Beyond the Hype: 5G and What You Need to Know

Lauren Cooper

Cybersecurity Engineer

lacooper@cert.org

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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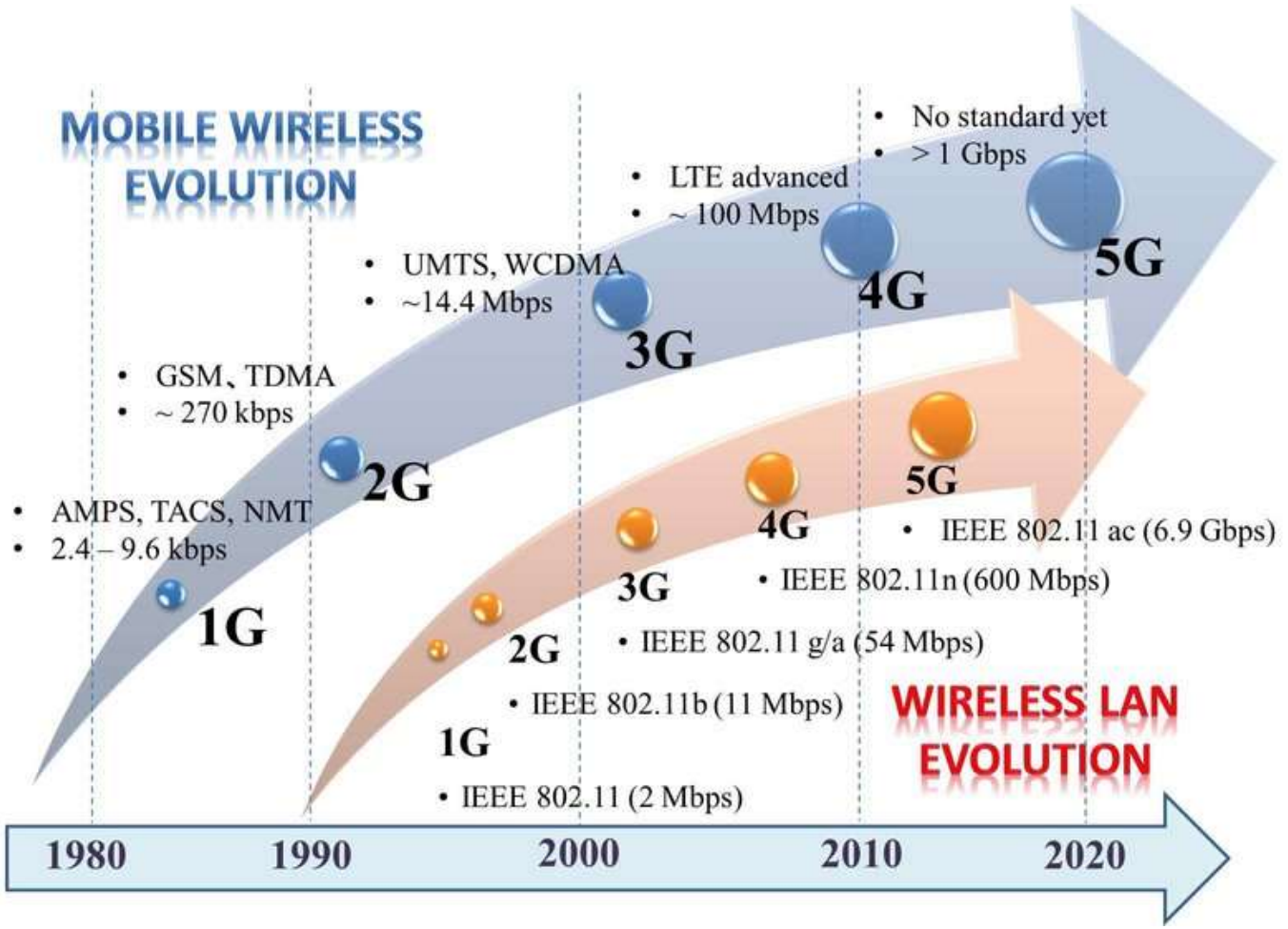
Agenda

- Introduction – What is 5G?
- Spectrum & Engineering
- 5G in Practice
  - Use Cases
  - Enabling Technologies
- Security

Introduction – What is 5G?

Brief History of Mobile Standards

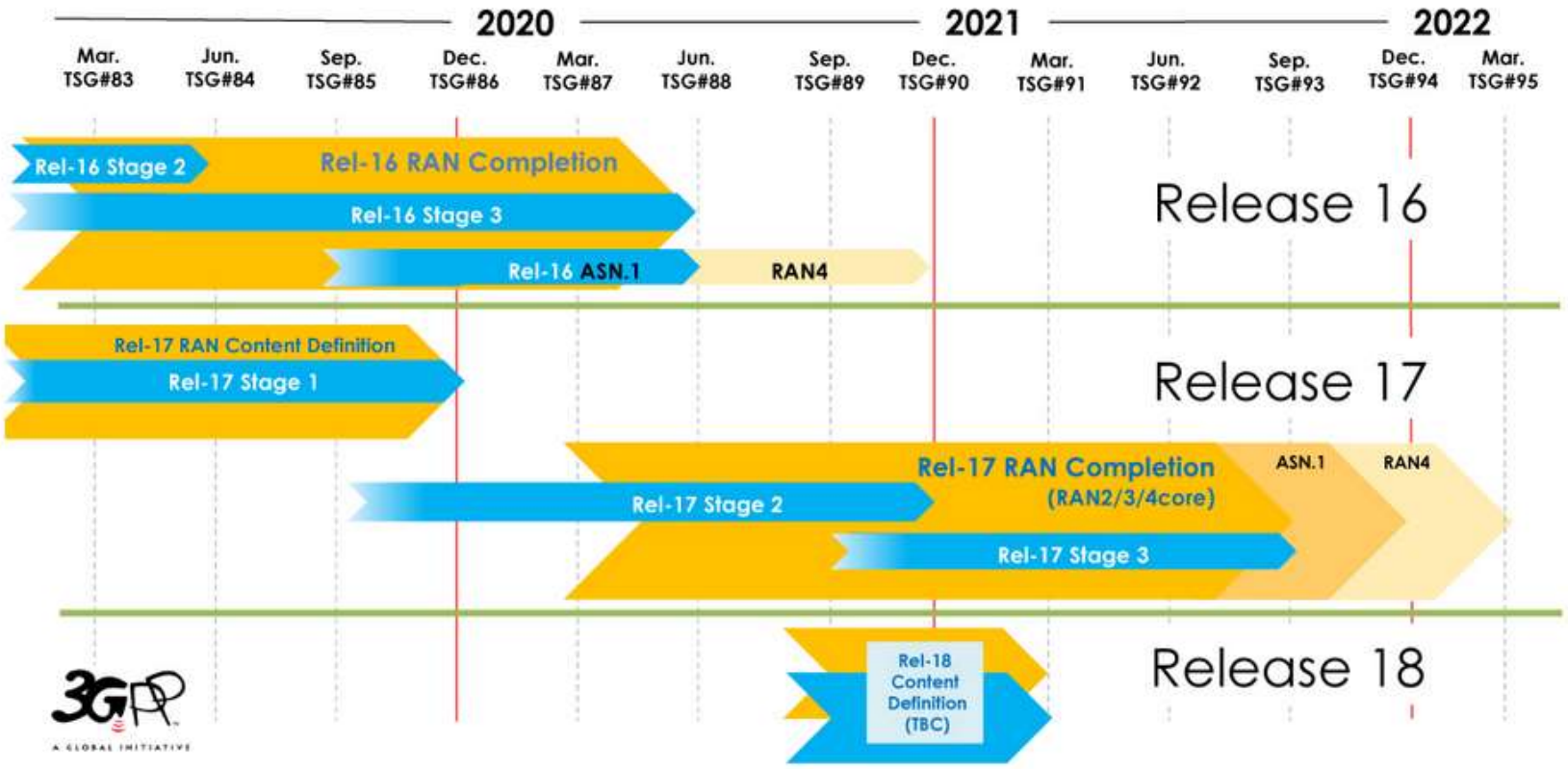


https://www.researchgate.net/figure/Wireless-technology-evolution_fig1_322584266

Who Develops 5G Standards?

- 3GPP
  - Primary standards development body
  - Cooperative, collaborative, and multinational effort
- Other standards contributors:
  - 5G Americas
  - IEEE
  - ITU

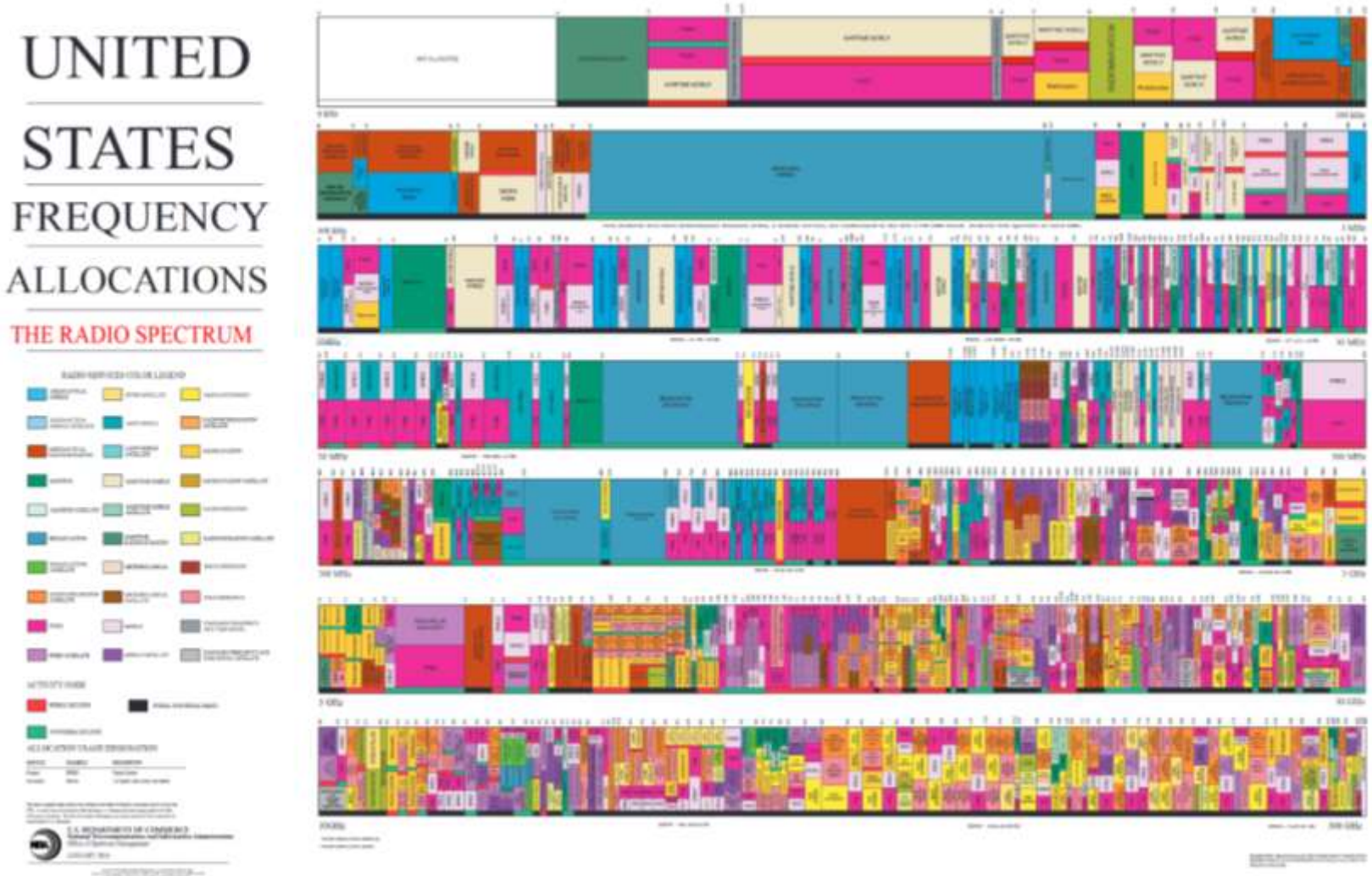
Standards Timeline



Source: 3GPP TSG SA#87e, 17-20 March 2020, e-meeting document SP-200222

Spectrum & Engineering

Spectrum: A Finite Resource



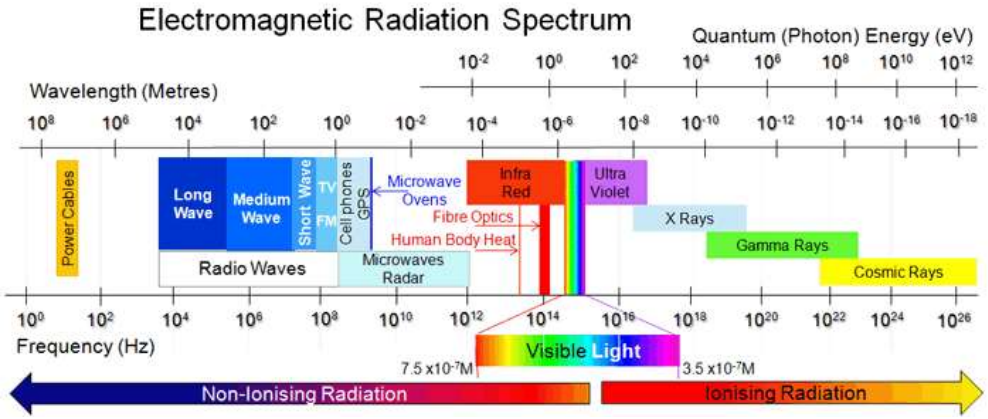
Two Paths for 5G Engineering Investment

Sub-6 GHz:

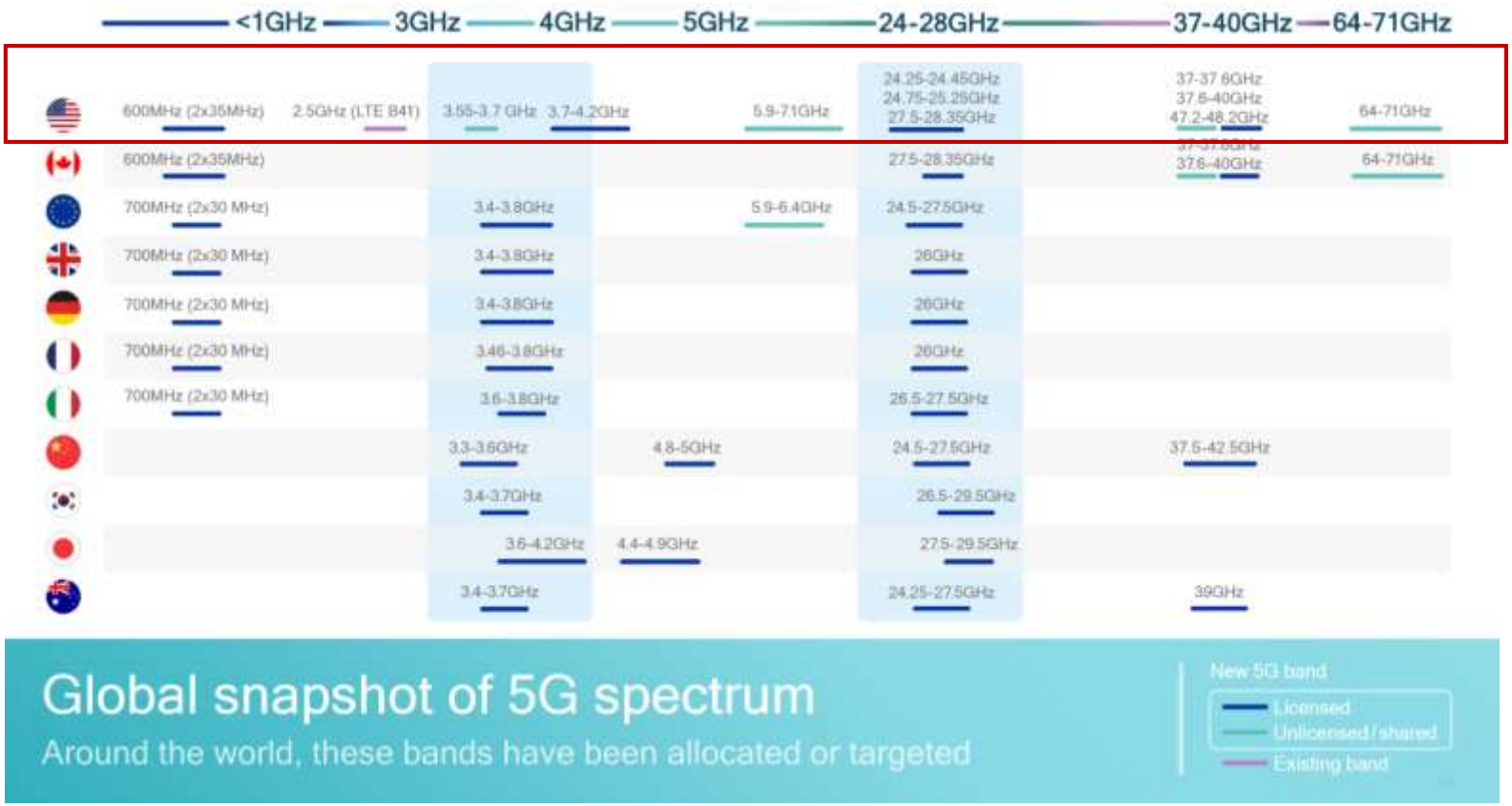
- Mostly 3 to 4 GHz Spectrum
- Lower power, therefore greater range
- Fewer number of base stations needed
- Majority of countries pursuing Sub-6 GHz options

mmWave:

- ~24 to 100 GHz Spectrum
- Higher power, but smaller range
- Greater number of base stations needed
- Few countries pursuing mmWave options



5G Proposed Spectrum Allocation

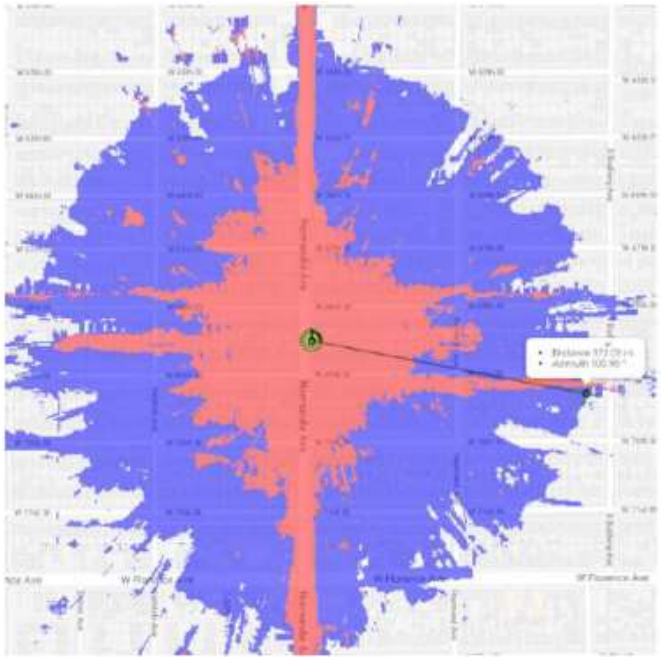


https://www.qualcomm.com/media/documents/files/spectrum-for-4g-and-5g.pdf

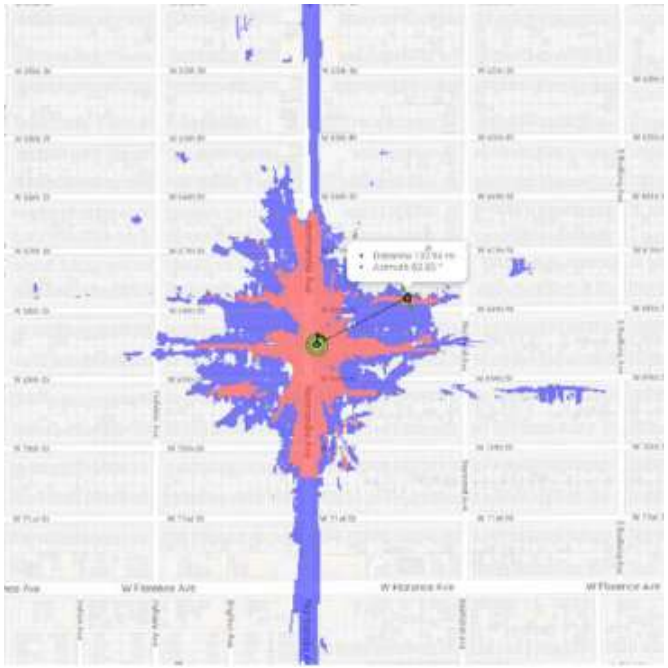
Propagation Challenges

100 Mbps

1 Gbps



Sub-6 GHZ Propagation
(3.4 GHZ)

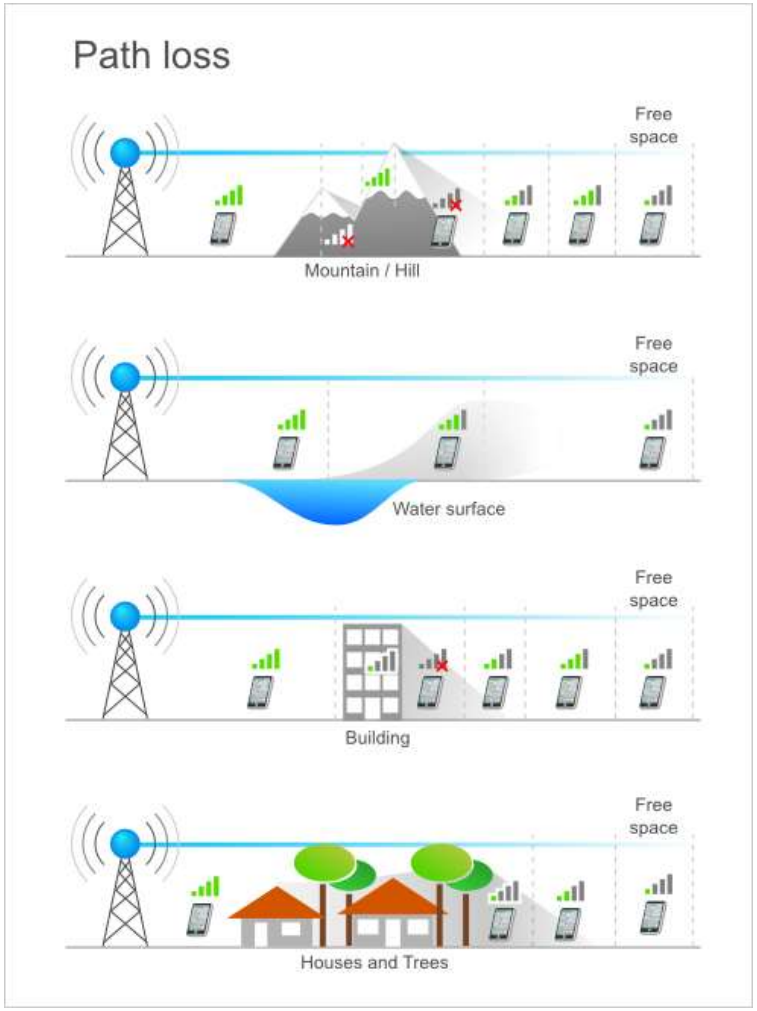


mmWave Propagation
(28 GHZ)

https://media.defense.gov/2019/Apr/03/2002109302/-1/-1/0/DIB_5G_STUDY_04.03.19.PDF

New Tech – Same Problems

- Interoperability Challenges:
  - 3.3 GHz to 3.65 GHz previously reserved for exclusive federal use
  - mmWave development emphasized in US, because of greater spectrum availability
  - Rest of world focusing on Sub-6 development
- Engineering standards still being finalized
- Physical limitations to effective propagation



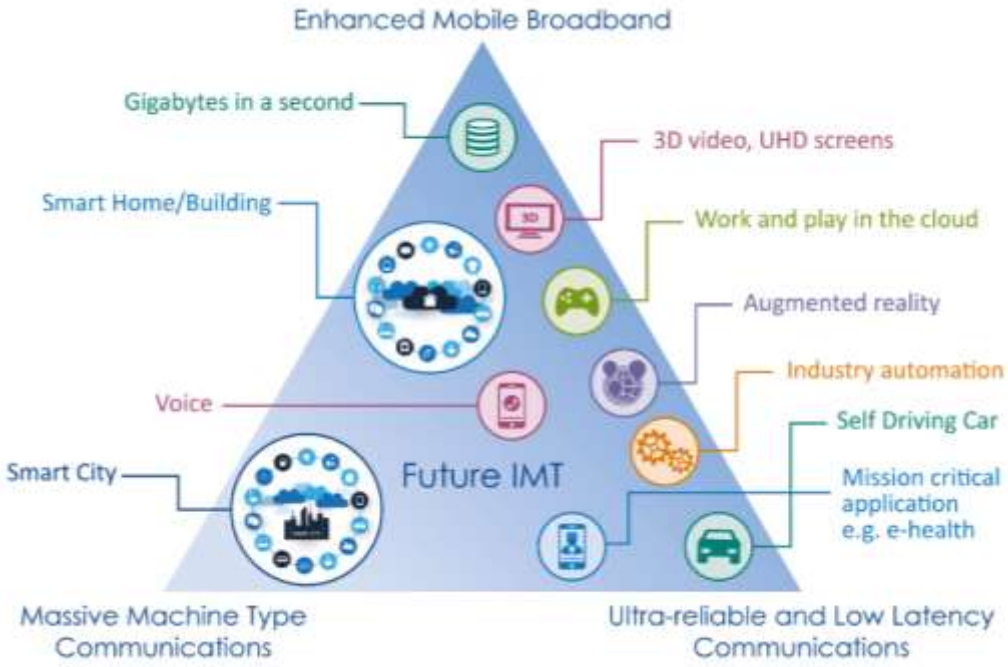
https://wiki.yatebts.com/index.php/Radio_Propagation_Concepts

5G in Practice

5G Use Cases

Three Main Use Cases:

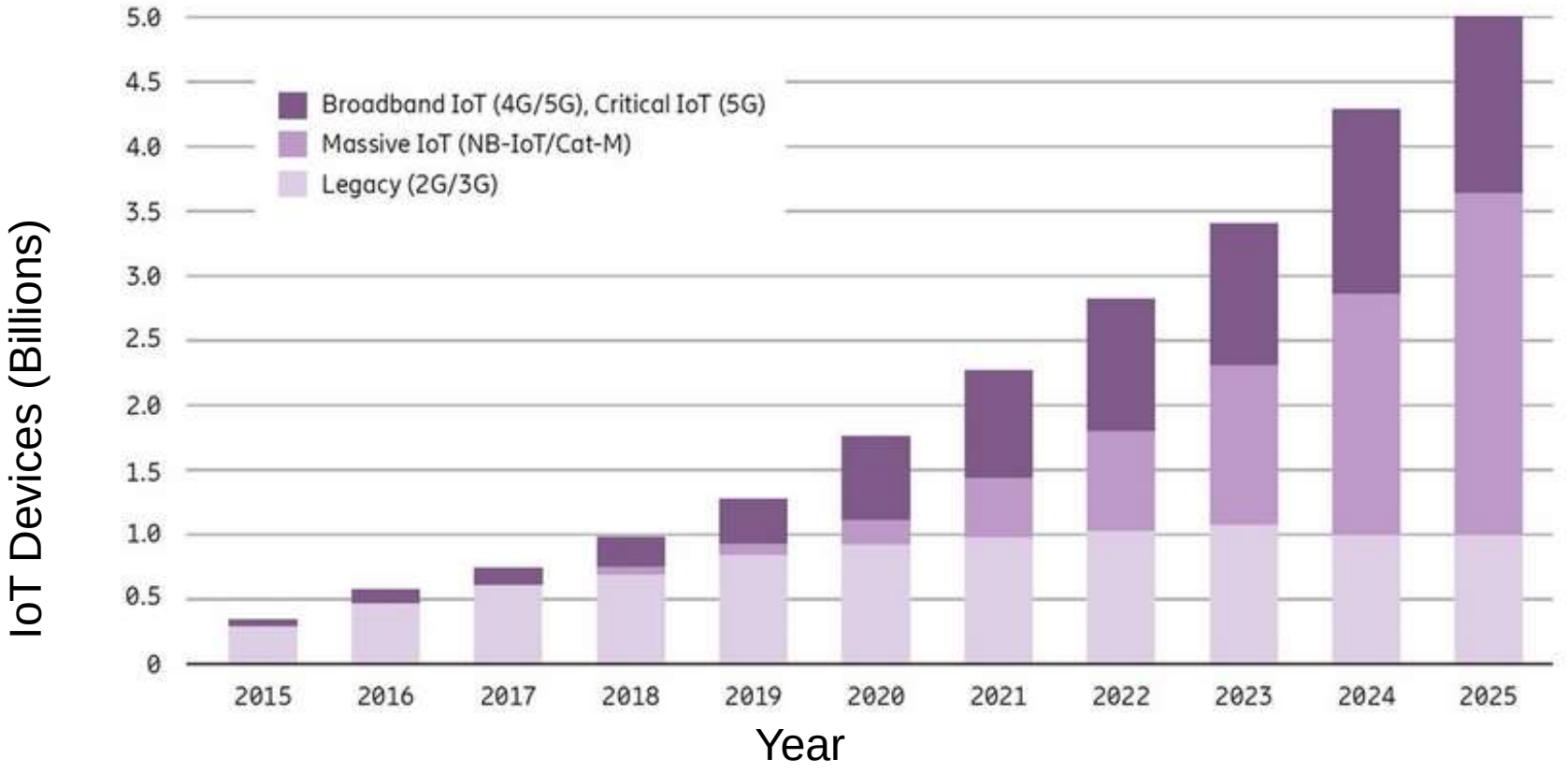
1. Enhanced Mobile Broadband (eMBB)
   - *Example: Mobile streaming*
2. Massive Machine Type Communications (mMTC)
   - *Example: Agricultural sensors*
3. Ultra-Reliable & Low Latency Communications (URLLC)
   - *Example: Autonomous vehicles*



https://www.itu.int/en/ITU-D/Documents/ITU_5G_REPORT-2018.pdf

Internet of Everything

Ericsson Predicts Massive Growth in IoT Devices



https://www.ericsson.com/en/reports-and-papers/white-papers/cellular-networks-for-massive-iot--enabling-low-power-wide-area-applications

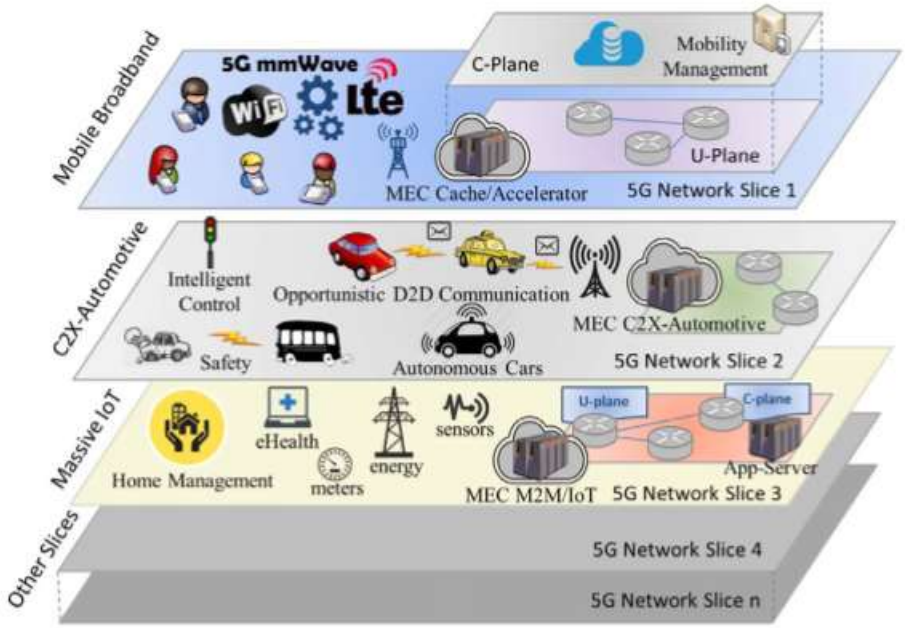
Key Enabling Technologies

SDN – Software Defined Networking

NFV – Network Function Virtualization

MEC – Multi-Access Edge Computing

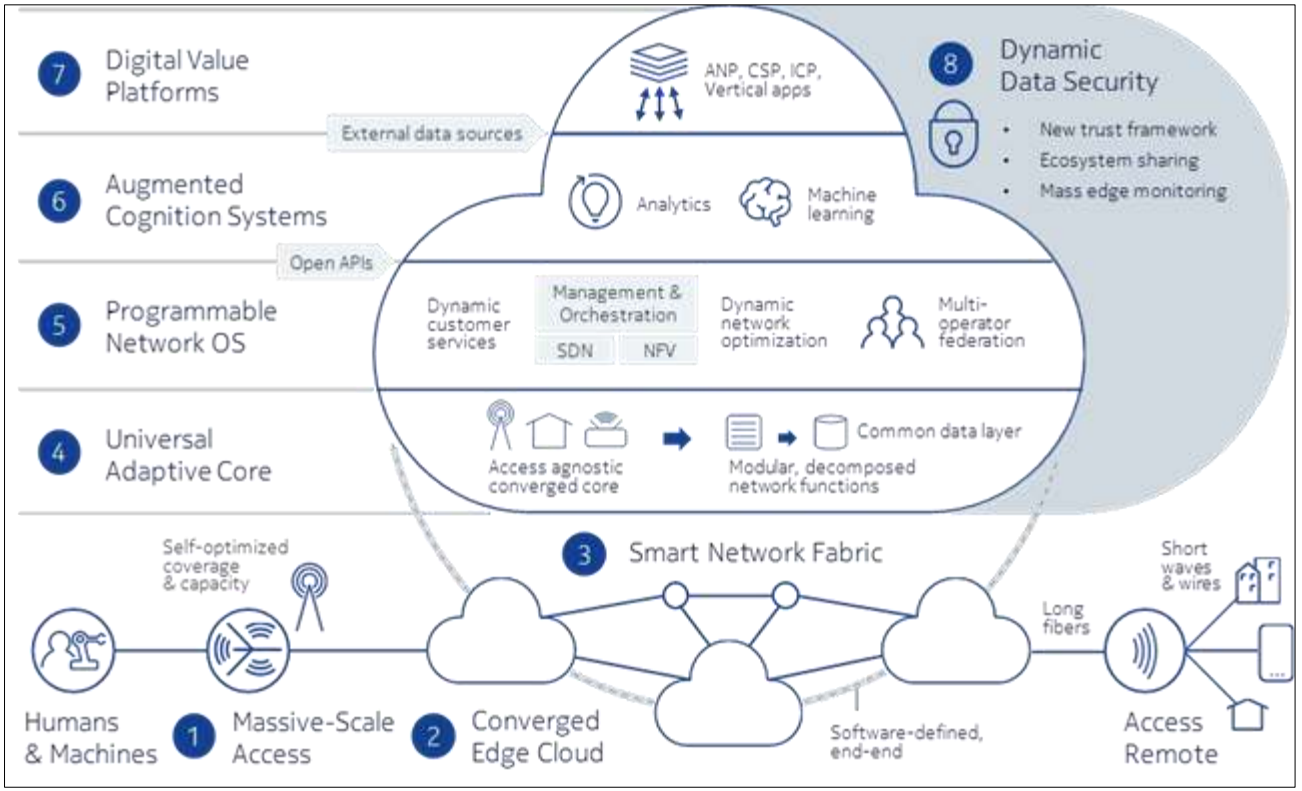
- Network slices logically separated
- Multi-tenant scenario
- Slices provisioned with different requirements



5G Network Slices

https://arxiv.org/ftp/arxiv/papers/1912/1912.02802.pdf

5G & SDN Ecosystem



https://networks.nokia.com/5g/get-ready

Security

Key Security Considerations

- 5G will be pervasive & ubiquitous
- Attack Surface:
  - Millions of devices and connections
  - Unprecedented amounts of data
- Two different deployments:
  - Standalone (SA)
  - Non-Standalone (NSA)
    - Co-exists with 4G LTE
- NSA deployments vulnerable to exploit of legacy protocols (GTP, SS7, and Diameter)
  - Disclosure of subscriber information & spoofing

https://newsroom.intel.com/editorials/intel-building-5g-revolution-today/

5G Component Marketplace

Huawei 

Ericsson 

Nokia 

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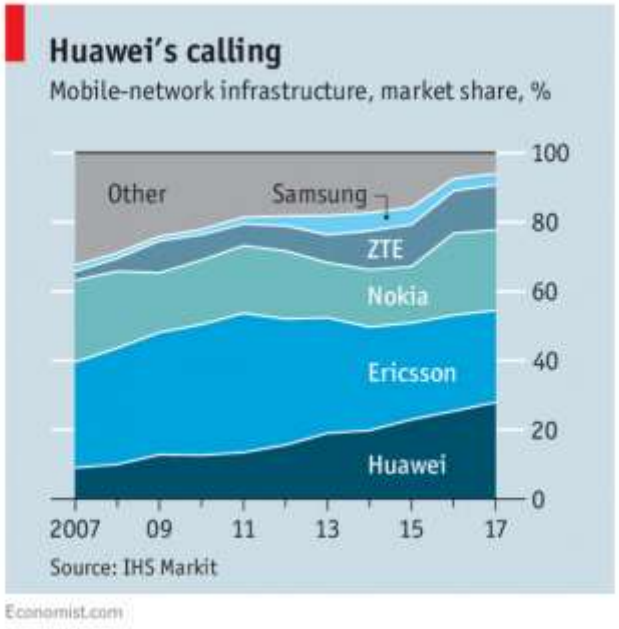
No American company currently can provide 5G core infrastructure components at scale



"By the end of March, Huawei said it had signed 40 commercial 5G contracts with carriers, shipped more than 70,000 5G base stations to markets around the world and expects to have shipped 100,000 by May."

-Reuters, April 21 2019

5G - Areas of Future Research

- Zero trust architecture models
- SDN, NFV, & MEC
- Vulnerability research
- Provisioning best practices
- Data protection & privacy
- And so much more

The sky is the limit!

Questions?