WORLD TELECOMMUNICATION
DEVELOPMENT CONFERENCE

Resilience Study insights and framework of evaluation

Workshop on Resilient Infrastructure for Effective Early Warning Dissemination

10 – 12 September 2025
Sendai, Japan

Aamir.riaz@itu.int

What to expect in slides

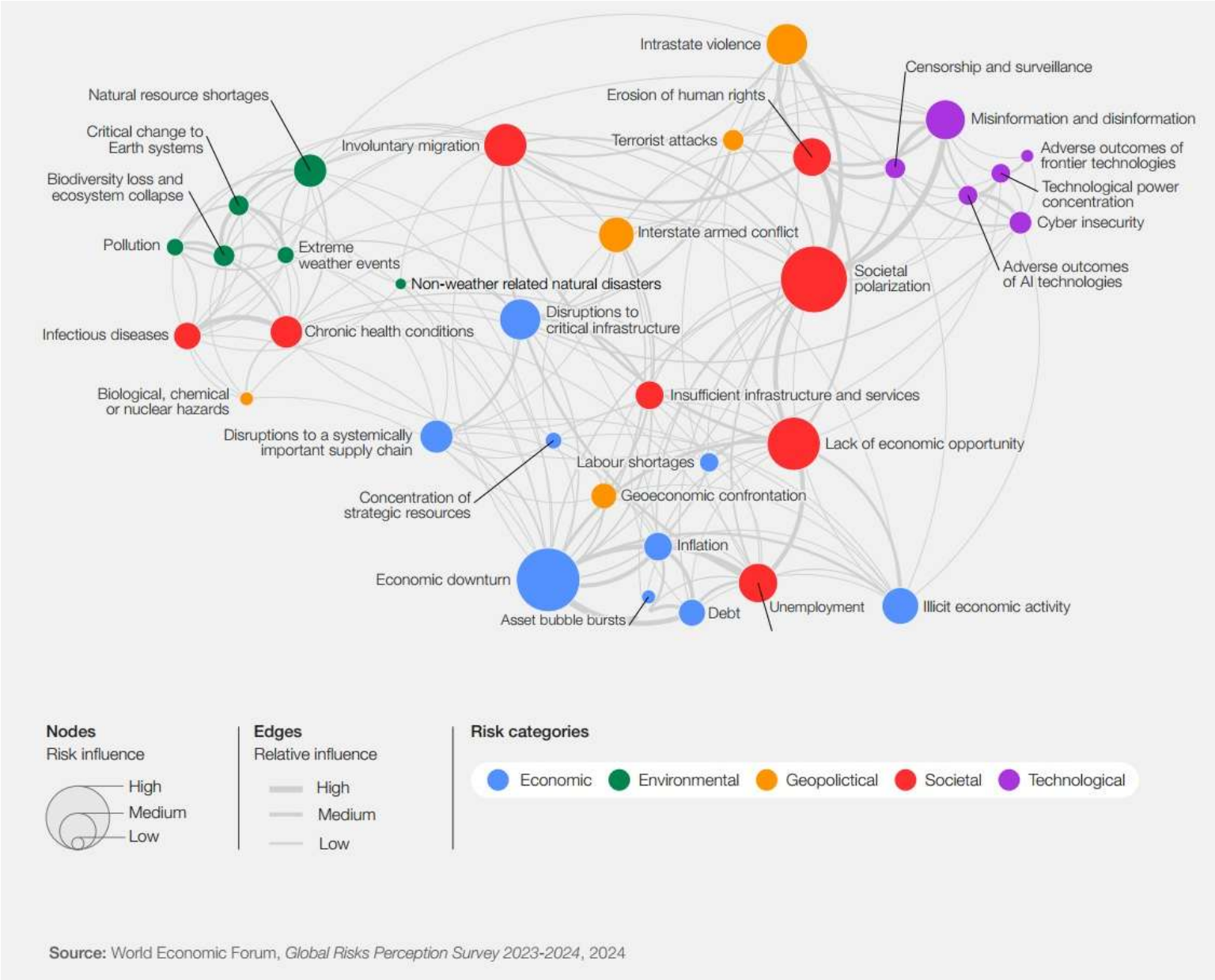
- Risk Landscape and ITU mandate
- Digital Networks and resilience context
- Insights on study
- Cooperation for a sustainable future

Global Risk Landscape

Interconnectedness of potential incidents

Resilience to these risks must address the interconnectedness in a holistic manner

- Preparedness before a disaster
- Response and relief at and during a disaster
- Recovery and reconstruction after a disaster



Source: World Economic Forum, *Global Risks Perception Survey 2023-2024*, 2024

Activity description:

Assist member countries in assessing the gaps in resilience and affordability of licensed national ICT infrastructure and services.

ITUWTDC BAKU2025

Focus of the study

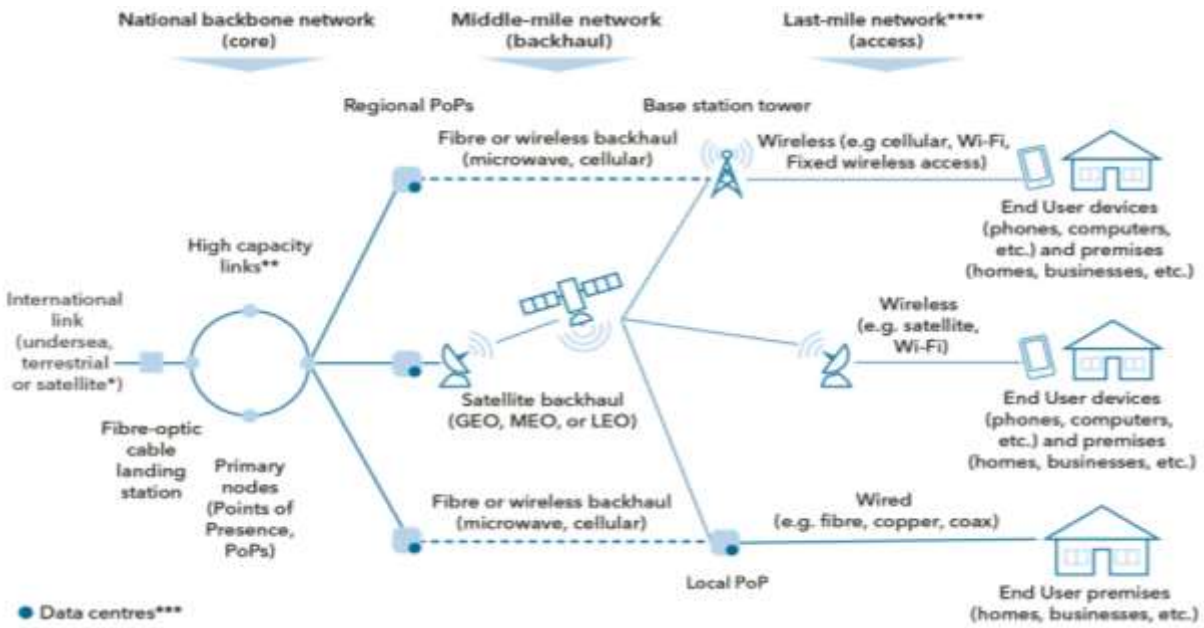
Building Resilient National ICT Infrastructure in Asia and the Pacific

ITUWTDC BAKU2025

What to expect in slides

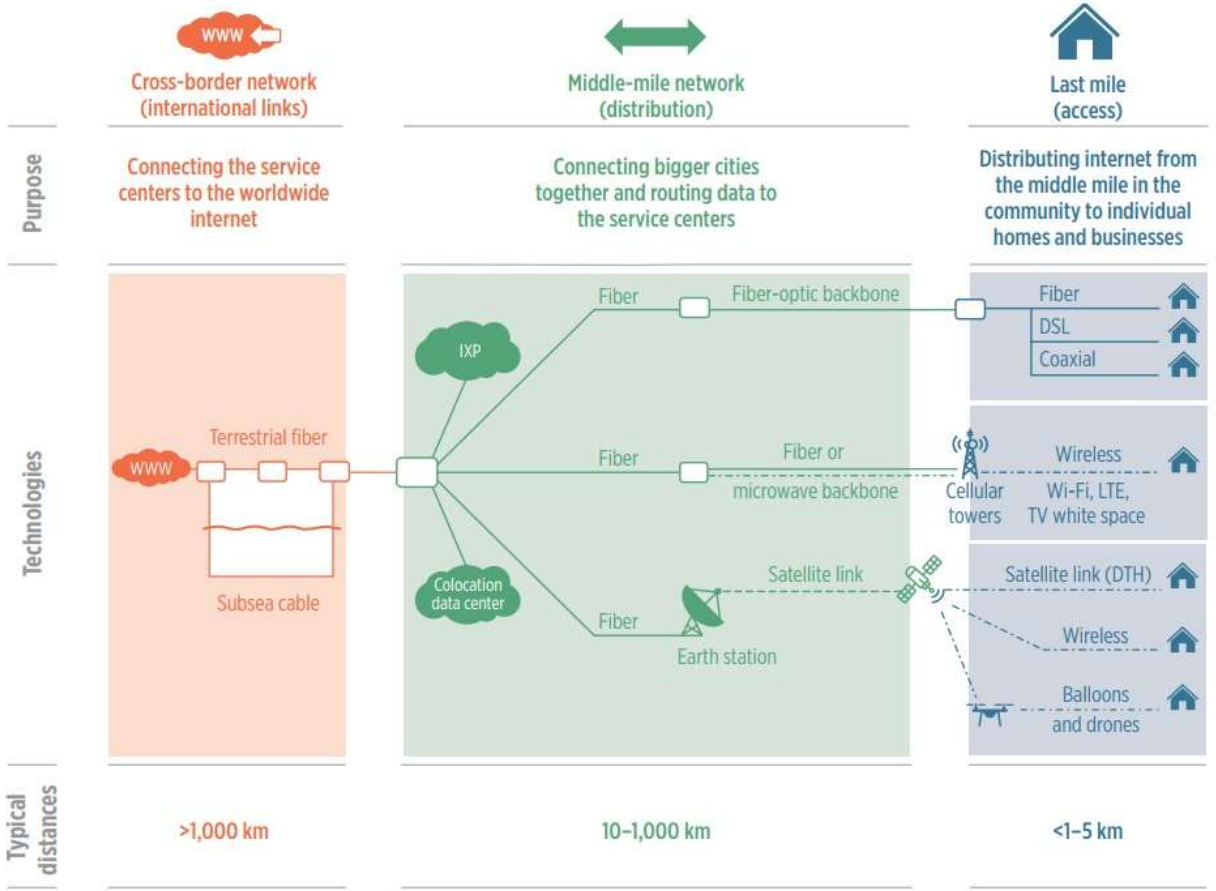
- Risk Landscape and ITU mandate
- Digital Networks and resilience context
- Insights on study
- Cooperation for a sustainable future

Telecommunications network components



Source: ITU- The [Last-mile Internet Connectivity Solutions Guide]

ICT Infrastructure



Source: World Bank, *World Development Report 2021: Data for Better Lives* (Washington DC, 2021). Available at https://wdr2021.worldbank.org/.

Resilience contexts

The resilience of telecommunication networks and infrastructure can be considered in three levels:

Passive resilience is the ability of an organization to return to its original state after being subjected to a shock to reduce losses. This type of resilience relies on the availability of equipment and a well-designed architecture.

Active resilience is a set of proactive activities that organizations must undertake to adapt to adversity and turbulence.

Organizational resilience is the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions to survive and prosper. It may consist of pre-positioning equipment and teams to react in time and provide temporary solutions.

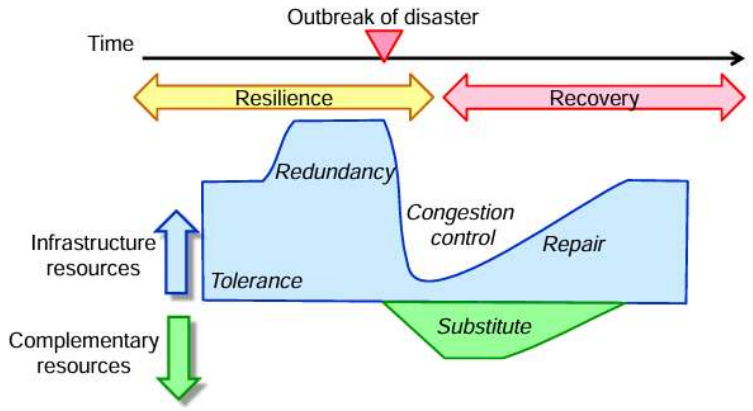


Figure 1 – Disaster phases and relevant approaches for network resilience and recovery

Source: ITU-T Requirements for Network Resilience and Recovery

Source: ITU Publications - Telecommunication networks and infrastructure resilience assessment in Haiti

What to expect in slides

- Risk Landscape and ITU mandate
- Digital Networks and resilience context
- Insights on study
- Cooperation for a sustainable future

Outline

Network Resilience	Affordability of ICT	Emergency Preparedness	Early Warning

1. Data collection done through a checklist (validated by ITU member countries in Asia and the Pacific)
2. Highlight common gaps
3. National stakeholder awareness
4. Showcase good practices or case studies for addressing the gaps
5. Support implementation through activities

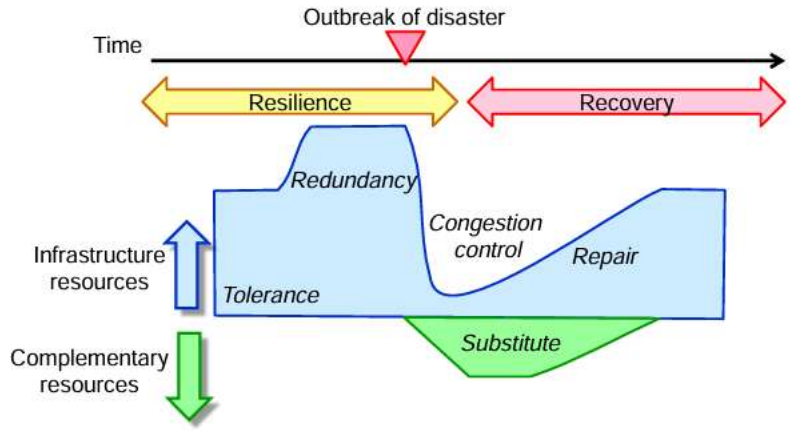


Figure 1 – Disaster phases and relevant approaches for network resilience and recovery

Source: ITU-T Requirements for Network Resilience and Recovery

Framework for Assessing the Resilience of National ICT Infrastructure

Network Resilience

- ✓ Types of connectivity available in the first, middle and last mile, and usage rates
- ✓ No. of IXPs and location
- ✓ No. of data centres and tier level
- ✓ DNSSEC validation
- ✓ Spectrum allocation for:
  - Harmonized use of frequencies
  - Public protection and disaster relief agencies
  - Amateur radio
  - Global maritime distress and safety system

Affordability of ICT

- ✓ Mobile data and fixed-broadband prices, relative to end-users' income
- ✓ Cost of smartphones and feature phones, relative to end-users' income
- ✓ Market competition – number of players and regulations
- ✓ Infrastructure and spectrum sharing arrangements
- ✓ Rural connectivity policy
- ✓ Universal access fund

Emergency Preparedness

- ✓ Cybersecurity policy
- ✓ Data protection and privacy policy
- ✓ Procedures for business continuity and disaster recovery
- ✓ Assessment of ICT infrastructure resilience
- ✓ National emergency telecommunication plan
- ✓ Quality of Service standard
- ✓ Name server redundancy
- ✓ Adaptive network – restoration and reallocation
- ✓ Predictive analytics
- ✓ Redundant power supply

Early Warning

Dissemination and Communication

- ✓ Governance of EWS – national authority, legislations, standard operating procedures, stakeholders, adoption of CAP
- ✓ EWS infrastructure – testing, upgrade, maintenance, use of cell broadcasting and/or location-based SMS system
- ✓ Inclusive EWS – assessment, testing and tailoring of EWS for vulnerable groups, multi-channel communication
- ✓ Quality and trust of EWS – clarity, awareness, drills, community engagement, feedback

Insights - **Network Resilience**

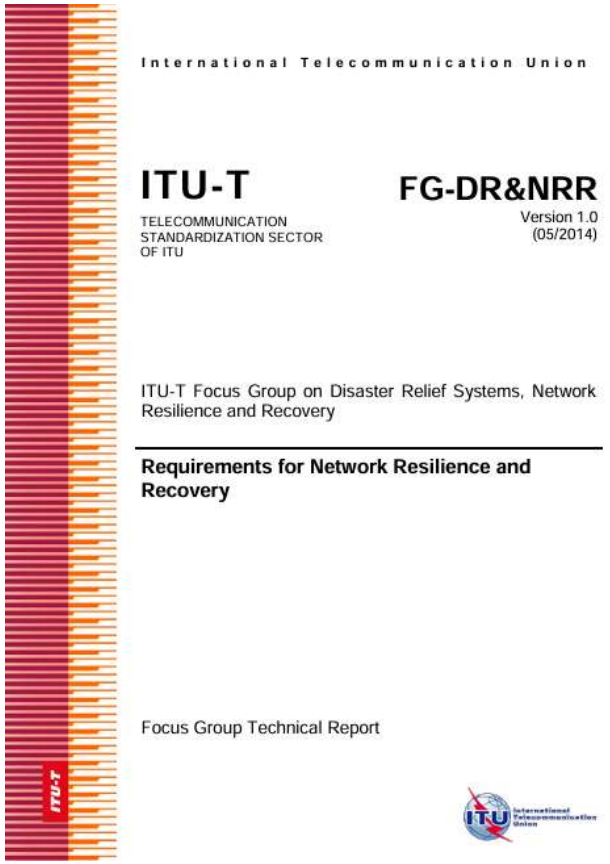
Indicators	Bhutan	Lao PDR	Nepal	Philippines
Access Availability	DSL, FTTH, 3G/4G/5G	DSL, FTTH, 3G/4G/5G	FTTH, 3G/4G, and a small number of satellite terminals for private licensees	FTTH, DSL, fixed wireless, 3G/4G/5G, and VSAT in some rural areas
Fixed Household Penetration	1%	11%	43%	29%
Mobile Data Penetration	99%	84%	96%	112%
No. of IXPs (Location)	1 (Thimphu)	1 (Vientiane)	1 (Lalitpur and Kathmandu)	10 (Manila and Cebu)
No. of Data Centres (Tier Level)	3 (Tier 2)	Few (not tier certified)	7 (Tier 3)	At least 8
Terrestrial Network	Parts of the network have diverse routes.	Critical nodes have been identified, and a ring topology provides network resilience.	Critical nodes upgraded and a ring topology provides network resilience.	Two major operators have built domestic fibre and microwave networks in self-healing loops.
International Network	Two international gateways but both connect to Siliguri, India. A third gateway that connects to Bangladesh is being negotiated.	There are multiple points of connections to Cambodia, China, Myanmar, Thailand and Viet Nam.	Limited international gateways, relying on submarine cables through India.	Connected to 11 international submarine cables. New cables such as Bitfrost and TPU will add more capacity and route diversity.

Network Resilience : Recommended Practices

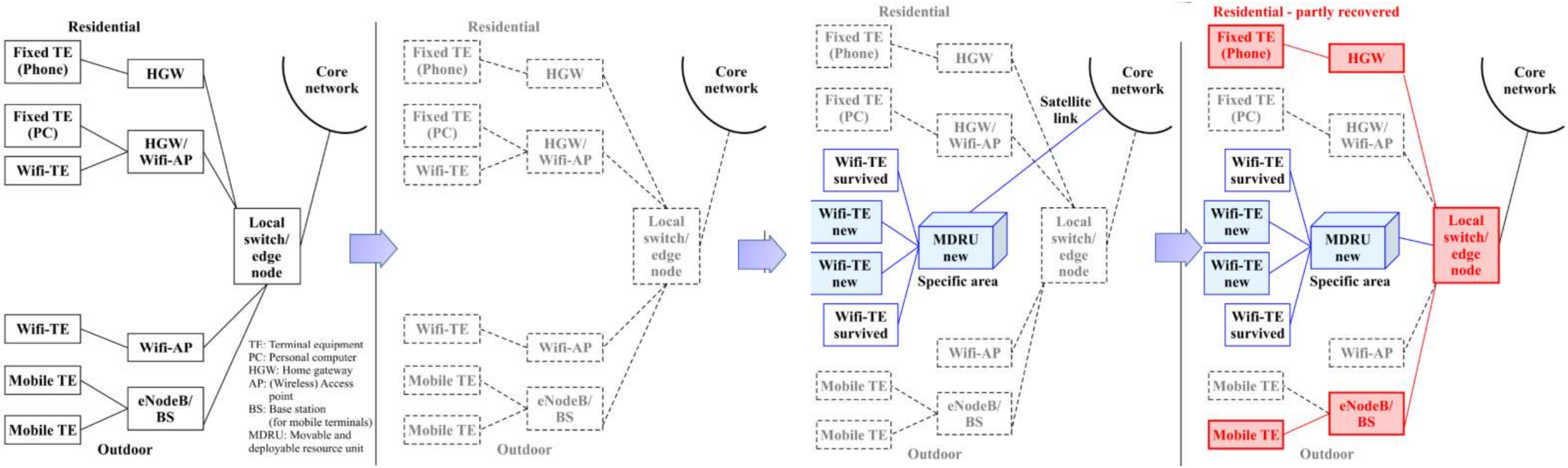
Key Observation:
Countries can do more to diversify network routes and connectivity choices and improve network quality (especially in preparation for pandemics like COVID-19, which is likely to require more connectivity and network capacity).

GOOD PRACTICES

- Leverage the **potential of non-terrestrial networks (NTN)** for expanding broadband connectivity to unserved and underserved areas, and for emergency preparedness:
  - *High-altitude platform station systems, balloons, drones (e.g., Malaysia balloon solution for marshy lands)*
  - *GEO, MEO and LEO satellite systems (e.g., Papua New Guinea reviewing regulatory framework and licensing process)*
- Incorporating **resilience, privacy, and security-by-design principles** in infrastructure roll out.
  - *Ensure risk-informed selection of IXP and data centre locations and create standards for their development to promote resilience, energy efficiency, integration of renewable energy sources, and security (both cybersecurity and physical security).*
- Support the **digital mapping of regional and national infrastructure assets** and promote cross-sectoral data sharing.
- Network operators maintain **operational plans for business continuity and disaster recovery**.



Network Resilience: Movable and Deployable ICT Resource Unit (MDRU) for network recovery



A: Normal Network

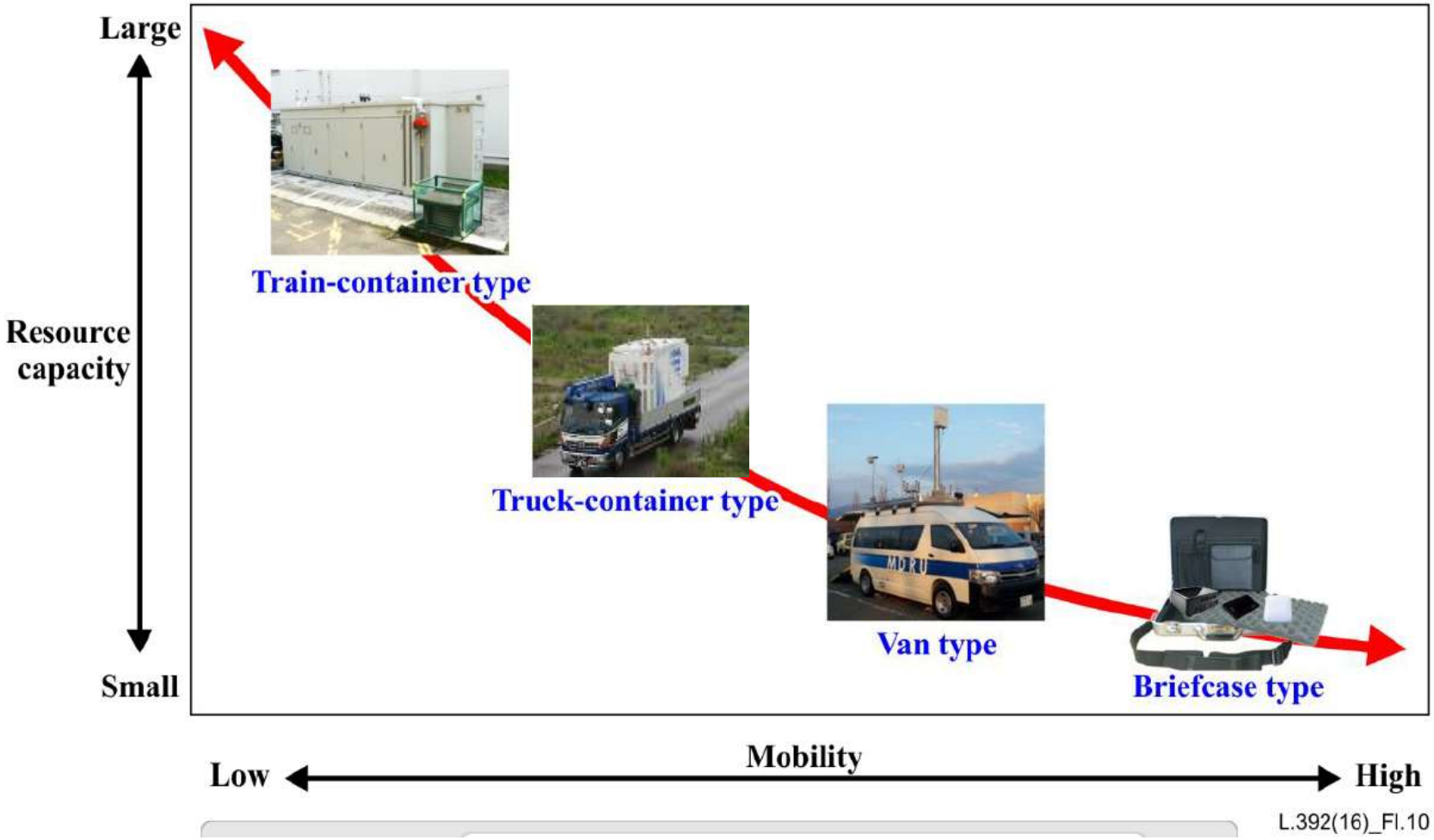
B: network – Dotted boxes and lines imply failures

C: Deployment of MDRU

D: Recovering Network

Source: **ITU-T L.392**: Disaster management for improving network resilience and recovery with movable and deployable information and communication technology (ICT) resource units

Network Resilience Movable and Deployable ICT resource unit (MDRU) use for network recovery



A menu of movable and deployable ICT resource units

Source: ITU-T L.392: Disaster management for improving network resilience and recovery with movable and deployable information and communication technology (ICT) resource units

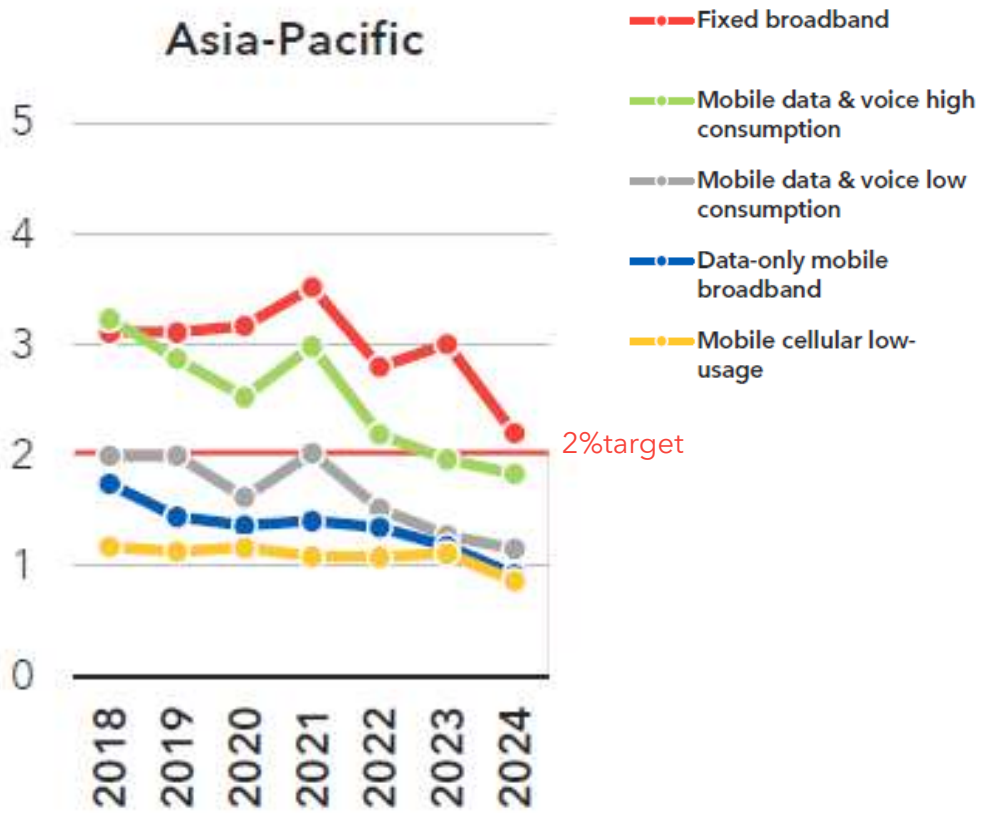
Affordable ICT services

- Enhances inclusive access to information and enables communication.
- Nations can better prepare for emergencies and natural disasters with affordable devices and services.
  - *During emergencies, timely and accurate information is vital for effective response and recovery.*
  - *During normal times, affordable ICT allows small businesses and entrepreneurs access to digital tools and platforms that can help them adapt and thrive.*
  - *During crises, such as pandemics, telehealth can be a crucial component of a resilient healthcare system.*
- Broadens access to educational resources and online learning platforms, and health information and services.
- Help build and strengthen communities by facilitating collaboration and networking.
  - *Strong, connected communities are better equipped to support each other during times of need and work together to quickly recover from crises, enhancing their resilience.*

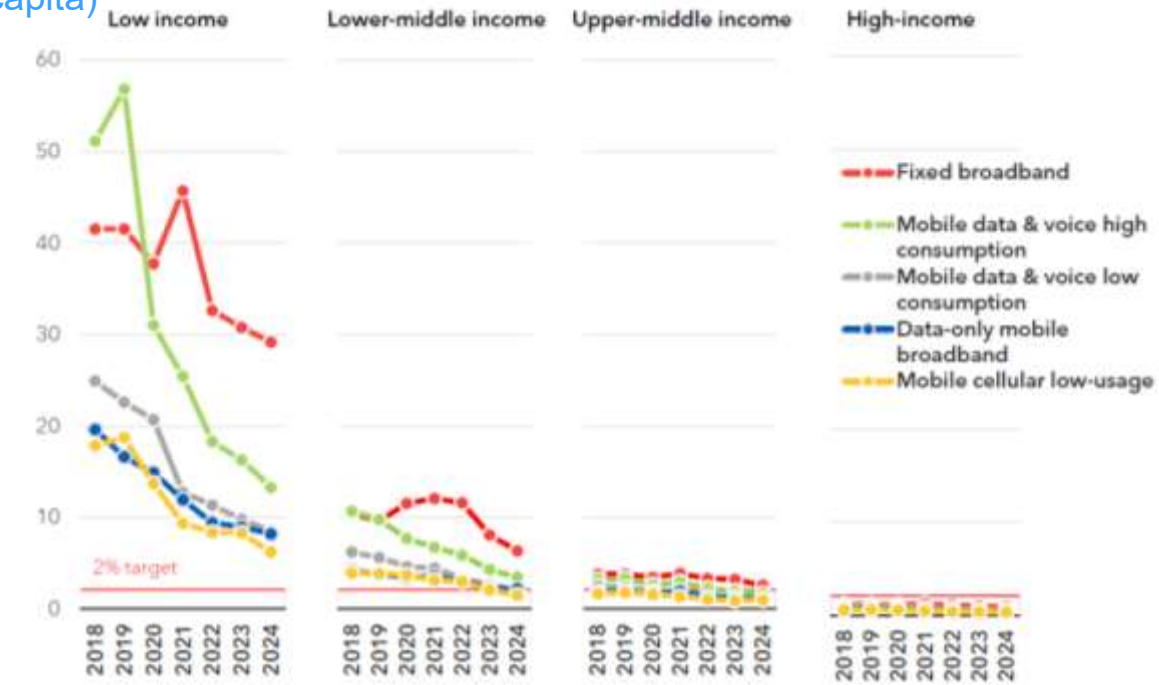
Affordability of ICT: Gaps and Recommended Practices

Lack of affordability of ICT services is one of the major barriers to access to critical information and services, especially for LDCs, LLDCs, and SIDS, for rural and remote areas, and women and other vulnerable groups.

Affordability of ICT as Percentage of GNI per Capita, 2018–2024



Affordability trends by income groups (basket prices as a % of GNI per capita)



Note: Income groups correspond to the World Bank's 2024 classification. Median values shown in the chart were calculated as a percentage of GNI per capita for the set of economies for which data were available for all years between 2018 and 2024 for a given basket to adjust the effect of changing data availability.

Source: ITU

Source: Measuring digital development – ITU Facts and Figures 2024

Insights - **Affordability** of ICT

Indicators	Bhutan	Lao PDR	Nepal	Philippines
Market Concentration: **Mobile HHI** **Fixed HHI**	 5,288 2,467	 3,926 4,975	 5,242 1,421	 4,463 3,532
Fixed Broadband Basket (GNI per capita) %	2.87	7.23	10.29	10.21
Mobile Data and Voice Low Consumption Basket (GNI per capita) %	1.18	4.03	2.48	1.78
Smartphone to Monthly Income Ratio %	17	13	9	13
Infrastructure Sharing	Yes, only passive infrastructure	No	Yes, only passive infrastructure	Yes, only passive infrastructure
Rural Connectivity Policy	National Broadband Master Plan	- Ten-Year National Digital Economy Development Strategies (2021–2030) - Five-Year Technology and Communications Development Plans (2021–2025)	License obligations	National Broadband Plan indicates a rural technology roadmap
Universal Access Fund	Universal Service Fund	Rural Telecommunication Development Fund	Rural Telecommunication Development Fund	National Broadband Plan indicates creation of Universal Access Fund
Mobile Spectrum Availability	Spectrum for 5G has been awarded in the 2.6GHz, 3.5GHz and 26GHz bands	538.8MHz assigned	200.9MHz assigned	530.9MHz assigned

Affordability of ICT: Gaps and Recommended Practices

Key Observation
Lack of affordability of ICT services is one of the major barriers to access to critical information and services, especially for LDCs, LLDCs, and SIDS, for rural and remote areas, and women and other vulnerable groups.

GOOD PRACTICES

- Adopt policies and regulations to promote and incentivize **passive and active infrastructure sharing**
- Improve ease of doing business and **promote competition**
- Promote the **coordinated deployment of infrastructure** alongside other public works, such as roads, by utilizing shared rights of way to enhance efficiency and reduce deployment costs
- **Include targets in national broadband plans or ICT policies**, strategies that relate to improving the affordability of ICT devices and data plans.

Emergency Preparedness

Effective emergency preparedness

- includes safeguarding the ICT systems and infrastructure from disrruption.
- Involves implementing measures like regular backups, disaster recovery plans and redundant systems to ensure that data and services remain available even during a crisis.
- Ensures organizational and network operational continuity and recover more quickly.

Emergency Preparedness

How prepared governments are to handle risks to ICT infrastructure. It looks at policies for cybersecurity, data protection, business continuity, and disaster recovery.

Indicators	Bhutan	Lao PDR	Nepal	Philippines
Cybersecurity Policy		✓	✓	✓
Data Protection and Privacy Policy	✓	✓	✓	✓
Government Procedures for Business Continuity and Disaster Recovery	✓	✓		✓
Country-level Mechanism to Conduct Resilience Assessments of ICT Infrastructure				✓
National Emergency Telecommunication Plan			✓	✓
Quality of Service Standard			✓	
Name Server Redundancy	✓	✓	✓	✓
Adaptive Restoration and Reallocation				
Predictive Analytics				
Redundant Power Supply for Critical ICT		✓		

Note: Yellow-shaded rows indicate critical gaps that need to be addressed.

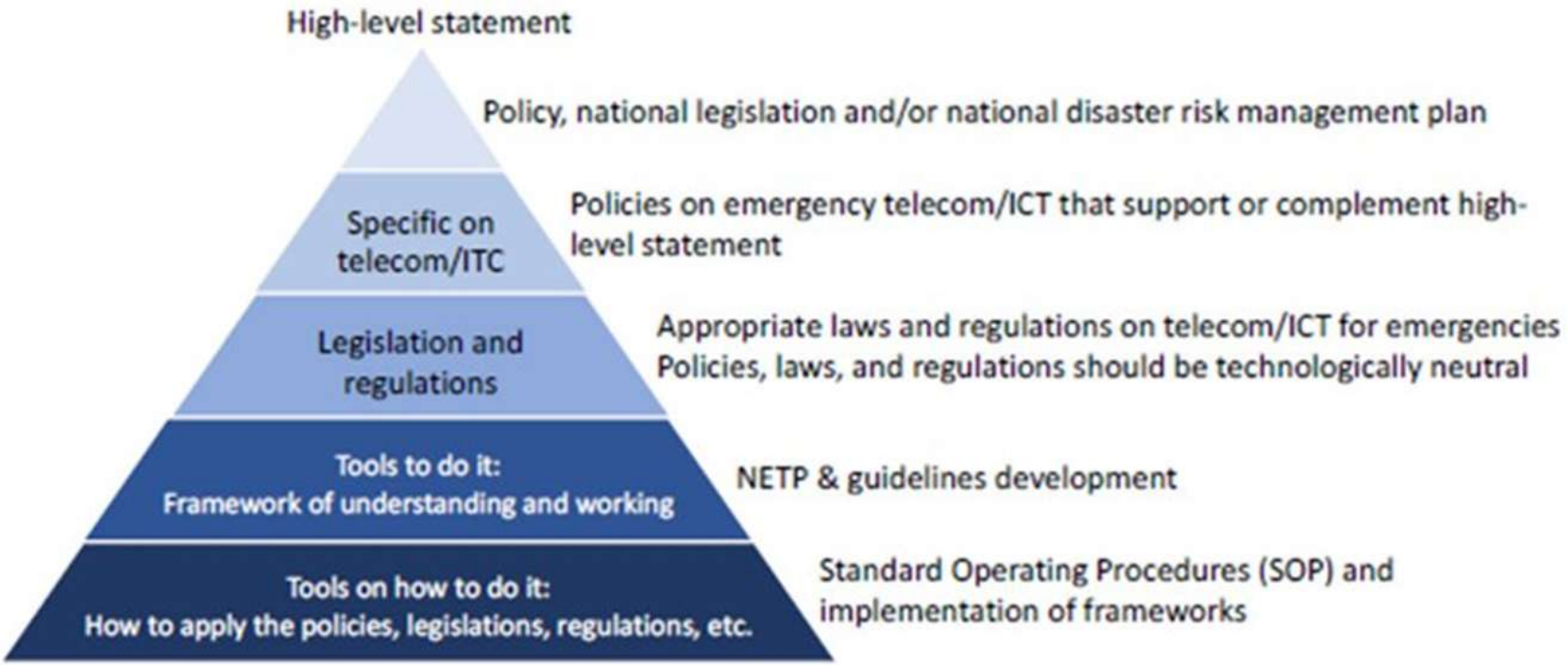
Emergency Preparedness: Gaps and Best Practices

- Develop and implement a **National Emergency Telecommunication Plan**.
- Develop standards for **Quality of Services/Experience (QoS/E),** especially during emergencies, and monitor their compliance.
- **Mandate infrastructure sharing** among network operators including Mandating **National Roaming** especially in places where there is single telecom operator
- Mandate that network operators establish institutional structures and plans for business continuity and disaster recovery, including multiple ready-to-deploy communication and power solutions for emergency response and evaluate periodically through National ETC (Emergency Telecom Cluster)

- Build capacity and **incentivize the implementation of adaptive restoration and adaptive reallocation, as well as predictive analytics**, to identify potential network congestion and failures.
- Leverage disaster connectivity mapping (DCM) to support informed decision-making across all phases of disaster management.
- Measures to ensure the **availability of power supply for critical ICT infrastructure**.

National Emergency Telecommunication Plan (NETP)

National emergency telecommunication development and implementation



Early warnings for all contribute to resilience by

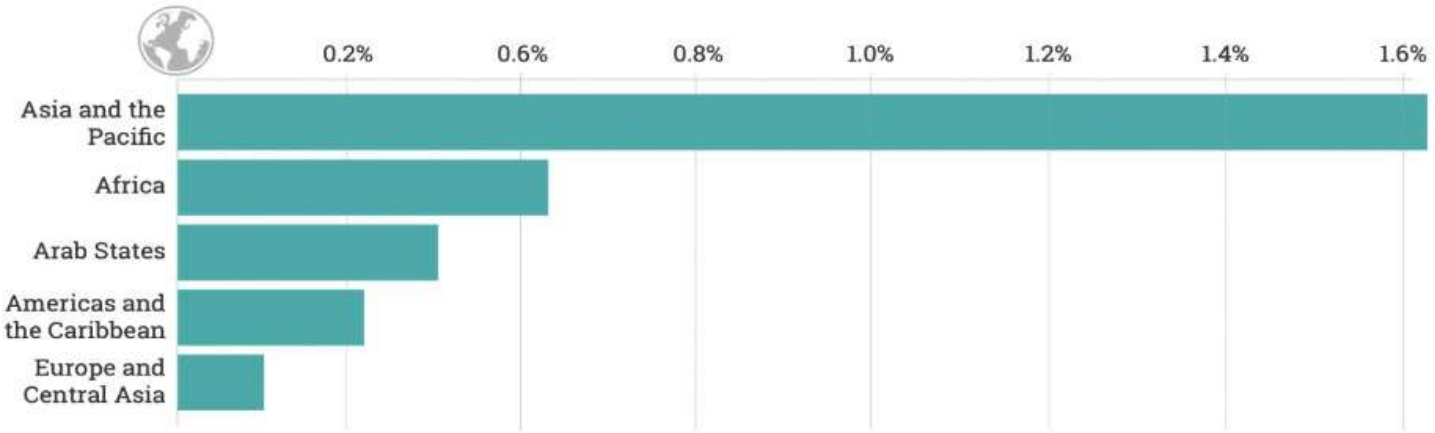
- Providing advance notice of potential threats, enabling individuals, organizations and communities to take preemptive actions.
  - For instance, an early warning of a natural disaster allows people to evacuate, businesses to secure assets and governments to mobilize resources, reducing potential damage and loss.

- Coordinating actions among various stakeholders, including government agencies, businesses and community organizations.
  - This collective approach enhances overall resilience by ensuring that everyone is aligned and working together to prepare for, respond to and recover from emergencies.

Early Warnings for All

Asia-Pacific: Disaster Impact Scenario

- Asia-Pacific remains the most disaster impacted region. Since 1970, two million people have lost their lives, equivalent to 105 lives being lost to disasters every day.
- The LDCs/SIDS accounts for mortality five times as compared to the rest of the Asia-Pacific
- The cost of inaction is on the rise, regression on SDG 13, Sendai targets off the tracks



The highest share of economic loss by region is borne within Asia-Pacific, where countries lose on average 1.6% of GDP to disasters
Source: GAR 2021

ESCAP

EW4All Return on Investment

- The World Bank has estimated that universal access to early warning systems would lead to **annual global reductions in asset losses of $13 billion**. In addition, socioeconomic conditions would be improved by reducing wellbeing losses by up to $22 billion per year, resulting in total avoided annual losses of $35 billion.

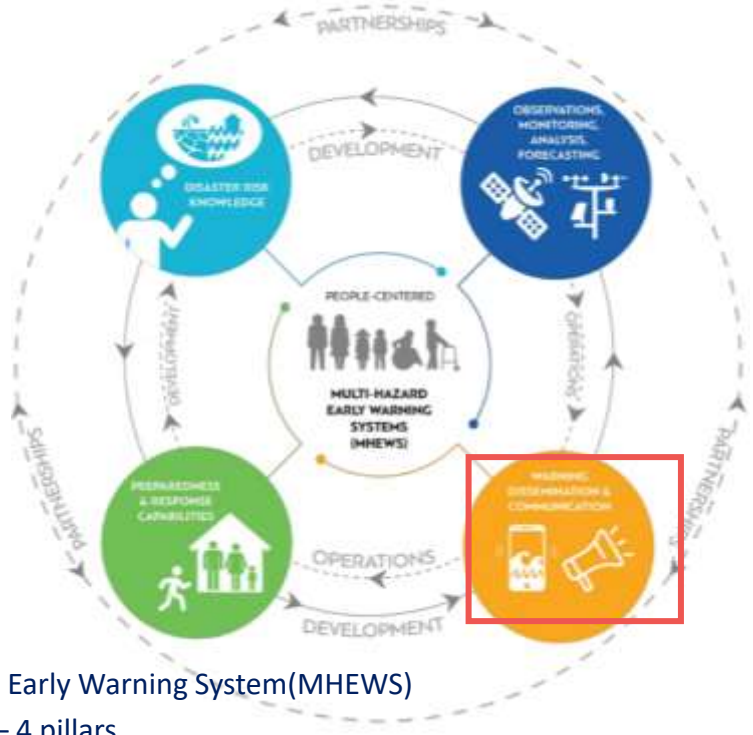
- The WFP-led Emergency Telecommunications Cluster undertook a study to quantify the cost-benefit returns in emergency telecommunications in 2022-2023. The findings demonstrated that for every one US dollar of invested resources, there is a monetary return of almost **three times the value of original investments** made (for assessed countries).

- The Global Commission on Adaptation found that just 24 hours warning of a coming storm or heat wave can **reduce the potential damage by 30 percent**, and an investment of $800 million in early warning systems in developing countries could prevent losses ranging from $3 to $16 billion annually, resulting in higher returns on investment than any other climate adaptation measure, with benefit/cost ratios of at least ten.

ITUWTDC BAKU2025

Early Warning for All Initiative Action Plan: launched during COP27

Pillar 3: Warning dissemination and communication



Multi-Hazard Early Warning System(MHEWS) Value Cycle – 4 pillars

Outcome 1: Governance

All countries have agreed on functions, roles and responsibilities for each actor in the warning dissemination process and this is defined through government policy

Outcome 2: Infrastructure networks and services

Last-mile communication - All countries have multichannel dissemination and communication alerting to ensure the warnings reach those at risk.

Outcome 3: Inclusion and people-centered approach

Strengthened and expanded alert dissemination and feedback channels reaching all people with actionable information.

Outcome 4: Quality and trust

All countries have the capability for effective, authoritative emergency alerting that leverages the Common Alerting Protocol (CAP), suitable for all media and all hazards.

Four target outcomes

Outcome 1: Governance

All countries have agreed on functions, roles and responsibilities for each actor in the warning dissemination process and this is defined through government policy

GOVERNANCE
At what stage is the country in establishing ICT-specific legislations or mandates that enable the ICT ministry, agency , and/or regulator to respond to disaster early warning?
To what extent is the government enforcing that each actor complies with their established functions, roles and responsibilities through policy, including the development of warning communication strategies and SOPs in each case?
At what stage is the government in designating a WMO Registered Alerting Authority to issue the warnings? *(whether the communication strategies are developed to reach the target population and whether the communication networks and equipment are resilient to an extreme event)*
To what extent is the government in identifying the stakeholders for specific roles and responsibilities including regional or cross border early warning to neighbouring countries?
At what stage is the government in establishing a regulatory framework to plan and implement interoperability solutions for data and voice communications ? *(i.e. governance, SOPS, technology, training and exercises, and usage of interoperable communications)*
To what extent has the government identified relevant network operators and service providers to be involved in providing emergency communications services? *(including domestic telecommunications providers and international satellite operators)*
How often have the regular coordination, planning, and review meetings been taking place? *(e.g. between the warning issuers, the media, and other stakeholders)*
At what stage is the country in the adoption of the Common Alert Protocol (CAP) in accordance with ITU-T Recommendation X.1303?
At what stage is the country in establishing a National Emergency Telecomnunication Plan (NETP) or similar strategy?
At what stage is the government establishing policies for the mobile handset manufacturer/importer to support Cell Broadcast
At what stage do the government standard operating procedures or protocols identify contact points in each relevant agency and outline step-by-step communication protocols to follow during disaster response?

Four target outcomes

Outcome 2: Infrastructure networks and services

Last-mile communication - All countries have multichannel dissemination and communication alerting to ensure the warnings reach those at risk.

INFRASTRUCTURE
To what extent have early warning infrastructure and systems been identified, established, tested, maintained and upgraded? *(to ensure resilience, redundancy, and functionality with back-up systems and processes?)*
To what extent have ICT infrastructure service providers been able to provide data about the scale of communications outages, and their progress on restoration as part of the warning establishment?
How many times has the assessment been conducted to understand which population groups can be reached by which services? *(including mobile-cellular, satellite and radio services etc)*
To what extent has the Cell Broadcast facility been enabled in mobile networks?
At what stage is the establishment of consensus to utilize private sector resources where appropriate? *(e.g. mobile-cellular, satellite, television, radio broadcasting, amateur radio, social media) to disseminate warnings?*
To what extent has the mobile early warning systems been used to send warnings via mobile networks? *(in particular cell-broadcast system and/or location-based SMS system)*
To what extent have assessments and plans for equipment maintenance, upgrades, and redundancies been implemented to ensure backup in case of a failure?
To what extent have the key stakeholders been provided with ICT tools needed to communicate during emergency operations?
At what stage are public mobile apps related to EWS been identified with the capability to provide secure services?
To what extent has the automated systems been in place to mitigate impacts in case of events with a short time frame for reaction? *(e.g. automatic stop of transport, activation of red lights in tunnels, stopping elevators on the closest floor, opening of fire-truck gates, in case of earthquake)*

Four target outcomes

Outcome 3: Inclusion and people-centered approach

Strengthened and expanded alert dissemination and feedback channels reaching all people with actionable information.

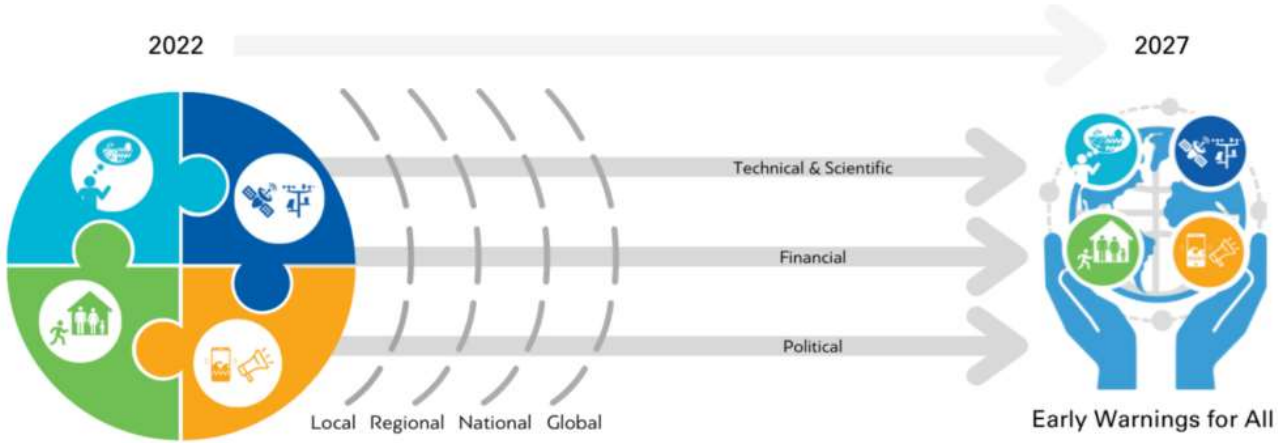
INCLUSION
To what extent have warning alerts and messages been tailored to the specific needs of those at risk? *(e.g. for children and youth, for diverse cultural, social, gender, linguistic and educational backgrounds)*
How far has the warning communications reach the entire population, including foreign, seasonal populations, roamers, and communities at remote locations?
At what stage has the mandatory technical standards for barrier-free access been established to all information and communications technology–related services ? *(including websites, media channels, and social media platforms, based on the internationally recognized accessibility standards WCAG 2.1)*
How many early warning local committees have been trained to read the alerts/warnings of extreme weather events? *(and ensure that in such committee there is the representation of vulnerable groups and children, youth, parents, and/or caregivers) .*
How many assessments have been conducted to evaluate the capacities and needs of vulnerable population? *(through surveys, focus groups, etc., and use this knowledge to inform a warning communication strategy, including through crafting fit-for audience messages and effective use of appropriate channels and messengers)*
Are test warnings addressing the needs of women and vulnerable groups being distributed in pilot sites?
Which of the following have been used for warning dissemination? - Cell Broadcast - LB-SMS - Registration-based SMS - National SMS - Mobile app - Apps designed for other use - Sirens - Fixed-line alert system - Emails - Social Media - TV and Radio - Billboards & public signs
What kinds of technological advances have been used to eliminate barriers in mobile phone for early warning dissemination? *(e.g. innovations to support schools and Child-Serving Institutions, innovations to translate messages, generate captions, read text out loud, among other innovations that can increase inclusivity for people with disabilities and elderly)*
How many professional and volunteer networks have been formed to ensure that warning are widely received by last-mile stakeholder groups?
To what extent has common alerting protocol (CAP) been applied in various platforms and media to ensure consistency and inclusivity in communicating warning messages? (digital; formal and informal networks and through a variety of media)

Four target outcomes

Outcome 4: Quality and trust

All countries have the capability for effective, authoritative emergency alerting that leverages the Common Alerting Protocol (CAP), suitable for all media and all hazards.

QUALITY AND TRUST
To what extent are the public and other stakeholders aware of which authorities issue the warnings and that they trust their message?
How often have the warning communication strategies been evaluated and been provided feedback? *(to verify that warnings have been received and to correct potential failures in dissemination and communication, leading to trust among and between stakeholders)*
How much social media has been utilized to share information in a regulated environment during a disaster?
To what extent has the impact-based early warning messages been used to communicate risk clearly and provide advice on actions that can be taken to reduce risks?
How many public mobile apps related to EWS have been identified to inform end users on their ability to provide secure services?
What kind of mechanisms have been put in place to activate features targeting specific communities? (mobile cell site-based, geofencing)
What kind of mechanism has been put in place to inform the community when the threat has ended?
How many studies have been conducted to understand how people access and interpret early warning messages? (and lessons learned incorporated into message formats and dissemination processes)
To what extent have communities been involved in the development of early warning messages?
What kind of two-way communication feedback mechanisms have been established with communities to allow them to share real-time information that helps support continued improvement?
How many early warning drills are conducted considering multiple hazards that could result in a “worst case scenario”.



Pillar 3: Warning dissemination and communication

In afternoon session

Linkedin URL:
https://www.linkedin.com/company/itu-regional-officefor-asia-and-the-pacific/?viewAsMember=true

THANK YOU

Twitter Handle:
@ITU_ASP (https://twitter.com/ITU_ASP)

ituasiapacificregion@itu.int