5G Features Overview

Optimization

Technology

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Feature/Parameter List

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- UL 256QAM
- PUSCH Waveform Adaptation
- DL Beamforming SRS Based
- SRB3 Activation

UL 256QAM

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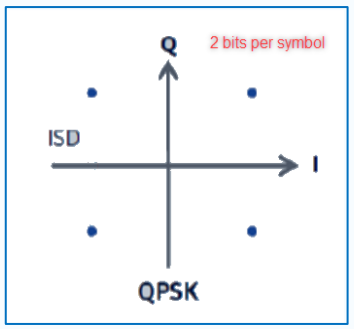
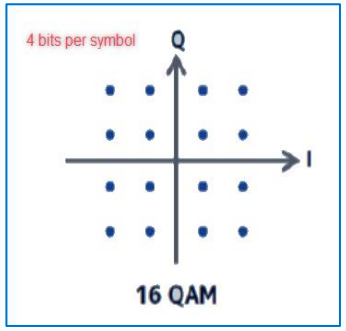
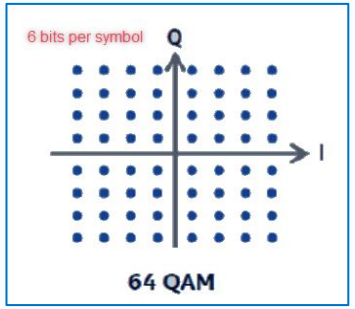
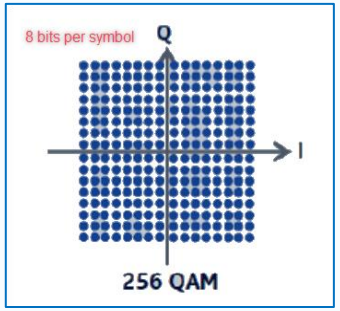
- UL 256QAM Increases uplink spectral efficiency for cell center users.
- Under favorable radio environments, the Peak UL User throughput can increase up to **33%** compared to 64QAM.

Overview









Feature Verification Steps

1) Confirm UE Capability – 256QAM support

```
.....multipleTCI --- supported(0)
.....pusch-256QAM --- supported(0)
.....ue-PowerClass --- pc2(1)
```

2) Confirm MCS-Table: 256qam delivered in RRC Reconfiguration msg

```
pusch-Config: setup (1)
  setup
    txConfig: codebook (0)
    dmrs-UplinkForPUSCH-MappingTypeB: setup (1)
    pusch-PowerControl
    resourceAllocation: resourceAllocationType1 (1)
    pusch-TimeDomainAllocationList: setup (1)
    mcs-Table: qam256 (0)
    transformPrecoder: disabled (1)
```

3) From OSS: Check related 256QAM Counters

UL 256QAM Table

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64QAM Table

Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	1	0
2	2	2	0
3	2	3	0
4	2	4	0
5	2	5	0
6	2	6	0
7	2	7	0
8	2	8	0
9	2	9	0
10	2	10	0
11	4	10	0
12	4	11	0
13	4	12	0
14	4	13	0
15	4	14	0
16	4	15	0
17	4	16	0
18	4	17	0
19	4	18	0
20	4	19	0
21	6	19	0
22	6	20	0
23	6	21	0
24	6	22	0
25	6	23	0
26	6	24	0
27	6	25	0
28	6	26	0
29	reserved		1
30			2
31			3

256QAM Table

Table 8.6.1-3: Modulation, TBS index and redundancy version table for PUSCH

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	2	0
2	2	4	0
3	2	6	0
4	2	8	0
5	2	10	0
6	4	11	0
7	4	12	0
8	4	13	0
9	4	14	0
10	4	16	0
11	4	17	0
12	4	18	0
13	4	19	0
14	6	20	0
15	6	21	0
16	6	22	0
17	6	23	0
18	6	24	0
19	6	25	0
20	6	27	0
21	6	28	0
22	6	29	0
23	8	30	0
24	8	31	0
25	8	32	0
26	8	32A	0
27	8	33	0
28	8	34	0
29	reserved		1
30			2
31			3

PUSCH Waveform Adaptation

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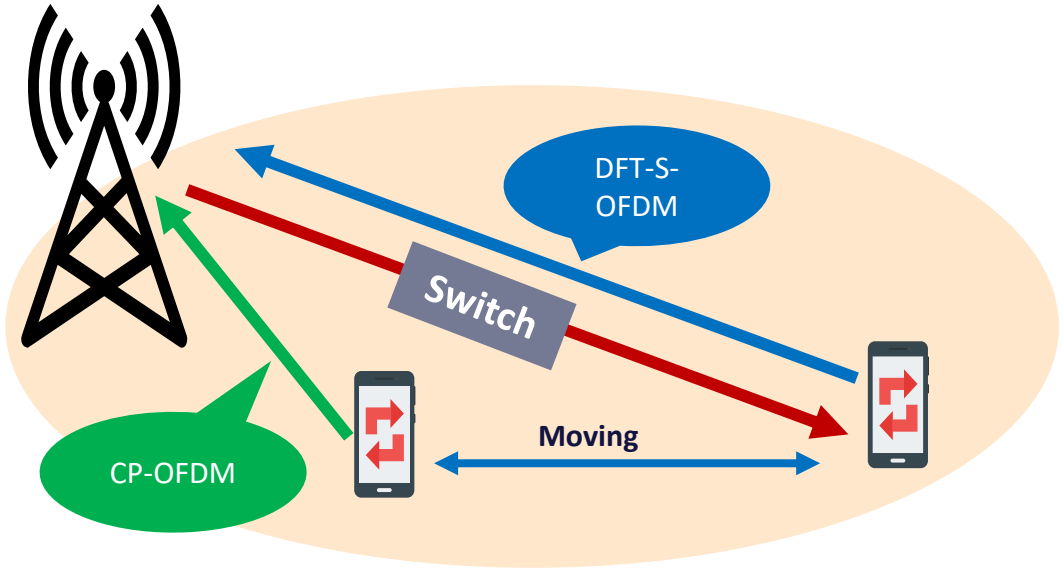
- The NR system supports Cyclic Prefix-Orthogonal Frequency Division Multiplexing (CP-OFDM) and DFT-spread OFDM (DFT-S-OFDM).
- DFT-S-OFDM waveform delivers 0–2 dB higher UE transmit power than using the CP-OFDM waveform

Waveform	Number of Layers	Resource Allocation	PAPR	Scenario
CP-OFDM	**1–4**	**Contiguous/ Non-Contiguous**	High	Near Cell Center
DFT-S-OFDM	1	Contiguous	**Low**	Cell EDGE Achieve around **0–2 dB Coverage gain**




```
initialUplinkBWP
Pusch-Config
   Setup
    txConfig
        txconfig: Codebook
resourceAllocation: resourceAllocationType1
transformPrecoder
  transformPrecoder: enabled/disabled
```

Switching is indicated through L3 Signaling

Enabled = DFTS-OFDM
Disabled = CP-OFDM

*PAPR: High peak to average power ratio

DL Beamforming SRS Based(1)

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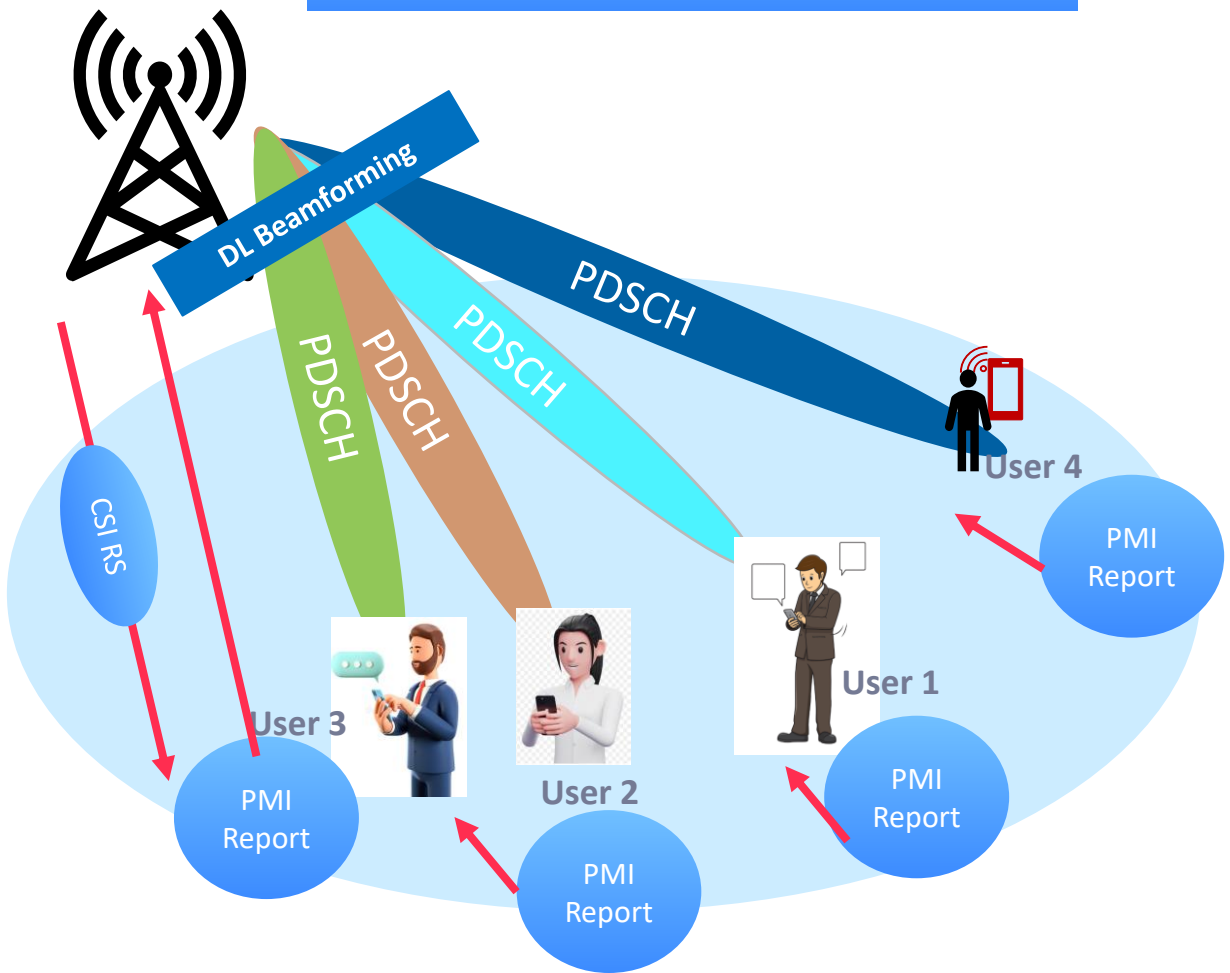
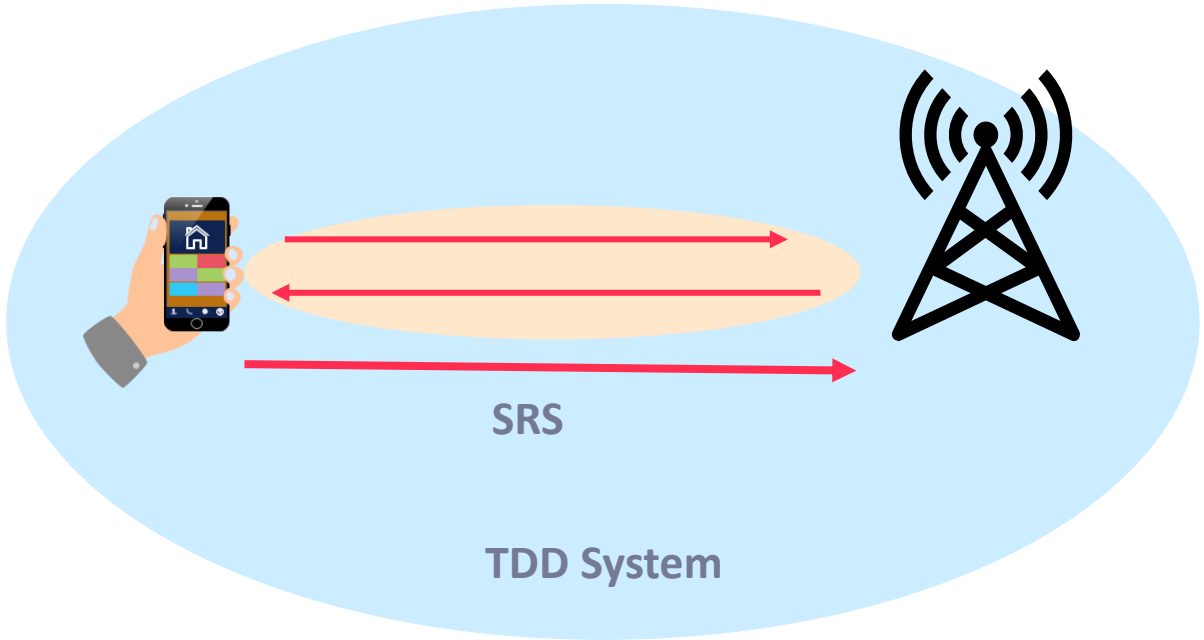
Codebook-based transmission



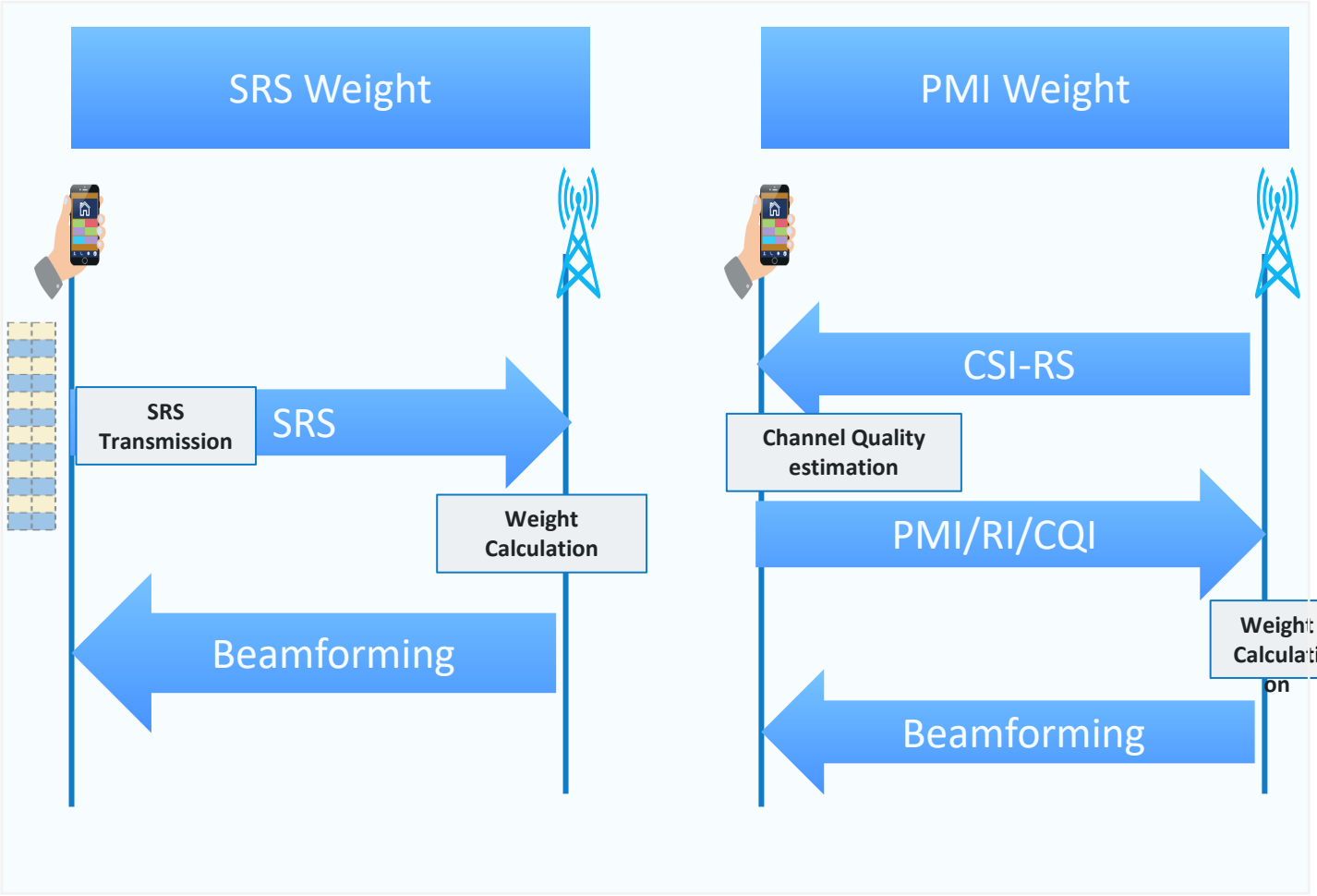
Reciprocity-based transmission

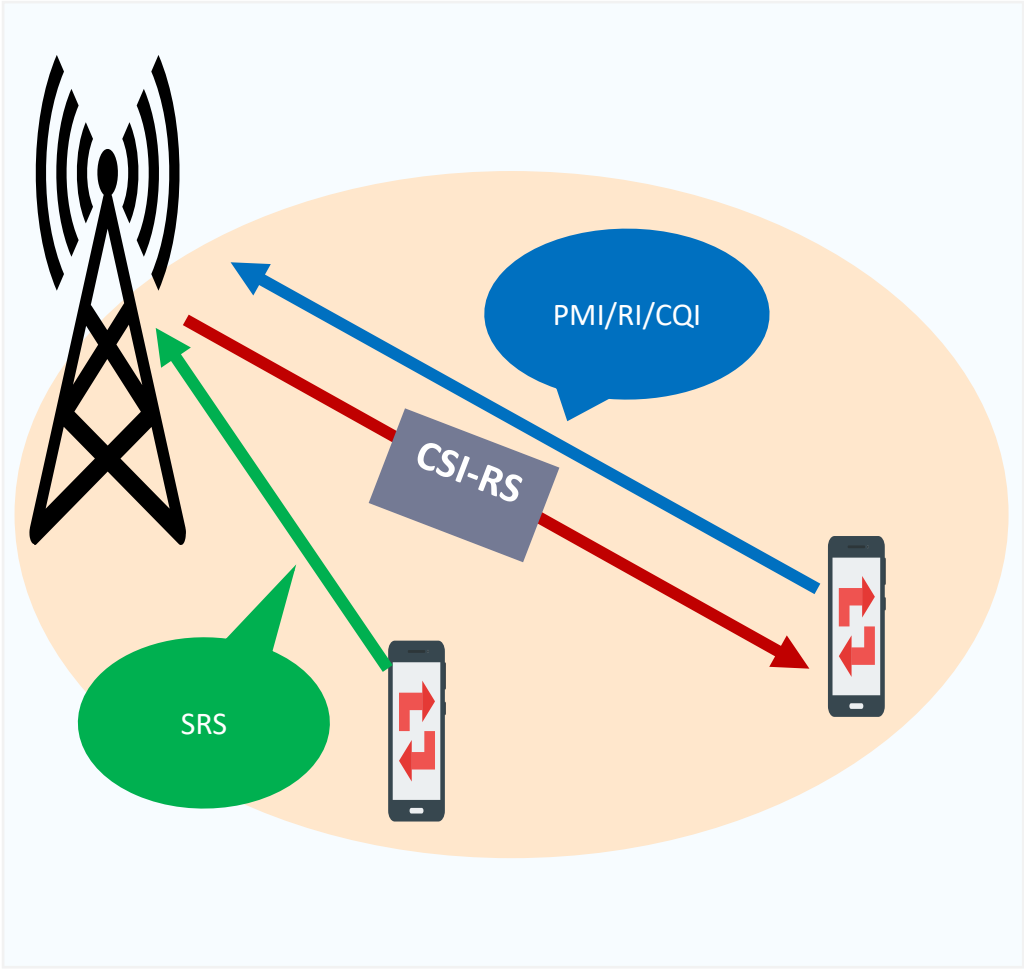


Same Frequency

DL Beamforming SRS Based "Antenna switching"(2)

- To Adjust the shape and direction of beams, the BTS calculates the weight based on the UE feedback for the DL Channel characteristics





SRS DL Based Beamforming "Test Verification"(3)

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- To Adjust the shape and direction of beams, the BTS calculates the weight based on the UE feedback for the DL Channel characteristics

```
supportedBandCombinationList-v1540

  BandCombination-v1540
    bandList-v1540

      BandParameters-v1540
        srs-TxSwitch

          supportedSRS-TxPortSwitch:t2r4 (2)
  BandCombination-v1540
    bandList-v1540
      BandParameters-v1540
        srs-TxSwitch

          supportedSRS-TxPortSwitch:t2r4 (2)
```

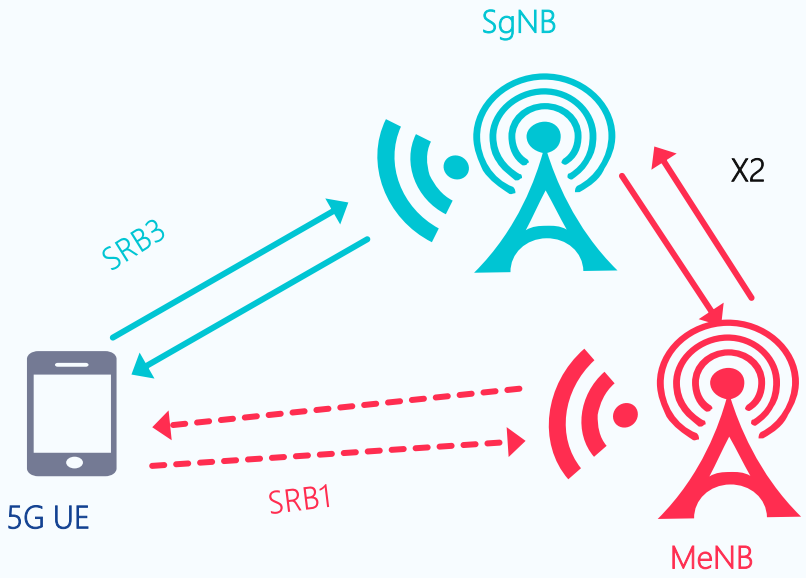
SRS Resouce Set	
3GPP- ParameterID	Value Range
usage	beamManagement, codebook, nonCodebook, antennaswitching

```
srs-ResourceSetToAddModList
  SRS-ResourceSet
    srs-ResourceSetId: ---- 0x0 (0)
    srs-ResourceIdList
      SRS-ResourceId: ---- 0x0 (0)
    resourceType
      periodic
    usage: ----  antennaswitching
    alpha: ---- alpha08 (5)
    p0: ---- 0xffffffb6 (-74)
```

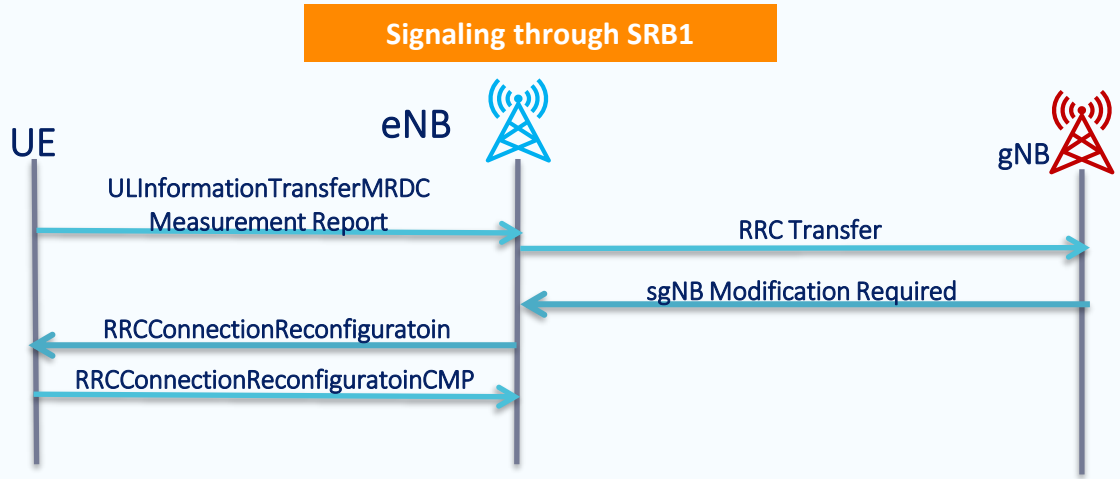
SRB3

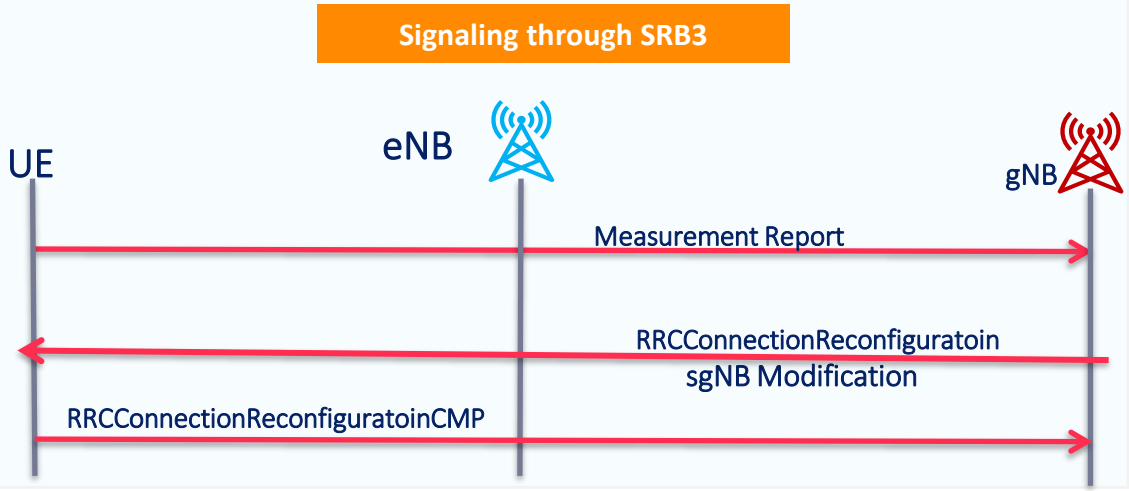
Overview

- SRB3 is optional and provides a direct SRB between the Secondary RAN Node and the device.
- RRC Signaling through using NR SRB3 might reduce the latency.
- The following RRC messages will be handled through SRB3 For EN-DC operation:
  - RRC Reconfiguration.
  - RRC Reconfiguration Complete.
  - Measurement Report.



Signaling Flow comparison





*Section 7.5 "SRB3" in 3GPP TS 37.340 V15.7.0,
*If the UE does not support SRB3, signaling cannot be directly exchanged between the gNodeB and the UE