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Internet Resilience Index

A framework to measure Internet Resilience

Naveed Haq

Regional Director for Infrastructure and Connectivity

haq@isoc.org

“Meaningful Connectivity - A4AI”

Regular Internet Access

An Internet **which is not subject to frequent disruption** (accidental or intentional) and which provides daily access to perform normal activities i.e. for work, education and communication purposes.

A fast Internet connection

For a smooth online experience, users needs to a decent connection to be able to use currently available services. **At least a 4G mobile connection.**

Unlimited connectivity

An Internet which is uncapped, affordable and **accessible at all times** will provide unlimited potential to users.

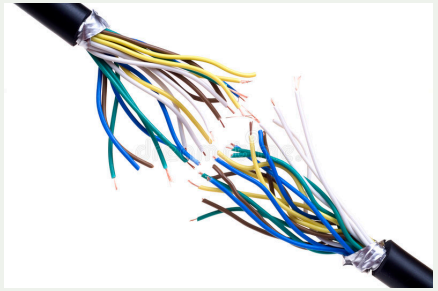
An appropriate device

A smartphone provides the functionality to create and consume Internet content and allows Internet Access everywhere.

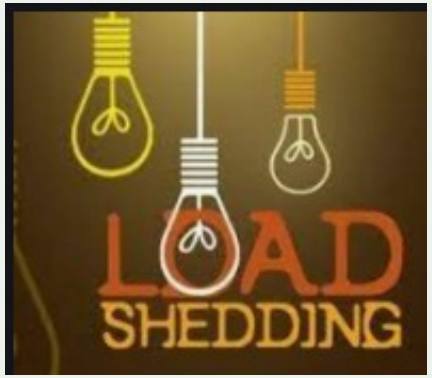
https://a4ai.org/meaningful-connectivity/

Our reality

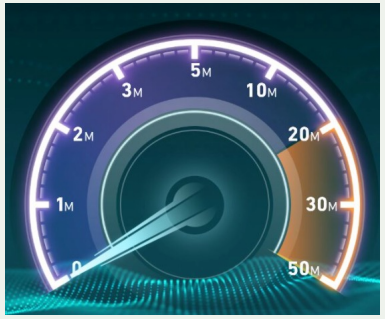
Internet disruptions



Unreliable access to electricity



Under provisioned networks



Lack of redundancy

Source: https://www.online-tech-tips.com/

The Internet Resilience Index (IRI) is a composite indicator that measures a country's performance against the key pillars of a robust Internet ecosystem

Internet Resilience Index

Theoretical framework

4 Pillars, 11 Dimensions, 30 Indicators

- Currently there is no composite indicator for Internet Resilience, which is a complex concept
- Inspired from existing indices such as MCI (Mobile Connectivity Index by GSMA), Global Cybersecurity Index (ITU)

Infrastructure

- Cable ecosystem
- Mobile connectivity
- Enabling infrastructure

Performance

- Fixed networks
- Mobile networks

Enabling technologies and security

- Enabling technologies
- DNS Ecosystem
- Routing Hygiene
- Security threat

Local ecosystem & Market readiness

- Market structure
- Traffic localization

Selection Criteria

- IRI is an input index therefore each indicator much be an input indicator (as opposed to an output indicator)
- We based our selection on a set of criteria as guided by the EU Joint Research Centre (JRC) and OECD
- As much as possible we make use of “hard” indicators e.g. measured/empirical data rather than qualitative data
- Whenever a direct indicator cannot be obtained, we used a proxy e.g. E-Government development index for local content

Relevance

The indicator should work towards showing a increase or decline in the resilience of the Internet in a selected country.

Accuracy

The indicator should correctly estimate or describe the quantities or characteristics they are designed to measure.

Coverage

The data should cover as many countries as possible, as the Index is intended to be a global index. An indicator is not included if there is missing data on more than 25% of countries in the Index.

Timeliness

The data should be collected consistently and systematically over time.

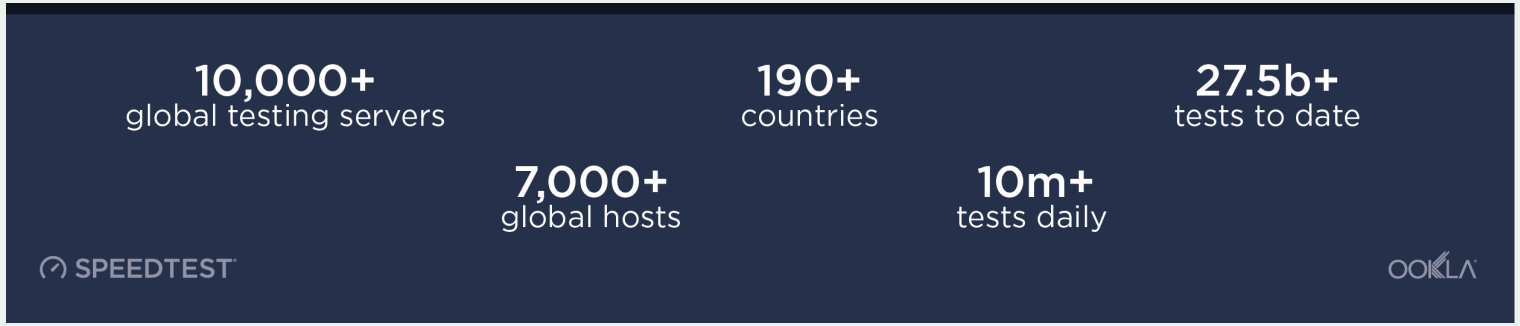
Infrastructure

Dimension	Indicator	Unit of measurement	Source
Cable ecosystem	Number of international gateways	Number	Afterfibre
	10-km fibre reach	% of population	ITU
	Power-availability	% of population	World Bank
Mobile connectivity	Network coverage	Calculated %	GSMA
	Spectrum allocation	Calculated %	GSMA
Enabling infrastructure	Number of IXPs	IXPs per 10 million	PCH/PeeringDB
	Number of datacentres	Datacenters per 10 million	Datacentermap

Performance

Dimension	Indicator	Unit of measurement	Source
Fixed Networks	Median Upload Speed	Mbps	Ookla
	Median Download Speed	Mbps	Ookla
	Median Latency	ms	Ookla
Mobile Networks	Median Upload Speed	Mbps	Ookla
	Median Download Speed	Mbps	Ookla
	Median Latency	ms	Ookla

OOKLA for Good™



Enabling technologies & Security

Dimension	Indicator	Unit of measurement	Source
Enabling technologies	IPv6 adoption	Country %	APNIC
	HTTPS	% of websites	Mozilla
DNS Ecosystem	DNSSEC Validation at country-level	Calculated %	APNIC
	DNSSEC Adoption by ccTLDs	Calculated %	ICANN
Routing Hygiene	MANRS Scores includes: (1) Filtering, (2) Coordination, (3) Global Validation IRR, (4) Global Validation RPKI	Aggregated %	ISOC
Security Threat	Secure Internet servers	Servers per 1 million	World Bank
	Global Cybersecurity Index	Index %	ITU
	DDOS Potential	TBit/sec	Cybergreen
	Spam infections	% of networks infected	Spamhaus

Local Ecosystem and Market Readiness

Dimension	Indicator	Unit of measurement	Source
Market Structure	Affordability	Country %	ITU
	Market concentration	HHI (Herfindahl–Hirschman Index)	APNIC
	AS Hegemony	GINI coefficient (inequality)	IIJ
Traffic Localization	Peering efficiency	% of ASNs peering	PCH/PeeringDB
	Domain count	Domains per 1 million	Zonefiles.io
	Popular Local content	Index %	Tranco List
	E-Government Development Index	Index %	UN

Data treatment phases

- Each country has data on at least 75% of indicators overall and at least half the indicators within each pillar
- Each indicator has data for at least 75% countries

Data imputation

We first check if there is any missing value in the indicators we collected. We use techniques such as regression, substitution, interpolation and extrapolation.

Winsorisation

It is important to remove outliers in the datasets. We use skewness and kurtosis to determine if there is a need to adjust the values.

Transformation

Because of skewness and kurtosis, we need to use logarithmic transformation to bring the data within specified ranges.

Normalization

Indicators are usually on different scale and using different units of measure. E.g. Number of IXPs per 1 million and domain counts. The aim to that all indicators are between 0 and 100.

Weighting and Aggregation

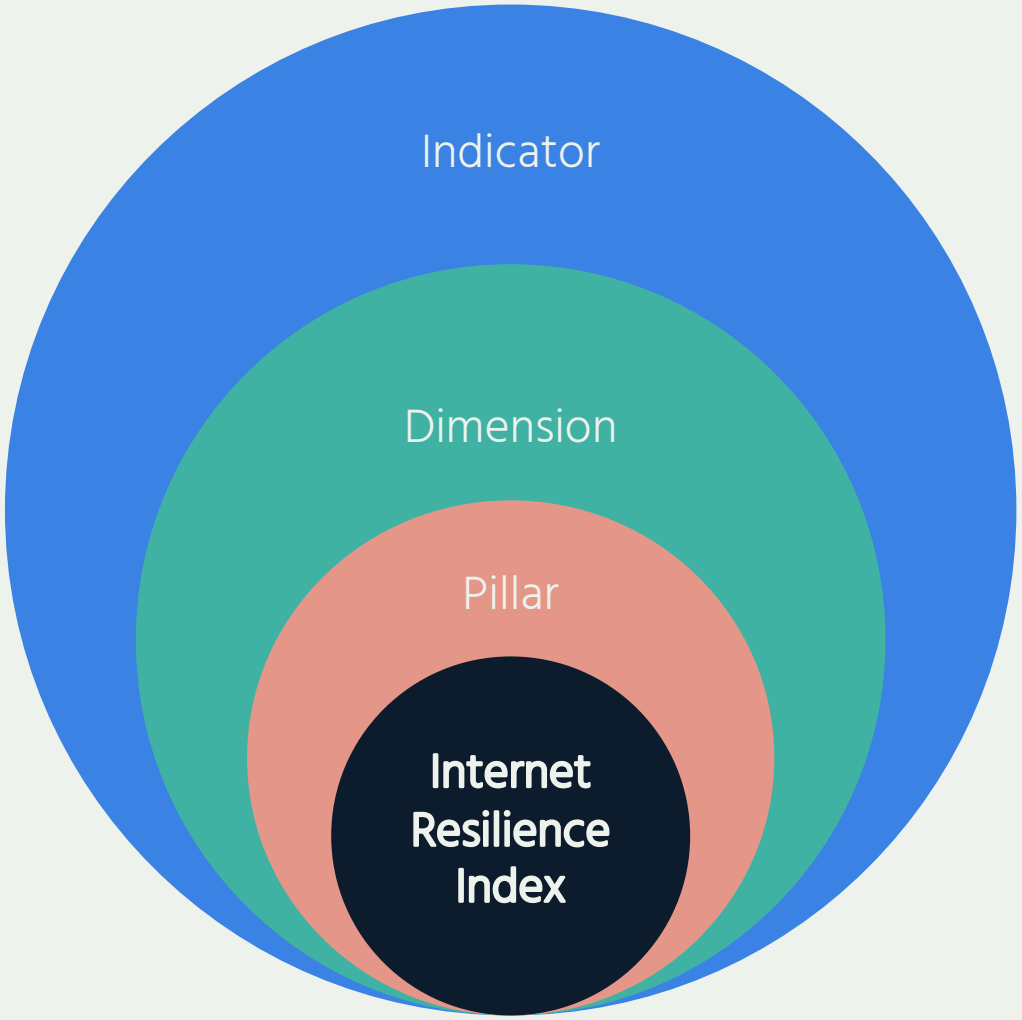
Weighting

- Statistical relationship between indicators
- Principal Component Analysis
- Qualitative approach and surveys
- Gathered expert opinions

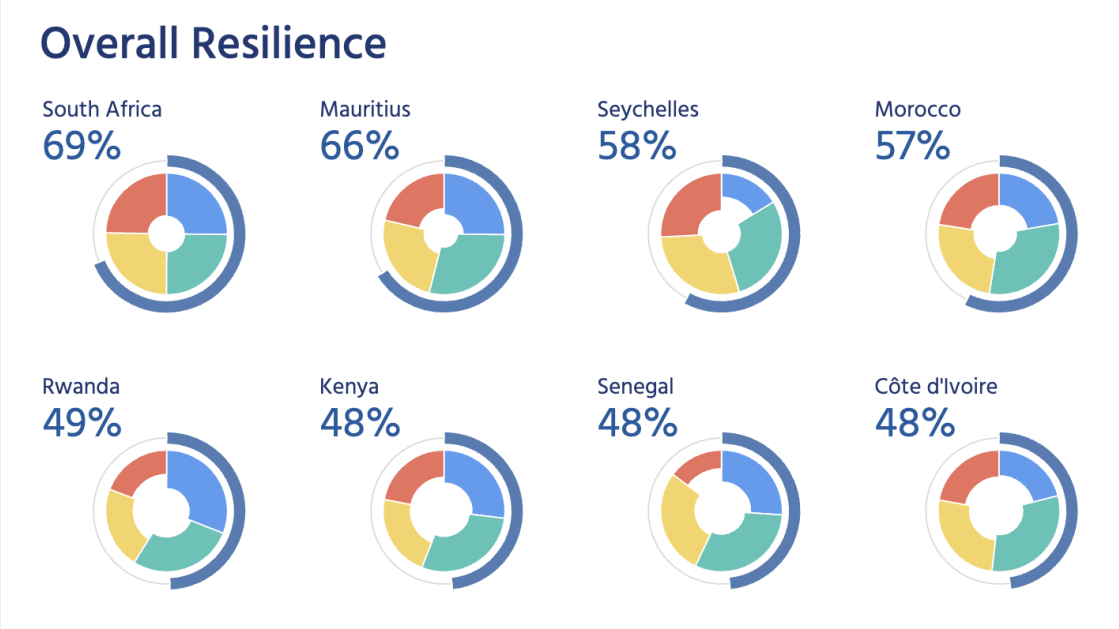
Pillar	Weight	Dimension	Weight
Infrastructure	25 %	Cable ecosystem	40%
		Mobile connectivity	40%
		Enabling infrastructure	20%
Performance	25 %	Fixed networks performance	50 %
		Mobile networks performance	50 %
Enabling technologies and security	25 %	Enabling technologies	20%
		DNS ecosystem	20 %
		Routing hygiene	30 %
		Security threat	30 %
Local Ecosystem and Market readiness	25 %	Market structure	60 %
		Traffic Localization	40 %

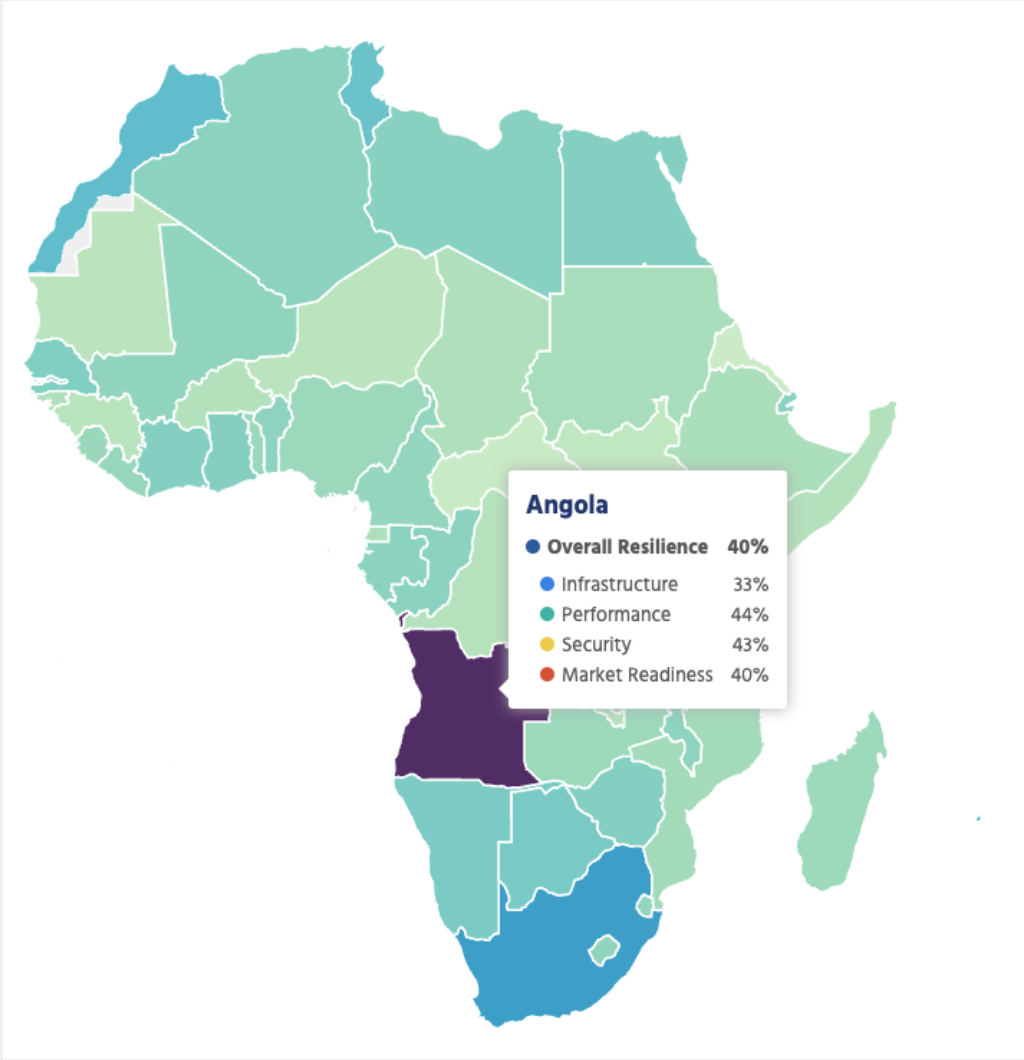
Aggregation

- Once the weights are assigned to the indicators, dimensions and pillars, they need to be aggregated.
- Depends on whether indicators are substitutable e.g. high market concentration but at very affordable prices
- When comparing the list of indicators, there is a greater degree of substitutabiity as opposed to at the “dimension” or “pillar” level.



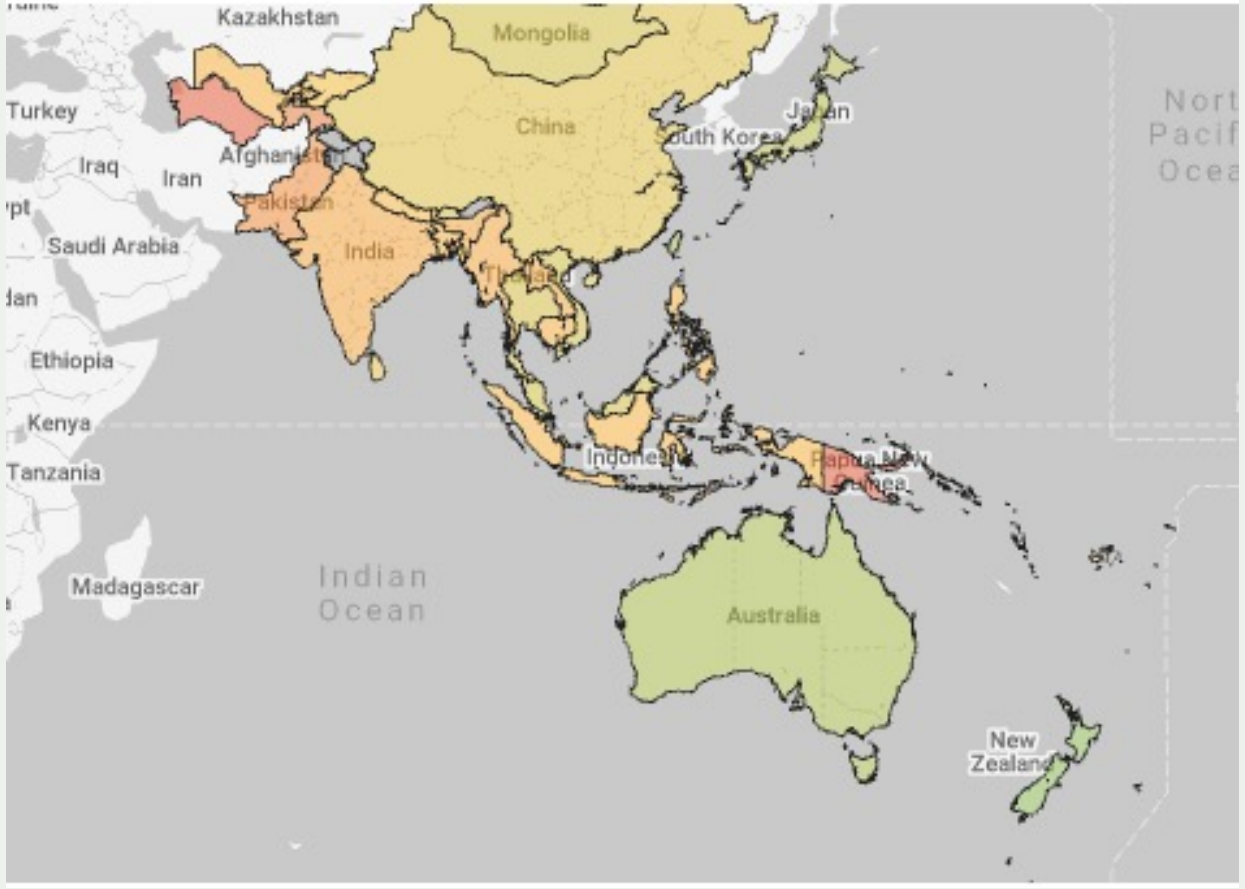
Internet Resilience Index





https://pulse.internetsociety.org/resilience

Internet Resilience Index (IRI) - APAC

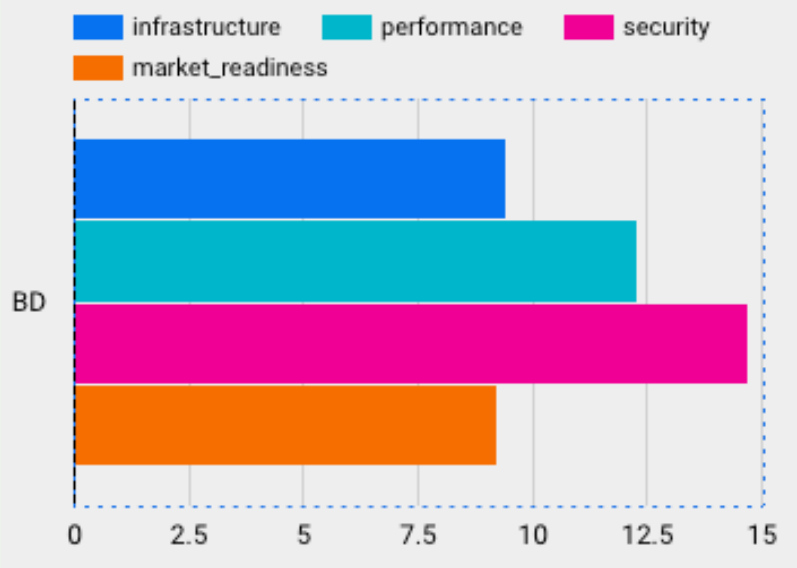


Top Scorers

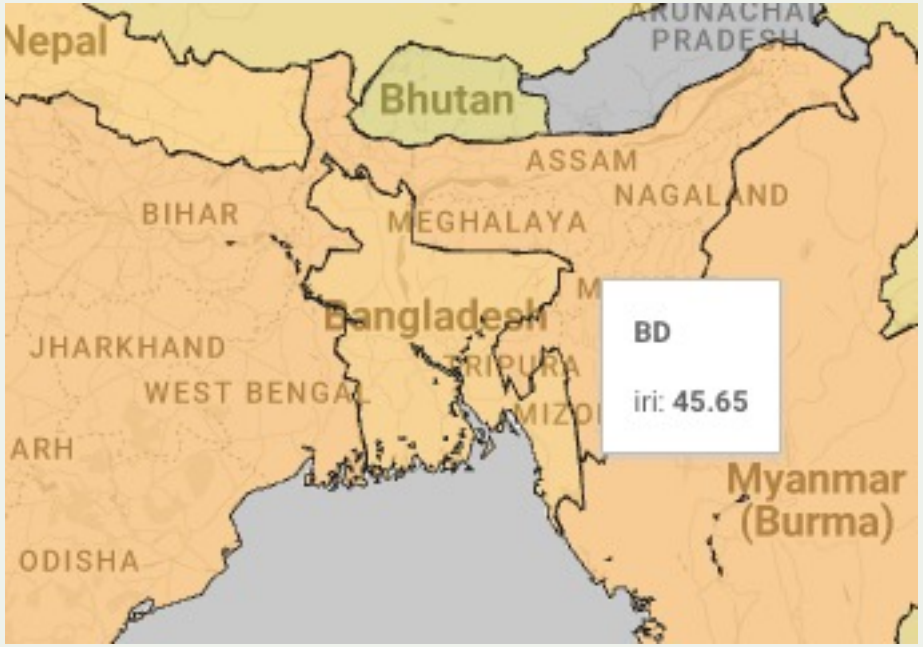
Singapore	74.11
New Zealand	66.37
Taiwan(CN)	63.03
...	
Solomon Islands	27.5
Turkmenistan	25.31
Papua New Guinea	24.58

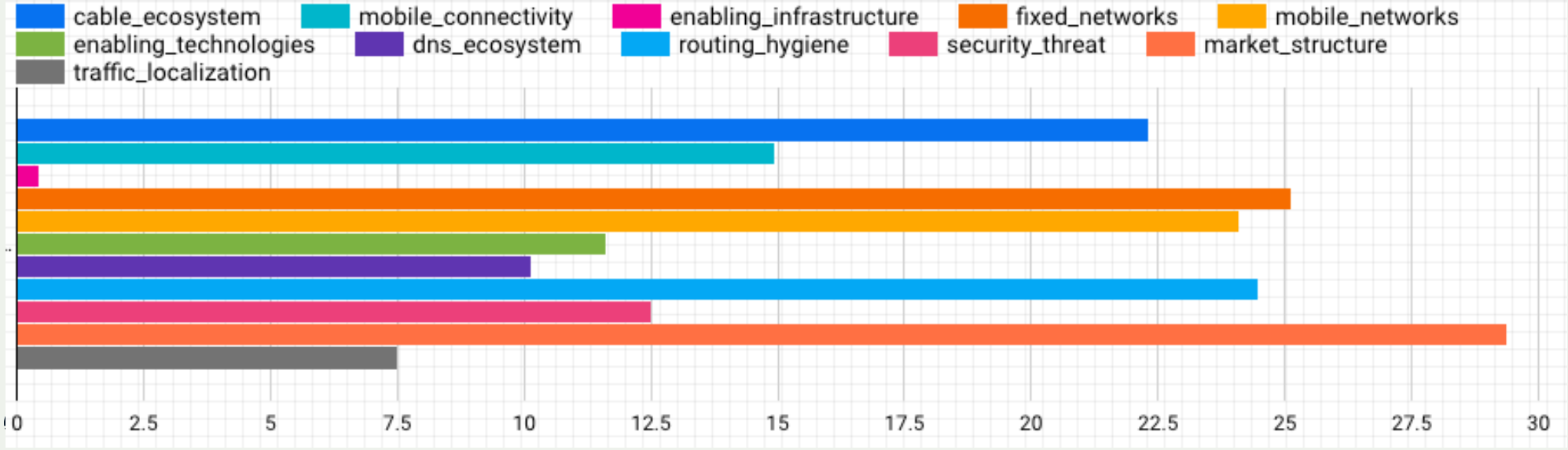
https://tinyurl.com/iri-apac

Bangladesh (IRI: 45.65 Rank 21/37)



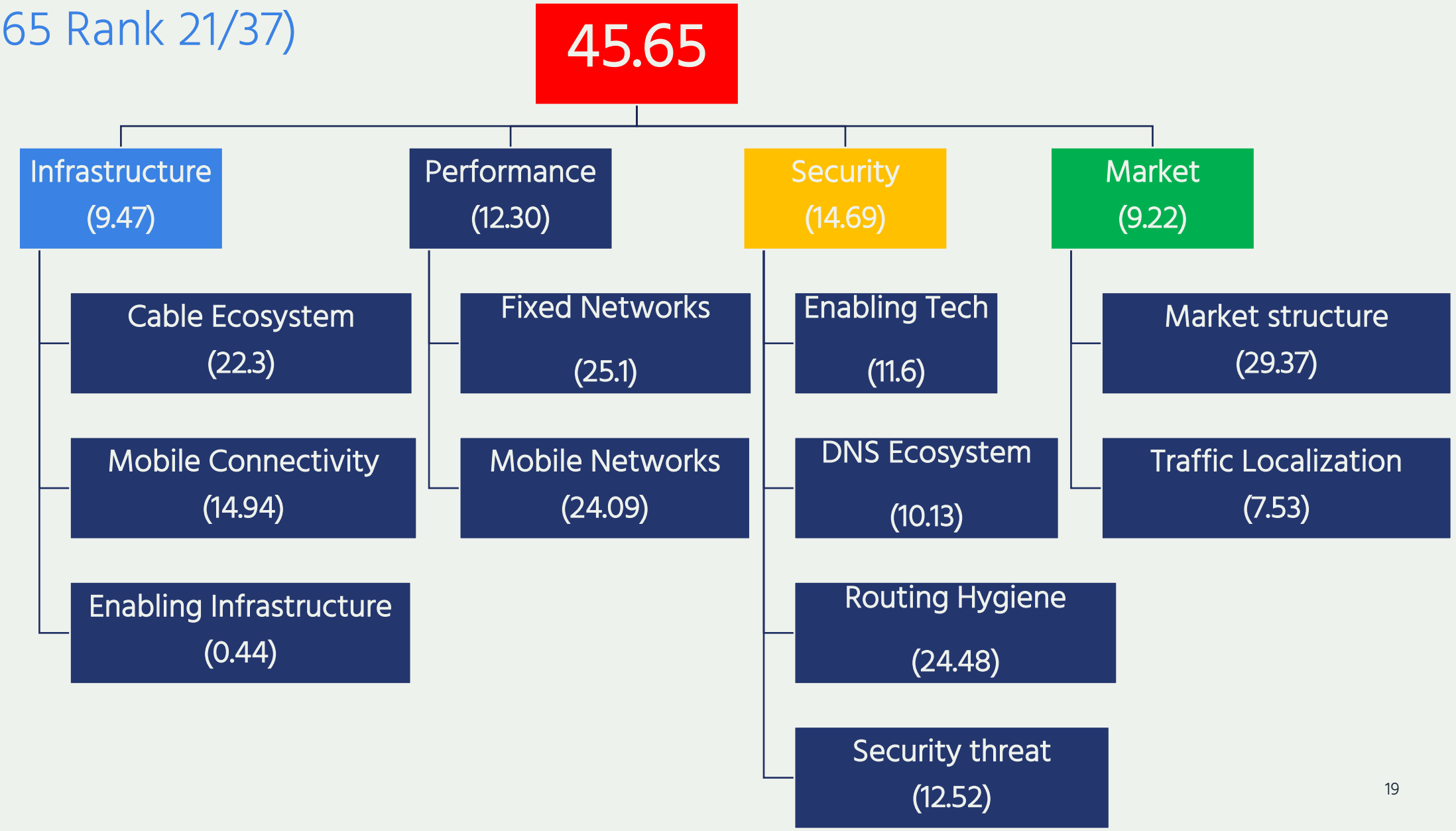
Pillars





Dimensions

Bangladesh
(IRI: 45.65 Rank 21/37)



Upcoming plans

- Build an interactive dashboard for the Internet Resilience Index
- Expanding partnerships with other regions (LAC, EU, ME)
- More case studies using the Internet Resilience Index

Data partners

Thank you.

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pulse.internetsociety.org/resilience

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Galerie Jean-Malbuisson 15,
CH-1204 Geneva,
Switzerland.
+41 22 807 1444

1775 Wiehle Avenue,
Suite 201, Reston, VA
20190-5108 USA.
+1 703 439 2120