“Real 5G” should be 4.9G

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Everyone's "5G" is Chitty-Chitty Race

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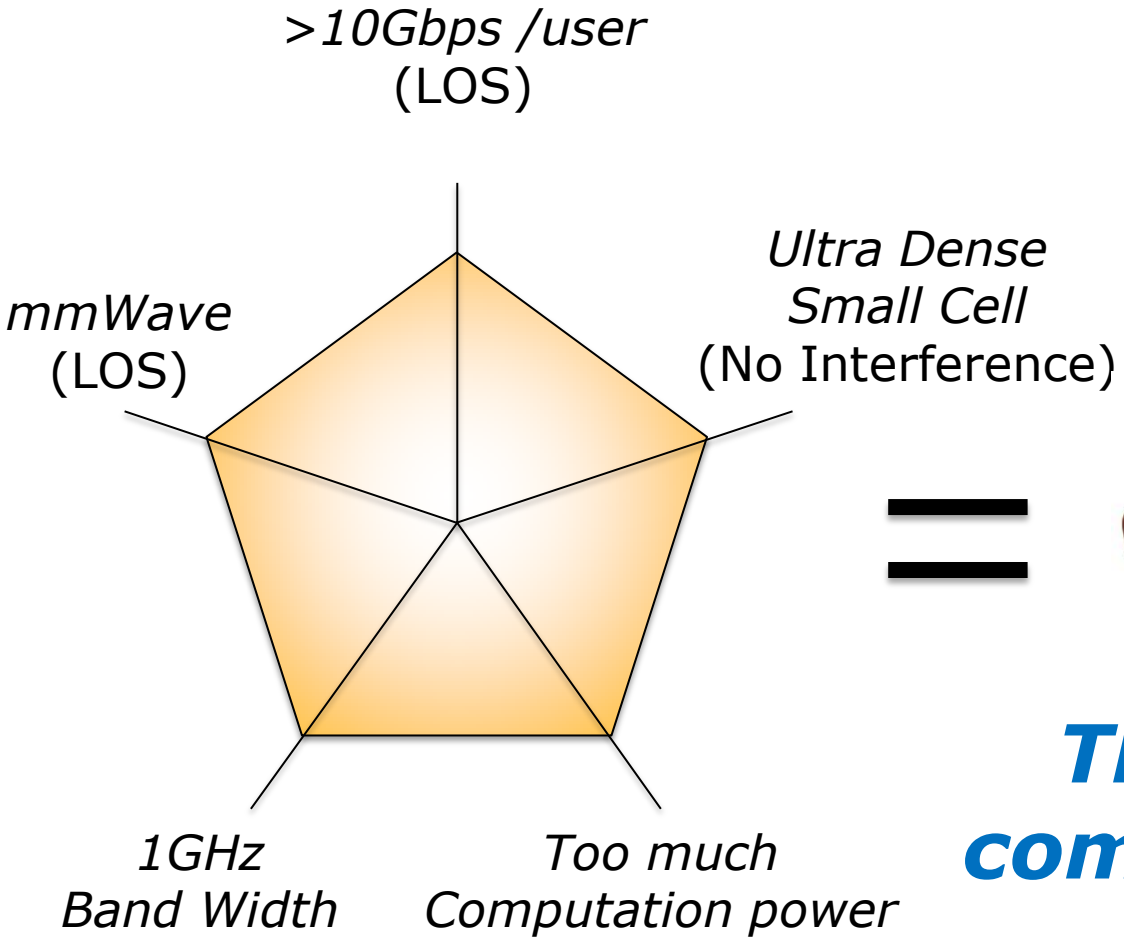

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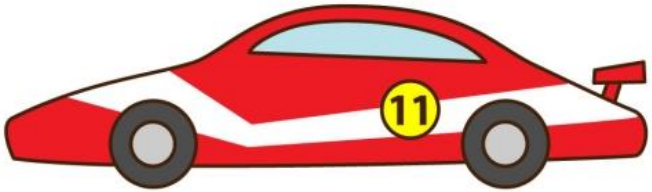

This cannot be a commercial product!

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“Real 5G” should be…

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- **Low bit cost** through mathematical computation strength relaxation
  - Linearly increasing cost along with computation power is horrible
  - Vendor should try to decrease computation power
- **Wide coverage** with improved UL link budget
  - Common channel sweeping should be realized
  - UL is mainly for SRS
  - Time domain SRS power concentration with 1/8 UL/DL ratio.
    - ➢9dB UL power boost
- **Broadcast channel beamforming**
  - LTE has area limitation with broadcast channel link budget
  - 5G’s common channel should be Beamforming somehow
- **User Centric Cell**
- **SDMA**
- **Should fall back and compatible with 4G radio**

These are almost the same as 4G

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Key function of “Real 5G”

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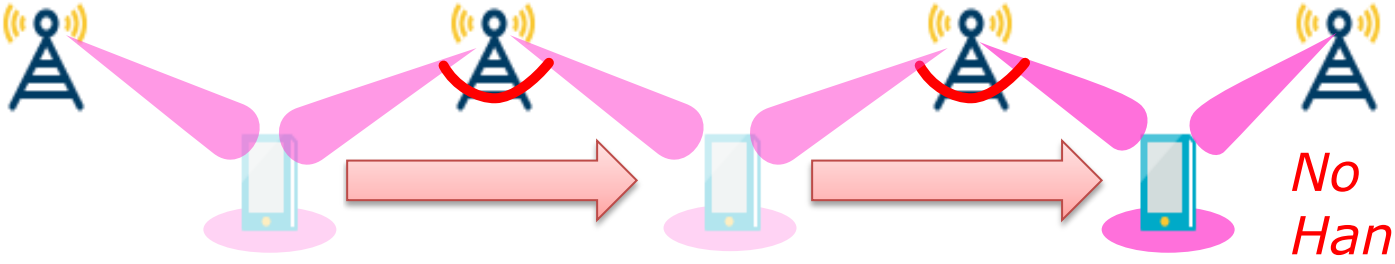
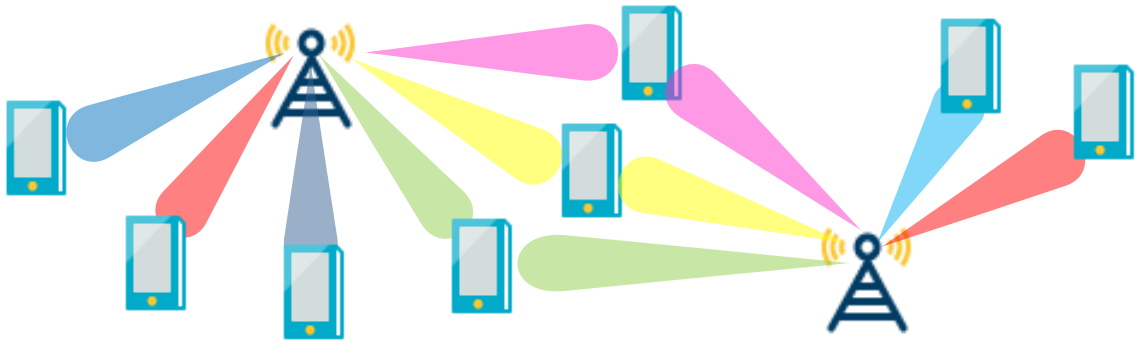
■ User Centric Cell

- Dedicated Reference Signal tracks UE with beamforming without handover in entire coverage



■ SDMA (MU-MIMO)

- Zero-Forcing based interference mitigation Massive MIMO or Distributed MIMO
- SDMA should use channel reciprocity of TDD with SRS from UE



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Our 5G strategy

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- Aligned with 5G trial in China initiated by CMRI and the vendors
  - China case, 3.5GHz would be used
  - Just changing frequency, nothing other

- Target is
  - Station and NLOS
  - Multi-User Massive MIMO (not single user)
  - User Centric Cell
  - Massive MIMO would eventually achieve 10Gbps/cell capacity

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2.5GHz, 3.5GHz and 5G

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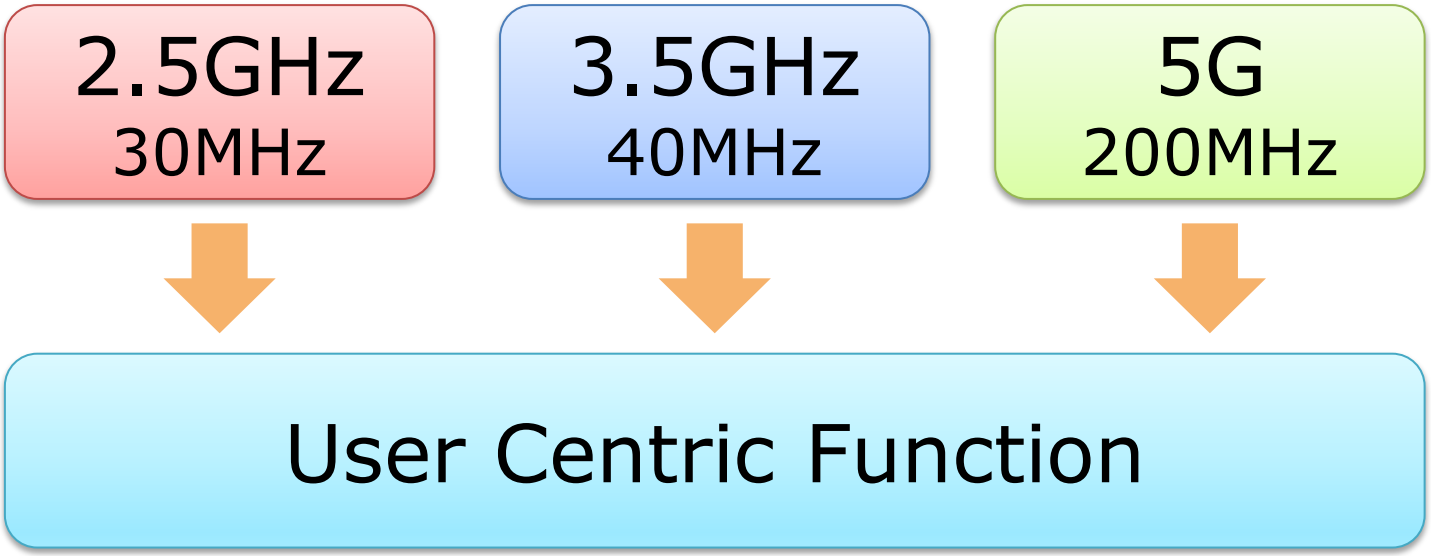

- Every TDD system should go to User Centric
- 5G is just wider band width

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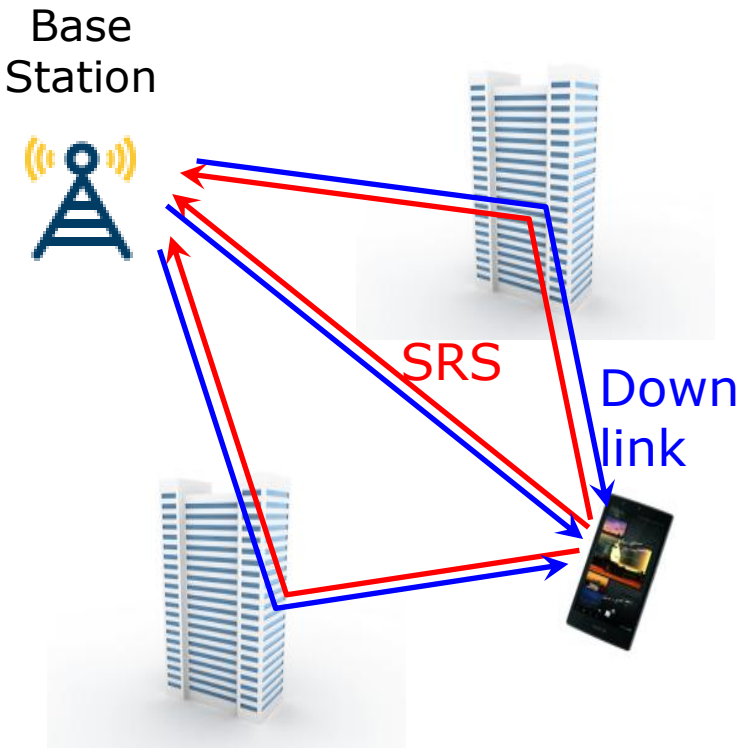
SRS Switching (4G/5G) is necessary for Carrier Aggregation



Reciprocal SDMA is key technology of 5G!

TDD can use SRS for uplink channel estimation

Secondary Carrier also needs SRS signal

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High Power UE (+9dB)

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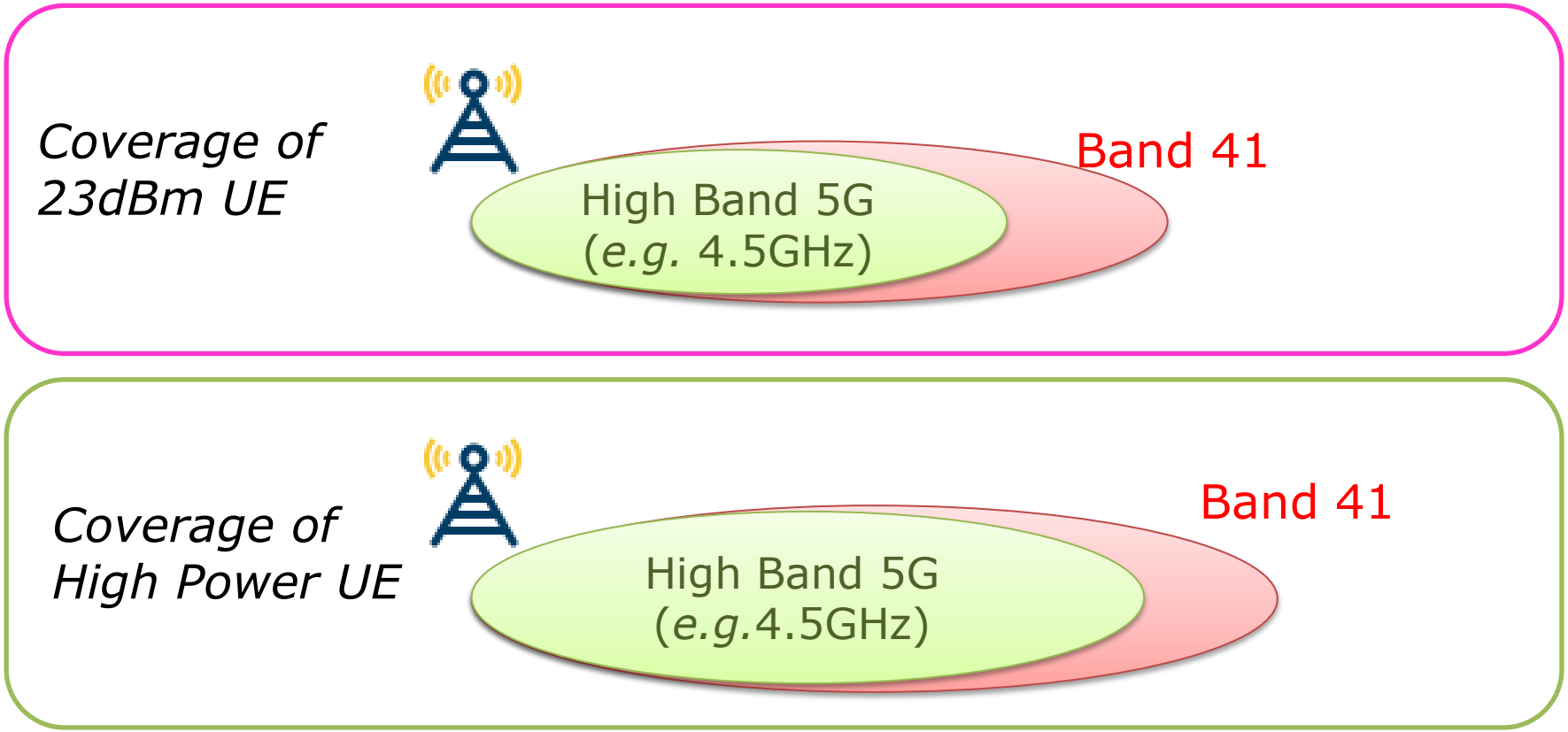
- Usually LTE network is uplink limited, especially TDD System
- 5G's frequency allocation would be in higher band, that means cell radius would be shrunk



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SoftBank Massive MIMO

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RF Parameter

Frequency : 2555-2575 MHz

(Band 41)

Band width : 20 MHz

Transmit Power : 20W

Cell Parameter

DL-UL ratio : DL / UL= 3 / 1

(Synchronized with commercial NW)

Surrounded by commercial network

UE:

Existing Rel-9 UE

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The difference is just bandwidth!

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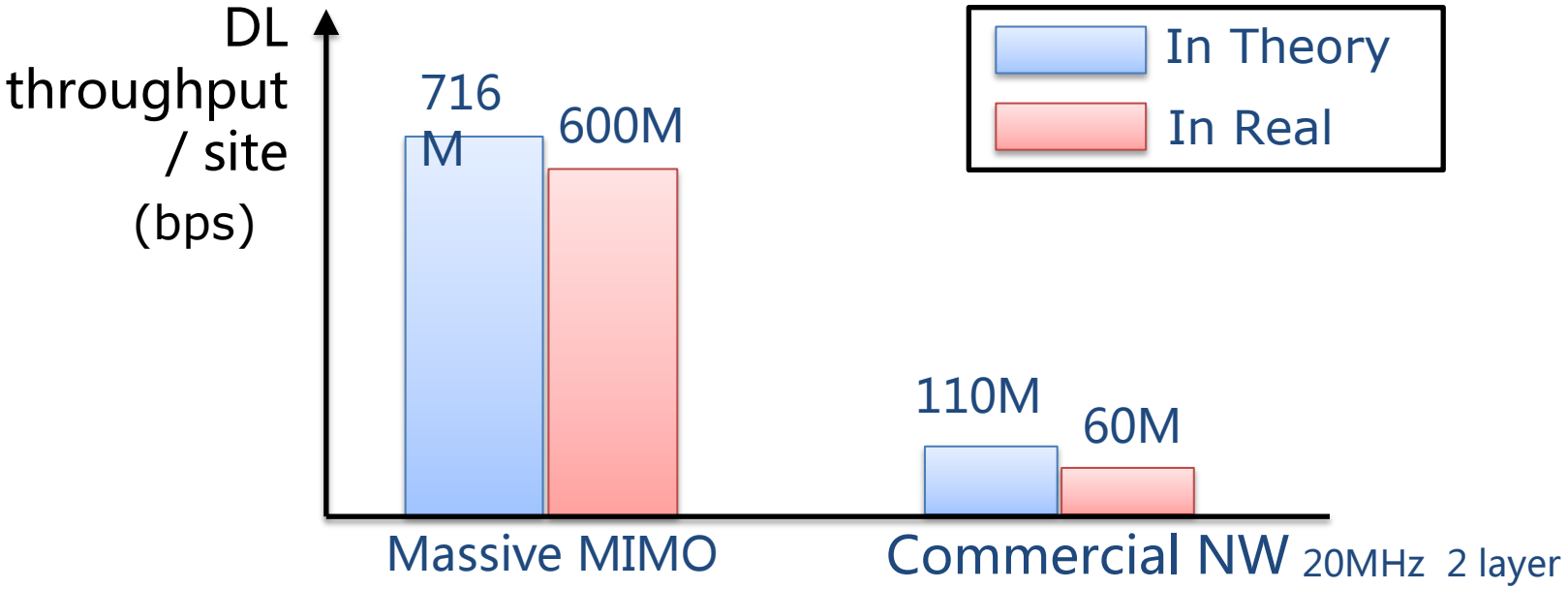
4G (20MHz BW) over 600 Mbps / site

5G (200MHz BW) over 6 Gbps / site



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Massive MIMO at 3.5GHz

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- We think Massive MIMO is suitable for 3.5GHz, too
- Our 3.5GHz is almost same configuration as 2.5GHz

It should not be smaller

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CPU Interconnect with GPGPU through CMN

- CPU with GPGPU (General-purpose computing on Graphics Processing Units) through CPU interconnect would be essential key for 5G low cost implementation for future high speed BBU
- CPU array and GPGPU array can be inside in one single chip with AMBA (Advanced Microcontroller Bus Architecture) bus
- Already BBU is similar structure but future one would definitely use CPU array + GPGPU array mixed through OpenACC based C++ plus pragma with regular C++ based no stress computing.
- AMBA (Advanced Microcontroller Bus Architecture) and CMN (Coherent Mesh Network) is proprietary technology of ARM

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