

Views on Candidate RRM and Demodulation Topics for Rel-19

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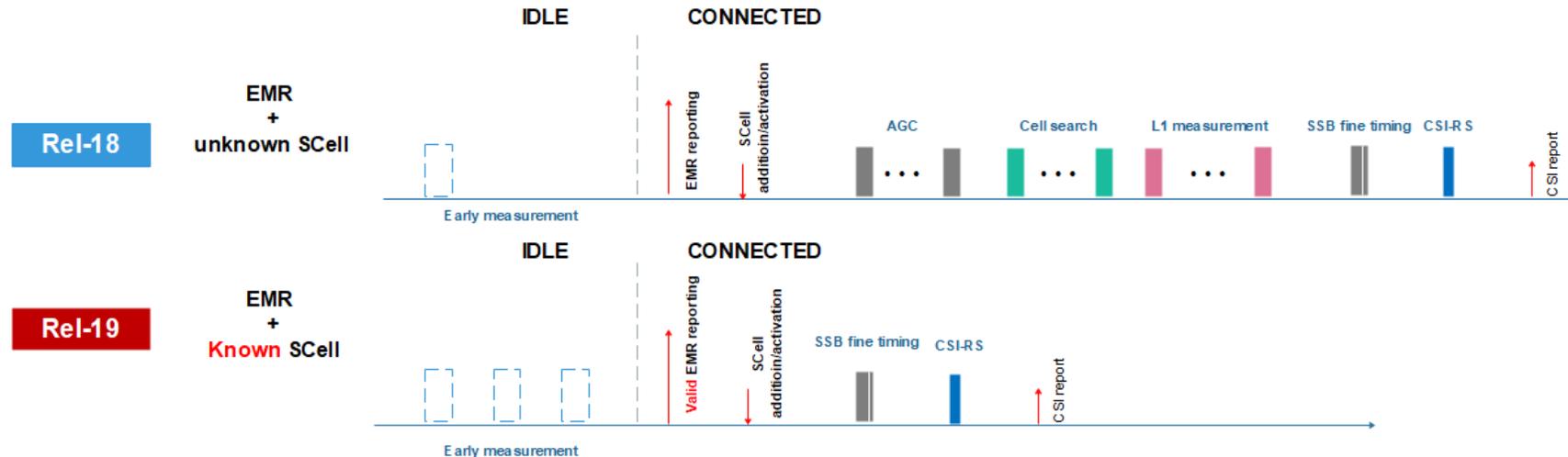
RRM evolution and enhancements

- EMR+ Fast SCell activation
- RRM delay reduction
 - > FR2 unknown SCell activation based on Temporary RS
 - > L3 Measurement enhancement for FR1+FR2
- Further RRM enhancement
 - > Interruptions at NR SRS antenna port switching
 - > L1/L2 mobility inter-frequency measurement enhancement

EMR+ Fast SCell activation

- Motivation

- > Early measure in IDLE/Inactive mode is introduced in Rel-16 to setup CA upon UE entering connected mode. According to the existing known cell condition, the to-be-added SCell is regarded as “unknown” even if the EMR report is valid, then SCell activation procedure would follow unknown requirements when UE enters CONNECTED mode from IDLE mode.
- > Fast SCell activation based on EMR is proposed to be enhanced when UE enters CONNECTED mode from IDLE/Inactive mode.



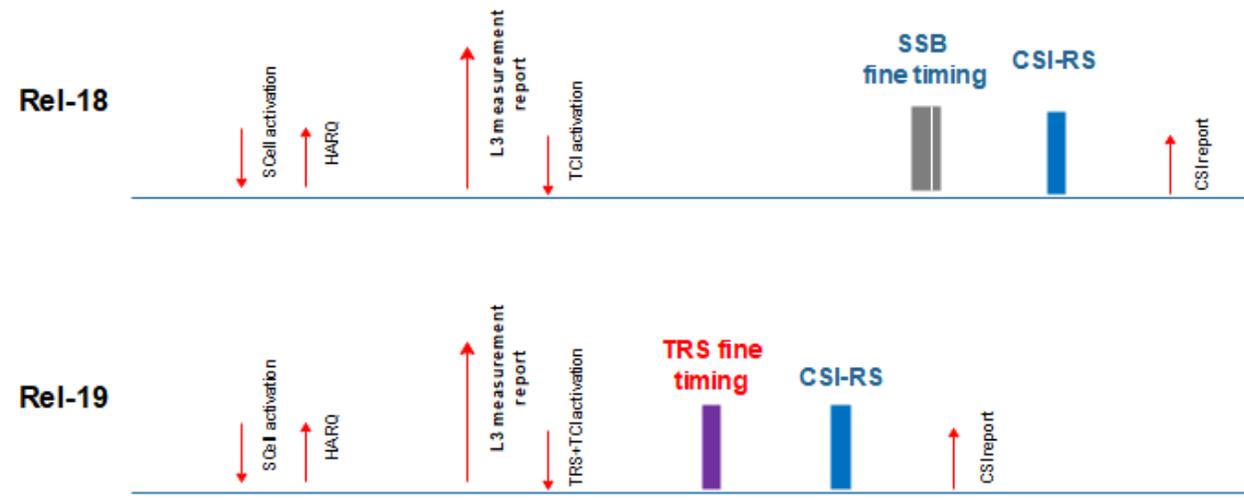
- Objective

- > Fast SCell activation with EMR reports upon UE enters connected mode
- > Introduce corresponding signaling if needed.

RRM delay reduction: FR2 unknown SCell activation based on Temporary RS

- Motivation

- > In Rel-18, one enhancement for FR2 SCell activation is to trigger L3 measurement by SCell activation command, and the activation delay can achieve comparable performance as known SCell activation. In Rel-17, Temporary RS is introduced for SCell activation delay reduction, which is not applicable for FR2 unknown cases without active serving in the same band.
- > If Temporary RS can be utilized based on L3 measurement triggered by SCell activation command, the SCell activation delay can be further reduced.



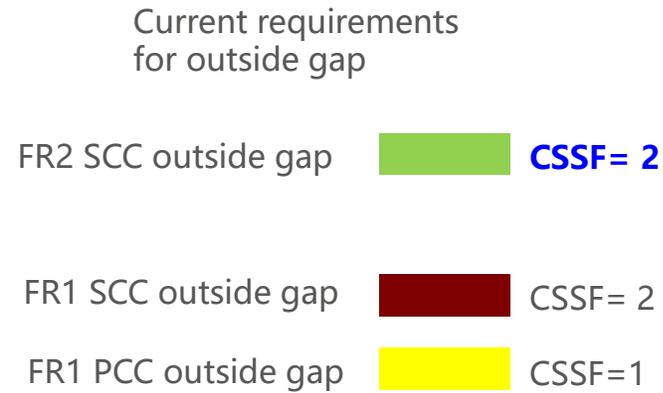
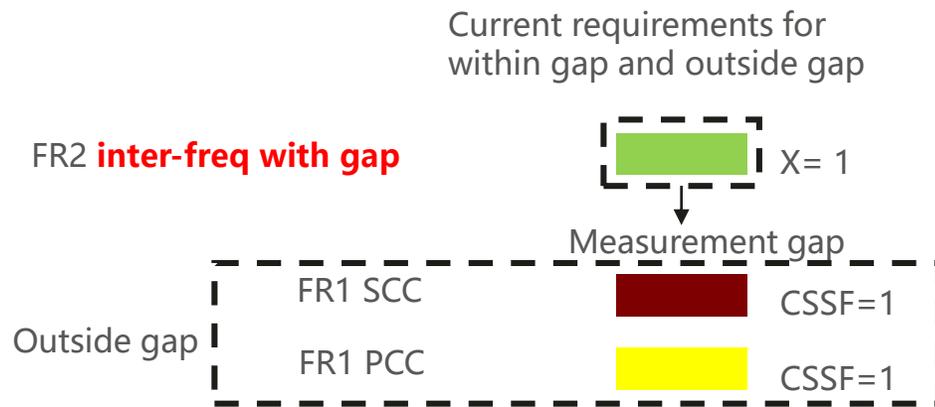
- Objective

- > FR2 SCell activation delay further reduction base on Temporary RS and L3 measurement triggered by SCell activation command.
- 5> Introduce corresponding signaling if needed.

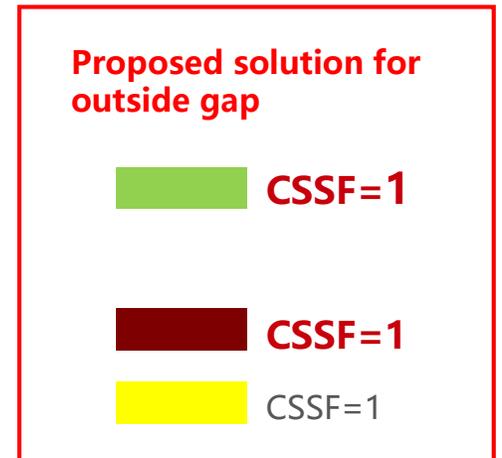
RRM delay reduction: L3 Measurement enhancement for FR1+FR2

- Motivation

- > Current status: Delay requirements for measurement outside gap are defined based on 2 searchers assumption for total CCs in FR1 and FR2
- > Observation: In FR1+FR2 scenario, a UE supporting **per-FR gap** shall support totally 3 searchers to meet the requirements for measurement **within gap** in FR2 and **outside gap** in FR1
- > Potential enhancement: when no gap is needed, the searcher within gap can be **borrowed** for outside gap, then 3 searchers are used for measurement outside gap. Shorter measurement delay for serving cell measurement (which is typically measured outside gap) can be achieved.



PCC uses one searcher; all SCCs share the other searcher



PCC uses searcher#1; FR1 SCC uses searcher#2; FR2 SCC uses searcher#3;

- Objective

- > Enhance CSSF (carrier-specific scaling factor) for L3 measurement outside gap in the above case

Further RRM enhancement: Interruptions at NR SRS antenna port switching

- Motivation

- > In current RRM spec, it is assumed that SRS resource for SRS antenna switching is allocated at the last 6 symbols of a slot. However, SRS starting in any symbol within a slot is already supported since Rel-16. Thus, some SRS antenna port switching scenarios are not covered by current RAN4 requirements.
- > In Rel-17 interruption requirements at NR SRS antenna port switching, following scenarios are considered:
 - *Scenario 1: when $X=1$ SRS symbol is configured in a slot for SRS antenna port switching*
 - *Scenario 2: otherwise, using $X=6$ SRS symbols in a slot as assumption of SRS transmission time*

Symbol level interruption requirement is only considered for scenario 1 for synchronized case. For all other cases, interruption requirement is defined in number of **slots**, which may be much longer than the actual interruption length.

- Objective

- > Interruption requirements at NR SRS antenna port switching when SRS starting in any symbol of a slot
- > Finer granularity of interruption requirements at NR SRS antenna port switching (i.e. symbol level interruption length for more applicable scenarios)

Further RRM enhancement: L1/L2 mobility inter-frequency measurement enhancement

- Motivation

- > According to current R18 LTM progress, only L1/L2 inter-frequency measurement with Type 1 gap is specified in R18.
- > For UE who supports NCSG, during measurement occasion UE is expected to transmit and receive data on the corresponding serving carrier(s).

- Objective

- > L1/L2 inter-frequency measurement with NCSG (Network Controlled Small Gap)
 - In FR1, SSB based L1-RSRP measurement can be performed simultaneously with L3-RSRP measurement;
 - In FR2, SSB based L1-RSRP measurement is to be shared with L3 measurement with one NCSG, Or define a dedicated NCSG for L1-RSRP measurement

Demodulation evolution and enhancements

- Demodulation performance enhancement for 8Rx
- Soft-IC for SU-MIMO

Performance enhancements for 8Rx capable UE

- Motivation

- > RAN4 has defined the performance requirements with MMSE-IRC receiver for suppressing inter-cell interference and intra-cell inter-user interference for 2Rx and 4Rx for FR1 in Release 17 (RP-221285)
 - Slot-based transmission and aligned SCS among cells
 - MMSE-IRC with DMRS based interference covariance estimation
- > RAN4 introduced the performance requirements with MRC/MMSE-IRC without interference assumption for 8Rx in Release 18 (RP-230314)
- > There are no performance requirements for 8Rx with MMSE-IRC with interference assumption
- > The performance for MIMO layer not less than 4 is verified under the limited scenarios

- Objective

- > Define PDSCH performance requirements with MMSE-IRC receiver for suppressing inter-cell interference for 8Rx with MIMO layer not less than 4 for FR1
- > Define PDSCH performance requirements with MMSE-IRC receiver for suppressing intra-cell inter-user interference for 8Rx for FR1
- > Define the enhanced demodulation performance requirements with MIMO layers not less than 4 layers for 8Rx capable UE

Soft-IC for SU-MIMO

- Motivation

- > NR UE demodulation performance under the medium correlation channel can be improved by introducing the soft IC receiver to cancel the inter-stream interference for SU-MIMO scenario, which does the iteration abstracting the soft information and cancelling the interference from each other between multiple layers by involving LDPC decoder.
- > The soft IC receiver can bring the performance gain not only over MMSE receiver but also over RML receiver.
 - It is observed that the performance could be improved by around 1.5 to 3dB using soft-IC receiver under the medium correlation channel.

Simulation Case 1: QPSK 0.58 Corr: 0.9/0.9				
SNR	30	31	70% relative throughput	Gain
RML	0.4315	0.2965	30.97	
SNR	27	28	70% relative throughput	
Soft IC	0.3935	0.2625	27.71	3.26

Simulation Case 2: 64QAM 0.65 Corr: 0.1/0.3				
SNR	36	37	70% relative throughput	Gain
RML	0.406	0.2345	36.62	
SNR	35	36	70% relative throughput	
Soft IC	0.3155	0.164	35.10	1.52

- Objective

- > Specify performance requirements for the advanced receiver with soft IC to cancel the inter-stream interference for single-cell multi-layer scenario
 - Evaluate the performance gain of the advanced receiver with soft IC compared to existing NR receiver(s)
 - Specify PDSCH requirements for the advanced receiver with soft IC