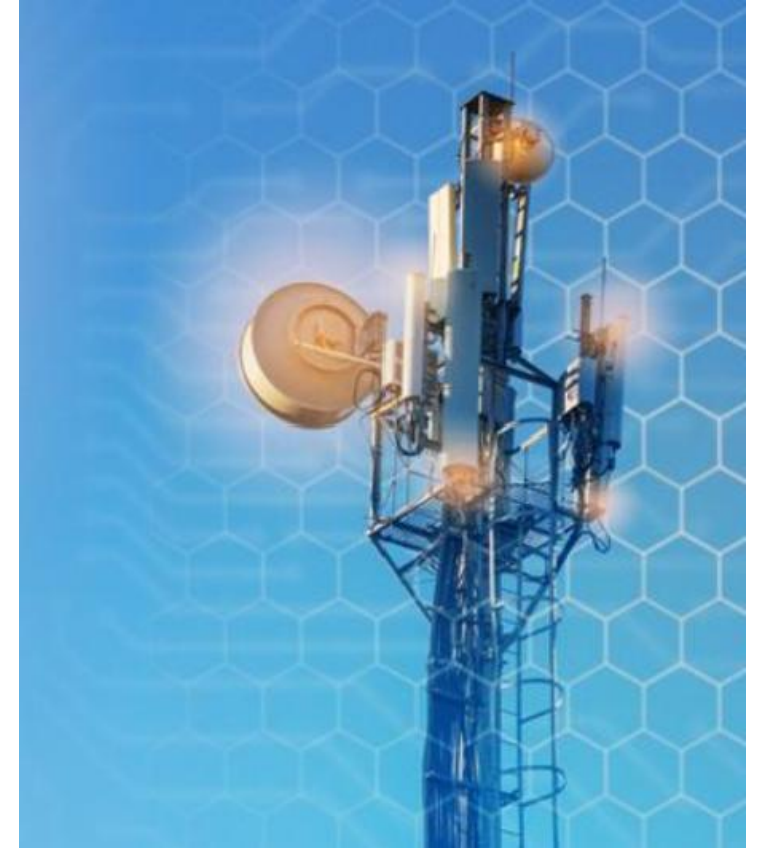

Digital Resilience:

Building and Operating Resilient Telecom Infrastructure

Zaki B. Khoury, Ph.D.

Lead, Korea Digital Development Program (KoDi)

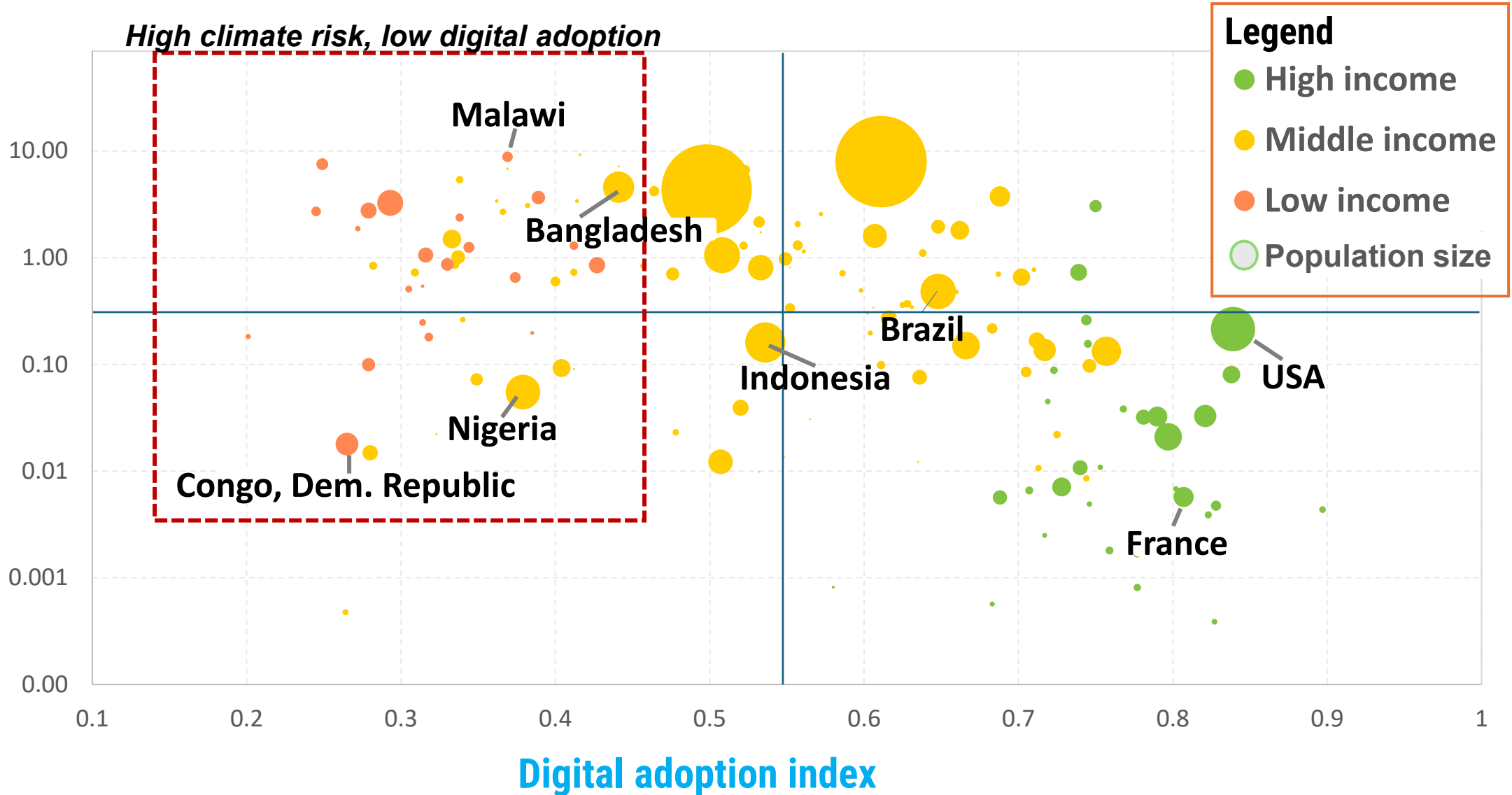




The digital divide is a resiliency divide

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Population at risk of extreme weather (%)





Digital for climate action framework

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Greening Digital

Greening *with* Digital

ADAPTATION



Resilient infrastructure

Resilient communities and economies

MITIGATION



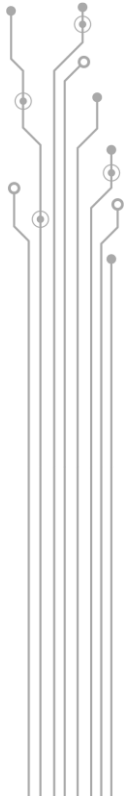
Energy efficiency and renewable energy

Decarbonize other sectors (e.g. energy and transport)



Total Emissions from the Digital Sector is 4% ... *but growing in the AI era*

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Connectivity network
16-40%



Data centers
20-48%



Consumer device
24-40%



Computers

Smartphones

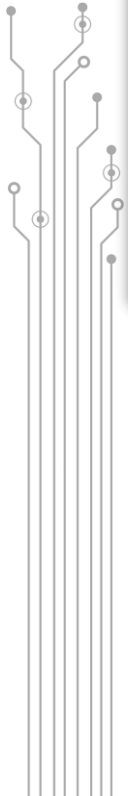
Others





Telecom Infrastructure Hazard Exposure

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Flashfloods sever fiber optic cables in the Philippines, 2022



Tropical storm submerges government data infrastructure in Dominica, 2017



Telecom towers collapsing from cyclone in Myanmar and Bangladesh, 2023



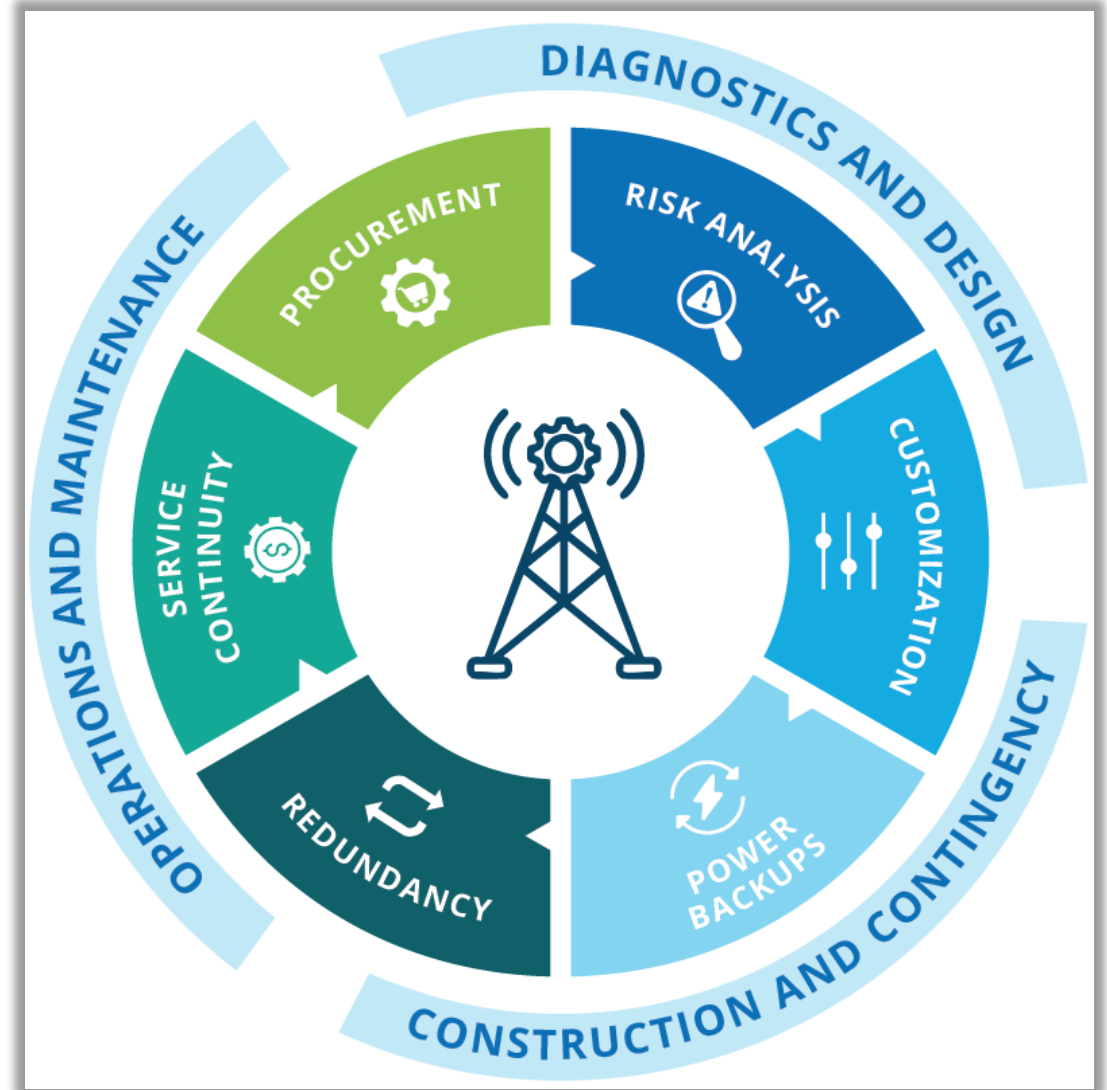
Resilient digital infrastructure

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Resilient telecommunications infrastructure A practitioner's guide



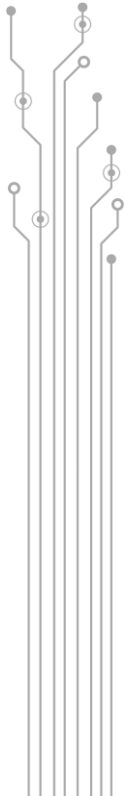
2024











Telecom Infrastructure Hazard Exposure

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----- TYPES OF TELECOM ASSETS -----

-----TYPES OF HAZARDS-----

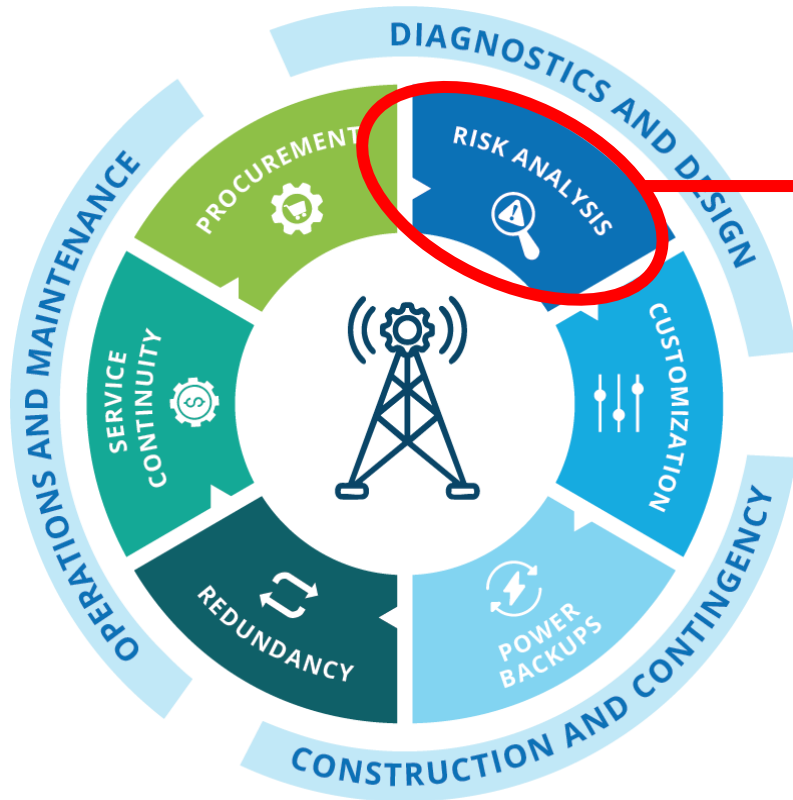
INFRASTRUCTURE/HAZARD							
	INLAND/ COASTAL FLOODS	HIGH WINDS/ STORM	SEA LEVEL RISE	HIGH TEMP	WILDFIRE	EARTHQUAKE	TSUNAMI
Submarine Cable (deep sea)	L	L	L	L	N/A	H	M
Submarine Cable (near shore)	L	L	L	L	L	H	H
Submarine Cable Landing Station	H	L	H	L	L	H	H
Terrestrial Cables (underground)	M	L	L	L	L	H	L
Terrestrial Cables (overland/aerial)	L	M	L	L	M	M	L
Network Nodes, IXPs, data centers	H	L	L	M	L	M	L
Wireless transmission antennas/BTS	M	H	L	L	M	M	L

Source: Adapted from Adams et al. 2014; Dawson et al. 2018; Fu, Horrocks, and Winnie 2016; and U.S Department of Homeland Security 2017.



Risk analysis

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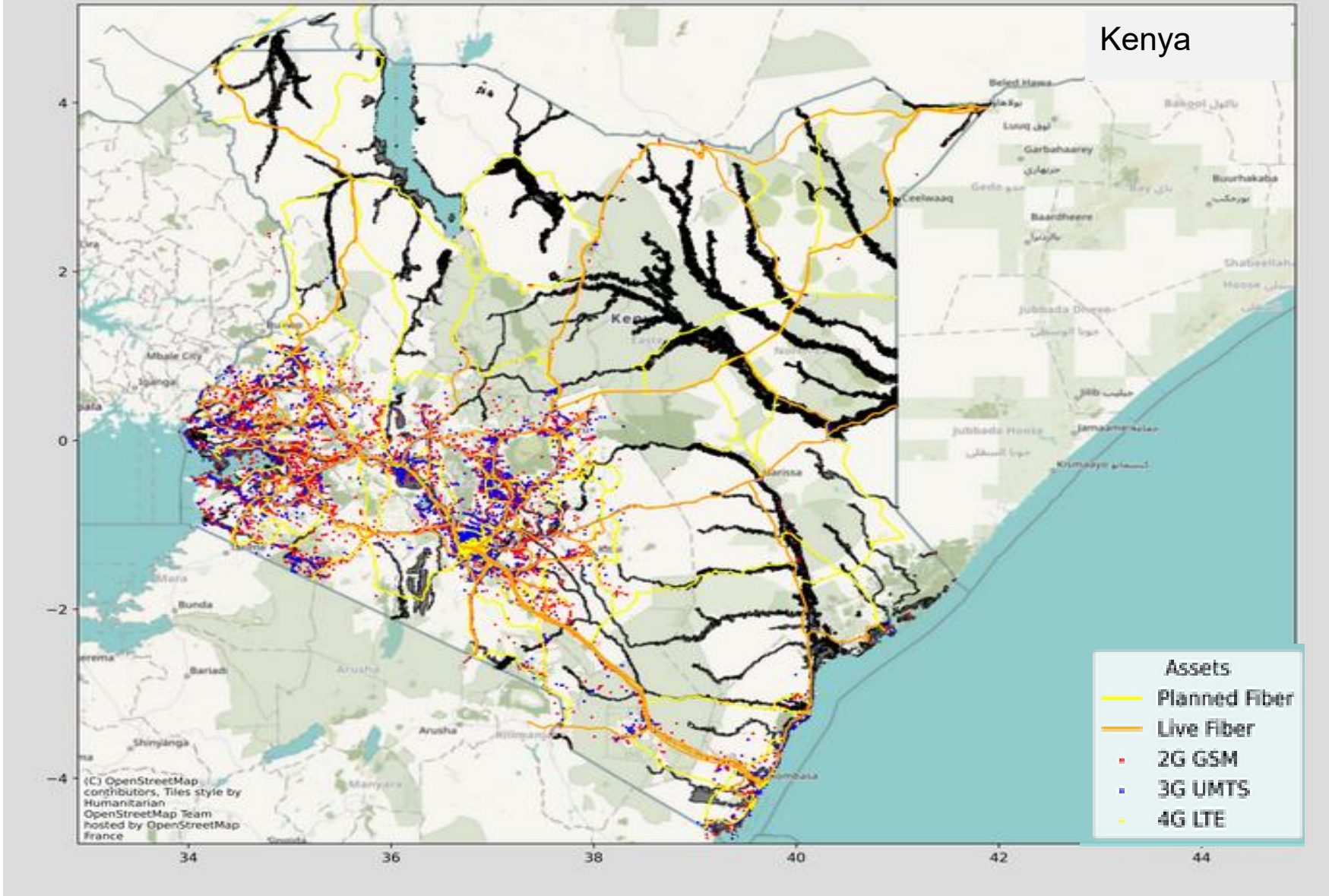
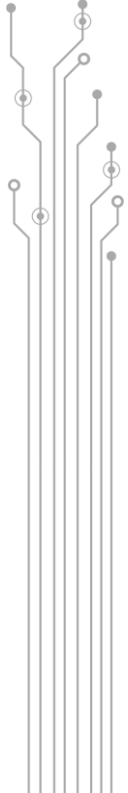
- Proactive Risk Identification
- Impact Assessment
- Monitoring and Adaptation
- Standard Frameworks

"The incremental cost of increasing the resilience of future infrastructure investments is significantly reduced if asset exposure is known"



Risks analysis – Kenya (flooding)

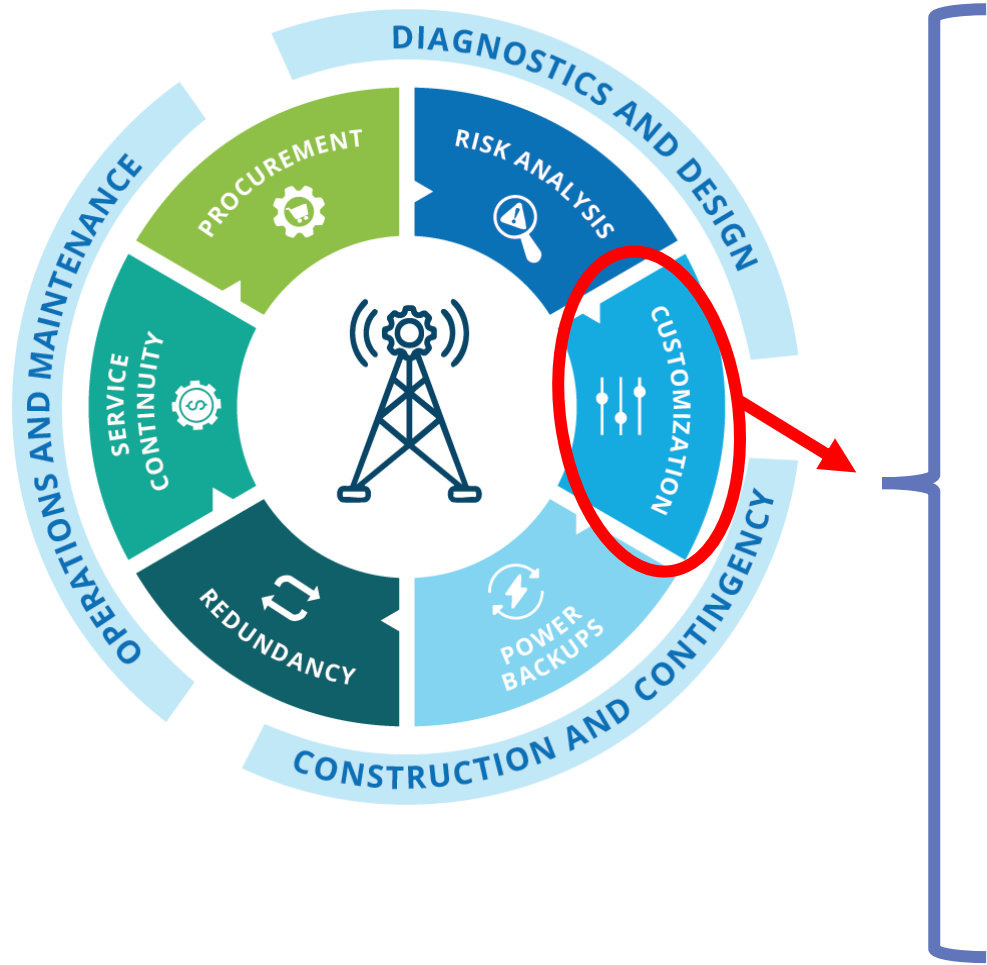
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Customization – site/asset specific measures

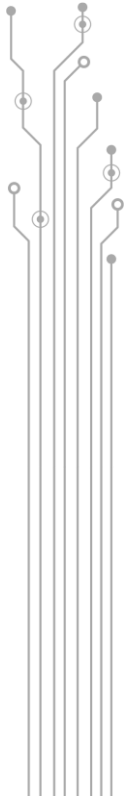
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- **Site selection**
- **Site assessment and preparation**
- **Physical protection / hardening**
- **Develop standards and best practices**
- **Additional key points to consider (e.g. power)**



Customization – Mobile Towers

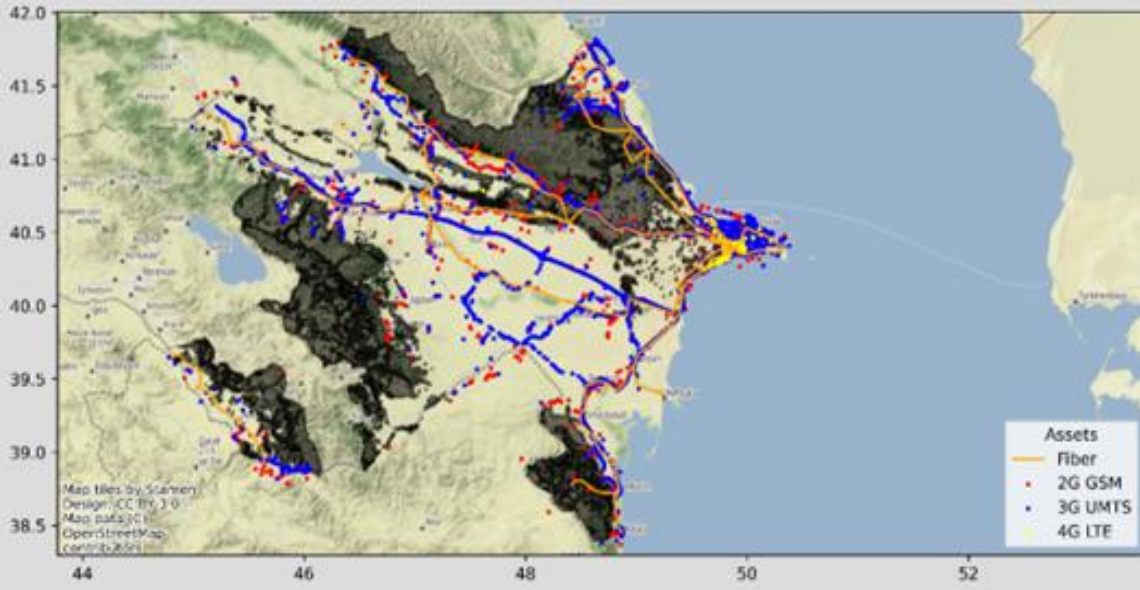


Asset	Risk	Resilience measure
Mobile Towers	Floods	Select elevated location and ensure proper site preparation with stable and possibly elevated foundation; ensure proper drainage system and possibly retaining walls around tower base; elevate electronic equipment, utilize corrosion-resistant materials and protective coatings; ensure power backup (consider solar and battery); conduct regular maintenance.
	Landslide	Ensure structurally sound and reinforced tower foundation; consider the construction of retaining walls; limit/monitor human activities increasing landslide risks (e.g. deforestation).
	Wind	Ensure reinforced structural integrity of mobile towers (to withstand max wind speeds) with guy wires and anchors, install surge protection and lightning rods/earthing; Conduct regular inspections.
	Heat	Thermal insulation paint, materials and coatings; install cooling systems for electronic components.
	Wildfire	Same as above + Remove vegetation and other combustible materials around the poles.
	Earthquake	Ensure mobile towers are structurally sound, incorporating appropriate dampening mechanisms and potentially flexible connectors.

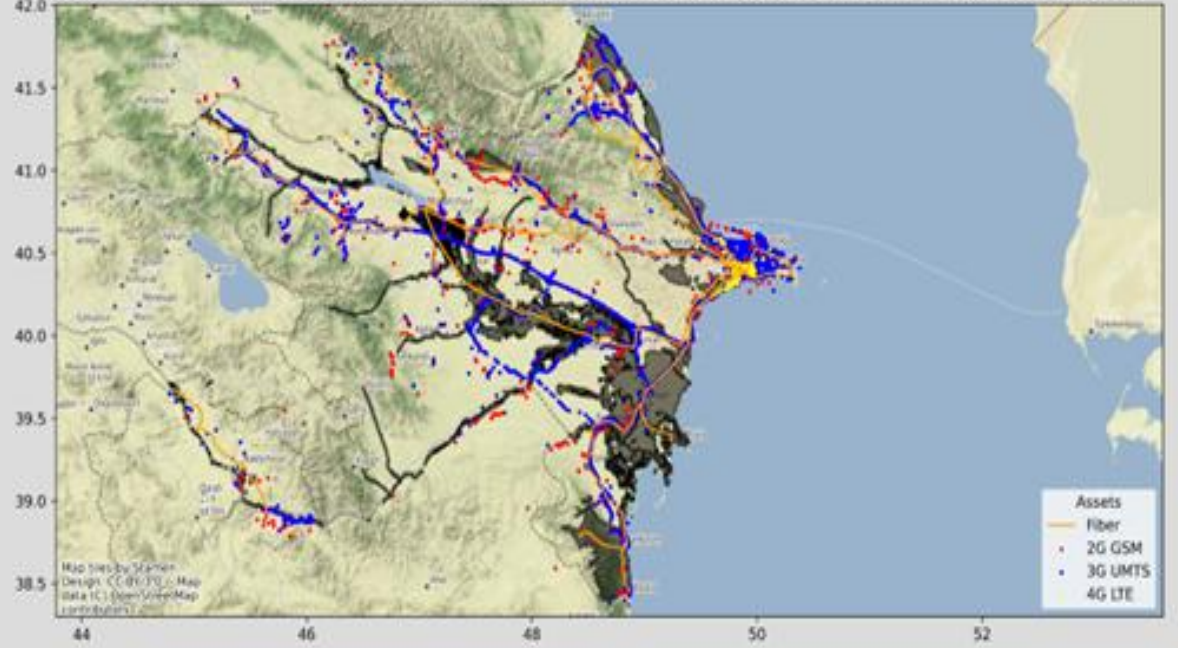


Customization – Azerbaijan

Landslide Risk Exposure for Medium and High Risk Areas



Projected River Flooding: Azerbaijan, rcp4p5, 0000HadGEM2-ES, rp01000, 2080

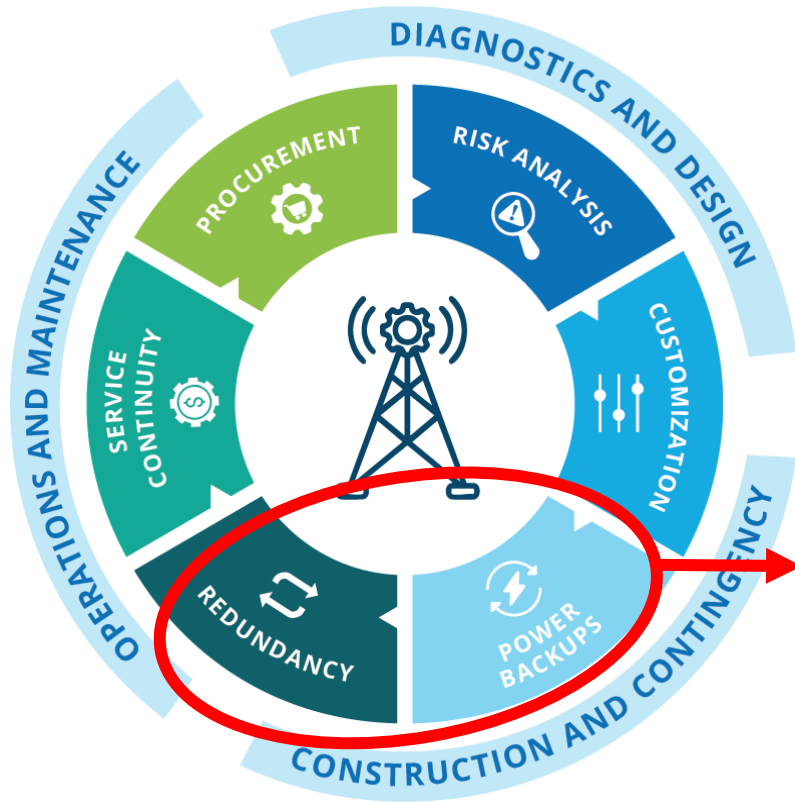
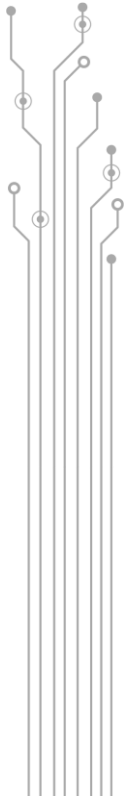


Majority of the networks are exposed to either landslide or flood risk. Knowing this enables infrastructure owners to take more targeted measures to strengthen infrastructures based on these hazards.



Redundancy and power backups

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- **Multiple Network Paths**
- **Backup Power Sources**
- **Fault-Tolerant Devices**
- **Load Balancing**
- **Regular Testing and Maintenance**
- **Consider Cost vs. Complexity**



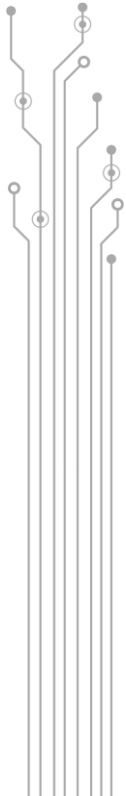
Power backup / Renewable energy – Jordan

Renewable energy policies

In Jordan, the Electricity Regulations Commission introduced a wheeling regime that allows large enterprises to generate electricity via renewable energy sources for their use.



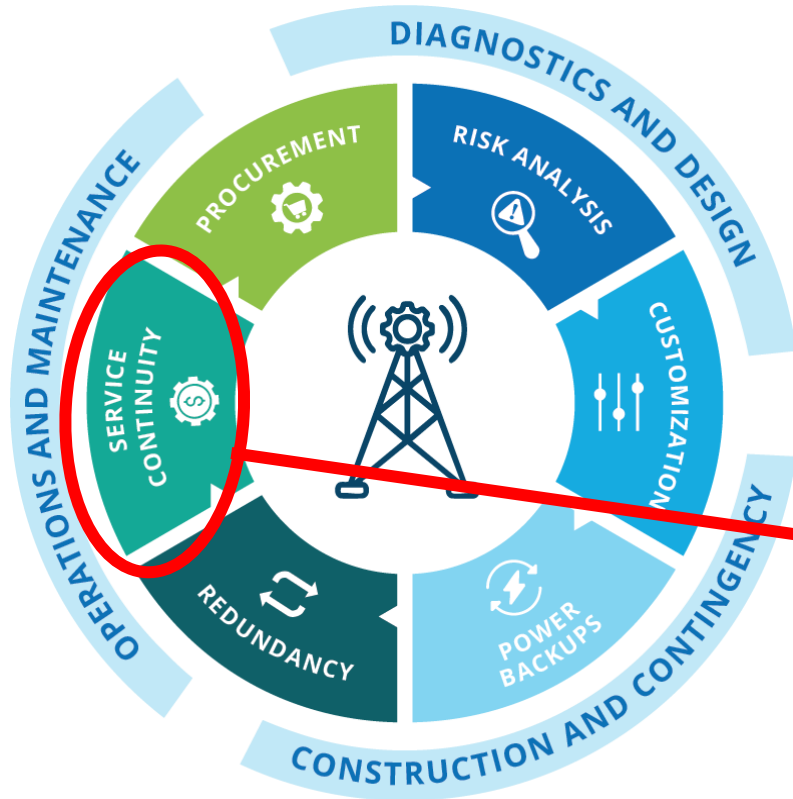
Source: GSMA





Service continuity and contingency plans

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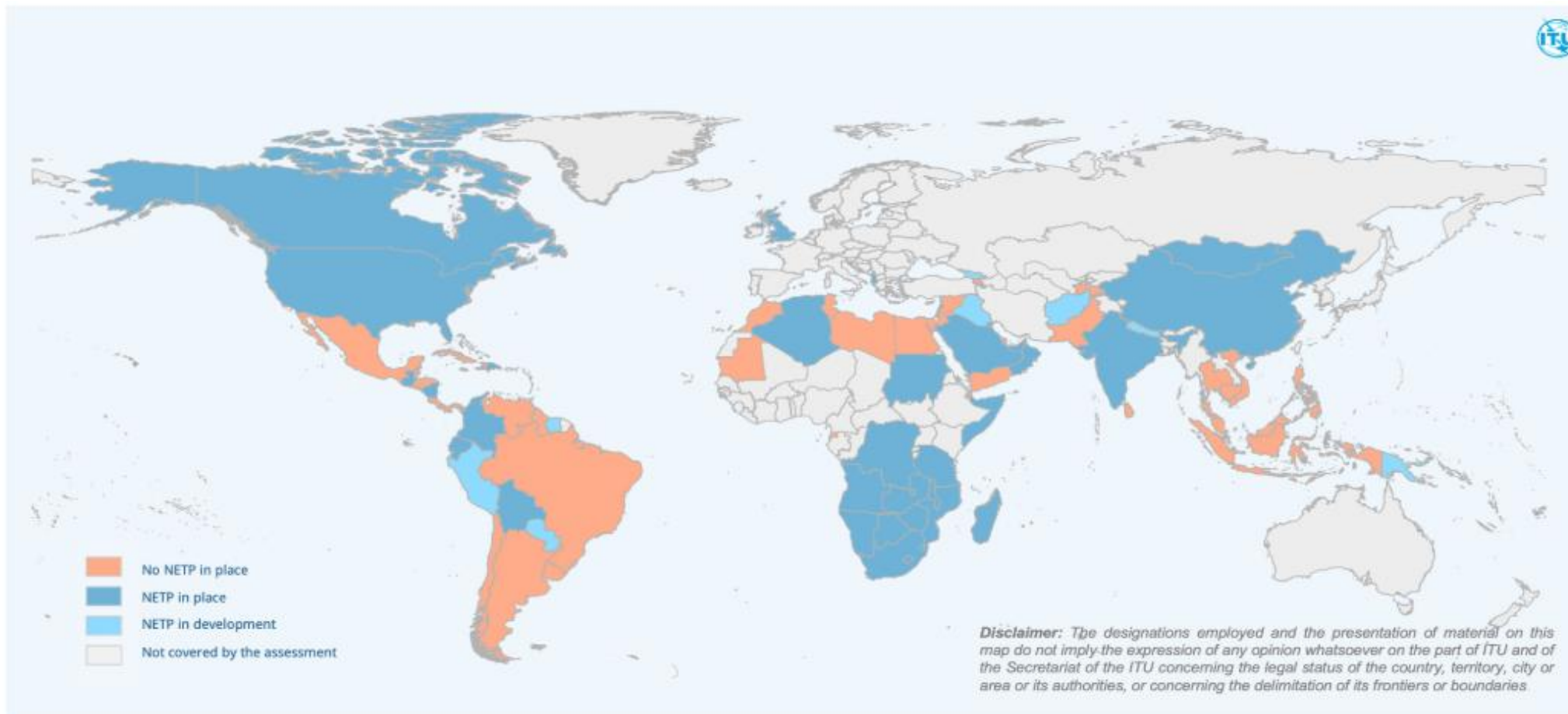
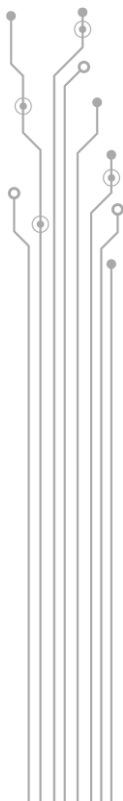


- **Assessment of risks**
- **Planning**
- **Implement**
- **Simulate/Test**
- **Monitor and Update**



Service continuity and contingency plans

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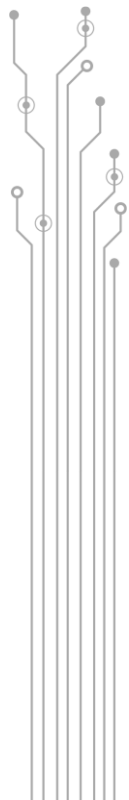
About 58% of countries have or are developing a National Emergency Telecommunication Plan (NETP)

...out of 100 countries covered by ITU Emergency Telecommunication Baseline Assessments (carried out in 2021-2023)



Service continuity and contingency plans

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Standards / guidelines

GSMA has developed detailed Business Continuity Guidelines specifically for mobile network operators, that also emphasizes the need for disaster resilience planning within mobile networks.

Contingency Plan

T-Mobile has a contingency plan designed to ensure operational resilience during emergencies and significant disruptions, including proactive risk management and effective response strategies.

Team roles / structures

Smart (Philippines) local representatives assist with disaster response to take advantage of their proximity and understanding of the realities on the ground.

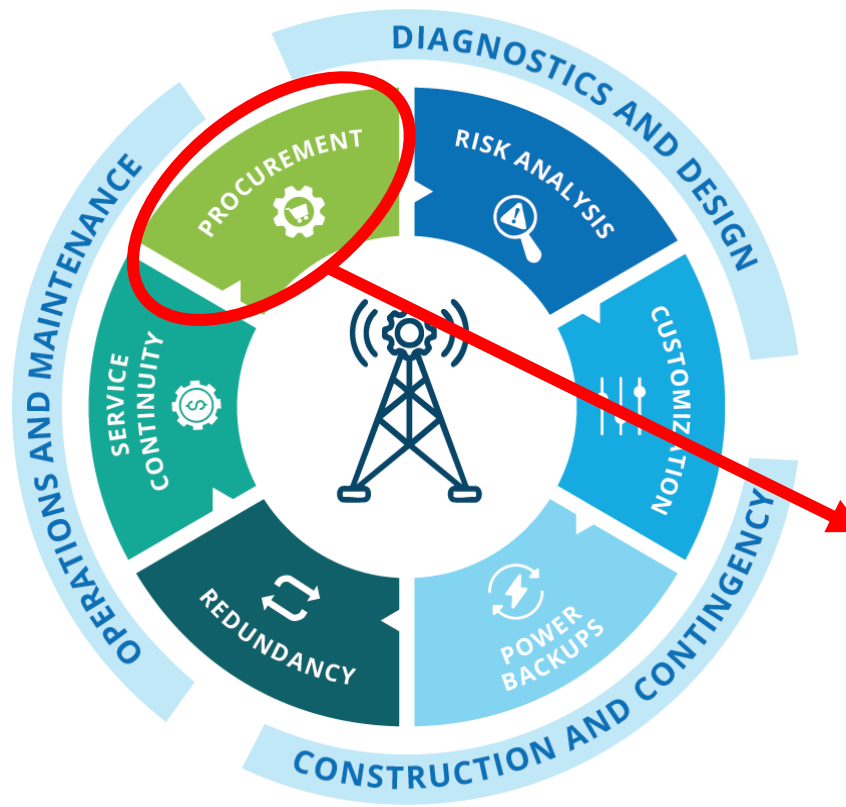
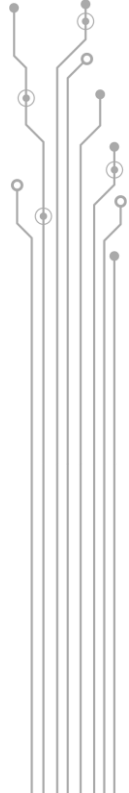
Simulations & drills

NTT Group (Japan) conducts comprehensive disaster drills that include establishing a combined disaster response headquarters in alternate locations.



Procurement

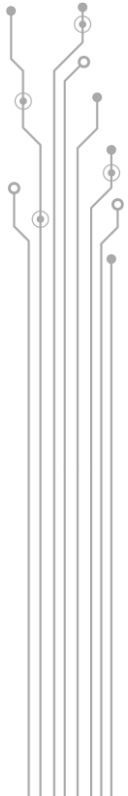
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- **Technical specifications**
- **Award criteria**
- **Monitoring supplier performance**



Procurement: technical specifications

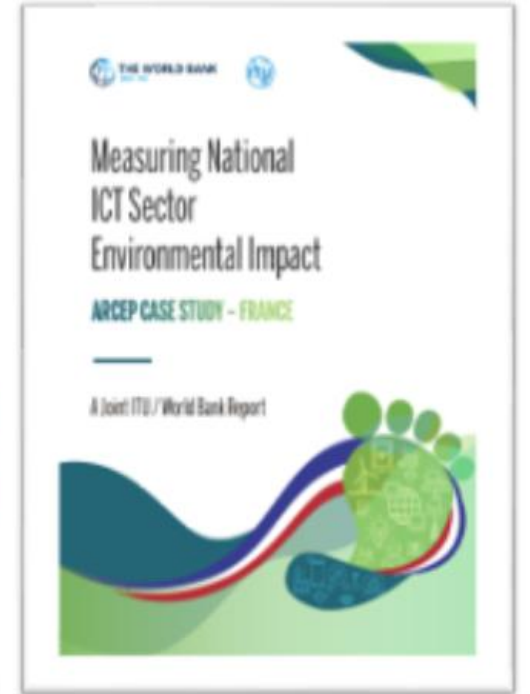


Performance requirement	Description
Extreme temperature resilience	Temperature tolerances for equipment and infrastructure components to ensure they can operate without compromising performance or durability
Water resilience	Water-resistant or waterproof designs for critical components and infrastructure to minimize damage from flooding and heavy rainfall.
Energy efficiency	Set targets for components to reduce carbon footprint and energy consumption. This can include energy-efficient servers, cooling systems, and power management practices.
Power backup and redundancy	Mandate the inclusion of robust power backup systems, such as uninterruptible power supply (UPS) or backup generators, to ensure continuous operation during power outages or disruptions caused by extreme weather events.
Resilient Network Connectivity	Specify requirements for redundant network connectivity to ensure reliable communication and data transmission.



More Knowledge & Resources

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Thank You

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