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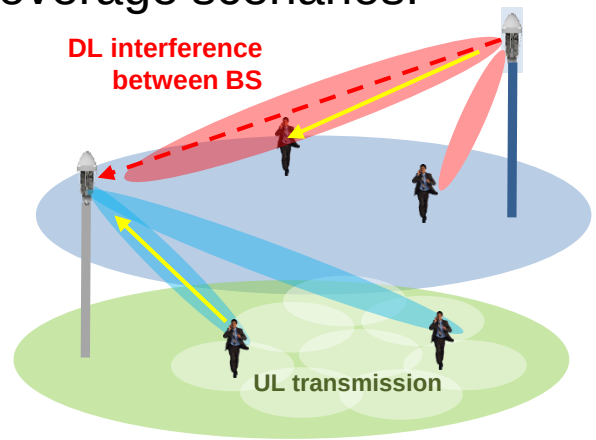
China unicom中国联通
创新·与智慧同行

# Motivation for 5G network enhancements for FR2 in R18

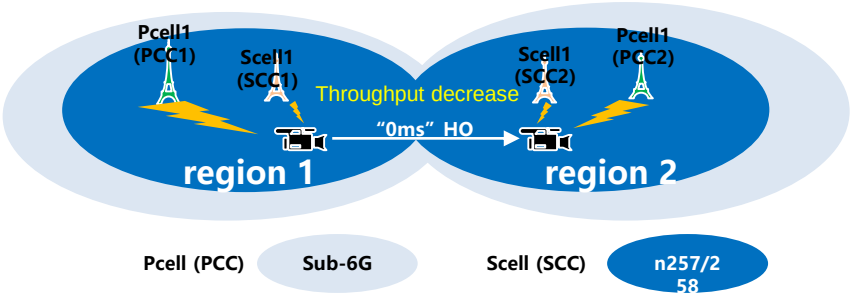
Source: China Unicom

# FR2 deployment scenarios

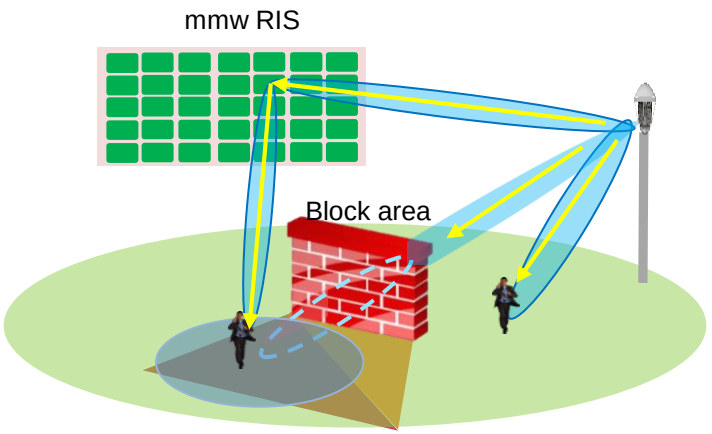
- Millimeter wave (mmw) band (e.g. n257/n258) has been deployed in 5G network across many countries and regions.
- It is very critical for operators to consider the hybrid deployment with combinations of higher frequency band (FR2) and lower frequency band (FR1).
- Considering the potential FR2 band deployment scenarios, there are several commercial deployment scenarios, including uplink dominant scenarios, service continuity in mobility scenarios, NLOS coverage scenarios.




**Uplink dominant scenarios (e.g. 4K/8K living camera)**



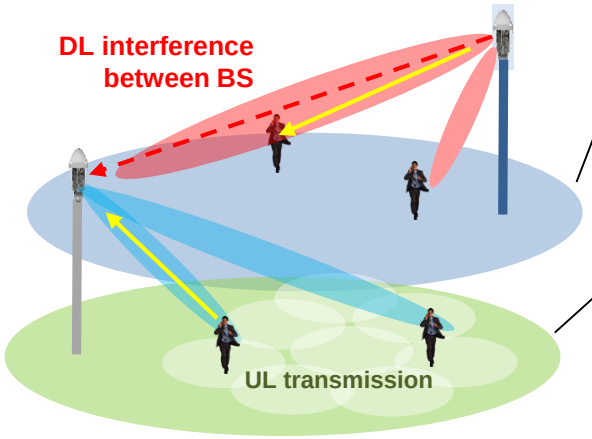

**Service continuity in mobility scenarios (e.g. liveTV, AR/VR/XR)**



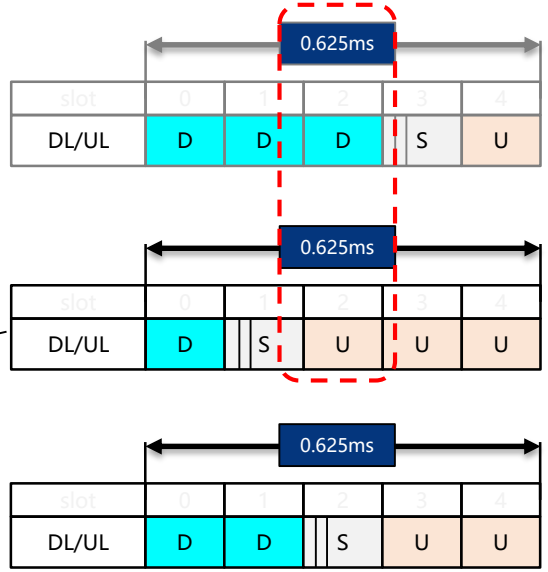

**Coverage issues in NLOS scenarios (e.g. eMBB service)**

# FR2 interference issues

- For FR2 band, gNBs can be adaptively configured with different frame structures according to the traffic load. For example,
  - Configuration 1: the downlink dominant frame is DDDSU.
  - Configuration 2: uplink dominant frame structure is DSUUU.
  - Configuration 3: uplink & downlink equalization frame structure is DDSUU.
- For example, there are 3 typical traffic load in the gymnasium, audience areas may configured with DDDSU, 4K/8K media interview area may configured with DSUUU, and VIP area may configured with DDSUU.
- When different frame structures are configured in adjacent cells, there may be BS-BS interference issues.




**BS-BS interference issues for mmw**




**Configuration 1: Downlink dominant frame structure**

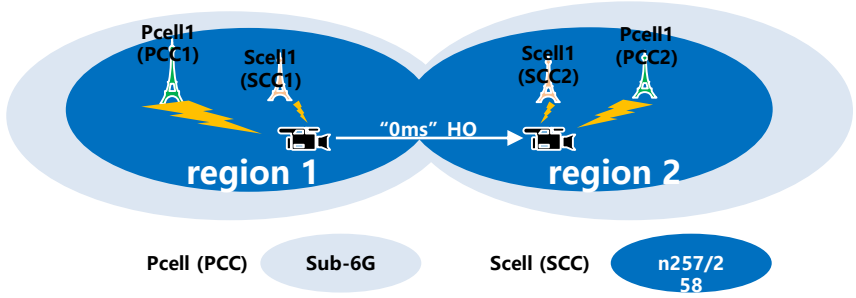
**Configuration 2: Uplink dominant frame structure**

**Configuration 3: uplink & downlink equalization frame structure**

# FR2 mobility issues (1)

## Service continuity in mobility scenarios

- The coverage of mmw gNB is smaller compared to the Sub-6G band, thus 5G evolution network will be deployed with higher frequency band and lower frequency band in NSA/NR-DC/NR-CA mode to provide a better user experience. For instance, 900MHz/2.1 GHz for coverage need and 26GHz for throughput need.
  - As shown in figure, when the 4K / 8K liveTV moves from region 1 to region 2, DAPS HO is necessary for the “0 ms HO” during a live broadcast.
  - If high throughput requirements for 4K / 8K liveTV are not guaranteed from network side, it will lead to a live broadcast interruption.




**4K / 8K liveTV move from region 1 to region 2 in MR-DC and/or NR-CA**

**Throughput requirements of 4K / 8K broadcast**

| Video service type | UL data rate |
|---|---|
| 4K | 40Mbps~80Mbps |
| 8K | 120Mbps~160Mbps |

# FR2 mobility issues (2)

## Frequently handover in mobility scenarios

- For mobile cameras/phones/VR devices, in order to meet high edge rates requirements (e.g. up to 160 Mbps for 8K videos), the mmw coverage range is about 150m in LOS scenario, and even smaller in NLOS scenario. So the 5G mmw network will be an ultra-dense network when coordinating with anchor stations.
  - In the ultra-dense network, the terminal will perform frequent handover and cell reselection, which may bring more signaling overhead.
  - For live cameras, strict handover access delay is required.
  - Beneficial for the UE power saving.

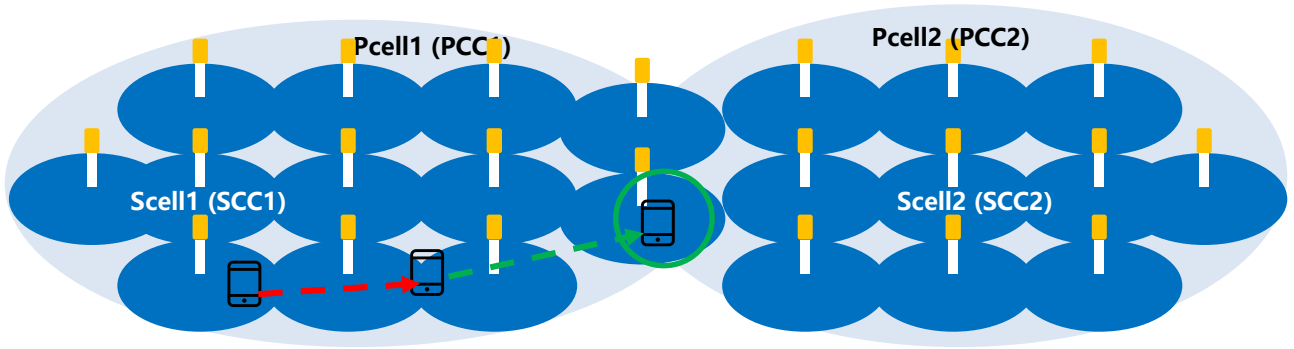


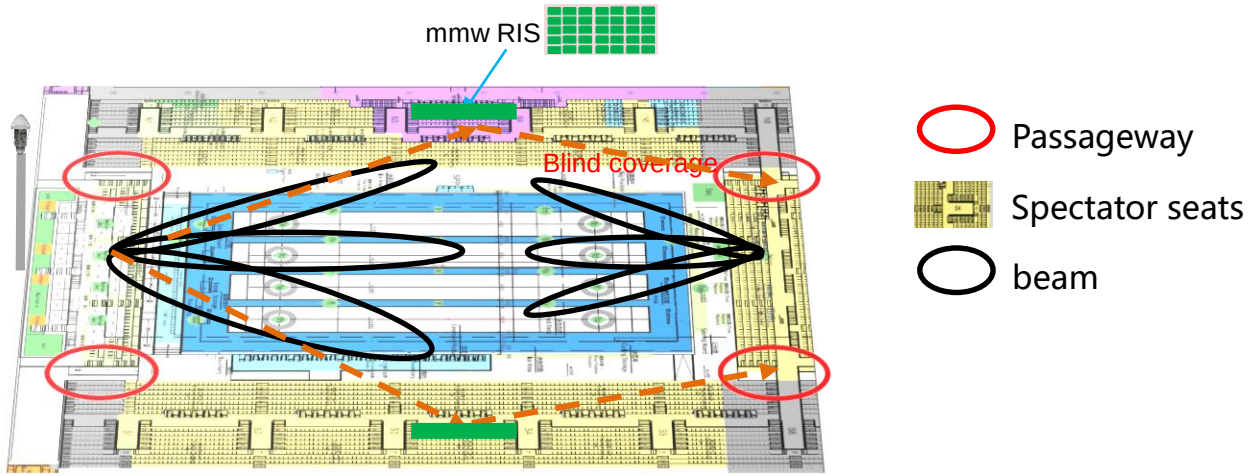

**Fig.2 UE rapidly move through millimeter wave cells in dense network**

# FR2 coverage issues

- According to TS 38.901, the path loss of 28GHz mmw is about 18dB more than 3.5GHz with the same assumption. The extra penetration loss caused by concrete, trees, bodies and glass up to 10dB.
- RIS is beneficial for extending the cell coverage in deployment scenarios, e.g. indoor, outdoor.

**Typical penetration loss for FR2**

| Material | 3GPP transmission loss model | mmwave loss[dB] | mmwave trials value[dB] |
|---|---|---|---|
| Concrete | $L_{concrete}$=5+4f | 125-1205 | >30-40 |
| Tree | —— | —— | 16-20 |
| Body | —— | —— | 11-28 |
| Glass | $L_{glass}$=23+0.3f | 32-113 | 17-23 |
| Note: f(GHz) | | | |




**Mmw trail scenarios in the stadium cooperated with RIS**

- Mmw gNBs are deployed to ensure the coverage of racetrack and media interview area.
- Passageway are blind coverage area with deep blockage.
- RIS is deployed to extend the coverage of mmw.

# Proposal

- It is proposed to consider the FR2 band commercial deployment issues and requirements. According to this motivation, all the above issues should be taken into account for R18.