EU EWG

BEREC OECD Webinar
BEREC End Users QoS Guidelines

Body of European Regulators
for Electronic Communications

BEREC

Paolo Lupi

Therese Hourigan

23 June 2020

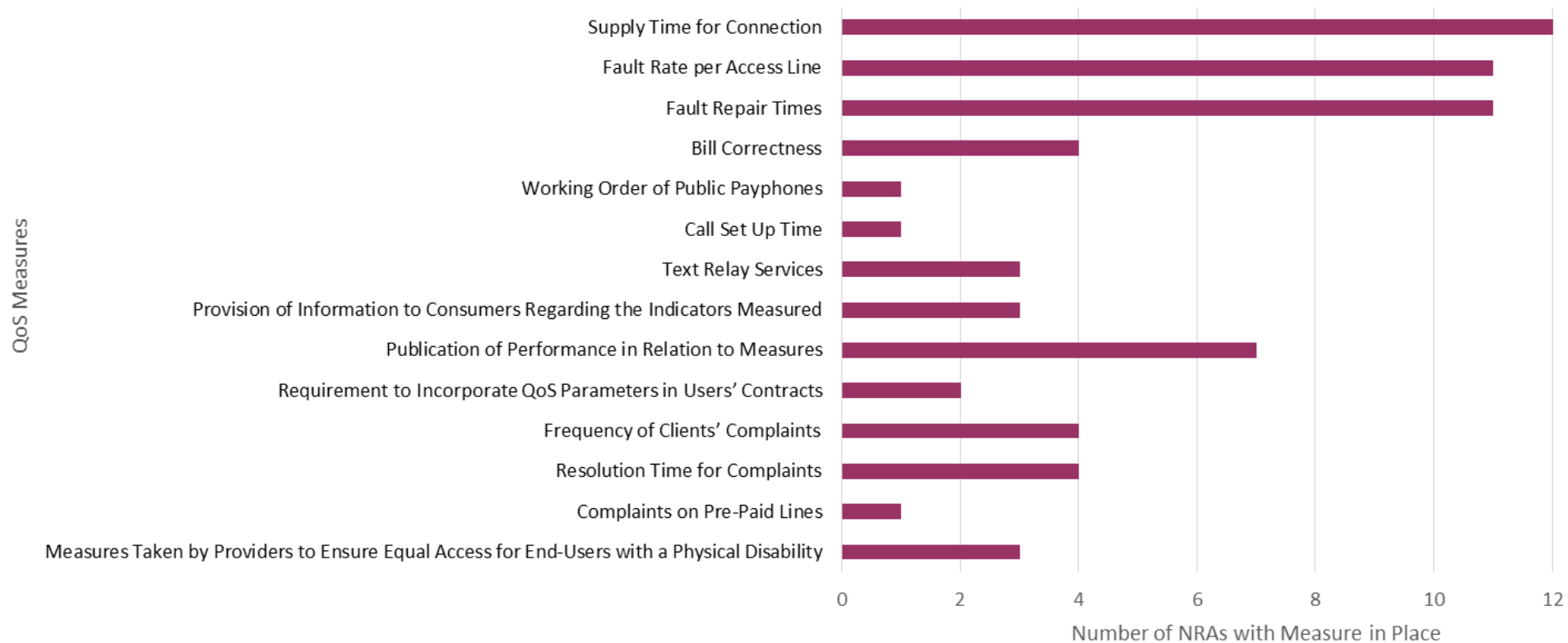Body of European Regulators
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➢ In the ever-connected, globalized and digital environment, ECSs play a **key role** in citizens' everyday activities.

➢ The **QoS** is a crucial factor for both customers and SPs and it is becoming increasingly more complex to manage, measure and regulate it.

- QoS can be **impacted by many factors** at the network level and along the value chain, including devices, hardware, infrastructures, services and applications.

➢ **Regulation** is intended to:

- help improve the end-user experience;
- lead to greater competition and investment;
- benefit all the different players in the digital ecosystem.

➢ EC and BEREC has undertaken a complex work aimed at achieving one of the very clear objectives of the EECC: **empowering and protecting end-users**.

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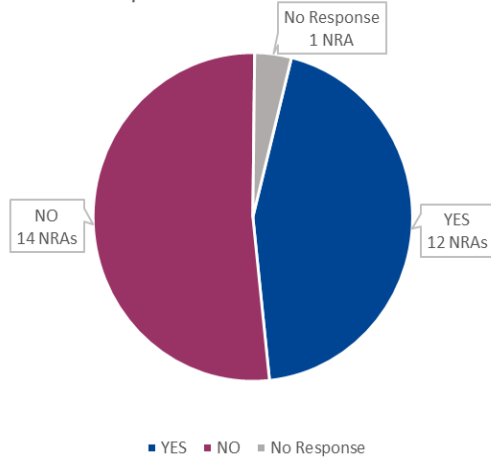**BEREC**

BEREC Guidelines on QoS (March 2020)

➢ **Legal Basis**: in accordance with Art. 104 EECC, by 21 June 2020, in order to contribute to a consistent application of the Art. and of Annex X, BEREC shall, after consulting stakeholders and in close cooperation with the EC, adopt guidelines with the aim of defining:

- QoS parameters and measurement methods for ICS and IAS;

- QoS parameters and measurement methods for end-users with disabilities;

- the content and format of publication of information;
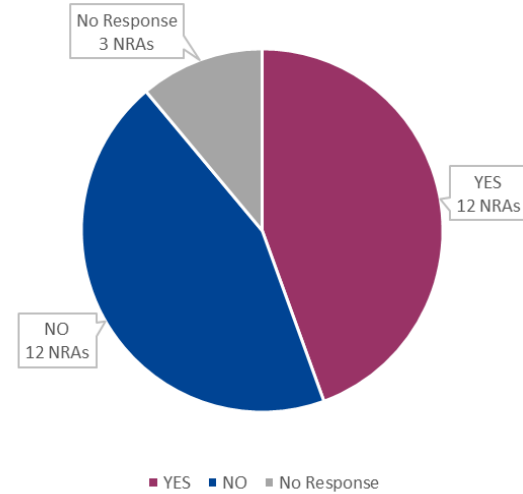
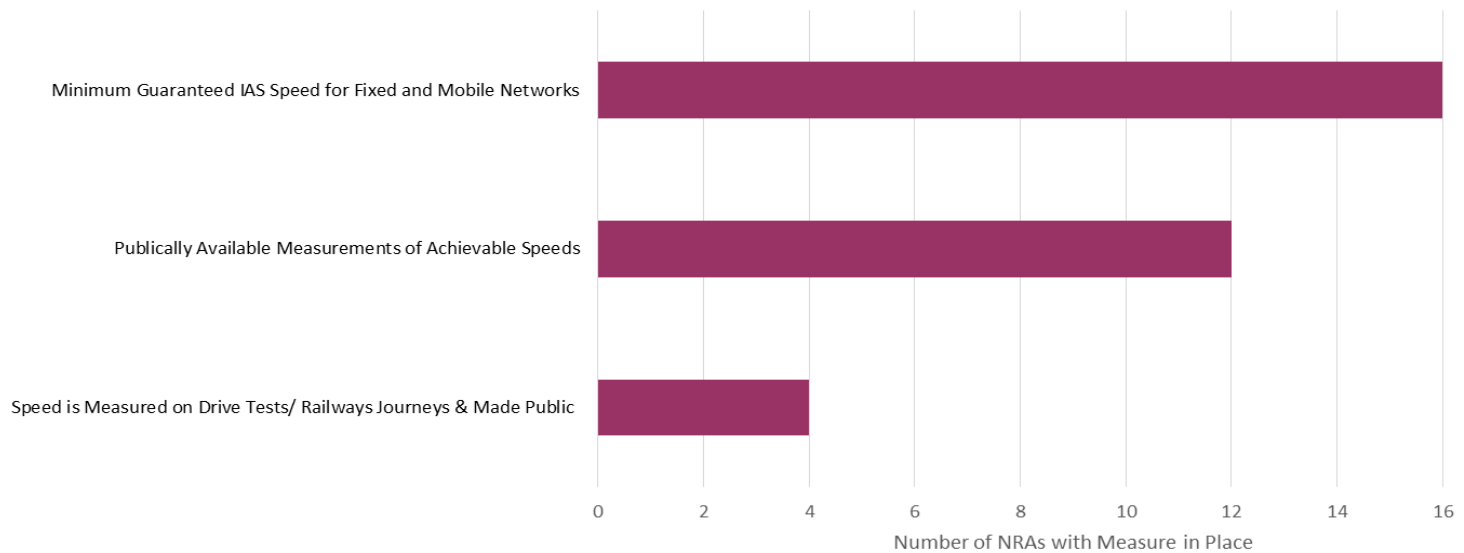- the quality certification mechanism.

QoS Measures ICS Benchmarking 2019

Measures in Place: Fixed ICS Networks

QoS Measures (y-axis):
- Supply Time for Connection — 12
- Fault Rate per Access Line — 11
- Fault Repair Times — 11
- Bill Correctness — 4
- Working Order of Public Payphones — 1
- Call Set Up Time — 1
- Text Relay Services — 3
- Provision of Information to Consumers Regarding the Indicators Measured — 3
- Publication of Performance in Relation to Measures — 7
- Requirement to Incorporate QoS Parameters in Users' Contracts — 2
- Frequency of Clients' Complaints — 4
- Resolution Time for Complaints — 4
- Complaints on Pre-Paid Lines — 1
- Measures Taken by Providers to Ensure Equal Access for End-Users with a Physical Disability — 3

Number of NRAs with Measure in Place

QoS Measures Mobile & IAS Benchmarking 2019

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NRA Stated Specific QoS Measures in Place for Mobile

No Response
1 NRA

NO
14 NRAs

YES
12 NRAs

■ YES ■ NO ■ No Response

Specific Measures in Place for End-Users with Disabilities

No Response
3 NRAs

YES
12 NRAs

NO
12 NRAs

■ YES ■ NO ■ No Response

Measures in Place: IAS

Minimum Guaranteed IAS Speed for Fixed and Mobile Networks

Publically Available Measurements of Achievable Speeds

Speed is Measured on Drive Tests/ Railways Journeys & Made Public

0   2   4   6   8   10   12   14   16

Number of NRAs with Measure in Place

QoS Parameters

The Guidelines provide definitions and measurement methods (ETSI, ITU, IETF, 3GPP) for ICS and IAS QoS parameters.

Table 1 – QoS Parameters for ICS as set out in Annex X			
Supply time for initial connection	Call signalling delays	Voice connection quality	Unsuccessful call ratio
Fault rate per access line	Call setup time	Dropped call ratio	Call set up failure probability
Bill correctness complaints		Fault repair time	

Table 1a – QoS Parameters for IAS as set out in Annex X
Latency (delay)
Delay variation (jitter)
Packet loss ratio

Table 2 – QoS Parameters not set out in Annex X
Response time for operator services (Customer Care Services – Help Desk)
Customer complaints resolution time

Table 3 – QoS Parameters for end-users with disabilities
Voice communication
Real-Time Text
Video communication

Publication of Information and Quality Certification Mechanisms

Publication of Information

➢ NRAs may require SPs to publish comprehensive, comparable, reliable, user-friendly and up-to-date information on QoS where it is demonstrated that such information is not effectively available.

➢ Information should be accessible for the broadest possible group of users (disabled, elderly, with special social needs, *etc.*).

➢ NRAs could oblige SPs to directly publish information via their own communication channels or through third parties, and to provide information to NRAs to publish simultaneously on NRAs websites.

Quality Certification Mechanisms

➢ The NRA should determine what factors are to be taken into account when choosing a quality certification mechanism.

➢ The certification shall ensure that the quality monitoring fulfils requirements (accurate, enables comparison, open, safe, future proof, accessible).
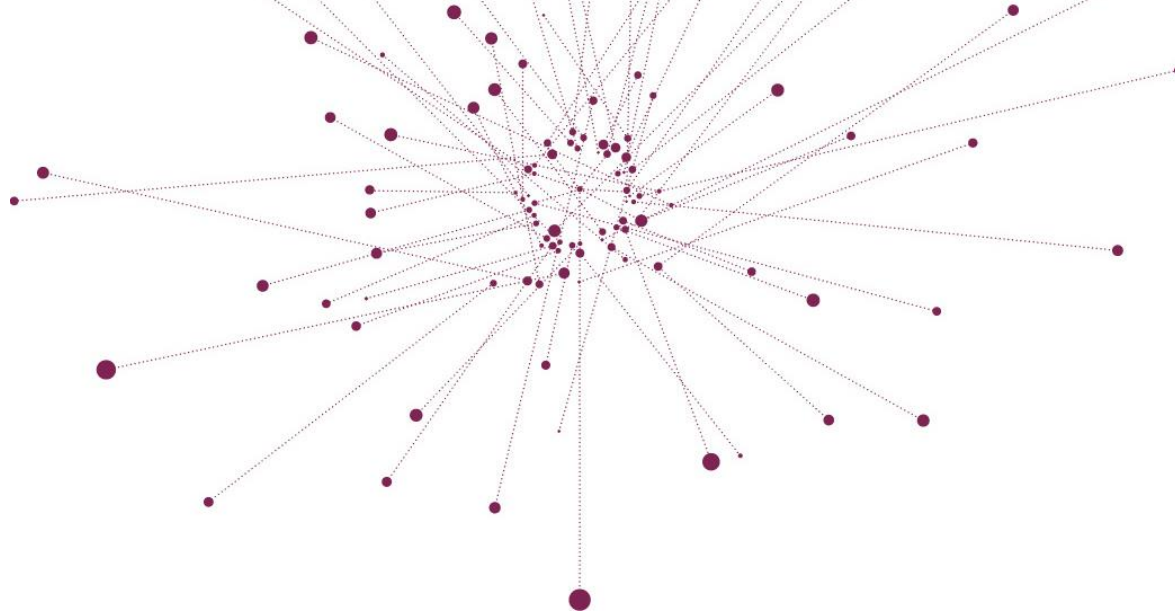
Thank you!

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OECD & BEREC QoS and QoE Webinar (Part I) Open Internet WG

Klaus Nieminen

Body of European Regulators
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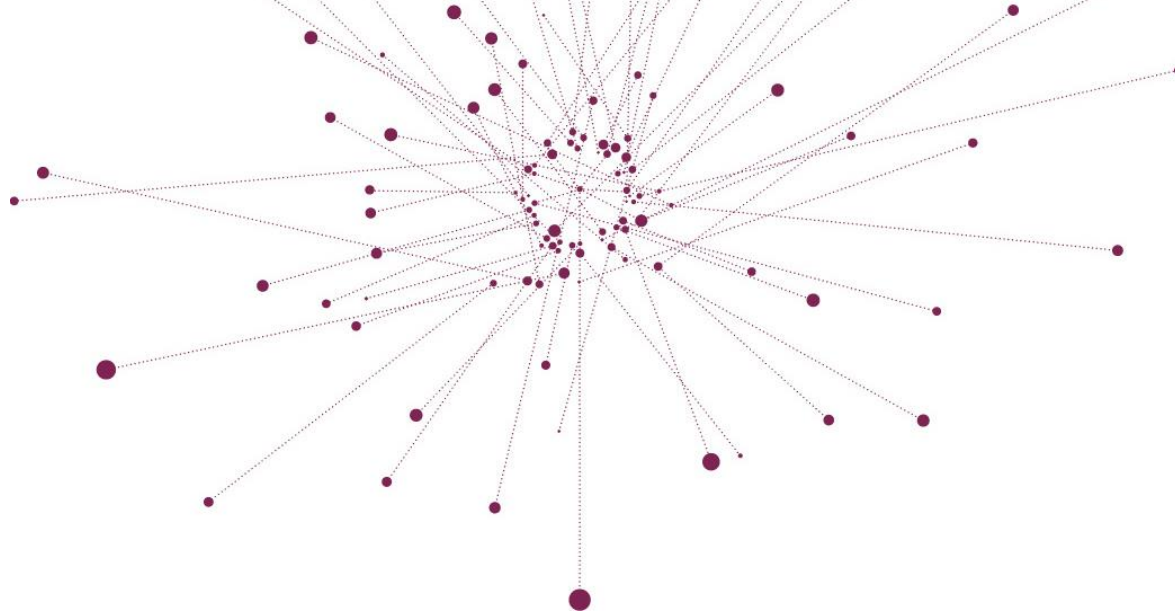for Electronic Communications
BEREC

- BEREC has been studying these topic for past 10 years
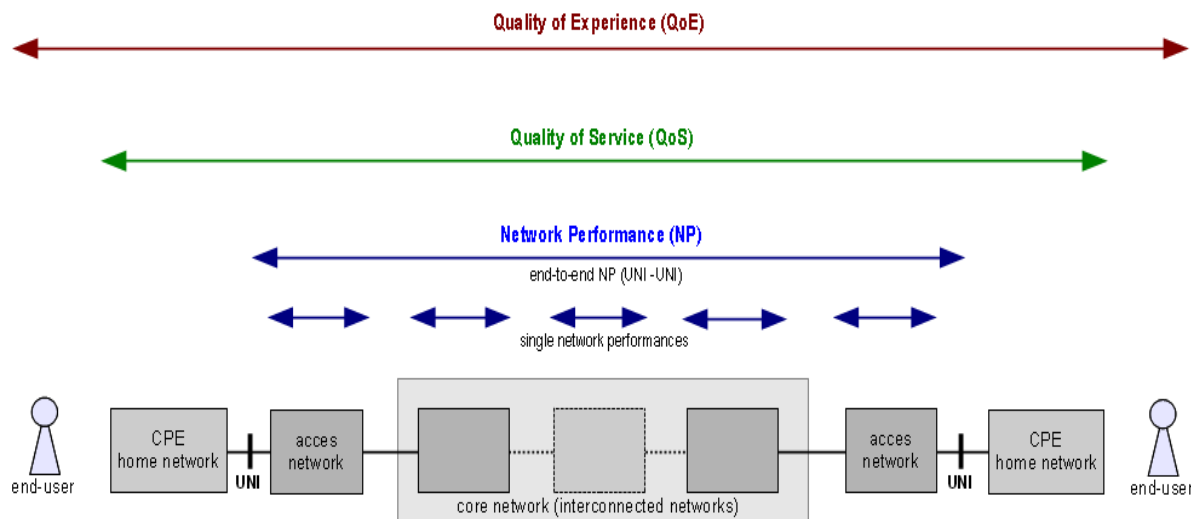
- Focus on evaluating QoS of internet access services (ISP's network performance) as the regulatory tasks from Open Internet Regulation are related to it:
  - monitoring of general internet access service quality
  - supervision of equal treatment of traffic and specialised services
  - supervision of contract conditions
  - certified monitoring mechanism

- An abstract illustration of QoS options under the Open Internet Regulation
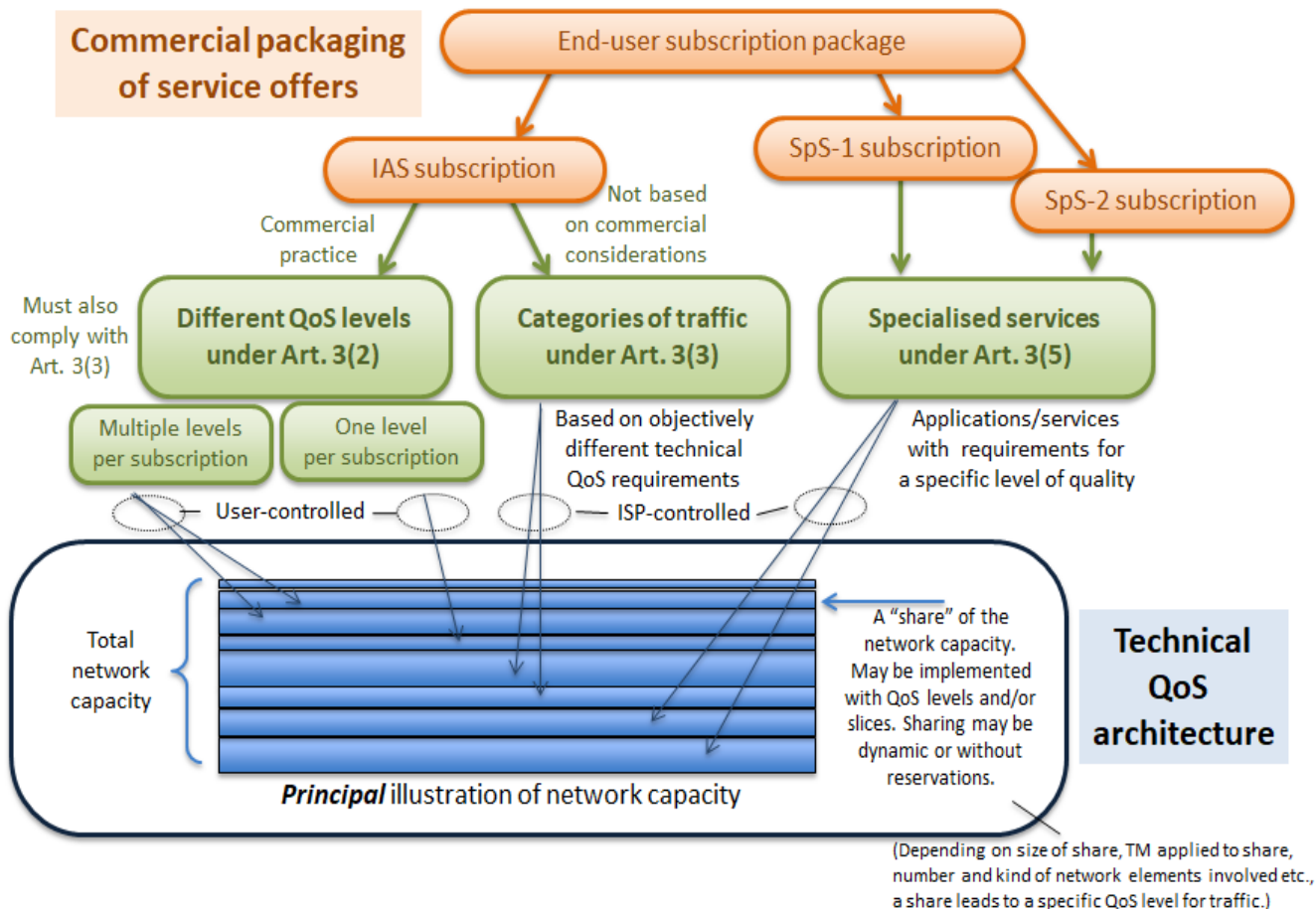
- BEREC Net Neutrality Regulatory Assessment Methodology:
  - a harmonised QoS measurement methodology
  - detecting traffic management practices that impact individual applications
  - factors to be taken into account when assessing the measurement results
  - validation of the collected measurement results
  - measurement system certification

- Work continues for example on
  - sharing information and best practices
  - support NRAs in their national deployments
  - benchmarking the measurement systems (lab testing)

- Discussion regarding a common measurement tool are still ongoing

- Based on the benchmarking, a there may be a need to revise the measurement methodology, but this is still to be seen.

Thank you!

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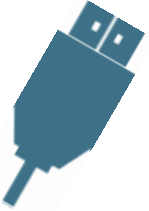for Electronic Communications
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Connectivity providing the key link between the IoT and AI: the pillar of all sectors of the economy

Networks

AI systems
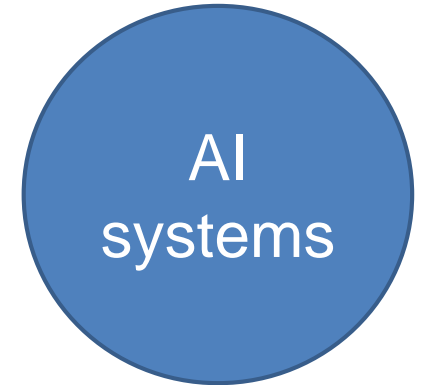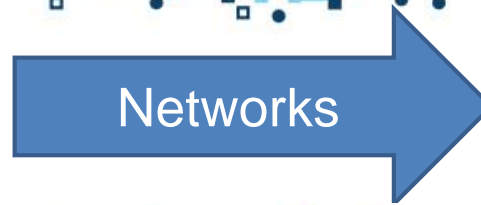
What is broadband QoS and how can it be approached?

Download speeds:
- It depends on how it is measured, sample selection, and differences in access (fixed and mobile broadband)

Other quality measures:
- Jitter, latency, web-page loading time, etc.

With the next evolution of networks:
- 5G and high-capacity fixed networks => QoS will depend on network densification
  - Measures of fibre backhaul will become increasingly important
- Resilience and robustness of networks

The importance of official broadband QoS measurement

✓ Information source for policy making and regulation

    ❑ Data in hands of the market (consumers) can trigger changes in investment and foster competition

✓ Consumer empowerment

    ❑ Reduce information asymmetry

✓ Overcoming sample selection effects of tests

✓ Achieving a harmonised measurement approach

Draft of the Revision of the 2004 Recommendation of the Council on Broadband Development

BACKGROUND

Broadband QoS measurement at the OECD: Historical background

- **OECD Council Recommendation on Principles for Internet Policy Making (2011):**
  - ➢ Measurement as a general policy direction

- **London workshop on Broadband metrics, June 2012:**
  - ➢ Two outcomes (2012) for the vision of how to approach broadband performance measurement

- **In addition, tangible outputs of the London WS 2012:**
  - ✓ Agreement and adoption of a harmonised set of speed tiers among OECD member countries:
    - ▪ <1.5 Mbps; 1.5 Mbps; 10 Mbps; 25/30 Mbps; 100 Mbps; > 1 Gbps
  - ✓ Broadband availability : DSL and Fibre
  - ✓ Broadband maps

Broadband QoS measurement work at the OECD

- **OECD Report on Access Network Speed Tests (2014):**
  - Research for a longer-term approach
  - Use of external sources (Ookla, M-lab and Steam)

- **OECD Communications Outlook (2013) and the Digital Economy Outlook (DEO) 2015**

  - Explores the different methodologies of private sources to measure broadband download speeds

- **Reports highlighting the importance of measurement:**
  - The Operators and their Future (2019)
  - The Road to 5G Networks (2019)
  - IoT Measurement and Applications (2018)

- **OECD DEO 2020**

WHERE WE STAND

Broadband QoS measurement work at the OECD: National Broadband Maps

- OECD Broadband Portal (National Broadband Maps):
  - ✓ The coverage of broadband service is mapped by access technologies in addition to speed tiers.

**Example:** *OECD Reviews of Digital Transformation: Going Digital in Sweden*
https://bredbandskartan.se/

Q Stockholms län	✕

Area: 2 350 km²
1 077 710 households, 289 802 workplaces
Present   Show more

Speed	access
Missing broadband	0% *
1 Mbit / s or more	100% *
3 Mbit / s or more	100% *
10 Mbit / s or more	100% *
30 Mbit / s or more	100% *
100 Mbit / s or more	94%

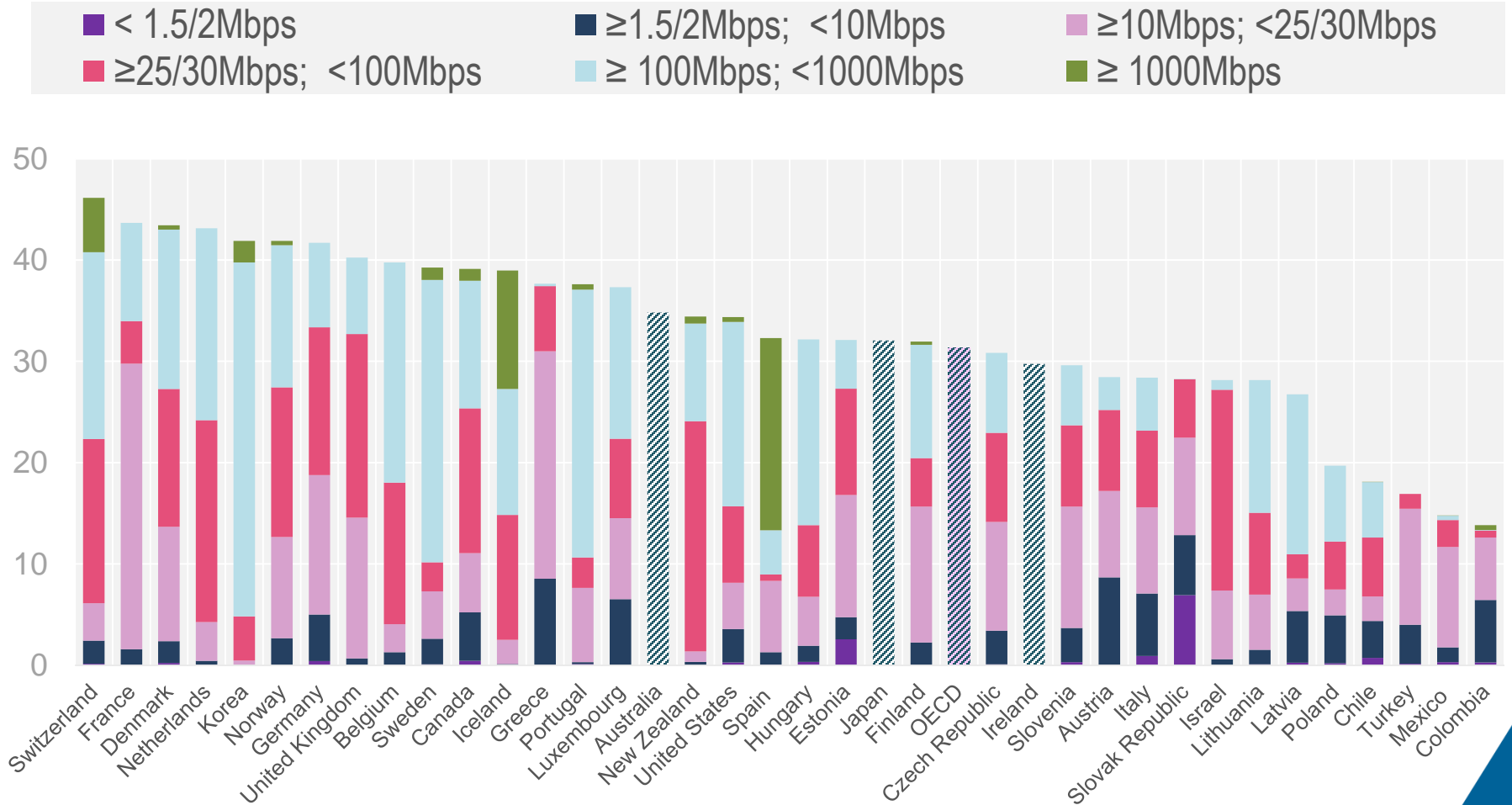Access to, including absolute proximity to broadband

30 Mbit / s or more	100% *
100 Mbit / s or more	97%
1 Gbit / s or more	97%
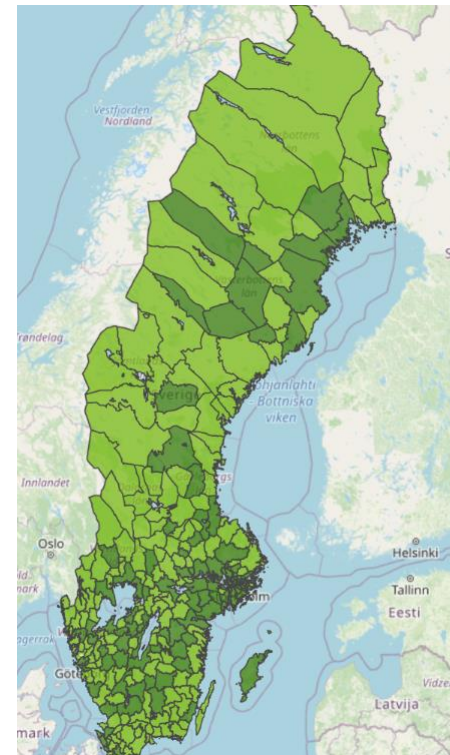
OECD Broadband advertised speed tiers

Fixed broadband subscriptions per 100 inhabitants, per speed tiers, June 2019

Legend:
- ■ < 1.5/2Mbps
- ■ ≥1.5/2Mbps; <10Mbps
- ■ ≥10Mbps; <25/30Mbps
- ■ ≥25/30Mbps; <100Mbps
- ■ ≥ 100Mbps; <1000Mbps
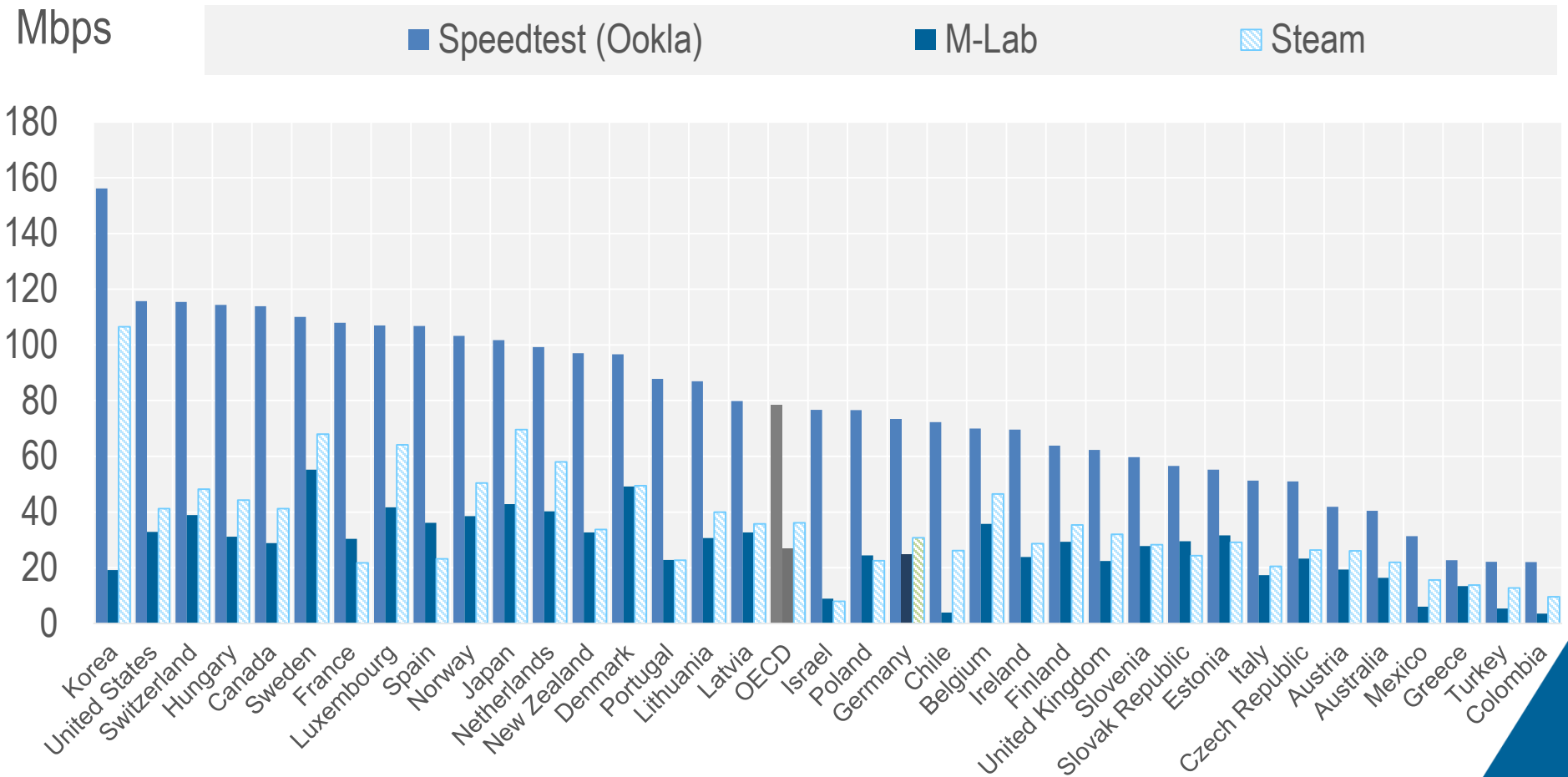- ■ ≥ 1000Mbps

OCED Broadband speed tiers (2)

Fixed broadband subscriptions with contracted speed >100 Mbps, 2018
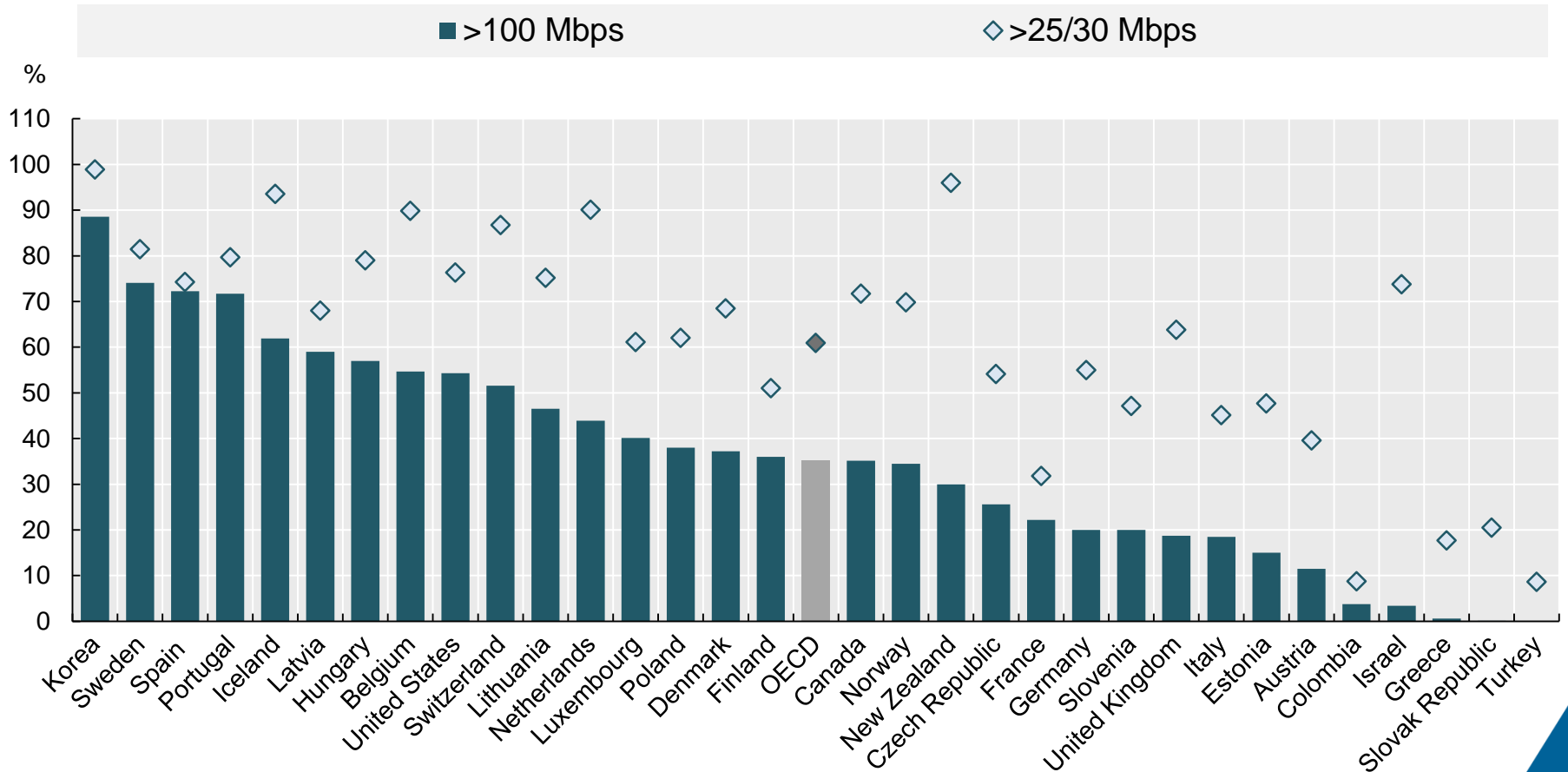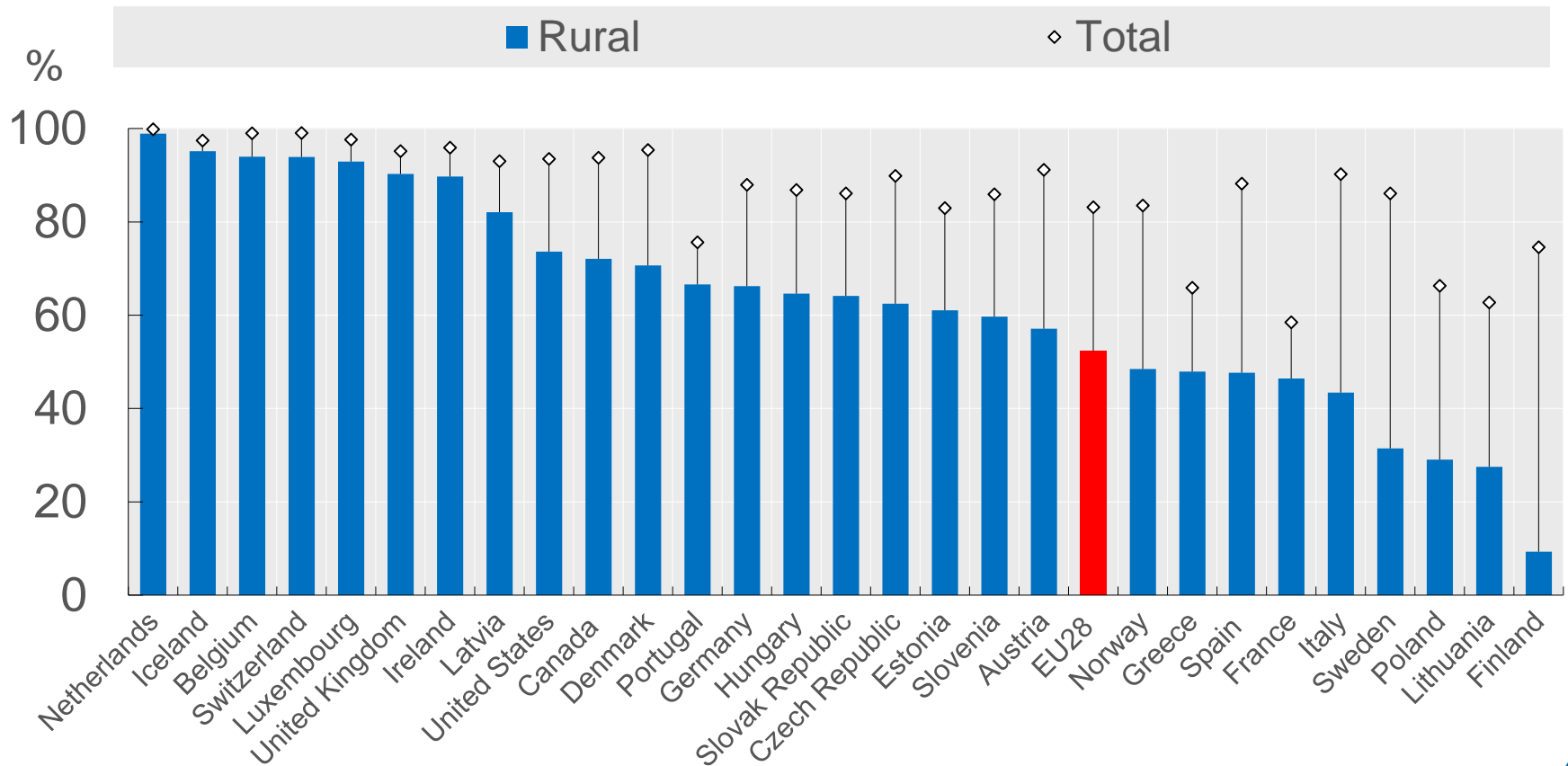
Actual speeds: Ookla, M-Lab and Steam

Average actual download speed (fixed broadband), 2019

Mbps

Legend: Speedtest (Ookla), M-Lab, Steam
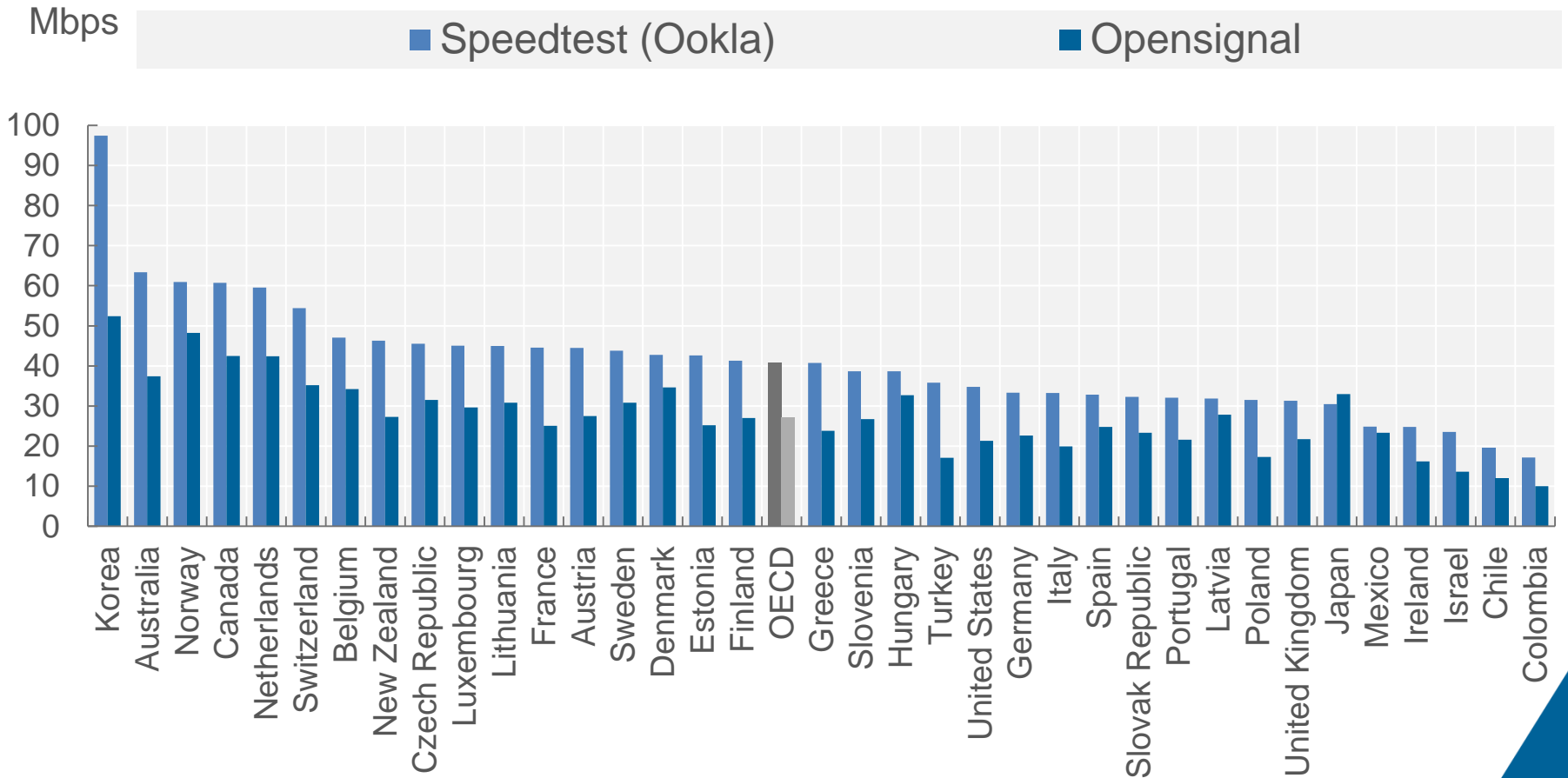
Urban/rural broadband digital divide

Fixed broadband coverage in rural and total areas, >30 Mbps, 2018

Mobile broadband speed tests

Mobile broadband download speeds from Ookla and Opensignal (2019)

OCD country examples of Data Driven Regulation

- **France (Arcep):**
  - Providing users precise and personalised information on network quality
  - December 2018, use of APIs in operators' set-top boxes

- **Korea (NIA):**
  - The NIA monitors the quality of broadband providers through "in the field" measurements, and renders the results publicly available.

Both country examples (and others) are featured in our forthcoming publication:

Digital Economy Outlook 2020

(Chapter 3: Access and Connectivity)

GOING FORWARD

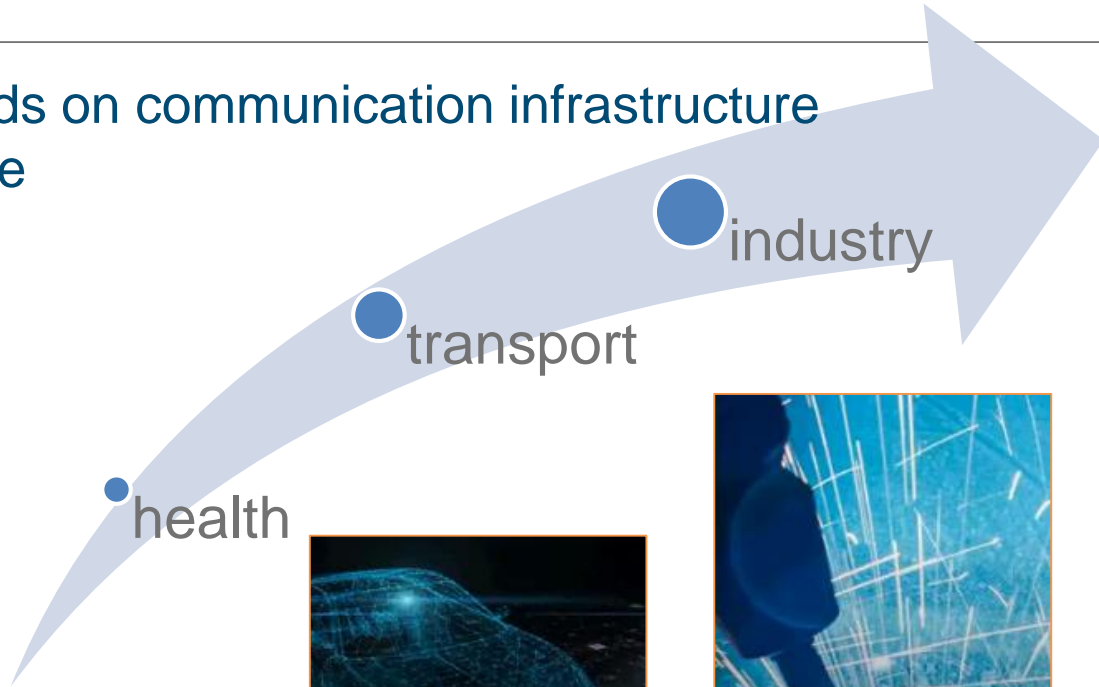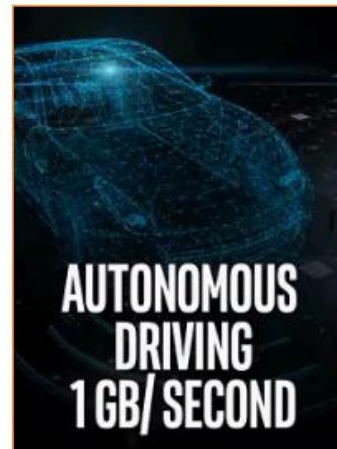# The combination of the IoT and AI generates massive amounts of data….

...placing new demands on communication infrastructure today and in the future

industry

transport

health

Billions of devices will connect through 5G networks and will use/embed AI

SMART HOSPITAL 4000 GB/ DAY

AUTONOMOUS DRIVING 1 GB/ SECOND

CONNECTED FACTORY 1 MILLION GB/DAY

PERSONAL USER 1.5 GB/DAY

Source: Intel

Indicators that become increasingly important with the next evolution of broadband networks

- Measures on resilience and robustness of networks

- Latency and reliability will be key for the usage case scenarios of 5G with an IoT world in mind:

  - Massive and disperse machine communications vs. critical IoT applications

- 5G: quality of service parameters per "network slice" catered to different usage case scenarios?

- Underlying factors determining the quality of service of the next evolution of fixed and mobile broadband networks:

  - The importance of measuring backhaul availability

  - Efficient spectrum management

- Digital security of networks

Conclusions: The role of the OECD in broadband QoS measurement going forward

- **Continued collaboration with BEREC**
  - On broadband QoS measurement
  - And other highly relevant policy topics

- **Role of OECD:** harmonising measurement (and definitions)
  - What we have achieved so far:
    - Download speeds (only one dimension of QoS)
    - Long road that started in 2012
- **Going forward for discussion among countries:**
  - Improving mobile networks QoS indicators
  - Other indicators (resilience, latency, digital security, etc.)
  - Indicators on wholesale inputs influencing QoS

- **Revision of the 2004 Recommendation of the Council on Broadband Development**

Thank you!

OECD CISP Secretariat

Alexia.Gonzalezfanfalone@oecd.org & Frederic.Bourassa@oecd.org

Further reading:

- **2020-OECD Broadband Portal:** https://www.oecd.org/sti/broadband/broadband-statistics/

- **2019-The road to 5G networks:** https://doi.org/10.1787/2f880843-en

- **2019- Operators and their future:** https://doi.org/10.1787/60c93aa7-en

- **2018-IoT measurement and applications:** https://doi.org/10.1787/35209dbf-en

QoS used as a policy tool in France

Audrey Goffi

Arcep's data-driven regulation policy

1/ Collect data from several producers

- Arcep's data
- Operators' data
- Partners' data
- Users' alerts
- Crowdsourcing

2/ Stock and analyze

arcep

3/ Publish information to end users

Formatted information

- Improved maps
- Observatories

Raw data

- Open Data

4/ Change behaviours

Virtuous circles

Encourages actors to invest in order to differentiate

Stimulates public debate

Action in case of an obligation not respected
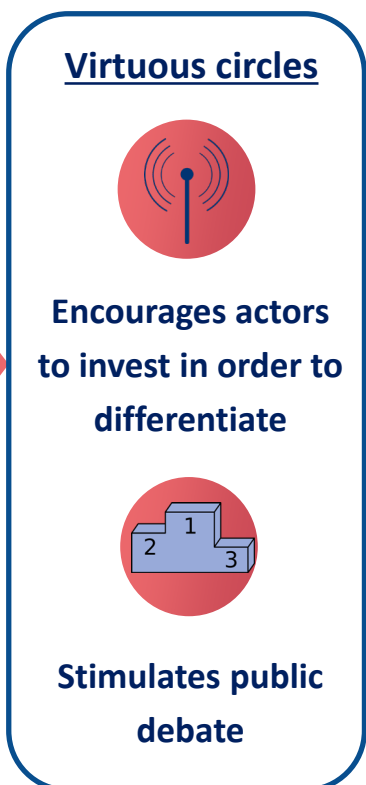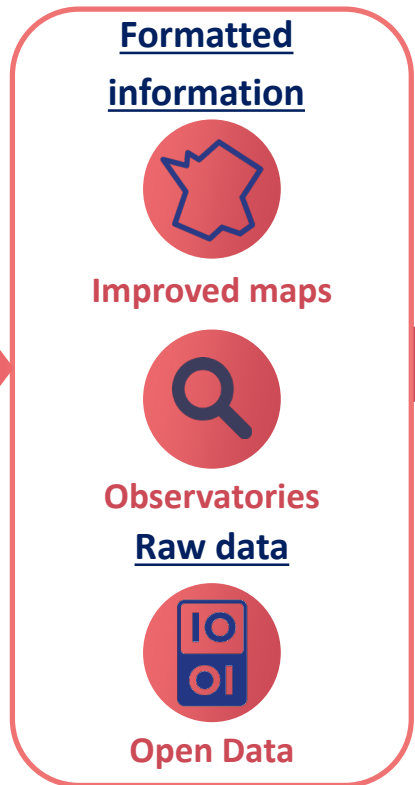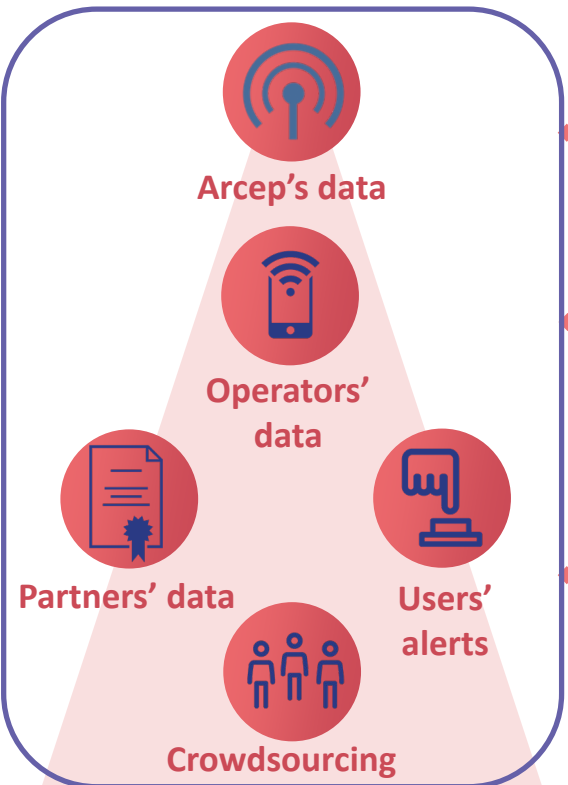
Arcep's user information tool on mobile networks: *Mon réseau mobile* (« My mobile network »)

Two complementary dimensions giving end users **a photography of mobile coverage and QoS/QoE** in France
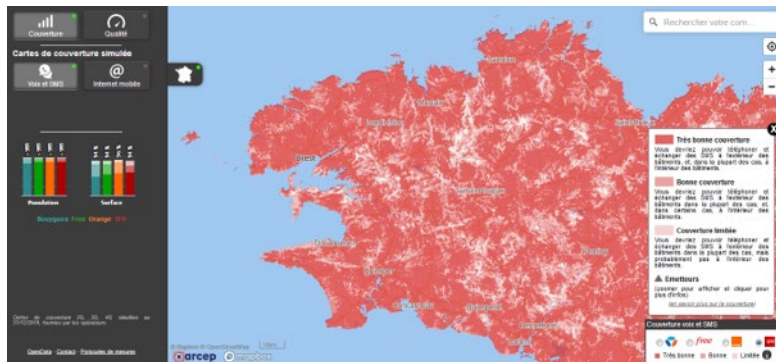
Mobile coverage

- **Mobile coverage maps** in calls/texts (2G) and mobile Internet (3G and 4G)
- **Theoretical data** : maps designed by operators by computer simulations and verified by Arcep
- **For calls/texts, multi-level maps ; for Internet, binary maps**

Quality of Service (QoS)

- **Results of Arcep's annual QoS campaign** carried out outdoor, indoor and incar
- **Measured data** : tests carried out by Arcep through a service provider

Every information published in open data, on the website « data.gouv.fr »

Mobile coverage

Coverage maps verification process

1 MNOs provide Arcep with **coverage maps for voice/texts** (2G) **and data** (3G and 4G)

2 Arcep publishes these maps on **monreseaumobile.fr** and in *open data* on data.gouv.fr

3 Arcep carries out <u>a yearly « accessibility campaign »</u> to verify the reliability of these coverage maps
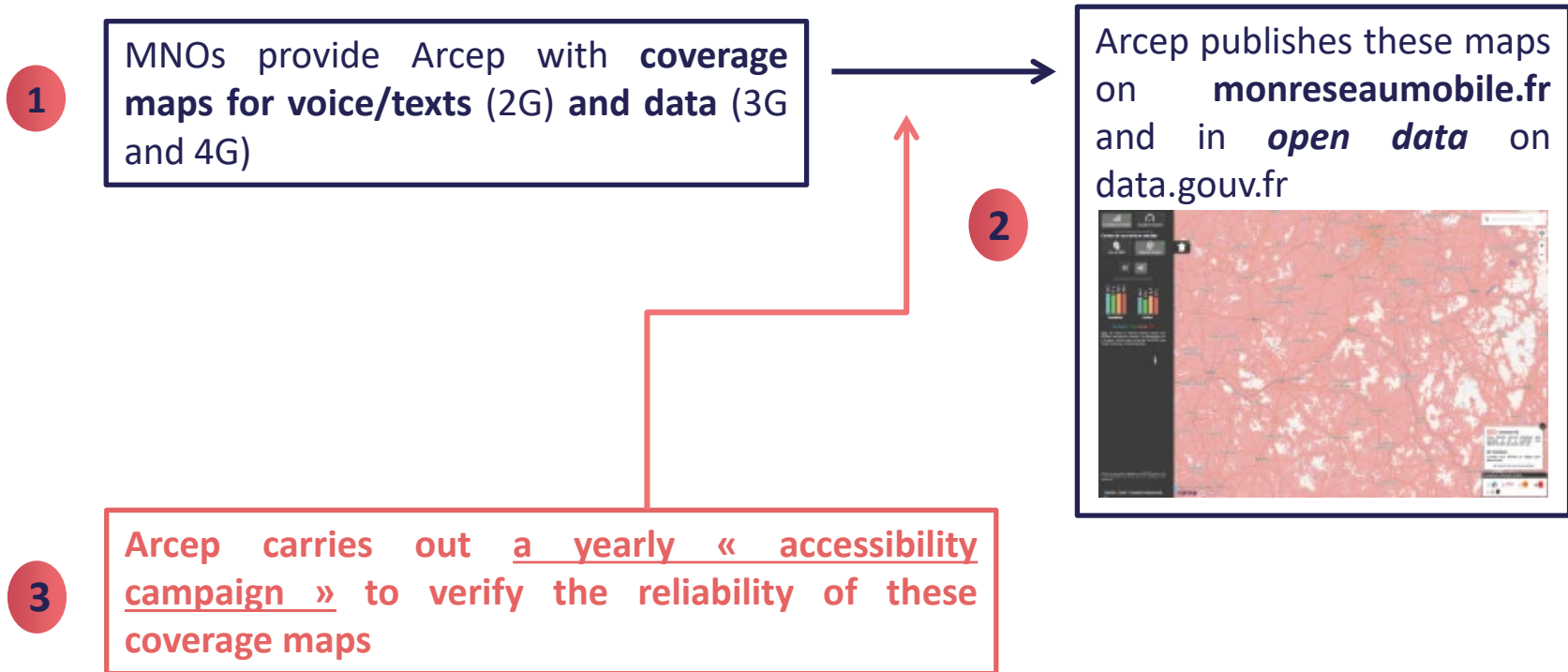
LEGAL FRAMEWORK : ARCEP'S DECISION NUMBER 2016-1678 DEFINES MAPS CONTENT, TRANSMISSION PROCESS AND VERIFICATION PROTOCOLS

Arcep's « accessibility campaign »

- **Yearly campaign, alternatively voice/texts and data**
- **Funded by operators**
- **App. 31 000 km² per year, in app. 10-15 zones**
- **« Light » tests :**
  - **Calls/texts: success rate for obtaining a ringtone under 30 seconds**
  - **Data: success rate for downloading a small file (512 octets) under 15 seconds**
- **App. 200 000 measurement points**
- **A coverage map is considered reliable if 95% or more of the tests carried out in the zone deemed covered by the given operator are successful**
- **Obligation of results rather than obligation of means**
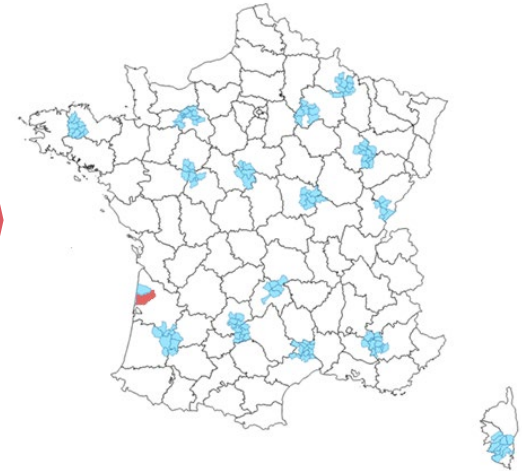
What if a map does not pass the 95% reliability treshold?
1. **Local rectification of the map or rectification of the simulation software's settings**
2. **Local actions on the radio equipments (no modification of the coverage map)**
3. **Identification of the cause of failure e.g. site breakdown (no modification of the coverage map)**

News segment: increasing the reliability treshold from 95%to 98%

Why?

- With the evolution of use cases, **consumers' demands** towards the precision and the reliability of mobile information **have increased**
- Users had reported **differences between coverage maps and their experience**, underlining the maps' insufficient reliability
- Arcep's accessibility campaigns show **different reliability rates between operators**

How and when?

- **January – March 2020**: public consultation
- **Late March 2020**: publication of an Arcep decision modifying the decision 2016-1678
- **September 2020**: the modified decision comes into force
- **Before the end of 2020**: transmission of the first maps by the operators

What?

Reliability treshold increased from 95% to 98%, with 3 levels:
- **Overall reliability treshold at 98%**
- **For every zone > 1 000 km²,** reliability treshold of **98%**
- **At the local scale, for every zone > 100 km²,** reliability treshold of **95%**

Quality of service

Arcep's annual QoS campaign

- **Yearly campaign**
- **Results published each fall**
- **Funded by operators**
- **On the whole territory (mainland *and* overseas)**
- **App. 1.5 million measurement points**
- **« Complex » tests:**
  - **Calls/texts:**
    - **Texts: success rate for receiving a text message under 10 seconds**
    - **Calls: success rate for maintaining a 2 mn phonecall with perfect quality**
  - **Data:**
    - **Web: success rate for loading a web page under 10 seconds**
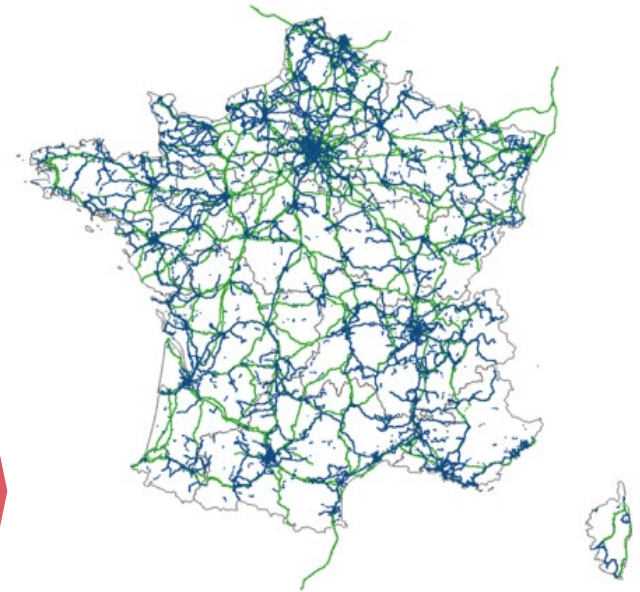   - **Download: success rate for receiving a 10 Mo file and sending a 2 Mo file under 60 seconds**
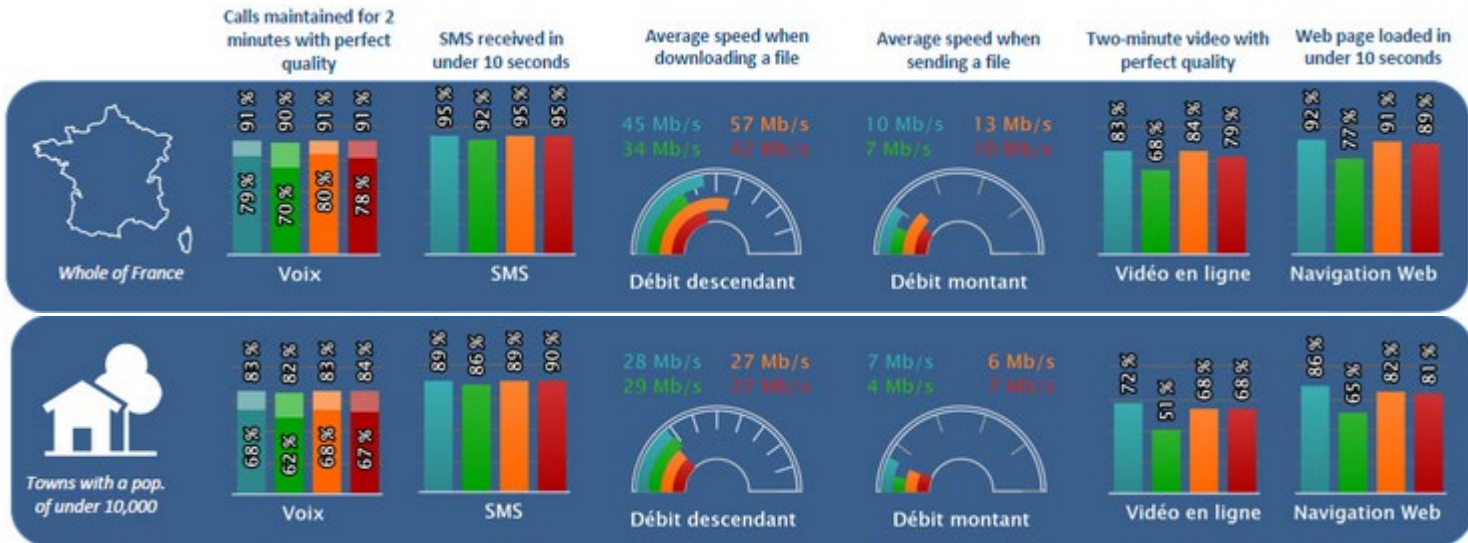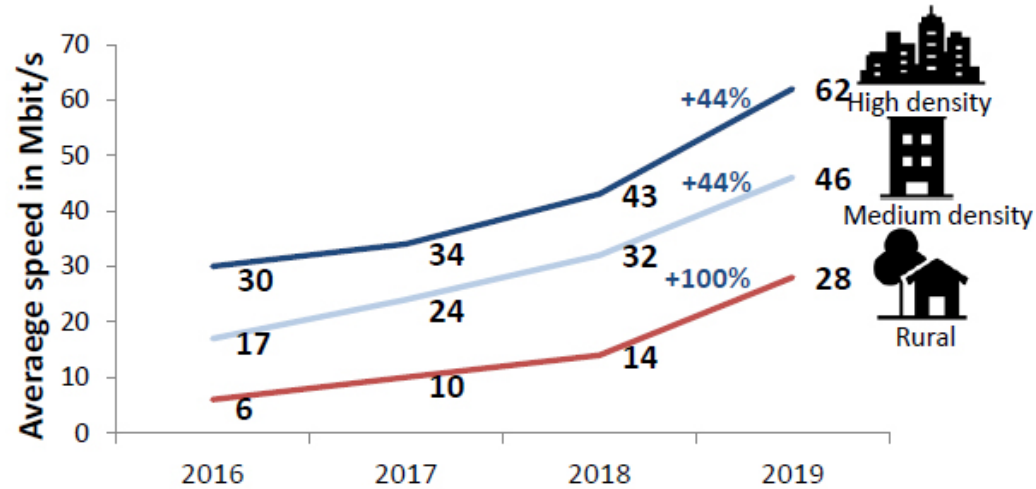   - **Speed: measuring downlink and uplink speed**
    - **Streaming: success rate for watching a 2 mn HD video in perfect quality**

Measurements in places of life

Measurements on transport paths

Insights from the 2019 QoS campaign results

News segment: integrating measurement carried out by third parties to *Mon réseau mobile* (1)

In late 2018, Arcep published **two documents enabling third parties** (local collectivities, companies, public services services…) **to carry out their own tests**:

- The **Regulator's Kit**, a **guide of Arcep measurement protocols** in controlled environment both for accessibility and QoS tests, notably providing **reusable technical specifications**

- A **Code of Conduct** for **crowdsourcing actors**, setting **minimum transparency and quality standards**

➢ This Code of Conduct applies to **both fixed and mobile actors**
➢ Crowdsourcing actors can declare themselves **compliant to this Code of Conduct** – on the fixed part, these actors will be **eligible to the « Access ID Card » API designed to characterize user environment**
➢ This Code will be **updated by the summer 2020**
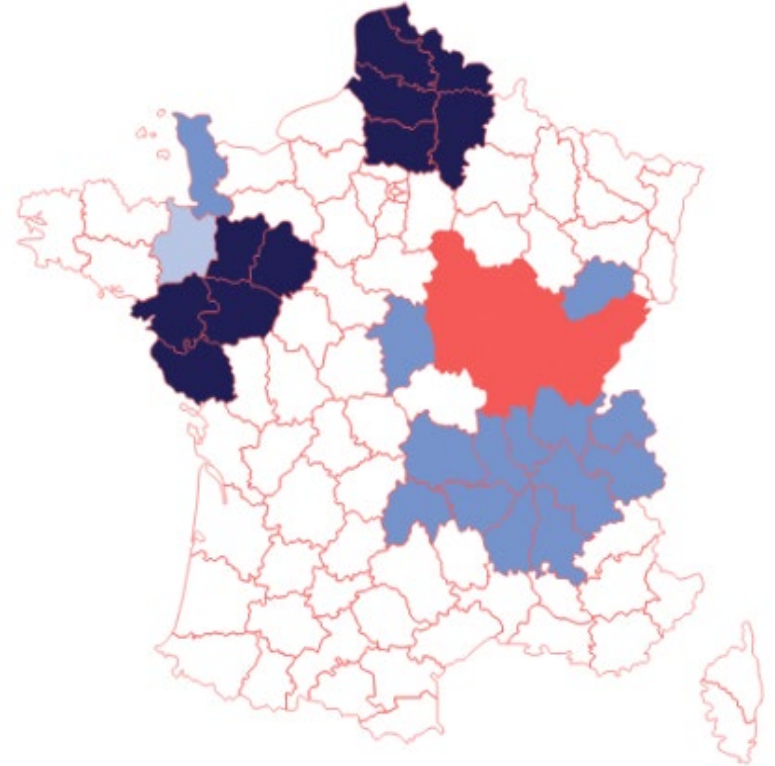
News segment: integrating measurement carried out by third parties to *Mon réseau mobile* (2)

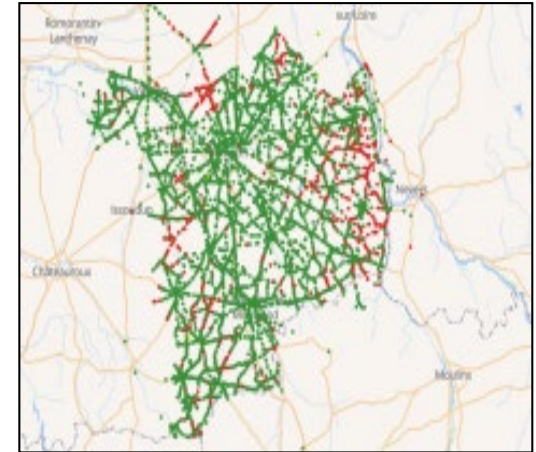- On **April 10th, 2020**, Arcep published for the first time on *Mon réseau mobile* **the results of tests carried out by third parties** on several territories and on the railway networkl
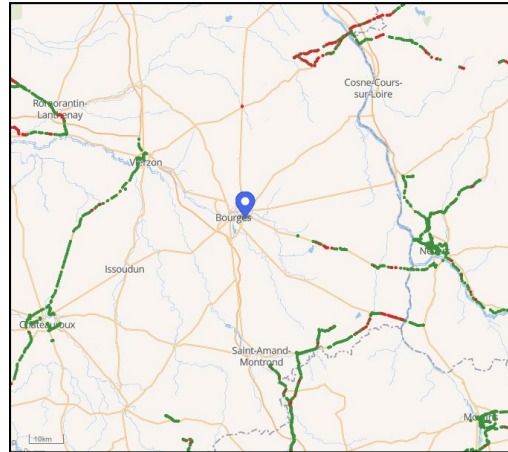
Ex. Cher (Arcep's data)   *Ex. Cher (local authority's data)*

- Publishing these data provides **end users and public authorities** with **a more detailed picture of mobile connectivity on these territories**

- It should be noted that Arcep provided these third parties with **a technical support** prior to publishing these data:
  - **Proofreading technical specifications**
  - **Verifying the consistency of the results**
  - **Analysing the results**

Disclaimer: tests results from local authorities cannot be interpreted in the same way as Arcep's tests results, and one should not attempt to calculate KPIs from these results

Thank you for listening

Useful links:

Mon réseau mobile (French version)

Results of the 2019 QoS campaign (English version)

Arcep's decision 2016-1678 on coverage maps (French version)

Regulator's Kit (French version)

2018 Code of conduct (English version)

Audrey Goffi
Tél : + 33 (0)6 95 11 41 41
Email : audrey.goffi@arcep.fr

www.arcep.fr

arcep les réseaux comme bien commun

Quality Evaluation of Telecom Services in Korea and Future Direction

June 23, 2020
Lee Yeong-ro, Vice President (lyr@nia.or.kr)
NATIONAL INFORMATION SOCIETY AGENCY

NIA NATIONAL INFORMATION SOCIETY AGENCY

Quality Evaluation of Telecom Services in Korea and Future Direction

Background of Quality Evaluation

Urban

Population ↑
Investment ↑
Good Quality

Rural

Population ↓
Investment ↓
Poor Quality

Significant quality gap in telecom service between urban and rural areas

Problem 1.
Equal Price but Different Quality
(depending on geo-environment and population density)

Problem 2.
Insufficient Quality Information to the Users

Problem 3.
Lack of Coverage Information

Annual Evaluation of QoS and Open it to the Public

Procedure of Quality Evaluation

■ Step1. Selection of Target Services

Wired

100 Mbps
1 Gbps
10 Gbps

Wireless

Wi-Fi
3G, 4G(LTE)
5G

Not to measure the best **technical** Capacity

But to measure the quality that **user experience** using real end user devices (Smartphone, PC)

■ Step2. Establishment of Measurement Scheme

Organising Working Group
that is independent on Stake Holders
to secure relevance of whole process

To determine measuring terminal
(End user devices : Smartphone, PC)
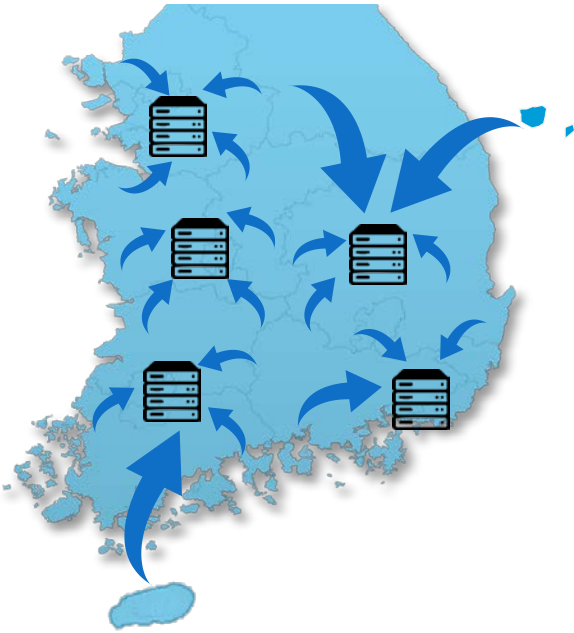
+

To determine method and metrics
(Throughput, Delay time, etc···)

‖

To set-up final Evaluation Plan

[Reference] Method and Metrics
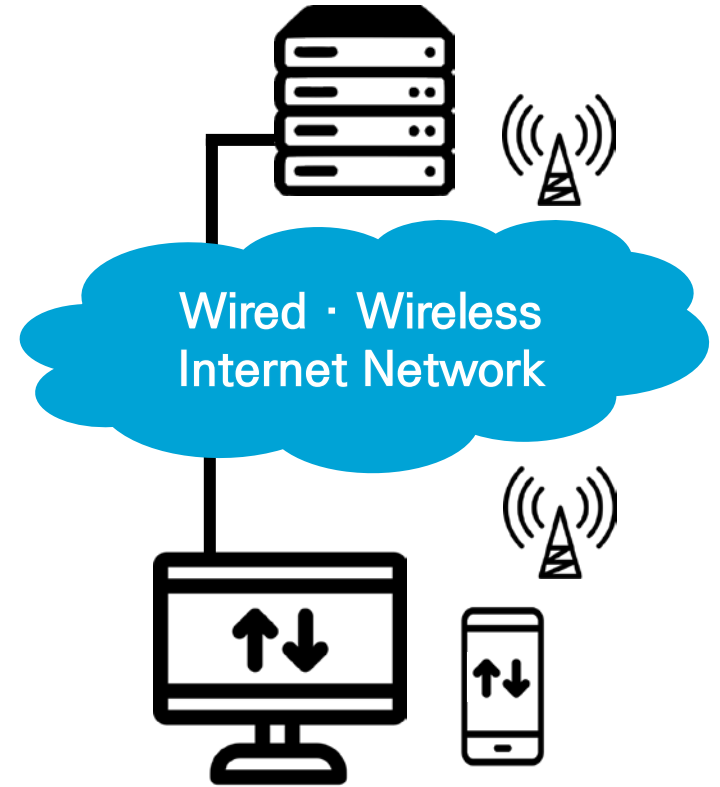
Measurement Method

10 Gbps Link

Wired · Wireless Internet Network

Install Measurement Servers
at the IDC of each providers
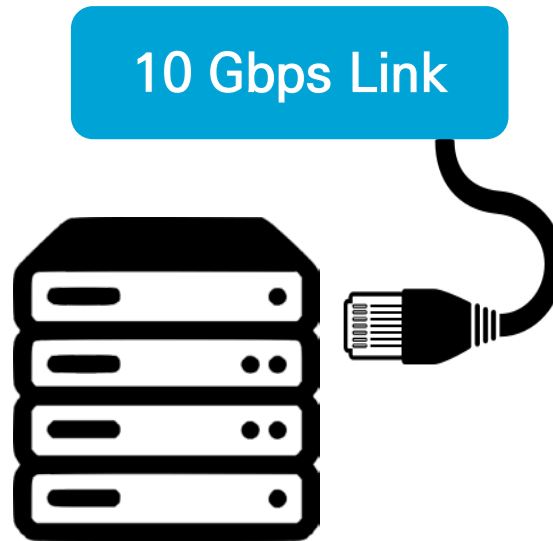
10 Gbps or higher links
to each measurement server

**Real End user device**
used to collect data

[Reference] Method and Metrics

◼ Measurement Metrics

Category		Metrics
Wireless	Throughput(Mbps)	Transmission and reception speed between terminal device-measurement server
	Connection success rate(%)	The rate of successful calls by attempting to connect to the measurement server
	Transmission success rate(%)	The rate of calls connected to the measurement server and transmitted at a certain speed
	Round trip latency(ms)	Time to transmit a signal to the measurement server and to receive a response signal
	Packet loss rate(%)	The rate of data that was not received during data transmission and reception
	Web-page loading time(sec)	Time until all screens of web page are displayed on the terminal device
Wired	Throughput_Intra(Mbps)	Transmission and reception speed between terminal device-measurement server
	Throughput_Inter(Mbps)	Transmission and reception speed between terminal device-web portal provider server
	Web-page loading time(sec)	Time until all screens of web page are displayed on the terminal device
Only for "5G"	5G to 4G Re-direction Rate(%)	The rate of network switching on to 4G network while using 5G network

[Reference] Method and Metrics

■ New Metrics for 5G Service Evaluation : 5G to 4G Re-direction Rate
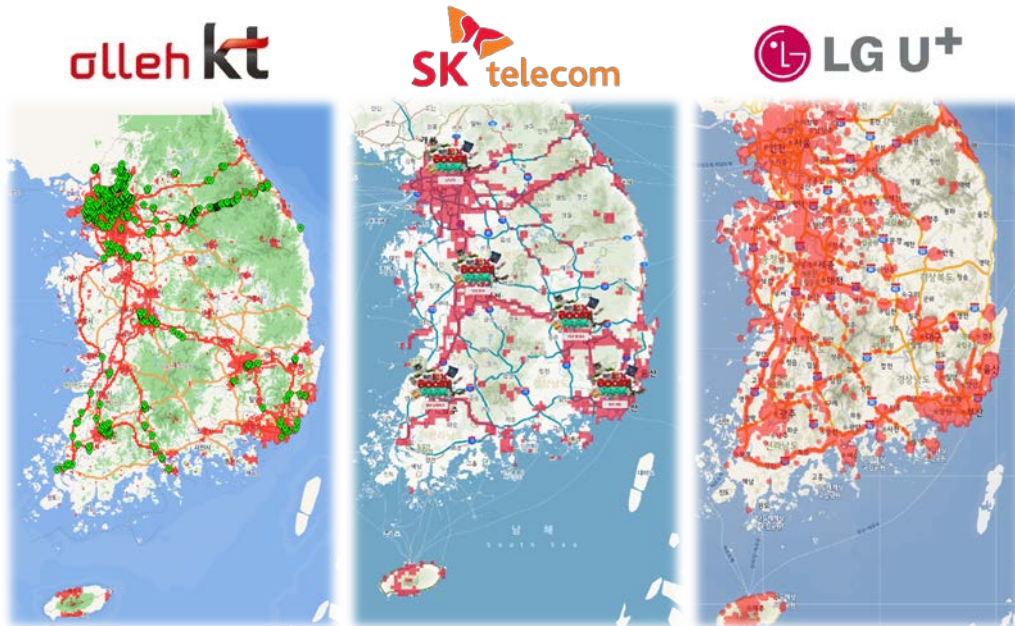
※ 5G service coverage map by providers (June 2020)

Low coverage rate,
5G Island
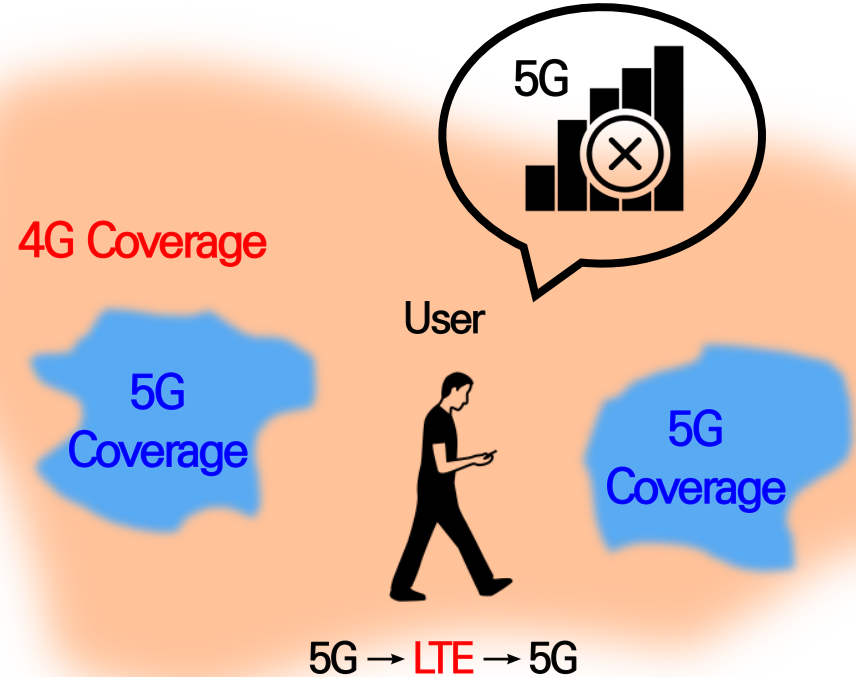
Frequent 5G Connection Off,
Switching On to 4G

Procedure of Quality Evaluation

Step3. To perform field tour and measurement

① By population density such as metropolitan, mid – to small cities, and rural areas.

② By region type such as transportation facility, underground shops, markets, and hospitals.

③ By sport and leisure area such as island, sea roads, coastal roads, and trails.

④ By public transportation such as high−speed railroad, city subways, and highways.

Procedure of Quality Evaluation

■ Step4. Collection of Data and Validation

① Pre-review meetings with third party experts

② Check devices and measurement software errors

③ Remove error data under the abnormal conditions

④ Validate whole process and Reporting

Wireless and Wired Internet Quality in 2019

▪ Quality of Wireless Internet Services

※ 2018 results in parentheses (　)

	Download Speed	Upload Speed	Connection Success rate	Transmission Success rate	Round Trip Latency	Packet Loss rate	Web-page Loading time
LTE	158.53 Mbps (150.68 Mbps)	42.83 Mbps (43.93 Mbps)	99.98% (99.97%)	99.18% (99.43%)	36.34 ms (40.73 ms)	0.85% (0.73%)	1.01 sec (1.29 sec)
3G	5.50 Mbps (6.08 Mbps)	1.73 Mbps (1.89 Mbps)	99.55% (99.30%)	98.43% (98.96%)	98.66 ms (88.65 ms)	1.21% (1.38%)	1.91 sec (2.48 sec)
WiFi	333.51 Mbps (305.88 Mbps)	288.02 Mbps (290.25 Mbps)	99.93% (99.98%)	99.57% (99.61%)	23.41 ms (20.77 ms)	0.76% (0.38%)	0.93 sec (1.11 sec)

▪ Quality of Wired Internet Services

※ 2018 results in parentheses (　)

	Download Speed (Intra)	Upload Speed (Intra)	Download Speed (Inter, Bulk e-mail)	Upload Speed (Inter, Bulk e-mail)	Web-page Loading time
100Mbps	99.27 Mbps (99.39 Mbps)	98.85 Mbps (98.36 Mbps)	92.25 Mbps (91.95 Mbps)	87.86 Mbps (56.57 Mbps)	0.80 sec (1.07 sec)
1Gbps	951.67 Mbps (913.83 Mbps)	949.19 Mbps (907.10 Mbps)	350.71 Mbps (359.53 Mbps)	294.80 Mbps (238.75 Mbps)	0.77 sec (1.07 sec)

Outcomes

■ Target services by years

1999 2G Voice, PSTN

+ 2001 High-Speed Internet

2006 WCDMA, WiBro

+ 2010 Wi-Fi

+ 2012 4G(LTE)

2013 VoLTE (LTE Voice)

2014 Vulnerable regions

+ 2015 1Gbps Internet

2016 Coverage Inspection

+ 2019 10Gbps Internet

+ 2020 5G

■ Download Speed Improvement (National Avg)

(Mbps)

Division	2017	2018	2019	CAGR
4G	133.4	150.7	158.5	9%
Wi-Fi	264.9	305.9	333.5	12.2%
1G (Wired)	873.8	913.8	951.7	4.4%
100M (Wired)	99.1	99.4	99.3	0.1%

■ Download speed of 4G in rural area

(Mbps)

Division	2017	2018	2019	CAGR
4G in rural area	99.6	126.1	128.5	13.6%

Outcomes

Average of total LTE in 2019

Download (DL)
158.53 Mbps

42.83 Mbps
Upload (UL)

Major changes in 2019 (Download unit: Mbps)

	LTE	3G	WiFi
'18	150.68	6.08	305.88
'19	158.53	5.50	333.51

LTE service quality by area type

Nationwide

Subways	Highways
221.33Mbps	116.91Mbps
42.76Mbps	29.98Mbps

Major Roads	Traditional markets
194.28Mbps	158.70Mbps
62.84Mbps	48.53Mbps

Railroad
84.85Mbps
17.92Mbps

Download (DL) **158.53** Mbps
Upload (UL) **42.83** Mbps

LTE service quality of vulnerable areas

Trails	Sea routes
77.56Mbps	51.63Mbps
17.34Mbps	16.69Mbps

Islands	Coastal roads
69.92Mbps	96.14Mbps
21.33Mbps	25.56Mbps

Download (DL) **67.29** Mbps
Upload (UL) **19.06** Mbps

Open quality information to the public
in various types by provider, service and region

Thank You

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SOCIETY AGENCY**