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.
- COVID, Conflict , and Climate have shown this

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. Again, COVID has proven it
- 90% of digital data has been created in the last 4 years.

Spectrum is critical for 5G success

Using all spectrum types and bands

5G

Licensed spectrum

Exclusive use

Over 40 bands globally for LTE, remains the industry's top priority

Shared spectrum

New shared spectrum paradigms

Ex: 3.5 GHz USA, 3.7 GHz Germany

Unlicensed spectrum

Shared use

Ex: 5 GHz / 6 GHz / 60 GHz global

High bands above 24GHz (mmWave)

Mid bands 1GHz to 7GHz

Low bands below 1GHz

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5G carrier aggregation

for ultimate operator flexibility and performance

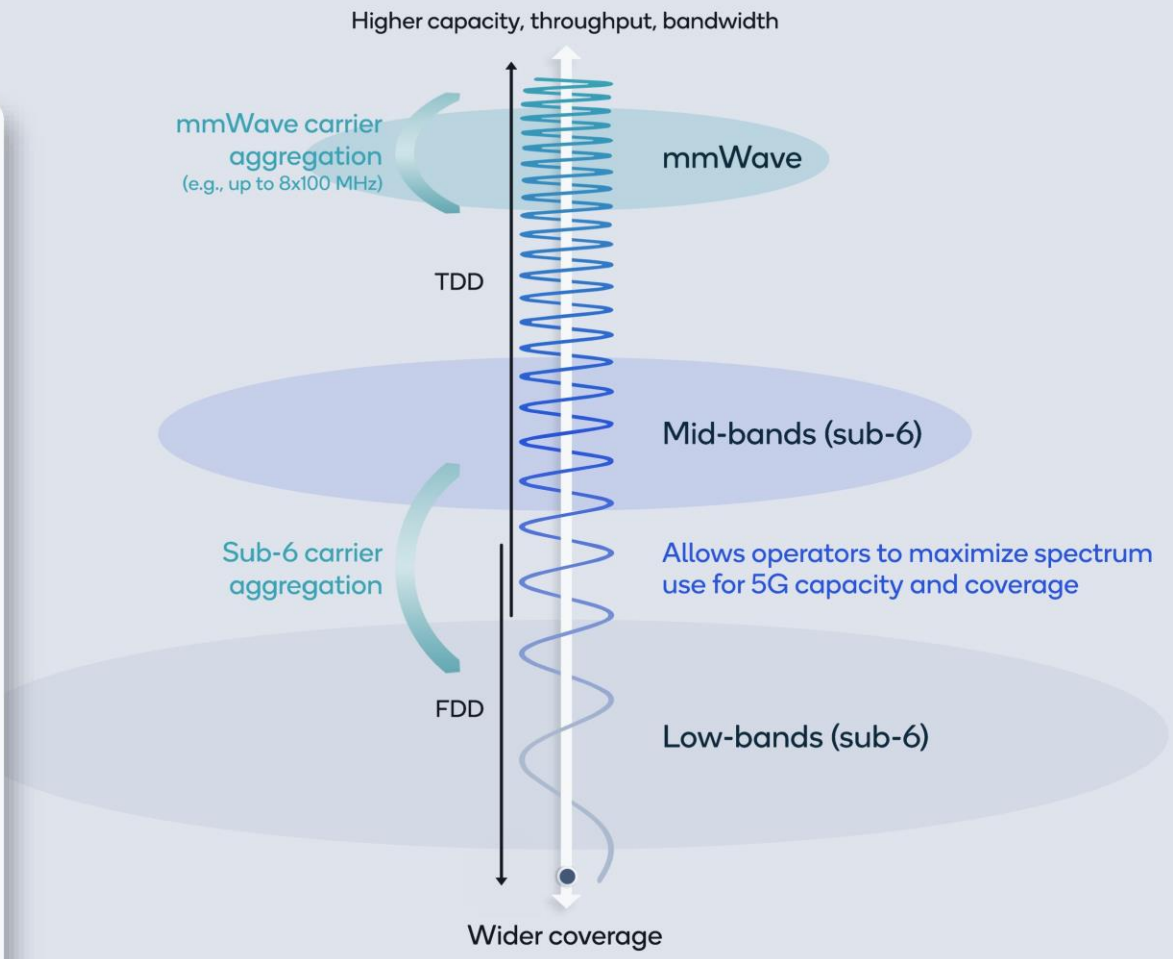
Double sub-6 peak speeds in standalone mode

Increase capacity

Expand coverage

Improve user experience

Accelerate transition to standalone mode



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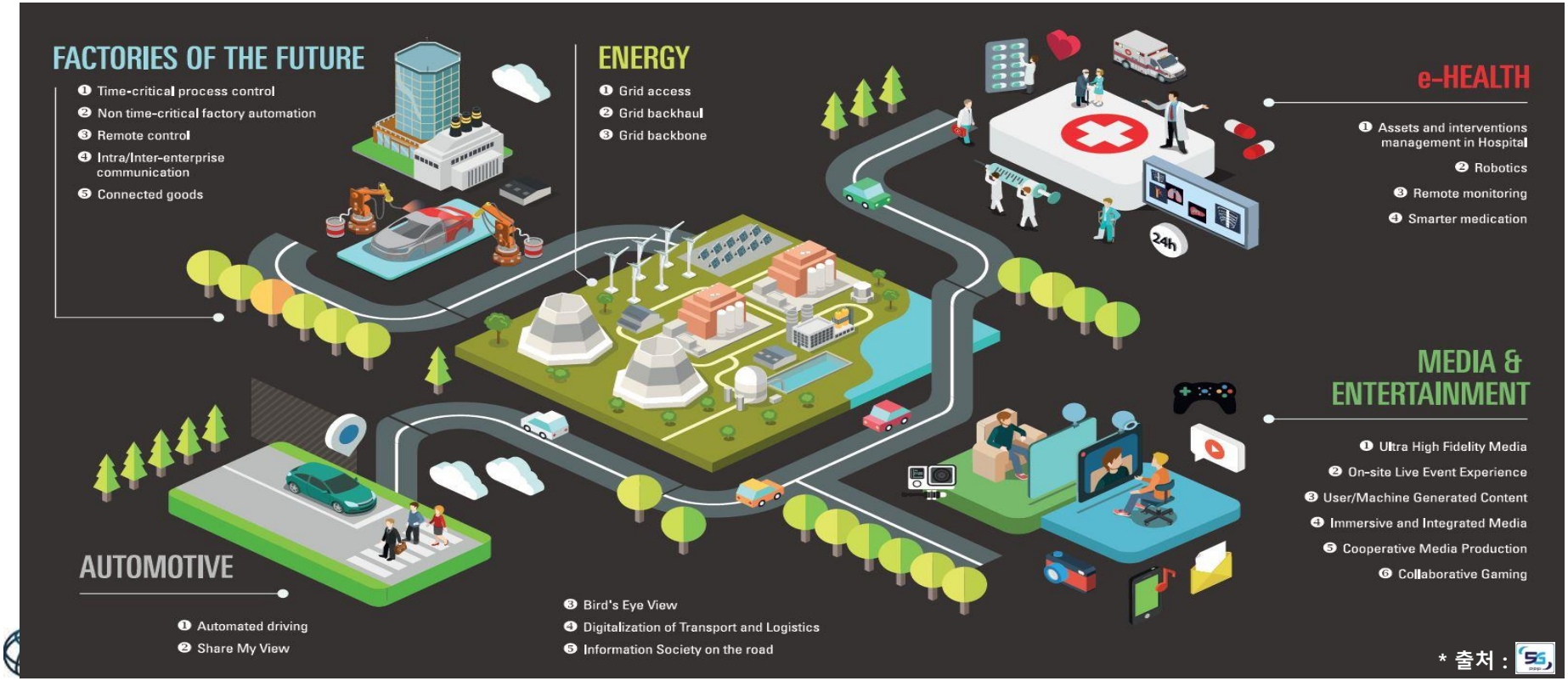
5G Services: beyond voice and data

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



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5G Rollout Outlook

USA

- Now: NSA Sub-6 GHz; mmWave; Sub-6 FDD; Standalone
- 2021: Sub-6 carrier aggregation; Sub-6 + mmWave aggregation

Europe

- Now: NSA Sub-6 GHz; Sub-6 FDD
- 2020: mmWave
- 2021: Sub-6 carrier aggregation; Standalone

LatAm

- Now: NSA Sub-6 GHz; Sub-6 FDD
- 2021: mmWave; Sub-6 carrier aggregation; Standalone

China

- Now: NSA Sub-6 GHz
- 2020: Sub-6 FDD; Standalone
- 2021: Sub-6 carrier aggregation; mmWave

India

- 2021: NSA Sub-6 GHz; mmWave; Standalone

SEA

- Now: NSA Sub-6 GHz
- 2020: mmWave
- 2021: Standalone

Japan

- Now: NSA Sub-6 GHz; mmWave
- 2020: Sub-6 FDD; Sub-6 carrier aggregation
- 2021: Standalone; Sub-6 + mmWave aggregation

Korea

- Now: NSA Sub-6 GHz
- 2020: mmWave; Standalone
- 2021: Sub-6 FDD; Sub-6 carrier aggregation; Sub-6 + mmWave aggregation

Australia

- Now: NSA Sub-6 GHz
- 2020: Sub-6 FDD
- 2021: mmWave; Sub-6 carrier aggregation; Standalone

"+" implies the year indicated and beyond

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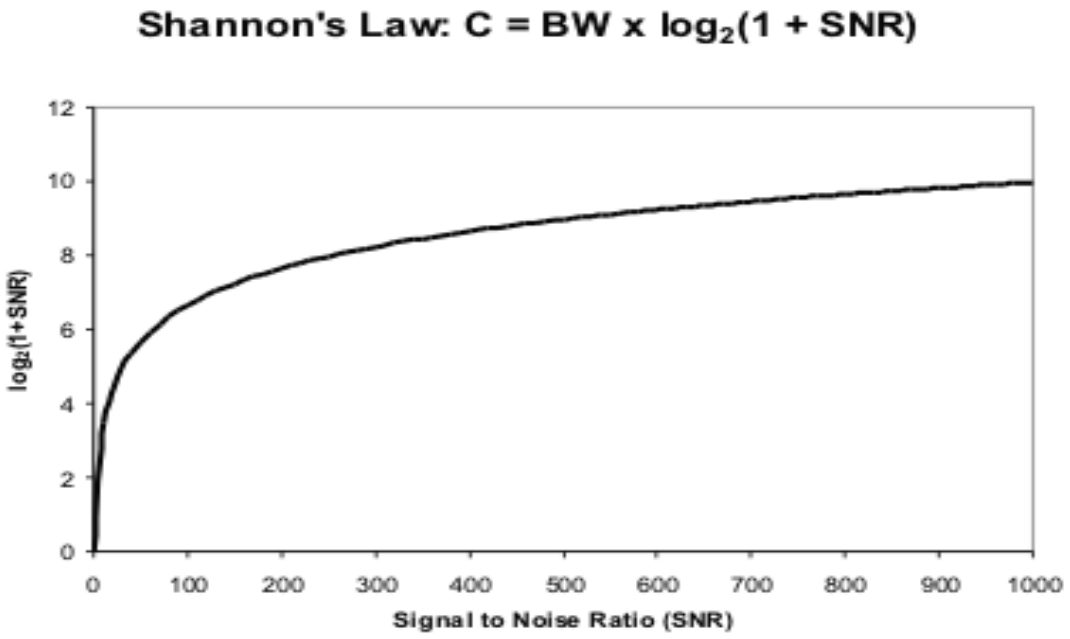
SHANNON'S THEOREM -WHAT DOES IT TELL?

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



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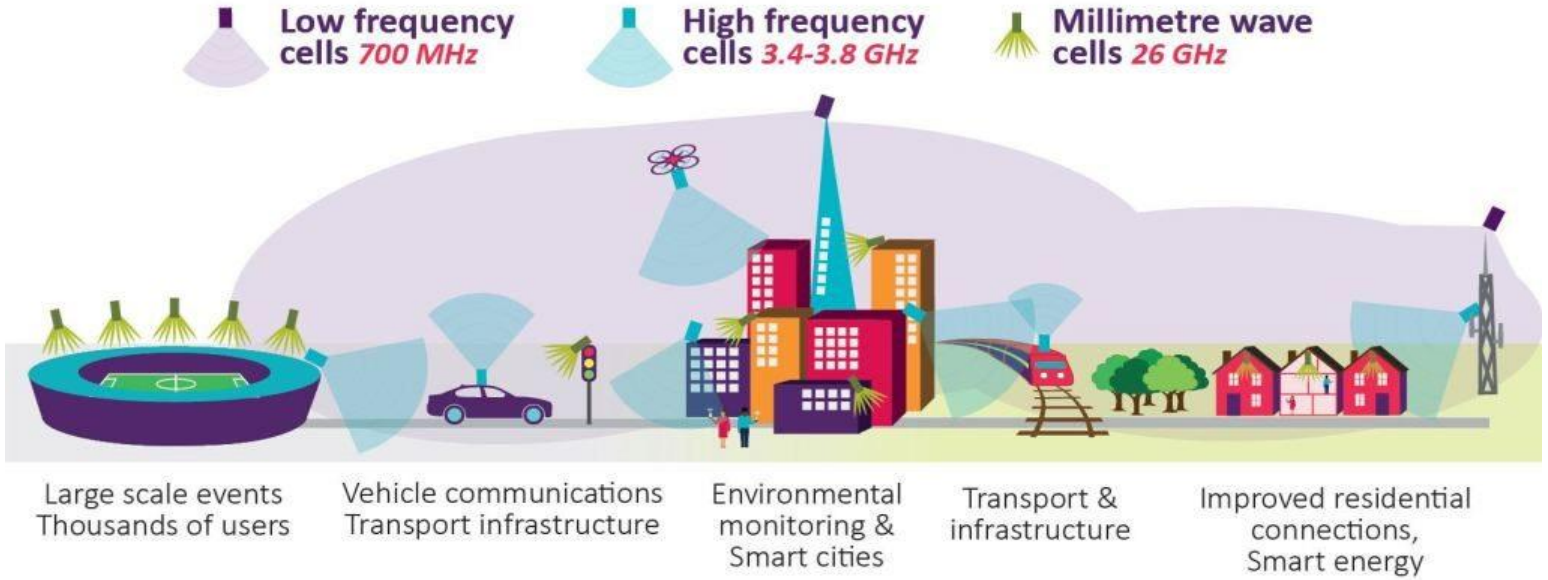
Spectrum Management

- 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)

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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 !