May 2024

Reading the Pulse

Measuring the Health and Resilience of the Internet with Internet Society Pulse.

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Outline

- What is Pulse?
- Quick overview of focus areas
  - Internet Shutdowns
  - Enabling Technologies
  - Market Concentration
  - Internet Resilience Index
  - Country Reports
- Focus on Internet Resilience
  - Components and data:
    - Infrastructure
    - Performance
    - Security
    - Market Readiness
  - Use Cases
  - The API
- Challenges and Discussion

Optional:

Sneak peak into upcoming areas of focus: IXP Dashboard, 50/50 KTL, historical data.

- Launched 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.

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Focus Areas

Internet Shutdowns

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Pulse: Internet Resilience and Internet Shutdowns

Resilience: How robust is the Internet ecosystem? Includes tracking:

- **Concentration**: How much are services concentrated in the hands of a few?
- **Technologies**: What is the state of deployment of technologies critical for the evolution of the Internet?
- **Country Reports**: Consolidate and illustrate critical Internet health metrics
    - **Coming soon:** IXP Dashboard and tracking the proportion of local traffic.

Shutdowns: Where do Internet Shutdowns take place and what is the economic cost?

- **Shutdown pages.**
- **NetLoss Calculator**

Across 2023, Pulse recorded

18

Countries experienced an intentional Internet shutdown

124

Shutdown events ranging from 2 hours to months

2370

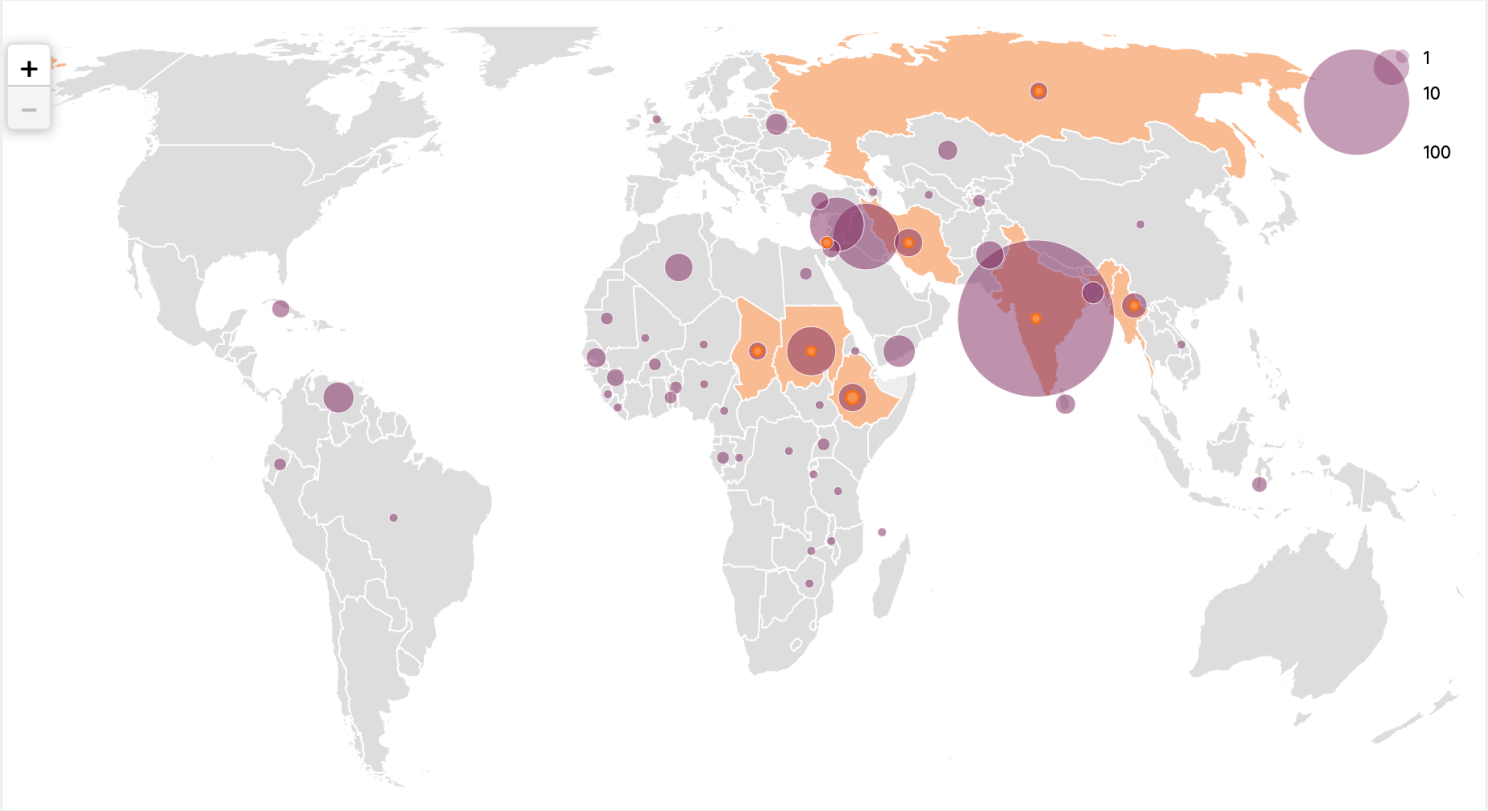
Total number of days of disruption

Global Shutdown Trends

Shutdowns tend to occur in response to several factors:

- Civil unrest and protests
- Armed conflict
- Elections
- National or regional exams

Shutdowns tend to be performed at the national level, although in India shutdowns are often ordered by regional governments.



Location of Shutdowns from 10/2019 to 3/2024

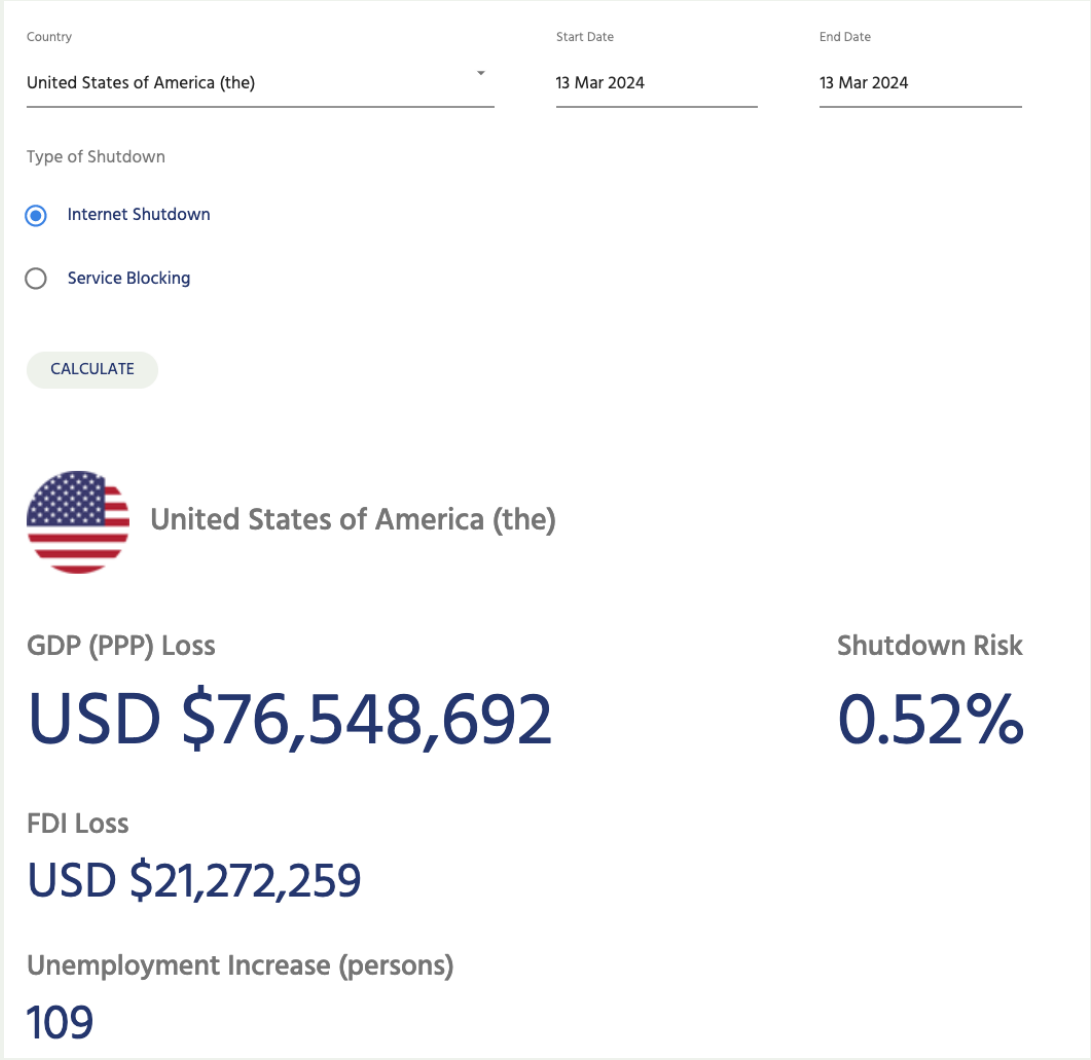
NetLoss: Calculating the Cost of Shutdowns

Our NetLoss tool allows users to estimate the economic cost of an Internet shutdown in a country or territory.

NetLoss helps Internet advocates make the point to governments that shutting down the Internet is harmful to their economy.

Important notes:

- NetLoss uses an economic framework to estimate the impact of Internet shutdowns on a range of economic, social, and other outcomes and uses econometric tools to provide a rigorous estimate of the economic impact of a given shutdown. But it is an estimate.
- Estimates the cost of national shutdowns, not regional shutdowns.



Health of the Internet

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Tracking the health of the Internet

- Pulse tracks the health and resiliency of the Internet by curating data on several areas:
  - The implementation of enabling **technologies**
  - The **concentration** of services on the Internet
  - Close to 30 individual metrics that we use to calculate our **Internet Resiliency Index**, and
  - **Country reports** highlighting key insights from the data

- Coming soon:
  - **Internet Exchange Point Dashboard**, tracking key data about IXPs
  - **Pulse 50/50**, tracking the proportion of traffic staying local
  - The ability to see **historical data**, allowing for analysis of how resilience has changed.
  - Improved usability and APIs

Enabling Technologies

HTTPS
96%

Current percentage of top 1000 websites globally that support HTTPS.

IPv6
48%

Current percentage of top 1000 websites globally that support IPv6.

TLS 1.3
81%

Current percentage of top 1000 websites globally that support TLS 1.3.

Network name ↑	IPv6 deployment	ASN(s)
3 Scandinavia	77%	44034
A DO NASCIMENTO SANT...	15%	267343
AAISP	21%	20712
achermann consulting ag	10%	43291
Active Network S.p.A.	1%	197075
ADDIX Internet Services	33%	25415
Airtek Solutions	8%	61461
Alcom	45%	3238
Altibox AS	57%	29695

DNSSEC
31%

Percentage of ccTLD registries with operational DNSSEC and global DNSSEC validation rate (data sources: DNS, APNIC)

ROA Coverage
43%

Percentage of address space covered by ROA (data source: APNIC)

HTTP/3
23%

HTTP/3 adoption (data source: Mozilla Firefox Telemetry)

Concentration

- **Market Concentration:** The concentration of providers in a given market
- **Country Market Shares:** The jurisdiction of providers in a given market.

Gini HHI

All Top 10,000 sites Top 1,000 sites

Data Center | Gini **0.67**
Data center providers supply hardware and software infrastructure to serve websites on the Internet.

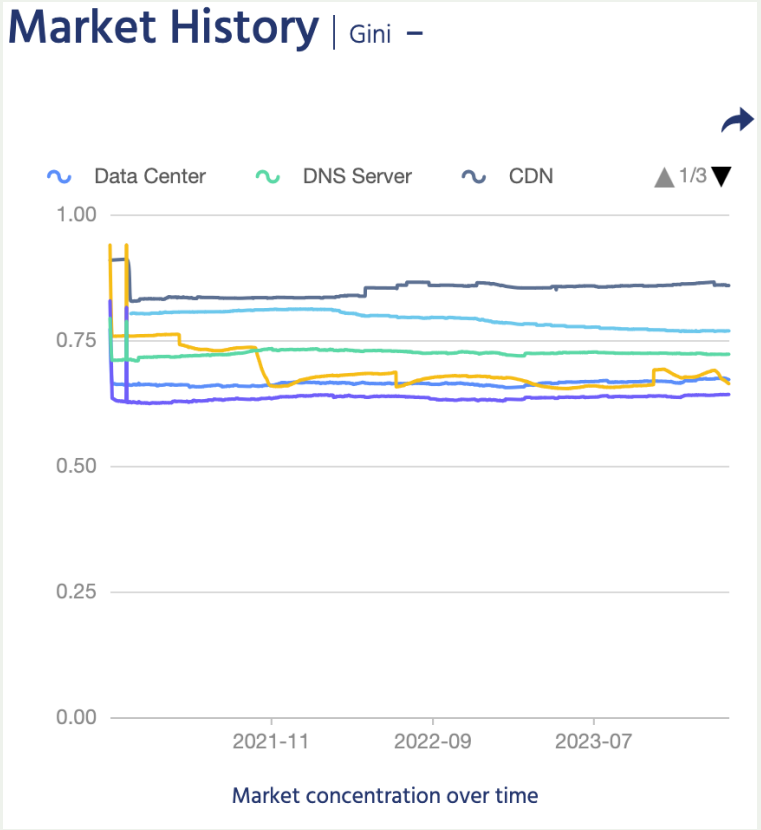
Top Level Domain | Gini **0.77**
Top Level Domains are the highest level in the hierarchical Domain Name System (DNS) of the Internet.

SSL Certificate | Gini **0.66**
SSL certificate authorities are trusted institutions that issue SSL certificates for verifying the owner of a website and encrypting web traffic with SSL/TLS.

DNS Server | Gini **0.72**
DNS (domain name system) servers manage mappings between Internet domain names and their associated records such as IP addresses.

CDN | Gini **0.86**
Content Delivery Networks (CDNs) are geographically distributed networks of proxy servers and their data centers.

Web Hosting | Gini **0.64**
A web hosting service provides hardware and software infrastructure to enable webmasters to make their websites accessible via the Internet.



The Internet Resiliency Index (IRI) pulse.internetsociety.org/resilience

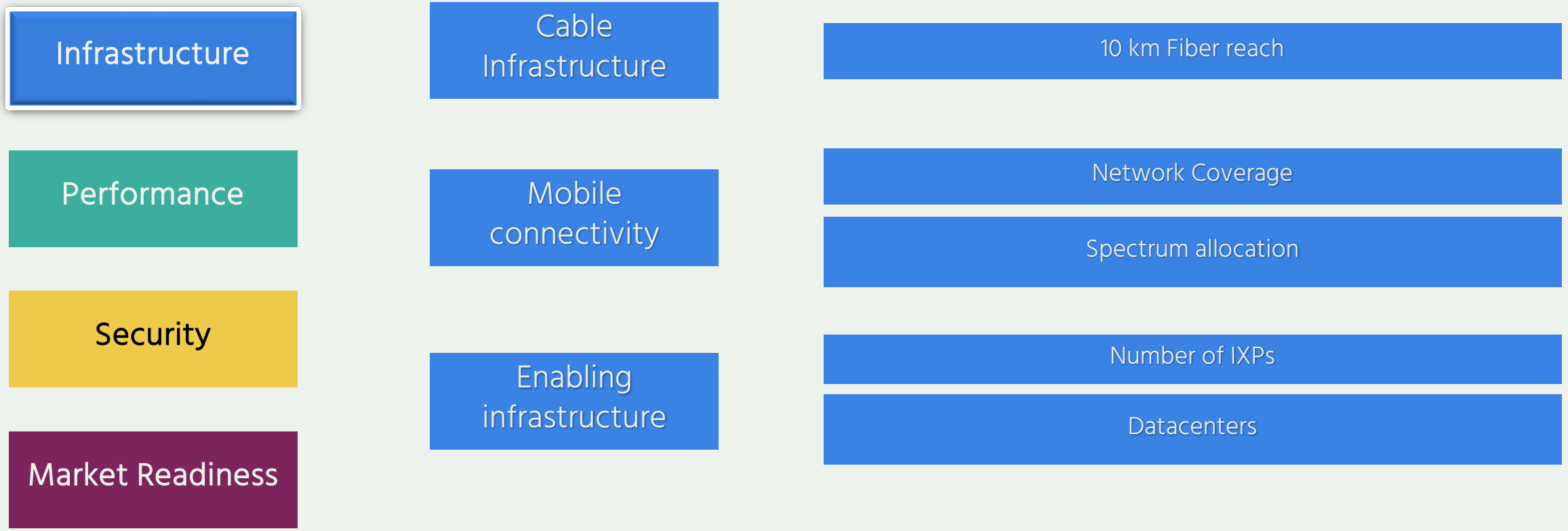
The framework collates around 30 sets of public metric data that relate to **four pillars** of a resilient Internet:

.

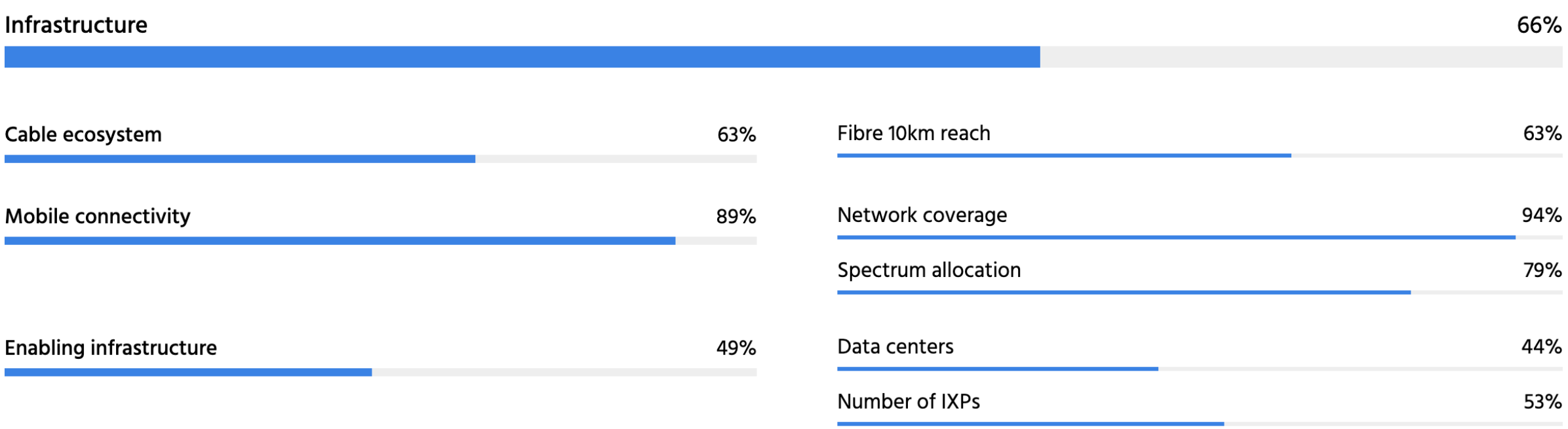
Infrastructure	Performance	Security	Market Readiness
The existence and availability of physical infrastructure that provides Internet connectivity.	The ability of the network to provide end-users with seamless and reliable access to Internet services.	The ability of the network to resist intentional 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.

Methodology: https://pulse.internetsociety.org/wp-content/uploads/2023/07/Internet-Society-Pulse-IRI-Methodology-July-2023-v2.0-Final-EN.pdf

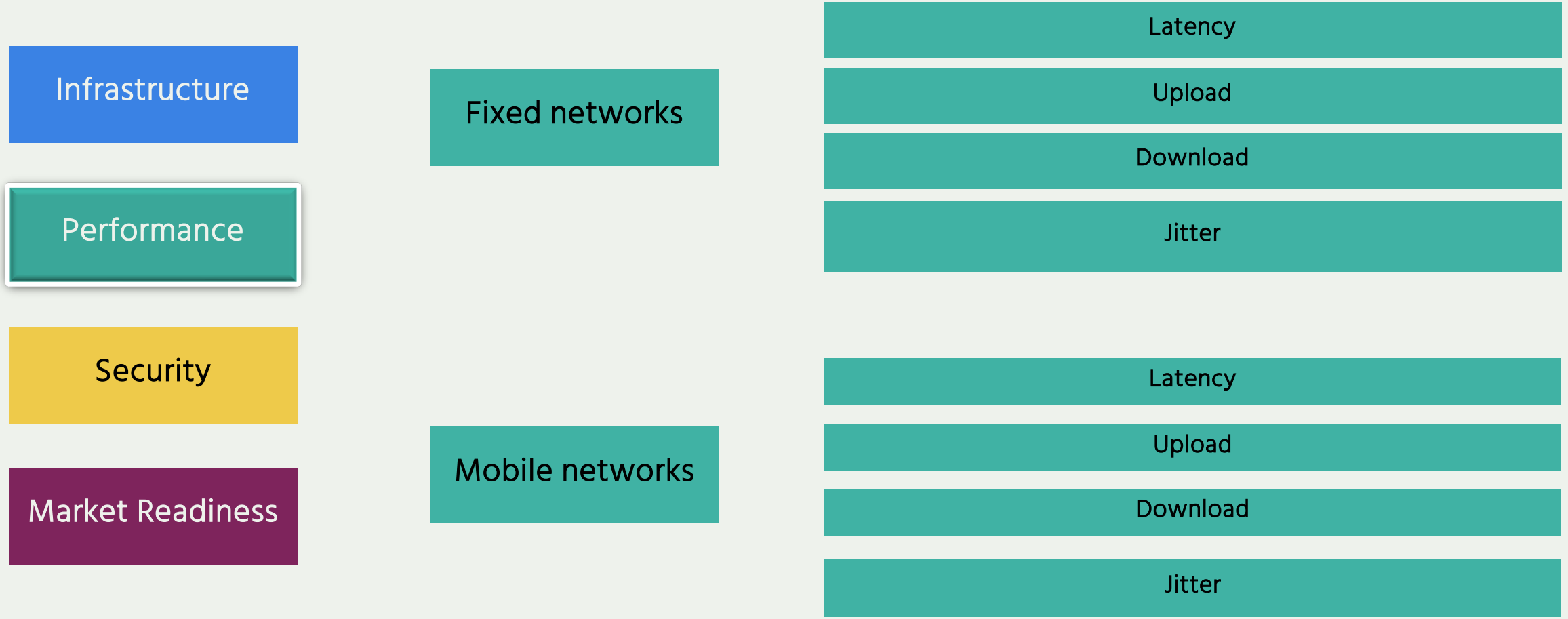
The Internet Resiliency Index — Performance

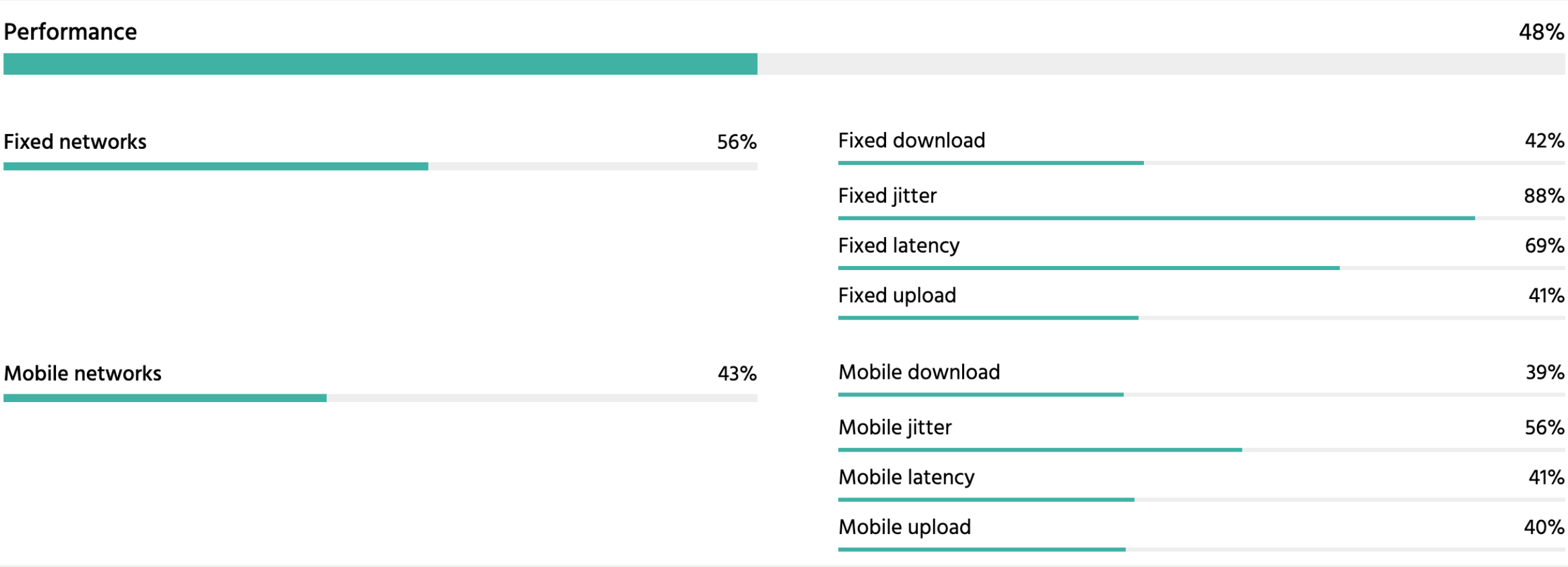


Poland


Infrastructure
66%
Cable ecosystem
63%
Mobile connectivity
89%
Enabling infrastructure
49%
Fibre 10km reach
63%
Network coverage
94%
Spectrum allocation
79%
Data centers
44%
Number of IXPs
53%

The Internet Resiliency Index — Infrastructure




Performance
48%
Fixed networks
56%
Fixed download
42%
Fixed jitter
88%
Fixed latency
69%
Fixed upload
41%
Mobile networks
43%
Mobile download
39%
Mobile jitter
56%
Mobile latency
41%
Mobile upload
40%

The Internet Resiliency Index — Security

- Infrastructure
- Performance
- **Security**
- Market Readiness

Enabling technologies	**Secure web traffic** (Webpage loads using HTTPS. Source Mozilla
	IPv6 adoption. Source APNIC Labs
DNSSEC	**DNSSEC adoption**, i.e., is ccTLD signed. Source: ICANN
	DNSSEC validation, i.e., Users validating DNSSEC. Source: APNIC Labs
Routing hygiene	**MANRS score.**. Source: MANRS
	Upstream redundancy i.e., Avg # of upstream providers. Source: CAIDA
Security Threat	**DDoS Protection.**. Source: Cybergreen
	Global cybersecurity index score. Source: ITU
	Secure Internet Servers Source: World Bank

Security 72%

Security: The ability of the network to resist intentional or unintentional disruptions through the adoption of security technologies and best practices

Enabling technologies 70%

Domain name system security 68%

Routing hygiene 72%

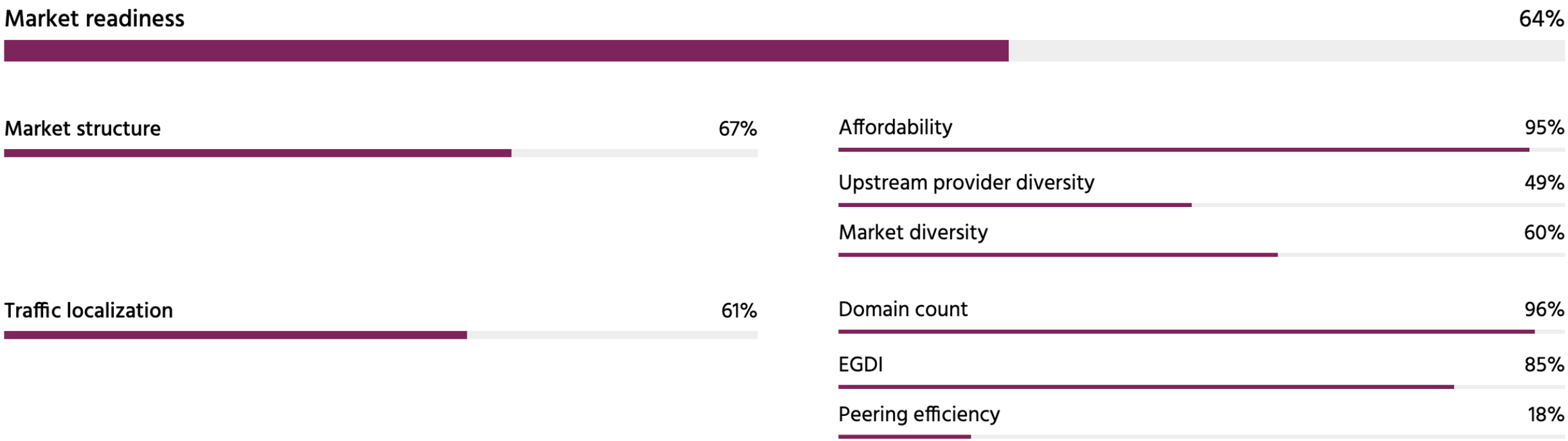
Security threat 80%

- Secure web traffic 91%
- IPv6 adoption 22%
- DNSSEC adoption 100%
- DNSSEC validation 36%
- MANRS 71%
- Upstream redundancy 73%
- DDoS protection 60%
- Global cybersecurity 94%
- Secure Internet servers 81%

The Internet Resiliency Index — Market Readiness

- Infrastructure
- Performance
- Security
- Market Readiness

- Market structure
  - Affordability
  - Market concentration
  - AS Hegemony
- Traffic Localization
  - Peering efficiency
  - Domain count
  - E-Government Development Index


Market readiness
64%
Market structure
67%
Traffic localization
61%
Affordability
95%
Upstream provider diversity
49%
Market diversity
60%
Domain count
96%
EGDI
85%
Peering efficiency
18%

Country Reports: Open Internet

Country Report

Poland
Europe, Eastern Europe

Search for countries ← →

Open Internet Environment

Internet Use
Individuals using the Internet as a percentage of the total population

87%
Regional Rank: 29

89%
Europe avg.

Internet Resilience Score
A resilient Internet connection is one that maintains an acceptable level of service in the face of faults and challenges to normal operation

63%
Regional Rank: 20

60%
Europe avg.

See details

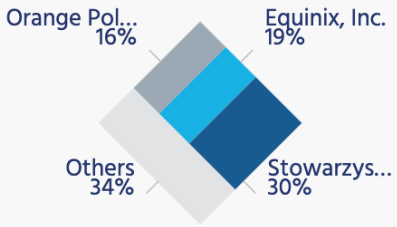
Transit Provider Diversity
More diversity in routes to the global Internet improves connection resilience

Fair

Retail ISP Diversity
Diversity of retail Internet providers improves resilience and user choice

Excellent

IXP Operator Market
A measure of the diversity and concentration of the local market for Internet Exchange Point operations



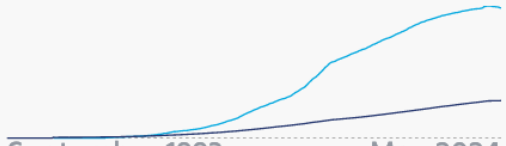
Globally Connected Infrastructure

Networks Assigned

A measure of how many Internet networks are active here

2,508
Regional Rank: 4

723
Europe avg.



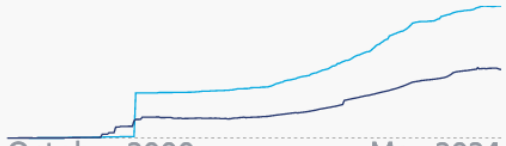
September 1993 May 2024

Addresses Assigned IPv6

A measure of how many Internet addresses are assigned here

406.8M
Regional Rank: 8

211.1M
Europe avg.



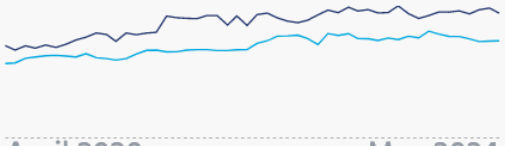
October 2000 May 2024

IPv6 Adoption

Enabling the Internet to support more users and more uses

16%
Regional Rank: 22

21%
Europe avg.



April 2020 May 2024

Internet Exchange Points

IXPs help strengthen local Internet connectivity, develop local Internet industry, improve competitiveness, and serve as a hub for technical activity

16
Regional Rank: 9

10
Europe avg.

Addresses Assigned IPv4

A measure of how many legacy addresses are assigned here

20.0M
Regional Rank: 10

16.1M
Europe avg.

Peering Networks

Peering networks help to keep Internet traffic local, provide faster connections, and improve the experience of the people relying on them

764
Regional Rank: 5

274
Europe avg.

Secure and Trustworthy Internet

A secure Internet is resistant to attacks on its infrastructure, delivering a robust service to its user community. A trustworthy Internet meets the expectations of its users by offering a resilient and reliable base for applications and services.

Naming Security Status

Adopting DNSSEC improves trustworthiness of Internet communications

.pl Active

Naming Security Coverage

A measure of how much local web content supports DNSSEC for improved trustworthiness

16%
Regional
Rank: 14

14%
Europe avg.

Naming Security Adoption

A measure of how much local Internet users are protected by DNSSEC

45%
Regional
Rank: 21

44%
Europe avg.

Routing Security Adoption

A measure of how much local Internet providers are checking validity of connectivity information they receive from other networks

38%
Regional
Rank: 23

35%
Europe avg.

Routing Security Coverage IPv4

One measure of how much local Internet network providers are securing their infrastructure

85%
Regional
Rank: 20

74%
Europe avg.

Routing Security Coverage IPv6

One measure of how much local Internet network providers are securing their infrastructure

76%
Regional
Rank: 24

67%
Europe avg.

Latest Posts

Use Cases

How can Pulse help you if you are:

- Decision Maker
- Journalist
- In charge of network provisioning
- In charge of implementing enabling technologies

The API

- How to get access: email us at pulse@isoc.org.

Challenges and Discussion

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Challenges

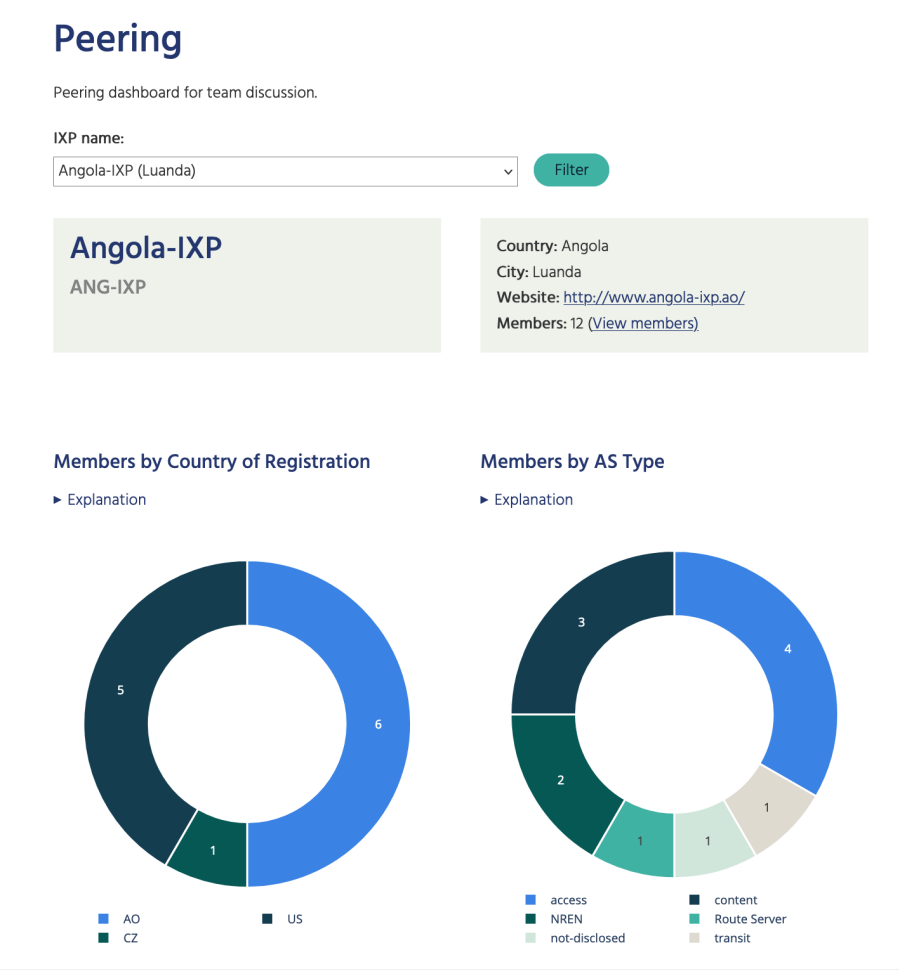
- The data is pulled from external public sources which are not always up-to-date.
- Some countries are missing due to a lack of data.
- Without in-country measurements, it's difficult to validate the data.
    - RIPE Atlas and OONI are doing great work in this area, but more is needed.

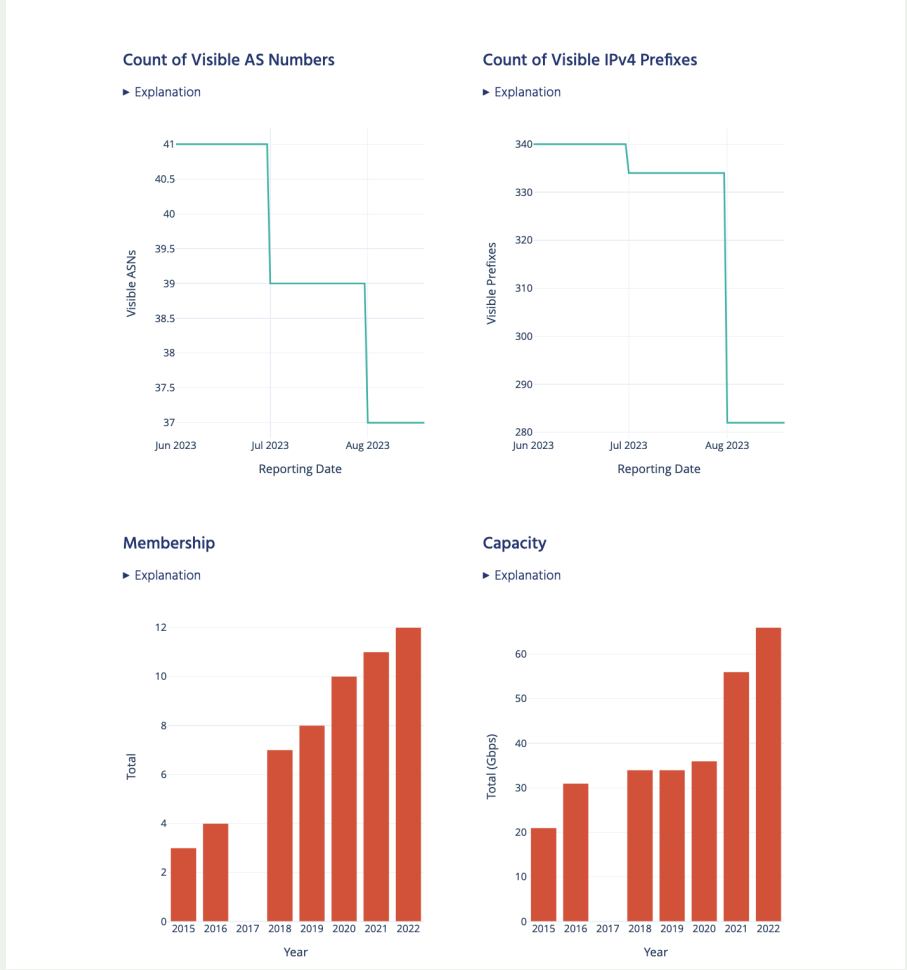
- Some of the data undergoes processing, normalization, and weighing, we use a methodology that is reproducible.

- Ultimately, the Index benchmarks countries with one another and helps decision makers recognize gaps and weaknesses to conduct further study into validating these and work towards addressing them.

IXP Dashboard

Under development.





Discussion

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Contribute to Pulse

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Thank you

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