3GPP TSG RAN Meeting #102
Edinburgh, Scotland, Dec 11-15, 2023

RP-233625

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Agenda: 9.1.4.1

General views on Rel-19 RAN4 led topics

General view on Rel-19 RAN4 led topics

- Proposal:
  - Rel-19 RAN4 led topcis should be commercially and market driven.
  - RAN4 should consider the work balance between RAN1/2/3 led items and RAN4 led items to ensure the reasonable workload in Rel-19.
  - RAN4 should consider some use cases expansion to further promote the commercial application of 5G technology.
  - RAN4 should consider the features to be introduced with full set of requirements including core requirement definition and the feasibility of measurement setup.

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Propsal summary for Rel-19 RAN4 led topcis

Topics	Proposal
BS RF	• EIRP mask for upper 6GHz depending WRC-23 • OTA conformance testing enhancements • Multi-band Repeater, NCR and (e)IAB in FR2 • In-band NB-IoT in NR over SAN • MSR SAN
UE RF	• HPUE for CA (e.g. PC1.5) • 3Tx handheld UE • 6Rx handheld UE/FWA • PC2 NTN UE • FR2-1 PC3 with UL 256QAM • Intra-band CA for 3MHz+other regular channel bandwidth
UE RRM	• Scell with UL only transmission • Further enhancement on FR2 UE multi-panel reception • Further enhancement on the SCell activation • RLM and BFD evaluation enhancement

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Propsal summary for Rel-19 RAN4 led topcis

Topics	Proposal
UE/BS Demod	• Redcap UE with CRS-IM • Advanced receiver to handle BS to BS CLI • 8Rx FWA with MIMO layers as 5,6,7
Cross areas	• AeroMacs • ATG
Others	• Further simplification of band combination specification
OTA	• Dynamic OTA testing • TRP/TRS for NTN UE • Reverberation chamber for FR2 UE

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Content

01 RF/OTA topics

02 RRM and Demod topics

03 Candidate topics on cross area

04 Others

BS RF evolution in Rel-19

- EIRP mask for frequency range 6245 to 7125 MHz.
  - Depends on the conclusion of WRC-23
- OTA conformance testing enhancements (e.g.Tx IMD).
- Multi-band repeater or NCR in FR2 similar as Rel-18 FR2 multi-band operation.
- Multi-band (e)IAB in FR2 similar as Rel-18 FR2 multi-band operation.
- In-band NB-IoT in NR over SAN.
  - The expected workload is limited and Rel-16 in-band NB-IoT in NR could be reused as much as possible.
- Multi-standard Radio SAN
  - Radio SAN is supposed to be capable of forwarding NR carrier, LTE carrier and NB-IoT carriers simultaneously, MSR SAN requirement should be specified in RAN4 accordingly.

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UE RF evolution in Rel-19

HPUE for CA

- PC1.5(PC2+PC2) inter-band UL NR CA if it is not included in existing Rel-18 WID
  - Clear demands from operators for a long time.
- PC1.5 TDD intra-band UL NR CA

3Tx(1Tx+2Tx inter-band NR CA/DC) for handheld UE

- In R18 3Tx/4Rx WI, it included one of the objectives on study the applicable 3Tx requirements for handheld UE. However, in terms of the RAN4's agreements, it was agreed that 3Tx requirements are restricted to FWA UE in R18.

High power for NTN UE in FR1

- PC2 for handheld UE

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UE RF evolution in Rel-19

- 6Rx with 4/6 MIMO layers for handheld UE and FWA
  - Currently, 4Rx is for handheld UE and FWA UE, while 8Rx is only for FWA UE in Rel-18.
  - Comparing to 4Rx, 6Rx can further provide higher throughput and better coverage for smartphone. Moreover, 6Rx is one of the scenarios for non-co-located intra-band NRCA/ENDC.
  - Example bands: n41,n77, n78 and n79
- 3MHz+Other BW for intra-band contiguous CA to meet the operator's request for irregular channel bandwidth.

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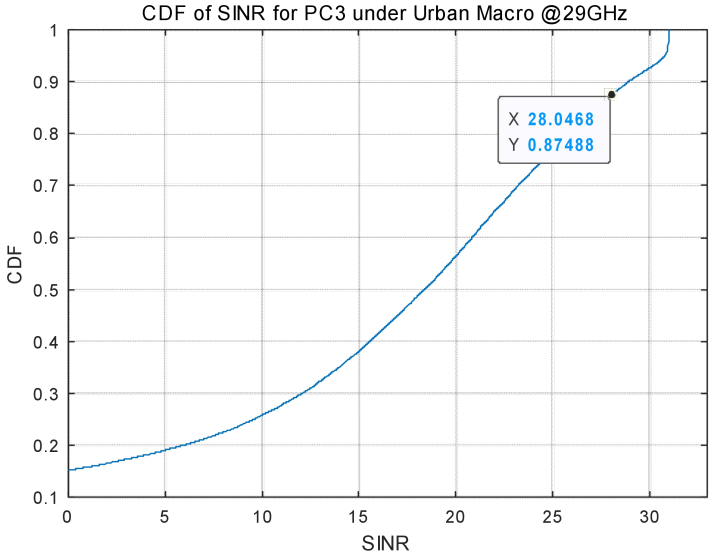
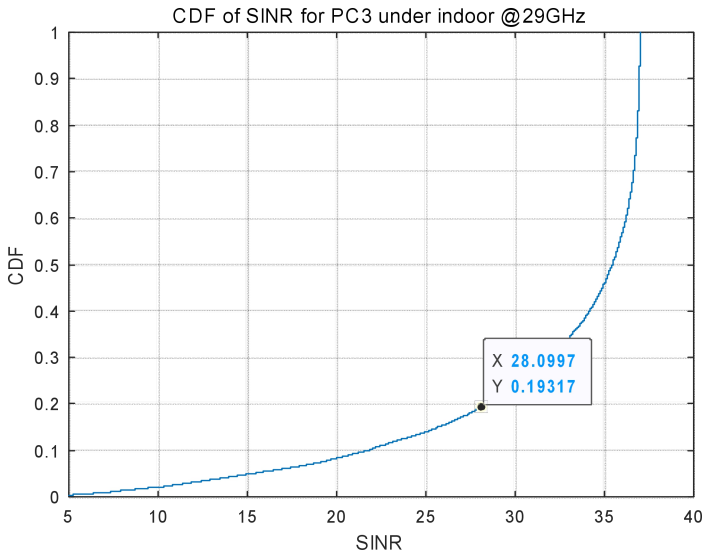
UE RF evolution in Rel-19

FR2-1 256QAM for PC3 (leftover from Rel-18)

- In Rel-18, FR2-1 256QAM for PC1/2/5 is first priority while for PC3 is second priority, and the work for RF requirements mainly focus on PC1/2/5 in Rel-18. If work for FR2-1 256QAM PC3 UE are not completed in Rel18, then it should be included in Rel-19.





PC3 is also feasible if the operating SNR is not higher than 28dB for 29GHz.
For 29GHz_ Urban Macro：More than 10% UE can achieve above 28dB SINR for PC3.
For 29GHz_ Indoor：More than 80% UE can achieve above 28dB SINR for PC3.

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Content

01 RF/OTA topics

02 RRM and Demod topics

03 Candidate topics on cross area

04 Others

UE RRM related evolution in Rel-19

- Justification:
  - For R18 FR2 UE, the existing requirements for RLM and BFD is highly related with Rx beam numbers and T_{DRX}. Especially when DRX is larger than 320ms with 8 Rx beams, side condition might have already changed due to UE mobility or UE rotation related behavior. It is necessary to shorten the evaluation period for long DRX cycles.
    - Apply non-DRX mode when large DRX cycle is configured
    - Reduce Rx beam numbers
- **Proposal**: to reduce RLM and BFD evaluation period for FR2 UE by reducing Rx beam numbers or apply non-DRX mode when large DRX cycle is configured.

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UE RRM related evolution in Rel-19

- Justification:
  - In Rel-18, multi-panel to enhance the MIMO layer and L1 measurement was supported. In fact, the RRM measurement could be further improved for UE capable of simultaneous multi-panel reception, such as
    - Reduce Rx beam numbers
    - Further study group-based reporting mechanism
    - L3 measurement enhancement
- **Proposal**: RRM measurement enhancement is expected by applying simultaneous multi-panel reception.

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UE RRM related evolution in Rel-19

- Justification:
  - The SCell activation further enhancement in Rel-19 due to TU budget concerns, multiple issues were not resolved in R18.
  - Candidate techniques to be considered for the further enhancements for both FR1 and FR2.
    - QCL information related enhancement
    - Update for ending point of SCell activation
    - TCI indication related enhancement
- **Proposal**: Further enhancement on the SCell activation, focus on the potential enhancements deprioritized in Rel-18, including QCL information related enhancement, ending point of SCell activation, TCI indication related enhancement, not restrict to FR2, both FR1 and FR2 could be applicable.

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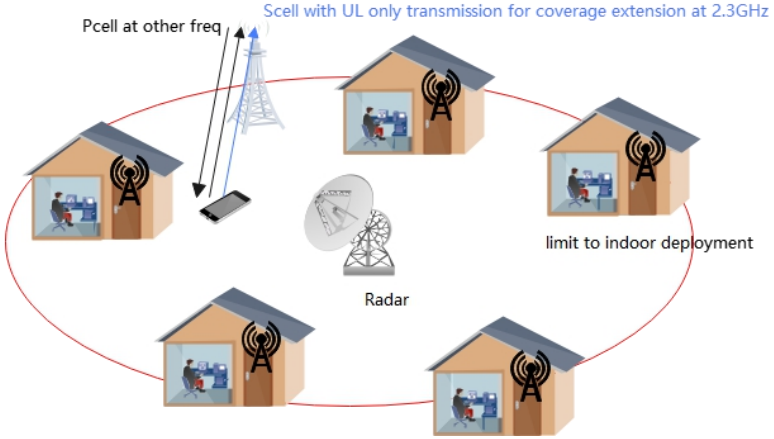
UE RRM related evolution in Rel-19

- Justification:
  - In certain regions, the deployment at 2.3GHz now is restricted to the indoor scenario due to the protection of the incumbent service.
  - In order to better utilize the spectrum of 2.3GHz at the outdoor scenario, **Scell with UL only transmission would provide good coexistence performance with the incumbent service due to its limited transmission power and carrier emissions from UE transmitter.**



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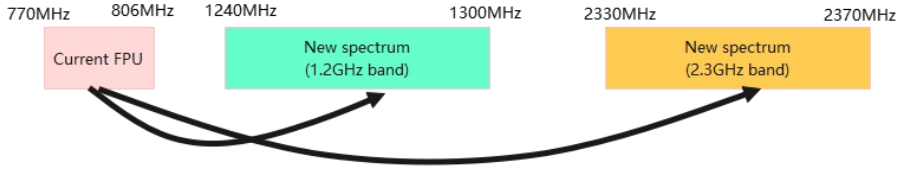
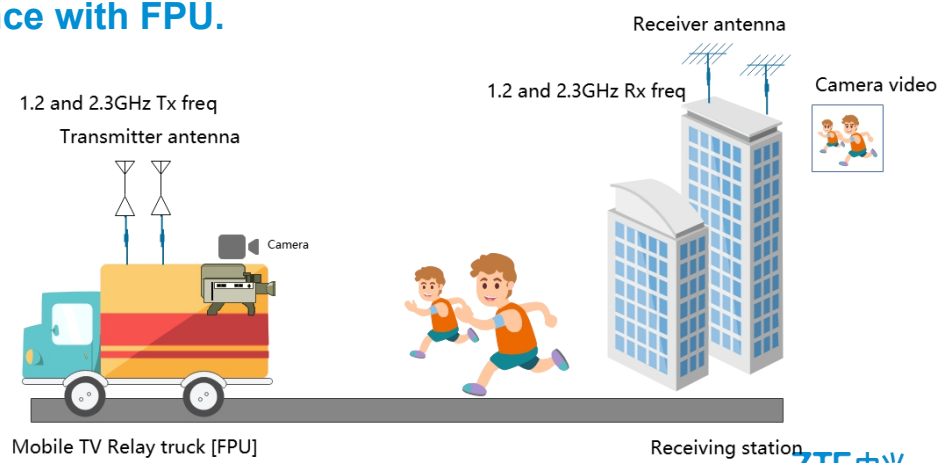
UE RRM related evolution in Rel-19

Justification:

- In Japan, MIC has decided to allocate the 700MHz band to IMT service and the 1.2GHz and 2.3GHz bands to FPU service.
- Japan was planning to start assigning frequencies in the 2.3 GHz band by the end of 2023 and triple allocations across all compatible spectrum bands in 2025.
- It's essential to protect the incumbent service FPU from the foreseen IMT deployment, otherwise IMT BS DL CLI towards to FPU receiver would be significant.
- **Scell with UL only transmission at 2.3GHz could mitigate the gNB to gNB CLI issue to enable the good coexistence performance with FPU.**





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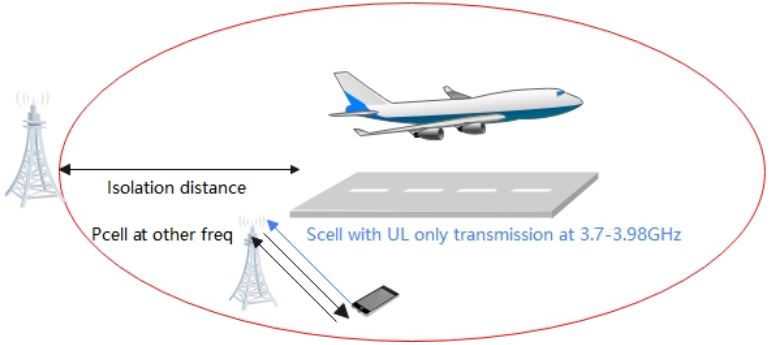
UE RRM related evolution in Rel-19

- Justification:
  - In USA, there are long discussion on coexistence issue between IMT deployment at C-band and aircraft radio altimeter at 4.2-4.4GHz.
  - The FAA determined that radio altimeters cannot be relied upon to perform their intended function if they experience interference from wireless broadband operations in the 3.7-3.98 GHz frequency band (5G C-Band).
  - **Scell with UL only transmission at 5G C-band could provide good solution to enable the good coexistence performance with aircraft radio altimeter if there are no additional filtering implemented for the protection of interference from IMT network at the aircraft.**



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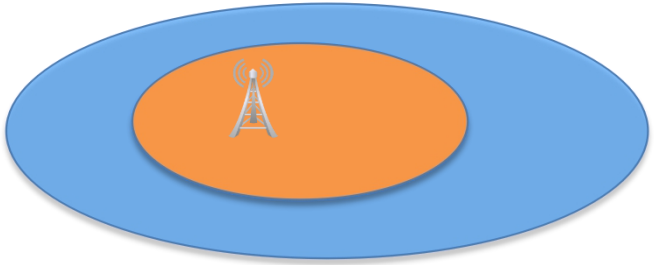
UE RRM related evolution in Rel-19

- Justification:
  - With the deployment of NR network, operators may refarm some of the LTE bands to NR to improve UL coverage and throughput.
  - Re-farm bands for UL transmission might be possible given NR coverage is UL limited. An operator may use other higher NR bands for capacity and the re-farming LTE band for coverage.
  - **Scell with UL only transmission can address such re-farming demands from operators.**



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UE RRM related evolution in Rel-19

- Justification:
  - Based on the study in Rel-18, UL only scell by shutting down the NW DL transmitter could achieve significant power saving. For BS Category 1, 65.5% to 71.7% of network power saving gain could be achieved and for BS Category 2, 80.7% to 83.3% of power saving gain could be achieved.
  - **Scell with UL only transmission could provide further network energy saving enhancement.**

Power state	BS Category 1			BS Category 2		
	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
Deep sleep	1			1		
Light sleep	25			2.1		
Micro sleep	55	50	38	5.5	5	3
Active DL	280	200	152	32	26	17.6
Active UL	110	90	80	6.5	5.8	4.2

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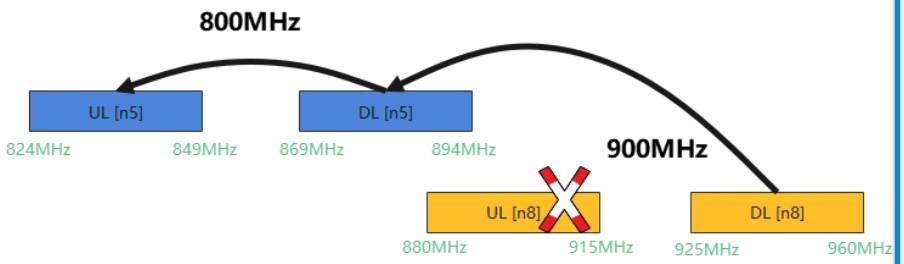
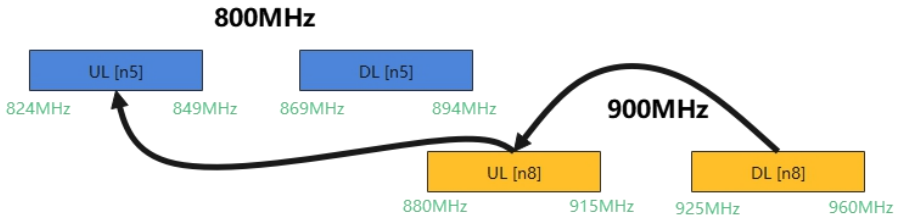
UE RRM related evolution in Rel-19

- Justification:
  - In Rel-18, for the band combination of CA_n5-n8, options 2 & 3 are dropped and only option 1 will be considered.
    - ✓ Option 1: DL CA_n5-n8 with single UL in n5 only
    - ✓ Option 2: UL/DL CA_n5-n8 with non-simultaneous Rx/Tx between n5 DL and n8 UL
    - ✓ Option 3: UL/DL CA_n5-n8 with additional dedicated filter for the restricted frequency ranges for specific operator
- **Scell with UL only transmission could enable the operators to utilize the uplink spectrum in band n8 in addition to Rel-18 Option 1 solution.**



Rel-18 solution for CA_n5-n8



Rel-19 complementary solution for CA_n5-n8

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UE RRM related evolution in Rel-19

- To consider the Scell with UL only transmission in Rel-19 RAN4 RRM WID:
  - ✓ Objective:
    - To define the RRM requirement for Scell with UL only transmission.
    - Potential RAN1/2 impact if any could be triggered by LS.

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UE Demod related evolution in Rel-19

- **Justification**:
  - In Rel-17, the evaluation scenarios of CRS-IM mainly focus on antenna configuration 4x2 or 4x4 which is basically targeted for normal UE.
  - For Redcap UE introduced in Rel-17, its receiver numbers are reduced to 1Rx and 2Rx to reduce the cost.
  - In Rel-15, RAN4 defined the performance requirement of CRS-IM for LTE Single RX Chain UEs.
- **Proposal**: to define CRS-IM Performance Requirements for Redcap UE with single receiver in Rel-19 to ensure that Redcap UE could have the same capability to handle LTE CRS interference similar as normal NR UE.

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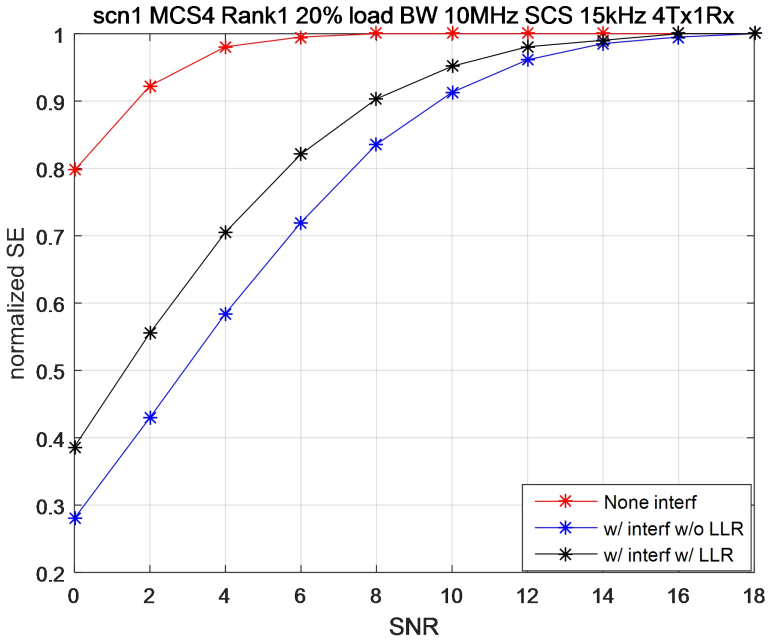
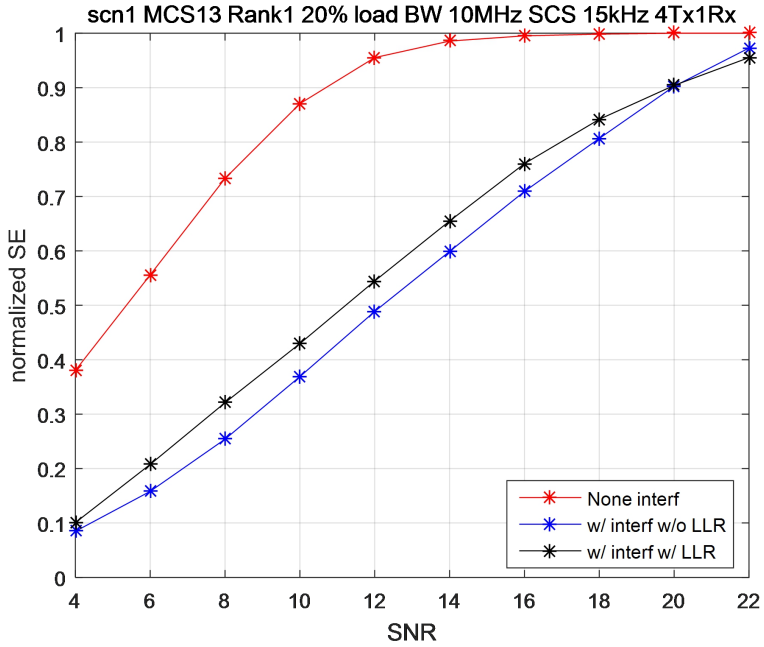
Simulation results-Scenario 1





» Required SNR (dB) at 70% max TP

Reference (No CRS-IM)	CRS-IM LLR weighting
5.7dB	3.9dB

» Required SNR (dB) at 70% max TP

Reference (No CRS-IM)	CRS-IM LLR weighting
15.8dB	14.8dB

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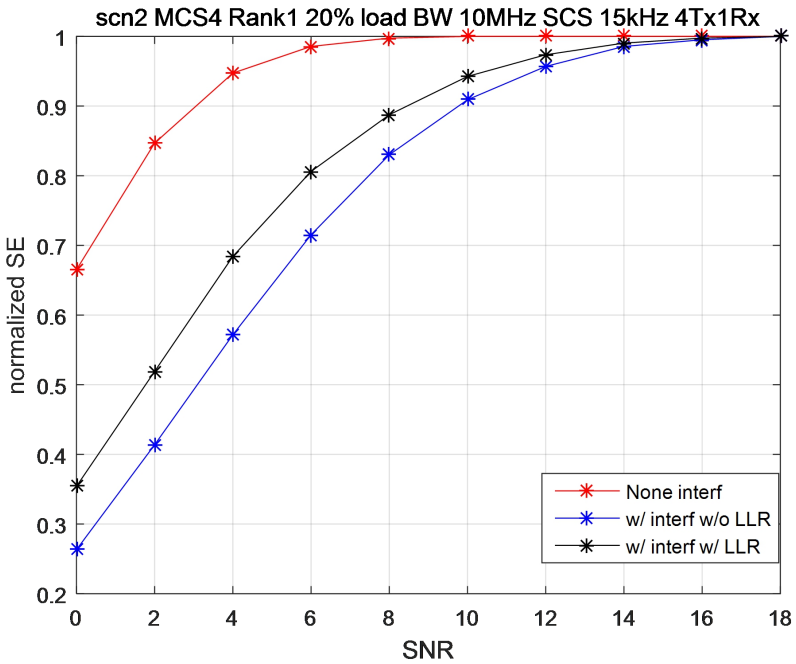
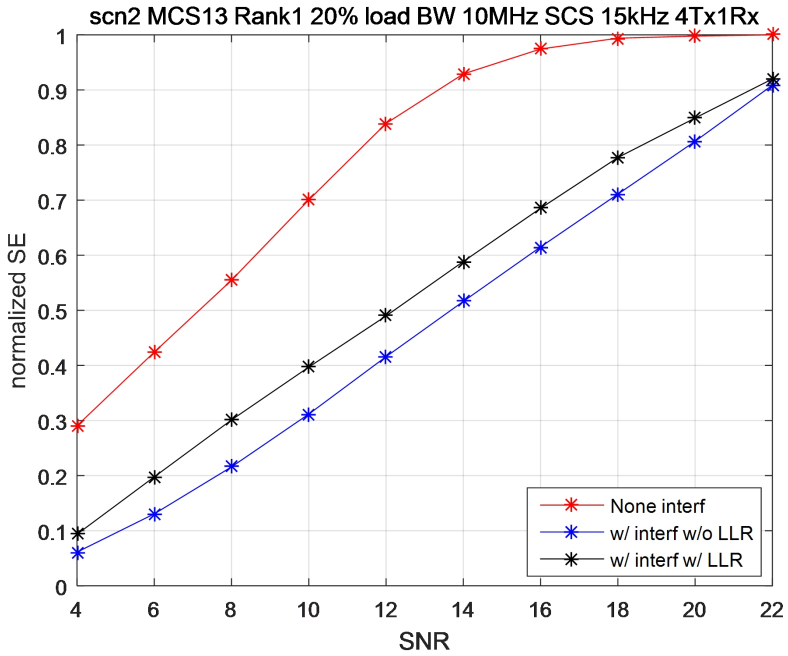
Simulation results-Scenario 2





» Required SNR (dB) at 70% max TP

Reference (No CRS-IM)	CRS-IM LLR weighting
5.7dB	4.3dB

» Required SNR (dB) at 70% max TP

Reference (No CRS-IM)	CRS-IM LLR weighting
17.8dB	16.3dB

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UE Demod related evolution in Rel-19

- **Justification**:
  - In Rel-18, only 4T8R with 4 MIMO layers and 8T8R with 8 MIMO layers are specified.
  - However in the practical netowork, 8 MIMO layers for 8Rx FWA is somehow difficult to be achieved in general.
  - In order to make the RAN4 requirement more aligned with the practical network channel condition, other MIMO layers should be also considered for 8Rx FWA.
- **Proposal**: to specify demod requirement for 8T8R with 5,6,7 MIMO layers.

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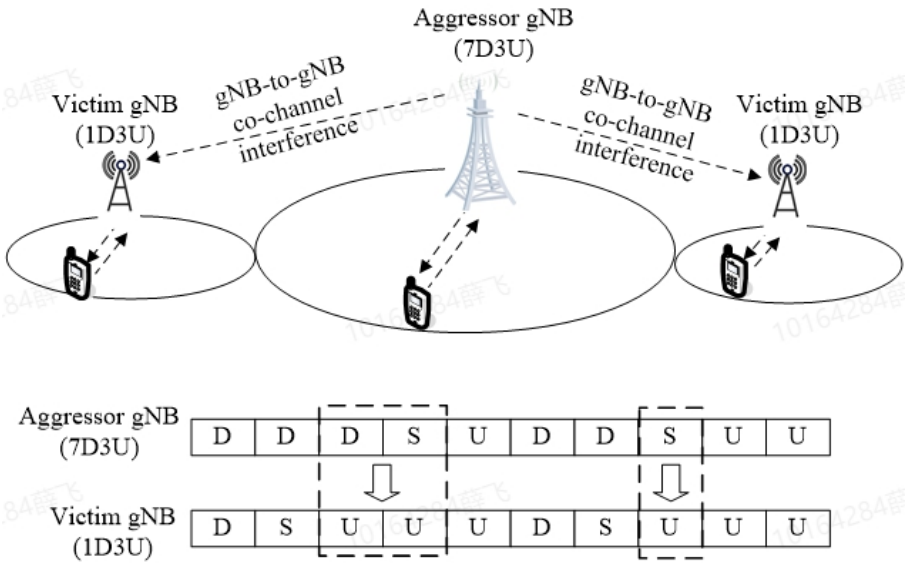
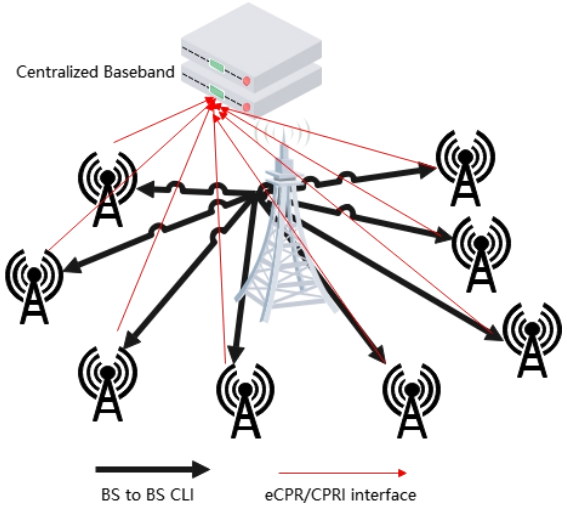
BS Demod related evolution in Rel-19

- **Justifcation:**
  - If to configure different TDD pattern in HetNet scenario, there will be some CLI probems from WA gNB to LA gNB.
- **Proposal:** to investigate some advanced receiver (e.g. MMSE-IRC etc) to handle the BS CLI problems in dynamic TDD scenario.





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Content

01 RF/OTA topics

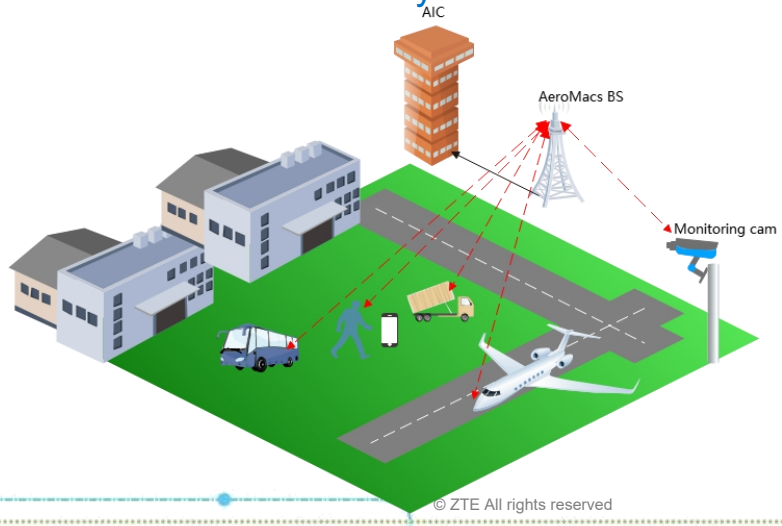
02 RRM and Demod topics

03 Candidate topics on cross area

04 Others

NR based AeroMACS-Use case

- Justification:
  - AeroMACS is the aeronautical mobile airport communication system (AeroMACS) which is used to provide the wireless communication system for airport to help airlines, airport authorities and airport ground service etc.
  - AeroMACS is still using the WiMAX standard (IEEE 802.16) at the aeronautical C-band (5 GHz) to provide the service till now.
  - Based on the latest decision from CAAC (Civil Aviation Administration of China), it's planned to provide the NR based AeroMACS system.



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NR based AeroMACS- Spectrum status

- Spectrum status:
  - ITU-R WRC-07 decided to assign the 5091-5150MHz for the spectrum of AeroMACS system;
  - ITU-R WRC-12 decided to assign the 5030~5091MHz for the spectrum of AeroMACS system;
  - NASA consider the use of the 5000-5030 MHz band to extend the tuning range for the the AeroMACS.

Proposal 1: to specify the band 5091~5150MHz for regional deployment and 5000~5150MHz for global deployment.

Proposal 2: to define RF requirement for BS and UE requirement;

Proposal 3: to define the RRM requirement for AeroMacs UE;

Proposal 4: to define the Demod requirement for AerMacs BS and UE;

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ATG evolution in Rel-19

- CA based ATG system based on the deployment demand;
- ATG operation in mmWave frequency range;
- Potential new FR1 bands based on the operator's deployment request;
- ATG UE EMC;
  - The current Spec in 3GPP does not cover the EMC requirements of ATG UE. However by considering the use case of ATG equipment, the EMC requirement limits would be different with current spec. In order to fill the missing gap of ATG UE EMC requirements, we recommend to study ATG UE EMC requirements in Rel-19.
    - To cover the Core&Perf EMC requirements for ATG UE;

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Content

01 RF/OTA topics

02 RRM and Demod topics

03 Candidate topics on cross area

04 Others

Rel-19 SID on Further simplification of band combination

- The simiplification of band combination shall continue due to more new rules/guildance would be foreseen.

- Recommended Objectives:

A new SI of FS_SimBC is proposed for further simplification of band combination specification in the stage of Rel-19.

- Rules or guidelines collection for band combination during the timeframe of Rel-19.
- Efforts on possible optimization for specification structure and reduce the signalling load and test burden.
  - RAN2 and RAN 5 work will be triggered by LS from RAN4.
- Study the possible simplifications for HPUE features.
- For the simplification on V2X band combinations, the following PC5 configurations with Uu configurations should be investigated in order to minimize the specification efforts.
  - Inter-band con-current V2X operating bands (TS 38.101-1&TS 38.101-3)
    - NR Uu+NR PC5 (TS 38.101-1)
    - LTE Uu+NR PC5(TS 38.101-3)
    - NR Uu+LTE PC5(TS 38.101-3)
  - Intra-band con-current V2X operating bands (TS 38.101-1)
- Investigate and simplify the working procedure for specifying band combination for future releases, e.g., 6G specifications.
  - Simplifications on BCS for band combinations.
  - Simplifications on band combinations of multiple features, e.g., NR-CA, EN-DC etc.
  - Develop the necessary tools to reduce RAN4's workload or easily retrieve the requirements for a certain band combination.
- A new TR for Rel-19 is to be created for capturing the new rules or guidelines in Rel-19 and handling the common rules or guidelines captured in previous TRs which are also applicable to Rel-19. Guidelines for future releases on band combinations will also be captured.

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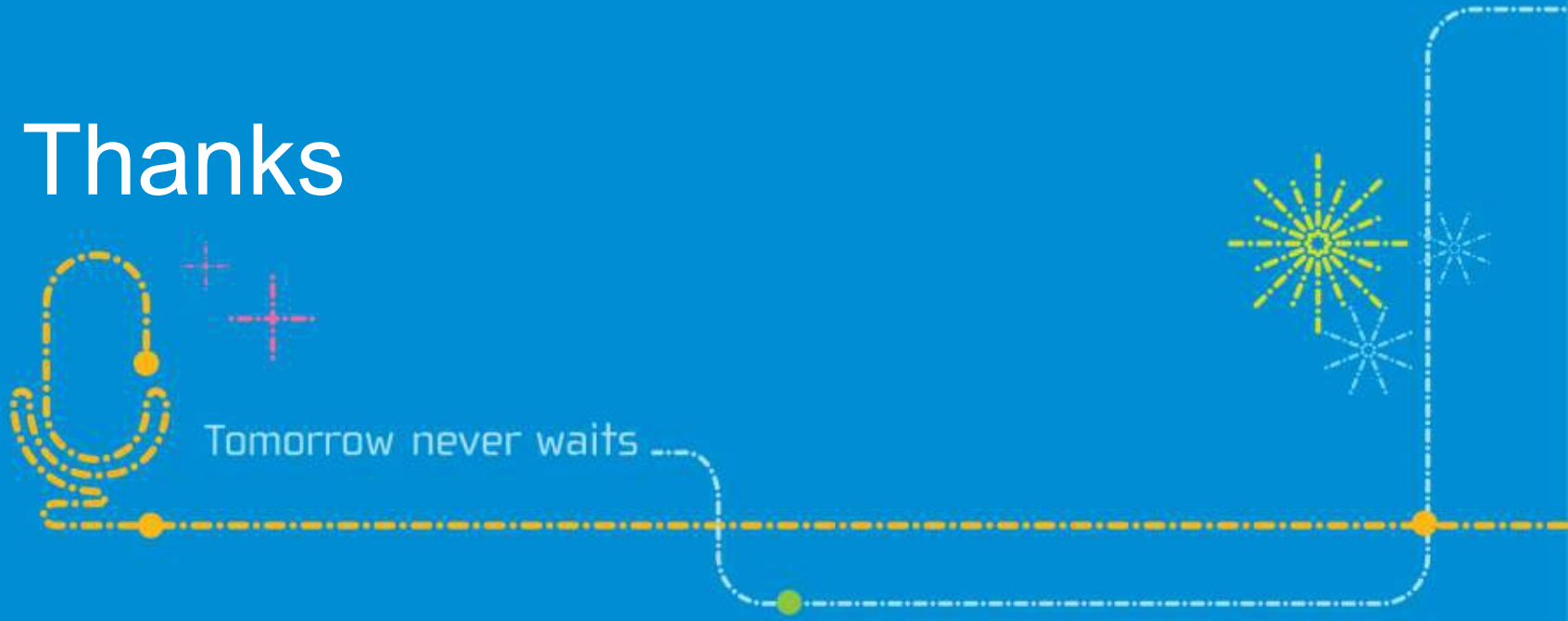
Thanks