Reviewing Internet Resilience in Southeast Europe

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Why we measure

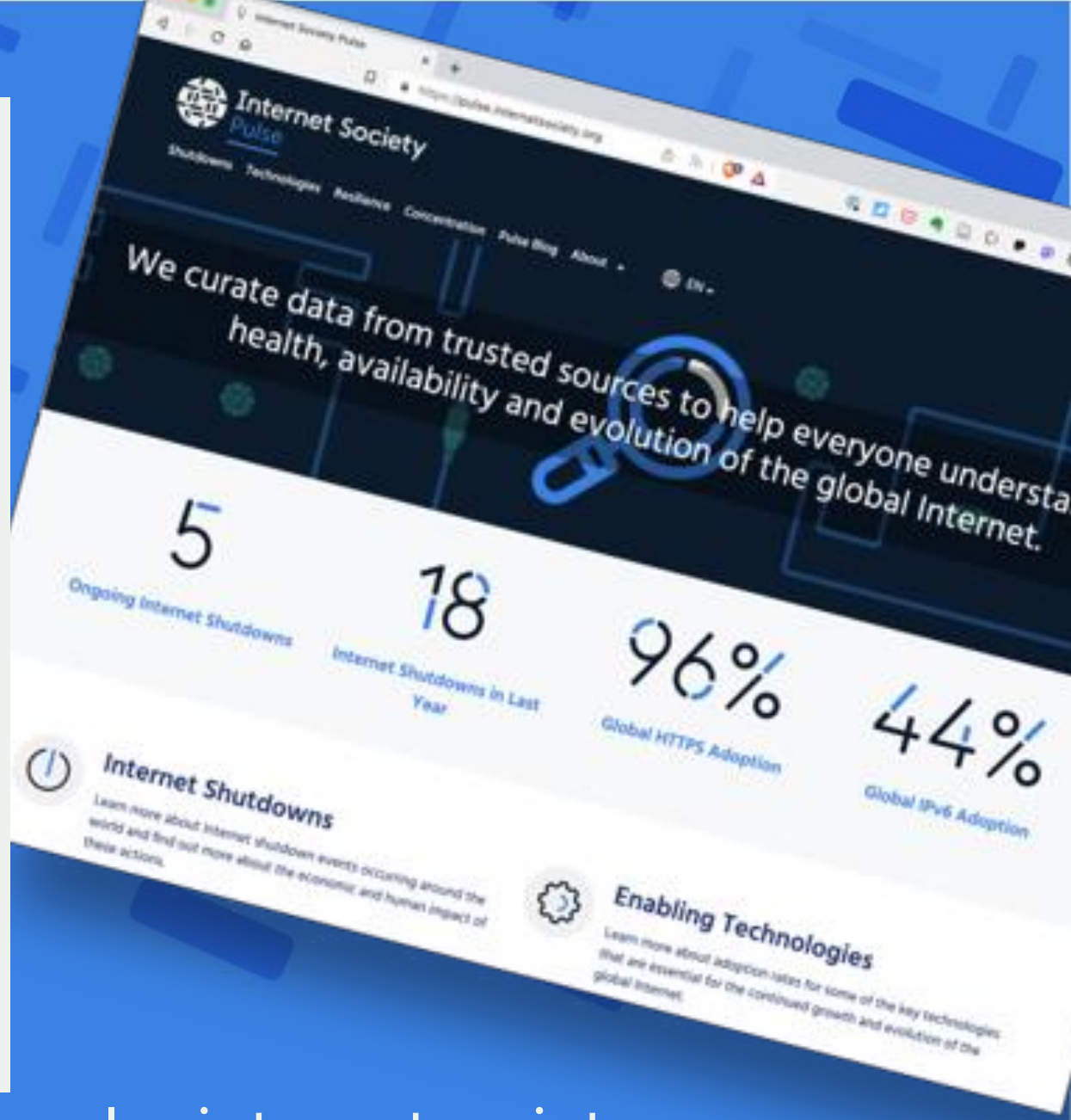
- To answer questions/validate beliefs
- To set a baseline from which we can track change/show results
- To demonstrate value
- To justify decisions
- To identify opportunities for improvement
- Advance our knowledge

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.



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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

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.

Canada, July 2022

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.

Italy, February 2023

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.

Australia, November 2023

Who's next?

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

The existence and availability of physical infrastructure that provides Internet connectivity.

Performance

The ability of the network to provide end-users with seamless and reliable access to Internet services.

Security

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

Market Readiness

The ability of the market to self-regulate and provide affordable prices to end-users by maintaining a diverse and competitive market.

Environmental/ Disaster [TBC]

The infrastructure and energy redundancy in place to offset climate change and disaster scenarios.

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Internet Resilience — Globally

53/100

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.

57 / 100

global average

Security

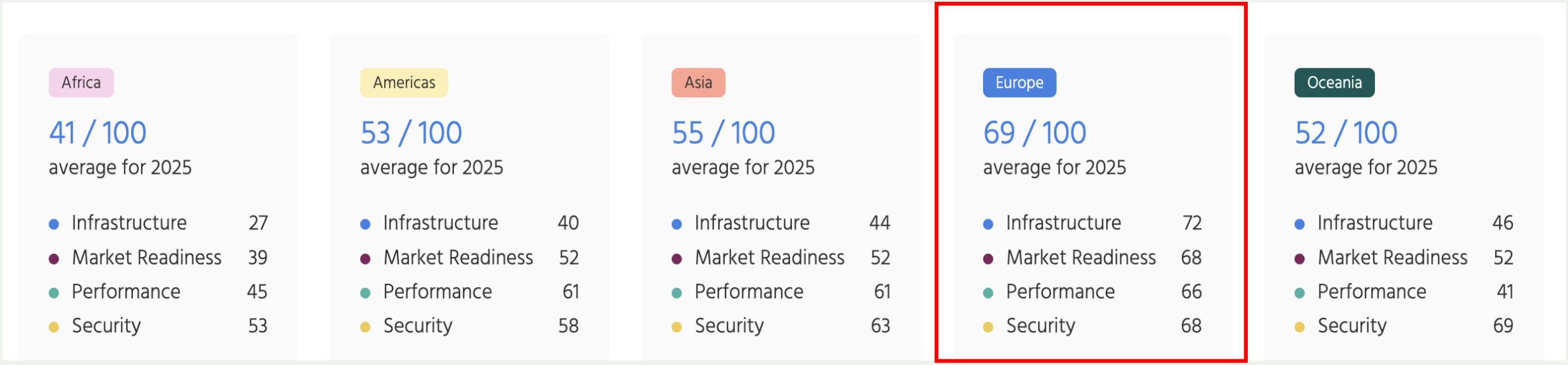
Technologies and best practices support a network's ability to resist disruptions.

61 / 100

global average

https://pulse.internetsociety.org/resilience

Overall Internet Resilience — By Continent



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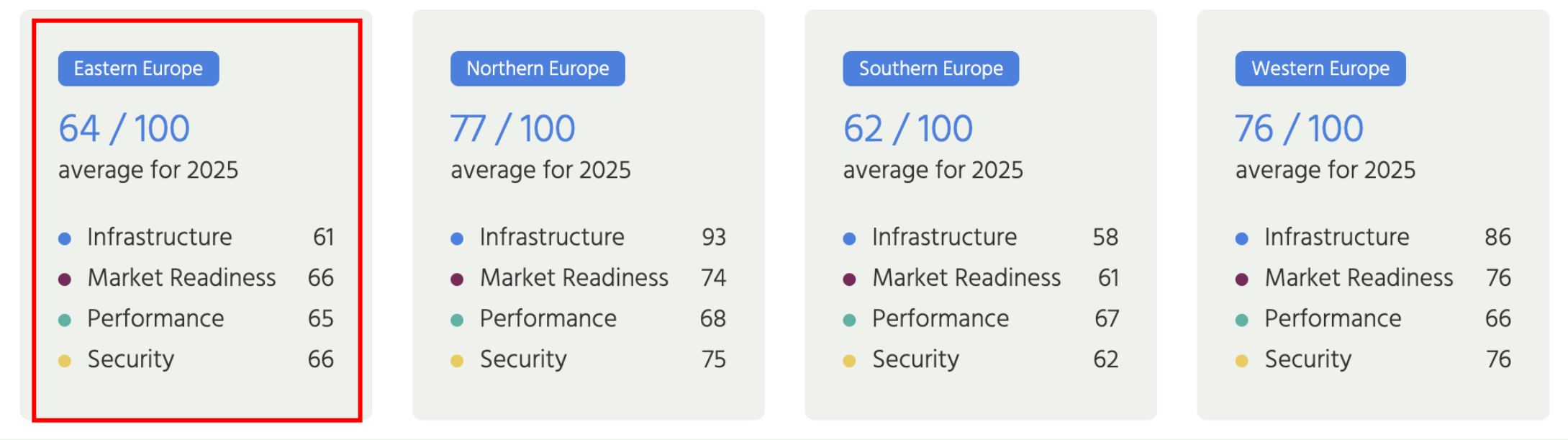
Overall Internet Resilience — By Region



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Overall Internet Resilience — By Country

Albania

60 / 100

Infrastructure	54
Market Readiness	61
Performance	69
Security	56

Bosnia and Herzegovina

49 / 100

Infrastructure	39
Market Readiness	54
Performance	50
Security	53

Bulgaria

72 / 100

Infrastructure	81
Market Readiness	59
Performance	73
Security	73

Croatia

63 / 100

Infrastructure	67
Market Readiness	59
Performance	68
Security	59

Greece

68 / 100

Infrastructure	74
Market Readiness	69
Performance	65
Security	66

Montenegro

61 / 100

Infrastructure	39
Market Readiness	64
Performance	69
Security	72

North Macedonia

58 / 100

Infrastructure	58
Market Readiness	55
Performance	69
Security	51

Romania

63 / 100

Infrastructure	55
Market Readiness	57
Performance	73
Security	66

Serbia

60 / 100

Infrastructure	45
Market Readiness	54
Performance	70
Security	69

Slovenia

73 / 100

Infrastructure	77
Market Readiness	69
Performance	72
Security	76

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https://pulse.internetsociety.org/resilience

Overall Internet Resilience — Bulgaria

Europe

69 / 100

Infrastructure	72
Market Readiness	68
Performance	66
Security	68

Eastern Europe

64 / 100

Infrastructure	61
Market Readiness	66
Performance	65
Security	66

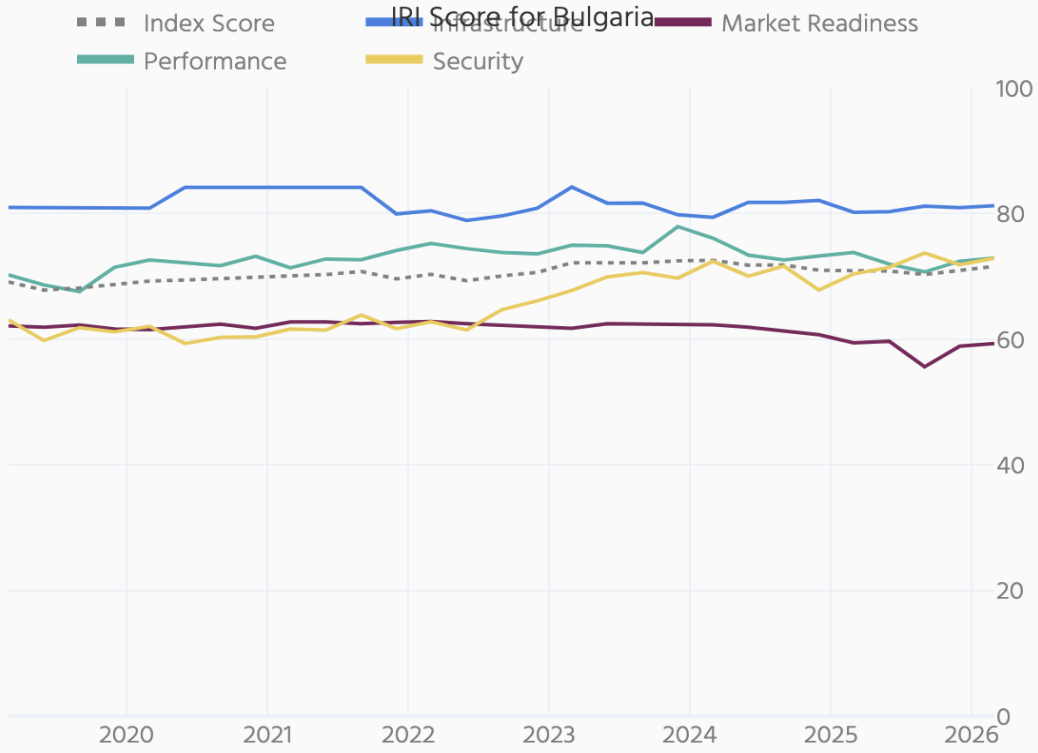
Bulgaria

72 / 100

The Internet in Bulgaria **is more resilient on average than other countries in Eastern Europe**, and is **high for Europe**. It ranks **1st in Eastern Europe for infrastructure**, a category that evaluates the availability of infrastructure for Internet connectivity. It ranks **32nd in Europe for market readiness**, a category that evaluates the overall competitiveness of the market, and the ability to offer affordable prices to consumers.

View country report for Bulgaria

Infrastructure	81
Market Readiness	59
Performance	73
Security	73



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

Opportunities To Strengthen Resilience

What is affecting Bulgaria's Internet Resilience?

Market readiness 59

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

Market structure 84

Affordability 88

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

Upstream provider diversity 76

Uses the Herfindahl-Hirschman Index (HHI) to measure the market concentration of upstream Internet connections. Source: Internet Initiative Japan (IIJ)

Market competition 86

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

Traffic localization 35

Domain count 17

Domains registered using ccTLD. Source: DomainTools

E-Government Development Index Score 81

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

Peering efficiency 13

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

Build IXPs and they will/might come?

Peering Efficiency

8 IXPs

357 in Europe

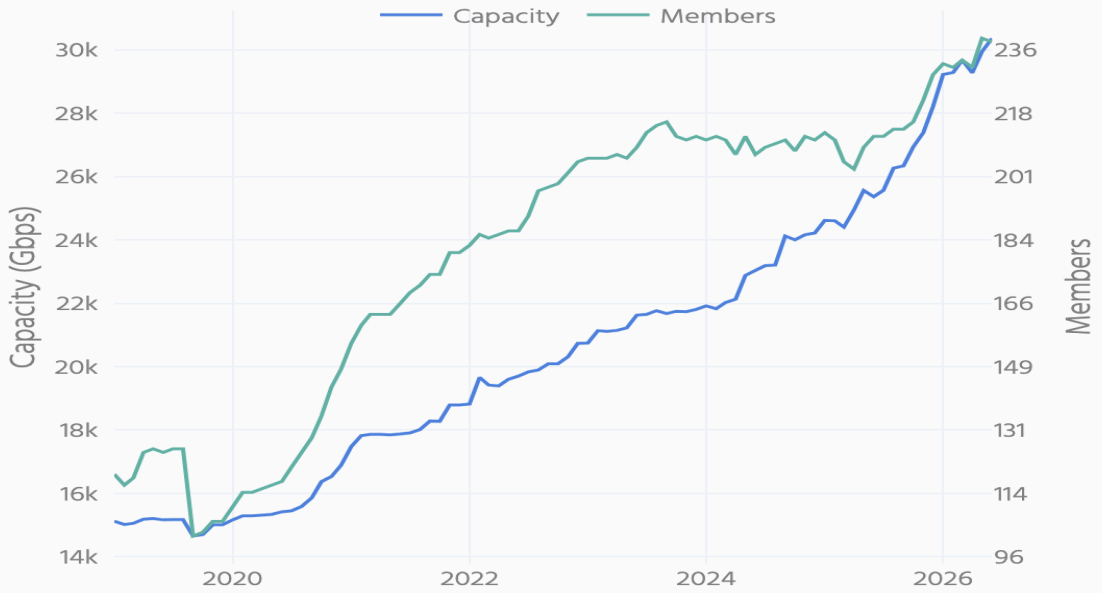
Members between 4 and 124 (Total number of local networks, ASNs, 669)

30 Tbps capacity

IXP membership and capacity

One way to measure the strength of IXPs in the Internet landscape is to look at membership and capacity. Larger networks tend to bring more capacity, which can benefit all members.

Measures changes in membership and capacity across all IXPs in **Bulgaria**, as shown in PeeringDB as of June 2026.



https://pulse.internetsociety.org/en/ixp-tracker/?country_code=MN

Closer Content, Faster Access

Locally cached content

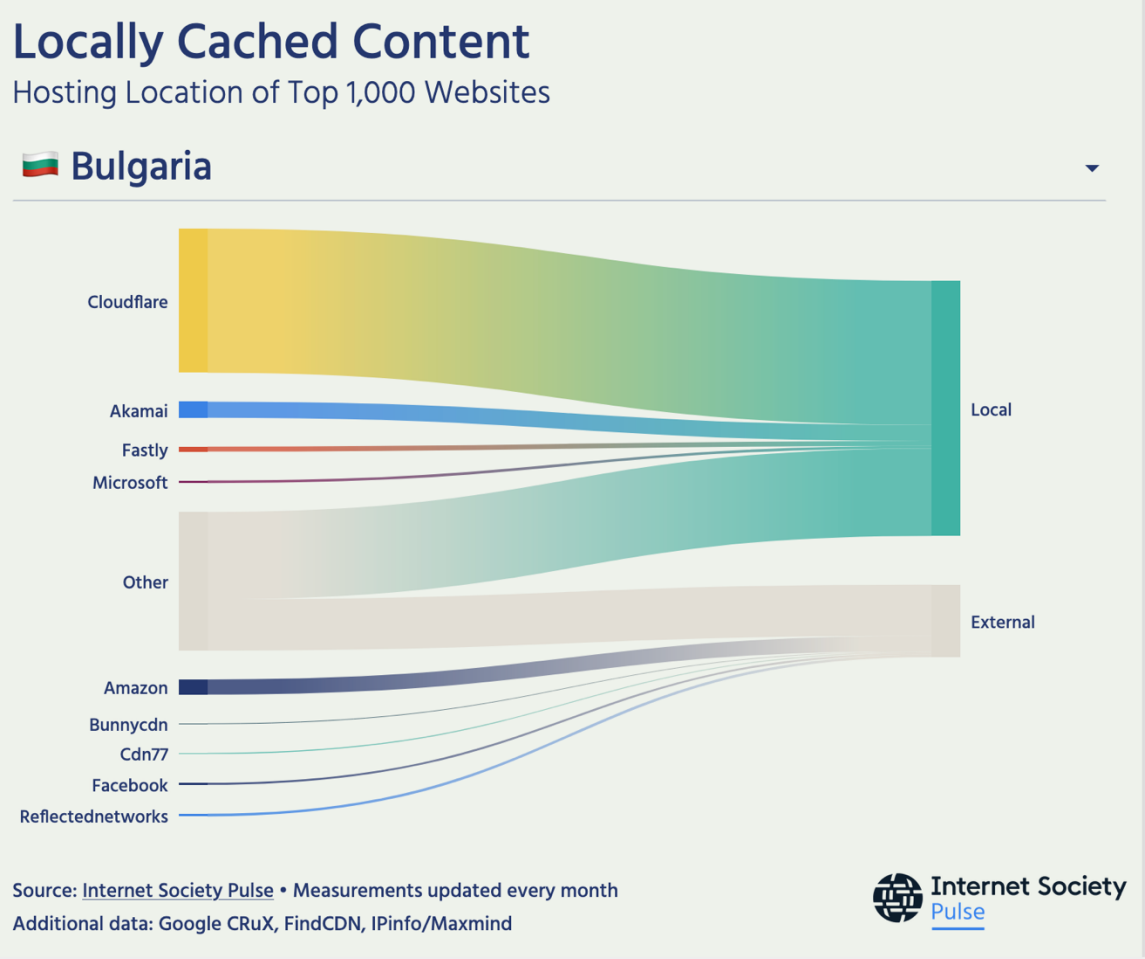
77%

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

69%

Europe average

2026



50/50 Vision

Working together to keep half of all traffic local.

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

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

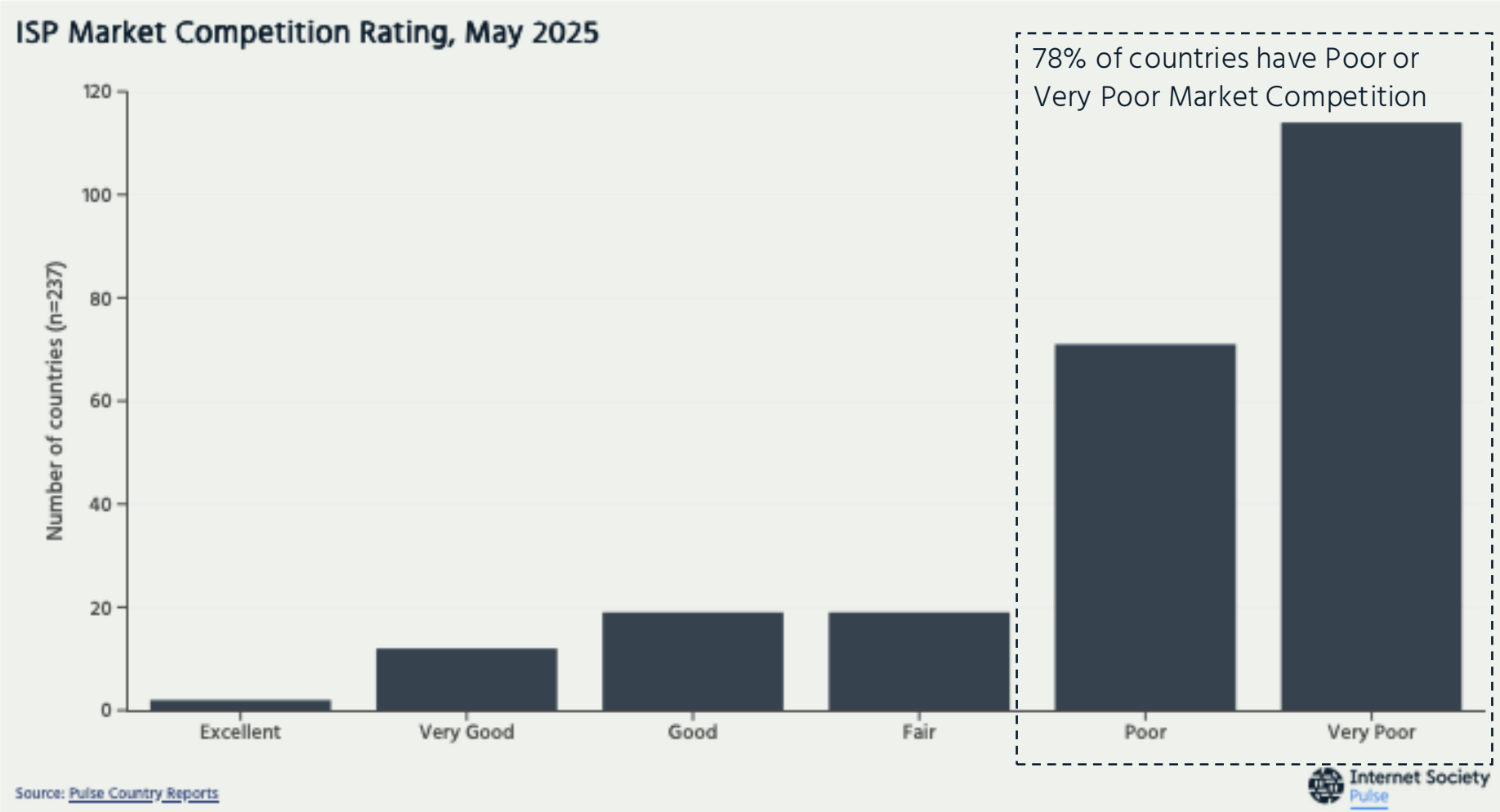
Recommendations

Increase market diversity

Increase local peering

Host content locally

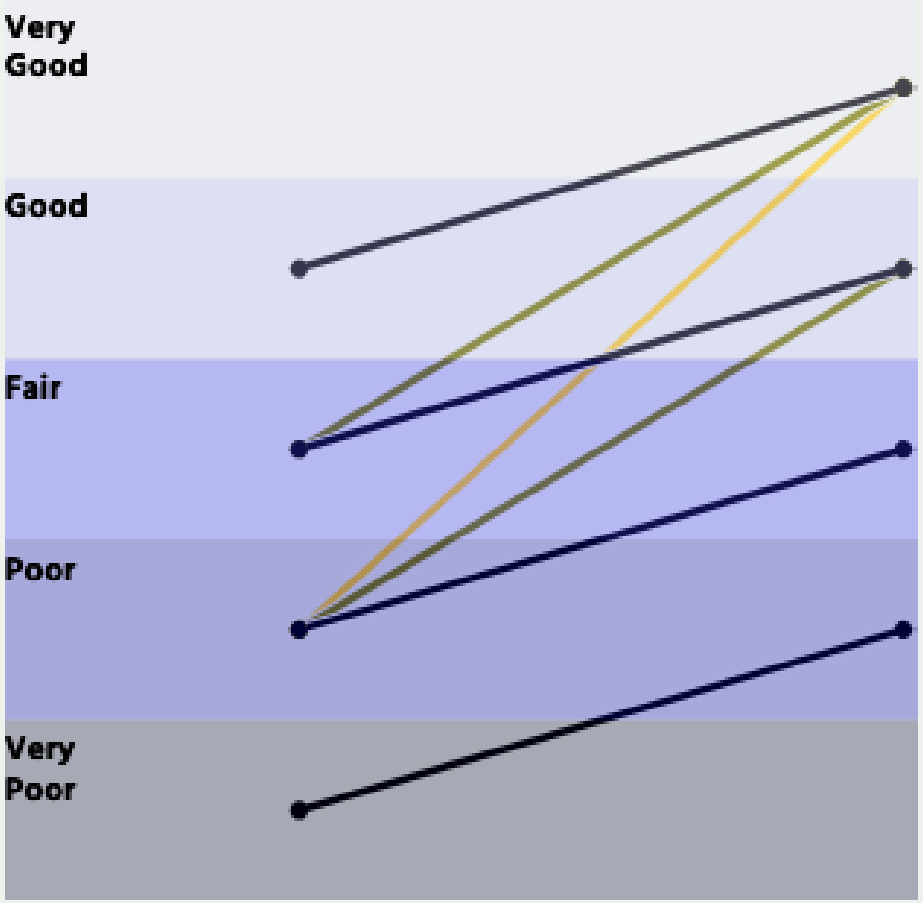
Measure constantly and consistently



https://pulse.internetsociety.org/blog/measuring-internet-market-competition

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

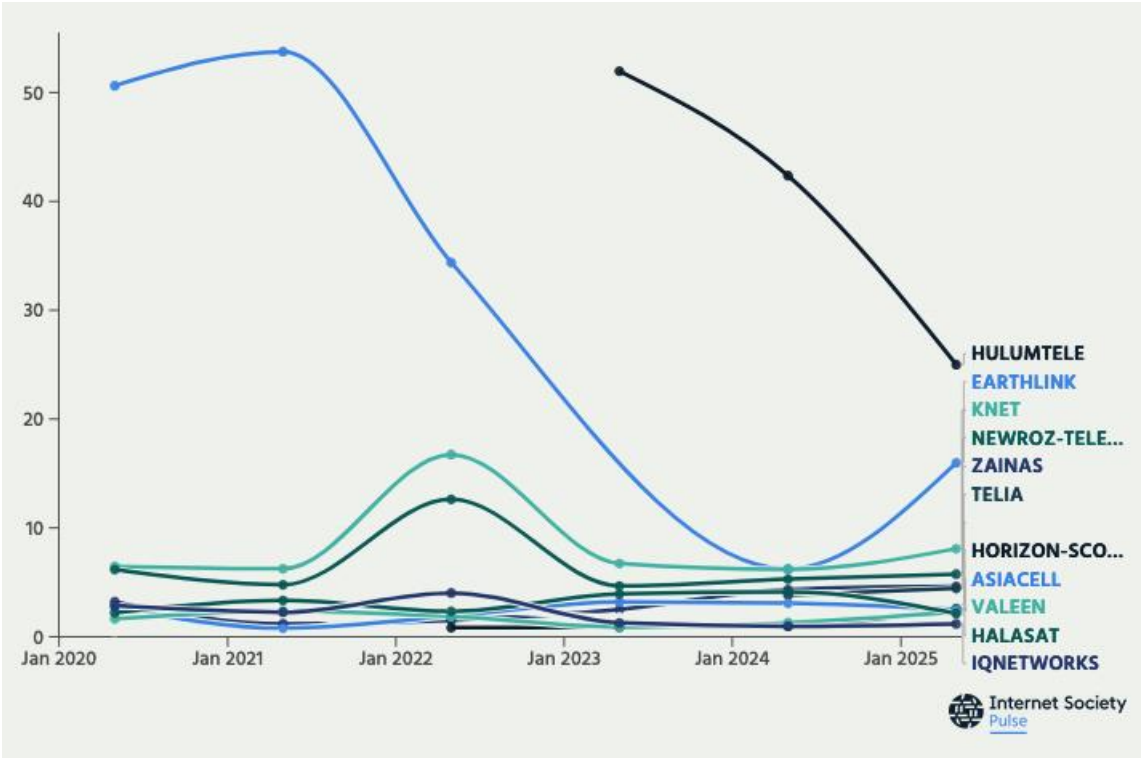
Germany | Latvia | Malaysia | Netherlands | Peru

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

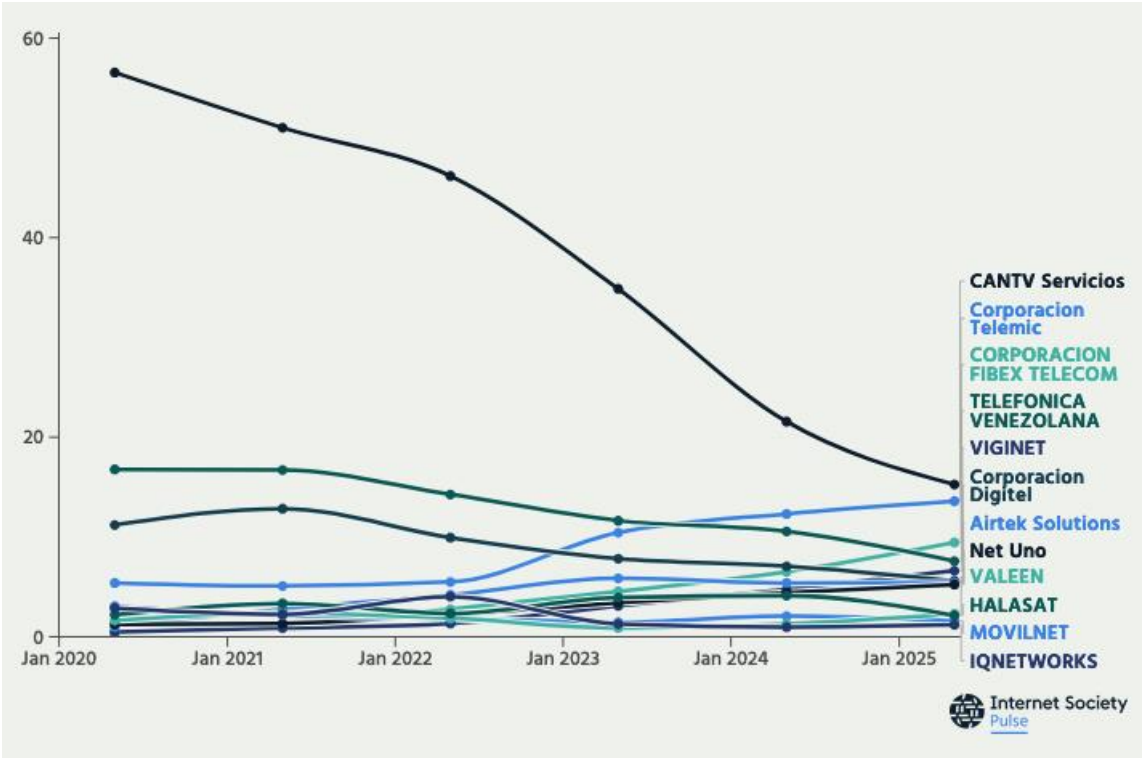
https://public.flourish.studio/visualisation/23411407/

Change Can Happen Fast

Change in Market Share between May 2020 to May 2025



Iraq



Venezuela

https://stats.labs.apnic.net/aspop

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

OFDS

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

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Review the Pulse IRI methodology