Overcoming connectivity barriers at the middle mile

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Session 2: Infrastructure for Digital Trade session

Daniel Vertesy, PhD
Economist
International Telecommunication Union (ITU)
ICT Data and Analytics Division

Questions addressed

- How do CAREC countries compare with the rest of the world in terms of Internet access and use?
- Is there evidence for infrastructure gaps at the first mile (international-), last mile of connectivity in the region?
- The middle-mile: the critical role of the Internet exchange points (IXPs), Cloud computing (CC), Data centers (DCs) in the connectivity infrastructure
- Data available on IXPs, CC and DCs in the region?

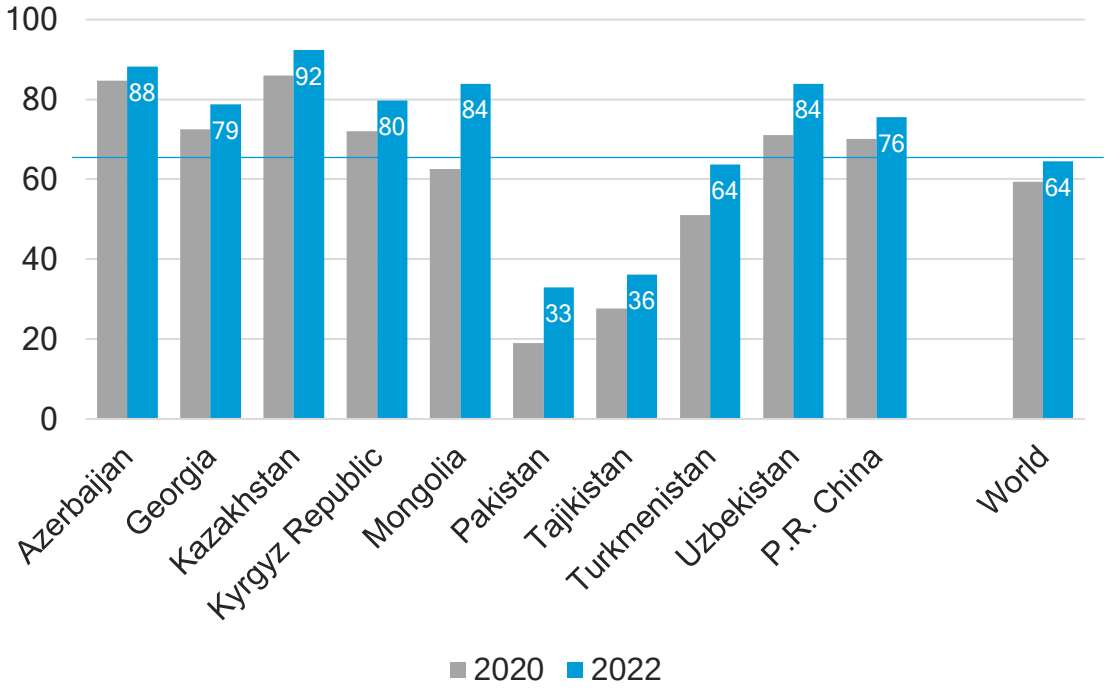
ITU | DataHub

Supply-side data

Demand-side data

Demand for digital connectivity: evidently strong in the region

% of population using the Internet



Source: ITU World Telecommunication/ICT Indicators Database

- Share of population who used the Internet exceeded the world average in most of the countries in CAREC
- But differences across the region are significant: ranging from Kazakhstan (92%) and Azerbaijan (88%) to Tajikistan (36%) and Pakistan (33%)
- Gaps within countries persist – e.g. by age group or urban vs rural:
  - Azerbaijan: 94% vs 77% (2021) or Georgia: 85% vs 69% (2022); (but: rural share high in Kazakhstan: 90%)

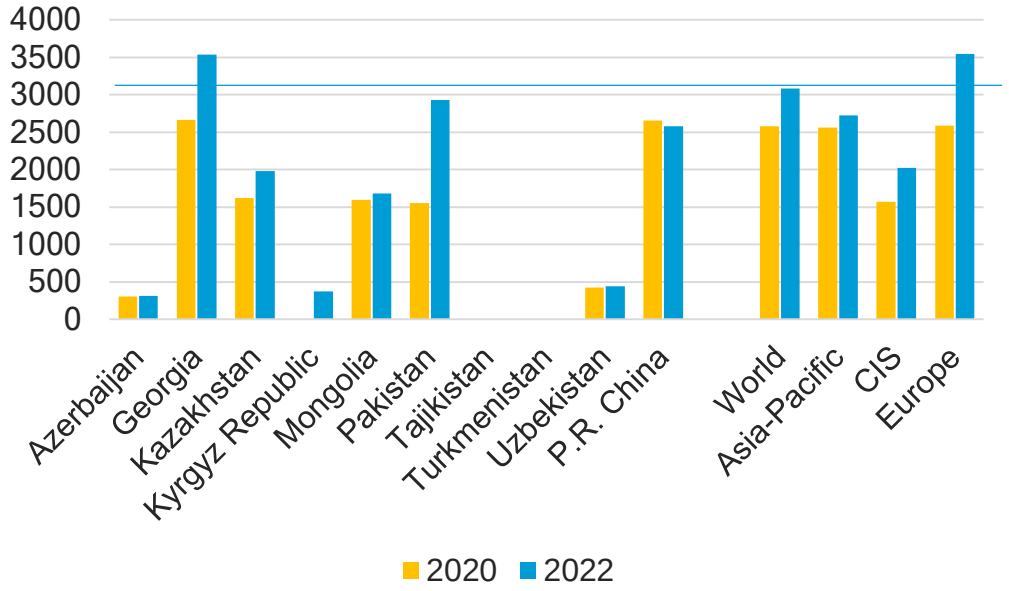
Intensity of Internet use: data usage gaps

- …however, Internet use in most of the CAREC countries is less intensive in comparison with the rest of the world, both in terms of mobile- and fixed-broadband data traffic
- Notable exceptions are Georgia (fixed), and Kazakhstan and P. R. China (mobile data traffic)

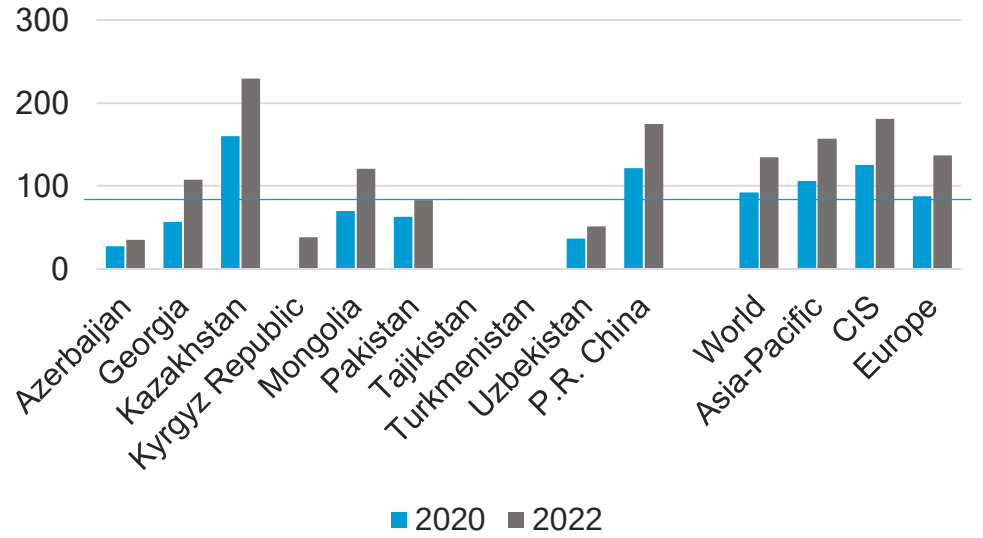
This indicates that achieving universal and meaningful connectivity remains a challenge for the region

- Is this due to bottlenecks in last-mile connectivity?

Fixed-broadband traffic per subscription (GB)



Mobile broadband traffic per subscription (GB)

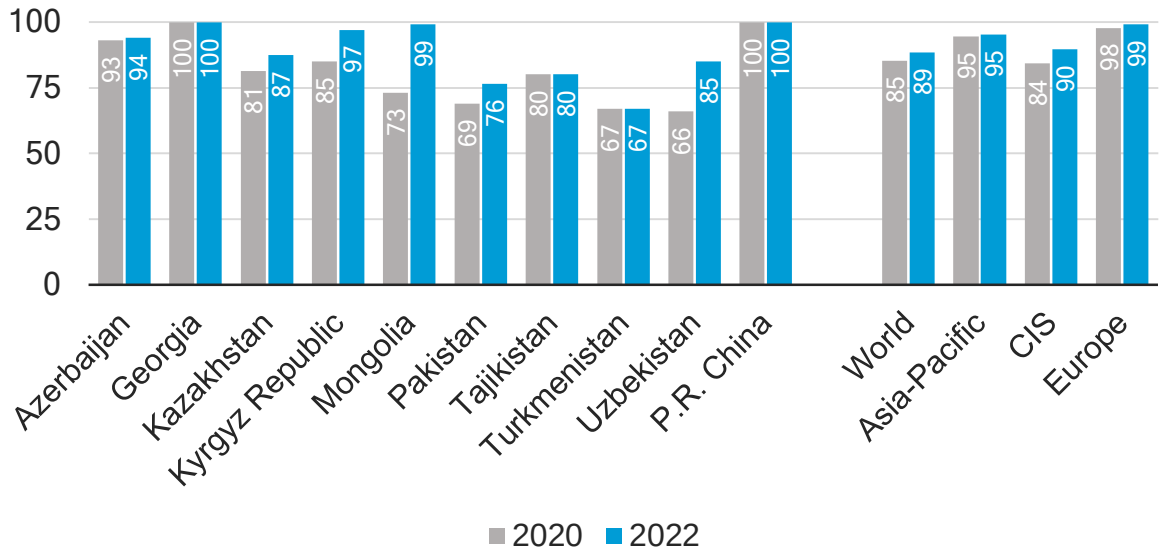


Source: ITU World Telecommunication/ICT Indicators Database

Infrastructure gaps: last-mile connectivity

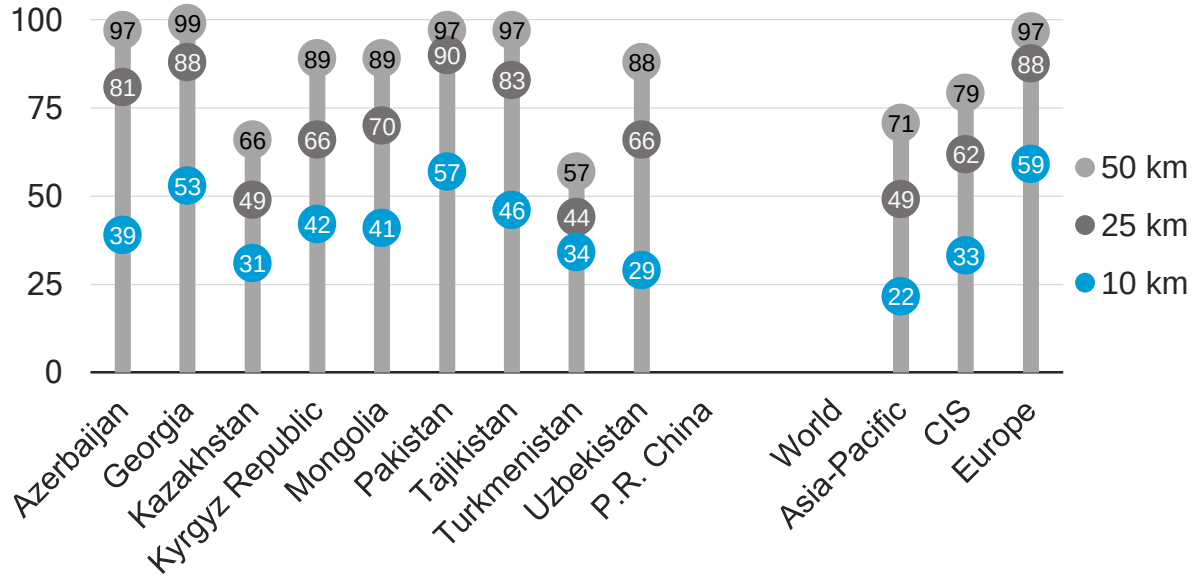
- Last-mile connectivity gaps exist in the region: both in terms of mobile (Pakistan, Turkmenistan) and fixed broadband access.
- Major improvements have been made already since the COVID-19 pandemic in providing mobile broadband connectivity – e.g. in Kyrgyzstan, Mongolia, Uzbekistan, Pakistan
- Geography – vast distances, mountainous terrain – continues to present a barrier;

Population covered by at least a 4G/LTE mobile network (%)



Source: ITU World Telecommunication/ICT Indicators Database

Population living within range of transmission networks (%)

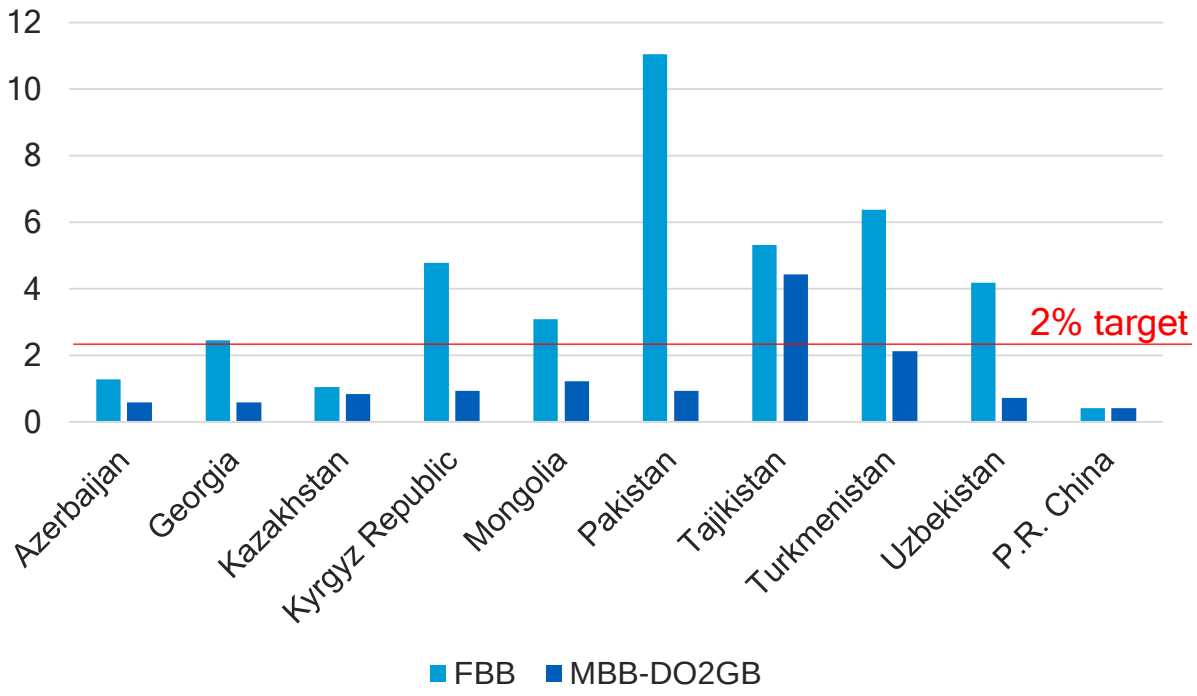


Source: ITU Broadband Maps. Note: Last year available.

Affordability: a barrier to connectivity

- UN Broadband Commission's Affordability target: broadband services should cost not more than 2% of monthly GNI per capita
- **Mobile broadband** services are mostly very affordable and not create a barrier to connectivity – Tajikistan is an exception
- Affording entry-level **fixed-broadband** services requires making sacrifices in many countries of the region!
  - Prevents meaningful connectivity
  - May indicate infrastructure gaps

Fixed- and mobile-broadband basket price as a % of GNI per capita, 2023



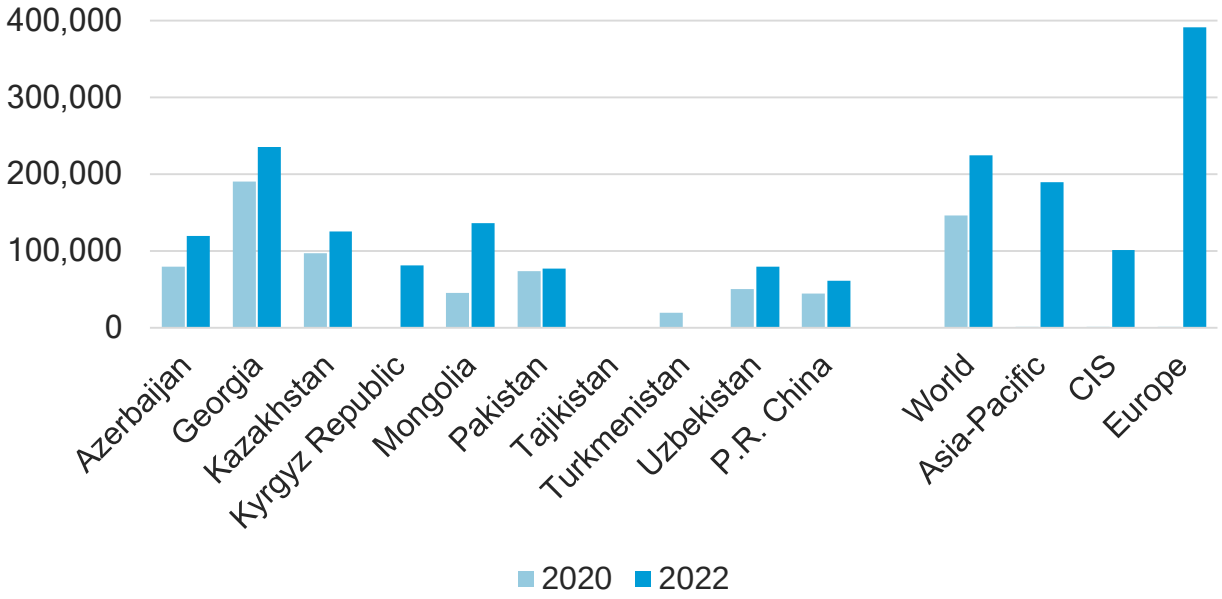
Source: ITU World Telecommunication/ICT Indicators Database

Infrastructure gaps: International connectivity

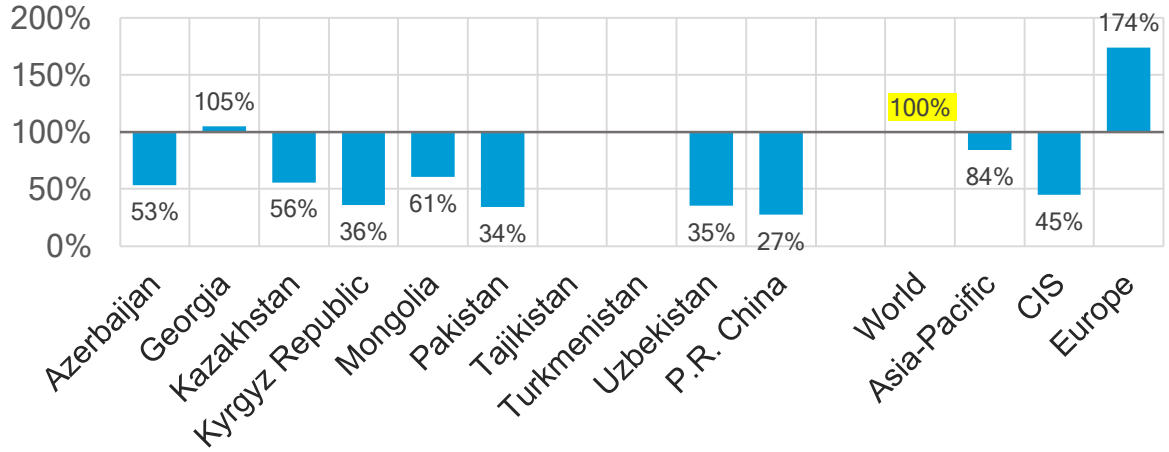
- Overland and submarine cables and satellite connections provide the backbone of linkages with the global data flows
- Apart from Georgia, countries with available data fall significantly below global averages
- Strengthening the backbone for international connectivity appears to be a priority

International bandwidth usage

per Internet user (kbits)



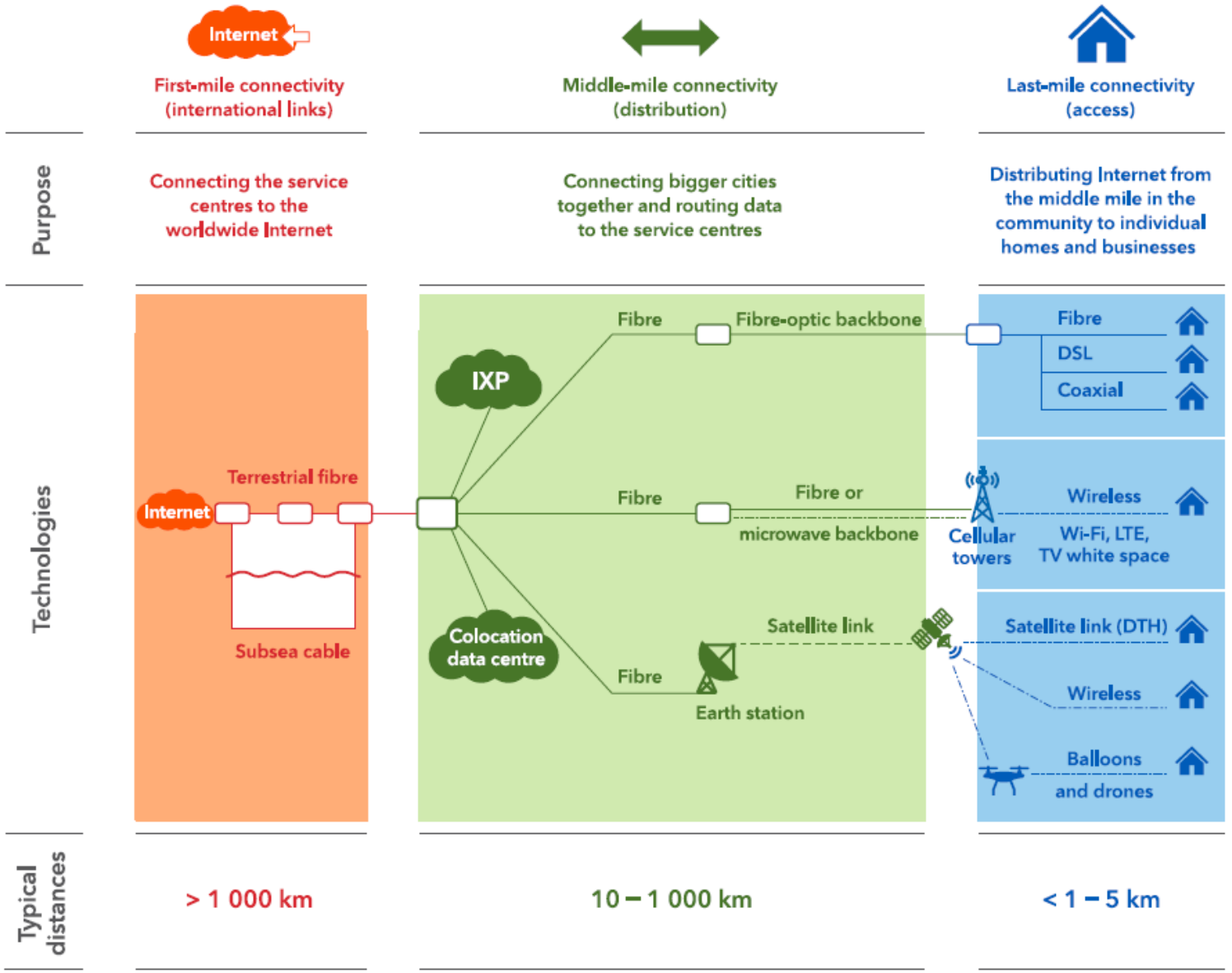
As a % of the world average



Source: ITU World Telecommunication/ICT Indicators Database

The critical role of the middle-mile connectivity infrastructure

- All “miles” of connectivity are important;
- internationally harmonized statistics most developed for the last mile and for international connectivity
- often less attention dedicated to the “middle mile”
- During the COVID-19 pandemic, IXPs have been indispensable to handle increased traffic (exchange traffic locally rather than using costly int’l bandwidth)



Note: IXP = Internet exchange point; DSL = digital subscriber line; DTH = direct-to-home; LTE = Long-term Evolution.
Source: Adapted from World Bank (2021).

Source: ITU Global Connectivity Report 2022

IXPs

What are IXPs?

- IXPs are a core component of the data infrastructure, enabling Internet service providers (ISPs) and content providers (CDNs) to exchange their data traffic (“peering”).
- physical locations containing network switches that route traffic between the different members networks.
- allow network providers to share transit outside their network;

What is their advantage?

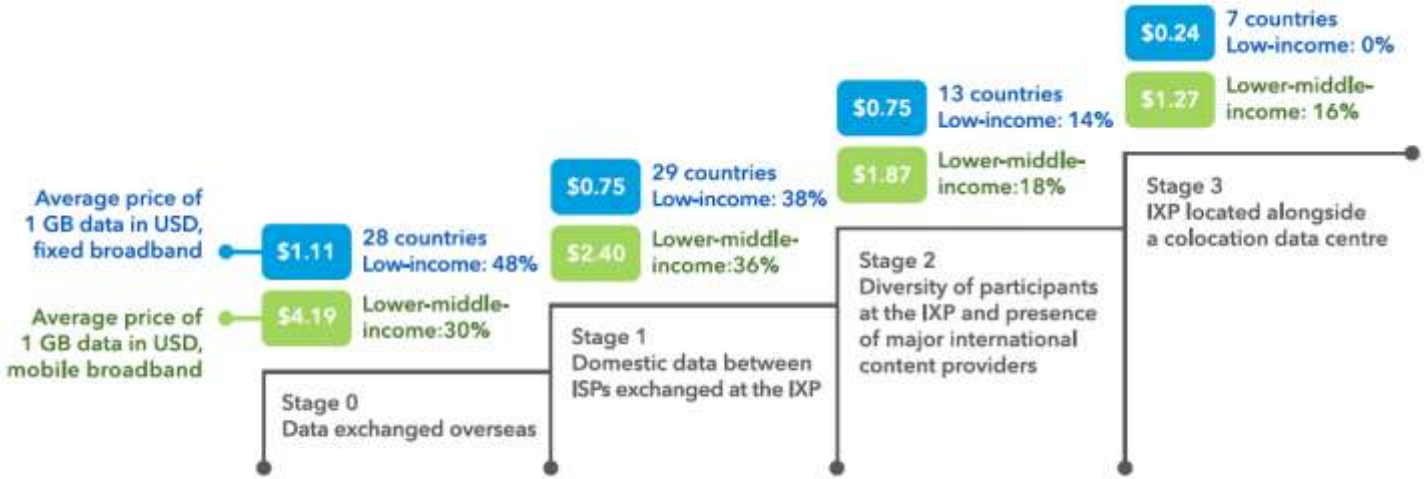
- IXPs contribute to cheaper and faster access to data: shortened transit path; alleviates international bandwidth by avoiding the “trombone effect” (improved roundtrip time)
- More efficient way for ISPs to peer with others;
- Enhanced redundancy
- Improved quality and lower latency

Main challenges

- Infrastructure requirement (reliable power, cooling, network equipment)
- Technical expertise required to deploy and operate IXPs
- Require sufficient local content, hosted locally to make it effective
- Asymmetries between ISPs (monopolies) or ISPs and content providers reduce incentives to cooperate, or make peering agreements
- Regulatory restrictions may limit certain participants

IXP growth stages

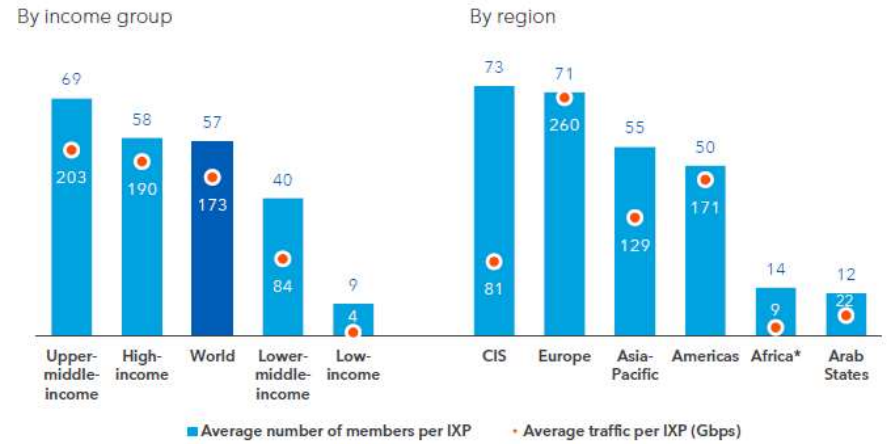
Figure 4.5: IXPs and stages of growth



Notes: Data provide close to global coverage for the year 2020, and are compiled from a variety of industry sources, including Packet Clearing House, CAIDA, PeeringDB, EURO-IX and AF-IX. Amounts are in United States dollars. Average price figures updated using the ITU 2021 price statistics and refer to the entry level data-only mobile broadband (2 GB) and the fixed-broadband (5 GB) baskets. GB = Gigabyte; ISP = Internet service provider; IXP = Internet exchange point.
Sources: ITU; Srinivasan *et al.* (2021).

Figure 4.4: IXP membership and traffic

Average members and traffic per IXP, December 2021



Notes: * Excluding South Africa. Chart shows the average of peak traffic based on available data. CIS = Commonwealth of Independent States.
Source: Packet Clearing House (www.pch.net/ixp/dir).

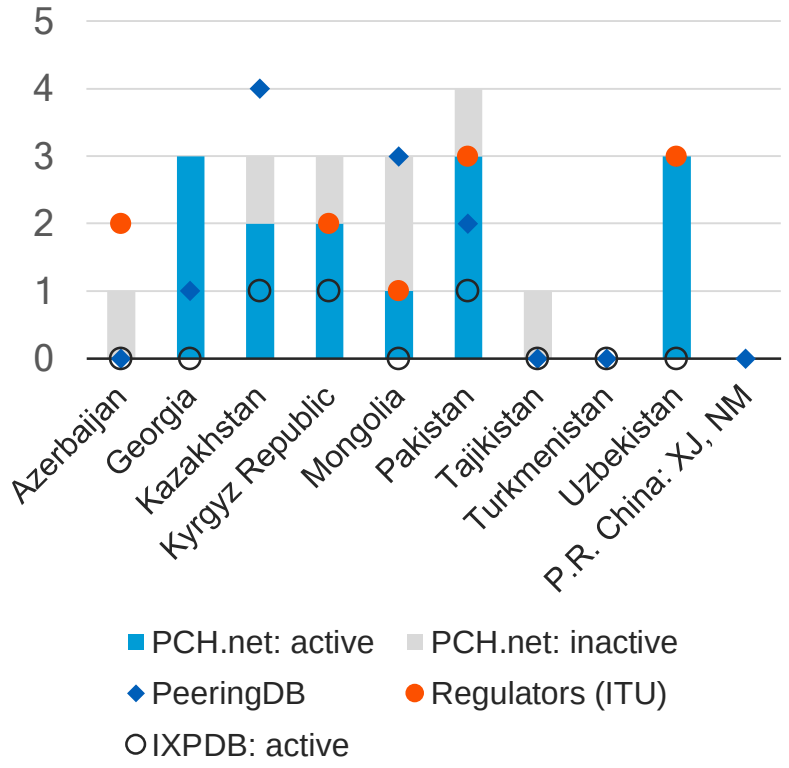
Source: ITU Global Connectivity Report 2022

- Maturity is required for IXPs to be effective and provide its benefits;
- Often IXPs in developing countries are stuck at a lower development stage – few participants, little traffic

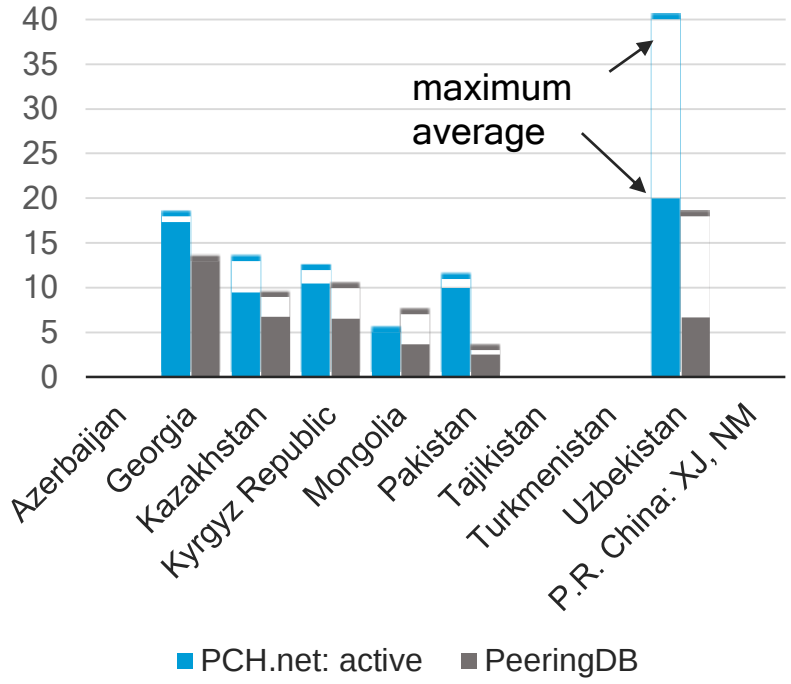
Lack of consistent, up to date statistics on IXPs

- There is a lack of up-to-date statistics even on basic information about IXPs in the CAREC region
- The main sources are inconsistent (PCH.net, PeeringDB, IXPBD, information from regulatory surveys)
- Based on the available information on the number of participants, IXPs in the region remain at an early stage of development

Number of IXPs in the CAREC region



Number of participants in IXPs



Source: ITU Global Connectivity Report 2022

Data Centers

What are DCs?

- Facilities providing space, power, cooling for servers processing, storing and sharing data;
- Data storage, local hosting of domestic content
- DCs may refer to…
  - Enterprise DC [single-tenant facilities];
  - Carrier DCs [telecom operators hosting clients' data]
  - Multi-tenant DCs [space rented for data storage];
  - Hyperscale DCs [cloud service providers]

What is their advantage?

- Use economies of scale: efficiency gains through optimized cooling processes; provision of security [incl. physical]; common maintenance;
- Designed for reliability (redundant power supplies and generators);
- Possibility for scaling up storage
- As opposed to using on-site data storage, companies can save storage space, cut IT costs – facilitator of e-commerce

Main challenges

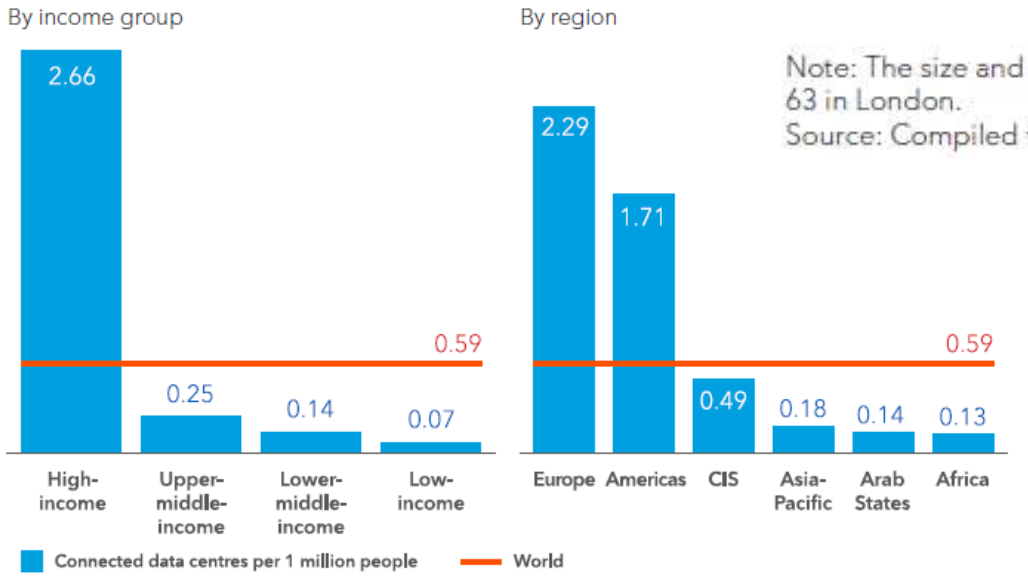
- Environmental footprint is significant (energy usage matching that of a small town);
- Vulnerability to natural disasters, energy security (power outages), unpredictable political environments, ease of doing business, depend on int'l bandwidth
- Costly to build and maintain

Data Centers

- Highly concentrated in high-income economies;
- Stark global imbalances

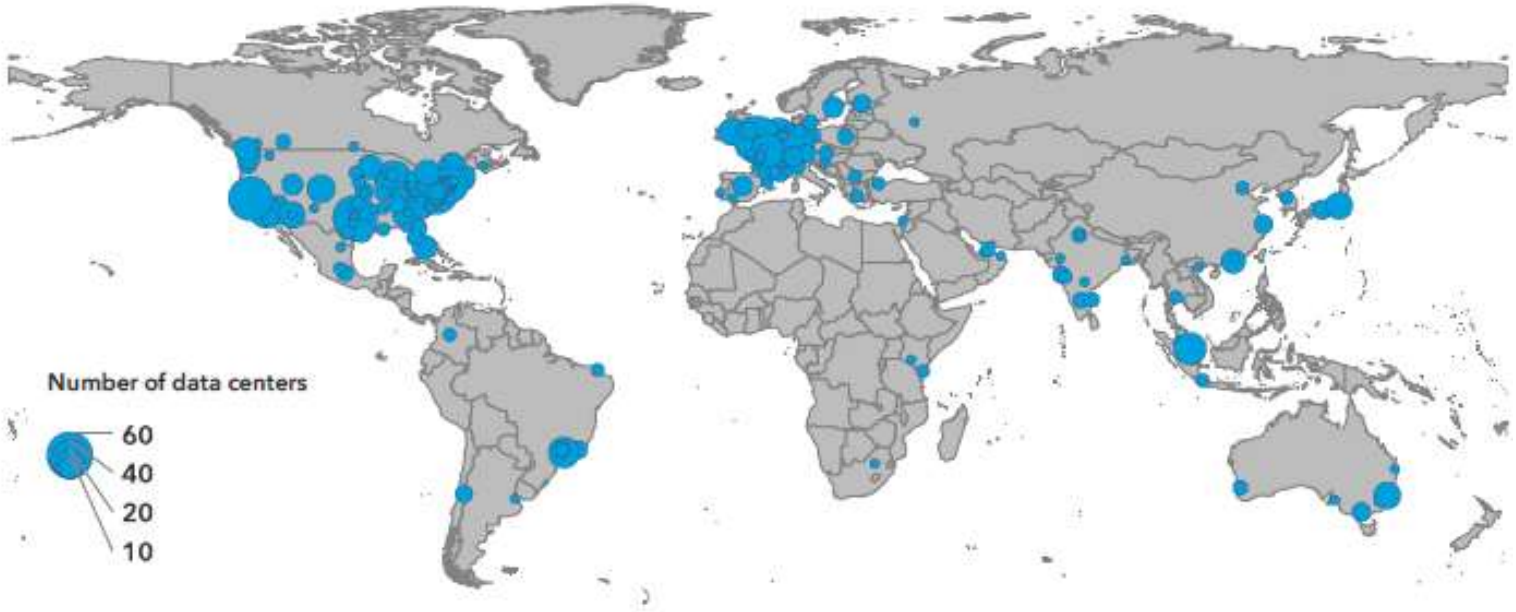
Figure 4.6: Data centres penetration

Connected data centres per 1 million people, 2021



Notes: *Connected data centre* refers to any kind of data centre connected to the Internet. CIS = Commonwealth of Independent States.
Source: PeeringDB.

Figure 4.7: Data centre locations of top 20 MTDC operators



Note: The size and colour of the dots refer to how many data centres there are in that location. For example, there are 63 in London.
Source: Compiled from locations reported by top 20 MTDC operators.

Source: ITU Global Connectivity Report 2022

ITU Data Collection: Methodological References

SUPPLY SIDE

DEMAND SIDE

Administrative data on telecom/ICT

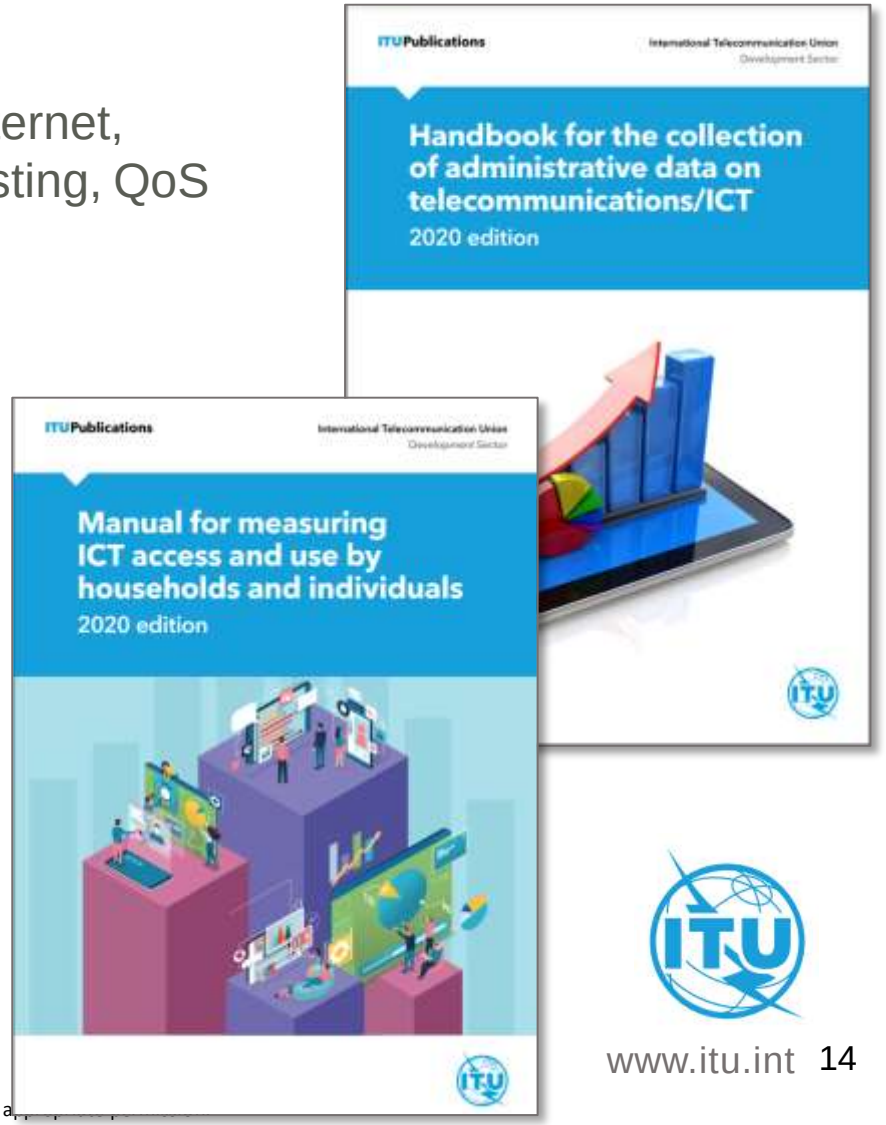
Covers harmonized indicators for fixed and mobile networks, Internet, bundles, traffic, employment, revenue and investment, broadcasting, QoS

ICT Service prices

Methodology for collecting data on ICT price baskets, units that make retail prices for mobile-cellular and fixed-broadband services globally comparable.

Data on household access to, and individual use of, ICTs

A comprehensive manual on methodologies for conducting ICT surveys for households and individuals (from planning and coordination to standards, collection techniques, sampling, quality assurance, etc.), including core list of indicators and model questionnaires

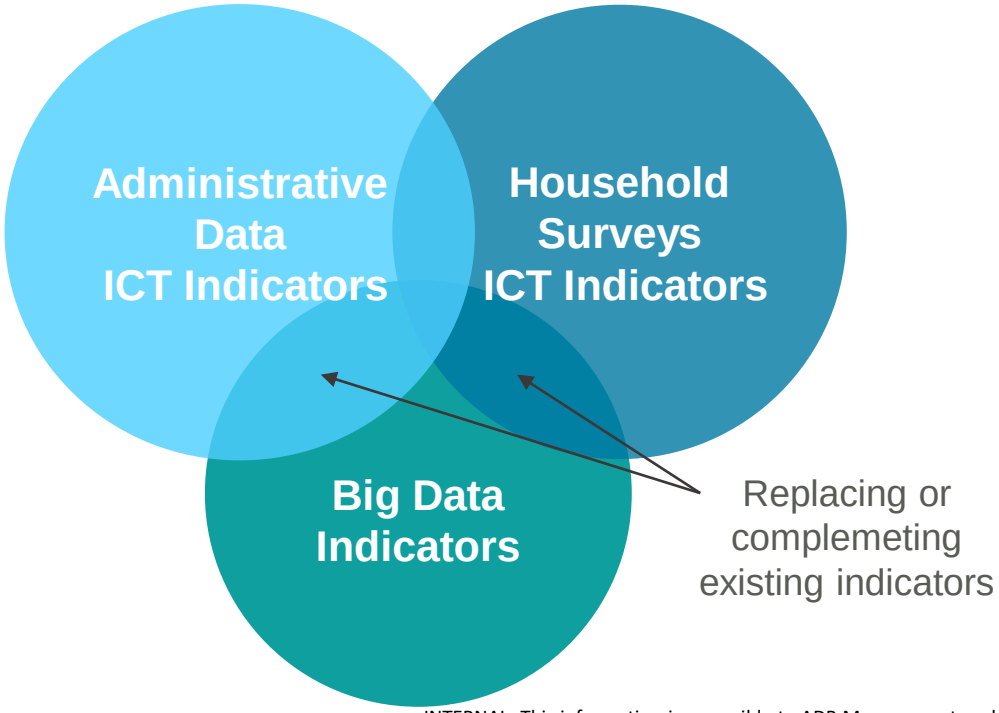


- Jointly developed; provide basis for data collection and validation
- Freely available in 6 languages

https://www.itu.int/en/ITU-D/Statistics/Pages/publications/handbook.aspx

Big Data for Measuring the Information Society

- “Big data” is revolutionizing the world of statistics.
- Opportunities: more granular, timely, accurate, insightful, valuable, less costly to collect (vs surveys).
- ITU is a pioneer in the field; Since 2016, projects run in a dozen of countries; these helped refined methods and models and created guidelines for countries exploring the use of mobile phone big data.



Statistics on IXPs and Data Centers

- Differently from statistics on the first- and last-mile connectivity, there is no internationally harmonized methodology for data collection
  - Available sources: IXP associations (IXPDB); Packet clearinghouse PCH.net; Peering DB; ITU regulatory surveys;
    Update frequency differs!
  - Relevant metrics for comparison: size (nr. networks; traffic /peak or average/, speed?)
- Why is it important?
  - Understand the state of play – e.g., what is the situation in CAREC countries…?
  - Understand maturity
- Who should collect it? Regulators?
- This is currently on the agenda of the ITU Expert Group on Telecommunication/ICT Indicators (EGTI)

Conclusion

- Importance of measurement and internationally comparable statistical data;
- All miles of connectivity are crucial for universal and meaningful connectivity and for digital transformation – infrastructure gaps evident at first- and last-mile in some of the CAREC countries;
- Available evidence suggests that in low- and middle-income economies, the data infrastructure often perform at higher costs and with poorer quality
- Key building blocks to develop the data infrastructure at the middle mile and support the digital economy include:
  - liberalization of the telecom market;
  - data protection laws;
  - energy (price and sustainability);
  - collaboration between government, IXPs, ISPs, data center operators, investors (incl. development partners and cloud services providers, content developers)
  - metrics

Рақмет сізге!
Thank you!

For questions and feedback: daniel.vertesy@itu.int

The slides benefitted from contributions from ITU colleagues and experts, which is gratefully acknowledged.

For more information: http://www.itu.int/ict