. close-range conversations at evacuation shelters). To make such arrangements, local governments need to have a full understanding of evacuation shelters, especially those where people gather voluntarily, or they will face serious difficulties.

The SOCDA AI chatbot system, which is in the research and development phase, will first provide information on such voluntary evacuation shelters and then distribute provisional information on COVID 19. SOCDA serves to visualize and analyse such situations in order to help protect people from the pandemic even in disaster evacuation shelters. Should the pandemic situation worsen, well-separated evacuation is required to avoid the "Three Cs". SOCDA can help both infected and non-infected victims by providing several types of useful information in a timely manner.

A1.2.11 Autonomous distributed ICT system (Japan)[62]

(1) Autonomous distributed ICT systems

In order to address the issues and needs facing local governments in the event of disasters, the use of an autonomous distributed ICT system should be considered as much as possible as a business system in the local governments. Such a system offers major benefits in an environment with limited telecommunications. It allows on-site workers to continue their business and share information between various remote departments and organizations, even when the telecommunication network is down. In addition, voice communication can be achieved by voice data exchanged via distributed servers.

[62] Document 2/401 from the National Institute of Information and Communications Technology (NICT) (Japan)

(2) Development of the "Die-Hard Network"

NICT Japan has developed the Die-Hard Network as an autonomous distributed ICT system with a store-carry-forward network supported by vehicles for disaster countermeasures. Parts of the study were supported by the Cross-ministerial Strategic Innovation Promotion (SIP) programme of the Council for Science, Technology and Innovation (CSTI) of Japan's Cabinet Office , entitled "Enhancement of national resilience against natural disasters" (Funding agency: National Research Institute for Earth Science and Disaster Resilience- NIED).

The Die-Hard Network consists of various communication systems and several edge servers, as shown in **Figure 11A**. In the event of telecommunication network outage in some areas, the system can transfer rescue and/or governmental information between distributed offices and headquarters through available networks, for example a low-power wide-area (LPWA) or satellite network, or a vehicle with an edge server as a part of store-carry-forward network. The vehicle-borne edge servers go around headquarters and distributed offices in telecommunication outage areas, and send and receive data to edge servers using device-to-device (D2D) communication technology and fast initial link setup (FILS) when the vehicle approaches a distributed area. Features of the Die-Hard Network are summarized below:

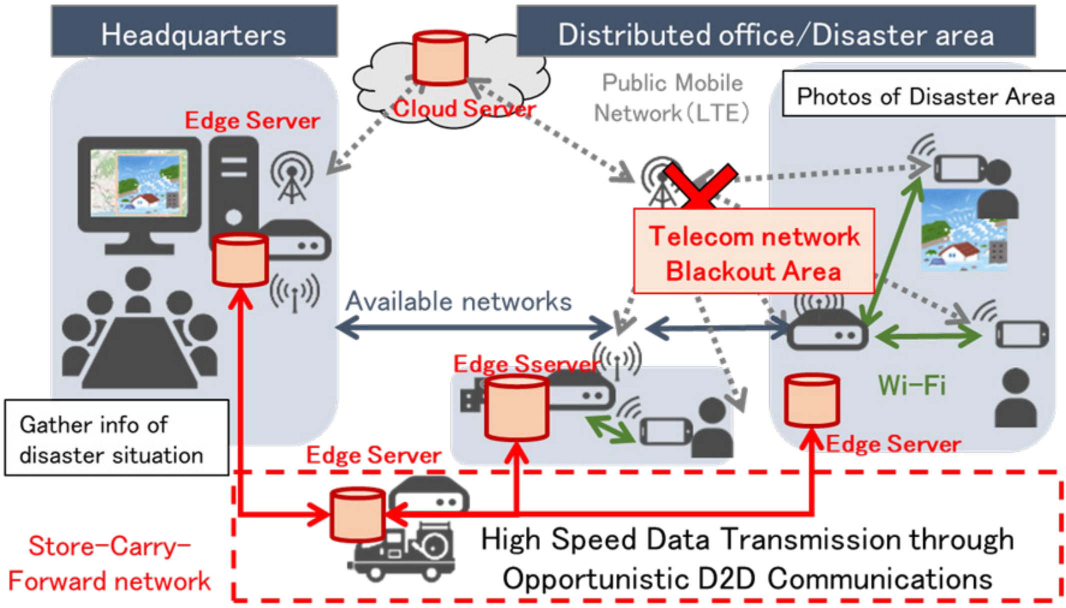
– Links between distributed on-premises systems: An autonomous distributed architecture does not have a node that centrally manages and controls the system; each node provides application services as on-premises. When a connection is detected, it is possible to automatically share information between remote locations by synchronously sharing data between the nodes.

– Utilization of heterogeneous communication systems: In the event that the fixed-line telecommunication network is down, various kinds of available transmission technologies should be exploited to connect the network. For example, cellphone network, Wi-Fi, LPWA, convenience radio and satellite should be used in an appropriate manner.

– Proactive use of mobile resources: By not assuming constant connection, D2D communication technology can be used just when a vehicle with the device installed approaches, and information can be stored and transported by actively utilizing the vehicle. This type of communication network is called "store-carry-forward network" or "delay/disruption-tolerant network".

– Authentication and access control in distributed environments: Even in the event of a disaster, officers of local governments have to process secure information such as personal data. Therefore, it is necessary to restrict the connection of each node to the distributed systems and access to data and information stored and managed, so that it is allowed only via the authenticated user and terminal.

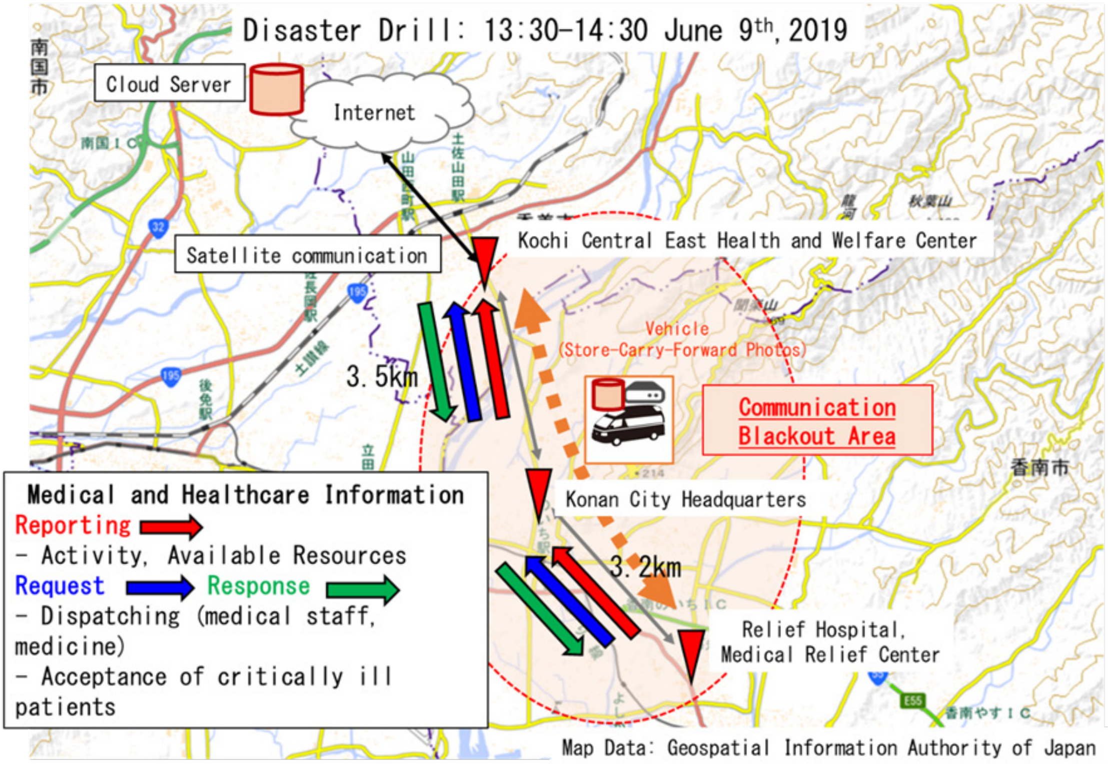
Figure 11A: Concept of Die-Hard Network



(3) Case study in Kochi prefecture in Japan

The Kochi Prefecture Comprehensive Disaster Prevention Drill was held on 9 June 2019. The nodes of the Die-Hard Network system were set up in the Kochi Central East Welfare Health Centre, the Konan City Headquarters, and the Relief Hospital and Medical Relief Centre (Akaoka Health Centre in Konan City). In this disaster medical training exercise, people were trained in information transmission using the system, such as the transmission of activity status reports from medical care centres, requests for dispatch of medical personnel and requests and consent for the acceptance of critically ill patients. An overview of the drill is shown in **Figure 12A**.

Figure 12A: Overview of disaster drills using Die-Hard Network



Assuming a Nankai Trough earthquake scenario in which public telecommunication networks were totally unavailable, the disaster drill was carried out using conventional means of information exchange, such as fax-based communication, involving filling out a paper form used in the prefecture and faxing it from the Medical Relief Centre to the City Headquarters, and from there to the Kochi Central East Welfare Health Centre. In parallel with this fax-based communication drill, a similar drill was carried out using the Die-Hard Network system.

With the latter system, when the report and the request were input at the Medical Relief Centre, the input text information was shared automatically and synchronously with the City Headquarters and the Prefecture Health and Welfare Centre by means of digital convenience radios.[63] At each site, the status information was automatically shared after approval processing. The drill was carried out according to the disaster drill scenario, with the system being used by city and prefecture employees.

Transmission of information that could not be accommodated in the format of the prefecture form, such as the condition of severe patients housed in medical relief centres and photos of triage tags, was also demonstrated by automatically synchronizing information through Wi-Fi via communication nodes mounted on moving vehicles. It was confirmed that the high-resolution photo data registered in the medical relief centre system were automatically synchronized to the vehicle through Wi-Fi. These data were automatically transferred from the system in medical relief centre to the server on the vehicle when the vehicle arrived at the centre's parking lot. As a result, it was confirmed that information sharing could be performed automatically by the Die-Hard Network, even in the case of large-capacity data that are difficult to transmit with the digital convenience radio during a public telecommunication blackout.

63 https://www.soumu.go.jp/main_content/000361388.pdf [in Japanese]

A1.3 Early-warning and alert systems

A1.3.1 CAP-based earthquake early-warning system in northern India (India)[64]

(1) Disaster-management framework in India

Due to its unique geo-climatic and socio-economic conditions, India is vulnerable in varying degrees to disasters such as floods, droughts, cyclones, tsunamis, earthquakes, landslides and forest fires. Of the country's 35 states and union territories, 27 are disaster prone. In addition, 58.6 per cent of the landmass is prone to earthquakes of moderate to very high intensity; 12 per cent is prone to floods and river erosion; of 7 516 km of coastline, 5 700 km are prone to cyclones and tsunamis; 68 per cent of arable land is vulnerable to drought; and hilly areas are at risk from landslides and avalanches. Fires, industrial accidents and other man-made disasters involving chemical, biological and radioactive materials are additional hazards that have underscored the need to strengthen mitigation, preparedness and response measures.

National Policy on Disaster Management

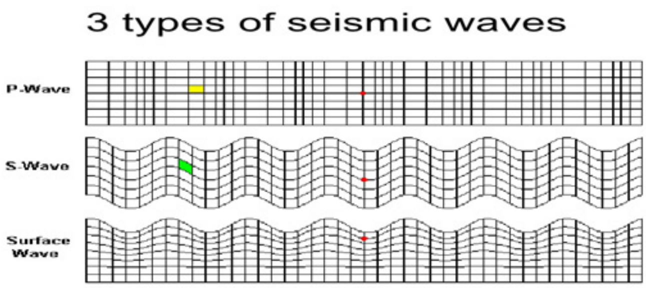
Pursuant to the Disaster Management Act, 2005, the National Policy on Disaster Management envisages a safe and disaster-resilient India that develops a holistic, proactive, multi-disaster-oriented and technology-driven strategy through a culture of prevention, mitigation, preparedness and response.

Earthquake Early-Warning system

Earthquakes produce vibrations – seismic waves – that travel in all directions and release huge amounts of energy. There are three types of wave (see **Figure 13A**):

- P waves compress and expand the ground like an accordion, travel through solids and liquids, and are fast moving and longitudinal;
- S waves vibrate from side-to-side as well as up and down, travel through solids only, and are slow moving and transversal;
- Surface waves move up and down like ocean waves; they are the slowest-travelling waves, with movement greatest at the Earth's surface and weakest beneath the surface.

Figure 13A: Types of seismic wave



During an earthquake, seismic waves radiate out from the epicentre. It is these waves that make the Earth shake and cause damage to structures. The technology exists to detect moderate to large earthquakes so quickly that a warning can be sent to locations outside the area where the earthquake begins before these destructive waves arrive. Data from a single station or from a network of stations form the basis of earthquake early warning. In a "single station" warning system, data are not sent to

64 ITU-D SG2 Document 2/36 from India

a central processing site. The single station alert is more prone to false alarms. The accuracy of early warnings can be enhanced by using a combination of alerts from single stations and a regional seismic network. The CISN Shake Alert demonstration system, for example, combines onsite and regional alerts for moderate to serious earthquakes. The future of earthquake early-warning systems may be in smartphones and vehicles, "smart" appliances and the increasing number of everyday objects embedded with sensors and communication chips that connect them to a global network.

Single-station approach: A single sensor located at the site to be protected detects the arrival of the P wave and sends out a warning before the arrival of the S wave. This method is simple, but is less accurate; it gives rise to false alerts and provides less warning time.

Network approach: Many seismic sensors distributed over a wide area where earthquakes are likely to occur are networked. A central site receives the data from these sensors, analyses ground motion signals, detects earthquakes and issues suitable warnings. The system maintains a higher level of readiness all the time and is more accurate in predicting quakes. Earthquake early warnings are most effective when the earthquake begins on a fault far from the current location and the rupture propagates towards that location. Earthquake early-warning messages are sent quickly to all members of the public with the help of every available ICT and IoT technology. The public is periodically sent messages and tutorials on how to understand and respond to alerts.

Earthquake early-warning alerts warn people to take protective action and trigger automatic responses in places like factories, dams and transit systems. They operate in means of transport, utilities, offices, industrial sites, medical facilities, restaurants, schools, cars and trucks, and during emergencies.

CAP-based earthquake early-warning system

ITU-T X.1303 Common alerting protocol establishes a common standard-oriented platform instead of a separate public warning system for each particular type of emergency and for each particular communication medium. The CAP is an XML-based data format for exchanging public warnings and emergencies between alerting technologies. It allows a warning message to be consistently disseminated simultaneously over many warning systems to many applications. It increases warning effectiveness and simplifies warning tasks. Standardized alerts can be received from many sources and configured for applications to process and respond as desired. By normalizing alert data across threats, jurisdictions and warning systems, the CAP can also be used to detect trends and patterns in warning activities or hostile acts. From a procedural perspective, the CAP reinforces a research-based template for effective warning message content and structure.

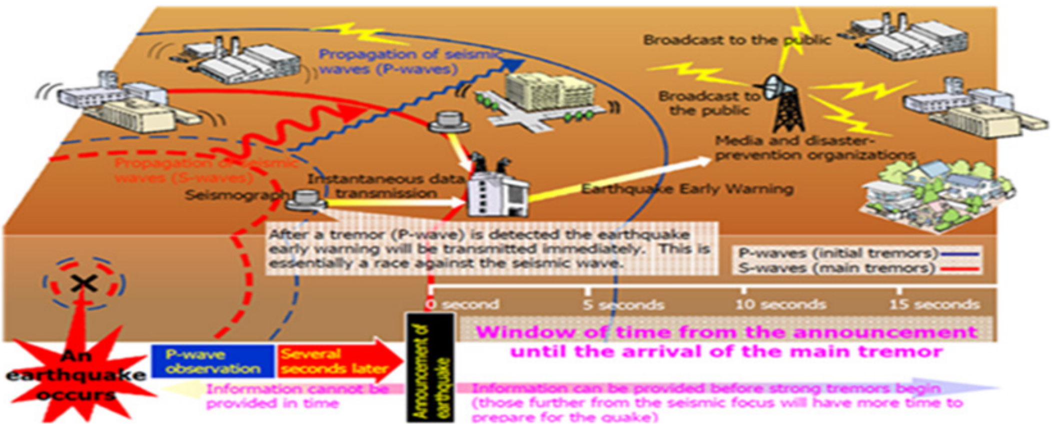
The CAP data structure is backward-compatible with existing alert formats, including Specific Area Message Encoding (the protocol used to encode the Emergency Alert System and NOAA Weather Radio, Wireless Emergency Alerts, etc.), while adding capabilities such as the following:

– flexible geographic targeting by using latitude/longitude "boxes" and other geospatial representations in three dimensions;
– multilingual and multi-audience messaging;
– phased and delayed effective times and expirations;
– enhanced message update and cancellation features;
– template support for framing complete and effective warning messages;
– digital encryption and signature capability; and,
– facility for digital images, audio and video.

Central and state government agencies can all receive information in the same format for the same type of application and then sound different alarms based on the information received. The CAP also detects trends and patterns in warning activity, such as might indicate an undetected hazard or hostile act. International organizations such as UNDP, ITU and WMO are urging nations to implement the CAP as an essential communications formatting step for emergency early warnings.

The main components of earthquake early-warning systems are velocity of electromagnetic waves >>> velocity of seismic waves (seismograph), propagation of seismic waves (S waves), propagation of seismic waves (P waves), instantaneous data transmission, e-warning-broadcast to the public (see **Figure 14A**).

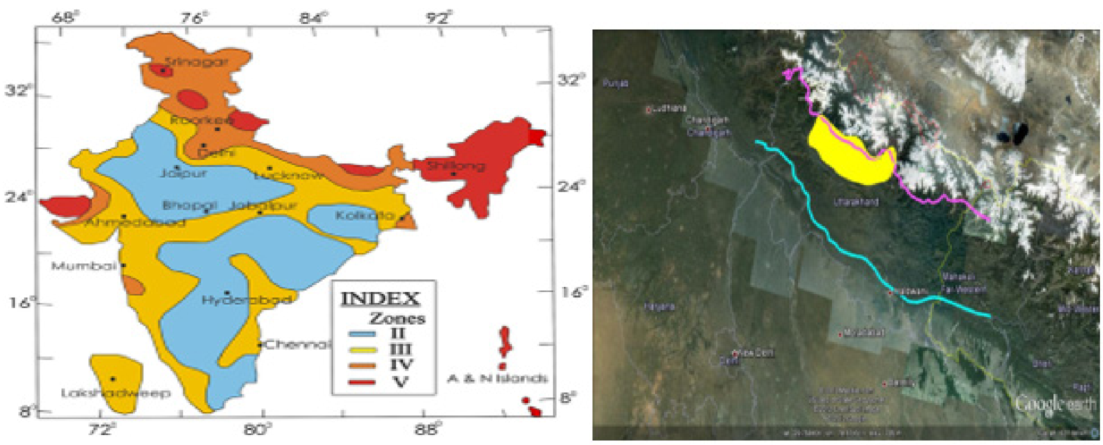
Figure 14A: Earthquake early-warning systems



Earthquake early warning in northern India

Major earthquakes originating in the central Himalayas, a prominent "seismic gap", frequently rock Indian cities (including New Delhi) and industrial hubs with high population densities located 100 to 300 km from the epicentre, with a lead time of 25 to 80 seconds. This makes an earthquake early-warning system very useful. More than 100 sensors (see **Figure 15A**) have been deployed in the Himalayas to detect and locate seismic events potentially affecting the cities of northern India, estimate their magnitude and issue alert notifications.

Figure 15A: Earthquake early warning in northern India



Components of the CAP-based earthquake early-warning system

- Information sharing by alerting agencies such as the Indian Metrological Department, the Geological Survey of India, the Central Water Commission, the Ministry of Home Affairs and the Indian National Centre for Ocean Information: Information in the same format can be received by all central and state government agencies, which can sound different alarms based on the information received.

- Alert-forwarding media agencies (see **Figure 16A**) include telecom operators, All India and other radio stations, Doordarshan and other television broadcasting agencies, the National Highway Authority of India for road displays, the Internet and other related organizations. People need to receive alerts of earthquakes, cyclones and heavy rainfall in advance.

Figure 16A: Common alerting media agencies

- The earthquake early-warning system has a management platform (see **Figure 17A** and **Figure 18A**) for collecting CAP-compliant input messages in XML/JSON format sent via web portals/mobile apps/SMS in standard message format by alerting agencies; processing SMS/e-mail notifications sent to the first-level alert-generating authority (i.e. the National Disaster Management Authority); storing (BTS data are stored); transmission; and control (for state/regional warning-issuing authorities). It also has a feedback evaluation system.

Figure 17A: Earthquake early-warning management platform

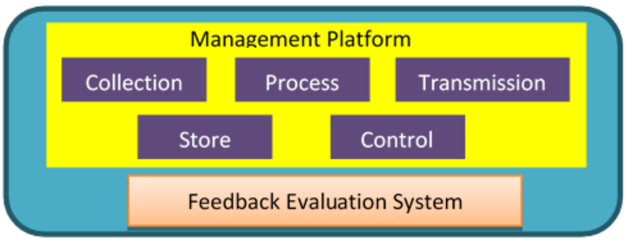
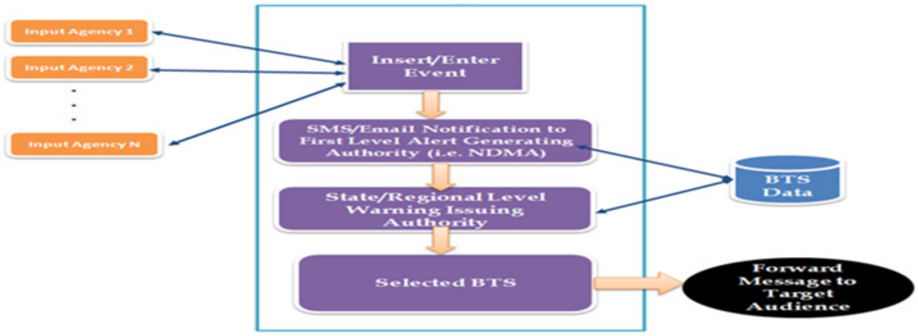
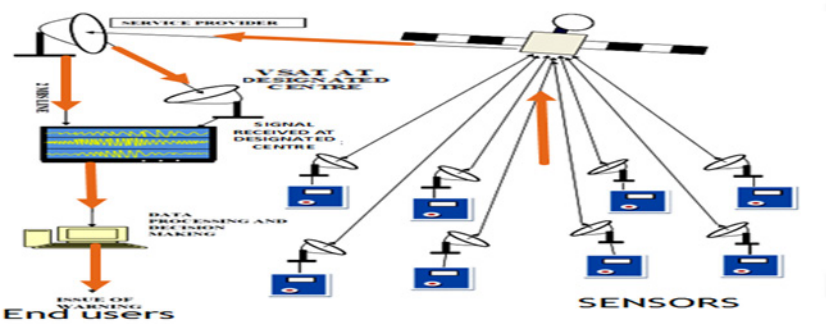


Figure 18A: Management platform



In terms of information flow (see **Figure 19A**), the Static Disaster Management Software Platform framework has been incorporated into the national network and plans are to integrate it with the National Disaster Management Authority. Disaster areas are identified using geofencing. Manual alarms are pushed using a two-tier approach to nationwide telecom networks able to send SMS automatically to marked areas.

Figure 19A: Common alerting system – Flow of information*



* The arrows indicate the direction of sensor signals received at the designated centre, data processing and issue of warnings to end users.

A1.3.2 Implementing a CAP trial (India)[65]

(1) CAP and its use in early-warning systems

ITU-T X.1303 Common alerting protocol establishes a common standard-oriented platform instead of a separate public warning system for each particular type of emergency and for each particular communication medium.

Trials of CAP use in early-warning systems are constantly being carried out in India. ITU-T X.1303 provides a detailed description of CAP features, as summarized below:

– the CAP allows a warning message to be consistently disseminated simultaneously over many warning systems;

– standardized alerts can be received from many sources and configured for applications to process and respond as desired;

– flexible geographic targeting using latitude/longitude boxes, polygons or circles and other geospatial representations in three dimensions;

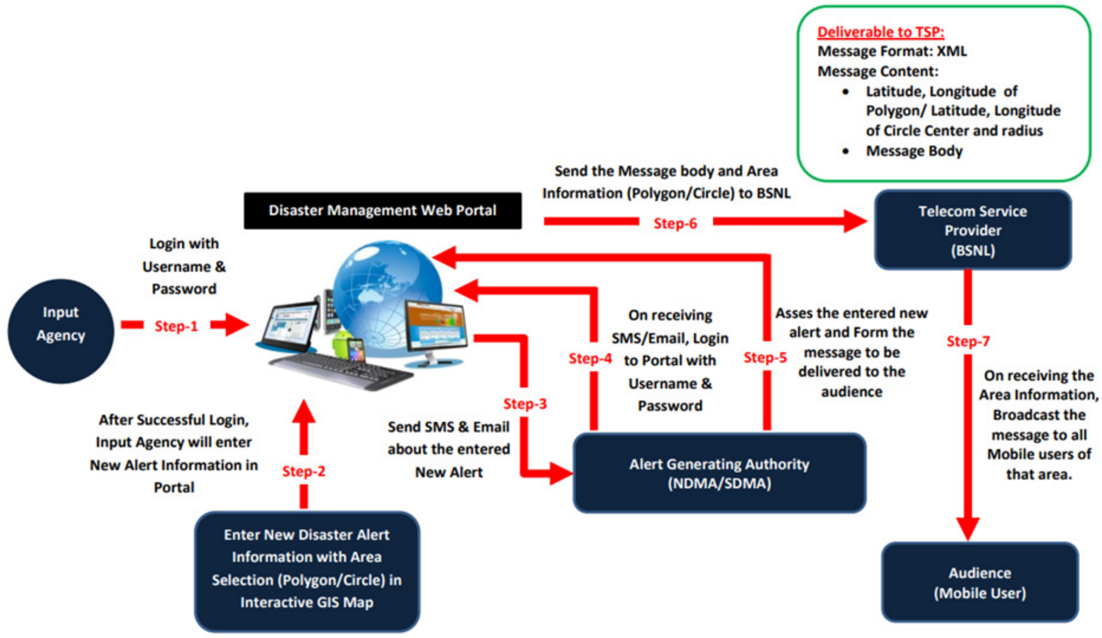
– facility for digital images, audios and videos.

International organizations such as UNDP, ITU and WMO are urging nations to implement the CAP as an essential communications formatting step for emergency early warnings.

(2) Recent trial run of CAP implementation carried out in India

Figure 20A depicts the workflow of a CAP trial carried out in different Indian states.

Figure 20A: CAP trial workflow



The CAP trials are run through the portal developed by the Centre for Development of Telematics (C-DoT), a government-owned telecommunication research and development centre.

[65] ITU-D SG2 Document SG2RGQ/77 from India

Access to the portal has been given to alerting agencies, the National Disaster Management Authority, the state disaster management authorities of different states in India, State Governments and the Department of Telecommunications. The portal is presently connected to telecommunication service providers through the Internet or multiprotocol label switching virtual private networks, so that alerts can be passed on to telecom service users. Customers are identified through the call detail records (last six hours) or network visitor location register and the warning SMS are sent to them. The SMS are also sent by cell broadcast from the base stations lying in the polygons identified.

The CAP trial runs are summarized in **Table 1A**.

Table 1A: CAP trial runs

Date	Area selected	Number of recipients
7 June 2018	Small area of Marina Beach Chennai	5 181
8 June 2018	Nungembakkam, Chennai	2 768
8 June 2018	Idduki, Kerala	883
13 June 2018	Vijaywada, Andhra Pradesh	4 125
13 June 2018	Begumpet Airport, Hyderabad	3 796
14 June 2018	Dehradun, Uttarakhand	1 386
18 June 2018	Civil Secretariat Srinagar and Amarnath Yatra Route	1 001
20 June 2018	Secretariat, Dispur, Assam	2 295
29 June 2018	Bhopal, Madhya Pradesh	4 474
3 July 2018	Guwahati, Assam	7 252
25 July 2018	Dharamshala, Nahan, Reckon Peo, Chota Shimla, Himachal Pradesh	56 772

The telecom service providers involved in the trial runs were BSNL, Airtel and Reliance Jio.

The agencies involved in the trial runs were the National Disaster Management Authority; the state disaster management authorities of Tamil Nadu, Kerala, Andhra Pradesh, Uttarakhand, Jammu and Kashmir, Assam, Madhya Pradesh and Himachal Pradesh; the India Meteorological Department; State Governments; the Department of Telecommunications; and C-DoT.

During Amarnath Yatra, a total of 200 399 SMS were sent in respect of six different events between 28 June 2018 and 25 July 2018 to customers of BSNL and Reliance Jio through the C-DoT CAP early-warning platform. The SMS contained information about weather conditions so that pilgrims and government authorities could take timely precautionary action. They were also delivered to all Airtel customers using cell broadcast.

(3) Conclusion: experience gained and way forward

The trial run was initially conducted in experimental conditions and later in real conditions. The following observations were made:

– during the actual run of the CAP early-warning system, authorities, agencies and pilgrims responded well, suggesting that the system should be regularly deployed in the future;

- it took considerably longer to send SMS from mobile networks using 2G/3G (20 to 60 minutes) than from 4G networks (3 to 5 minutes);
- efforts are being made to optimize the response times, especially in 2G (which predominates in rural areas) (3G is gradually being replaced by 4G);
- smartphones club message parts if the message size exceeds the prescribed limit; normal phones do not have this facility, and efforts are being made to overcome the issue;
- the trial runs used messages in English only; efforts are being made to introduce vernacular languages for better and effective outreach.

A1.3.3 ICT disaster preparedness (China Telecom, China)[66]

(1) Disaster preparedness

There are many aspects to disaster preparedness.

- Publishing early-warning information: The ability and means to publish disaster warning information must be organized before a disaster occurs. Warnings of imminent danger should reach every customer in the designated area within 10 minutes.
- Making suggestions on the LTE SMS cell broadcasting network, terminal support and deployment, researching the specifications and requirements already in place and deployed on both the network and terminal sides of LTE SMS medium and small cell broadcasting, and putting forward relevant requirements in network planning and construction; sending early-warning information to users through various just-in-time mobile Internet means of communication (such as WeChat) (operator networks interconnected with just-in-time mobile Internet communication systems send early-warning information promptly).
- Carrying out multiple optical cable route deployments, formulating plans to transform the optical fibre cable lines on single routes or vulnerable routes in the light of the damages sustained in recent years. Employing optical fibre cable fast recovery technology such as erbium-doped fibre amplifiers in emergency communication repairs.
- Satellite transmission: scenarios and recommendations regarding the use of Ka high throughput satellites, Ku and C band satellites, various middle and low orbit satellites in emergency communications; using Ka high throughput broadband satellites to provide 4G services to mobile emergency communication vehicles, islands and remote base stations, and engaging in research on the use of Ku and C band satellites for high-definition video transmission and low orbit satellites for satellite IoT.
- Miniaturization and portability of VSAT devices, and scenarios and suggestions for their application in emergency communications: keeping track of the development of miniaturized and portable VSAT devices in various frequency bands and making it possible for a single person to carry the devices on foot to the disaster areas to open up services.

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[66] ITU-D SG2 Document 2/56(Rev.1) from the China Telecommunications Corporation (China Telecom) (China)

- The application scenarios and recommendations regarding short wave transmission in emergency communications: studying the application of short wave in emergency communications on account of its long transmission distance and strong damage-resistant characteristics.

- Deployment and testing of 4G/5G in emergency communication vehicles: researching the deployment of 4G equipment and the application of some 5G technologies in emergency communication vehicles. The application of spherical antennas and various new types of antenna in emergency communications has resulted in a multifold increase in capacity or directional transmission distance. Research has also been conducted on emergency communication vehicle-supported IoT applications, namely deploying narrowband-IOT equipment in emergency communication vehicles to support IoT applications.

- Studying the use of various satellite telephones and the application of satellite telephone positioning, data and SMS in emergency communications: The positioning information return, data service and SMS functions of satellite telephony are used to position and rescue people and vehicles in distress beyond mobile signal coverage.

- Researching UAV-borne base stations and the results of application scenario study, testing and field operation of tethered UAVs, wingspan UAVs, airships, helicopter-borne LTE base stations and other equipment in emergency communications: research on providing 4G services with the LTE base stations on board tethered UAVs used wireless ad hoc network devices (mesh) carried by tethered UAVs to examine how to apply the transmission relay to provide fixed and vehicle-borne base station services that are able to recover damaged transmissions and promptly access current networks to deliver 4G services during a disaster. The LTE base station satellite transmission or microwave equipment on board stratospheric airships is able to connect with current networks to offer 4G services to remote areas.

- Researching the use of mesh technology to rapidly re-establish network connections damaged by the disaster and the joint employment of mesh and UAV to commence 4G services: Wireless ad hoc network (mesh) devices serve to quickly open up the last 10 kilometres.

- Studying the specifications of the emergency command and dispatch system based on Internet+ emergency communication, with the system applied in vehicle positioning, disaster warning, resource scheduling, command and dispatch, task management and so on: The emergency vehicle location and tracking function, by providing information on real-time vehicle location, monitoring and control, vehicle status, etc., mobilizes vehicles and personnel in the vicinity to participate in disaster relief efforts as required. The system is able to display specific information on wind, rain, haze and other weather disasters, and on typhoons and earthquakes, collected from professional Internet websites at high frequencies, on the GIS map at different levels, facilitating the deployment of advance personnel with targeted early-warning information to the areas concerned. The emergency task command has put in place flat, streamlined and close-looped process monitoring to keep track of task execution. With the implementation of vehicle/personnel location and tracking, and the adoption of command and dispatch visualization, the system takes overall responsibility for managing emergency personnel, vehicles, equipment/supplies, spare parts, circuits, satellite bandwidth, and so on, thus achieving intensive emergency resource management and optimization of resource allocation, dynamic tracking of resource distribution, a fully controlled and visualized resource allocation process and whole-process management of equipment and other resources.

- Conducting research on sending the disaster scene video back to the command centre or accessing the video via Internet: By way of satellite, 4G and other means, the video of the disaster site is returned to the command centre or accessed through online terminals, personal computers, mobile phones, and so on. Examination and analysis of the quality of video service transmitted by satellite has resulted in indications of the time delay and jitter of image transmission.

- The storage and allocation of emergency supplies such as generators: keeping in reserve all kinds of fuel generator, such as 5 kW light generators, 10-12 kW generators, 30-50 kW generator vehicles, and 100-500 kW large generator vehicles for different application scenarios.

- Drills organized on the basis of real emergency situations: Based on real and simulated emergency scenarios, drills have been conducted of rapid relief team assembly and dispatch at short notice. The teams provided all kinds of emergency services in designated areas, building a well-trained and skillful corps of relief personnel.

- Training: Establishing training requirements for emergency response personnel and developing graded training content and materials.

- Studying the emergency plan preparation; formulating emergency plans in response to various disaster scenarios, defining the types and focus of the plans and conducting drills accordingly; testing the contingency plans for the command system, circuit scheduling, line repairs, emergency power supply, service launch on board emergency communication vehicles, etc., in the wake of disasters such as earthquakes, typhoons, floods and mudslides in totally cut-off areas.

(2) Disaster mitigation

Disaster mitigation also has a number of different aspects.

- Mitigation of floods: Moving low-lying machine rooms to higher ground, elevating generators and other equipment, adopting protective measures for outdoor equipment before rainstorms.

- Typhoons: Delivering generators and other emergency materials and equipment in advance to disaster areas.

- Building a robust disaster fighting network based on the disaster damage data collected over the years.

(3) Response

Disaster response also comprises a number of different aspects.

- The process of making use of the mobile phone positioning function to rescue trapped people; selectively calling and positioning mobile users in disaster areas; sending the relevant information to the rescue team to facilitate relief efforts.
- Conducting big-data analyses through mobile network-related network management and based on customer information (i.e. of damage location, number of victims and/or damage/impact/repairs), and informing the relevant government agencies of the results for use in disaster relief command.
- Following the emergency plan to rapidly restore communication services in disaster-stricken areas.

A1.3.4 Implementation of emergency alerts (Brazil)[67]

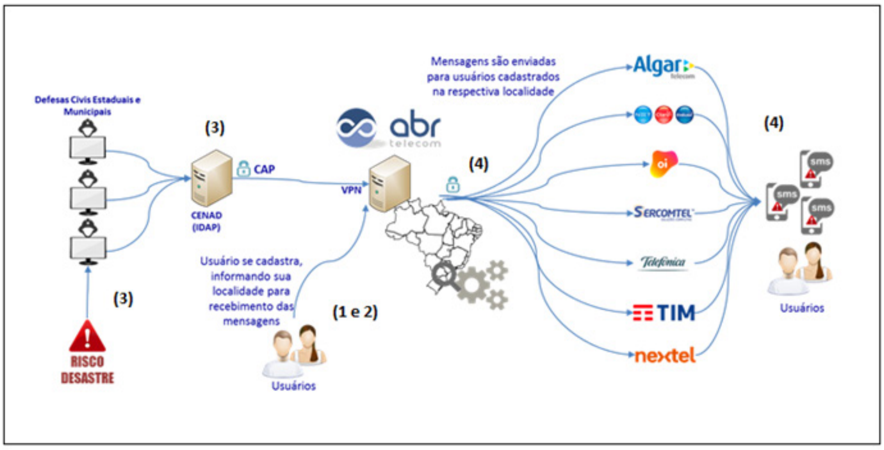
(1) Model implemented

The working group of the main stakeholders in the process (regulatory agency, telecommunication operators and civil defence organizations, represented by national and some state bodies) decided to prioritize the delivery of alerts to mobile phone users, who are more numerous than pay-TV costumers.

The regulations do not limit the technological possibilities that can be used in emergency situations, and the working group judged that the technology with the greatest reach, considering the terminals used by the Brazilian population, would be SMS, which could be implemented more quickly and at lower costs, without prejudice to future developments in other technologies such as cell broadcasting.

The first step taken by the working group was to establish the process (see **Figure 21A**).

Figure 21A: Establishment of the process to send SMS alerts



Legend:

Defensas civis estaduais e municipais: State and municipal civil defence

Risco desastre: Disaster risk

Usuário se cadastra, informando sua localidade para recebimento das mensagens: Users register, indicating their location for receiving messages

[67] ITU-D SG2 Document SG2RGQ/33 from Brazil

Usuários: Users

Mensagems são enviados para usuários cadastrados na respective localidade: Messages are sent to registered users in the location concerned

(1 e 2): (1 and 2)

The procedure consists in identifying an imminent disaster, mapping the area at risk and determining the content of the message to be sent. Then civil defence organizations access a web portal to record the event and request delivery of the message. The system platform receives the request and identifies operators in the region at risk and consumers enabled to receive the messages, which are then triggered by a concentrator agent (ABR) contracted by the operators for that purpose (broker).

The process has four main steps:

1) the campaign: inform the population that the alert service will be available in a given region, and make available to the interested parties the option of joining the service;

2) registration and emergency database: build a database of the cell phone numbers of the people interested in receiving civil defence alerts, using the postal code(s) of the places indicated during the registration process;

3) Civil defence alert: determine the region at risk, the submission period and the text of the alert message to be forwarded;

4) Alert message: the IDAP system (public alert interface) and the web portal automatically send registered alerts to the concentrator agent, which uses the database to convert the georeferenced polygon into a list of terminals for the alert message (based on the postal codes in that polygon) and each user's mobile operator.

Before the process could be implemented nationally, it was important to test the platform and the communication protocols between the various civil defence agents and telecommunication operators. Functional tests were thus conducted in 20 municipalities of Santa Catarina state starting on 7 February 2017 and in five municipalities of Paraná state starting on 13 June 2017. On 16 October 2017, the service began to be expanded first to all municipalities of those two states, then to other states, according to the schedule indicated in **Table 2A**.

Table 2A: Schedule for deployment of the emergency alert model

Start data	State/federative unit
16 Oct. 2017	Santa Catarina and Paraná (other municipalities)
16 Nov. 2017	São Paolo
18 Dec. 2017	Rio Grande do Sul, Rio de Janeiro and Espírito Santo
15 Jan. 2018	Minas Gerais, Matto Grosso do Sul and Goiás
19 Feb. 2018	Distrito Federal, Matto Grosso and Tocantins
19 March 2018	Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará, Piauí, Maranhão, Pará, Amapá, Acre, Amazonas, Rondônia and Roraima

One of the aspects of great importance for successful implementation was how the population was informed, with the regulatory agency taking active steps to distribute the schedule and forms of operation through national and local media. Whenever the service was about to expand to a particular federative unit, the agency repeated its communication with the local media for the entire population.

The service is free, so messages can be sent and received even if the user's phone has no credit or Internet access – suffice it for interested people to register to receive emergency alerts.

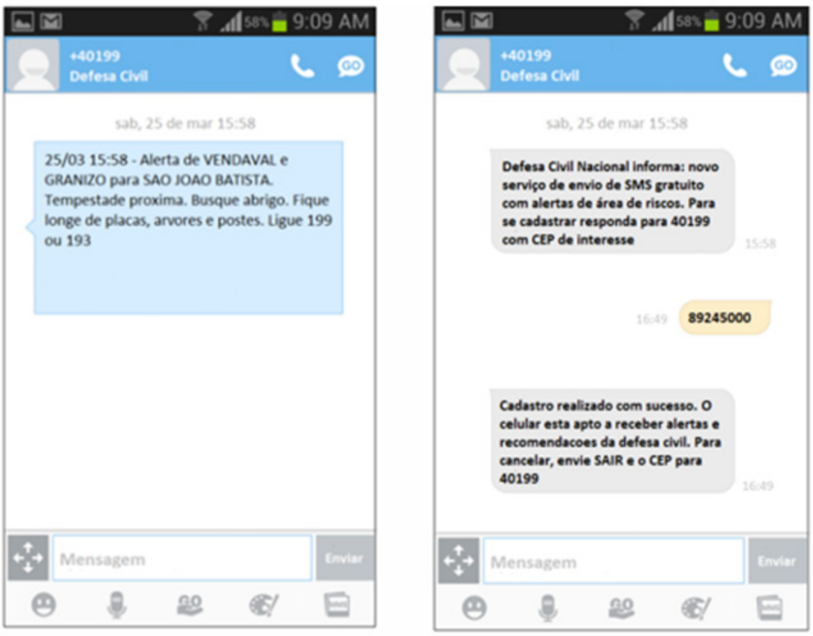
One of the project's limits is that users have to first register. This can be done in one of two ways:

1. When the service is provided in a municipality, the users of that municipality will receive a text message (SMS) from the number 40199 inviting them to register. In this case, the user simply responds to the message with the postal code(s) of their regions of interest. There is no limit to the number of individual postal codes per user.

2. Users who do not receive the text message (SMS) informing them about the start of the registration phase can, at any time, send a text message (SMS) to the number 40199 with the postal codes of interest.

In both cases, the user will receive a reply via text message (SMS) indicating if the registration was successful. The process is illustrated in **Figure 22A**.

Figure 22A: Registration and sending of alerts to citizens



(2) Civil defence organizations

In Brazil, disaster monitoring and preparation activities are headed by the Ministry of National Integration, whose National Centre for Risk and Disaster Management (CENAD) receives and consolidates information from various federal government agencies responsible for forecasting weather and temperature; assessing geological conditions in hazardous areas; monitoring the movement of tectonic plates; monitoring river basins; controlling forest and other fires; and transporting and storing hazardous products.

The agencies concerned include the National Centre for Natural Disaster Monitoring and Alerting, the Brazilian Geological Survey, the Brazilian Institute for the Environment and Renewable Natural Resources, the National Agency of Water, the Brazilian Intelligence Agency, the Centre for Weather

Forecasting and Climate Studies, the National Institute of Meteorology, the Centre for Amazonia, the Armed Forces and other organizations of the Federal Executive Branch.

The data are evaluated and processed at the CENAD and forwarded to the civil protection and defence organizations of at-risk states and municipalities.

Law No. 12,608/2012, on the National System for the Protection of Civil Defence, establishes the roles of the union, states and municipalities in terms of national protection and civil defence policy. The result is a trustworthy ecosystem of public institutions and a set of voluntary initiatives integrating the common goal of preventing and mitigating the effects of natural disasters.

In disaster situations, the response is usually coordinated by the local civil defence agency; all those involved must act jointly, hence the need for local bodies to be well structured.

Further studies should include contributions or suggestions from Question 5/2 participants about the types of early-warning system used by developing countries and how to provide services to citizens and visitors (international and regional), so that they receive early-warning messages.

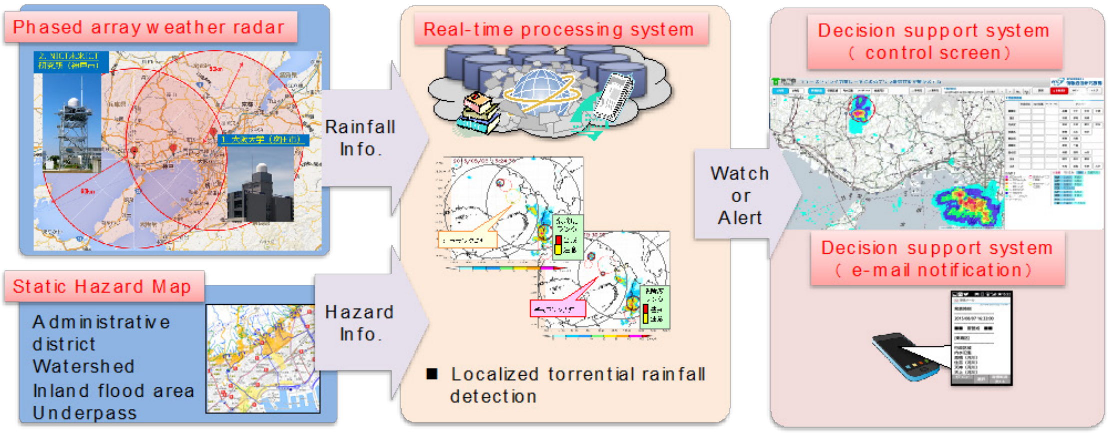
A1.3.5 Early warning and the collection of disaster information (NICT, Japan)[68]

(1) Torrential rainfall short-term early warnings using phased array weather radar

An increase in localized torrential rainfall events has recently been observed in urban areas in Japan. To prevent the damages caused by this kind of event, the NICT has developed phased array weather radar (PAWR). PAWR can observe three-dimensional rainfall information (radar reflectivity and Doppler velocity) every 30 seconds. It can therefore detect locally and rapidly developing cumulonimbus at an early stage. The NICT has also developed a system to monitor localized torrential rainfall using the early detection algorithm of baby rain cells. The cells are first extracted using three-dimensional radar reflectivity. The target area is covered by two PAWR, so it is less susceptible to rain attenuation. Secondly, the vertical vorticity in the baby cell is calculated using the Doppler velocity. Finally, a cell with a vertical vorticity above a threshold value is determined to develop into heavy rainfall on the ground. For the decision-support system, a dynamic hazard map (see **Figure 23A**) with location-dependent degree-of-risk information is produced by integrating the early detection of baby rain cells into the localized torrential rainfall and local static hazard map. The dynamic hazard map is displayed on the control screen and the warning information distributed by e-mail to a limited number of authorized staff. Real-time demonstrations were conducted in Kobe between August and October 2016. The entire system is operated using SNS data stripped of private information purchased by the NICT from third parties.

[68] ITU-D SG2 Document SG2RGQ/60 from the National Institute of Information and Communications Technology (NICT) (Japan)

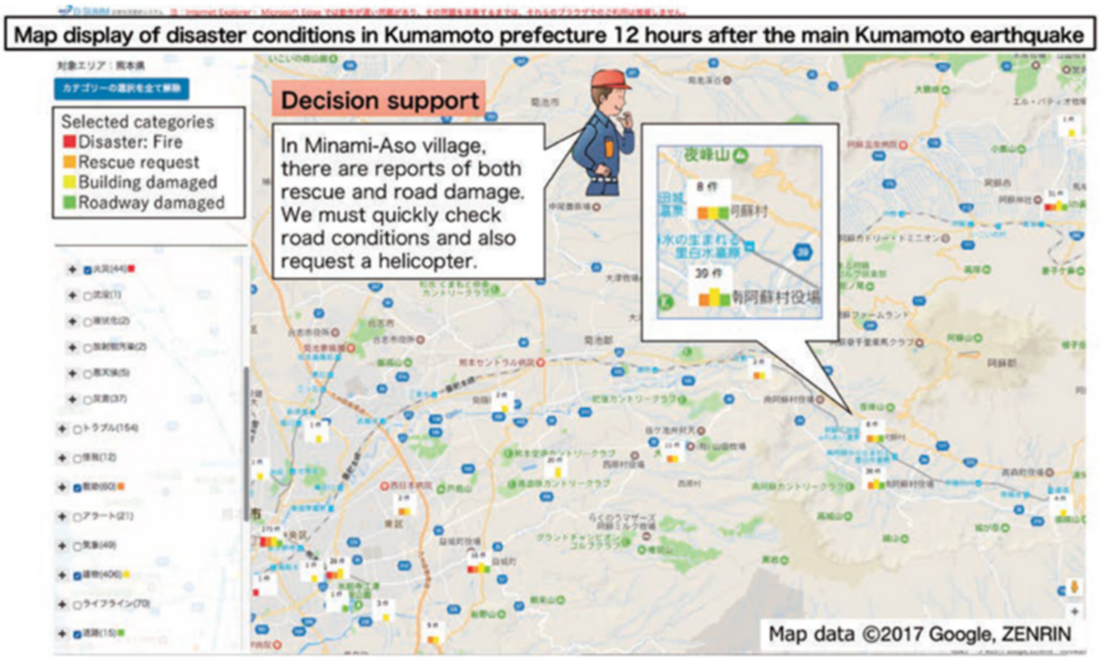
Figure 23A: Example of a dynamic hazard map produced using the PAWR



(2) Disaster data analytics systems

The NICT has developed two data analytics systems: the Disaster information SUMMarizer (D-SUMM) and the DISaster information ANAlyser (DISAANA) (for information on what the systems do, see **Section 3.6** of this report). The systems are used to obtain an overview of disaster conditions, as shown on the map in **Figure 24A**.

Figure 24A: Example of an evacuation map generated by D-SUMM



A1.3.6 Advanced early-warning technologies (Japan)[69]

(1) Background

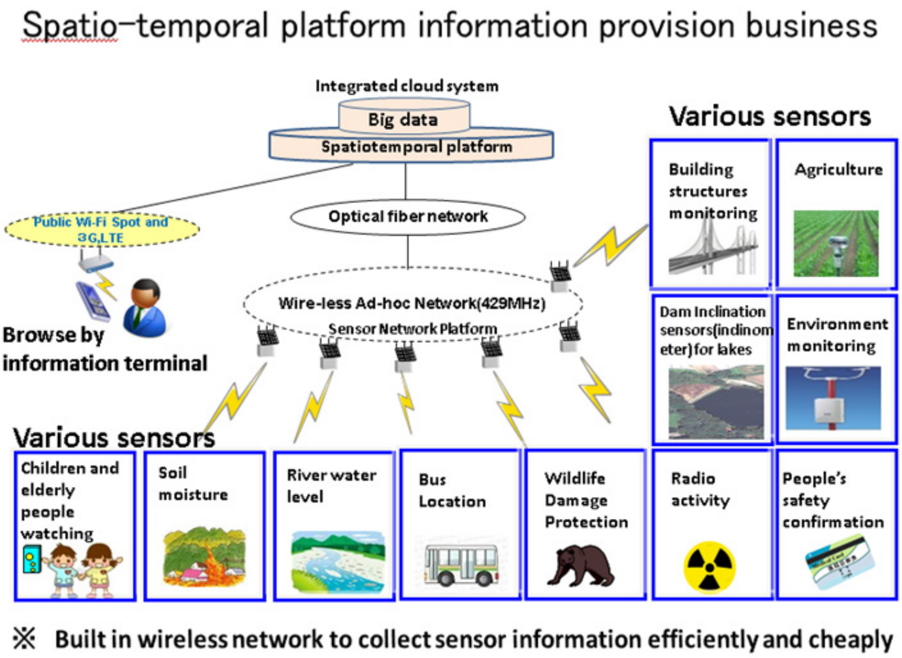
In 2000, Shiojiri municipality started to build an autonomous optical fibre network of 90 km (later extended to 130 km) and 75 public facilities in the city are now connected by gigabit ether network. The network is interconnected with upper-layer service providers. The municipality then established

[69] ITU-D SG2 Document SG2RGQ/28+Annex from Japan

an information and incubation plaza for the IT-literate population. It built a low-power wireless area network with an ad hoc network configuration at 429 MHz. The 640 wireless repeater stations distributed are powered by solar panels and self-sustaining, thanks to their low cost and efficiently interconnected IoT sensors.

Japan is one of the first countries to experience a fall in population numbers and a declining birth rate – a serious and accelerating social phenomenon. In the coming 50 years, the population's age composition will change again, a source of further social concern. The effect on the country's rural municipalities is remarkable. The aim of building a smart society using ICT is to improve the lives of rural community dwellers and thus help suppress migration from rural to urban areas or even promote migration in the opposite direction. The IoT sensor network is partially government subsidized; Shiojiri has promoted the development of ICT-related devices and application software by small and medium-sized enterprises and the region's academic institutions (university, college and technical high school), establishing an incubation plaza where they can collaborate on ICT development. It recently invested in building a network of IoT sensors (see **Figure 25A**) that reaches every corner of the region and automatically collects environmental data that are then exchanged among the organizations concerned for the benefit of community dwellers. In order to meet individual household and ICT network power demands, Shiojiri invested in a biomass power plant to supply low-cost, eco-friendly and carbon neutral power to the region's 67 000 residents. The investment will contribute to regional socio-economic development in the forestry and related industries, and create job opportunities. It is expected to drive a marked improvement in the quality of life of the region's residents in the coming years.

Figure 25A: Shiojiri's environmental information data-collection platform and IoT sensor network



a) Watching children and elderly people

The network of sensors watches and locates children going to and from school and elderly people walking outside in remote communities, detecting the signal emitted by the active tag with embedded button battery that they carry.

b) Soil moisture

Sensors detect soil moisture content at 20-cm increments to predict landslides or mudslides. They send out alerts when the moisture level exceeds the threshold or safety announcements when the level goes down.

c) River water level

Sensors measure the water level of lakes and rivers. They send out alerts when the water level exceeds the threshold, so that the community can evacuate to a shelter before being hit by floods or debris.

d) Bus location

Sensors inform users of the location of buses on routes through the city every 30 seconds. In remote areas of Shiojiri, buses run every one or two hours, so this service is for the convenience of residents in remote areas.

e) Wildlife damage protection

Sensors are used to protect villagers or farmers in rural and remote areas in the suburbs of Shiojiri from wildlife such as boar and monkeys. They detect wildlife movements with a view to reducing the damages the animals cause.

f) Radioactivity

The network of sensors protects people from radioactive pollution by detecting the level of aerial radioactivity in the city.

g) Safety confirmation

Sensors locate residents when they evacuate to community shelters and compile the number of people in each shelter, confirming their safety to family and relatives.

h) Structure monitoring

Sensors monitor the age deterioration of public structures, in particular bridges, detecting abnormalities in their characteristics with a view to taking measures to suppress further deterioration.

i) Agricultural sensors

Sensors track the long-term behaviour of farmers, and agricultural and environmental data such as temperature, humidity and solar radiation, which may be useful for predicting massive insect infestations. They store expert agricultural know-how in digitized format, so that it be easily passed on to new farmers.

j) Dam inclination sensors (inclinometer) for lakes

Sensors record the micro inclinations of dam lakes over the long term; the digitized difference may indicate a dangerous change resulting in the dam bursting.

k) Environment monitoring

The environmental data such as temperature, humidity, wind direction, wind speed, solar radiation and rainfall obtained from the sensors can be digitized and stored in the cloud, for use in combination with other data.

(2) Platform for analysis of unique data collected from various IoT sensors

The unique data collected can be analysed in combination with other data obtained at other times and locations to obtain valuable information of importance for regional economic development.

(3) Case studies

a) Data such as temperature, humidity and solar radiation can be used to predict insect infestations or to reduce the amount of agricultural chemicals needed. Indeed, it may be possible to reduce pesticide use by at least one-fifth, thus lowering costs and easing environmental destruction.

b) The conventional method of gauging the risk of mud- or landslides was to draw on expert knowledge of rainfall amounts and duration. Now that soil moisture levels are detected by IoT sensors, alerts can be sent automatically to the Shiojiri municipality risk manager when the level exceeds a certain digital value. The alerts can be switched on/off automatically and accurately.

c) In the past, it was difficult to predict serious frost damage to crops. Thanks to the IoT sensor network, however, frost warnings can now be issued according to temperature and moisture levels at the sites.

A1.3.7 Emergency alerts using the Tuibida service (China)[70]

(1) Background

Because they provide the widest coverage and most effective means of reaching subscribers, mobile intelligent terminals are the most important channels for delivering emergency alert messages. As major methods of reaching target groups via terminal devices, SMS and push notifications still pose problems. While they may be highly reliable in terms of real-time messaging, SMS can only transmit text messages containing a limited number of characters and no audiovisual content; they also feature deep service entrance, and emergency alerts sent by SMS are very likely to be buried in large amounts of junk text messages. While push notifications can initiate the relevant application, pushing value-added information such as excavation maps or weather trends to subscribers, the sending of emergency alerts is affected to some extent by issues such as low reachability and a low rate of real-time delivery.

Developed jointly by the China Academy of Information and Communications Technology with China Unicom, China Mobile and China Telecom, the Tuibida service delivers the push experience via highly reliable signalling pathways provided by telecom operators. Tuibida is based on the signalling network and features capabilities, such as Quick Apps (click-to-run services, including Google's instantApp/PWA), installed on the terminal device. If the app has not been installed on the terminal device, the service offers the click-to-run function instead, ensuring that subscribers can obtain the relevant service by pushing the Tuibida notification on the terminal device.

(2) Tuibida helps deliver emergency alerts

[70] ITU-D SG2 Document 2/157(Rev.1) from China

By integrating Tuibida into the distribution of emergency alerts, longstanding problems in the delivery of emergency alerts, such as monotonous text messaging, a lack of interaction and follow-up service, and insufficient use of the capabilities of the subscriber's terminal device, can be fixed. Use of Tuibida can accelerate the transition from distributing simple text messages to emergency alert services based on mutual interaction.

Message reliability ensured by signalling and pathways

The Tuibida service employs highly reliable signalling pathways to push messages. In contrast to conventional push notifications, Tuibida has some obvious advantages. Close cooperation with telecom operators can ensure instantaneous information delivery. By classifying information so as to give emergency alerts high priority, and by connecting to the relevant signalling pathways of telecom operators, critical/red alerts can be distributed in timely fashion.

From message delivery to reaching the target audience

Currently, emergency alerts are distributed mainly via SMS text messages. One weakness of SMS is that they can only deliver text messages, whereas emergency-related services often have more valuable information to deliver to the subscriber, e.g. an excavation map in the case of an earthquake, the scope of a tsunami or the path of a typhoon.

Tuibida has a 100 per cent delivery guarantee and, thanks to better integration with instant apps, can trigger the clink-to-run function when an app is not installed on the subscriber's device. Subscribers will thus not only be informed of upcoming disasters or emerging events as they happen, they will also be provided with a variety of useful information in real time. This can have a big impact in terms of maintaining social order and strengthening public confidence in the area when a disaster or emergency happens.

From one-way broadcast to two-way interactions

At present, the distribution of emergency alerts is mainly based on one-way broadcasts. In an enduring disaster, however, two-way interaction is of huge importance, as it will not only provide substantial support for more accurate delivery of emergency alerts in follow-up efforts, it will also help subscribers help themselves. For example, conventional SMS cannot provide feedback on location information. In contrast, since the Tuibida service can invoke the QuickApp, it can obtain the subscriber's location information during an emergency and provide support for rescue efforts by fully utilizing the capabilities of the subscriber's terminal device. Such two-way interactions are of great value and significance with respect to disaster assistance and emergency relief operations.

A1.3.8 The status of remote-sensing activities (United States)[71]

(1) Early warning and prevention

Early warning and prevention include:

- disaster prediction, including the acquisition and processing of data concerning the probability of future disaster occurrence, location and duration; and
- disaster detection, including the detailed analysis of the topical likelihood and severity of a disaster event.

Meteorological aids, meteorological-satellite and Earth exploration-satellite services play a major role in activities such as:

[71] ITU-D SG2 Document SG2RGQ/150 from the United States

- identifying areas at risk;
- forecasting weather and predicting climate change;
- detecting and tracking earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc.;
- providing alerts/warning information of such disasters;
- assessing the damage caused by such disasters;
- providing information for planning relief operations; and
- monitoring recovery from a disaster.

These services provide useful if not essential data for maintaining and improving the accuracy of weather forecasts, monitoring and predicting climate change, and furnishing information on natural resources. The frequencies used by these services and their associated applications are summarized in Table 1 of Recommendation ITU-R RS.1859.

On-the-ground, at-the-spot (in situ), at-the-time measurements or observations are usually more precise and more accurate than similar observations made from space. These kinds of observations are known as "ground truth" and are used to calibrate space-borne instrumentation. However, when in situ instrumentation or the supporting infrastructure needed to use such instrumentation is not in place or has been disabled by the disaster, or the ground measurements are not accurate enough, space-borne observations can provide useful information for alleviating the effects of disasters. Space-borne observations are particularly useful in vast areas with low population densities, and when the technical infrastructure is vulnerable or not well developed.

(2) ITU-R activities

Recommendation ITU-R RS.1859 has been revised to add examples of how space-borne sensors can help identify areas at risk by using synthetic aperture radar (SAR)-generated digital elevation models to locate low areas subject to flooding, or by using SAR-generated bathymetry to identify ocean bottom structure that might worsen an incoming tsunami or storm surge. It also demonstrates how satellite-based remote sensors have proven useful in providing an overall assessment of drought conditions or have identified nearby, previously unrecognized areas having much better-than-average crops. Such information enabled quick yet inexpensive relief to be provided, since transportation time and costs were minimized (i.e. using nearby trucks instead of distant airplanes). After a major earthquake, the sooner an accurate damage estimate is made, the sooner the appropriate rescue assets can be mobilized. Interferometric SAR (InSAR) observations pinpoint the location of earthquake epicentres far more accurately than remote seismographs, thus enabling more precise damage estimates on which to base relief efforts. Recent launches of fleets of SAR-equipped satellites (COSMO-SkyMed (ASI), TDX and TSX (DLR), the Sentinel–1 series (ESA), and the upcoming RADARSAT constellation (CSA)) have made these assessments more readily available than in the past. Precipitation radars flown on NASA's Global Precipitation Mission provide 3-dimensional images of the rainfall from severe storms. The mission includes passive instruments which provide complimentary storm information extending beyond the swath of the radar.

Table 3A indicates for which type of disaster a particular technology may provide useful data.

(3) Obtaining remote-sensing data

To gain the maximum benefit from remote-sensing data, a local emergency management agency is needed to direct the appropriate information to people in the field who need it. UN-SPIDER is focused on helping nations develop the capacity to manage disasters. While UN-SPIDER helps organize relief organizations and train their personnel, other organizations are more data-oriented.

The WMO Observing Systems Capability Analysis and Review Tool includes a table showing all known past, current and future satellites for meteorological and Earth observation purposes. The table can be used to identify additional sources of data.

Another source of analysed remote-sensing data is UNOSAT, a United Nations programme created to provide the international community and developing nations with enhanced access to satellite imagery and GIS services.

Table 3A: Satellite-based technologies for managing natural disasters

Objective / Technologies	SAR Imagery	In SAR Imagery	Active microwave imagery	Radar altimetry	Radar scatterometry	Precipitation radar	GPS radio occultation	Passive microwave imagery	Passive microwave sounder	Geographic visual and infrared imagery	Optical imagery	Multispectral optical imagery	Infrared imagery
Coastal hazards	X										X		
Drought	X		X	X	X			X		X	X	X	
Earthquakes	X	X					X				X		
Extreme weather					X	X	X	X	X	X	X		
Floods	X		X		X	X	X	X	X		X		
Landslides	X	X									X	X	
Ocean pollution	X											X	
Pollution											X	X	
Sea/lake ice	X							X			X		
Volcanoes	X	X						X			X	X	X
Wildland fires								X			X	X	X

A1.3.9 Monitor and accurately predict the path of cyclones (India)[72]

(1) Background

India has adopted a "Zero Casualty" policy to the management of disasters like cyclones, and its federal and state governments are now better prepared in terms of early-warning systems, evacuation plans, rescue and rehabilitation. Disaster drills help prepare for disasters, but the real test comes only when disaster actually strikes, in all its fervour and intensity. Recently, in May 2019, an extremely severe cyclone, Fani, struck Odisha state, on India's eastern coast. It was almost as severe as the "super cyclone" that hit the same state in 1999, killing more than 10 000 people. In the last two decades, India has prepared well to deal with disasters, including cyclones. As a result, Fani caused only 64 fatalities, despite its intensity. The United Nations Office for Disaster Risk Reduction praised the accuracy of the India Meteorological Department's early warnings, which helped the authorities in Odisha evacuate people and minimize the number of deaths.

(2) Cyclones/hurricanes/typhoons

[72] ITU-D SG2 Document SG2RGQ/147 from India

Cyclones, hurricanes and typhoons are types of storms caused by atmospheric disturbances, wherein the air rotates cyclically around a low-pressure centre called the "eye". In the northern hemisphere, winds rotate counter-clockwise, and in the southern hemisphere, clockwise. Cyclones of variable intensity are born almost every year in the seas off India, during the months of June and July. Fani occurred in May, which is rare.

Cyclonic disturbances are classified depending on the wind speed around the centre. Satellite imagery of clouds and other meteorological features is used to estimate the intensity and wind speed of these intense systems. Satellite cloud configurations, expressed as "T" numbers, have a unique relationship with the wind field of a cyclonic disturbance. **Table 4A** below shows the categories of cyclones. The strong winds, heavy rains and large storm surges associated with tropical cyclones are the factors that eventually lead to loss of life and property.

Table 4A: Categories of cyclonic disturbances

Categorisation of Cyclonic Disturbances

S. No.	Intensity	Strength of wind Satellite	'T' No.	condition of Sea	Wave Height (m)
1	Depression (L)	31- 49 kmph (17-27 knots)	1.5	Moderate to Rough	1.25-2.5 2.5-4.0
2	Deep Depression (DD)	50 – 61 kmph (28-33 knots)	2.0	Very Rough	4.0-6.0
3	Cyclonic Storm (CS)	62 – 87 kmph (34-47 knots)	2.5-3.0	High	6.0-9.0
4	Severe Cyclonic Storm (SCS)	88-117 kmph (48-63 knots)	3.5	Very High	9.0-14.0
5	Very Severe Cyclonic Storm (VSCS)	118-166 kmph (64-89 knots)	4.0-4.5	Phenomenal Over	14.0
6	Extremely Severe Cyclonic Storm (ESCS)	167-221 kmph (9--119 knots)	5.0-6.0	Phenomenal Over	14.0
7	Super Cyclonic Storm (SuCS)	222 kmph and more (120 knots and more)	6.5 and more	Phenomenal Over	14.0

Source: http://www.rsmcnewdelhi.imd.gov.in

(3) Early-warning models adopted by the Indian Meteorological Department

The India Meteorological Department translates observational data into numerical weather prediction models. The information is collated and analysed with that of other countries. The Department refers to 10 different numerical models every day. These models ingest the current observations and are applied in different physical principles and mathematical equations. With the help of high-powered computing systems, experts solve and analyse these equations to obtain actual observations. They then issue a prediction for different days. Forecasters go through all the models developed every day to find out whether any low-pressure system is developing anywhere offshore. Based on the observations, scientists discuss the models and arrive at a consensus and then decide to issue warnings and predictions. Warnings have the following components: warning generation; warning product presentation; warning dissemination; coordination with emergency response units; post-event review; pre-season exercise; and public education and outreach.

(4) Four-stage warnings for states

Warnings are issued to states in a cyclone's path in four stages.

The first-stage warning, the **Pre-Cyclone Watch**, is issued 72 hours in advance. It warns that a cyclonic disturbance is developing in the Indian Ocean/seas.

The second-stage warning, the **Cyclone Alert**, is issued at least 48 hours in advance of the expected commencement of adverse weather over the coastal area. It contains information on the location and intensity of the storm, its likely direction and intensity, coastal districts likely to experience adverse weather and advice to fishermen, general public, the media and disaster-management agencies. It is issued by the Area Cyclone Warning Centres (ACWCs), Cyclone Warning Centres (CWCs) and Cyclone Warning Divisions (CWDs) concerned.

The third-stage warning, the **Cyclone Warning**, is issued at least 24 hours in advance of the expected commencement of adverse weather over the coastal area. The point of landfall is forecast at this stage. Third-stage warnings are issued by the ACWCs, CWCs and CWDs at three-hour intervals, giving the cyclone's latest position and intensity, the likely point and time of landfall, associated heavy rainfall, strong wind and storm surge, along with information on potential impact and advice to the general public, the media, fishermen and disaster managers.

The fourth-stage warning, the **Post-landfall Outlook**, is issued by the centres at least 12 hours in advance of the expected time of landfall. It gives the cyclone's likely direction after landfall and indicates the adverse weather likely to be experienced in the interior.

Different colour codes are used to denote the stages of cyclone warning bulletins. Cyclone alerts are **yellow**, cyclone warnings are **orange** and post-landfall outlooks are **red**.

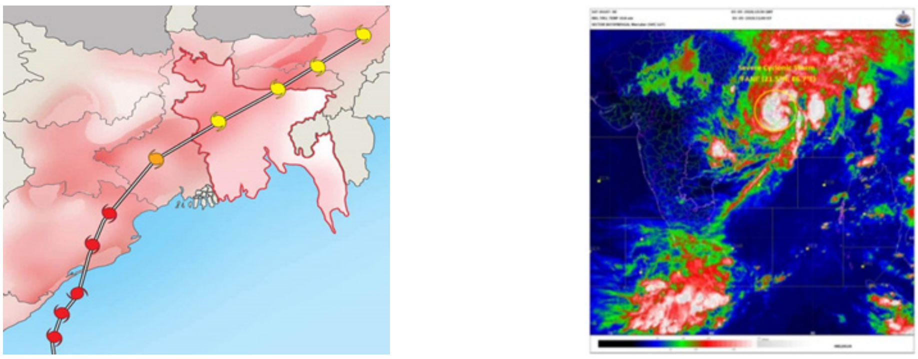
(5) ICTs used to issue early warnings in India

The following ICTs are used to send early-warning information: mobile phones, VSATs, satellite phones (Inmarsat), interactive voice response systems, LAN and virtual private networks, radio, TV, web media, loudspeakers and the national knowledge network.

(6) Cyclone Fani

Cyclone Fani, a rare summer cyclone in the Bay of Bengal, hit eastern India on 3 May 2019. It was one of the strongest cyclones to reach India in the last 20 years. Fani was an Extremely Severe Cyclonic category storm. It crossed the temple town of Puri in Odisha state (see **Figure 26A**) at a speed of 175 to 185 km/h, gusting to 205 km/h, resulting in widespread loss of property. The fact that loss of human lives and livestock was significantly reduced can be credited to a number of things: the effective early-warning system; the availability of adequate infrastructure; the timely evacuation of millions of people; better coordination between federal and state governments; the deployment of national disaster relief forces; India's Zero Casualty approach; and the Meteorological Department's improved model for predicting cyclone paths and landfall accurately and with minimum errors.

Figure 26A: Cyclone Fani



(a) Path of Cyclone Fani

(b) Winds along the path

(7) Steps taken to reduce loss of lives during Cyclone Fani

As mentioned above, the Government's Zero Casualty approach to natural disasters and the improved accuracy of the India Meteorological Department's early-warning system helped reduce the number of deaths during Cyclone Fani.

A record 1.2 million people (equal to the population of Mauritius) were evacuated in less than 48 hours, and almost 7 000 kitchens, providing food for 9 000 shelters, were made functional overnight.

This mammoth exercise involved more than 45 000 volunteers. Thanks to this timely action, Fani resulted in about 60 fatalities.

(8) Comparison with other cyclones/hurricanes

The statistics are striking when compared to the impact of big weather events around the world. When Hurricane Maria hit Puerto Rico in 2017 with wind speeds of 175 miles per hour, it caused a death toll of 2 975. The same year, Hurricane Harvey struck Texas with winds of 130 mph, causing devastating flooding. Texas reported USD 125 billion in damages and at least 68 direct storm-related deaths. Cyclone Idai hit Mozambique in March 2019; after it ripped through Madagascar, Malawi and Zimbabwe, more than 1 000 people were feared dead.

Thus, Odisha's ability to put such an effective disaster-management plan in place and save thousands of lives is a template that the world can learn from.

(9) Key takeaways from the Fani response

Build relief infrastructure and establish a clear command-and-control structure

Until 1999, when it was hit by a super cyclone, Odisha did not have a well-laid-out plan for disaster management. Two months after the cyclone hit, the Odisha state Disaster Management Authority was set up and plans put in place. Around 900 cyclone shelters were built in vulnerable pockets of the state, with systems in place for the evacuation of hundreds of thousands of people.

There is a clear command-and-control structure for disaster relief and there are clear protocols in place for carrying out relief operations. These were successfully used in the response to Cyclone Phailin in 2013 (a storm five times the size of Hurricane Katrina), Cyclone Hudhud in 2014 and Cyclone Fani in 2019.

Accuracy of early-warning systems

The India Meteorological Department has built an effective service able accurately to predict when a cyclone will form in the Bay of Bengal and when it will make landfall along India's coastline. This early-warning system promotes disaster readiness and minimizes loss of lives. It is then crucial that people follow the protocols in place when the warnings come in.

Clear communication plan

Roughly 6.5 million text messages were sent to locals and farmers in clear language before Cyclone Fani hit, alerting those potentially affected. People were repeatedly advised over all media not to panic and given clear "do and don'ts". This helped in the record evacuation of 1.2 million people to safe buildings.

Effective coordination of groups

Preparations to fight the onslaught of Fani involved a number of government agencies, local community groups and volunteers working together. The government's disaster-response forces were pre-positioned in vulnerable locations and food packets were made ready for air force helicopters to drop to people. Senior state officials and police officers were sent to the districts affected to coordinate the efforts of various agencies.

A1.3.10 Alert and warning systems (United States)[73]

(1) Introduction

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters.[74] Timely and effective alert and warning systems strengthen mitigation and community resilience by informing citizens of risks they may face and recommended actions to save lives and protect property. Development of better alert and warning capabilities helps to mitigate hazards and lessen the impact of disasters.

Proper authorities, policy and governance are critical foundational elements for the development of an alert and warning system, especially to prioritize personnel and resource justifications. The United States established the IPAWS as a unique, multi-hazard, multi-user alert and warning infrastructure that the US Federal Emergency Management Agency (FEMA) makes available for use by its constituents – federal, state, local, tribal and territorial entities – across the country. The IPAWS uses technology and information standards to join multiple private sector communication technology infrastructures, providing the ability to deliver a single emergency message simultaneously to multiple public dissemination pathways (e.g. radio, TV, mobile devices and Internet-connected systems, websites and applications). Authorized public Alerting Authorities (AAs) draft tailored messages to send alerts and warnings to citizens, residents and visitors in their jurisdiction. Using the IPAWS helps the constituent AAs to communicate information about an emergency situation to the greatest number of people in the shortest amount of time by leveraging local private sector ICTs to disseminate alerts and warnings. Distributing the same message across multiple sources increases the likelihood that people will receive it and will take timely action consistent with the threats or emergency situation.

FEMA's IPAWS Programme Management Office works to sustain and enhance the platform's unique abilities by continuously interfacing with industry to track and ultimately develop or interface new and emerging ICTs and thus expand the number of systems available for distribution of alerts and warnings using the same standards-based format (electronic road signs, sirens, smart kiosks, etc.). This is done by working hand-in-hand with the Federal Communications Commission (FCC), the United States regulatory body, and private industry partners. To date, this alliance has enabled the IPAWS to help over 1 300 AAs send emergency messages to the public using radio, television and cell phones in the United States.

(2) The IPAWS architecture

The IPAWS architecture was and is designed to support interoperability with any alert and warning system in the nation that employs the same standards. IPAWS-OPEN is the infrastructure that routes authenticated alert and warning messages to the public using the radio and television systems in the Emergency Alert System, Wireless Emergency Alerts to cell phones, NOAA Weather Radios and other communication systems.

The first critical step in initiating this design solution was to use the CAP and other technical standards. When alert and warning services are made CAP-compliant and integrated with the IPAWS, the platform acts as a mediator, authenticating messages from authorized users disseminating authentic emergency information to people in a specific geographic area quickly through multiple dissemination pathways. Information from a single source about a single incident can thus reach the public via radio, television, wireless phones, Internet services and future CAP-compliant IPAWS-connected technologies. The standards-based approach enables a national alert and warning architecture to adapt to and leverage future technologies. Making use of multiple dissemination pathways for public alerts significantly increases the likelihood that the message will reach its target. In addition, disseminating a single CAP alert message simultaneously via multiple pathways reduces the time needed to send alerts and the workload on emergency managers, who would otherwise have to prepare and send multiple

[73] ITU-D SG2 Document SG2RGQ/152+Annex from the United States

[74] United States Government. FEMA. FEMA's Mitigation Directorate fact sheet.

separate channel-specific formatted alerts. The IPAWS standards-based approach speeds the delivery of critical, life-saving information.

Use of the open CAP standard enables industry partners (i.e. Internet, carriers, software vendors, broadcast) to develop technology and/or devices that can be used by individuals with disabilities, and others with access and functional needs, to receive alerts and warnings. Thanks to standards-based interoperability, the CAP enables the transport of rich multimedia attachments and hyperlinks in all alert and warning messages. The IPAWS adopted the Emergency Data Exchange Language (EDXL) CAP, which is developed and maintained by the Organization for the Advancement of Structured Information Standards (OASIS). It continues to work with the OASIS Standards Committee to adapt changes to the CAP standard specifications for IPAWS-OPEN. The current system utilizes the CAP v1.2 Standard and the CAP v1.2 IPAWS USA Profile v1.0. The IPAWS does not provide an alert origination tool; instead, it works with more than 25 different alert origination tool vendors to ensure that their products are compliant with the CAP v1.2 Standard and United States profile specification. Constituent AAs can find the tool that best fits local operations. The IPAWS engages and provides training to AAs and tool vendors, and encourages them to adopt the system for their alert and warning needs.

Together with the Alliance for Telecommunications Industry Solutions (ATIS), a United States-based technical and operational standards and solutions development organization for the ICT industry, the IPWAS developed and adopted standards used for wireless emergency alerts in the United States. ATIS addresses common, critical priorities and shares resources, efforts and costs to develop large-scale, interoperable solutions. It is accredited by the American National Standards Institute. The IPAWS actively participates in ATIS meetings with cellular service providers and partners to continuously update wireless emergency alert capabilities.

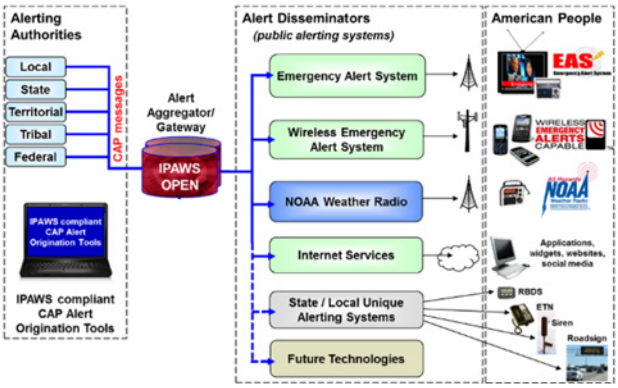
The IPAWS liaises and collaborates with relevant professional associations, including the National Association of Broadcasters, the NCTA Internet & Television Association (formerly the National Cable & Telecommunications Association), the National Emergency Management Association and the International Association of Emergency Managers. In addition to working with standards institutes and various associations, the IPAWS, in coordination with FEMA headquarters, actively engages with the FCC and Congress to update laws and regulations and thus improve alert and warning capabilities. It worked with committees of the National Research Council and The National Academies Press to develop published workshop reports on the Public Response to Alerts and Warnings on Mobile Devices[75] and Geotargeted Alerts and Warnings[76].

Thanks to its regular use and development of standards, and participation in associations, the IPWAS participates proactively in operational tests, training, exercises and evaluations of new and emerging technologies. These activities enable progress toward the integration of additional and new technologies into the national alert and warning interoperability backbone, and encourage industry and other private sector innovators to meet the mitigation risk reduction and risk management needs of the emergency management community at large. The IPAWS architecture is shown in **Figure 27A**.

[75] Sub-title: “Summary of a Workshop on Current Knowledge and Research Gaps”. Computer Science and Tele-communications Board, National Research Council, The National Academies Press, Washington, DC, 2011.

[76] Sub-title: “Report of a Workshop on Current Knowledge and Research Gaps”. Computer Science and Tele-communications Board, National Research Council, The National Academies Press, Washington, DC, 2013.

Figure 27A: IPAWS architecture



Source: FEMA

(3) Using IPAWS capabilities

The original requirement for the IPAWS was to provide the President with a means of warning the public of impending disasters and attacks. At present, however, the national IPAWS is used daily by local emergency managers in a very wide variety of situations that threaten public safety and property. Local authorities have used it to issue emergency messages related to chemical spills, child abductions, dam failures, the availability of disaster recovery resources, earthquakes, evacuations, flash floods, gridlocked traffic, hurricanes, large-scale power outages, law enforcement operations, nuclear facility accidents, roadway closures, shelter-in-place orders, snowstorms, tornados, toxic plumes, volcano eruptions, wildfires and water contamination. Details can be obtained from the IPAWS website.

(4) Alerting Authorities

Over 1 300 constituent AAs use CAP-based alert origination tools to create alerts and warnings that are compatible with the national architecture. In the United States, depending on constituent policies, AAs can include, but are not limited to, government agencies at all levels, fire and police departments, military bases, colleges and universities, nuclear power plants and hospitals. All AAs requesting use of the IPAWS platform must independently acquire software compatible with the IPAWS CAP specifications and sign a memorandum of agreement with FEMA. Each memorandum dictates the development of effective local alert and warning practices and procedures, requires completion of FEMA IPAWS training, and stipulates monthly training to demonstrate that the AA can react and send a properly formatted alert and warning in a test environment. All emergencies are local, and each area threatened by a disaster or emergency is unique, which is why AAs have the freedom and autonomy to determine message content and when to send alerts and warnings.

(5) Success stories

– Wildfires: During the Southern California wildfires of 2017, the Governor's Office of Emergency Services warned seven counties to stay alert and listen to authorities during periods of strong winds. Winds did in fact spread fires, at times over more than one acre per second. Wildfires burned over 307 900 acres and forced the evacuation of over 230 000 people, but only one civilian death was recorded, thanks in part to advance notification. In 2018, many wireless and Emergency Alert System alerts were sent during a wildfire that burned in four counties for 54 days. Media reports indicate that many people were evacuated on time as the public seemed very receptive to the alerts.

– Bomb threat: New York City Emergency Management sent a wireless emergency alert in the form of an electronic wanted poster to identify the suspect in connection with bombings in

Manhattan and New Jersey in 2016; the suspect was captured within hours. This was the first widespread effort to transform the citizens of a major American city into a vigilant eye for authorities. "This is a tool we will use again in the future… This is a modern approach that really engaged a whole community," said Mayor Bill de Blasio.[77]

– Tornado alert: In 2016, the groom at a wedding reception in Ohio received a tornado alert on his phone. The phones of family members in attendance from New York, New Jersey, South Carolina and even Canada immediately received the same alert. Even when the guests and family members in attendance are from different geographic areas, wireless emergency alerts can reach any cell phone using a specific tower, including those in moving vehicles.[78]

– Child abduction/Amber Alert: On 31 December 2016 in Sharpsville, Pennsylvania, an armed and dangerous adult male abducted his eight-month-old daughter. An off-duty security worker in Reading, Pennsylvania, received an Amber Alert on his phone and noticed a vehicle matching the description provided in the alert. He provided 911 dispatchers with information that allowed police to find the vehicle. The child was found safe less than an hour after the Amber Alert was issued.[79]

A1.4 Drills and exercises

A1.4.1 Emergency telecommunication drills (China)[80]

This case study introduces the purpose, types and requirements of emergency telecommunication drills. It suggests further strengthening emergency telecommunication drills and experience sharing in the field of telecommunications/ICT for disaster preparedness, mitigation and response.

(1) Purpose of emergency telecommunication drills

Exercises are a great way to:

- Evaluate the preparedness programme and identify planning and procedural deficiencies: Preparedness programmes may be untested, not updated or unable to adapt to new situations. Emergency telecommunication drills can reveal shortcomings in the programme, check its adaptability to unexpected situations and gauge the need for modifications and improvements.

- Improve capabilities to respond to real events: Emergency telecommunication drills can help verify new technology application and information communication resources, assess new equipment capabilities and enhance emergency telecommunication support capability. They can provide indications of the capabilities of existing resources and identify resource gaps.

[77] J. David Goodman and David Gilles. Cellphone Alerts Used in New York to Search for Bombing Suspect. The New York Times, 19 September 2016.

[78] Samuel Reed. Wedding almost a disaster – literally. Sidney Daily News, 13 September 2016.

[79] CBS News. Report: Pa. man who saw Amber Alert helped find infant abducted by murder suspect. 3 January 2017.

[80] ITU-D SG2 Document SG2RGQ/61 from China

- Improve coordination between internal and external teams, organizations and entities, and boost the level of cross-regional support: Drills serve to strengthen the coordination ability of multi-department and rapid response operations, and to improve communication and coordination between emergency organizations and personnel.
- Train the emergency telecommunication team: Emergency drills help improve the team leader's ability to analyse, make decisions, organize and coordinate. They help telecommunication personnel understand onsite roles and responsibilities. They can also help heighten awareness and understanding of hazards and their potential impact, reduce panic and promote cooperation with the government and its departments, in order to improve the overall social emergency response capacity.

Figure 28A: Emergency telecommunication drill

(2) Types of emergency telecommunication drill

Different types of drill can be used to evaluate programme plans, procedures and capabilities.

- Emergency telecommunication drills that focus on **organization** include tabletop exercises and actual-combat drills. In tabletop exercises, team members use maps, sand tables, flowcharts, computer simulations, video conferencing and other means to discuss their roles and responses during an emergency situation. Such exercises are usually conducted in rooms. In actual-combat drills, the participants use the emergency equipment and materials available to simulate pre-set emergency scenarios and subsequent development scenarios through actual decision-making, action and operations. Such drills are usually conducted in specific locations.
- Emergency telecommunication drills that focus on **content** include single and comprehensive drills. A single drill involves only one specific emergency response function in the emergency plan or a series of emergency response functions in the onsite plan. It focuses on specific units and functions. Comprehensive drills involve multiple or all emergency response functions in contingency plans. They emphasize testing of various links and functions, especially the emergency mechanism and joint response capability of different departments.
- Emergency telecommunication drills that focus on **purpose and function** include test drills, demonstration drills and research drills. Test drills test emergency plan feasibility, emergency preparation, emergency mechanism coordination and the ability of relevant

personnel to take their places. Demonstration drills are a kind of performance drill carried out in strict accordance with the emergency plan to demonstrate emergency ability or instruct observers. Research drills are organized to study and solve the key difficulties of emergency plan activation and to test new schemes, technologies and equipment.

- Emergency communication drills that focus on **notification** include notification and script-free drills. Notification drills follow a script and check the emergency communication support according to the plan of action. In double-blind emergency telecommunication drills or flight inspections without script or notification, the drill time and place are not announced in advance. The emergency telecommunication equipment and personnel are temporarily deployed to the drill site, where the equipment is assembled; both are then dispatched to an actual-combat simulation drill in a certain area.

Different types of drill can be combined: table-top drill, integrated table-top drill, demonstration of single drill, demonstration of integrated drill, and so on.

The general emergency telecommunication drill is a comprehensive drill. The drill scenario might be as follows: a simulated earthquake causes business disruptions; a group organized via a remote emergency rescue and disaster relief drill in neighbouring provinces comprises seven teams; 24 emergency vehicles, 24 sets of equipment and 78 drill personnel are sent in; topics covered in the drill include coverage of the UAV base station, Wi-Fi coverage of Ku and Ka portable stations, a C network base station with satellite circuit, optical fibre fusion, emergency power supply and other business subjects.

Figure 29A: Emergency telecommunication drill

A1.4.2 Exercise to simulate the implementation of the civil security plan for telecommunications (Algeria)[81]

In order to strengthen disaster preparedness for emergency telecommunication resources, the Ministry of Post and Telecommunications of Algeria, in cooperation with the Algerian Space Agency, the General Directorate for Civil Protection and the telecommunication operators organized a partial

[81] ITU-D SG2 Document SG2/384 from Algeria

civil security (ORSEC) simulation exercise for the telecommunication module on 24 October 2020 in the wilaya of Boumerdes located 45 kilometres to the north-east of the nation's capital city.

(1) Legal framework

Operators who hold licenses for setting up and operating public telecommunication networks (fixed and mobile) have certain obligations under their licensing terms. In particular there is an article relating to emergency calls:

– to elaborate, in concert with the officials in charge of disaster relief and the local authorities, plans and preparations for the provision and rapid restoration of a minimum level of emergency telecommunications, and to implement them at their own initiative or upon a request from the competent authorities;

– to reserve equipment that is mobile, transportable and suitable for response work and participate in exercises organized by the responsible public bodies.

(2) Objective of the simulation exercise

The principal objective of this simulation exercise was to test the continuity of operations of telecommunication services, particularly with regard to the command structure and the population, and to permit Civil Protection to evaluate the effectiveness of the emergency measures put in place on the operational level.

Accordingly, it aimed to first, strengthen coordination between the different operators in the telecommunication sector and to ascertain their readiness and effectiveness in a disaster situation; and second, employ the resources of Algeria's ALCOMSAT-1 satellite in cooperation with the Algerian Space Agency (ASAL) and Algérie Télécom Satellite (ATS). ALCOMSAT-1 was launched in December 2017 and is the country's first telecommunication satellite.

(3) Scenario of the simulation exercise

The simulation manoeuvres were based on "an earthquake of magnitude 6.8 on the Richter scale, with the epicentre located 8 km to the north of the town of Boumerdes, leading to loss of life and major damage to urban areas, infrastructure and residences. The zone most heavily affected is that of the communes of Boumerdes and Zemmouri, with total disruption of the telecommunication networks."

For the links and telecommunications module, the scenario had two aspects:

– Operational aspect: telecommunication links were provided by ASAL with the installation of mobile and fixed VSAT stations to enable VoIP, data and videoconference transmission between the various command sites managed by Civil Protection via ALCOMSAT-1, complementing the voice-only VHF relays and terminals;

– Civil aspect: (Deployment exercise) involving telecommunication operators for fixed and mobile telephony so as to maintain service continuity in the affected zone and provide telecommunication services to the population.

(4) Human and material resources

This large-scale exercise involved some 100 participants from such telecommunication players as ASAL, ATS, the Agence **Nationale des Fréquences** (ANF), Algérie Télécom (AT), Algérie Télécom Mobile (ATM Mobilis), Wataniya Télécom Algérie (WTA-OOREDOO) and Orascom Télécom Algérie (OTA-Djezzy), as well as Civil Protection members at various levels.

With regard to the telecommunication resources deployed for the simulation exercise, Civil Protection and ASAL, as well as the telecommunication operators, made available some major technical equipment, including:

– Civil Protection: VHF stations, relays and terminals;

– ASAL: six VSAT station, including two mobile (van and 4x4 vehicle), one portable and three fixed;

– AT: two eNodeB trailer-mounted 4G stations with built-in generator sets, one mini eNodeB 4G station, two complete DRSS links, and five 25 kVA generator sets;

– ATM: one trailer-mounted 2G/3G/4G-compatible station with built-in generator set and VSAT antenna;

– OTA: one trailer-mounted 2G/3G-compatible station with an Outdoor generator set;

– WTA: one mobile lorry-mounted 2G/3G-compatible station with built-in generator set;

– ATS: two VSAT stations (for Mobilis, the VSAT station is already integrated), six satellite modems and two 1.8-metre antennas;

– ANF: two spectrum monitoring units.

(5) Conduct of the simulation

The simulation exercise took place on the five following sites:

- **Sites 1 and 2**: two zone command posts (PCZ), located in the affected zones;
- **Site 3**: an operational command post (PCO) for representatives of the executive bodies under the authority of the Civil Protection for coordinating the rescue efforts;
- **Site 4**: a fixed command post (PCF) at the Wilaya headquarters for the officers in charge, under the authority of the wali or a representative;
- **Site 5**: the headquarters for the General Directorate for Civil Protection, simulating the interministerial crisis cell.

Operational portion

At the different sites involved ASAL deployed fixed VSAT stations, a mobile station (van), a VSAT station and a 4x4 vehicle equipped with a VSAT link for transmitting imagery filmed by a camera mounted on a Civil Protection helicopter and providing the different mobile-mode transmission services to remote sites. Voice and videoconference transmission between those sites was tested successfully, as was the reception of aerial images and videos of the affected areas transmitted by the Civil Protection helicopter. Transmission was done via ALCOMSAT-1. In addition, all of the sites were interconnected by the Civil Protection VHF network for the provision of voice transmission.

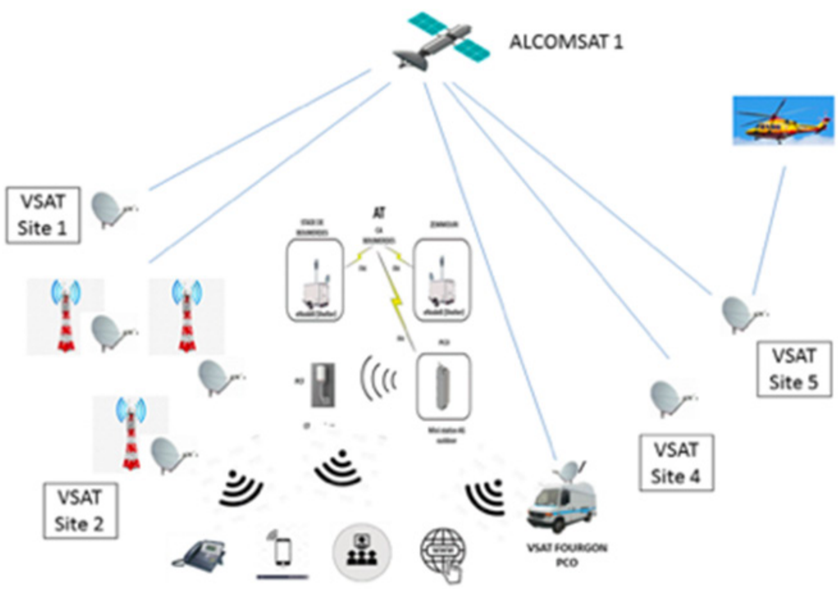
Civil portion

Coverage of the affected areas was provided by the three mobile telephony operators and by the incumbent fixed telephony operator AT.

The topology of the networks deployed on the day of the simulation was organized around the following points:

- AT deployed two trailer-mounted 4G stations, one mini 4G station at the PCO, with the installation of 4G CPE, one Outdoor CPE unit and videoconference equipment at the five sites. Tests for voice, data and video were successful and transmission was provided by the 800 Mbit/s DRSS links;
- the mobile operators deployed three trailer-mounted stations in the affected area to provide voice coverage for the population with a 2 Mbit/s VSAT satellite link by ATS for each operator;
- ANF put up two spectrum analysers to monitor and verify the quality of the signal and frequencies used.

Figure 30A: Emergency telecommunication drill



(6) Conclusion

Thanks to the different tests performed on the day of the simulation, it was possible to obtain information on the resources available from each operator and establish direct contact with the different players. In the same framework, future simulation days organized annually across the entire country should lead to improvements at the organizational and procedural level, while preserving the dynamic interaction and coordination between the players as regards the civil security plan and providing solutions for the different technical and organizational problems that simulation operations invariably bring to light.

The tests also contributed to informing the vision of Algeria's Ministerial Department with regard to the preparation and elaboration of a national emergency telecommunication plan, in accordance with Target 3.5 defined in the strategic plan for the period 2020-2023 in Resolution 71 (Rev. Dubai, 2018) of the Plenipotentiary Conference of the International Telecommunication Union: **"By 2023, all countries should have a national emergency telecommunication plan as part of their national and local disaster risk reduction strategies"**.

These national plans will make it possible to bring together all of the players so as to examine the disaster-management cycle, define the ICT capabilities needed to deal with emergency and elaborate a governance framework allocating roles and responsibilities.

A1.5 Others

A1.5.1 Global disaster statistics (Japan)[82]

The Global Centre for Disaster Statistics (GCDS, see **Figure 31A** for a detailed scheme) was established in partnership with the International Research Institute for Disaster Science (IRIDeS) at Tohoku University, Fujitsu, and other organizations with a view to implementing the Sendai Framework for Disaster Risk Reduction 2015-2030 and achieving the Sustainable Development Goals. The following outputs are expected:

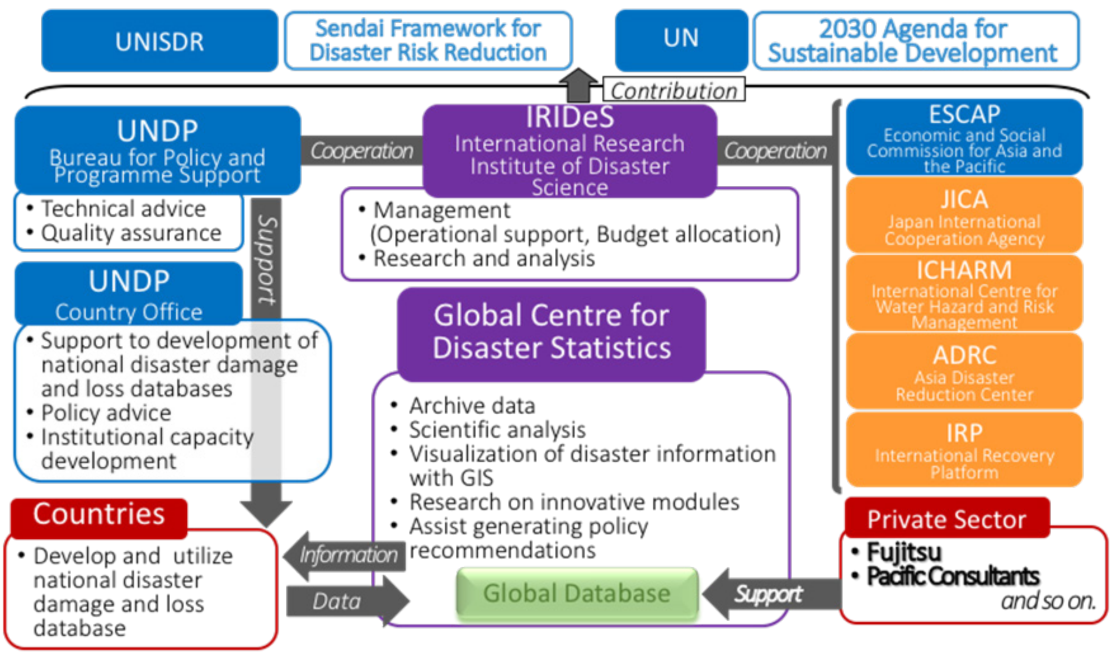
i) national capacities to produce disaster statistics are strengthened;

ii) a global information platform is developed for the analysis of disaster statistics; and

iii) independent scientific analyses are conducted of progress towards achievement of the Sendai Framework global targets and the Sustainable Development Goals.

In terms of academic contributions, the GCDS will publish a special issue of the Journal of Disaster Research on the development of disaster statistics.

Figure 31A: Detailed scheme of the GCDS



A pilot phase started in 2017, with UNDP and IRIDeS working with Cambodia, Indonesia, the Maldives, Myanmar, Nepal, the Philippines and Sri Lanka, which had been selected by the UNDP Asia-Pacific Hub, to increase their capacities in disaster statistics and convening regular meetings to share experiences. In terms of ICT, Fujitsu has developed a global database to store disaster loss and damage data. The

82 ITU-D SG2 Document SG2RGQ/74+Annex from Japan

GCDS has started to collect and store data from the pilot country governments. **Table 5A** shows the progress made in that respect.

Table 5A: Data collection progress

Indonesia	The API* developed by the BNPB** is stored in the database (22 442 data).
Myanmar	The GCDS has commenced proceedings to collect data to store in the database.
Philippines	The GCDS has commenced proceedings to collect data to store in the database.
Cambodia	The GCDS has commenced proceedings to collect data to store in the database.
Sri Lanka	The GCDS has commenced proceedings to collect data to store in the database.
Nepal (Republic of)	The GCDS plans to commence proceedings in this fiscal year to collect data to store in the database.
Maldives	The GCDS plans to commence proceedings in this fiscal year to collect data to store in the database.

*API: Application Programming Interface

**BNPB: National Agency for Disaster Management in Indonesia

Consultations with UNDP regional hubs have resulted in the countries listed in **Table 6A** being nominated as priority countries for GCDS implementation.

Table 6A: Priority countries for GCDS implementation

Africa	Uganda, Mozambique, Rwanda, Niger, Angola
Arab States	Djibouti, Egypt, Iraq, Lebanon, State of Palestine under Resolution 99 (Rev. Dubai, 2018), Somalia, Sudan, Tunisia
Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Georgia, Armenia
Latin America and the Caribbean	Peru, Paraguay, Chile, Cuba, Ecuador, Mexico, Nicaragua, Dominican Republic

The GCDS is now planning to take advantage of Fujitsu's Cloud Service K5. Needless to say, ICT is vital to connect numerous stakeholders. The GCDS mission will be achieved all the more effectively and efficiently in that it goes beyond various resource restrictions.

A1.5.2 Pre-positioned emergency telecommunication systems (Japan)[83]

When disaster strikes, damaged telecommunication equipment may lead to telecommunication blackouts or telecommunication traffic may become congested. When this happens, emergency telecommunication systems prepared in advance can rapidly restore important telecommunication services, e.g. for the police, fire department, local government and hospitals. They can also send safety confirmation messages to people in disaster areas. Using the systems in normal times, i.e. not in a disaster, can avoid problems such as system unavailability. In addition, emergency telecommunication systems can provide communication services in rural areas where service would otherwise be insufficient.

[83] ITU-D SG2 Document SG2RGQ/188(Rev.1) from Japan

The Japanese Government Cabinet Office's Strategic Innovation Programme plans to implement research results society-wide. One of its projects was a field trial of an MDRU initially designed as a disaster communication tool in the Republic of Nepal in February 2019.

The Republic of Nepal is a rugged country that is over 60 per cent hills and mountains. Many schools in remote villages in the hills and mountains have few resources and learning materials. Schools are closed for long periods during the monsoon and winter seasons because teachers and students cannot reach them. Remote education is one way to overcome the geographical conditions in Nepal, serve areas that are hard to access and encourage the participation of students and other stakeholders in education.

With the assistance of Japan, Educating Nepal, a Nepalese NGO, conducted a field trial in which an MDRU was used to provide remote education in the rural community of Jholunge, Indrawati Rural Municipality, in the hilly region of Sindhupalchowk District, roughly 85 km from Kathmandu.

The MDRU was used to connect the elementary school and two nearby villages, as shown in **Figure 32A**. The school was the main venue, while the two other locations were remote venue A and remote venue B. **Figure 33A** shows the geographical conditions of the trial.

Figure 32A: Testing remote education in the Republic of Nepal

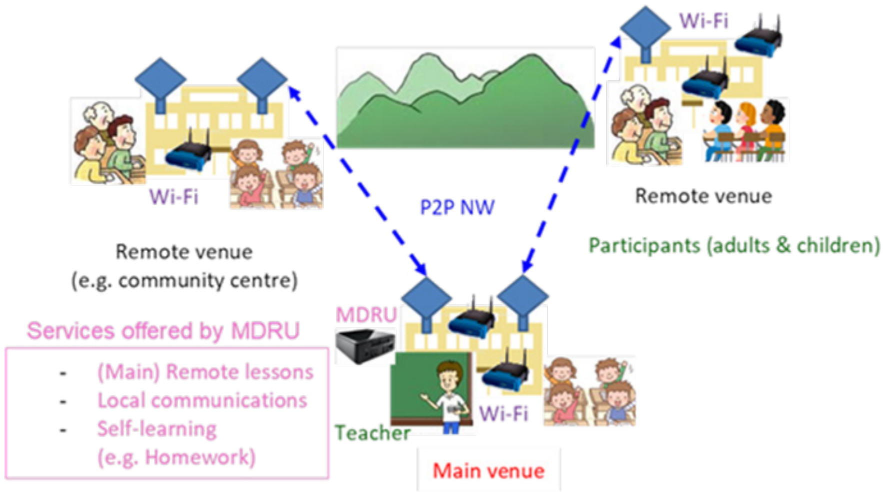


Figure 33A: Geographical conditions of Jholunge village

During the trial, remote teaching and learning were demonstrated to elementary school pupils, and remote consulting and agricultural support were tested for adults, especially farmers.

The results of the trial were evaluated by means of a questionnaire and interviews of key participants and observers. They show that the MDRU was very effective for remote education at a general level. Adult remote learning received the highest scores, followed by overall self-learning and then student remote learning. The MDRU user experience in terms of effectiveness, relevance and innovation received higher scores, while MDRU convenience and suitability for daily use received lower scores. The MDRU is therefore an effective tool for remote education that should be installed in various places to provide effective education through distance or e-learning.

The results also showed that it can be useful to redesign the dedicated user application or interface for remote learning, since the current application was fully tailored for disaster communication and was therefore at one point a little inconvenient to use for remote education. Apart from that one niggle, the MDRU obtained commendable test scores for its effective use in remote education.

Disaster-management solutions such as emergency telecommunication systems can be used for remote education in rural areas without enough telecommunication infrastructure in ordinary times. This has the added advantage of ensuring that children and farmers will know how to use the emergency telecommunication system when disaster strikes, as they will have been "trained" in its use in ordinary times.

A1.5.3 Fighting the Ebola virus disease (Democratic Republic of the Congo)[84]

Telecommunications are being used in the Democratic Republic of the Congo (DRC) to fight an outbreak of Ebola virus disease in the province of North Kivu in the east of the country and a threatened outbreak in the neighbouring countries of Rwanda and Uganda. The Democratic Republic of the Congo is affected by different kinds of disaster, the most common being those related to illnesses such as cholera and Ebola.

The main participants in the fight against Ebola are:

[84] ITU-D SG2 Document 2/252 from the Democratic Republic of the Congo

- the Office of the President of the Republic, through the anti-Ebola technical committee;
- the Ministry of the Interior and Security, through the DRC National Police, which provide security at sites and centres where patients are treated and cared for;
- the Ministry of National Defence, through the DRC Armed Forces, which are pursuing the armed groups that operate in the eastern part of the country and regularly attack medical and other health-care personnel, hospitals and members of the public;
- the Ministry of Health;
- the Ministries of Humanitarian Affairs and of Social Affairs;
- the Ministry of Posts and Telecommunications, through the regulatory authority;
- NGOs active in the field of humanitarian and health services;
- civil society, for public education and outreach campaigns;
- religious communities, in particular the Catholic Church (assistance is provided by the Vatican).

Given that armed groups are operating in the area where the Ebola epidemic has taken root, in the east of the Democratic Republic of the Congo, and that the epidemic has reached alarming proportions, with more than 2 000 cases, the Government has launched an epidemic response strategy, one of the pillars of which is telecommunications. Thanks to telecommunications, people in epidemic-affected areas can inform friends and relatives, the public authorities and humanitarian associations about the onset of disaster, the public authorities can issue alerts and plan relief operations, and rescue teams can coordinate their operations from the initial alert to the intervention process.

The telecommunication sector of the Democratic Republic of the Congo, which was opened to competition under the framework law of 16 October 2002, currently comprises the following:

- four mobile telephone operators (Vodacom Congo S.A, Airtel Congo S.A, Orange and Africell);
- one wired fixed telephone operator (the public/incumbent operator);
- one wireless fixed telephone operator (Standard Telecoms);
- about 20 Internet service providers;
- over 150 radio stations and about 60 television channels across the country, in urban and rural areas;
- over 10 national digital terrestrial TV channels;
- private telecommunication networks (operated by private organizations and NGOs).

Other forms of communication being used in the fight against Ebola include visual media such as banners, streamers, posters and T-shirts displaying public health advice.

In short, there are two types of telecommunication network being used in the fight against Ebola:

– **public networks**: mobile telephone networks, fixed telephone networks, radio and television broadcasting networks and Internet access networks;

– **private networks**: private companies, NGOs, etc.

These various telecommunication networks enable and facilitate:

– early warnings for prevention or intervention;

– the circulation, exchange and sharing of information and data among the different players involved;

– prompt decision-making so as to reduce the threat of the disease;

– planning and coordination of relief operations on the ground.

Are there specific regulations governing the use of telecommunications in the event of disasters in the Democratic Republic of the Congo?

While the answer to that question is "No", the Government has established provisions in the licensing agreements for telephone operators requiring them **inter alia** to help relief teams use their networks free of charge in their operations. To that effect, holders of licences for a public telecommunication service are required to organize free-of-charge emergency call services, in particular for the national police and relief services in the operating area of the service licensed.

In addition, the general regulations on telecommunications grant favourable terms for the possession, movement and use of satellite terminals such as Thuraya, Iridium and so on by NGOs. By virtue of agreements signed with the Government, NGOs are also exempt from any and all taxes and levies on telecommunication equipment and materials that they have and use for the fulfilment of their mission. All these various measures serve to increase and reinforce the relief capabilities of NGOs.

The mobilization of significant telecommunication resources has led to an improvement in the management of the Ebola epidemic in recent months, as confirmed by the encouraging results reported by medical sources. As control over Ebola is established, the number of positive diagnoses is decreasing and there are even cases of recovery.

A1.5.4 Disaster Maps programme (Facebook, United States)[85]

(1) Introduction

The enormous number of people using social networks such as Facebook means that extensive geospatial information is available on connectivity that is difficult to capture quickly through conventional methods. Many apps rely on location services data collected via smartphones. In the case of Facebook, people have the option to provide this information. Location data are used to provide myriad features, such as targeted alerts and prompts to check in as "safe" after a hazard event to allay the concerns of friends and family. In addition to powering product crisis response features, location data, when aggregated and anonymized, can provide insights into how populations are affected by crisis events.

Beginning in 2017,[86] Facebook began providing aggregated geospatial data sets to crisis response organizations and researchers to help fill information gaps in service delivery. These Disaster Maps utilize information about usage in areas impacted by natural hazards, producing aggregate pictures

[85] ITU-D SG2 Document 2/308 from Facebook (United States)

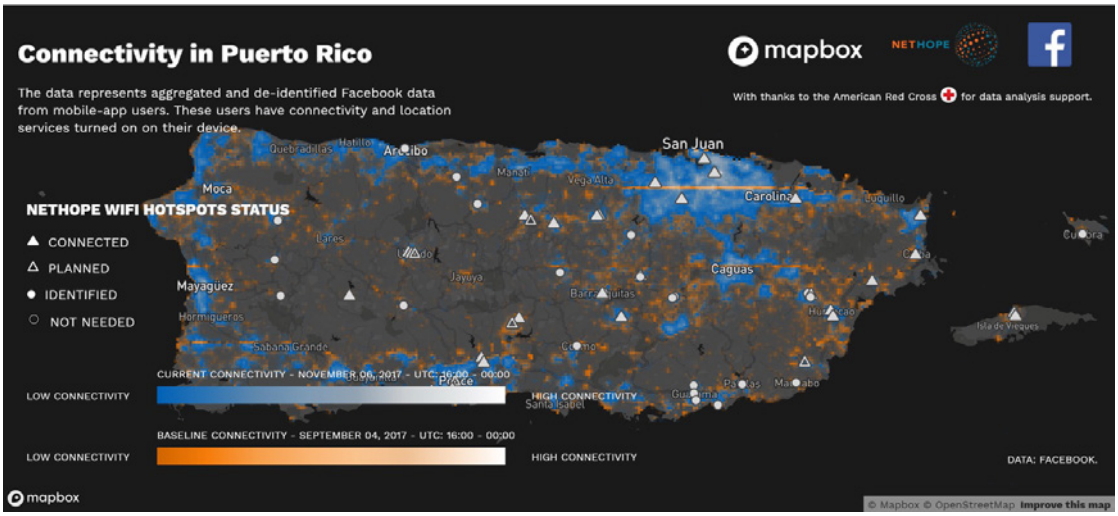
[86] Molly Jackman. Using Data to Help Communities Recover and Rebuild. Facebook Newsroom, 7 June 2017.

of how the population is affected by and responding to the crisis. The maps include insights into evacuations, cell network connectivity, access to electricity and long-term displacement. Since their launch, Disaster Maps have been activated for over 500 crisis events and made available to over 100 partner organizations. The connectivity maps in particular have proven to be instrumental in aiding emergency communication efforts.

(2) Case Study: Hurricane Maria

In the aftermath of Hurricane Maria in Puerto Rico in 2017, response organizations were in desperate need of information for rescue operations and aid coordination. The storm had knocked out the majority of communication services, including cellular Internet service, on the island. NetHope crews were quickly deployed and worked to restore connectivity, to enable responding organizations to coordinate rescue and aid efforts. Their challenge was how to target efforts to the areas of highest need. As shown in **Figure 34A** below, Disaster Maps data were used to show drops in connectivity on a daily basis by comparing the aggregate number of users connecting to Facebook before the storm and the number able to connect in the days after the hurricane.[87] The data helped NetHope identify the areas of greatest need and efficiently prioritize its relief efforts.

Figure 34A: Example connectivity map generated with Facebook Disaster Maps data by NetHope



The Disaster Maps programme was developed in a cross-functional effort by research, design, engineering, legal and policy teams to ensure that useful data are reliably provided to vetted NGOs and research organizations. The programme is ongoing and seeks to reach more people in need after a crisis, increase the data types surfaced in each Disaster Map and improve the accuracy of existing Disaster Maps data sets. Of particular note is the emphasis on ensuring that the privacy-protecting methods (such as aggregation and spatial smoothing) used in Disaster Maps are published openly. Companies in the tech sector draw on a wide range of privacy-protecting methods when considering how to share data, and these must be weighed against both technical limitations and legal requirements. These considerations require considerable effort and time. By publishing the solution that works for it, the company has dramatically reduced the barrier of entry for other entities to provide similar data sets in order to create a more complete picture for crisis response organizations.

(3) Facebook's data-sharing approach

87 NetHope Blog. Unlocking insights from data: Collaboration with private sector creates cutting-edge maps for disaster response, 9 October 2018.

Facebook generates and shares Disaster Maps as part of its Data for Good programme, which shares data sets externally with humanitarian response organizations while preserving user privacy. While building these efforts, the company developed key lessons and resources that can lower barriers for other companies to participate in similar crisis response data-sharing efforts.

- Facebook published the privacy protection methods it uses in Disaster Maps, which include aggregation, spatial smoothing, dropping small counts, and other techniques, as part of the proceedings of the 16th International Conference on Information Systems for Crisis Response and Management, in May 2019.[88]This open publication represents a critical contribution made in order to stimulate other private sector companies to consider providing similar data sets to crisis response organizations. Determining an acceptable privacy protection threshold in geospatial data sets is a complex undertaking, and it is Facebook's hope that by openly publishing its methods, it will lower barriers to entry for other private sector agencies to move forward with similar data-sharing efforts.
- The company launched improved displacement maps at the October 2019 NetHope Global Summit in Puerto Rico. These maps help non-profit and research partners better understand the volume of people displaced after a natural disaster and where they have been displaced.
- The company launched simplified and improved network connectivity maps in December 2019 based on feedback from existing emergency communication partners wishing to better understand where network connectivity was completely out following a natural disaster rather than simply reduced. These new network connectivity maps show where users have cellular connectivity of a 2G, 3G or 4G connection type based on the speed and latency of data being sent between the user's device and the servers hosting the mobile app.

(4) A collaborative approach

The goal of the Disaster Maps programme is to empower crisis response organizations and researchers with data that improve delivery of life-saving interventions while preserving user privacy. The programme also seeks to drive innovation in crisis response and emergency communication efforts that extends beyond the company. To date, Facebook has partnered with over 100 NGOs and research organizations through Disaster Maps, and a number of its NGO partners also work to share derivative products with broader coalitions of response agencies, including federal, state and local entities. These crisis response organizations are experienced in engaging government agencies and providing them with geospatial data. The company's programme model is to empower such partners with new data sources rather than displace their role in coordinating with governments directly. This has proven very successful and scalable. All Facebook partners complete a data license agreement in order to be granted access to Disaster Maps data.

When specific crisis response data gaps emerge, the company seeks organizations to work with closely, to guide its research and development of new or improved data sets. For example, the methodology for the improved displacement maps released in October 2019 was co-created by Facebook and the Internal Displacement Monitoring Centre (IDMC), which works on measuring numbers of internally

[88] Paige Maas et al. (Facebook). Facebook Disaster Maps: Aggregate Insights for Crisis Response and Recovery. WiPe Paper – Social Media in Crisis and Conflicts (ID 176), in Zeno Franco et al. (Eds). Conference Proceedings, 16th International Conference on Information Systems for Crisis Response and Management. Valencia (Spain), 19-22 May 2019, pp. 836-847.

displaced people. The company's Data for Good team continues to work with the IDMC to compare the insights derived from displacement data from recent crises in 2019, such as Cyclone Idai in India/Bangladesh and Typhoon Hagibis in Japan, and to compare displacement data with more traditional sources in order to refine and educate ongoing development efforts.

Collaboration with crisis response organizations in the emergency communication space has also led to new network connectivity maps. A specific example is the collaboration and feedback received from NetHope and its member organizations on the need to simplify the nature of coverage map generation for efficient operational decision-making. Critical questions facing these organizations included whether people had cellular connectivity, where drops in cellular connectivity had been observed in disaster-impacted areas, and how certain they could be that there had been a drop in cellular connectivity in a disaster-impacted area. To answer the first question, Facebook developed a simple coverage map showing the grid tiles that had network coverage on a given date. To address the second question, it surfaced a map that shows which grid tiles had not seen network connections on that date but had coverage during the 30-day baseline period. The company's teams addressed the third question by publishing the probability of a grid tile receiving network coverage on that date based on 30-day baseline observations.

(5) Testing and usability

All Disaster Maps undergo testing with users in order to ensure that new data sets are clear to understand and fit within the workflows of crisis response organizations. The company's Data for Good team has invested heavily in usability research with organizations across the spectrum of geospatial experience. For example, research with advanced users was a key part of refining and improving the format of data set files to enable customized analysis methods across a range of GIS applications. This research also included one-on-one interviews with novice users of Disaster Maps, to test early prototypes and determine the best means to visualize complex displacement data in vector format. Based on this feedback, the company's Data for Good team updated visualizations to allow for filtering by outbound or inbound displacement for a given location. In addition, the team improved the depth of documentation on the statistical methods used to compare pre-crisis connectivity levels with those observed in real time.

(6) Creating an enabling policy and regulatory environment for sharing information during a disaster

Facebook supports policies that protect and promote user privacy, especially during times of increased vulnerability such as following an emergency crisis. It recognizes that protecting privacy while improving the effectiveness of potentially life-saving response efforts requires concerted efforts and time by technical and programmatic teams.

The company and its partners encourage other entities from across the public and private sector to share geospatial data sets that preserve user privacy. A variety of collaborative approaches, including data governance frameworks, should be considered for scaling data-sharing efforts across private sector companies, so as to avoid overwhelming response organizations with additional data. The Data Collaboratives framework provided by GovLab has proven extremely useful in helping to ensure that decision-makers are able to be more data-driven and collaborative with the private sector.

Collectively, the emergency response community should advance policies and programmes that encourage a transparent approach to privacy protection and afford continued collaboration for improved humanitarian operations.

A1.5.5 ICTs in the fight against the COVID-19 pandemic (China)[89]

(1) Introduction

In the face of the COVID-19 pandemic, China has launched emergency communication measures to fight the pandemic from the perspectives of government and companies. First, more resources have been provided, to help telecom operators meet people's needs for more broadband Internet connectivity and telecommunication services. Second, during the pandemic, some countries have adopted measures to reduce and abolish telecommunication fees, cancel the upper limit of fixed broadband or mobile Internet access, abolish all telecommunication late payment fees, provide free calls or increase the data flow of tariff packages, so as to ensure the normal use of the telecommunication lifeline by users. The third is to provide decision-making support in the form of big-data analysis. The fourth is to develop new applications and launch a number of cloud services, which have played an important role in supporting services.

(2) Network guarantee

The Chinese Government has provided overall guidance to operators to ensure the construction of designated high-quality hospital communication networks within the shortest possible time. The operators completed the construction of telecommunication facilities at Huoshenshan, Leishenshan and shelter hospitals in Wuhan, overcoming various difficulties, and put into operation the 5G base station in Huoshenshan Hospital within 36 hours, providing full coverage of 4G/5G signals. The network deployment at Leishenshan Hospital was completed within 24 hours and can meet the concurrent telecommunication needs of 30 000 people. The wireless network coverage and optimization of Wuhan shelter hospitals was completed within 48 hours.

(3) Service guarantee

At the request of the joint prevention and control regime and relevant departments, the Chinese Government has organized operators to send tens of billions of public short messages on pandemic prevention and control, effectively supporting prevention and control efforts in various places. In areas where the situation was severe, operators offered convenient services, such as non-stop service and emergency start-up, and services enabling users to handle telecommunication issues without leaving home. Some areas connected people with the health and pandemic prevention agencies, and reduced the telephone charges for medical staff lending a hand in Hubei Province. Internet companies have been helped and encouraged to give full play to their respective advantages and provide public services such as online diagnosis and treatment, an e-commerce platform, teleworking and online education, so as to help realize "working without going to work, schooling without going to school", contributing greatly to the fight against the pandemic.

(4) Big-data analysis application

China can provide strong, accurate and comprehensive decision-making support for real-time pandemic prevention and control by using telecommunication big-data analysis. Since the outbreak, it has organized industry experts to carry out big-data analyses and established a telecom big-data analysis model for the pandemic.

The sharing and combining of big data on communication with data from health and disease control and prevention centres are important sources of support for the advance study and assessment of pandemic spread and prevention trends, contributing to dynamic prediction and early warning of the overall pandemic situation.

Telecommunication administrations of all provinces (autonomous regions and municipalities) have actively communicated with local COVID-19 prevention and control organizations, trying to understand the local needs for big data on pandemic prevention and control, organizing local operators to carry

[89] ITU-D SG2 Document SG2RGQ/220(Rev.1) from China

out big-data analyses, and providing detailed data support for pandemic prevention and control from the source and at grass-roots level, and for accurate government policy formulation.

Drawing on mobile user data, operators have cooperated with relevant departments on joint prevention and control, focusing on the dynamic analysis of people flows in key areas such as designated hospitals, fever clinics and points of assembly, and providing big-data analysis support services for population flows related to pandemic prevention and control. The results of big-data analyses related to pneumonia research released by Internet companies independently have also provided a useful reference for relevant government agencies in their decision making.

(5) Development of new applications and services

To fight the pandemic and help people resume work, production and school, Chinese operators have launched a number of cloud services that have played an important support role. In terms of cloud command, operators are free to launch "cloud conference" services for hundreds of parties online, for an unlimited number of times and for extended periods, thereby meeting the needs of governments at all levels, medical institutions and other agencies fighting COVID-19 in terms of command, dispatch and videoconferencing.

To facilitate cloud health care, the medical cloud system has been successfully applied in many areas during the pandemic. For example, China Mobile helped the General Hospital of the People's Liberation Army in Beijing and the Huoshenshan Hospital in Wuhan make the first critical remote diagnosis: medical experts at the General Hospital were kept on alert with the "5G telemedicine system" 24 hours a day. By using two medical trolleys in the infection division, Huoshenshan Hospital achieved interconnection and interoperability with the General Hospital wards using cloud video equipment and thus enjoyed real-time, professional and efficient diagnosis and treatment of difficult and severe cases at a distance of 1 200 kilometres, fully demonstrating the benefits of smart medicine. The successful application of the medical cloud system will facilitate the improvement of smart medicine and its widespread use in China.

To help people return to work and production, the information and communication industry has made full use of its technological advantages, fully promoted "cloud" services and helped enterprises to overcome difficulties, so as to ensure that both pandemic prevention and work can be carried out without delay. During the pandemic, many teleworking software and cloud services (e.g. collaborative offices, videoconferencing, document collaboration and equipment management) were launched, providing strong support enabling enterprises to quickly resume their work and production. In order to fully cooperate with COVID-19 prevention and control agencies and speed up the resumption of work and production, the Ministry of Industry and Information Technology made rapid arrangements for the China Academy of Information and Communications Technology and three operators, namely, China Telecom, China Mobile and China Unicom, to jointly launch the Telecommunication Big Data Travel Card, which uses communication big-data technology. Under strict provisions for the protection of personal information, domestic mobile phone users can check information on places they have visited (including overseas countries or regions) in the past 14 days for free, through SMS, mobile apps, the WeChat miniprogram, webpages and others. At the same time, the Telecommunication Travel Card app, which uses internationally accepted Bluetooth technology, alerts close contacts of confirmed COVID-19 patients, providing strong support for pandemic prevention and control.

In order to help students return to school, the Ministry of Industry and Information Technology, together with the Ministry of Education, made arrangements to network school operations and thus support "schooling without going to school" during the pandemic prevention and control period. Services across the country covered nearly 180 million primary and middle school students learning at home. The Ministry of Education has launched the national primary and secondary school network cloud platform. Baidu, Alibaba, China Mobile, China Unicom, China Telecom, Network Host and Huawei have provided technical support and coordinated the deployment of 7 000 servers with a bandwidth of 90 TB, enough to support 5 000 students going online at the same time, ensuring a smooth online learning experience.

A1.5.6 COVID-19 response (United States)[90]

(1) Introduction

To support COVID-19 response efforts, the United States Congress made available funds from the Coronavirus Aid, Relief, and Economic Security (CARES) Act for the COVID-19 Telehealth programme and the Education Stabilization Fund, to help students learn from home during the pandemic. The CARES Act, passed by Congress in March 2020, provides over USD 2 trillion in economic assistance to American workers, families and small businesses, to preserve jobs and help the economy during the COVID-19 emergency. The independent and collaborative efforts undertaken by the Federal Communications Commission (FCC) to maintain communications, provide important information to the public and support public health providers are summarized below.

(2) FCC actions in response to the COVID-19 pandemic in the United States

The COVID-19 pandemic has significantly increased voice and Internet traffic globally as lives and economies around the world move online. Teleworking, distance learning, online commerce and e-governance all rely on the availability of robust broadband and mobile technologies. Governments have had to quickly develop and implement strategies to ensure broadband availability as a cornerstone of economic life.

In the United States, the FCC took a number of actions to help keep consumers online and address the digital divide. FCC actions in this regard helped wired and wireless networks handle the surge without significant service disruptions or declines. Throughout the pandemic, the FCC helped increase national broadband penetration and provide additional support to consumers, businesses, schools and health-care providers.[91]

The FCC COVID-19 broadband strategy was largely based on three principles. First, anticipating that a large portion of American life would be moved online, the FCC determined that access to the internet would be the top priority. Second, the FCC determined that it would secure market participation before using government mandates. And third, the FCC took action to expedite existing FCC processes and partner with other agencies to develop new initiatives. Using these principles as a foundation to build upon, the FCC was able to help keep the United States population connected, help the health-care sector remain effective and efficient, and protect consumers.

(3) Keeping Americans connected

In March 2020, FCC Chairman Ajit Pai announced the Keep Americans Connected Pledge. Under this initiative, broadband and telephone service providers were called on to enter into a voluntary commitment to: (1) not terminate service to any residential or small business customer because of an inability to pay bills due to the disruptions caused by the coronavirus pandemic; (2) waive any late fees that residential or small business customers incurred because of their economic circumstances related to the coronavirus pandemic; and (3) open their Wi-Fi hotspots to any American who needed them.[92] More than 800 service providers agreed to the voluntary terms and took the pledge, with several going above and beyond the original request. One company, for example, provided unlimited Internet data to all customers with home Internet; another offered four months of free broadband service for new customers with telehealth, education and work-from-home needs; while others offered free Internet service and installation for certain low-income families with students, or families living in rural areas where Internet service was unavailable. Actions taken pursuant to the pledge were in effect through 30 June 2020. Thereafter, the FCC encouraged broadband and telephone service

90 ITU-D SG2 Document SG2RGQ/283 from the United States

91 See the coronavirus page on the FCC website

92 Statement of Chairman Ajit Pai, Federal Communications Commission, Hearing on the Oversight of the Federal Communications Commission Spectrum Auctions Program, Fiscal Year 2021, before the Subcommittee on Financial Services and General Government, U.S. Senate Committee on Appropriations, 16 June 2020.

providers to take additional steps to help American consumers and small businesses stay connected. Several companies agreed to place customers into pro-rated payment plans for up to 12 months, defer device payments, waive a portion of unpaid balances or, in cases of extraordinary hardship, work with customers on an individual basis. Many also agreed to provide free service to customers in low-income housing through the end of July and to keep Wi-Fi hotspots open until the end of 2020.

As the pledge was nearing expiration, the FCC Chairman sent a letter to Congress seeking to collaborate on legislation to help consumers and small businesses stay connected. He informed Congress that the public-private partnership reflected in the pledge had been critical to maintain connectivity for American consumers and access for low-income families, teleworkers, veterans, and students participating in remote learning. He requested Congress to provide additional funding for telehealth expansion, broadband mapping and an end to American reliance on manufacturers posing a threat to the integrity of the ICT supply chain.

In addition to working with communication providers to secure the pledge in March 2020, the FCC simultaneously took measures to make sure that carriers had sufficient spectrum to meet the anticipated spike in demand for mobile and broadband services caused by quarantine. It issued special temporary authority licences granting mobile carriers access to additional spectrum to serve Puerto Rico and the U.S. Virgin Islands,[93] help Americans participate in telehealth, distance learning and telework, and meet the needs of first responders[94]. The FCC also granted a number of such licences to wireless Internet service providers in rural communities and elsewhere.

The FCC also took action to ensure that Tribal lands in the United States remained connected. In March 2020, it granted special temporary authority licences for 2.5 GHz of spectrum to the Zuni Pueblo Tribe[95] and the Navajo Nation[96]. Additionally, the FCC partnered with the Institute of Museum and Library Services to support using USD 50 million in funding from the CARES Act to work towards bridging the digital divide during the pandemic. Both agencies worked together to inform libraries and Tribal organizations of the funds and resources available to them. They also ensured that libraries across the country were aware that community use of Wi-Fi networks supported by the FCC's Universal Service Fund E-Rate programme was permitted during library closures.[97] The goal of these partnerships was to make sure that rural communities, the Tribes, and organizations serving and representing Native Hawaiians had the resources to respond to the pandemic in ways that met the immediate and future needs of the communities they served.

(4) Public safety and health-care support

Those teleworking, attending class from home or working in the health-care sector need immediate and continued access to mobile and broadband services. Additionally, individuals have increased their reliance on connected care to get virtual medical attention and consultation. To assist with health-care support, the FCC implemented the COVID-19 Telehealth programme, which provided USD 200 million in funding[98] for Americans to safely access vital health-care services. This funding helps health-care professionals provide connected care services to patients at their homes or mobile locations. It provides immediate support to eligible health-care providers responding to the COVID-19

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93 FCC. News Release. FCC Grants AT&T Temporary Spectrum Access for Puerto Rico and U.S. Virgin Islands to Meet Growing Broadband Needs during Covid-19 Pandemic. 26 March 2020.

94 FCC. News Release. FCC Provides T-Mobile Temporary Access to Additional Spectrum to Help Keep Americans Connected during Coronavirus Pandemic. 15 March 2020.

95 FCC. News Release. FCC Grants Temporary Spectrum Access to Support Connectivity on Tribal Reservation during Covid-19 Pandemic. 30 March 2020.

96 FCC. News Release. FCC Grants the Navajo Nation Temporary Spectrum to Meet Increased Wireless Broadband Needs during Covid-19 Pandemic. 30 March 2020.

97 FCC. News Release. FCC Partners with Institute of Museum and Library Services to Address Digital Divide during COVID-19. 21 May 2020.

98 Funding appropriated by Congress as part of the CARES Act

pandemic by fully funding their telecommunication and information services, and devices necessary to provide critical connected care services. The FCC approved 539 funding applications in 47 states, Washington, DC, and Guam, which included recipients in both urban and rural areas of the country, and from coast to coast.[99] To further ensure that health-care providers had the resources they needed, the FCC adopted an order to fully fund all eligible Rural Health Care programme services for the current funding year.[100] The order will enhance connectivity and promote telehealth solutions for patients during this global health emergency.[101]

The FCC also implemented changes to the Rural Health Care[102] (RHC) and E-Rate[103] programmes, to make it easier for broadband providers to support telehealth and remote learning efforts during the pandemic. It waived certain rules to allow service providers to offer, and RHC and E-Rate programme participants to solicit and accept, improved connections or additional equipment for telemedicine or remote learning during the outbreak, thus ensuring that telehealth and remote learning efforts remained available and accessible.[104] In addition to providing support for telehealth services, the FCC and the Department of Education announced efforts to promote remote learning using funds from the CARES Act Education Stabilization Fund.[105] Through this effort, the agencies will work with governors, states and local school districts to leverage funding to help students learning from home during COVID-19. Funding from this initiative may also be used to finance educational technologies, including, hardware, software and connectivity.[106]

As part of utilizing pre-existing programmes to manage the crisis, the FCC took steps to help ensure that no American would be involuntarily removed from the Lifeline programme during the coronavirus pandemic. This programme provides a monthly discount on either a wireline or a wireless service. Lifeline also supports broadband Internet access service and broadband-voice bundles to low-income consumers.[107] To keep consumers connected, the FCC waived several rules that would have otherwise removed subscribers from the programme. The order also waived the programme's usage requirements and general de-enrollment procedures, and extended a recent waiver of its recertification and reverification requirements initially until 29 May 2020 and then until 30 November 2020.[108] The FCC stated that it would continue to monitor the situation to determine whether any additional extension of these waivers was appropriate. Ensuring that individuals already enrolled in the Lifeline programme remain, along with extending access to those recently affected by the pandemic, provides relief to millions of Americans who otherwise would have lost mobile and/or broadband services.

Since the start of the pandemic, many private and public sector employees have been working from home and students have shifted to taking classes online. Employees and students alike have had to

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99 FCC. News release. FCC Approves Final Set of COVID-19 Telehealth Program Applications. 8 July 2020.

100 FCC. News Release. Chairman Pai Welcomes Increase in Rural Health Care Funding. 13 March 2020.

101 Ibid.

102 The Rural Health Care programme provides funding to eligible healthcare providers for the telecommunication and broadband services needed to provide healthcare.

103 The FCC's E-Rate programme makes telecommunication and information services more affordable for schools and libraries by providing discounts for telecommunications, Internet access and internal connections to eligible schools and libraries.

104 FCC. News Release. FCC Waives Rural Health Care and E-Rate Program Gift Rules to Promote Connectivity for Hospitals and Students during Coronavirus Pandemic. 18 March 2020; see also FCC. Order. E-Rate and RHC COVID-Related Waivers Extended. 3 September 2020.

105 USD 16 billion in funding is to come from the CARES Act and was announced in April 2020.

106 FCC. News Release. FCC and U.S. Department of Education promote remote education so students can continue learning. 27 April 2020.

107 FCC. Consumer Guide. Lifeline Support for Affordable Communications. Accessed 27 August 2020.

108 FCC. News Release. FCC Acts to Keep Low-income Americans Connected during Coronavirus Pandemic. 30 March 2020; see also FCC. Order. WCB Extends Lifeline Program Waivers Due to COVID-19., 17 August 2020.

rely heavily on platforms that host videoconference services to attend meetings and classes. Under normal circumstances, the sharp increase of users on these platforms would have caused additional rules to be placed on the companies that host them. To mitigate this, the FCC specifically issued a temporary waiver of its access arbitrage rules[109] for one of the telecommunication companies that hosts the traffic for two of the nation's largest conference calling providers. This waiver prevents companies that host applications for videoconferencing from facing financial consequences under the rule. Prior to the waiver, the massive increase of users on applications like Zoom and WebEx would have caused the companies who host these service providers to be deemed an "access-stimulating" carrier under the FCC's rules. Normally, if triggered, this would add additional financial burdens that could impede their ability to host companies providing such video services.[110]

(5) Consumer protection and safety

To maintain relay services for individuals who are deaf, hard of hearing, deaf-blind or have a speech disability during the pandemic, the FCC granted temporary waivers to Telecommunications Relay Service (TRS) providers allowing American Sign Language interpreters to work from home.[111] As a result of the pandemic and states' responsive emergency regulations, traffic levels have increased, challenging the ability of TRS providers to properly staff call centres and answer and process TRS calls. Temporary emergency waivers of the FCC's speed-of-answer requirement, at-home video relay service (VRS) call-handling rules, VRS subcontracting restrictions and provisions of the emergency call handling rule have given TRS service providers greater flexibility to provide valuable services during the pandemic.

Broadcasters have also contributed substantially by making voluntary public service announcements in English and Spanish about social distancing, airing educational programming to help with distance learning, expanding the news coverage of COVID-19, and holding fundraisers to help those facing financial hardship due to the virus.[112] Broadcasting companies have also offered teaching services and tools for students in grades 6-12 along with special programming on the coronavirus. The National Association of Broadcasters offers a coronavirus toolkit in both English and Spanish.

Unfortunately, scams related to Coronavirus fears have increased in the United States and around the world. To combat this, the FCC is raising awareness of the dangers of these fraudulent activities, and of how consumers can mitigate home network and mobile device security issues. It is keeping Americans informed about the types of schemes being used, and how to identify and avoid them. The FCC's Coronavirus Scam webpage identifies text messages, robocalls and contact tracing as the three such schemes used most often to target individuals who may be considered at risk of the virus. The FCC also provides information to consumers through its Consumer Help Center and through the FCC Scam Glossary.mIn partnership with FEMA, it offers tips for communicating during an emergency, including how to prepare for a power outage. Finally, the FCC has issued guidance on how to optimize the performance of consumer home networks and how to safely sanitize mobile devices.[113]

In a collaborative effort with the Federal Trade Commission (FTC), the FCC has worked to protect consumers from robocalls and provided important information on the dangers of contact tracing scams. On 20 May 2020, both agencies required gateway providers allowing COVID-19-related scam robocalls to cut off this traffic or phone companies would be allowed to block all traffic from those

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109 The FCC’s arbitrage rules are aimed at preventing telecom companies from exploiting the intercarrier compensation system by generating inflated call volumes to pad their bottom lines.

110 FCC. News Release. FCC Waives Rules to Ensure Consumers Can Continue Accessing Conference Calling Services From Zoom And WebEx During The Covid-19 Crisis. 27 March 2020.

111 FCC. News Release. FCC grants flexibility to relay service providers to preserve communications access for Americans with disabilities. 16 March 2020.

112 For example, one company raised USD 275 000 for a relief fund for COVID-19 related economic hardship and another raised USD8 million for coronavirus relief via a virtual music concert.

113 See FCC. Consumer. Home Network Tips for the Coronavirus Pandemic. Updated 1 July 2020.

gateway providers' networks. Scams being routed to American consumers included fake COVID-19 refunds, Social Security Administration COVID scams, and Loan Interest Rate Reduction scams. Within 24 hours of the notice, three gateway providers had complied with the demands. This came after a similarly successful push in April 2020 from the agencies that effectively terminated other robocallers' access to American phone networks.[114] Additionally, the FCC has worked hard to inform the public about the dangers of giving information to individuals falsely claiming to be involved in contact tracing. Both the FCC and FTC warn consumers that contact tracing is typically carried out by state health departments and is not a federal programme. These initiatives help prevent users from falling victim to one of these scams.

Finally, the FCC's Broadband Deployment Advisory Committee (BDAC), which is a multistakeholder committee that provides advice and recommendations to the FCC on how to accelerate the deployment of high-speed Internet access, was called upon to provide support for COVID-19 relief initiatives. The BDAC Disaster Response and Recovery Working Group is comprised of representatives from across a broad spectrum of public and private organizations, and includes individuals from states and localities, industry, and consumer and community organizations.[115] In April 2020, it was tasked with assisting the BDAC in documenting the various strategies and solutions being developed and implemented by public and private stakeholders to address the deployment-related challenges presented by the pandemic. The Working Group will use the data collected to report on best practices and lessons learned from the response in order to prepare for and respond to any comparable future crises. The first report and recommendations of the current Working Group were presented to and approved by the full BDAC on 27 March 2020, outlining the strategies for emergencies related to planning, responding and restoring communication access.

[114] FCC. News Release. FCC, FTC demand robocall-enabling service providers cut off COVID-19-related international scammers. 20 May 2020.

[115] FCC Public Notice. DA 20-420. FCC Tasks BDAC Working Group with Addressing COVID-19 Challenges. 16 April 2020.

Annex 2: ITU intra-Sector and inter-Sector mapping

A2.1 Collaboration with other Questions in ITU-D Study Groups 1 and 2

This section provides a list matching ITU-D Question 5/2 to other Questions being examined by ITU-D Study Groups 1 and 2. The list was reviewed and discussed at Question 5/2 meetings, after which the table below was agreed without any further comments.

Table 7A: Matrix of ITU-D Study Group 1 and 2 intra-sector coordination

	Q1/1	Q2/1	Q3/1	Q4/1	Q5/1	Q6/1	Q7/1	Q1/2	Q2/2	Q3/2	Q4/2	Q6/2	Q7/2
Q5/2	X	X	X	X	X			X	X	X		X	

A2.2 Mapping of ITU-T and ITU-D Questions

Based on ITU study group activities, with the assistance of the three Bureaux the ITU General Secretariat has developed mapping documents[116], including the mapping of ITU-D and ITU-T Questions.[117]

[116] ITU. Inter-Sector Coordination Group (ISCG) documents. Mapping Tables.

[117] ITU. ISCG. Mapping of ITU-D SG1 and SG2 Questions to ITU-T Questions.

Table 8A: Matrix of ITU-D Question 5/2 and ITU-T Questions

		Q5/2			Q5/2
ITU-T SG2	Q1/2		**ITU-T SG9**	Q1/9	
	Q3/2	X		Q2/9	
	Q5/2			Q4/9	
	Q6/2			Q5/9	
	Q7/2			Q6/9	
ITU-T SG3	Q1/3			Q7/9	
	Q2/3			Q8/9	
	Q3/3			Q10/9	
	Q4/3		**ITU-T SG11**	Q1/11	
	Q6/3			Q2/11	
	Q7/3			Q3/11	X
	Q9/3			Q4/11	
	Q10/3			Q5/11	
	Q11/3			Q6/11	
	Q12/3			Q7/11	
	Q13/3			Q9/11	
ITU-T SG5	Q1/5			Q10/11	
	Q2/5			Q11/11	
	Q3/5			Q12/11	
	Q4/5			Q13/11	
	Q6/5	X		Q14/11	
	Q7/5			Q15/11	
	Q8/5				
	Q9/5	X			

		Q5/2			Q5/2
ITU-T SG12	Q2/12		ITU-T SG16	Q8/16	X
	Q3/12			Q13/16	
	Q4/12	X		Q14/16	X
	Q5/12			Q21/16	
	Q6/12			Q24/16	
	Q7/12			Q26/16	X
	Q8/12			Q27/16	
	Q11/12			Q28/16	
	Q12/12		ITU-T SG17	Q1/17	
	Q13/12			Q2/17	
	Q16/12			Q3/17	
	Q18/12			Q4/17	
	Q19/12			Q5/17	
ITU-T SG13	Q1/13			Q6/17	
	Q5/13			Q7/17	
	Q6/13			Q8/17	
	Q7/13			Q9/17	
	Q16/13			Q10/17	
	Q17/13			Q11/17	
	Q18/13			Q13/17	
	Q19/13		ITU-T SG20	Q1/20	
	Q20/13			Q2/20	X
	Q21/13			Q3/20	X
	Q22/13			Q4/20	X
	Q23/13			Q5/20	
ITU-T SG15	Q1/15	X		Q6/20	
	Q11/15			Q7/20	
	Q12/15				
	Q16/15	X			
	Q17/15	X			

A2.3 Mapping of ITU-R and ITU-D work

The mapping with ITU-R[118] is detailed below:

Table 9A: Matrix of ITU-R working parties and ITU-D Question 5/2

R\D	WP 1A	WP 1B	WP 1C	WP 3J	WP 3K	WP 3L	WP 3M	WP 4A	WP 4B	WP 4C	WP 5A	WP 5B	WP 5C	WP 5D
Q5/2		X	X					X	X	X	X	X	X	X

R\D	WP 6A	WP 6B	WP 6C	WP 7A	WP 7B	WP 7C	WP 7D
Q5/2	X	X	X			X	

[118] ITU. ISCG. Mapping of ITU-D SG1 and SG2 Questions to ITU-R Working Parties.

Annex 3: Information from ITU-T and ITU-R

A3.1 Framework of disaster management for network resilience and recovery (ITU-T Study Group 15)

ITU-T Study Group 15 provided information on the establishment of the supplement ITU-T L.Sup35, Framework of Disaster Management for Network Resilience and Recovery, which summarized several architectural frameworks for network resilience and recovery aimed at ensuring continuity of communications as much as possible in the event of a disaster.

A3.2 Informative update in the area of disaster communications (ITU-R Disaster Relief Liaison Rapporteur)

The ITU-R Disaster Relief Liaison Rapporteur frequently provided updated information related to disaster communications in ITU-R and other organizations.

The Liaison Rapporteur provided a comprehensive and informative update of the disaster communication activities, reports, resources, deployments and programmes of ITU-R and numerous ITU, regional and industry partners through October 2017, including a comprehensive update on known Caribbean hurricane responses.

The Liaison Rapporteur also provided a comprehensive list of recent disaster-related activities noted across ITU Sectors, in regional organizations and in industry-specific groups.

The Liaison Rapporteur further provided information about a revision of Question ITU-R 77-8/5, on the needs of developing countries in IMT development and implementation.

Lastly, the Liaison Rapporteur provided a comprehensive overview of recent developments relating to emergency communications. The overview included WRC-19 outcomes, ongoing work in ITU-R and ITU-T and various activities by BDT to help countries prepare for and respond to disasters. It also stated that ITU had joined the Crisis Connectivity Charter, a mechanism created between the satellite industry and the wider humanitarian community to make satellite-based communications more readily available to humanitarians and communities in times of disaster.

A3.3 Remote-sensing systems (ITU-R Working Party 7C)

ITU-R Working Party 7C submitted a report on remote-sensing systems in which it noted that ITU-R was updating Recommendation ITU-R RS.1859, on the use of national remote-sensing systems for data collection in the event of disaster. The update would be finalized and sent to the parent group, ITU-R Study Group 7, in September 2018.

A3.4 Country national emergency telecom systems (ITU-T Study Group 2)

ITU-T Study Group 2 sought the review and comments of the Question 5/2 team on the contribution from Benin on improving the emergency telecom system in Benin, which proposes that a new work item be created in ITU-T on developing country national emergency telecom systems. The idea is to define norms and practices regarding countries and their level of development and to work on developing emergency telecommunication infrastructure.

A3.5 Terms and definitions for disaster relief systems, network resilience and recovery (ITU-T Study Group 2)

ITU-T Study Group 2 provided information on its work on E.TD-DR, Terms and definitions for disaster relief systems, network resilience and recovery.

ITU-T Study Group 2 also provided information about the finalized ITU-T Recommendation E.102 (ex E.td-dr), Terms and definitions for disaster relief systems, network resilience and recovery, and E.100-series Supplement 1 (ex. E.sup.fdr).

A3.6 Framework of disaster management for disaster relief systems (ITU-T Study Group 2)

ITU-T Study Group 2 informed the Question 5/2 meeting about E.SUP.FDR, Framework of disaster management for disaster relief systems. It was noted that section 6 of this supplement ("Overview of early-warning and disaster relief systems") is relevant to Question 5/2.

ITU-T Study Group 2 also informed the meeting that a new Focus Group on Artificial intelligence for natural disaster management (FG-AI4NDM) has been established under ITU-T SG2. The background and practical information can be found on the group's homepage: http://itu.int/go/fgai4ndm .

A3.7 Global broadband Internet access by fixed-satellite service systems (ITU-R Working Party 4A)

ITU-R Working Party 4A provided information on progress on Recommendation ITU-R S.1782, Possibilities for global broadband Internet access by fixed-satellite service systems.

A3.8 The fast deployment emergency telecommunication network (ITU-T Study Group 11)

ITU-T Study Group 11 provided information on its progress in drafting Recommendation ITU-T Q.ETN-DS, Signalling architecture of the fast deployment emergency telecommunication network to be used in a natural disaster, which focused on a number of emerging technologies.

ITU-T Study Group 11 reported that Recommendation ITU-T Q.3060 (former Q.ETN-DS) had been consented at its meeting in July 2020.

It was noted that the corresponding completed work item should be removed from the mapping table between ITU-D and ITU-T.

A3.9 Fixed wireless systems for disaster mitigation and relief operations (ITU-R Study Group 5)

ITU-R Study Group 5 provided information on its update of Recommendation ITU-R F.1105, Fixed Wireless Systems for disaster mitigation and relief operations.

A3.10 Satellite systems (ITU-R Working Party 4B)

ITU-R Working Party 4B, on interrelated activities of ITU-R and ITU-D, noted the update of Report ITU-R M.NGAT-SAT, on Key Elements for Integration of Satellite Systems into Next Generation Access Activities. It also provided information on the update of Recommendation ITU-R S.1782, Possibilities for Broadband Internet Access by Fixed Satellite Service Systems.

A3.11 Public protection and disaster relief (ITU-R Working Party 5A)

ITU-R Working Party 5A provided information on several ITU-R Recommendations and Reports that could be relevant to work on Question 5/2. All ITU-R Recommendations and Reports on PPDR, including those related to the role of the amateur service in disaster relief, are included in section 6 of the document entitled 'Guide to the use of ITU-R texts relating to the land mobile service, including wireless access in the fixed service'. Recently updated publications include Recommendations ITU-R M.2009 and ITU-R M.2015 and Reports ITU-R M.2377 'Radiocommunication objectives and requirements for Public Protection and Disaster Relief (PPDR)' and ITU-R M.2415 'Spectrum needs for Public Protection and Disaster Relief'.

A3.12 IMT Public protection and disaster relief (ITU-R Working Party 5D)

ITU-R Working Party 5D informed the Question 5/2 meeting that Report ITU-R M.2291, which addressed the use of International Mobile Telecommunications for broadband PPDR and had originally been completed by Working Party 5D in 2013 before being updated in 2016, had been updated again in March 2021. This report describes the benefits of using LTE to support PPDR radiocommunications. The current update addresses the use of IMT 2020 to support PPDR radiocommunications.

Annex 4: Information on workshops and panel sessions

A4.1 Panel session on early-warning systems[119]

Geneva, Switzerland

8 May 2018

Summary

Introduction

As part of the work of **ITU-D Study Group 2** on **Question 5/2,** and with the support of the administrations of Japan and the United States, the Question 5/2 meeting organized a **panel session on early-warning systems, including safety confirmation**, on 8 May 2018. The session was an opportunity to present a high-level introduction to numerous stakeholders involved in early warning, with activities including disaster prediction and detection, alerts, emergency information and safety confirmation. The discussion focused on identifying the lessons learned from the experiences of a diverse group of stakeholders. The discussion results were to be considered for further study as the Question turned to early warning in 2018, with key findings incorporated into the annual report of Question 5/2 for 2018 on early warning.

Session details

The session was opened by **Hideo Imanaka, Vice-Rapporteur of Question 5/2, NICT, Japan,** who briefly explained the background and objectives of the panel session.

Cosmas Zavazava, Chief, Project Support and Knowledge Management, BDT, delivered opening remarks on ITU activities on disaster relief. Panel sessions and workshops were very important for exchanging information and experience within ITU-D, with other ITU sectors and with other organizations. The conclusions and best practices from the panel session would be valuable for the work on Question 5/2.

Discussion

The panel session, led by **Joseph Burton, Co-Rapporteur for ITU-D Study Group 2 on Question 5/2, Department of State, United States,** discussed both current and emerging technologies for early-warning systems. The experiences of government, industry and research institute stakeholders in planning and preparation for detecting disasters and issuing alerts must continuously evolve based on lessons learned from previous disasters.

Xu TANG, Weather and Disaster Risk Reduction Service Department, WMO, briefly explained WMO activities that can benefit national early-warning and alert activities, including the Multi-Hazard Early-Warning Systems Checklist and the Climate Risk and Early-Warning Systems Initiative. WMO had also adopted the CAP (ITU-T X.1303) and the alerting platform called Alert Hub. The Global Multi-hazard Alert System aimed to provide authoritative information and advice for the operational and long-term decision-making processes of United Nations agencies and the humanitarian community.

Imani ELLIS-CHEEK SY, Federal Communications Commission, United States, provided an overview of the modernization of United States alerting systems, including the Emergency Alert System and Wireless Emergency Alerts. The Emergency Alert System delivered alert messages by broadcast radio and television, cable television and direct broadcast satellite. Wireless Emergency Alerts sent alert messages to mobile phones in targeted areas. It could also send Child Abduction Alerts.

[119] For further information, see the panel session webpage.

Azar ZARREBINI, Iridium, United States, shared information about the importance of early-warning systems using satellite technologies. Satellites could provide timely emergency communications in the event of a disaster, but emergency deployments of satellite equipment were often hindered by licensing or regulatory issues. In the future, communication policy-makers should consider policies that would enable, and not delay, the use of M2M-based disaster detection applications, which had implications for early warning.

Yulia KOULIKOVA, EMEA Satellite Operators Association (ESOA), Belgium, introduced the activities of the ESOA Multi-hazard Early-Warning System. ESOA had a programme called SATLAS, which was co-funded by European Space Agency Advanced Research in Telecommunications Systems (ARTES). SATLAS was an incubator for developing satellite communication applications. Its target market was the Middle East and Africa, plus Europe. As with the flood early-warning system, the ESOA stand-alone flood monitoring solution used BGAN M2M, which could also be used to create a tsunami early-warning system whereby sensors monitored real-time changes in sea level and other parameters. The resulting data could be sent via specific platforms to systems able to trigger sirens to alert citizens to an emergency situation. The system was being tested in Thailand.

Yoshiaki NAGAYA, Ministry of Internal Affairs and Communications, Japan, briefly introduced the latest research activities on early warning in Japan. Real-time big-data analysis could be used to detect localized torrential rainfall. 3-D images captured by newly developed radars were analysed in a very short time and alert messages sent 20 minutes before the rainfall started. Analysing SNS messages could be helpful for disaster detection. The DISAANA (DISaster information ANAlyzer) system developed by NICT could analyse SNS (e.g. Twitter) messages, which were available in extremely large numbers and contained non-structured data. The outputs of DISAANA could be used to assess victim needs and monitor disaster-affected areas.

Conclusions and best practices

During the panel discussion, the representatives of Sudan, Niger, Benin, ATDI, Côte d'Ivoire, the United Republic of Tanzania, South Africa and Ghana engaged in an active discussion with the panellists and BDT. The following items were recognized as best practices (see **Section 7.1(A)** of this report for a complete description of each item):

- keep developing country needs in mind;
- ensure flexibility;
- ensure regulatory flexibility;
- adapt emergency alert systems;
- ensure connectivity;
- build capacity;
- develop enabling policies;
- continuously improve emergency procedures;
- be alert to technological advances;

Other areas for consideration were as follows:

- advance training on satellite systems;

- last-mile warning messages from local government to citizens, and the capacity of satellite systems;
- the ongoing pursuit of disaster risk knowledge, which can be expanded by systematically collecting data and assessing disaster risks (detection, monitoring, analysis and forecasting of hazards and possible consequences) and thus enable the communication of timely, accurate, relevant and actionable warnings with information on likelihood, impact and recommended action;
- the need for ongoing stakeholder coordination.

Contributions to Question 5/2 in 2018 that took early-warning system experiences and needs into account would be valuable for further consideration.

Sanjeev BANZAL, Co-Rapporteur of Question 5/2, Telecom Regulatory Authority of India, India, summarized the outcomes of the panel discussion, which had covered everything from regulatory issues to emerging technologies such as M2M and SNS, and the importance of the Multi-Hazard Early-Warning Systems Checklist. Early-warning systems were clearly of great interest to participants, who were encouraged to engage in further information exchanges, in particular by submitting contributions providing specific examples of the application of technologies to specific areas of early-warning systems, and of enabling policies, to the October 2018 meeting on Question 5/2.

Ahmad R. SHARAFAT, ITU-D Study Group 2 Chairman, Islamic Republic of Iran, closed the session by thanking the Question 5/2 management team, BDT, the panellists and the participants for their fruitful discussions.

A4.2 Session on disaster drills and emerging technologies on disaster management[120]

Geneva, Switzerland

3 October 2018

Summary

Introduction

As part of the work of **ITU-D Study Group 2** on **Question 5/2**, the Question 5/2 meeting organized a **session on disaster drills and emerging technologies on disaster management** on Wednesday, 3 October 2018. The session consisted of three detailed workshops and aimed to present and exchange information on disaster drills, exercises and emerging technologies. The discussion focused on identifying lessons learned based on the experiences of a diverse group of stakeholders. The discussion results would be considered for further study as the Question turned to disaster drills in 2019, with key findings incorporated into the annual report of Question 5/2 for 2019 on disaster drills using ICTs.

Note: All presentations for this session are available on the event website.

Session details

The session was opened by **Sanjeev Banzal, Co-Rapporteur for Question 5/2, India**, who welcomed participants, then briefly explained the background and objectives.

Workshop 1: Experiences of disaster drills using emergency telecommunication systems

[120] For further information, see the panel session webpage.

Workshop 1 was moderated by Hideo Imanaka, Vice-Rapporteur for Question 5/2, NICT, Japan. Its objectives were:

– to explore experiences of actual disaster drills using ICTs;

– to consider the lessons learned from those experiences and the effectiveness of the drills in emergency situations;

– to discuss the key objectives of drills, and how stakeholders were involved.

Lars Bromley, United Nations Institute for Training and Research (UNITAR), presented UNITAR's role in disaster preparedness and drills, briefly explaining UNITAR and UNOSAT activities for disaster drills and assessment of disaster-affected areas using satellite imagery analysis technologies. The Triplex exercise, a large-scale field simulation exercise focusing on strengthening preparedness and response in regard to coordination and effective emergency response held in Norway in 2016, had simulated hurricanes and floods and been attended by over 100 participants from several organizations, including UNOSAT, which had hosted the Virtual Onsite Operations Coordination Centre. The exercise had shown that frequent drills were important for ensuring that emergency systems were available and operational when needed.

Jeffrey Llanto, Central Visayas Information Sharing Network Foundation (CVISNet), Philippines, gave a remote presentation on the Use of emergency telecommunication systems in disaster-management drills: the case of the Philippines, which provided an overview of CVISNet's emergency telecommunication drills, exercises and training courses in the Philippines. MDRUs had been used in ITU projects in the Philippines in 2014. Because of the dual benefits of regularly utilizing this technology and bringing connectivity, CVISNet was considering using MDRUs to provide connectivity between disasters.

The representative of **India** asked how MDRUs connected with communication networks. **Mr Llanto** responded that MDRUs had interfaces with ordinary telephone networks and the Internet.

Hiroshi Kumagai, NICT, Japan, gave a presentation on Emergency communication drills in metropolitan areas, which introduced MDRUs, the "NerveNet" (ad hoc network system) and actual disaster drills using ICTs held in Japan. The lessons learned from the drills were that the battery capacity of ICT equipment was a significant factor; that it was important to ensure a power supply in disasters; and that NerveNet and MDRUs could be utilized in disasters.

The representative of **India** asked how big the MDRU was. **Dr Kumagai** responded that there were several types of MDRU, some as large as containers, others fitting into attaché cases (the moderator showed the participants an actual attaché case-type system). No additional equipment was needed when MDRU software was installed on smartphones. In reply to a question from the representative of the **United States**, he said that MDRUs could be pre-positioned before a disaster and deployed post-disaster.

Akihiro Nakatani, Astem, Japan, gave a presentation on Disaster relief applications for broadcasting services, introducing an IPTV-based translation system for persons with impaired hearing, called "Eye Dragon", which combined sign language and captions with live terrestrial TV programmes to assist persons with disabilities. The system could provide significant information to such persons in the event of a disaster. Thanks to the system and to the experience of disaster drills, the lives of persons with disabilities had been saved during the Great East Japan earthquake and the tsunami of March 2011.

In reply to a question from the representative of **Nigeria**, Mr Nakatani said that IPTV broadband networks were needed to receive sign language translation for live television; the service could not be provided on over-the-air television (terrestrial TV).

Workshop 2: Emerging technologies on disaster management

Workshop 2 was moderated by **Abdulkarim Ayopo Oloyede, Vice-Rapporteur for Question 5/2, Nigeria**. The discussion points were as follows:

– understand how technologies are being applied;

– policies that enable the advancement and deployment of evolving technologies;

– explore examples and types of new emerging disaster-management technology, including recent and expected technological evolutions.

Emily Yousling, Google, United States, gave a presentation on The role of the Loon project in disaster risk reduction. She explained how Google Loon had been used after Hurricane Maria in Puerto Rico and floods in Peru, and how it could be used around the world to provide access to telecommunication services before, during and after a disaster. It was important to pre-position communication capacity, and not wait until disaster struck to take action to ensure communication redundancy, as it took some time to restore network infrastructure.

The representative of **India** asked whether Loon's altitude (20 km above ground) posed flight path issues, how licensed spectrum for LTE services would be obtained for deployments, and how power was supplied to Loon (which was considered a "base station-in-the-sky") in the rainy season and at night, given that Loon was solar powered. **Ms Yousling** responded that due care was taken to ensure that the Loon network did not interfere with flight paths and that the spectrum utilized was that of existing telecom operators for whom Loon had been deployed. Regarding power supply, the fact that multiple Loons were deployed enabled consistent service.

Salma Farouque, Emergency Telecommunications Cluster (ETC), WFP, gave a presentation on the Practical use of drones in disaster response and recovery. The ETC was the part of the United Nations Cluster System responsible for telecommunications. In certain disasters, it could provide secure communications through VHF and Internet connectivity thanks to quick deployment of satellite terminals and Wi-Fi. It could also provide user assistance and help support communication coordination and information management. Other potential services included liaison with government authorities, preparedness assistance and services for communities, including drone coordination. Drones could be used for multiple humanitarian purposes, including mapping, monitoring, search and rescue, delivery, and providing communication during the response and recovery phases.

Yuichi Ono, Tohoku University, Japan, gave a presentation on the Global Centre for Disaster Statistics. He described the use of big data in emergency situations, noting the need for statistics/record keeping on the impacts of disasters in different countries of the world. The data collected could be used by a country during the recovery process. The Centre had helped different countries to prepare and plan in order to shorten the recovery process and mitigate future disasters.

Vanessa Gray, ITU/BDT, gave a presentation on Disruptive technologies and disaster management. ITU supported Member States with capacity-building assistance to promote preparedness and post-disaster recovery. Technology should be used to assist in all phases of disaster management. ITU was putting together a disaster-management toolkit and drafting guidelines for emergency communication planning that could be adapted by Member States.

Workshop 3: Disaster management and drills using ICTs

Workshop 3 was moderated by **Joseph Burton, Co-Rapporteur of Question 5/2, United States**. The objectives were as follows:

– provide examples of the range, scope and frequency of emergency communications exercises and drills;

- understand how exercises and drills can increase preparedness, and ways to increase the effectiveness of drills;
- how to tailor drills and exercises to national conditions and complex emergencies;
- identifying potential participants and enabling robust stakeholder engagement;
- discuss the use of innovative technologies in preparedness exercises and of old technologies in innovative ways to support preparedness and response.

Salma Farouque, Emergency Telecommunications Cluster (ETC), WFP, gave a presentation on Coordinating communications drills and exercises – setting the stage. She discussed the range of communication exercises that might be considered, from a table-top exercise to a functional exercise, to perform a full-scale drill like WFP's "opEx Bravo". The purpose of an exercise was to test procedures and enhance preparedness, by documenting and verifying existing procedures and identifying and addressing gaps. Among the factors and steps to consider when planning an exercise, it was important to set objectives in advance, and to hold not only a debriefing or an after-action, but also to draft an action plan to address and fix any issues identified. Exercise participants might include the regulator, the Ministry of Communications, the national disaster-management agency, meteorological and geophysics departments (or other hazard-warning entities), communication service providers, power utilities, humanitarian organizations and community stakeholders.

Rod Stafford, International Amateur Radio Union (IARU), gave a presentation, Communications drills and exercises – the amateur radio perspective, in which he described the use and application of amateur radio in a range of communication drills. When communication infrastructure was down, amateur radio might be the only way to communicate in certain areas. It was therefore important to incorporate amateur radio, which might provide communication redundancy, into drills and exercises. Communication technologies used by amateur radio included HF, VHF, microwave frequencies and amateur radio satellites.

The representative of **Japan** noted that amateur radio enabled SIDS to communicate across many islands and great distances. Many participants agreed that young people were often unaware of the existence of amateur radio; that generation gap should be overcome. **Ahmad Sharafat, Chairman of ITU-D Study Group 2, Islamic Republic of Iran**, suggested that the IARU submit a white paper on the benefits and operational modes of amateur radio.

Preeti Banzal, India, gave a presentation on India's experience executing a mega drill in the Western Himalaya region, to provide the perspective of communication officials coordinating part of a national disaster (earthquake) exercise. The scenario had enabled a detailed review of preparedness, training and coordination between national and state officials. The exercise had not only tested the response capabilities of various agencies across all levels of government, it had also identified gaps in policies, procedures and training for further action, and helped facilitate preparation of response plans at all levels of government.

The representative of **Intel** stressed the importance of educating people about back-up/redundant means of communication.

Conclusions and best practices

Sanjeev Banzal, Co-Rapporteur for Question 5/2, India, summarized the outcomes of the workshop discussions in terms of lessons learned and best practices related to disaster drills and exercises, and the use of emerging technologies for disaster management (see **Section 7.1(B)** of this report for a complete summary). He thanked all the speakers, moderators, participants, BDT staff and interpreters for their active support and contributions.

A4.3 Session on conducting national-level emergency communications drills and exercises: Guidelines for small island developing States and least developed countries[121]

Geneva, Switzerland

7 October 2019

Summary

Introduction

The session on national emergency ICT drills and exercises was held on Monday, 7 October 2019, in conjunction with the Question 5/2 Rapporteur Group meeting on Utilizing telecommunications/ICTs for disaster risk reduction and management.

The session was opened by **Doreen Bogdan-Martin, Director, BDT, ITU,** who had just returned from the Bahamas, where she had witnessed the devastating damage in Abaco and Grand Bahamas caused by Hurricane Dorian. ITU had identified numerous opportunities to provide disaster preparedness capacity-building support to the Bahamas and other Member States, including for the advance consideration of policies/regulations to enable roaming in disasters, the implementation of the ITU Global Guidelines for Drafting National Emergency Telecommunications Plans, and guidance from ITU partners on the conduct of ICT drills and exercises. ICT preparedness planning was a universal need, hence the importance of holding continued ICT preparedness-focused workshops. She thanked the panellists for coming to Geneva, highlighted the importance of drills and exercises for testing and refining policies and plans, and outlined the session programme and objectives.

Session methodology

The session featured three workshops, each moderated by Question 5/2 Co-Rapporteur Joseph Burton. Workshop 1 featured presentations by Vanuatu and Haiti, followed by a guided table-top exercise. In addition to a presentation by each panellist, an open discussion among panellists was held in Workshops 2 and 3, which reflected the phases of drills and exercises, from planning to after-actions and translating lessons learned into updated policies.

The session then introduced capacity-building resources and tools that BDT had recently developed in coordination with partners such as the Emergency Telecom Cluster, to help Member States develop a robust emergency communication framework and preparedness programme, including NETPs and ICT drills and exercises.

The outcomes of the discussions would be incorporated into the annual report by Question 5/2 on guidelines for conducting ICT drills and exercises.

Workshop presentations

Workshop 1. Small island developing State and least developed country experiences of planning disaster drills

- **John Jack, Office of the Government Chief Information Officer**, Vanuatu, gave a presentation on Vanuatu's experience of exercises and drills.
- **Gregory Domond, Conseil National des Télécommunications (CONATEL)**, Haiti, gave a presentation on earthquake and tsunami drills and exercises in Haiti.

[121] For further information, see the panel session webpage.

– **Joseph Burton, Cyber and International Communications and Information Policy**, United States, led participants through a table-top simulation exercise developed by the ETC and ITU for the 2019 Global Symposium for Regulators, on the role of the regulator in disaster management.

Workshop 2. Conducting drills: a guided discussion with panelists and participants

- **Antwane Johnson, FEMA**, United States, gave a presentation on IPAWS and the use of alert and warning in drills and exercises.
- **Rod Stafford, International Amateur Radio Union**, gave a presentation on Amateur radio – prepared for drills and exercises.
- **Justin Williams, Network Disaster Recovery, AT&T, United States**, gave a presentation on Leveraging ICTs for disaster and response: what have we learned.
- **Dulip Tillekeratne, Mobile for Humanitarian Innovation, GSMA**, gave a presentation on engaging with mobile network operators on drills and exercises.

Workshop 3. The wrap-up: capturing and turning lessons learned into action

- **Ria Sen, Emergency Telecommunications Cluster (ETC), WFP**, introduced the ETC-ITU table-top simulation exercise guide, which was soon to be finalized.
- **Maritza Delgado, BDT, ITU,** presented the range of available ITU capacity-building assistance. BDT developed information resources to increase overall ICT preparedness and response coordination, including by utilizing the recently developed Guidelines for national emergency telecommunication plans, in addition to other preparedness services developed in partnership with the ETC for Member States.

Note: Most of the presentations for this session are available on the event website. Best practices and lessons learned from presentations (and workshop discussions) will be reflected in the Question 5/2 session outcome document on guidelines for conducting national ICT drills and exercises.

Session outcomes

Preparations for the session resulted in a draft outcome document containing guidelines for conducting national ICT exercises and drills that could be tailored to meet the unique needs of SIDS and LDCs. Co-Rapporteur Joseph Burton presented the draft in Document SG2RGQ/TD/12 during the Rapporteur Group meeting for Question 5/2 held on 8 October 2019. The guidelines will be updated with key learnings, including lessons learned and best practices from workshop discussions. Input from workshop participants is welcome. The final draft of the guidelines will be incorporated into the annual report of Question 5/2 on ICT drills and exercises. (See **Section 7.1(C)** of this report).

A4.4 Public webinar on enabling policy environment for disaster management, including for COVID-19 response[122]

Virtual meeting

14 July 2020

[122] For further information, see the panel session webpage.

During the study period, Question 5/2 conducted a public webinar, Enabling Policy Environment for Disaster Management, including for COVID-19 response, chaired by Ahmad Reza Sharafat, Chairman of ITU-D Study Group 2. The main objectives of the webinar were to:

– discuss the constituent elements of an enabling policy environment for increasing emergency telecommunication preparedness, network resilience, disaster risk reduction and disaster management;

– provide examples of policies that enable flexibility when deploying emergency communication equipment and successful disaster preparedness and response with respect to telecommunications and ICTs;

– share ITU member experiences and lessons learned in developing and implementing enabling policies and NETPs.

During the webinar, expert panellists discussed the importance of implementing measures and polices that would ensure the continued functioning of communication networks during disasters, such as declaring telecommunication networks as essential services or performing organized drills. The webinar also featured examples of policies for preparedness and different responses observed around the globe during the COVID-19 pandemic.

Juan Roldan, Luxon Consulting Group, initiated the presentations by discussing the challenges that come with developing an NETP. An effective NETP accounted for multiple hazards, used multiple technologies, contained multiple phases and was supported by multiple stakeholders. NETPs needed political will and support, and governments must clearly identify which specific department or agency was responsible for emergency telecommunications.

Continuing on the theme of cross-sectoral collaboration, **Chris Anderson, CenturyLink Global Network**, advocated for public-private partnerships, declaring them to be necessary for effective disaster management. Such partnerships should always be assembled during the "blue sky scenario", meaning before disaster actually struck, since it was much harder to bring the necessary people together during a crisis.

Concluding the first segment of the webinar, **Paul Margie, Télécoms Sans Frontières (TSF)**, explained that, while disaster management was never one-size-fits-all, commonalities could be observed in the countries where TSF worked. These included training beforehand, formally recognizing ICTs as critical infrastructure, publicly identifying points of contact for ICT response, developing procedures so that experts could enter quickly, and adopting mechanisms within the telecom regulator to speed decision-making. In that respect, special temporary authorities could enable rapid changes to be made when they were most needed.

COVID-19 responses from around the globe

The second segment of the webinar focused on COVID-19 responses observed in different countries worldwide. **Maritza Delgado, ITU Programme Officer,** explained that tracking and analysing such responses was one of the main objectives of REG4COVID, an ITU initiative designed to help communities stay connected during crises and to prepare medium- and long-term recovery measures. The Global Network Resiliency Platform was just one example.

Kathryn O'Brien, Chief of Staff, International Bureau, Federal Communications Commission (FCC), United States, shared some of the FCC's guiding principles, the first being to set clear priorities. It was also important to work with the private sector. Technology must go hand-in-hand with policy to produce effective disaster responses.

Ryosuke Shibasaki, professor, University of Tokyo, Japan, focused on information on people flows and population density statistics for better-informed decision-making. Open-source analysis software could use big data from mobile serial data to support COVID-19 responses by measuring movements. The software's development had originally been triggered by ITU in 2015, and it was now in operation in several African countries.

Funke Opeke, MainOne CEO, Nigeria, shared the challenges faced by developing countries in coping with COVID-19.

Rahul Vatts, Chief Regulatory Officer, Bharti Airtel Limited, India, explained that traffic had surged by up to 50 per cent during the pandemic, creating infrastructure challenges for India at a time when maintenance staff found it difficult to move because of lockdowns. Telecommunication service providers had overcome the challenge thanks to the special permissions from the Government and the regulator to move telecom staff across critical sites. To address maintenance concerns, the telecommunication service providers worked with over-the-top providers, as network optimization was an ongoing necessity. The Government had directed providers to change the ring-back tone and ringtone of all landlines – nearly 987 million working phones – to a special COVID-19 message asking subscribers to stay home and practice social distancing.

Lessons learned: Enabling policy today saves lives tomorrow

Access to a robust, resilient and secure ICT infrastructure worldwide is critical in a pandemic and in any kind of disaster. ICTs are essential for power, security, health and sanitation – essential services in a global emergency. However, their ability to perform as needed required an enabling policy environment able to do many things, from granting temporary authority for additional spectrum use to giving complimentary recharge margins for emergency calls.

Among the many other lessons learned from the COVID-19 pandemic was the fact that the world's telecommunication networks and digital infrastructure must be better prepared for disasters of all kinds. Collectively, drills had to be carried out and rapid response measures prepared, since future disasters – including pandemics – could occur anytime, anywhere, and with little to no warning.

Any negative consequences of disasters could be diminished if robust and resilient networks and disaster-management tools were in place well ahead of time.

(See **Section 7.1(D)** of this report)

Note: All presentations for the webinar are available on the event website.

Annex 5: List of contributions and liaison statements received on Question 5/2

Contributions on Question 5/2

Web	Received	Source	Title
2/420	2021-03-15	Co-Rapporteurs for Question 5/2, Vice-Rapporteur for Question 5/2	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-R Working Party 5D on the Output Report on Question 5/2
2/419	2021-03-15	Co-Rapporteurs for Question 5/2, Vice-Rapporteur for Question 5/2	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-R Working Party 5A on the Output Report on Question 5/2
2/418	2021-03-15	Co-Rapporteurs for Question 5/2, Vice-Rapporteur for Question 5/2	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-T SGs, ITU-R SGs, UN organizations and external organizations on the Output Report on Question 5/2
2/410	2021-03-03	Inmarsat	Input Contribution to the Draft Output Report on Question 5/2
2/401	2021-03-02	National Institute of Information and Communications Technology (NICT) (Japan)	Proposal of communication technologies and its use case of an autonomous distributed information and communications system "Die-Hard Network" for disaster countermeasure
2/397 (Rev.1)	2021-03-15	Co-Rapporteurs for Question 5/2, Vice-Rapporteur for Question 5/2	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-T Study Group 2 and FG-AI4NDM on the Output Report on Question 5/2 and future of the Question
2/TD/36	2021-02-23	Co-Rapporteurs for Question 5/2, Vice-Rapporteur for Question 5/2	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-T Study Group 2 and FG-AI4NDM
2/391 +Ann.1	2021-02-17	EMEA Satellite Operators Association (ESOA/GSC)	Proposed observations and suggestions for final report
2/388	2021-01-28	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
2/384	2021-01-28	Algeria	Exercise to simulate the implementation of the civil security plan for telecommunications
2/383	2021-01-28	China	Suggestions for adding ICT to respond to major epidemics in the new research period Qx/2 subject
RGQ2/ TD/29	2020-10-15	Algérie Télécom SPA (Algeria)	Proposed liaison statement from ITU-D Study Group 2 Question 5/2 to ITU-R Working Party 5B on utilizing telecommunications/ICTs for disaster risk reduction and Management

(continued)

Web	Received	Source	Title
RGQ2/ TD/24 (Rev.1)	2020-10-14	Co-Rapporteurs for Question 5/2	Proposed liaison statements from ITU-D Study Group 2 Question 5/2
RGQ2/283	2020-09-22	United States	FCC Actions in Response to COVID-19 in the United States
RGQ2/279 (Rev.1)	2020-09-22	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
RGQ2/262	2020-09-20	National Institute of Information and Communications Technology (NICT) (Japan)	Proposal for case studies of a chatbot system "SOCDA" for disaster countermeasure
RGQ2/237	2020-08-20	EMEA Satellite Operators Association (ESOA/GSC)	Satellite Connectivity for Climate Monitoring & Early Warning
RGQ2/228	2020-08-16	China	Considerations and practices related to disaster preparedness, reduction, and response from an Operator's perspective
RGQ2/222	2020-08-07	Burundi	The contribution of ICTs in managing the effects of floods in Burundi
RGQ2/220 (Rev.1)	2020-08-06	China	Contribution of ICT to the fight against the COVID-19 pandemic
RGQ2/207 +Ann.1	2020-05-05	AASCTC (Sudan)	Global Open Science Cloud for Disaster Risk Reduction (GOSC-DRR)
2/TD/33	2020-02-27	Co-Rapporteurs for Question 5/2	October workshop concept for discussion: "The Enabling Policy Environment Increased Emergency Telecommunication Preparedness, Network Resilience, Disaster Risk Reduction and Disaster Management"
2/TD/32	2020-02-26	Co-Rapporteurs for Question 5/2	Draft guidelines for conducting national level emergency communications drills and exercises for Small Island Developing States (SIDS) and Least Developed Countries (LDCs)
2/TD/31	2020-02-26	Co-Rapporteurs for Question 5/2	Updated Document: Draft annual report of Question 5/2 on Early-Warning Systems, including Safety Confirmation
2/327 (Rev.1)	2020-02-11	Loon LLC (United States)	Regulatory considerations when enabling innovative preparedness and emergency communications solutions
2/310	2020-01-24	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
2/309	2020-01-27	Japan	Proposal for case studies of locally accessible cloud system for disaster countermeasures

(continued)

Web	Received	Source	Title
2/308	2020-01-24	Facebook	Sharing Mobile Application Data to Empower Disaster-Response Organizations
2/277	2020-01-03	China	Use of telecommunication/information and communication technology (ICT) for disaster prevention, mitigation and response
2/269	2019-12-31	India	The role of social media platforms in disaster mitigation, response and relief
2/252	2019-12-16	Democratic Republic of the Congo	Utilizing telecommunications/ICTs to manage Ebola virus disease in the Democratic Republic of the Congo
RGQ2/ TD/12	2019-10-07	Co-Rapporteur for Question 5/2	Draft guidelines for conducting national level emergency communications drills and exercises for Small Island Developing States (SIDS) and Least Developed Countries (LDCs)
RGQ2/190	2019-09-23	World Food Programme	Standardization forum: emergency telecommunications
RGQ2/188 (Rev.1)	2019-09-24	Japan	Proposal for case studies of e-education in rural areas through ordinary use of emergency telecommunication systems
RGQ2/183	2019-09-23	China	Analysis of emergency communication key service requirements and technology development
RGQ2/182 +Ann.1-2	2019-09-23	World Food Programme	ETC-ITU Emergency Telecommunications Preparedness Checklist
RGQ2/152 +Ann.1	2019-08-22	United States	Integrated Public Alert and Warning System Open Platform for Emergency Networks (IPAWS-OPEN) on standards-based alert and warning
RGQ2/150	2019-08-22	United States	Remote-sensing activities in ITU-R
RGQ2/148	2019-08-22	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
RGQ2/147	2019-08-21	India	Importance of ICT early-warning system for saving life and property: case of extremely sever Cyclone 'Fani'
RGQ2/145	2019-08-21	New Zealand	Implementation of Common Alerting Protocol (CAP) in New Zealand
RGQ2/121	2019-07-09	Haiti	Emergency telecommunication system in Haiti
2/216	2019-03-12	Co-Rapporteurs for Question 5/2	October workshop concept for discussion: "Guidelines for Conducting National Level Emergency Communications Drills and Exercises for Small Island Developing States (SIDs) and Lesser Developed Countries (LDCs)"

(continued)

Web	Received	Source	Title
2/212	2019-03-12	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
2/184	2019-02-12	Co-Rapporteurs for Question 5/2	Output Document: Draft annual report of Question 5/2 on Early-Warning Systems, including Safety Confirmation
2/176	2019-02-07	Co-Rapporteurs for Question 5/2	Proposed revised work plan for study Question 5/2
2/159	2019-02-05	China	Development and practices of intelligent emergency telecommunications
2/158	2019-02-05	China Telecommunications Corporation (China)	Thinking and Practices of Operator's Disaster Preparedness, Disaster Reduction and Disaster Response
2/157 (Rev.1)	2019-02-05	China	Disseminating emergency alerts via new signalling pathways
2/134	2019-01-11	Cameroon	Support for regional implementation of the National Emergency Telecommunications Network project
RGQ2/TD/7	2018-10-01	Russian Federation	ITU-D SG1 and SG2 coordination: Mapping of ITU-D Study Group 1 and 2 Questions
RGQ2/83	2018-09-18	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
RGQ2/78	2018-09-18	India	The role of Information and Communication Technology (ICT) in disaster mitigation, prediction and response
RGQ2/77	2018-09-18	India	Trial runs for implementation of Common Alert Protocol-based early-warning system
RGQ2/74 +Ann.1	2018-09-18	Japan	Global Centre for Disaster Statistics - a joint initiative with UNDP contributing to the Sendai Framework for Disaster Risk Reduction and SDGs
RGQ2/61	2018-09-13	China	Emergency telecommunication drill
RGQ2/60	2018-09-13	National Institute of Information and Communications Technology (NICT) (Japan)	Early warning and early data collection of disaster information; recent development in Japan
RGQ2/33	2018-08-16	Brazil	Emergency, public calamity and disaster alerts using telecommunication services - Brazil's implementation
2/TD/4	2018-04-27	WMO	Multi-Hazard Early-Warning Systems: A Checklist

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Web	Received	Source	Title
2/93 (Rev.1)	2018-04-24	BDT Focal Point for Question 5/2	ITU-D activities in disaster risk reduction and management
2/70	2018-04-23	India	The role of information and communication technology (ICT) in disaster mitigation, prediction and response
2/59	2018-03-23	United States	Draft work plan for Question 5/2
2/56 (Rev.1)	2018-03-21	China	Operators' consideration of disaster preparedness, disaster reduction and disaster response
2/50	2018-03-21	China	Further enhanced studies on emergency telecommunications as well as related knowledge and experience sharing
2/36	2018-02-19	India	Implementing a common alert protocol-based Earthquake Early-Warning system in North Region of India

Incoming liaison statements for Question 5/2

Web	Received	Source	Title
2/422	2021-03-15	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D Study Group 2 Question 5/2 on utilization of telecommunications/ICTS for disaster preparedness, mitigation and response
2/365	2021-01-12	ITU-T Study Group 2	Liaison statement from ITU-T Study Group 2 to ITU-D SG1, ITU-SG2 Question 5/2 and Question 6/2 on establishment of a new ITU-T Focus Group on Artificial Intelligence for Natural Disaster Management (FG-AI4NDM) and first meeting (Virtual, 15-17 March 2021)
2/362	2020-11-20	ITU-T Study Group 11	Liaison statement from ITU-T Study Group 11 to ITU-D SG2 Q5/2 on Disaster Relief Use Cases
2/361	2020-11-23	ITU-R Working Party 5B	Liaison statement from ITU-R Working Party 5B to ITU-T Study Group 11 (copy to ITU-D SG2 Q5/2) on Disaster Relief Use Cases
2/359	2020-11-04	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
2/357	2020-10-21	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-T Study Group 11 (copy to ITU-D SG2 Q5/2) on Disaster Relief Use Cases
2/355	2020-10-21	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D SG2 Q5/2 on utilization of telecommunications/ICTs for disaster risk reduction and management

(continued)

Web	Received	Source	Title
RGQ2/286	2020-07-14	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D SG2 Q5/2 on utilization of telecommunications/ICTs for disaster risk reduction and management
RGQ2/225	2020-08-07	ITU-R Working Party 5A	Liaison statement from ITU-R Working Party 5A to ITU-D SG2 Q5/2 on utilization of telecommunications/ICTs for disaster risk reduction and management
RGQ2/224	2020-08-07	ITU-R Working Party 5A	Liaison statement from ITU-R Working Party 5A to ITU-D SG2 Q5/2 on Disaster Relief Use Cases
RGQ2/211	2020-07-17	Disaster Relief Liaison Rapporteur	Report on Disaster Relief
RGQ2/206 +Ann.1	2020-03-25	ITU-T Study Group 11	Liaison statement from ITU-T SG11 to ITU-D SG2 Q5/2 on disaster relief use cases
2/256	2019-12-05	ITU-R Study Group 5	Liaison statement from ITU-R SG5 to ITU-D SG1 and SG2 on consideration of the needs of developing countries in the development and implementation of IMT
2/245 +Ann.1	2019-11-22	ITU-T Study Group 11	Liaison statement from ITU-T Study Group 11 to ITU-D Study Group 2 Question 5/2 on disaster relief use cases
RGQ2/130 +Ann.1	2019-07-22	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and SG2 on inter-Sector coordination
RGQ2/124 (Rev.1)	2019-07-18	ITU-R study groups - ITU-R Working Party 4B	Liaison statement from ITU-R WP4B to ITU-D SG1 and SG2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/120	2019-07-09	ITU-R study groups - ITU-R Working Party 4B	Liaison statement from ITU-R WP4B to ITU-D SG1 and SG2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/116 +Ann.1-2	2019-05-29	ITU-T Study Group 20	Liaison statement from ITU-T SG20 to ITU-D SG1 and SG2 on ITU inter-sector coordination
RGQ2/114 +Ann.1-2	2019-06-12	ITU-T Study Group 5	Liaison statement from ITU-T SG5 to ITU-D SG1 and SG2 on ITU inter-sector coordination
RGQ2/112	2019-04-19	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
2/TD/18 +Ann.1	2019-03-20	ITU-T Study Group 11	Liaison statement from ITU-T SG11 to ITU-D SG2 Q5/2 on disaster relief use cases

(continued)

Web	Received	Source	Title
2/TD/13	2019-03-15	ITU-T Study Group 2	Liaison statement from ITU-T SG2 to ITU-D SG2 Q5/2 on Terms and Definitions for Disaster Relief Systems and Framework of Disaster Management
2/183	2019-02-11	ITU-R Study Group 5	Liaison statement from ITU-R Study Group 5 to ITU-D Study Group 2 Question 5/2 on Recommendation ITU-R F.1105-4 (Fixed wireless systems for disaster mitigation and relief operations)
2/124	2018-11-09	ITU-R study groups – ITU-R Working Party 5A	Liaison statement from ITU-R SG5 WP5A to ITU-D Study Group 2 Question 5/2 on disaster relief systems
2/120	2018-10-30	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
RGQ2/TD/3	2018-09-28	ITU-R study groups – ITU-R Working Party 7C	Liaison statement from ITU-R WP7C to ITU-D SG2 Q5/2 on utilization of telecommunications/ICTs for disaster preparedness, mitigation and response
RGQ2/17 +Ann.1	2018-08-02	ITU-T Study Group 11	Liaison statement from ITU-T SG11 to ITU-D SG2 Q5/2 on disaster relief use cases
RGQ2/14 +Ann.1	2018-07-18	ITU-R study groups – ITU-R Working Party 4A	Liaison statement from the ITU-R WP 4A to ITU-D Study Group 1 and 2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/12 +Ann.1	2018-07-18	ITU-T Study Group 2	Liaison statement from ITU-T SG2 to ITU-D SG2 Q5/2 on E.sup.fdr "Framework of disaster management for disaster relief systems"
RGQ2/11 +Ann.1	2018-07-18	ITU-T Study Group 2	Liaison statement from ITU-T SG2 to ITU-D SG2 Q5/2 on E.td-dr "Terms and definitions for disaster relief systems, network resilience and recovery"
RGQ2/10	2018-07-17	ITU-R study groups – ITU-R Working Party 4B	Liaison statement from ITU-R WP 4B to ITU-D SG1 Q1/1 and Q2/1 and SG2 Q1/2 and Q5/2 on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15)
RGQ2/2	2018-05-23	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
2/32	2017-11-24	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
2/31	2017-11-24	ITU-R study groups - Working Party 7C	Liaison Statement from ITU-R Working Party 7C to ITU-D Study Group 2 Q5/2 on the utilization of telecommunications/ICTs for disaster preparedness, mitigation and response

(continued)

Web	Received	Source	Title
2/20	2017-11-24	ITU-T Study Group 2	Liaison Statement from ITU-T SG2 to ITU-D SG2 Question 5/2 on national emergency telecommunication system in developing countries
2/16	2017-11-24	ITU-R Disaster Relief Liaison Rapporteur	Report from the ITU-R Disaster Relief Liaison Rapporteur
2/15	2017-11-22	ITU-T Study Group 15	Liaison Statement from ITU-T SG15 to ITU-D Study Group 2 Q5/2 on new Supplement on the framework of disaster management

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