

# Antenna challenges

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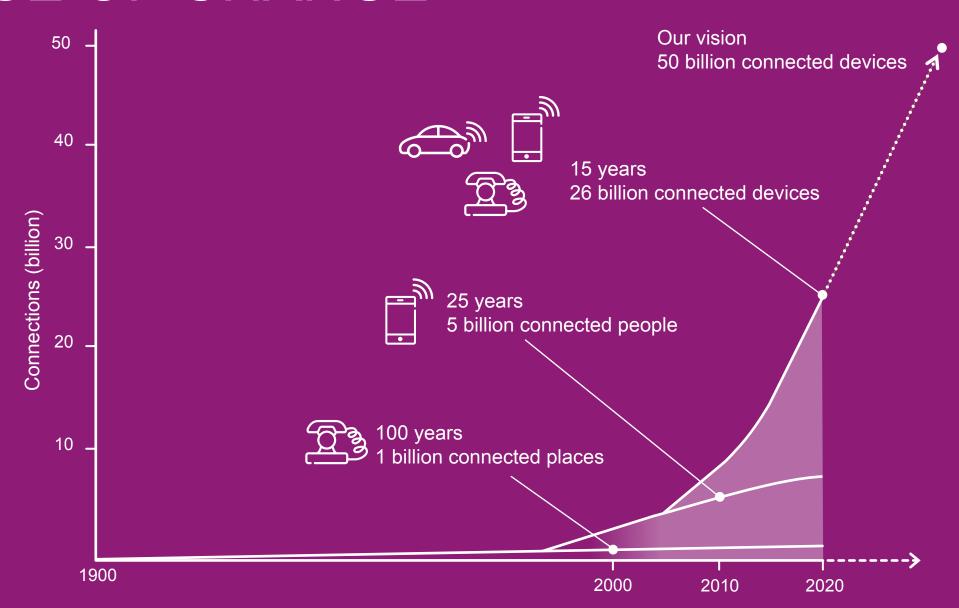
### Outline



- > What drives antenna system evolution
- > Spectrum issues
- > Propagation
- > How to handle increased demands
- > 5G Testbed
- > Take away

# PACE OF CHANGE

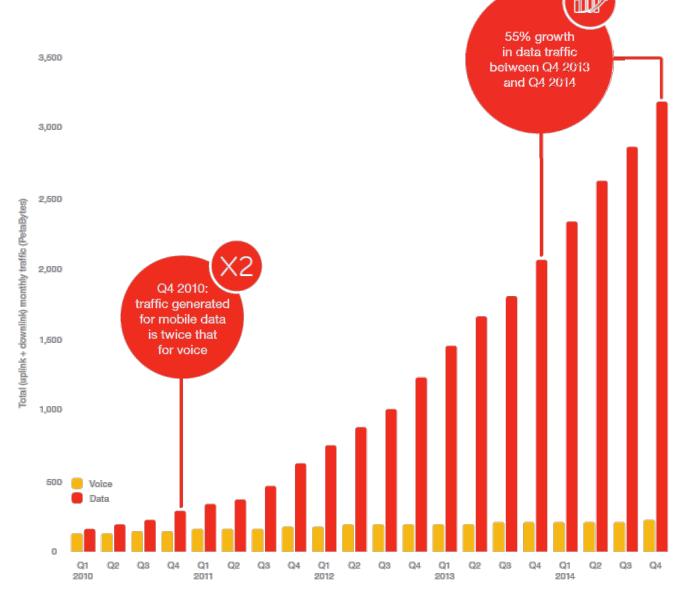




Mobile Traffic growth



55%
Growth in mobile data traffic YoY



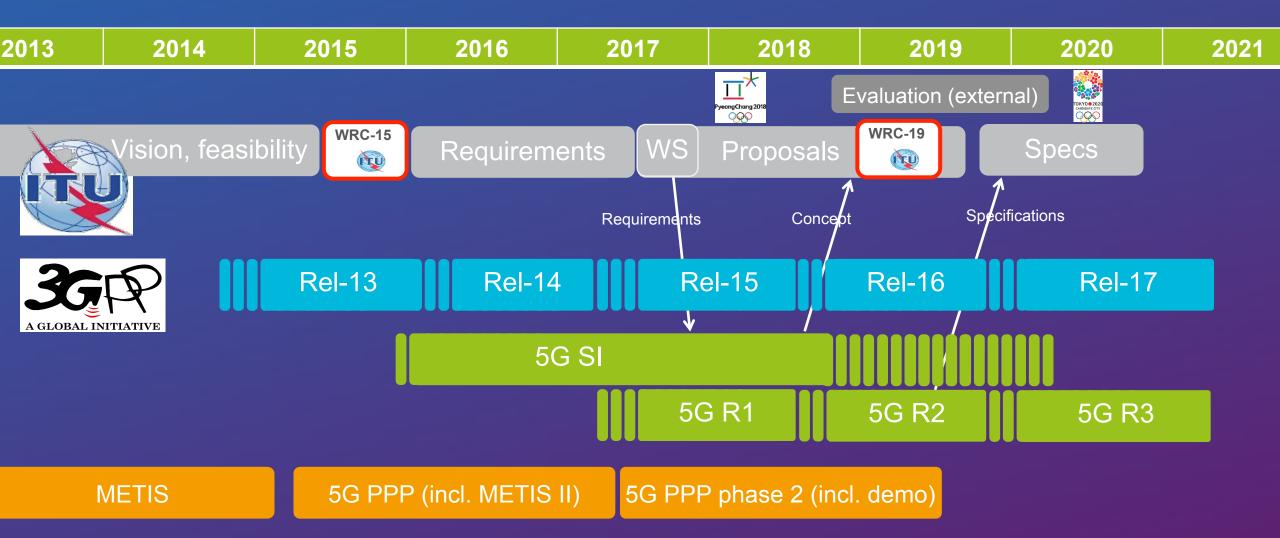
# Wide variety of Use cases



- A wide range of use cases and a corresponding wide range of requirements. Examples are
  - -Mobile broadband, everywhere and everytime
  - Remote controlled machines
  - Smart transport infrastructure and vehicles
  - Meters, sensors (massive MTC)
- > Main focus of presentation is on the first three.

# 5G time plan

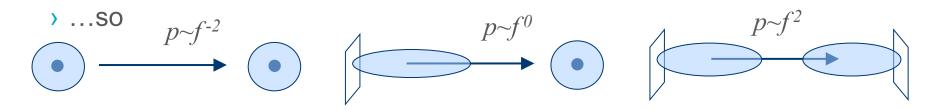


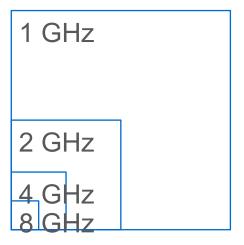


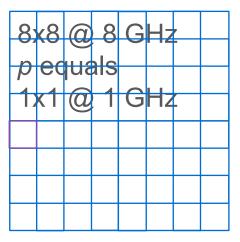
# Antenna area and frequency



- > Path loss between isotropic (fixed gain) antennas: ~20 log<sub>10</sub>(f)
  - As receive antenna area shrinks prop to f<sup>-2</sup>
- > How to counteract?
  - Put more receiver antennas same total area gives same received power irrespective of frequency
  - ...but signals need to be combined constructively → directivity
- What about transmit antenna?
  - Constructive beamforming over more antenna elements → directivity
- > Result for fixed area at both ends
  - $-20 \log_{10}(f)$  gain





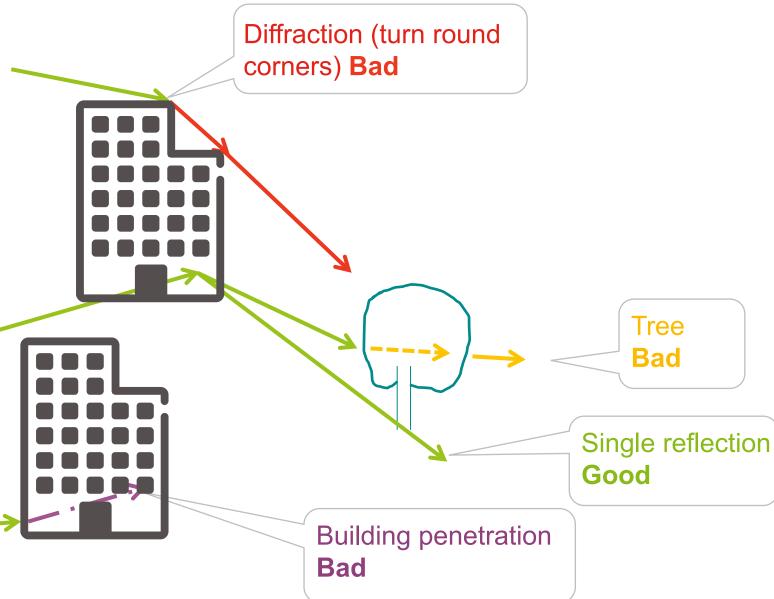


N-LOS propagation

3

The high frequency impact on some propagation phenomena

 TX power density exposure limitations above 6-10 GHz

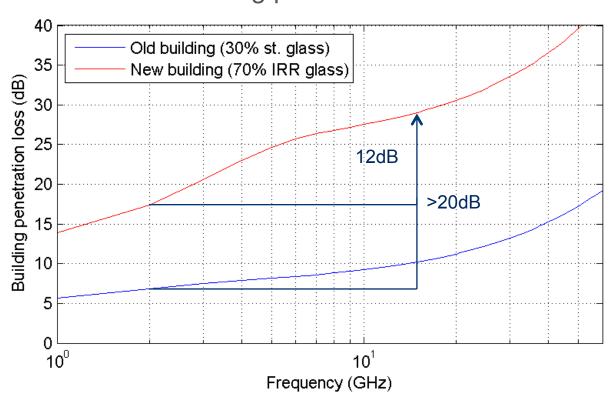


# Propagation



- > Building penetration loss
  - Very much dependent on type of building, windows etc

### Building penetration model:





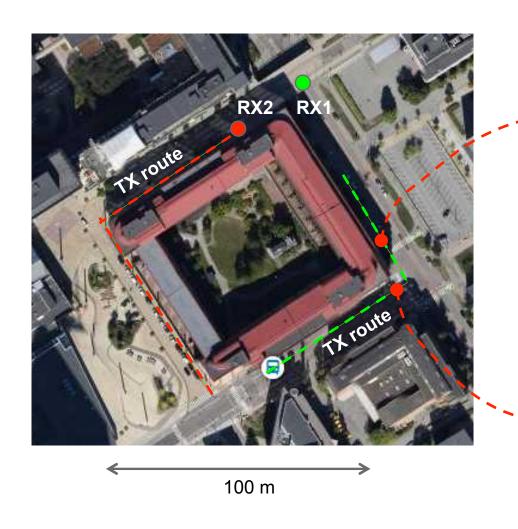
# A measurement campaign

#### **Preliminary results!**

Source: Jonas Medbo, Nima Seifi and Dennis Sundman, Ericsson Research

# TX, RX Locations





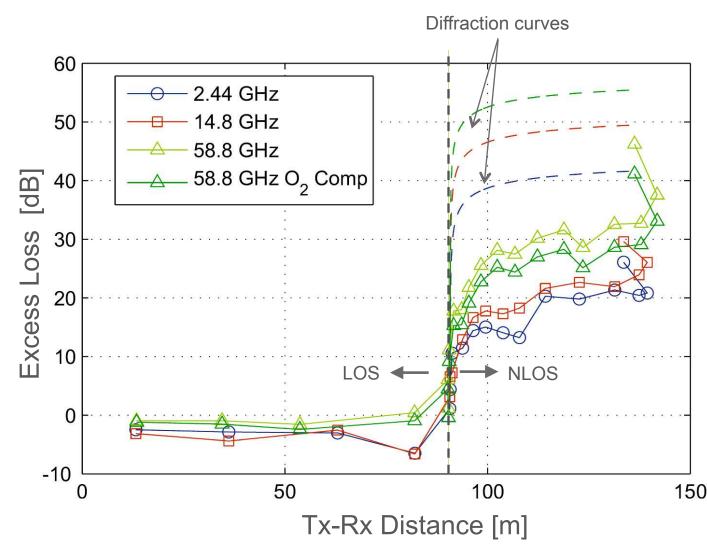




### Excess loss RX2



- Loss in excess of free space loss shown
- Negative loss in LOS region due to multipath gain
- > Frequency dependency of NLOS Loss
  - Slight in 2-15 GHz
  - Substantial in 15-60 GHz
- Reflected/scattered paths dominates over diffraction in NLOS



Distance along a straight line connecting the TX and the RX, not around the corner

# Propagation



- > All-in-all ....
  - –A challenging task to combat the increased pathloss!

### Measures at BS



- Large arrays with substantially many elements
  - Need for beam steering functionality!
    - Coherent radio paths
  - Need for many simultaneous beams
    - Multi-user MIMO
  - –HW integration
    - > Active elements to reduce losses
  - Data aggregation needed
    - > Bit shuffling potentially explodes!





# Measures, UE



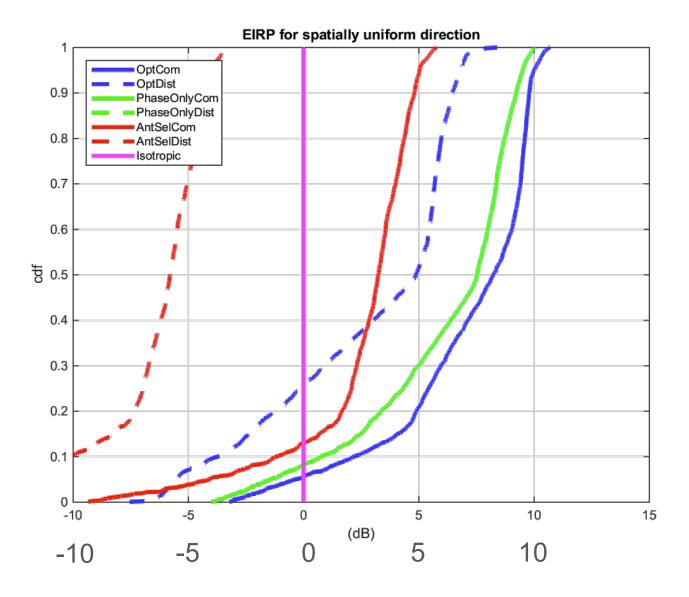
- Antenna elements gets more directive when frequency increases
  - Less angular coverage per element but still "omni-coverage" is required
    - Multiple elements with different characteristics



# Measures, UE



- –UE beamforming on RX and TX
  - Utilize beam overlap and angular spread also for TX
  - Precoder choice must take power amplifier configuration into account



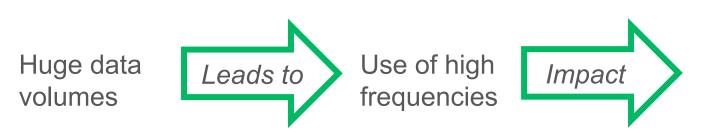
# 5G radio test bed





# **TAKE-away**





#### > At BS:

- Large antenna arrays, in terms of antenna elements
- Massive beamforming
- High level of integration

#### > At UE:

- Many antennas
- Beamforming, both RX and TX



# **ERICSSON**