5G Evolution

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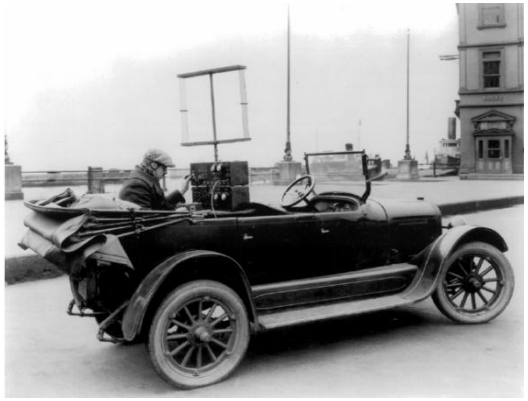
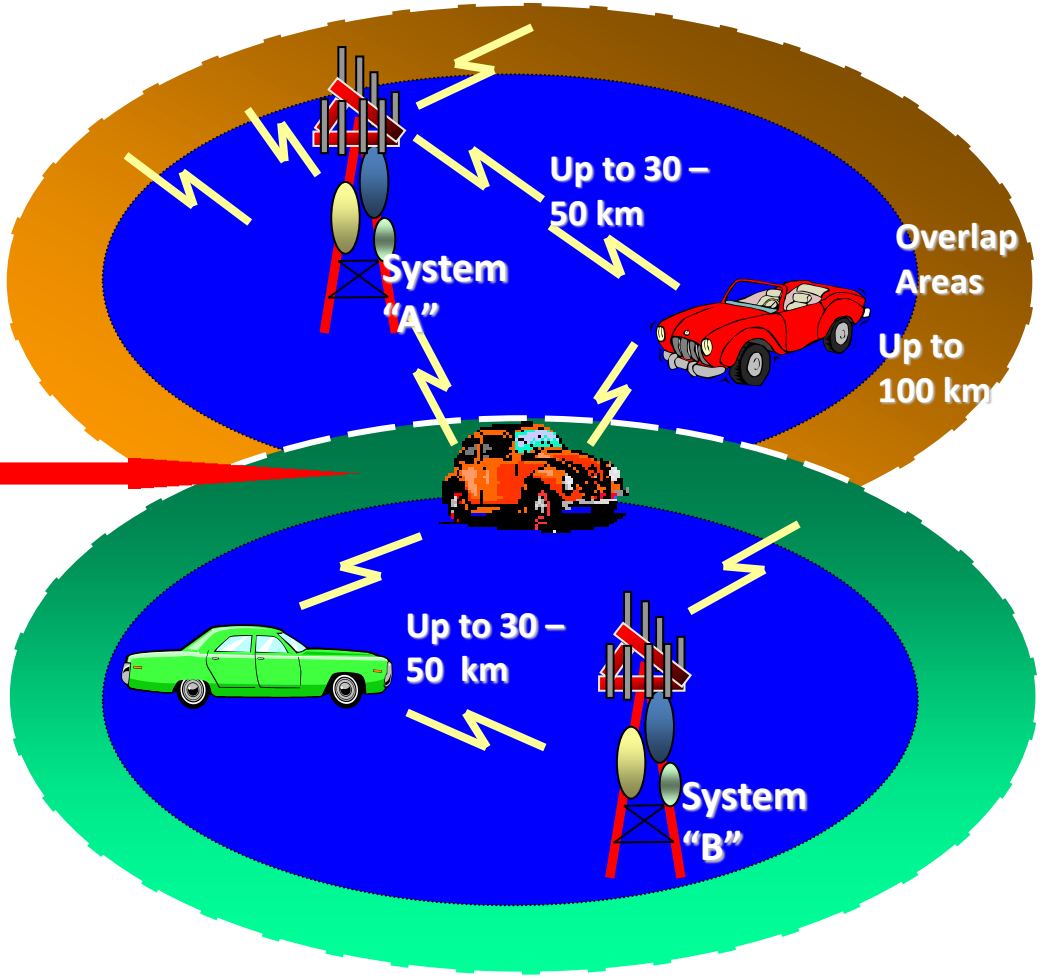
Presentation Outline

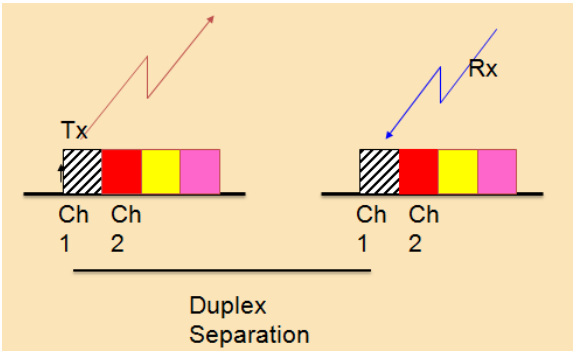
- Mobile Radio Communication Evolution
- 5G
  - Vision and Requirement
  - Use Cases
  - Research Activities at UTM
- Summary

Conventional Radio Telephony





Could get service from either transmitter, causing interference



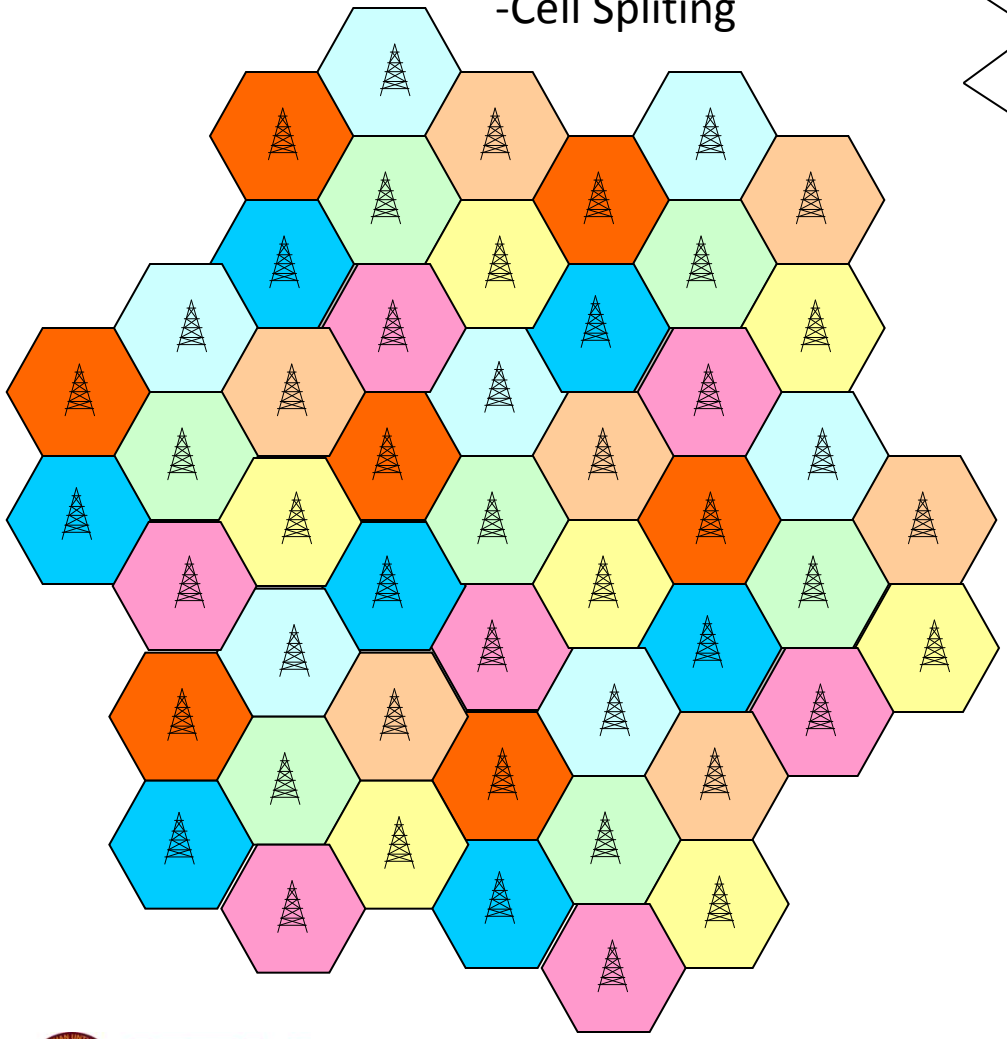
CELLULAR RADIO SYSTEM

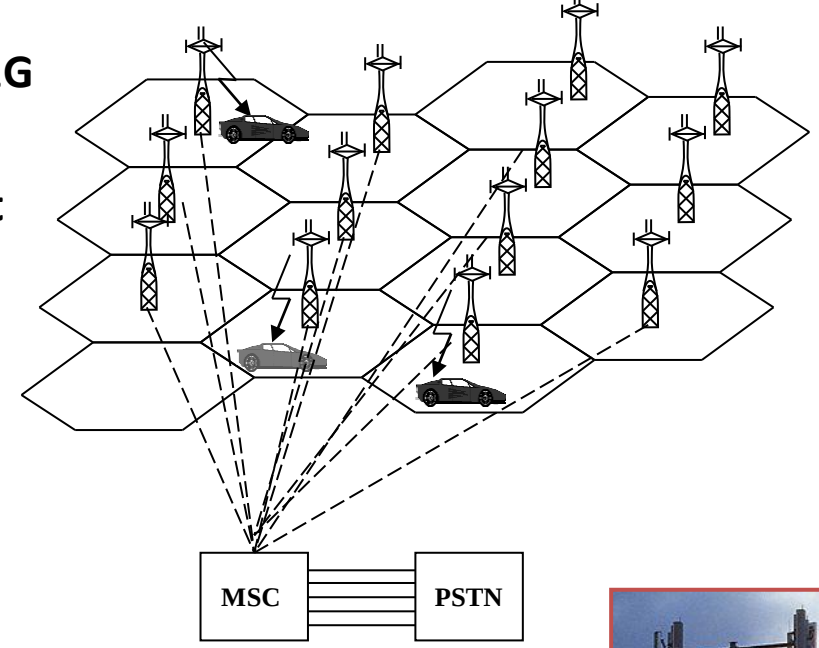
1G

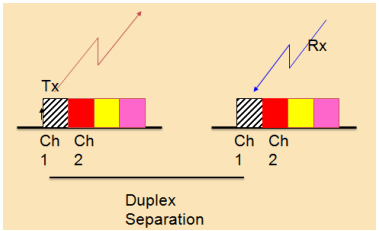
Cellular Radio Concept

-Frequency Reuse

-Cell Spliting

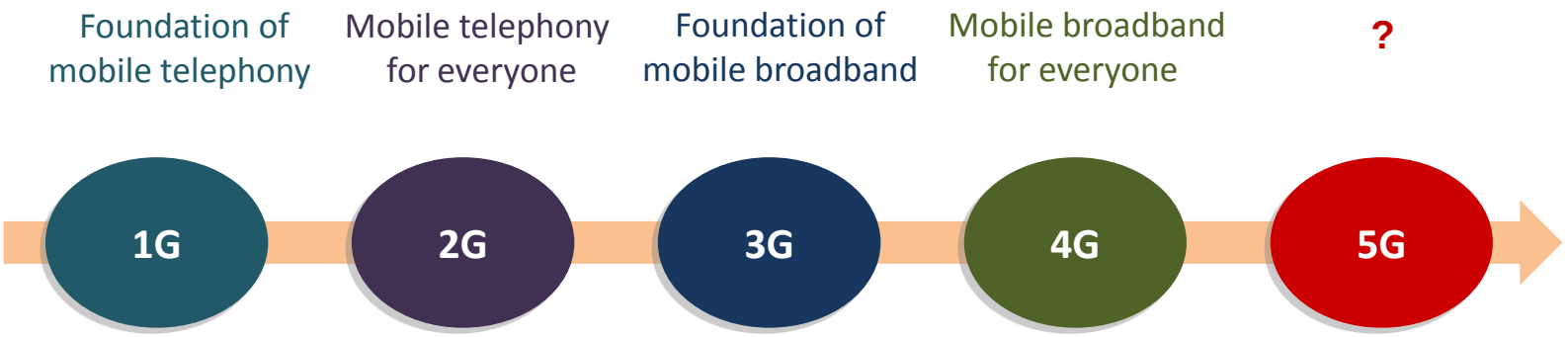






Evolution Mobile Communication
10-year cycle between generations

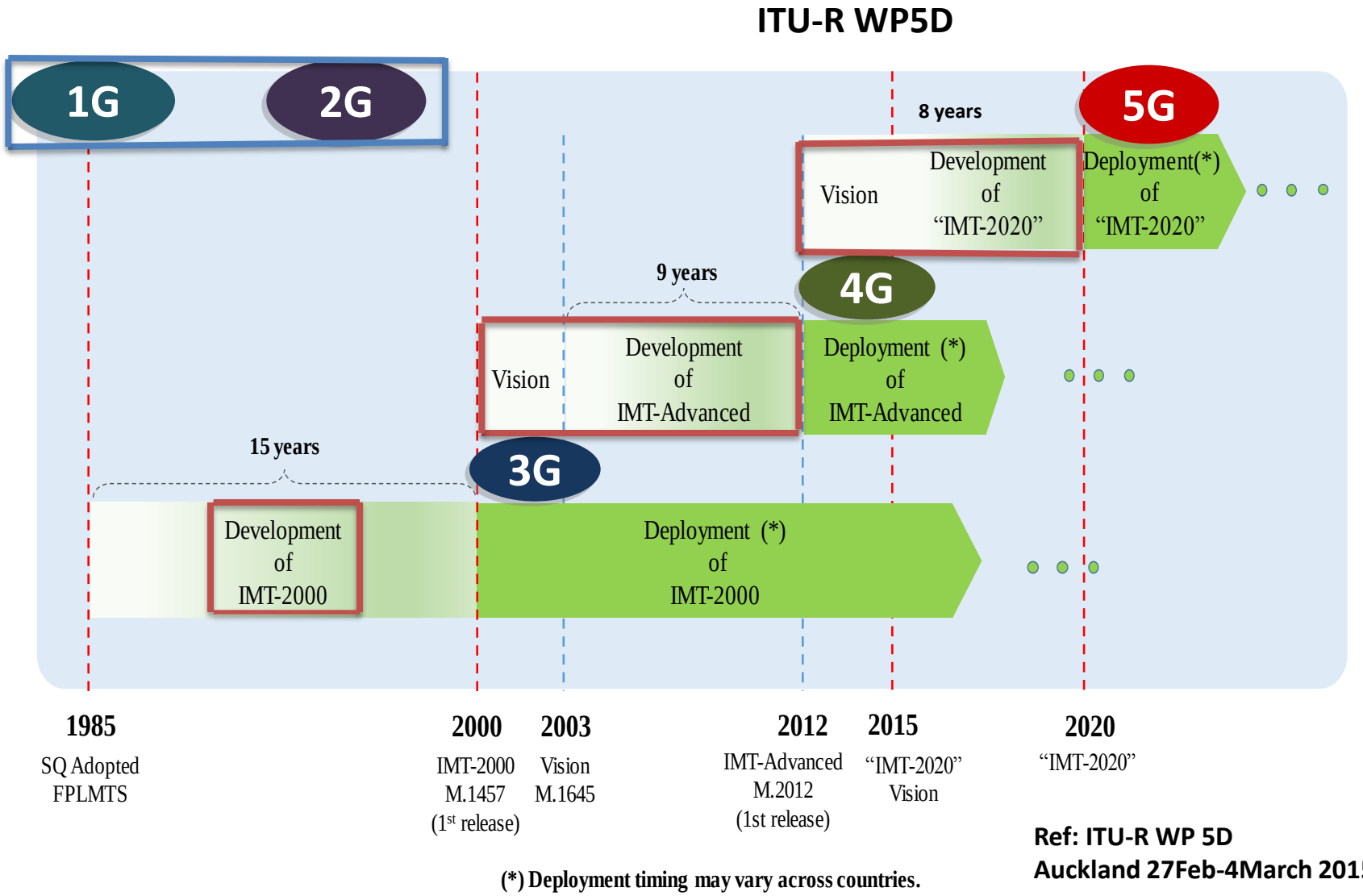
Analogue Voice | **Digital Voice** | **Mobile Data** | **Mobile Broadband** | **Network Society**



RAN CN

Source: Ericsson, Jun 2013, 5G Radio Access: Research & Vision

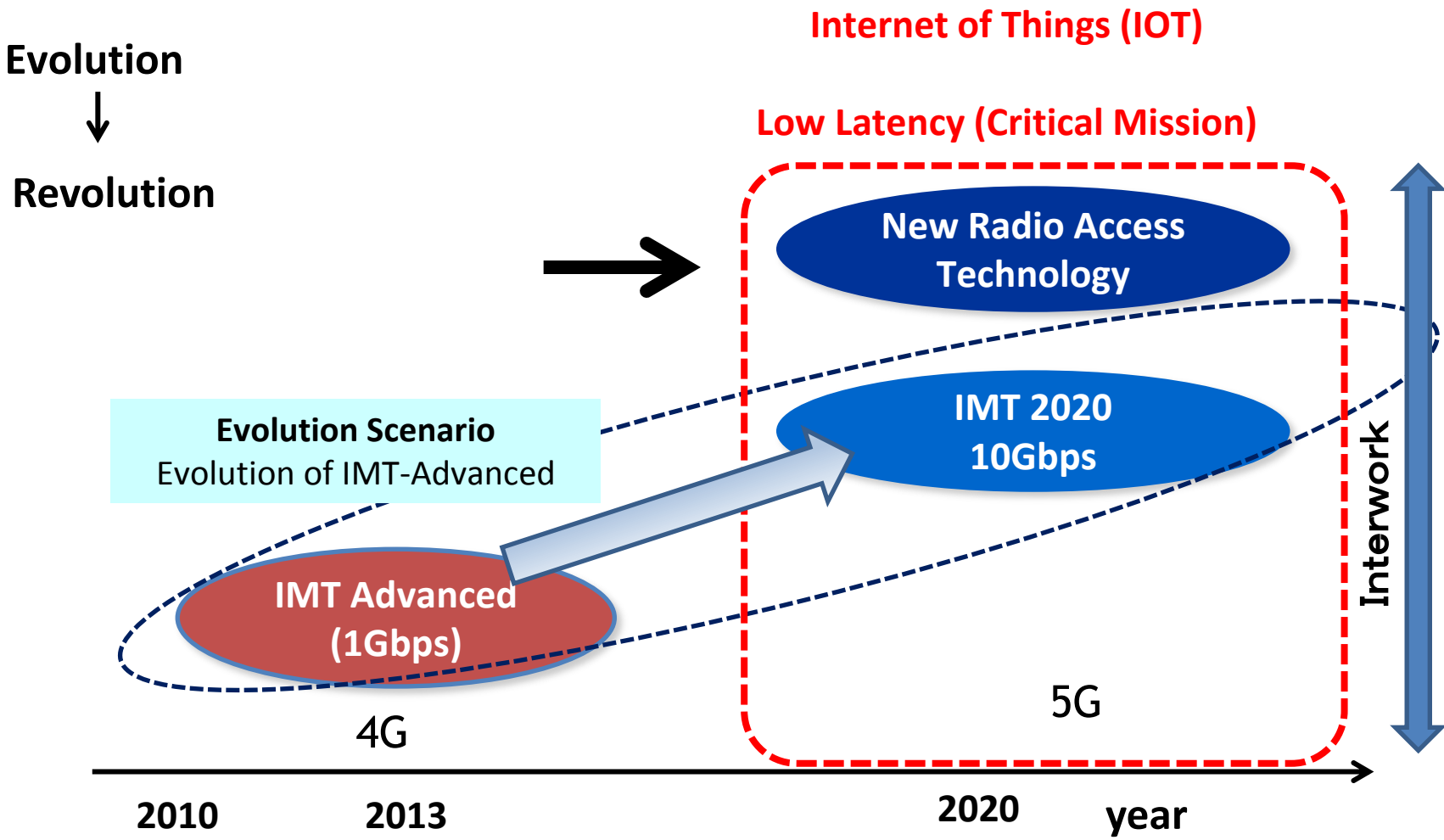
Overview of timeline for IMT development and deployment



(*) Deployment timing may vary across countries.

Ref: ITU-R WP 5D
Auckland 27Feb-4March 2015

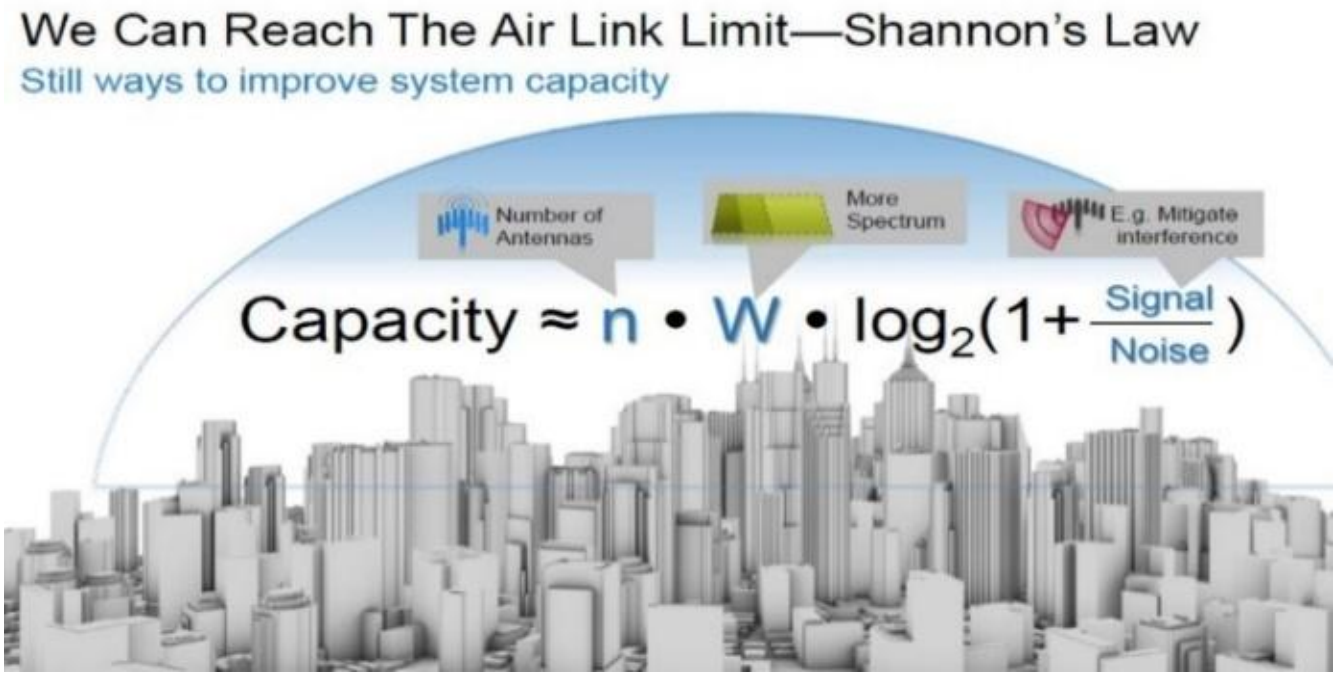
5G: Evolution and Revolution

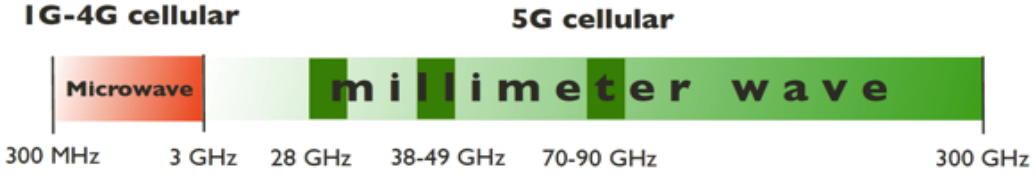


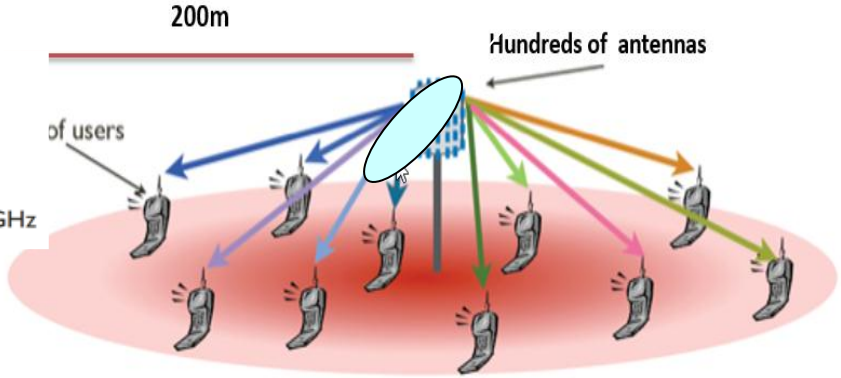
5G: Vision and Requirements

- All machines, humans, things are wirelessly connected by 2020:
- 25 billion connection
- Massive Connectivity
- Download speeds of 10Gbps
- Latency of 1 milliseconds
- Ultra Reliable
- Long Battery Life

5G in 2020: Capacity



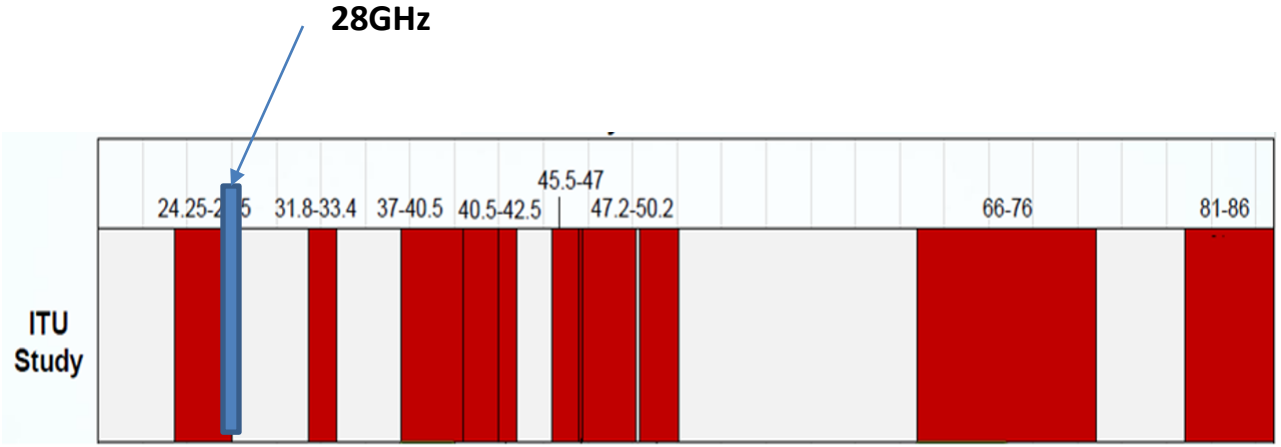




World Radio Conference (WRC) 2015

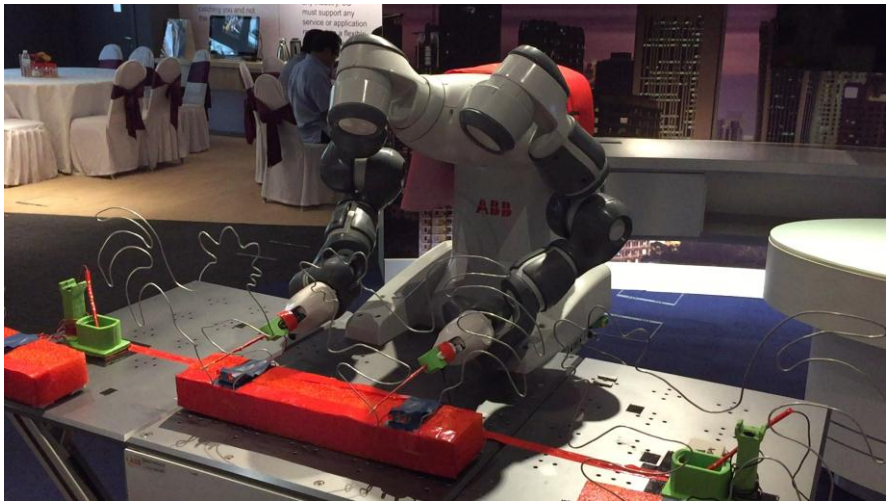
RESOLUTION 238 (WRC-15)

Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond



Innovation Centre for 5G, the future in the making.

Robot Arm for Remote surgery



Massive IOT

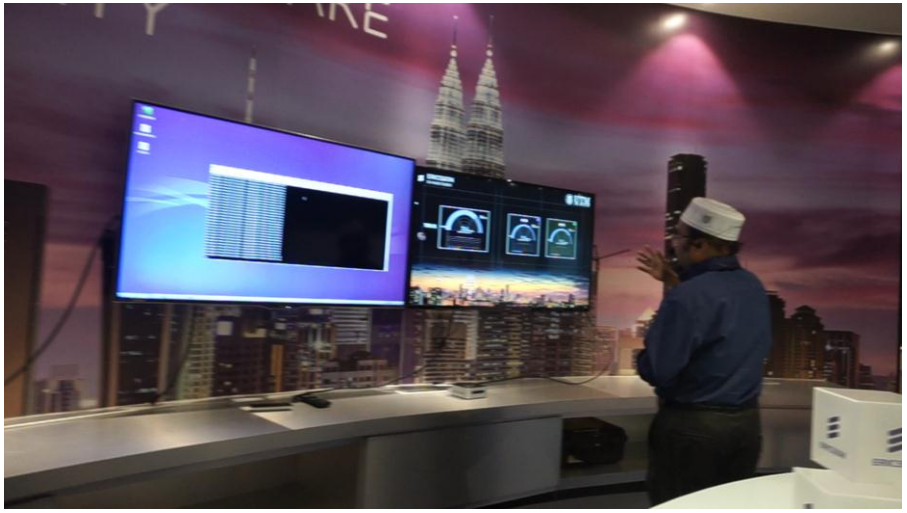
Smart Building

NBIOT: Smart Parking

Smart Meter

Connected Water

Demo 5G BS and UE at IC5G

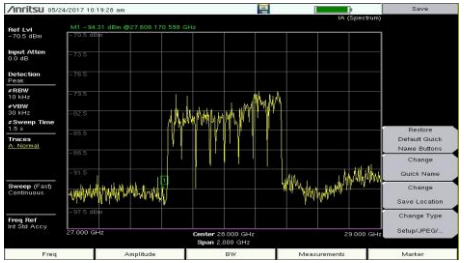


Enhanced Mobile Broadband and Latency

Beamforming

Base Station

User Equipment



Awarded HICoE Status

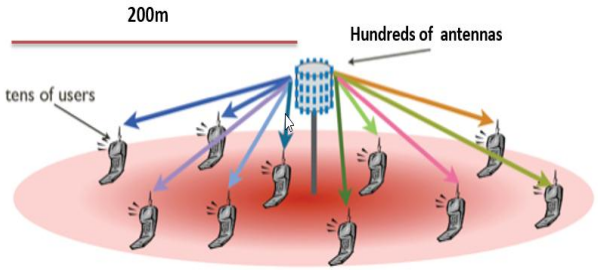
MINISTRY OF EDUCATION MALAYSIA

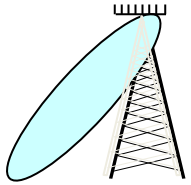
WCC
WIRELESS COMMUNICATION CENTRE

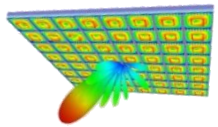
"First HICOE in the niche area of Antenna and Propagation for 5G Wireless Communications in Malaysia"

Antenna Studies

- Adaptive Beamforming
  - Follows the User / User Group dynami
  - Increases S/N Ratio
  - The Focus of the Beam is stronger with increasing number of antennas

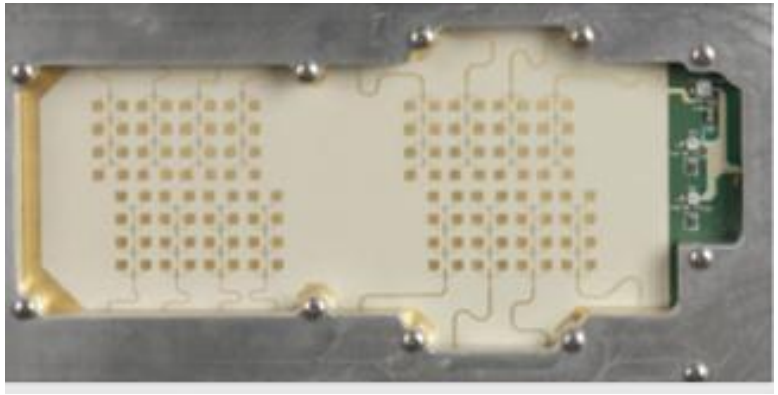


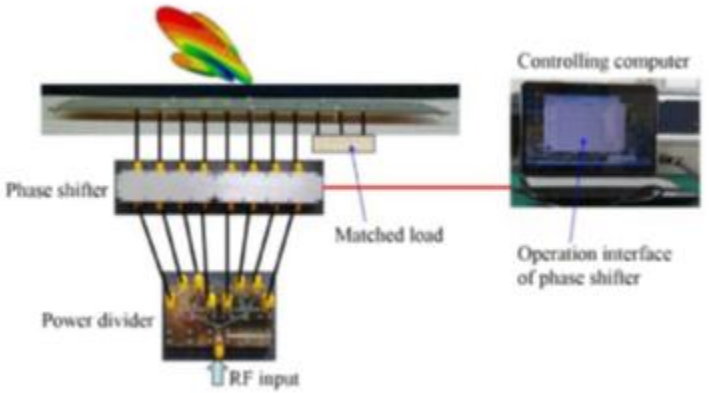


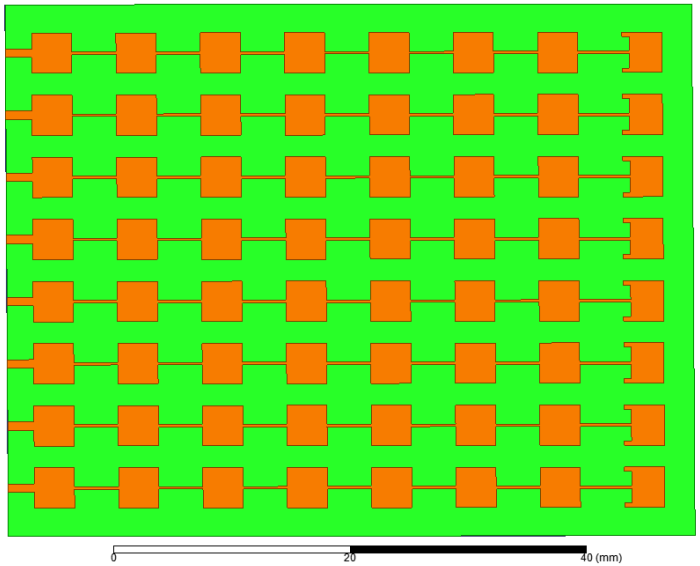


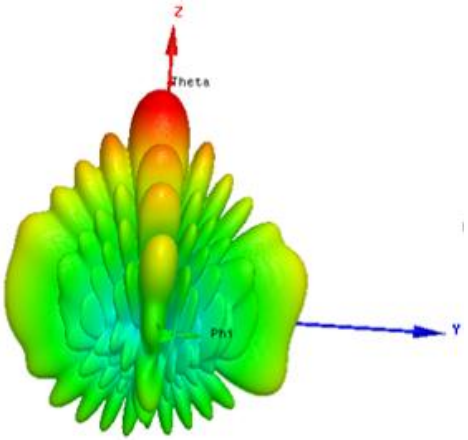
Beamforming increases S/N Ratio

Beamforming Antenna



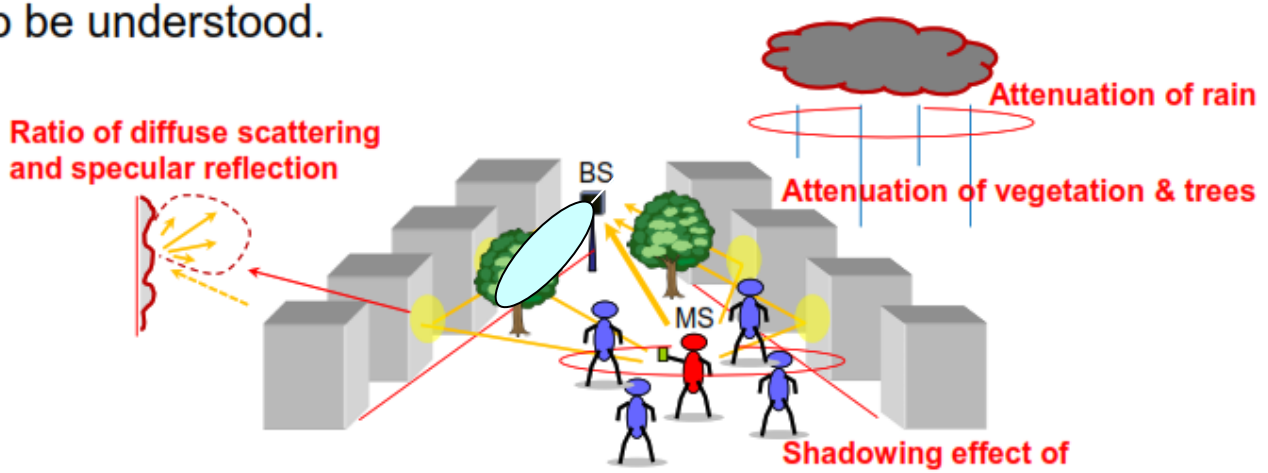


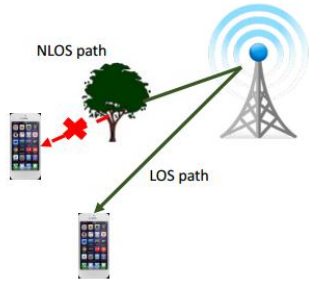


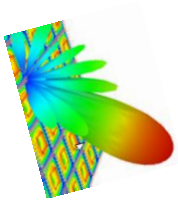


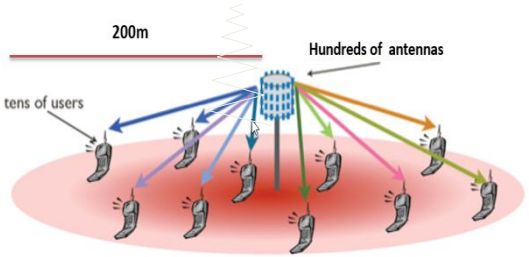
Propagation Studies

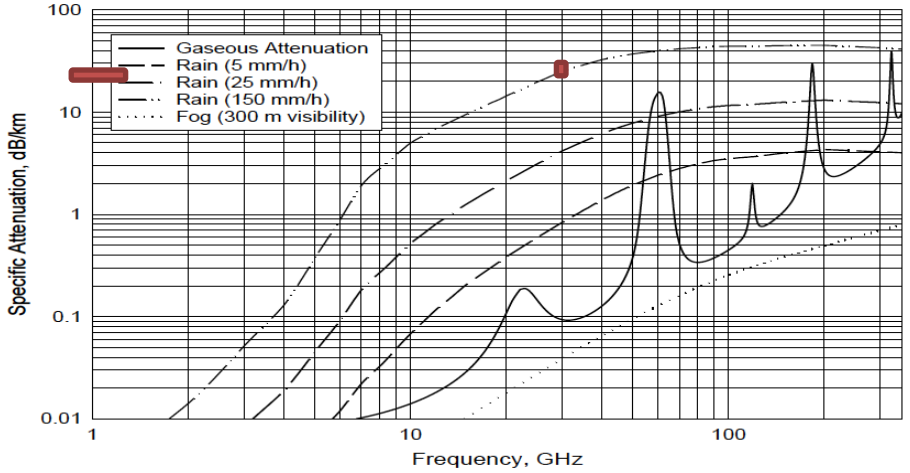
To develop channel model for frequency range above 6 GHz, frequency dependency of path loss and channel properties need to be understood.



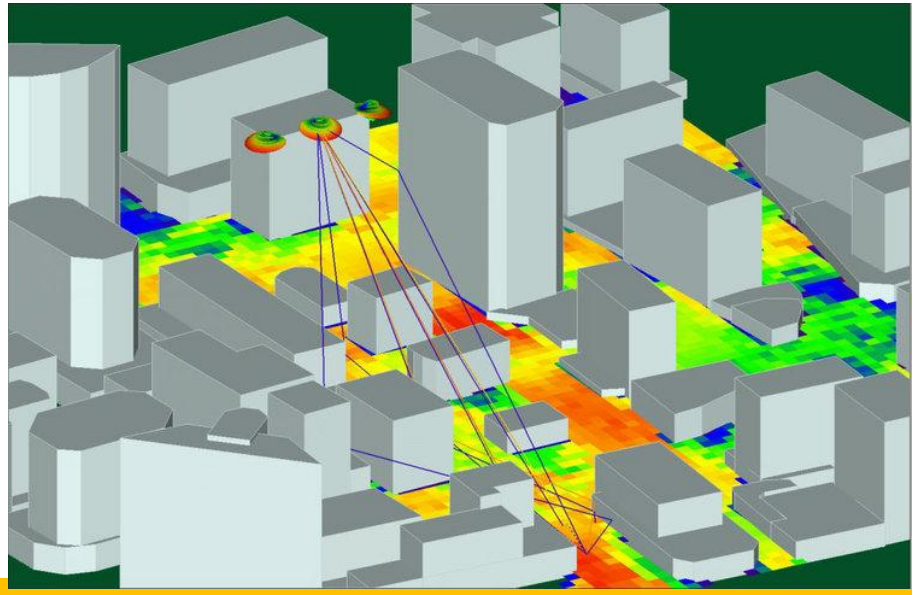








Outdoor Propagation Studies



Summary

- Evolution and Revolution
- Standardization
- Vision and Spectrum Requirement
- Antenna and Propagation Research
- IOT: Use Cases

Thank You