

NEXT GENERATION SPECTRUM MANAGEMENT

USTTI, WASHINGTON DC



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Future Areas of Focus

- Transformative Agenda of 5G-IoT, Data, AI and other disruptive technologies
- Spectrum Management
- Building out infrastructure including infrastructure sharing
- Consultative approach- Policy and Regulatory Decisions

What Next ? Do we really Know?

- Future is nearer than what we think
- Infrastructure competition may not be sustainable.
- Future may have type of services using digital connectivity platform which you and me may not imagine today.

Digital is bending the arc of development and offering ways to shape the development paradigm

- In 2016 the Global Digital Economy was worth \$11.5 Trillion, 15.5 percent of The World's GDP. Expected to reach 25 % of the world's GDP in less than a decade.
- The digital economy is the single most important driver of innovation , competitiveness and growth
- 90% of digital data has been created in the last 2 years.

5G Services: beyond voice and data

5G will bring disruptive changes and new opportunities in many areas

FACTORIES OF THE FUTURE

- 1 Time-critical process control
- 2 Non time-critical factory automation
- 3 Remote control
- 4 Intra/Inter-enterprise communication
- 5 Connected goods

ENERGY

- 1 Grid access
- 2 Grid backhaul
- 3 Grid backbone

e-HEALTH

- 1 Assets and interventions management in Hospital
- 2 Robotics
- 3 Remote monitoring
- 4 Smarter medication

MEDIA & ENTERTAINMENT

- 1 Ultra High Fidelity Media
- 2 On-site Live Event Experience
- 3 User/Machine Generated Content
- 4 Immersive and Integrated Media
- 5 Cooperative Media Production
- 6 Collaborative Gaming

AUTOMOTIVE

- 1 Automated driving
- 2 Share My View

- 3 Bird's Eye View
- 4 Digitalization of Transport and Logistics
- 5 Information Society on the road

* 출처 : 

Where are they now?

GLOBAL MARKET

Unique mobile subscribers

2017

5.0bn

66% PENETRATION RATE (% of population)

5.9bn

2025



CAGR 2017-25

21%

Mobile internet users

43% PENETRATION RATE (% of population)

3.3bn 2017

5.0bn

2025



CAGR 2017-25

5.3%

Smartphones % of connections*



57% 2017
77% 2025

4G

% of connections*

29% 2017

53% 2025

5G

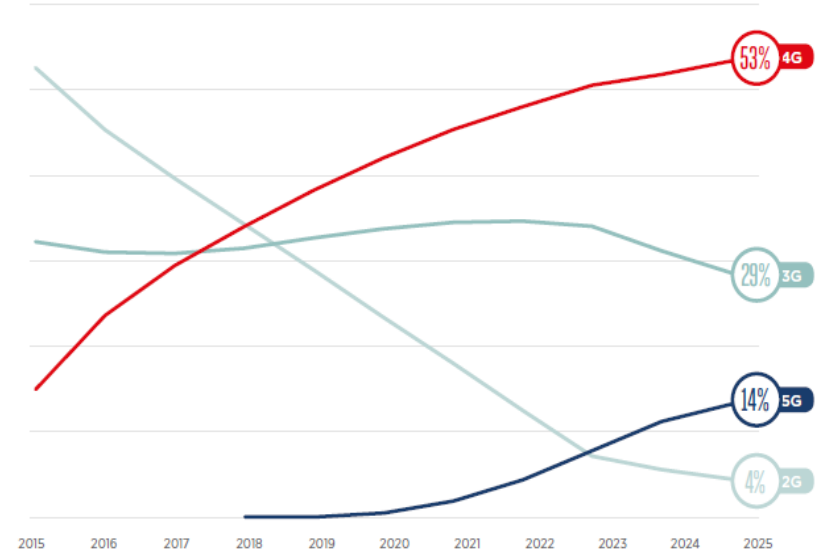
1.2bn 2025

14% of connections*

*Excluding cellular IoT

Global mobile adoption by technology

Share of mobile connections, excluding cellular IoT

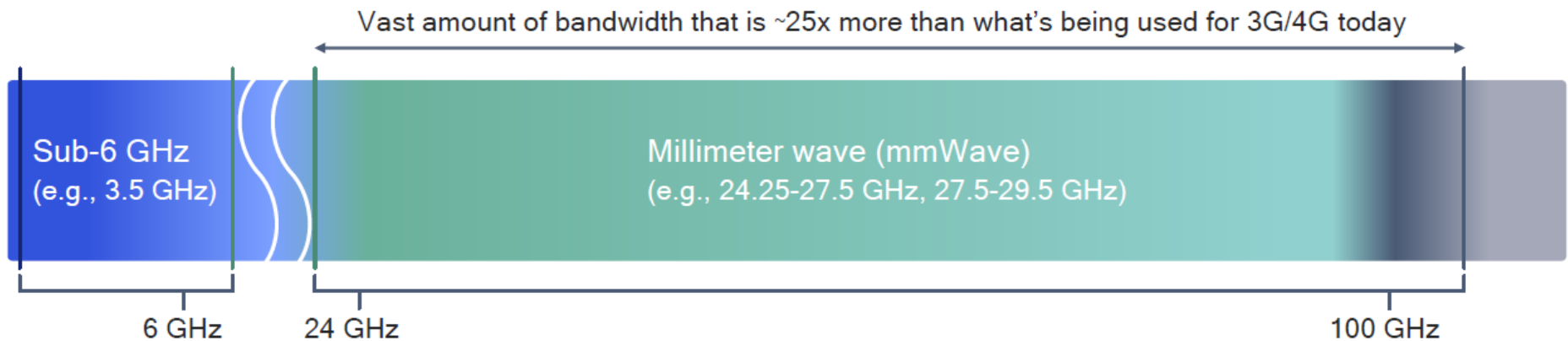


4G takes the lead in 2019, while 5G moves from trials to commercialization, GSMA

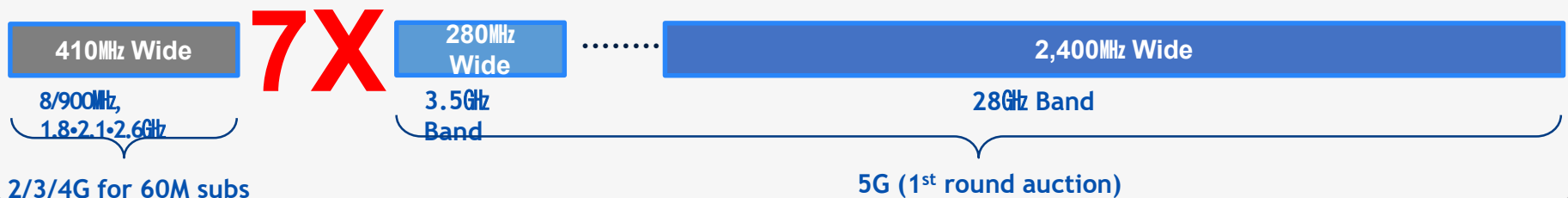


What sets 5G apart from 4G?

Mobilizing mmWave; New frontier of mobile broadband



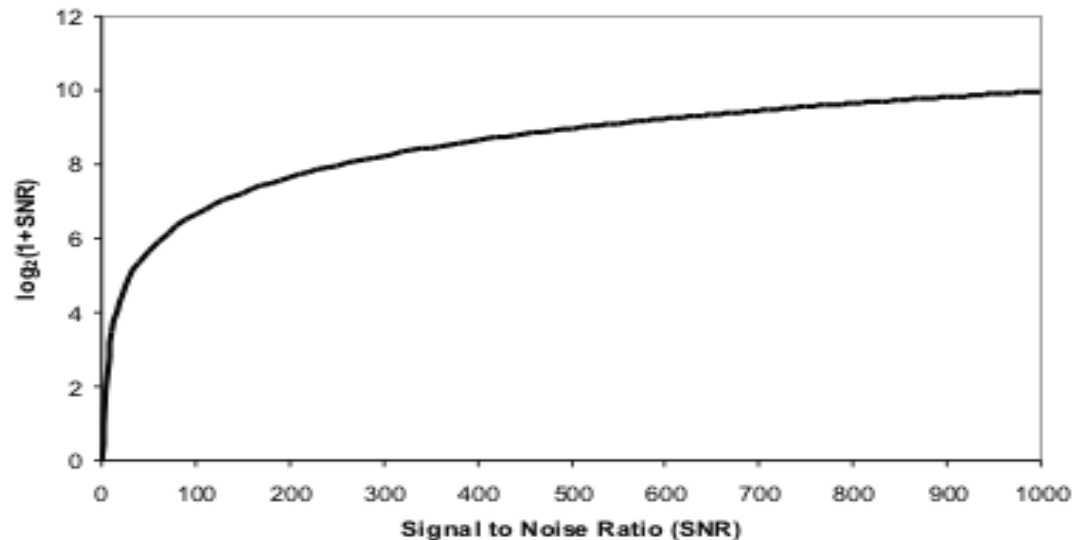
✓ 5G Spectrum Auction of Korea



SHANNON'S THEOREM -WHAT DOES IT TELL?

Bandwidth(BW) increase is the only solution to enhance the channel capacity(C) beyond a limit

Shannon's Law: $C = BW \times \log_2(1 + \text{SNR})$

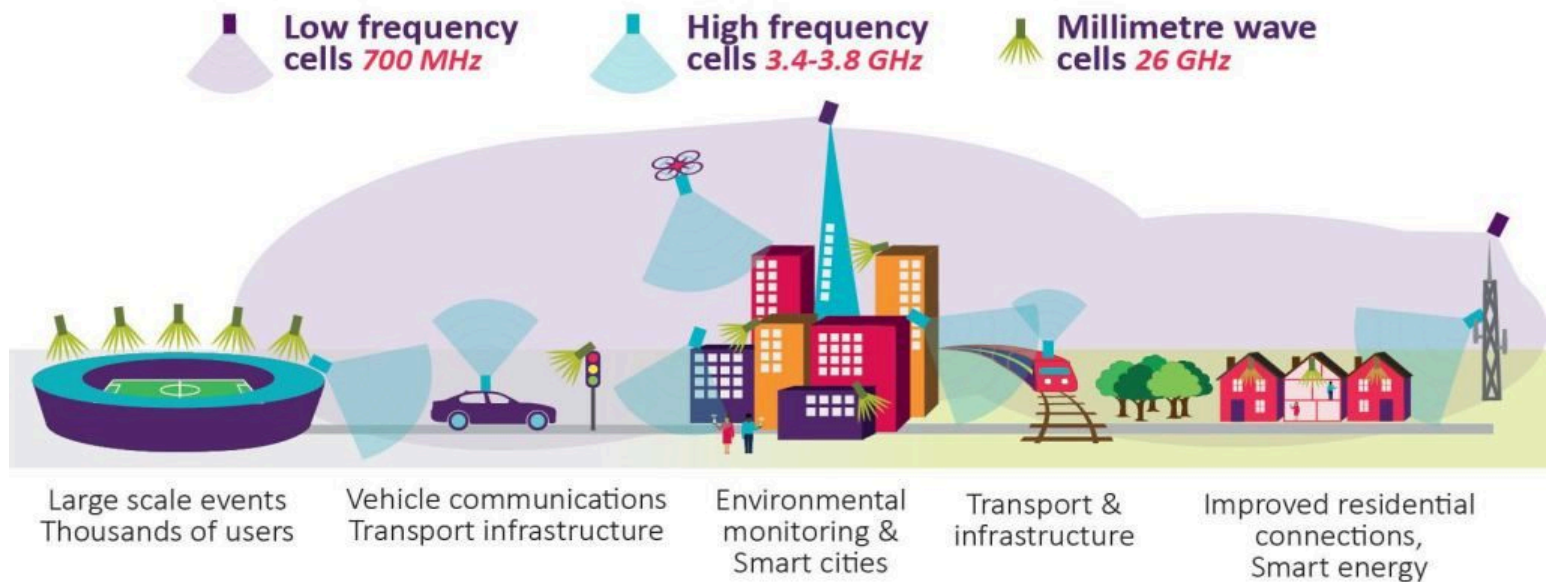


Spectrum Management

- Future wireless technologies will be driven by massive bandwidth , low latency as well, but high bandwidth is a big differentiator.
- About eight years ago, 4G services were launched with 10X10 MHz spectrum in different sub 3 GHz bands but today we are talking about 400 MHz to a Gig bandwidth. With more than ten fold increase in spectral efficiency the uplink and downlink data speeds will be in multiple Gigs.
- Even the current technology launch will easily achieve 1 GBPS peak speed
- Use of MM wave (6-100 GHZ frequency range) will have its own challenges to the industry and regulators like small cell configurations in dense urban areas
- Government has a monopoly in supplying spectrum

Risks of Increasing Digital Divide

- Deployment of 5G infrastructure is most likely to happen in dense urban areas to provide a return on investment not the rural areas that are commonly underserved.
- Because of its integrated nature with vertical sectors, investment in 5G can determine the competitiveness of economy as a whole.



5G Frequency Bands (credits: [Ofcom/UK](#))

Infrastructure sharing

Challenge: How to reduce the cost of investing in 5G deployment?

Policy Consideration

1. passive infrastructure sharing: duct, poles, towers, lampposts, traffic signals, cabinets, etc. (Best Practice)

✓ **Mandated network sharing**

- Netherlands(Nov 2017), to accelerate broadband roll-out
- Indonesia, new rules to encourage passive infrastructure sharing
- UK, Ofcom, a market consultation to mandate incumbent and SMP to offer duct fiber access
- Italy, Utility companies' assets

✓ **Commercially driven network sharing**

- Spain(MASMOVIL+Orange Espana); Portugal(Vodafone+NOS), Cameroon(Vodafone Cameroon + CamTel), Denmark(Telenor Denmark+Telia Denmark+Nokia /TT-

2. independent wholesale infrastructure providers (Best practice)

✓ **New Zealand Chorus, calling on the government a single 5G mobile network**

Streamlining regulation

Challenge: How to remove or relax regulatory barriers blocking the deployment of small cells ?

Policy Consideration

1. Streamline regulations related to 5G small cell deployment

(Actions required)

- ✓ Grants providers non-discriminatory access to public property
- ✓ Standardize the right of way agreement and procedures of approval
- ✓ Limit the costs charged by local governments
- ✓ Hold a central database identifying key contacts, showing assets

(Best Practice)

- ✓ US, FCC The 5G FAST Plan, DECLARATORY RULING AND THIRD REPORT AND ORDER
- ✓ US California, Florida, Washington state
- ✓ London, Standardized right of way agreement toolkit

Incentivizing private investment

Challenge: How to accelerate 5G deployment when Telcos are skeptical about ROI

* High levels of investment needed in small cells, backhaul, edge computing, and new core network

Cost Estimate

For US nationwide coverage

- Ovum(T-mobile US), \$25 billion ~ Barclays, \$300 billion

For Europe wide coverage

- EC, \$64 billion ~DT, \$335~\$558 billion

Small Cell Deployment

Software upgradeability

Policy Consideration

1. Policy makers' actions will make a difference
(Actions required) tax, grants, loans, investment fund, PPPs, infrastructure sharing

(Best practices)

- Korea, tax incentives(3% of total investment)
- UK, grants to local government; Malaysia, low-cost loans
- PPP
 - Publicly led: Qatar, government builds/owns fibre networks
 - Privately led: Germany, gov't partly funds the deployment of fibre networks

Consultation Process

- All policy and regulatory decisions should be taken in consultation with various stakeholders
- We suggest to streamline the consultation process. The World Bank team will be very happy to share international experience in this regard.

Thank you !