Reviewing the Internet Holistically

Robbie Mitchell
14 November 2025
mitchell@isoc.org

Why we measure

- To answer questions/validate beliefs
- To set a baseline from which we can track change/show results
- To demonstrate value
- To justify decisions
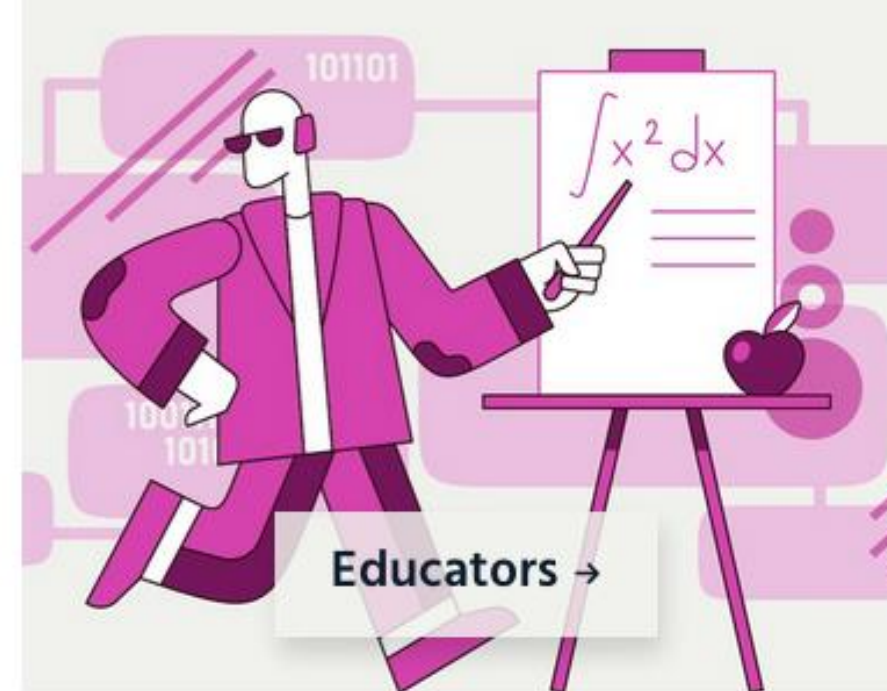- To identify opportunities for improvement
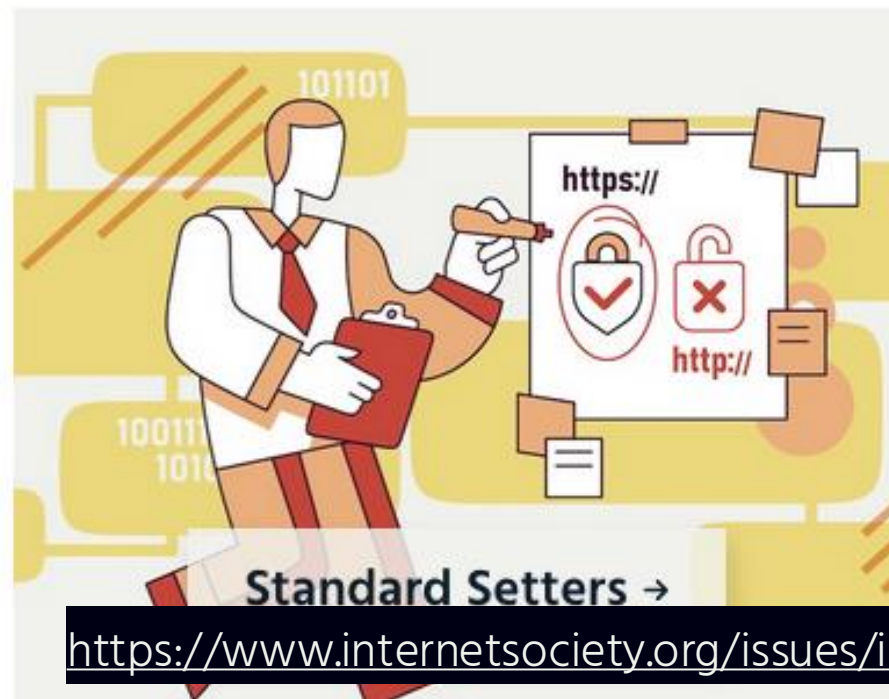- Advance our knowledge

Nonprofits →

Policymakers →

Educators →

Technical Communities →

Standard Setters →

You →

Internet Society Pulse

- Launched in December 2020.

- We curate Internet measurement data from trusted sources to help everyone gain deeper, data-driven insight into the Internet.

Trusted data from multiple sources:

- **Benefit**: Helps to assess whether efforts to ensure that the Internet remains open, globally connected, secure, and trustworthy are working.

- **Benefit:** Allows policymakers, researchers, journalists, network operators, civil society groups, and others to better understand the health, availability, and evolution of the Internet.
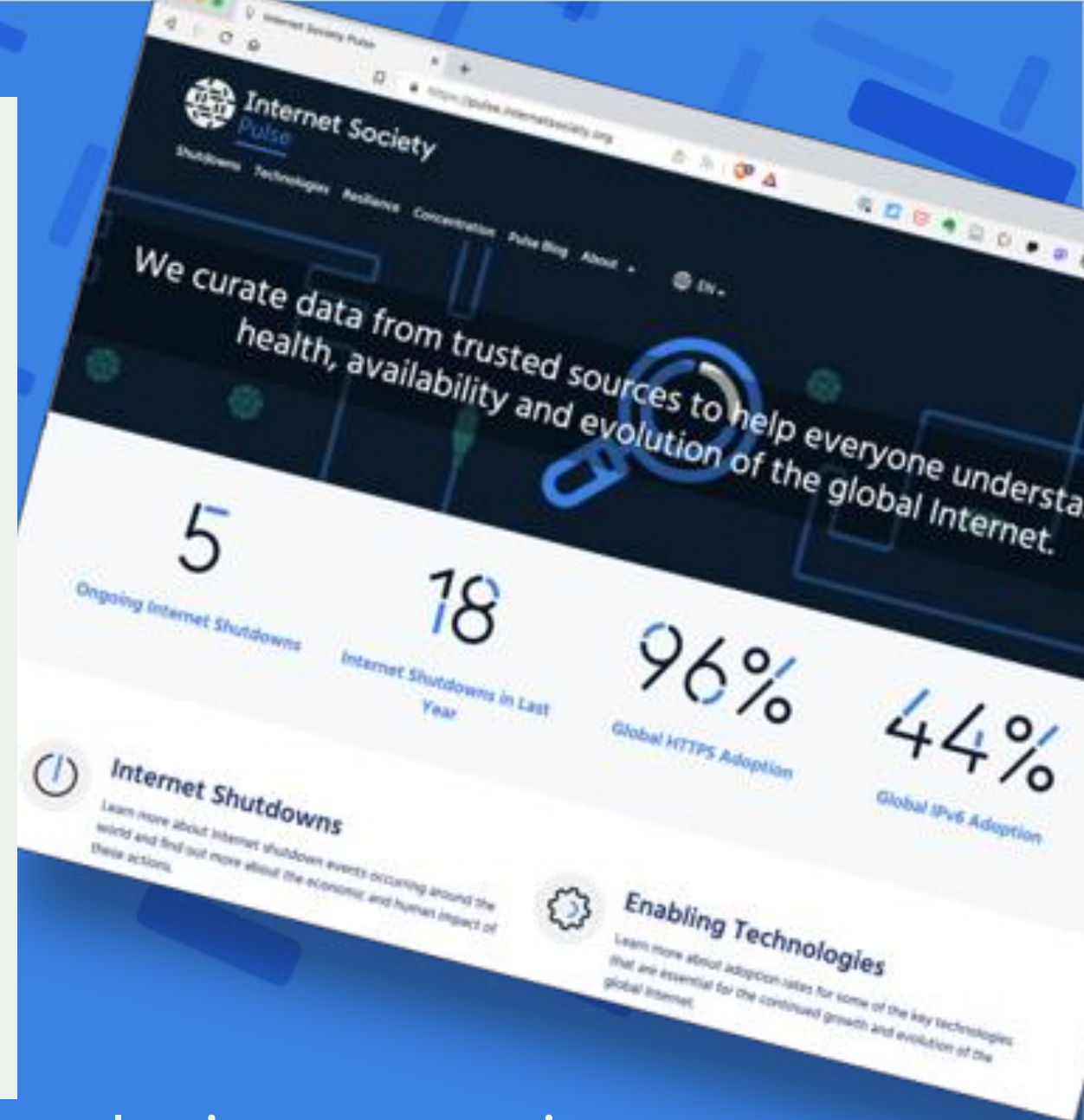
pulse.internetsociety.org

Focus Areas

Enabling Internet Technologies

- IPv6
- TLS
- DNSSEC
- RPKI (ROA & ROV)

Internet Shutdowns

- Artificial Internet shutdowns
- Service blocking events
- Economic loss

Internet Concentration

- Local ISPs
- Upstream providers
- Data centers
- DNS servers
- CDNs
- SSL Certificates
- Hosting
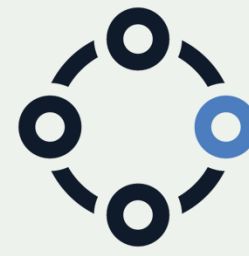
Interconnectivity and content locality

- IXPs
- Data centers
- Peering efficiency
- Locally cached content

Internet Resilience

- Infrastructure
- Performance
- Security
- Market readiness

5

Resilience

A resilient Internet connection maintains an acceptable level of service despite faults and challenges to normal operation.

Not if, but when

9 September 2022

Rogers Outage: What do we Know After Two Months?

Jim Cowie
Former Resident Advisor, Internet Society

Categories:
Concentration, Resilience

Hiding operational failures in darkness helps nobody.

8 February 2023

Italy's Internet Outage a Perfect Storm

Massimiliano Stucchi
Regional Technical Advisor - Europe, Internet Society

Categories:
Resilience

Italy's recent Internet outage was a failure that was years in the making and could have been negated through greater interconnectivity.

15 November 2023

Optus Outage Exposes Australia's Internet Resilience

Aftab Siddiqui
Senior Manager, Internet Technology - Asia-Pacific, Internet Society

Categories:
Resilience

A minor technical slip-up by Australia's second-largest operator causes one-third of Australians to lose Internet and mobile connectivity.

Who's next?

Canada, July 2022   Italy, February 2023   Australia, November 2023

The Internet Resiliency Index (IRI)

The framework collates around 30 sets of public metric data that relate to **four pillars** of a resilient Internet:

Infrastructure	Performance	Security	Market Readiness	Environmental/ Disaster [TBC]
The existence and availability of physical infrastructure that provides Internet connectivity.	The ability of the network to provide end-users with seamless and reliable access to Internet services.	The ability of the network to resist intentional or unintentional disruptions through the adoption of security technologies and best practices.	The ability of the market to self-regulate and provide affordable prices to end-users by maintaining a diverse and competitive market.	The infrastructure and energy redundancy in place to offset climate change and disaster scenarios.

pulse.internetsociety.org/resilience

Internet Resilience — Globally

54/100
Overall global average

Infrastructure

Physical infrastructure for Internet connectivity exists, and is available.

45 / 100

global average

Market Readiness

The ability of the market to offer affordable prices to consumers by maintaining diversity and competition.

51 / 100

global average

Performance

Consumers have seamless and reliable Internet services.

60 / 100

global average

Security

Technologies and best practices support a network's ability to resist disruptions.

60 / 100

global average

https://pulse.internetsociety.org/resilience

Overall Internet Resilience — By Region

Africa

41 / 100
average for 2024

- Infrastructure   27
- Market Readiness   38
- Performance   47
- Security   53

+ Show sub-regions

Americas

53 / 100
average for 2024

- Infrastructure   40
- Market Readiness   51
- Performance   66
- Security   56

+ Show sub-regions

Asia

55 / 100
average for 2024

- Infrastructure   45
- Market Readiness   52
- Performance   64
- Security   62

+ Show sub-regions

Europe

69 / 100
average for 2024

- Infrastructure   72
- Market Readiness   68
- Performance   69
- Security   68

+ Show sub-regions

Oceania

51 / 100
average for 2024

- Infrastructure   46
- Market Readiness   49
- Performance   44
- Security   66

+ Show sub-regions

https://pulse.internetsociety.org/resilience

Overall Internet Resilience — By Region

Central Asia

53 / 100
average for 2024

- Infrastructure — 35
- Market Readiness — 50
- Performance — 68
- Security — 58

Eastern Asia

58 / 100
average for 2024

- Infrastructure — 48
- Market Readiness — 59
- Performance — 66
- Security — 58

South-eastern Asia

59 / 100
average for 2024

- Infrastructure — 51
- Market Readiness — 53
- Performance — 65
- Security — 65

Southern Asia

49 / 100
average for 2024

- Infrastructure — 33
- Market Readiness — 47
- Performance — 56
- Security — 61

Western Asia

57 / 100
average for 2024

- Infrastructure — 48
- Market Readiness — 52
- Performance — 65
- Security — 61

https://pulse.internetsociety.org/resilience

Overall Internet Resilience — By Country

Bhutan
59 / 100
- Infrastructure 51
- Market Readiness 49
- Performance 62
- Security 74

Maldives
54 / 100
- Infrastructure 52
- Market Readiness 43
- Performance 64
- Security 57

Bangladesh
56 / 100
- Infrastructure 37
- Market Readiness 56
- Performance 61
- Security 71

India
56 / 100
- Infrastructure 45
- Market Readiness 53
- Performance 62
- Security 64

Nepal
54 / 100
- Infrastructure 32
- Market Readiness 51
- Performance 81
- Security 50

Sri Lanka
46 / 100
- Infrastructure 28
- Market Readiness 41
- Performance 47
- Security 67

Pakistan
42 / 100
- Infrastructure 15
- Market Readiness 46
- Performance 49
- Security 55

Afghanistan
35/ 100
- Infrastructure 14
- Market Readiness 37
- Performance 31
- Security 57

https://pulse.internetsociety.org/resilience

Infrastructure and Market Readiness are the Least Resilient Pillars

Bhutan

59 / 100

- Infrastructure — 51
- Market Readiness — 49
- Performance — 62
- Security — 74

Maldives

54 / 100

- Infrastructure — 52
- Market Readiness — 43
- Performance — 64
- Security — 57

Bangladesh

56 / 100

- Infrastructure — 37
- Market Readiness — 56
- Performance — 61
- Security — 71

India

56 / 100

- Infrastructure — 45
- Market Readiness — 53
- Performance — 62
- Security — 64

Nepal

54 / 100

- Infrastructure — 32
- Market Readiness — 51
- Performance — 81
- Security — 50

Sri Lanka

46 / 100

- Infrastructure — 28
- Market Readiness — 41
- Performance — 47
- Security — 67

Pakistan

42 / 100

- Infrastructure — 15
- Market Readiness — 46
- Performance — 49
- Security — 55

Afghanistan

35 / 100

- Infrastructure — 14
- Market Readiness — 37
- Performance — 31
- Security — 57

https://pulse.internetsociety.org/resilience

Overall Internet Resilience — India

Asia

55 / 100

- Infrastructure — 45
- Market Readiness — 52
- Performance — 64
- Security — 62

Southern Asia

49 / 100

- Infrastructure — 33
- Market Readiness — 47
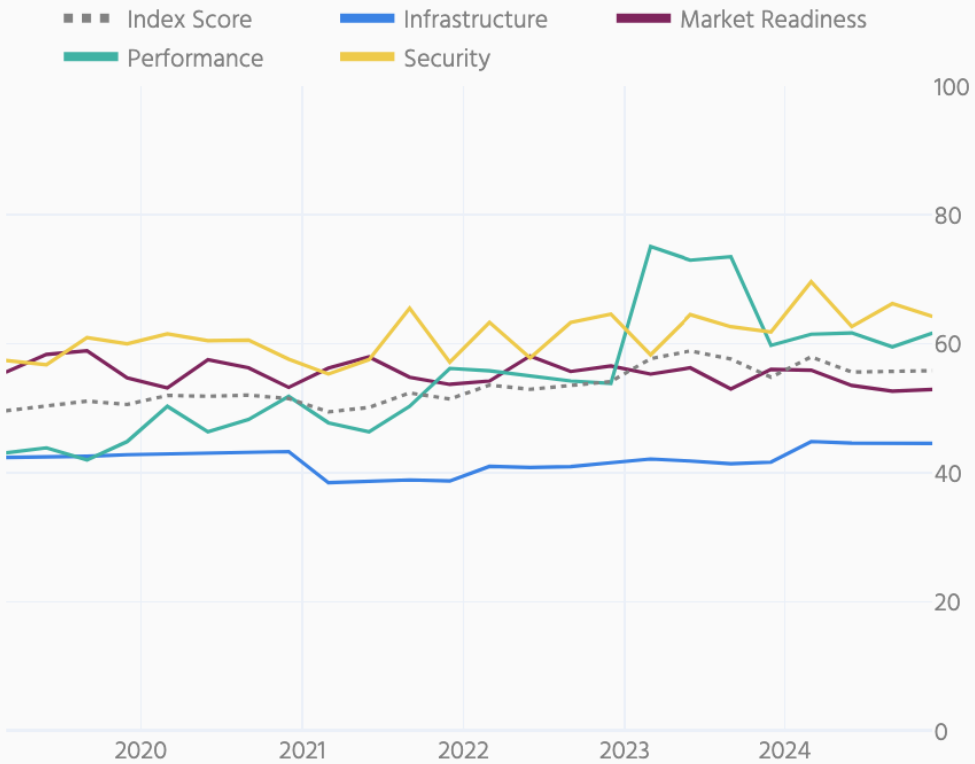- Performance — 56
- Security — 61

India

56 / 100

The Internet in India **is more resilient on average than other countries in Southern Asia**, and is **about average for Asia**. It ranks **2nd in Southern Asia for market readiness**, a category that evaluates the overall competitiveness of the market, and the ability to offer affordable prices to consumers. It ranks **30th in Asia for performance**, a category that evaluates how well the network provides seamless and reliable Internet services to consumers.

View country report for India

- Infrastructure — 45
- Market Readiness — 53
- Performance — 62
- Security — 64

Legend: Index Score · Infrastructure · Market Readiness · Performance · Security

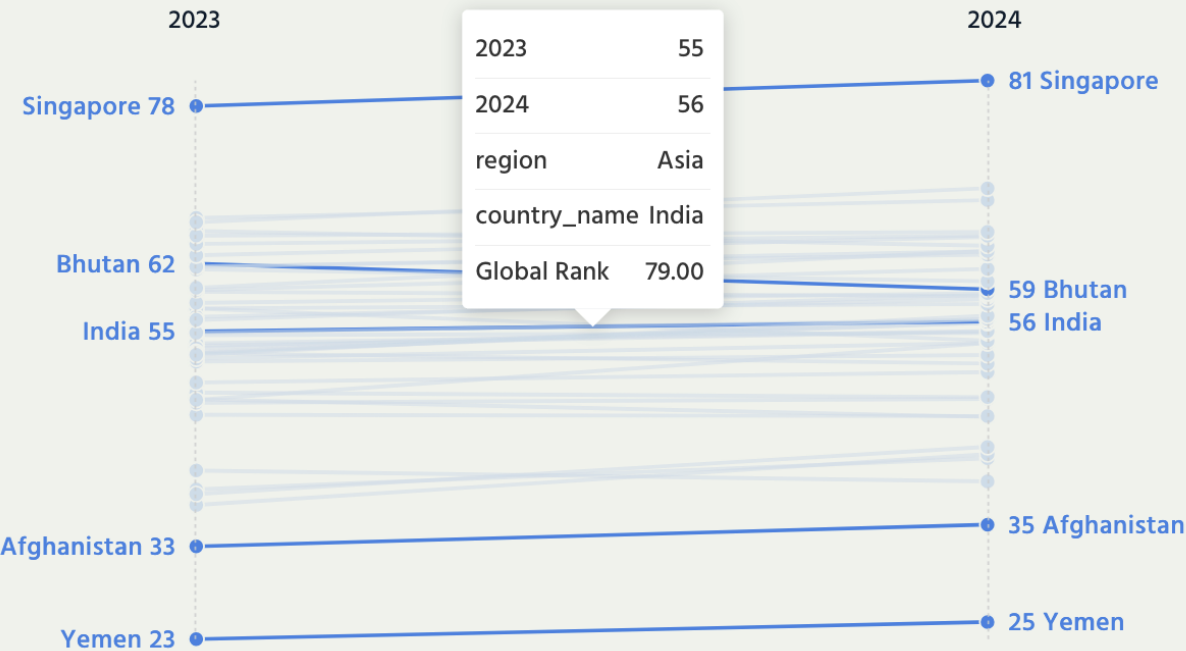https://pulse.internetsociety.org/en/resilience/in

India ranks 79 out of 180 globally

What's Changed in the Pulse Internet Resilience Index?
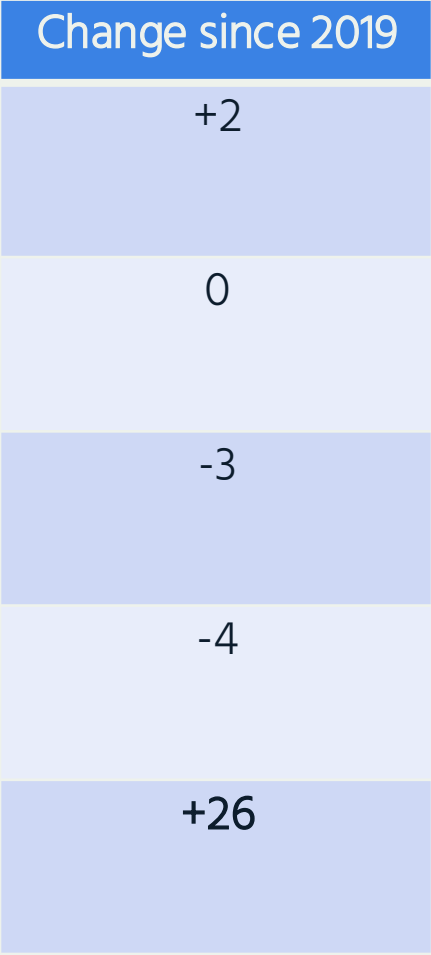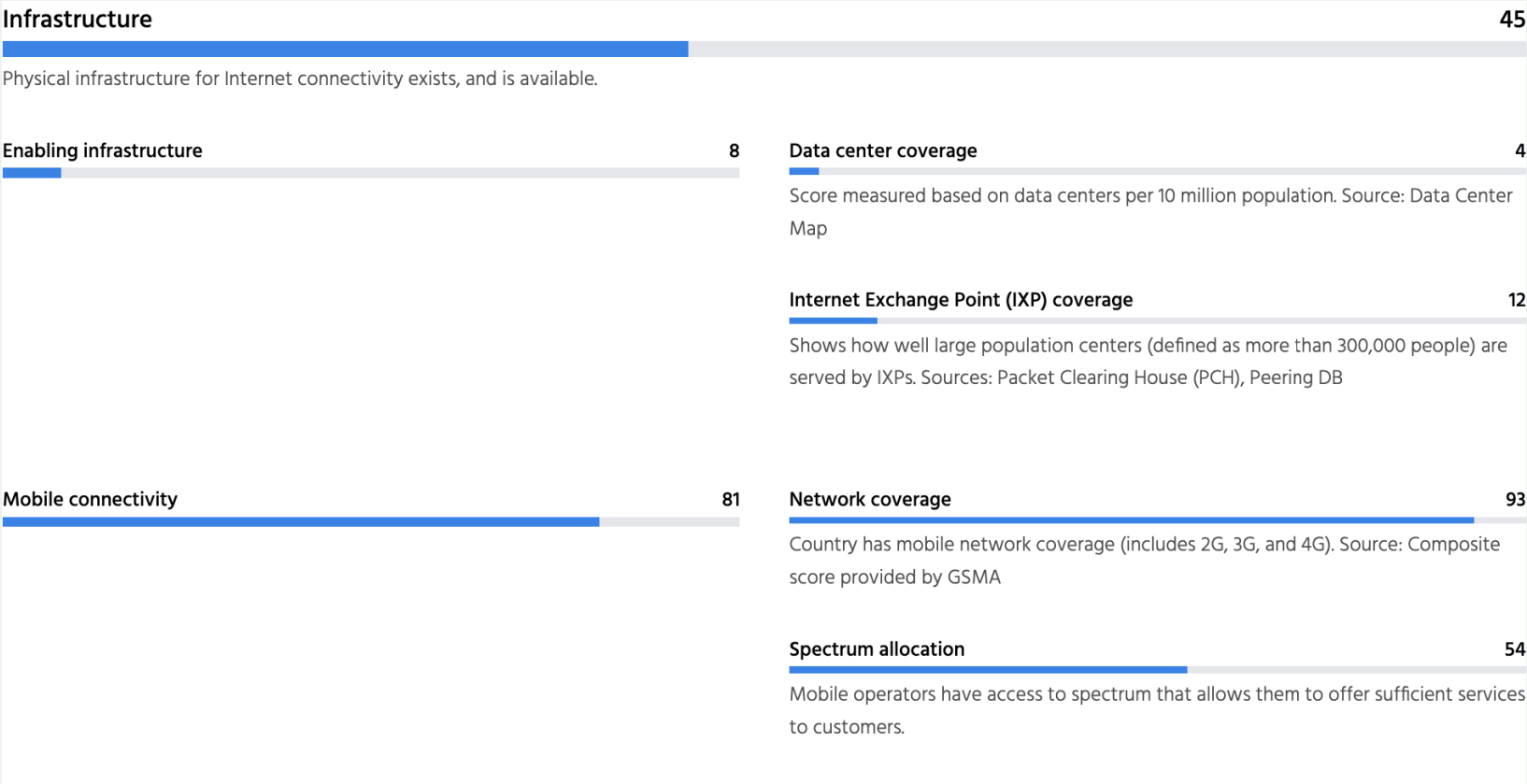
Change in ranking between 2023-2024

Asia ▼

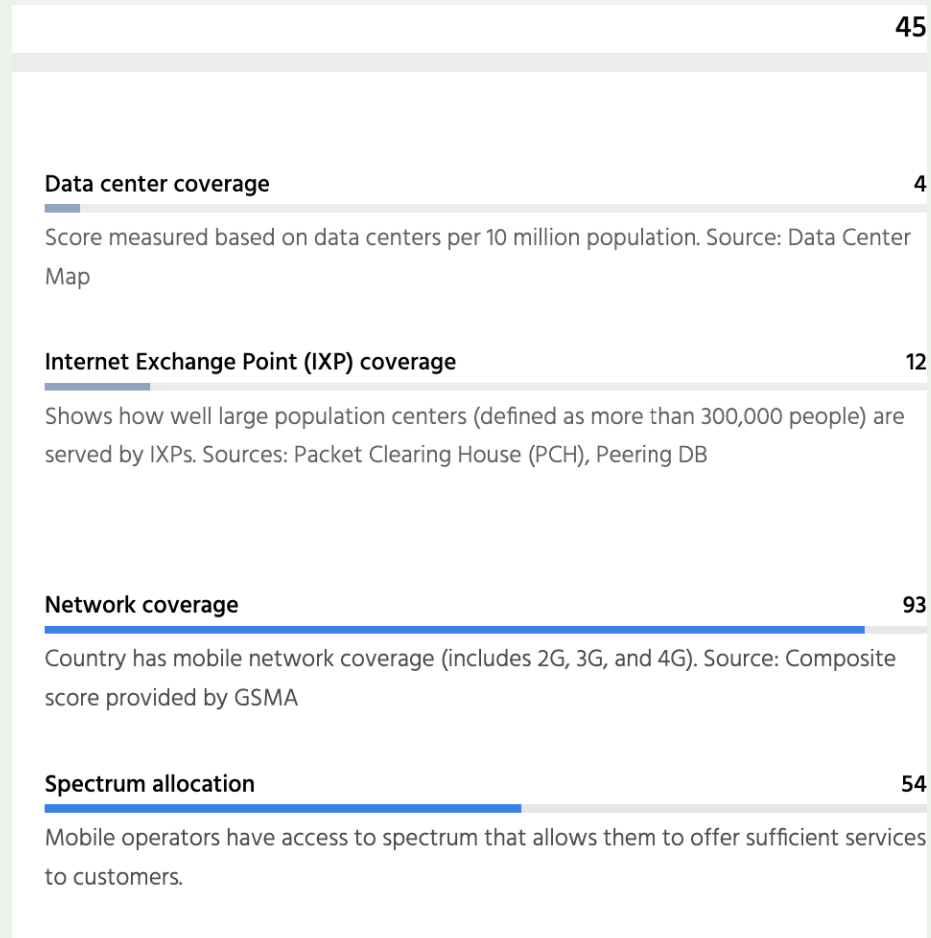**region** ■ Africa ■ Asia ■ North America ■ Australia/Oceania ■ South America ■ Europe

2023		2024

2023	55
2024	56
region	Asia
country_name	India
Global Rank	79.00

Singapore 78 ●━━━━━━━━━━━━━━━━━━━━━● 81 Singapore

Bhutan 62 ●━━━━━━━━━━━━━━━━━━━━━● 59 Bhutan

India 55 ●━━━━━━━━━━━━━━━━━━━━━● 56 India

Afghanistan 33 ●━━━━━━━━━━━━━━━━━━━━━● 35 Afghanistan

Yemen 23 ●━━━━━━━━━━━━━━━━━━━━━● 25 Yemen

Source: Pulse Internet Resilience Index

Internet Society
Pulse

15

Infrastructure – What's changed since 2019

Infrastructure   45

Physical infrastructure for Internet connectivity exists, and is available.

Enabling infrastructure   8

Mobile connectivity   81

Data center coverage   4

Score measured based on data centers per 10 million population. Source: Data Center Map

Internet Exchange Point (IXP) coverage   12

Shows how well large population centers (defined as more than 300,000 people) are served by IXPs. Sources: Packet Clearing House (PCH), Peering DB

Network coverage   93

Country has mobile network coverage (includes 2G, 3G, and 4G). Source: Composite score provided by GSMA

Spectrum allocation   54

Mobile operators have access to spectrum that allows them to offer sufficient services to customers.

Change since 2019
+2
0
-3
-4
+26

https://pulse.internetsociety.org/en/resilience/in

Infrastructure – Mobile connectivity

45

Data center coverage **4**

Score measured based on data centers per 10 million population. Source: Data Center Map

Internet Exchange Point (IXP) coverage **12**

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Network coverage **93**

Country has mobile network coverage (includes 2G, 3G, and 4G). Source: Composite score provided by GSMA

Spectrum allocation **54**

Mobile operators have access to spectrum that allows them to offer sufficient services to customers.

Key developments in mobile spectrum policy (2019–2024)

- **Launch of 5G services:** The primary policy push was enabling the launch of 5G services, which occurred in October 2022 by operators like Jio and Airtel.

- **Spectrum auctions:** Several auctions were conducted, and new spectrum bands, including the 700 MHz, 3300 MHz, and 26 GHz bands, were assigned for 5G services.

- **Spectrum refarming:** The Union Cabinet approved the refarming of 687 MHz of spectrum, primarily from the Ministry of Defence and ISRO, to meet the increasing demand for mobile services.

- **Policy and procedural reforms:**
    - Financial reforms included the rationalization of Adjusted Gross Revenue (AGR) and Bank Guarantees.
    - Spectrum sharing, trading, and surrender were permitted for more efficient use.
    - The Telecommunication (Right of Way) Rules were introduced, and the PM GatiShakti Sanchar portal was launched to streamline the process for installing telecom infrastructure.

Infrastructure - Region

Country	Infrastructure	Network Coverage	Spectrum Allocation	Data Centers	Number of IXPs
Afghanistan	0.1371	0.171	0.1766	0	0.2033
Bangladesh	0.365	0.7107	0.295	0.0442	0.2439
Bhutan	0.512	0.5593	0.3449	0.8549	0.2033
India	0.4458	0.9305	0.5368	0.0354	0.1228
Maldives	0.5213	0.8935	0.3394	0.4274	0.2033
Nepal	0.3225	0.4917	0.2366	0.0533	0.4065
Pakistan	0.1536	0.308	0.2344	0.0171	0.0254
Sri Lanka	0.2804	0.6766	0.2731	0.0103	0
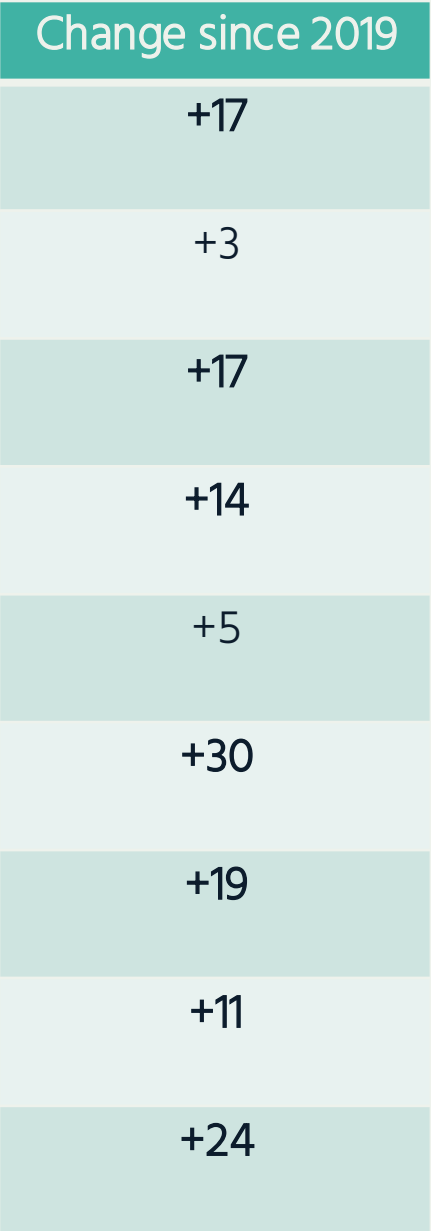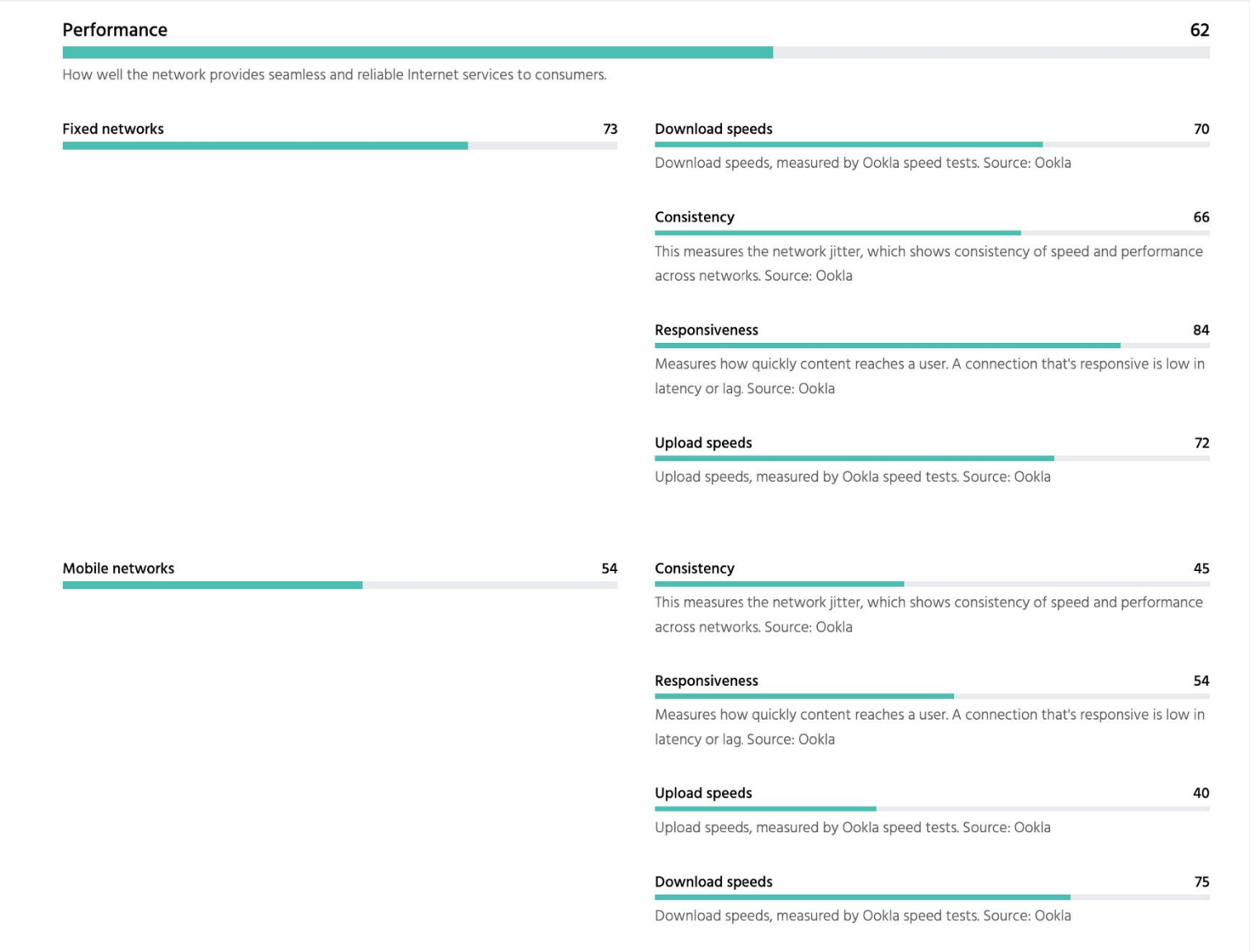
Performance

Performance — 62

How well the network provides seamless and reliable Internet services to consumers.

+17

Fixed networks — 73

Download speeds — 70

Download speeds, measured by Ookla speed tests. Source: Ookla

+3

Consistency — 66

This measures the network jitter, which shows consistency of speed and performance across networks. Source: Ookla

+17

Responsiveness — 84

Measures how quickly content reaches a user. A connection that's responsive is low in latency or lag. Source: Ookla

+14

Upload speeds — 72

Upload speeds, measured by Ookla speed tests. Source: Ookla

+5

Mobile networks — 54

Consistency — 45

This measures the network jitter, which shows consistency of speed and performance across networks. Source: Ookla

+30

Responsiveness — 54

Measures how quickly content reaches a user. A connection that's responsive is low in latency or lag. Source: Ookla

+19

Upload speeds — 40

Upload speeds, measured by Ookla speed tests. Source: Ookla

+11

Download speeds — 75

Download speeds, measured by Ookla speed tests. Source: Ookla

+24

19

Performance

20

Performance - Region

Country	Performance	Fixed Download	Fixed Upload	Mobile Download	Mobile Upload
Afghanistan	0.3067	0.2326	0.2445	0.335	0.0632
Bangladesh	0.6062	0.6609	0.6949	0.5344	0.4617
Bhutan	0.6216	0.4164	0.5153	0.394	0.6055
India	0.6165	0.7023	0.7238	0.7497	0.401
Maldives	0.6357	0.4662	0.4832	0.7332	0.6755
Nepal	0.8065	0.7235	0.7218	0.6847	1
Pakistan	0.4946	0.4596	0.4973	0.4831	0.3592
Sri Lanka	0.474	0.5259	0.4014	0.4839	0.3114

Security

Security — 64

Technologies and best practices support a network's ability to resist disruptions.

Domain name system (DNS) security — 81

DNSSEC adoption — 100

Shows whether the country code top-level domain (ccTLD) using the extra layer of security known as DNSSEC. Source: ICANN

DNSSEC validation — 62

A score showing how well DNS queries are protected by DNSSEC, across all web traffic. Source: APNIC

Routing hygiene — 61

MANRS score — 81

An overall score that measures routing security in a country's networks. Source: MANRS Observatory

Upstream connections — 41

Shows how well a country's networks are connected with upstream providers. Source: CAIDA

Security threat — 55

DDoS protection — 0

Level of protection across networks, preventing DDoS attacks against another country's networks. Source: Cybergreen

Global Cybersecurity Index Score — 98

Estimates the ability of a country or economy to prevent and manage cyber incidents. Source: ITU

Secure Internet servers — 51

Number of secure Internet servers per 1 million population. Source: World Bank

Change since 2019
+4
0
+3
+27
+1
No Cybergreen data
+21
+6

22

Security - Regionally

Country	Security	DNSSEC Ecosystem	Routing Hygiene	Security Threat
Afghanistan	0.5729	0.7759	0.6195	0.4249
Bangladesh	0.7098	0.9105	0.6913	0.5948
Bhutan	0.7417	0.9783	0.6795	0.6963
India	0.6424	0.8097	0.6111	0.5481
Maldives	0.5692	0.2559	0.8285	0.5081
Nepal	0.5029	0.1376	0.606	0.6709
Pakistan	0.5546	0.411	0.6151	0.6488
Sri Lanka	0.6731	0.5397	0.6785	0.7502

Market Readiness

Market readiness   53

The ability of the market to offer affordable prices to consumers by maintaining diversity and competition.

-2

Market structure   70

Affordability   86

Measures the affordability of Internet connectivity for consumers. Source: ITU, A4AI

-8

Upstream provider diversity   53

Uses the GINI Coefficient to measure the level of inequality when it comes to dependency on upstream connections. Source: Internet Initiative Japan (IIJ)

+7

Market competition   70

Calculates the level of competition in the market. This uses the Herfindahl-Hirschman Index (HHI). Source: APNIC

3

Traffic localization   36

Domain count   3

Domains registered using ccTLD. Source: DomainTools

1

E-Government Development Index Score   64

Score on the United Nations E-Government Development Index (EGDI), which measures readiness for providing digital public services. Source: United Nations

5

Peering efficiency   40

RScore that uses the ratio of networks that peer at Internet Exchange Points (IXPs), compared with the total number of networks in a country. Sources: Packet Clearing House (PCH), PeeringDB

-16

Market Readiness - Regionally

Country	Market Readiness	Affordability	Market Concentration	Domain Count	Peering Efficiency
Afghanistan	0.3749	0	0.8951	0.0012	0.3244
Bangladesh	0.5603	0.8583	0.9783	0.0027	0.1154
Bhutan	0.4924	0.8644	0.5655	0.0389	0.5046
India	0.5294	0.8598	0.6963	0.0273	0.4048
Maldives	0.4285	0.77	0.5417	0.1531	0.3785
Nepal	0.5129	0.6877	0.8618	0.0541	0.2672
Pakistan	0.4641	0.7882	0.9436	0.0066	0.0058
Sri Lanka	0.4145	0.9482	0.6788	0.0425	0

Opportunities To Strengthen Resilience

Recommendations

Increase market diversity

Increase local peering

Host content locally

Measure constantly and consistently

How Much Competition Is There in India?
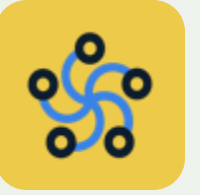
Market competition

Poor

market competitiveness for Internet customers and end users

2025

Top Internet service providers

Top Internet Service Providers (ISPs) by market share

2025
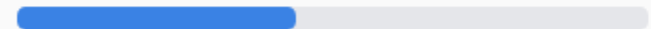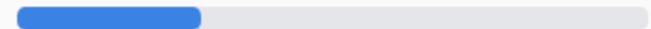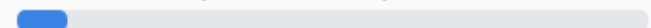
Reliance Jio Infocomm Limited: 44%
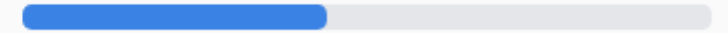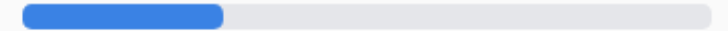
Bharti Airtel Ltd. AS for GPRS Service: 29%

Vodafone Idea (Vodafone India): 8%
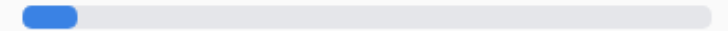
BSNL (Bharat Sanchar Nigam Ltd): 3%
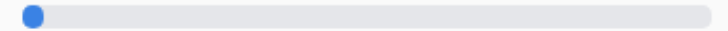
Atria Convergence Technologies: 2%
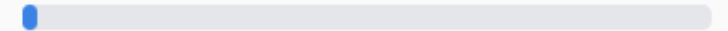
Don't Worry, You're Not Alone

ISP Market Competition Rating, May 2025

78% of countries have Poor or Very Poor Market Competition

Source: Pulse Country Reports

Internet Society Pulse

https://pulse.internetsociety.org/blog/measuring-internet-market-competition
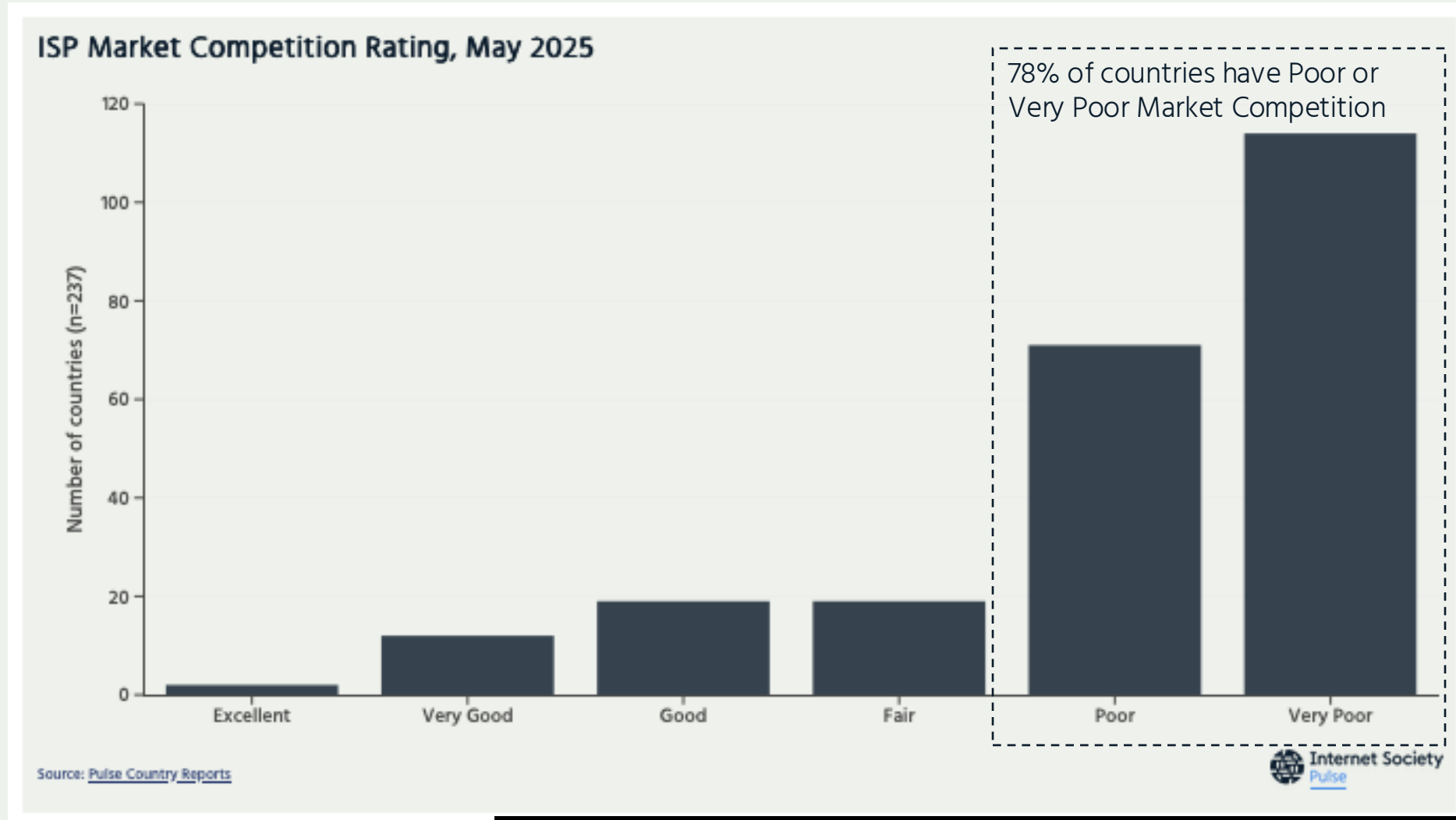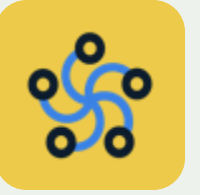
Hat's Off to Reliance

Average download speed

Based on an average of 300 users

58.18 Mbps
Broadband

87.43 Mbps
Mobile

2023

Internet penetration

46%
of the population used the Internet at least once over a 3-month period

62%
Asia average

2021

2016
—— Value: 16%

2000   2010

Mobile 4G and 5G coverage

99%
has access to at least one device with 4G mobile Internet

82%
has access to at least one device with 5G mobile Internet

2024

Average Internet cost

< 1%
of average income (GNI) is needed to cover a low-consumption basket, using at least 3G technology.

2024

2018   2020   2022   2024

What Does Excellent Look Like
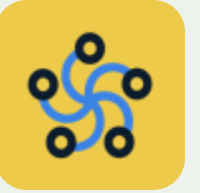
Top Internet Service Providers

Top Internet Service Providers (ISPs) by market share

Claro NXT Telecomunicacoes Ltda: 11%
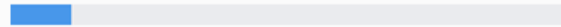
TELEFONICA BRASIL S.A: 7%
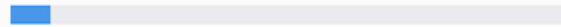
TIM SA: 4%
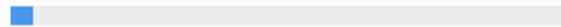
TELEFONICA BRASIL S.A: 3%
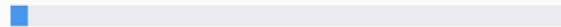
BRISANET SERVICOS DE TELECOMUNICACOES S.A: 3%
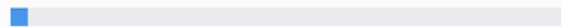
K-TELECOM-NETWORK: 11%
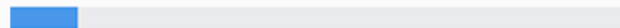
AEZA-AS: 8%
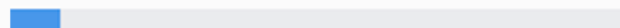
INT-PDN-STE-AS STE PDN Internal AS: 6%
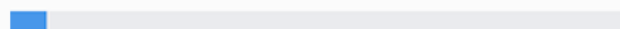
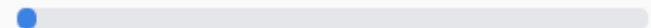SHARENKOV: 4%
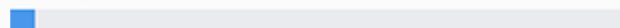
GCS-AS: 3%
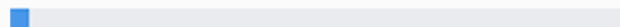
Reliance Jio Infocomm Limited: 44%
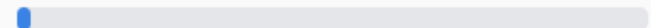
Bharti Airtel Ltd. AS for GPRS Service: 29%

Vodafone Idea (Vodafone India): 8%

BSNL (Bharat Sanchar Nigam Ltd): 3%
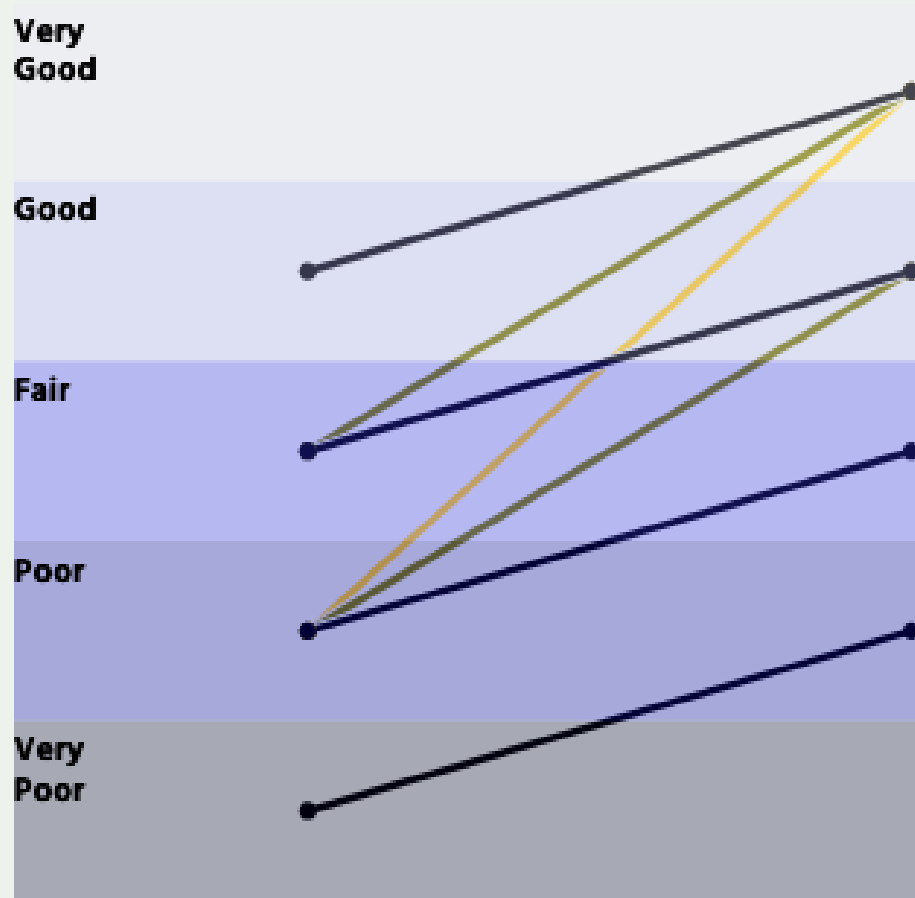
Atria Convergence Technologies: 2%

Brazil   Russia   India

https://pulse.internetsociety.org/en/reports

Change Can Happen Fast
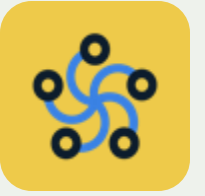
Countries that have experienced an increase in market competition rank between May 2023 and May 2025

Canada | Myanmar | Venezuela

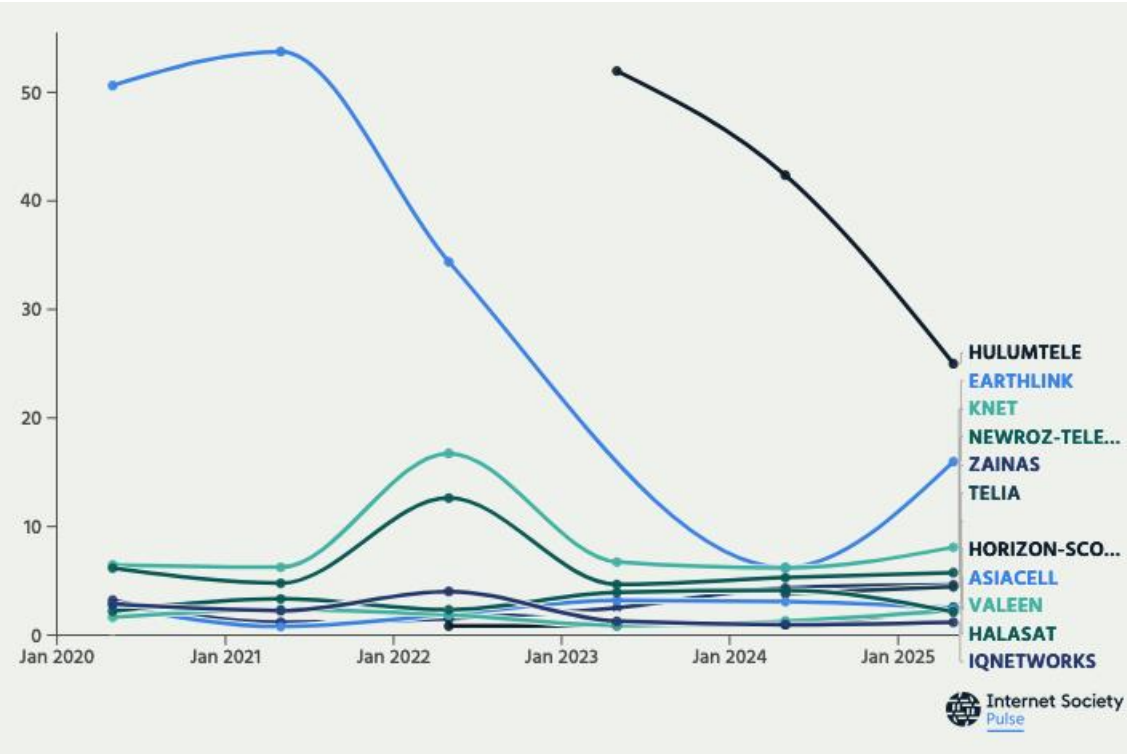Armenia | Chile | Iraq | Italy | Nepal | Spain

Germany | Latvia | Malaysia | Netherlands | Peru

Benin | Burkina Faso | Micronesia | Nauru | Nicaragua | Saint Kitts and Nevis | Sierra Leone | Tonga | Tuvalu | Vanuatu | Virgin Islands
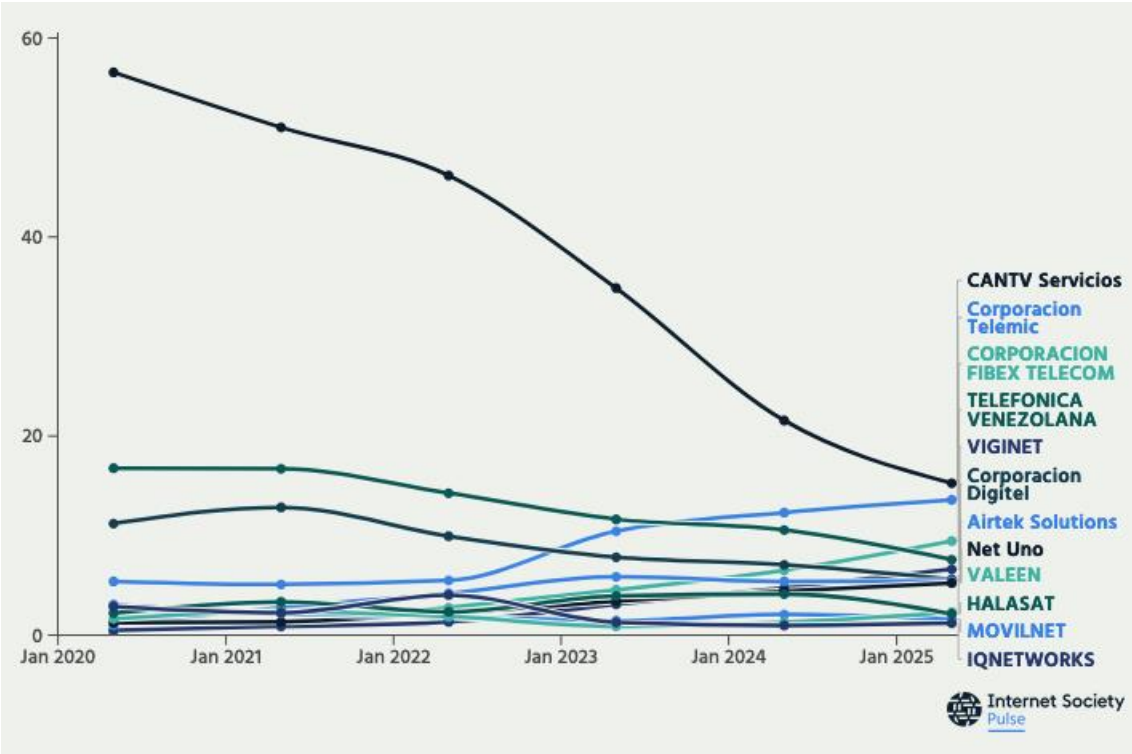
Change Can Happen Fast

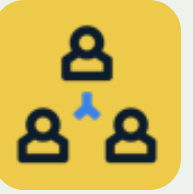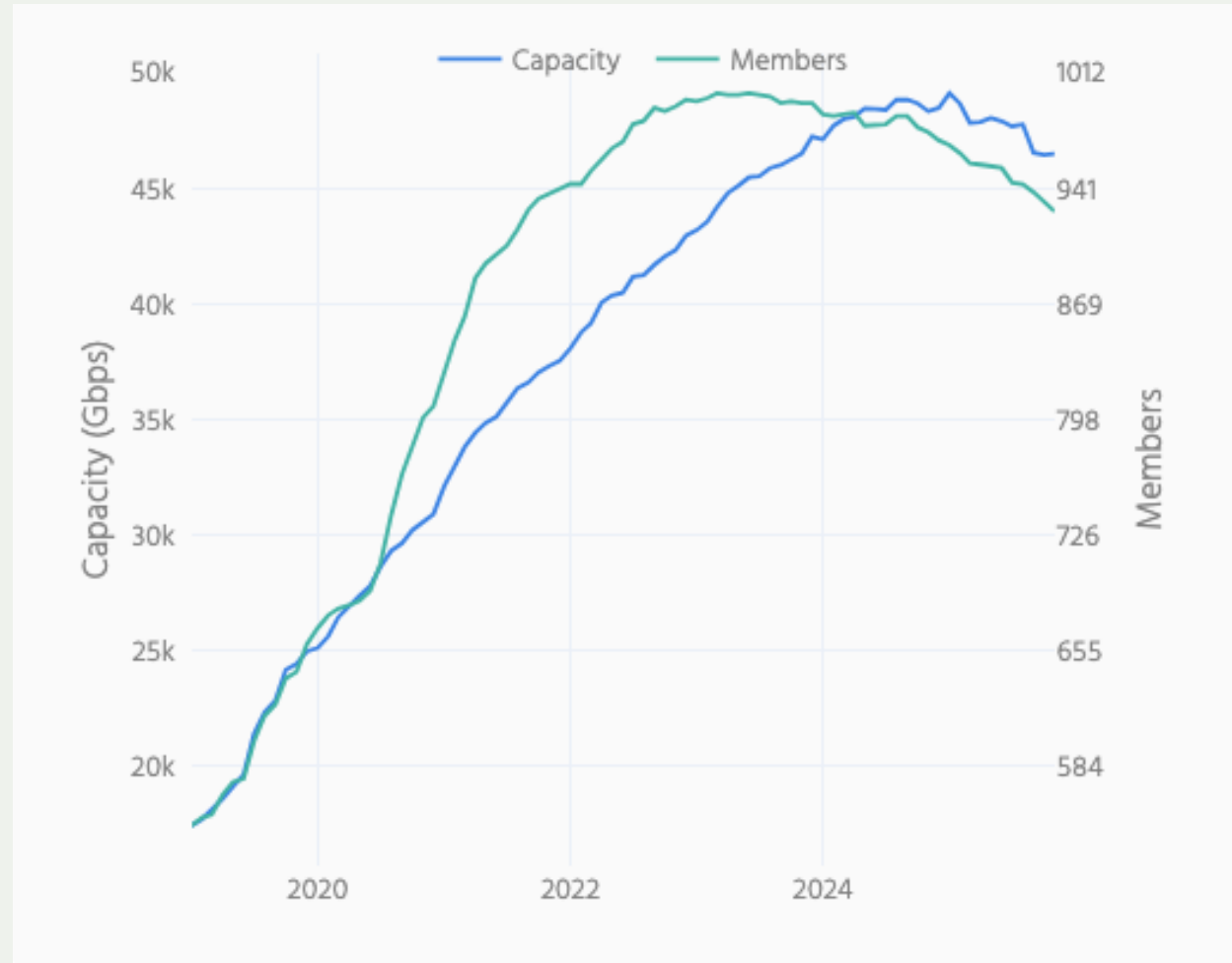Change in Market Share between May 2020 to May 2025

Iraq

Venezuela

Build IXPs and they will/might come?

31 IXPs
(Asia avg = 5)

926 Members
(84% of local networks
are peering at IXPs.)

46 Tbps capacity

Location, Location, Location

IXP	Locations	Members
Mumbai	60	948
Delhi	40	404
Chennai	22	214
Kolkata	10	117
Hyderabad	10	55
Bangalore	8	42
Amaravati	1	11

https://www.internetsociety.org/funding-areas/sustainable-peering-ixp/
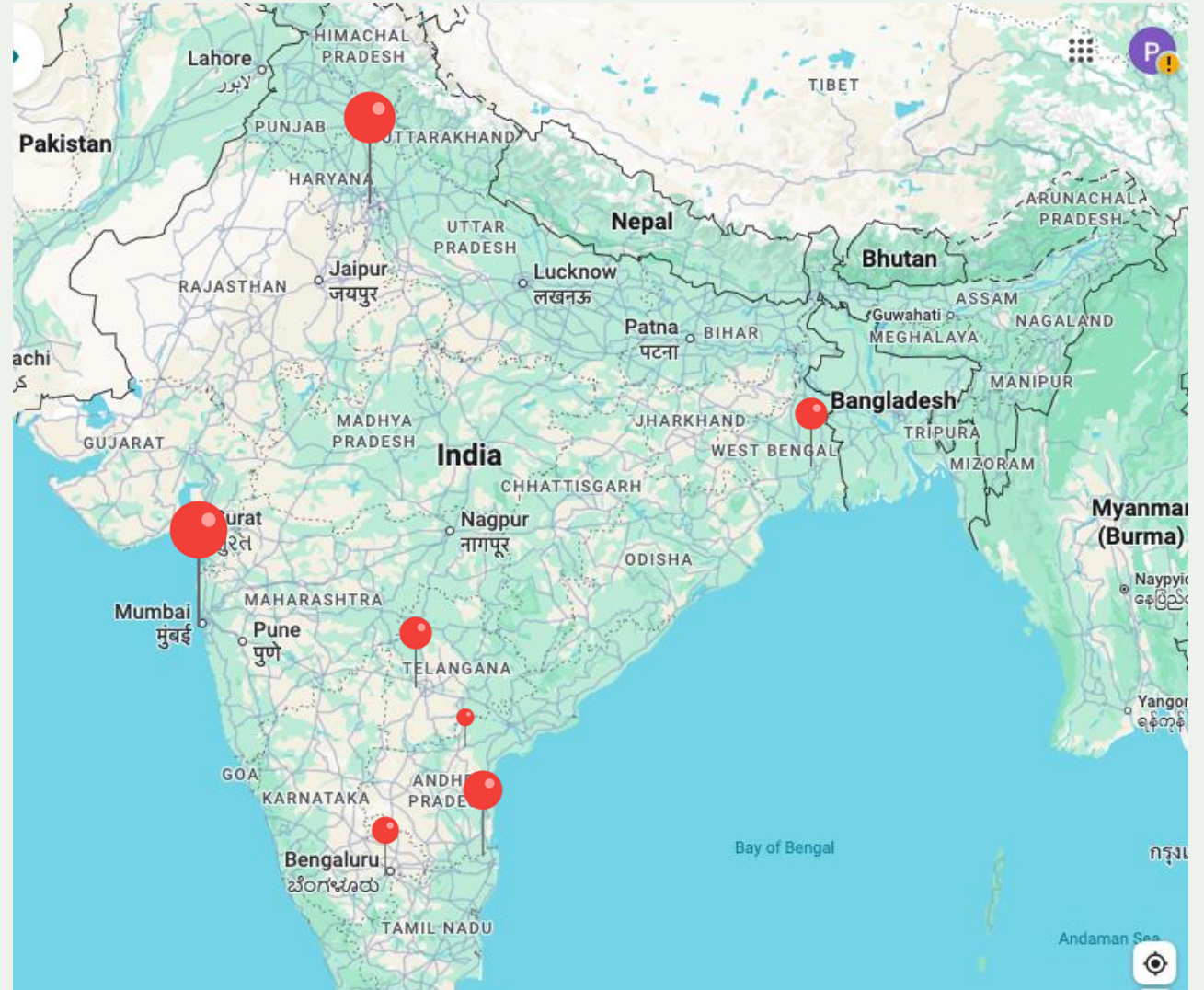
Closer Content, Faster Access

Locally cached content

83%

of the top 1000 websites in India can be accessed through an in-country server or cache

50%

Asia average

2025

🇮🇳 India
Hosting Location of Top 1,000 Websites

Cloudflare
Other
Amazon
Akamai
Fastly
Facebook
Microsoft
Alibaba

Local

External

Source: Internet Society Pulse • Measurement date: October 2025
Additional data: Google CRuX, FindCDN, IPinfo/Maxmind

Internet Society
Pulse

50/50 Vision
Working together to keep half of all traffic local.

https://pulse.internetsociety.org/en/reports/in/

https://www.internetsociety.org/issues/access/50-50-vision/

https://public.flourish.studio/visualisation/26155066/

Domains registered using ccTLD

100%

Antigua and Barbuda	
Austria	
Australia	
Belgium	
Canada	
Switzerland	
Czech Republic	
Germany	
Denmark	
Estonia	
Finland	
United Kingdom	
Hungary	
Iceland	
Lithuania	
Luxembourg	
Montenegro	
Netherlands	
Norway	
New Zealand	
Sweden	
Slovakia	
Sao Tome and Principe	
Tonga	
Saint Vincent and the Grenadines	
Samoa	

South Asia avg 4.08

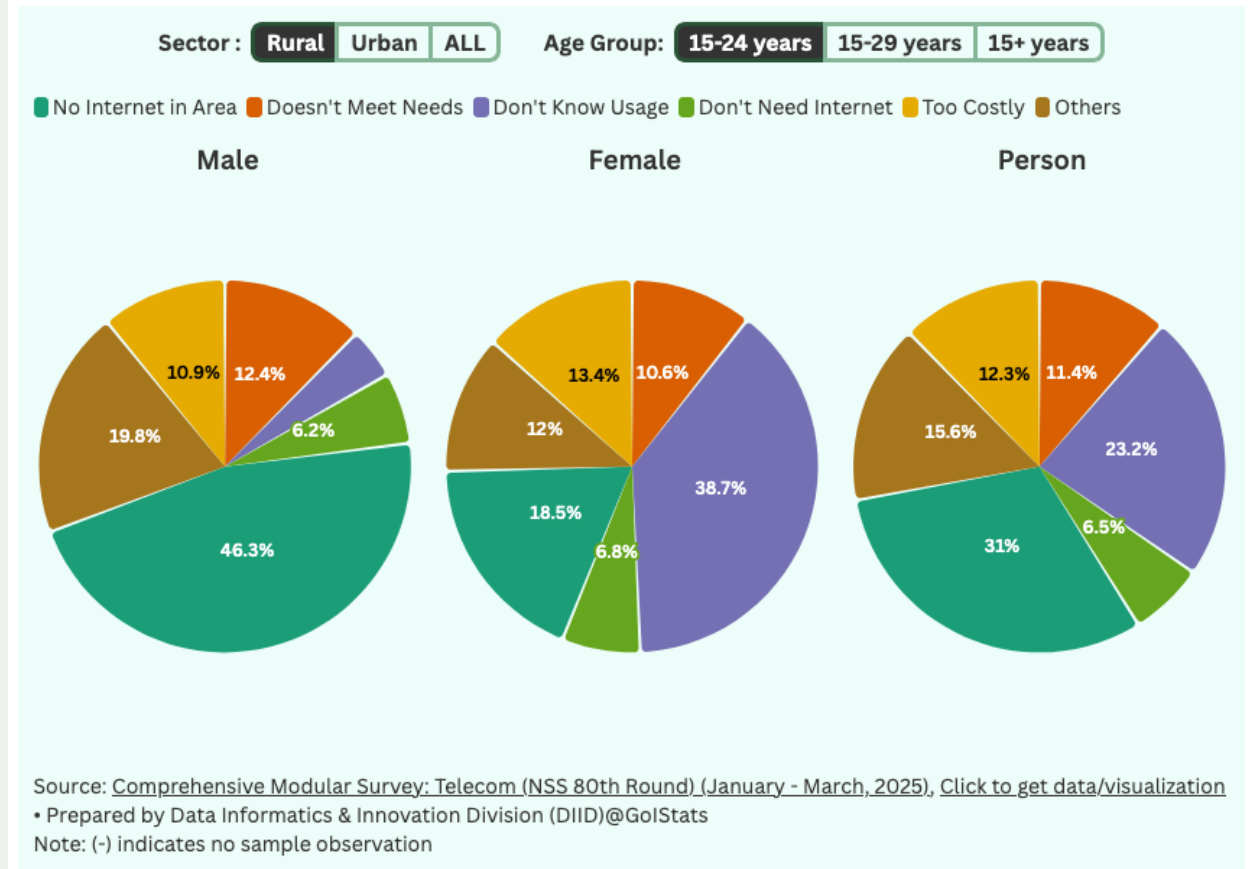|	
Afghanistan	.12
Pakistan	.66
Sri Lanka	4.25
Nepal	5.41
Maldives	15.31
India	2.73
Bangladesh	.27
Bhutan	3.89

International avg is 27%
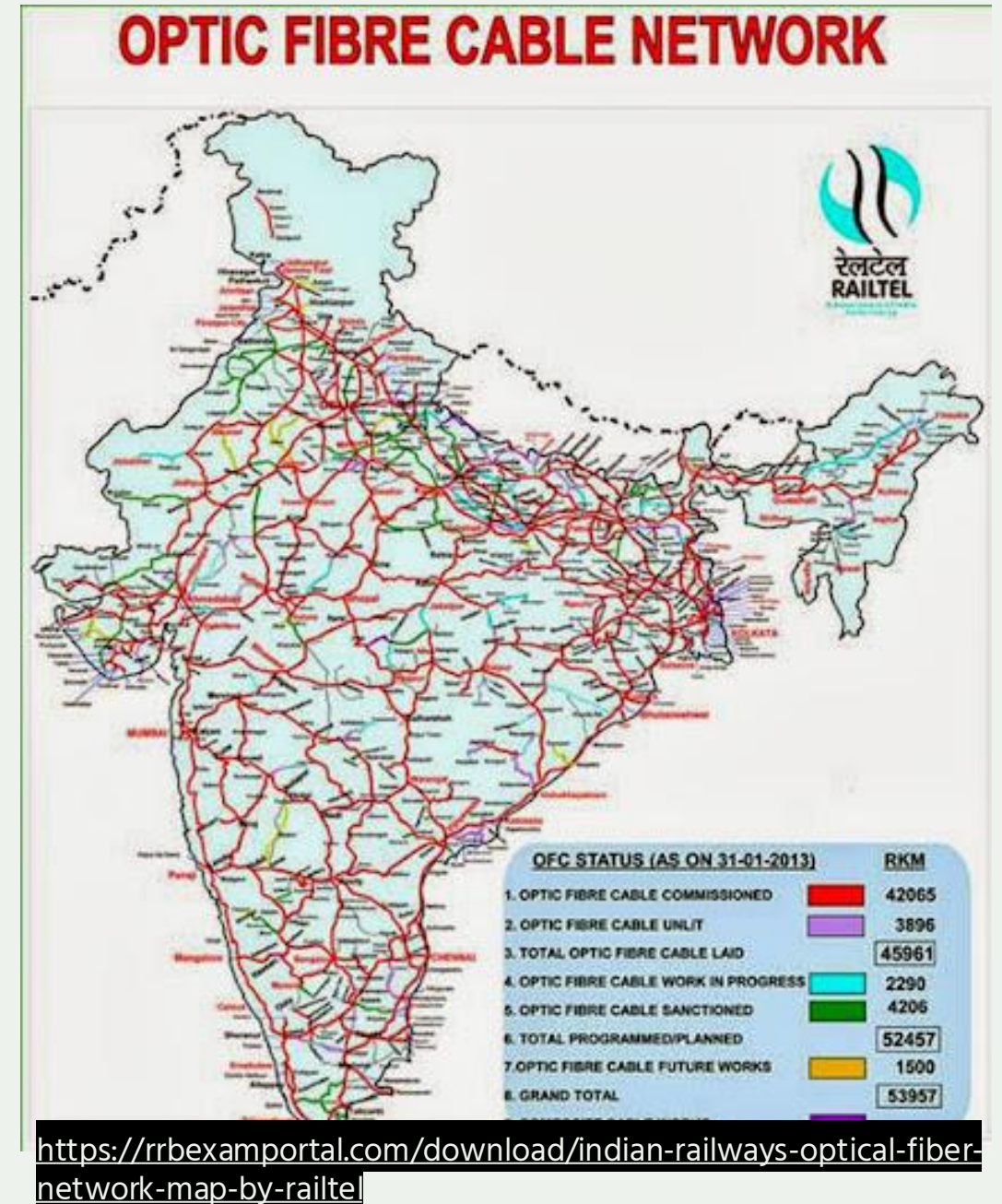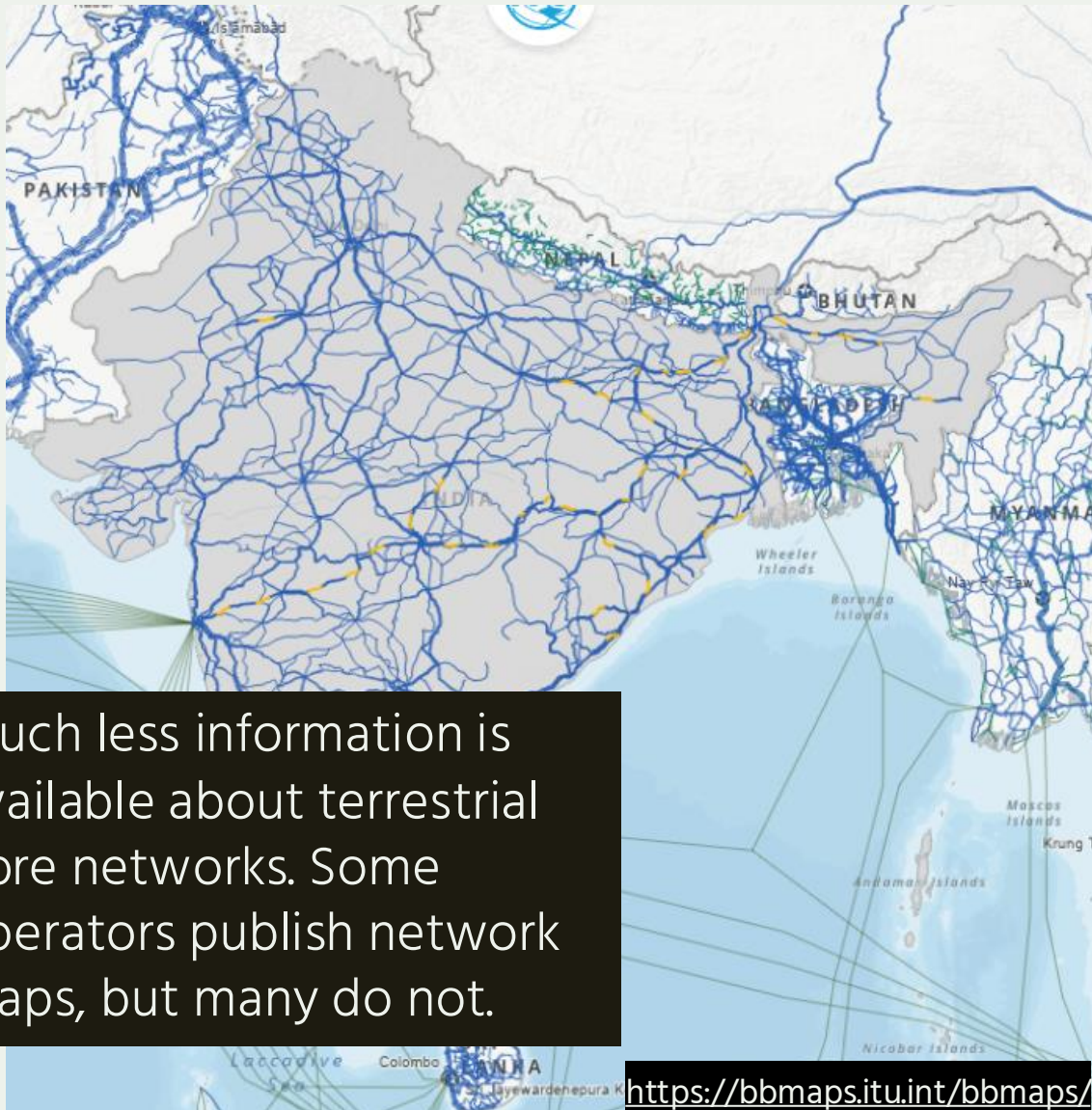
Measure, Measure, Measure

- Local measurement data is gold
  - Without in-country measurements, it's difficult to validate the data
- Holds services accountable
  - Particularly important if there are monopoles/ duopolies in place
- The key is cadence and consistency
  - These are major limitations of measurement data

Major reasons, sector,gender and age-group wise percentage of persons who are able to use internet but did not used it during last three months from January to March, 2025 at All-India level

Sector : **Rural** Urban ALL   Age Group: **15-24 years** 15-29 years 15+ years

No Internet in Area   Doesn't Meet Needs   Don't Know Usage   Don't Need Internet   Too Costly   Others

Male / Female / Person

Source: Comprehensive Modular Survey: Telecom (NSS 80th Round) (January - March, 2025), Click to get data/visualization
• Prepared by Data Informatics & Innovation Division (DIID)@GoIStats
Note: (-) indicates no sample observation

Growth of Terrestrial Fibre

Much less information is available about terrestrial fibre networks. Some operators publish network maps, but many do not.

OPTIC FIBRE CABLE NETWORK

RAILTEL

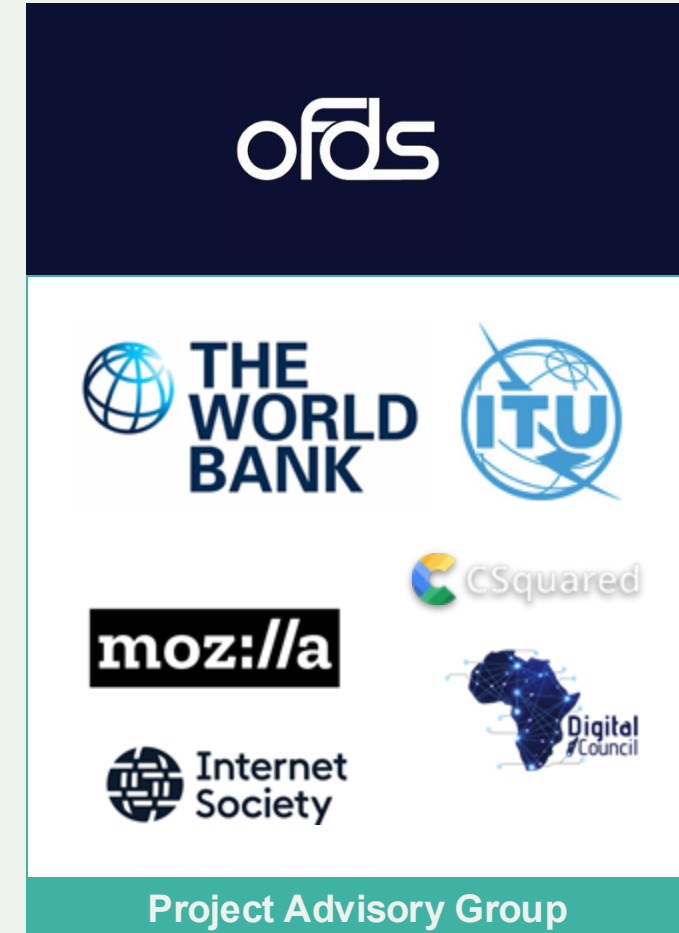| OFC STATUS (AS ON 31-01-2013)		RKM
1. OPTIC FIBRE CABLE COMMISSIONED		42065
2. OPTIC FIBRE CABLE UNLIT		3896
3. TOTAL OPTIC FIBRE CABLE LAID		45961
4. OPTIC FIBRE CABLE WORK IN PROGRESS		2290
5. OPTIC FIBRE CABLE SANCTIONED		4206
6. TOTAL PROGRAMMED/PLANNED		52457
7. OPTIC FIBRE CABLE FUTURE WORKS		1500
8. GRAND TOTAL		53957

Open Fibre Data Standard
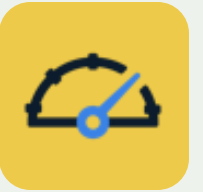
- **OFDS** is a multi-stakeholder effort to produce a standard for publishing data on terrestrial fibre optic broadband infrastructure.
  - Some operators publish network maps, but many do not.

- Benefits for Governments and Regulators
  - More effective network investments by accurately targeting the unserved.
  - Improved coordination across infrastructure sectors e.g. road, electricity, rail, oil & gas.
  - Reduction of physical network interruption and destruction.
  - Opportunity for national and regional benchmarking.
  - Understanding the true extent of the national fibre infrastructure.
  - Benefits of cybersecurity. Redundancy is key to network resilience.

- Learn more: www.ofds.info

ofds

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Project Advisory Group

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pulse@isoc.org

Review the Pulse IRI methodology