3GPP TSG RAN Meeting #94-e
Electronic Meeting, December 6 - 17, 2021

RP-213313

Views on RAN4 Rel-18 scope

Agenda Item: 8A.4
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RAN4 Rel-18 TU budget

Background

- Discussion on RAN4 TU allocation took place in Rel-18 email discussions [RP-211667 and RP-212682]
- General understanding is that RAN4 TU allocation shall balance between RAN4-led work and RAN1/2/3-led work items
- The WI approval process may implicitly deprioritize TU allocation for RAN4-led SI/WI and many companies prefer to make a reservation of TUs dedicated to RAN4-led WIs
- To maintain the TU balance RAN4 objectives of other WG-led WIs shall be reviewed, and proper down-scoping may be required
- Based on Rel-16/Rel-17 experience new urgent market requests may arise after approval of the RAN4 work package

Proposals

- Reserve dedicated RAN4 TUs for RAN4-led WI/SI and WI/SI led by other WGs during December 2021. TU allocation in RP-212682 can be used as a starting point (see below)
- Clearly identify RAN4 related objectives as well as required TUs for Rel-18 WI/SI led other WGs in December 2021
- If the pre-allocated RAN4 TUs for Rel-18 WI/SI led by other WGs are exceeded, down-scoping of RAN4 objectives for Rel-18 WI/SI led by other WGs would be required
- Reserve a certain amount of RAN4 TUs for urgent market requests during the Rel-18 timeframe

TU allocation proposed in RP-212682

Reserved TU table for Rel-18 in RAN4 (Total TU: 45; RF TU 24.5, RD TU 20.5, assume Rel-18 work starts from Q3 2022)

Reserved TU (Average TU for Quarter with two meetings)	2022 Q2		2022 Q3		2022 Q4		2023 Q1		2023 Q2		2023 Q3		2023 Q4		2024 Q1		2024 Q2	
	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD
Maintenance </= R17 closed	19.5	5.5	4	3.5	3	3.5	3	3	3	2	2	2	2	2				
Rel-18 RAN1~3, 5 impacts on RAN4	0	0	0	0	1	1	7	8	7	8	8	10	8	10				
Rel-18 RAN4-led spectrum	0	0	6.5	0	6.5	0.25	6.5	0.25	6.5	0.25	6.5	0.25	6.5	0.25				
Rel-18 RAN4-led non-spectrum	0	0	**7.5**	**4**	**12**	**13.75**	**7**	**8.25**	**7**	**9.25**	**7**	**7.25**	**8**	**7.25**				
Rel-17 performance part	5	15	4.5	11	0	0	0	0	0	0	0	0	0	0				
Reserved TU for Rel-18 LS reply	0	0	1	1	1	1	0	0	0	0	0	0	0	0				
Reserved TU	0	0	1	1	1	1	1	1	1	1	1	1	1	1				

Finalize Rel-17 Perf. Part, Rel-17 maintenance

RAN4 Rel-18 package

Key principles for RAN4 WI package contents

- Balance the needs of the industry and the RAN4 workload constraints
- Balance work among in-field issues, leftover issues from early release(s), and new enhancement
- Meet the commercial demand for practical deployment and open the opportunities for further network evolution

Rel-18 RAN4-centric evolution areas based on pre-RAN #94 email discussion (non-spectrum)

- **Device (cross-area)**
  - FR2 UEs with multi-beam RX (4 MIMO layer)
  - FR1 UEs 6RX and 8 RX
- **RF**
  - UE FR1 & FR2 RF evolution
  - Rel-17 SI continuation (Irregular CBW, pi/2 BPSK)
  - BS RF evolution
- **RRM**
  - NR FR2 enhancements
  - General & Leftovers
  - Measurement Gap enhancements
- **Demodulation**
  - UE & BS advanced RX
- **Use Cases (cross area)**
  - NR FR1 non-co-located intra-band EN-DC/NR-CA
  - NR ATG (air-to-ground)
  - NR FR2 HST enhancement
- **OTA**
  - FR2 UEs with multi-beam/chain RX
  - New FR2 devices
  - Dynamic OTA testing
- **EMC**
  - BS & UE enhancements

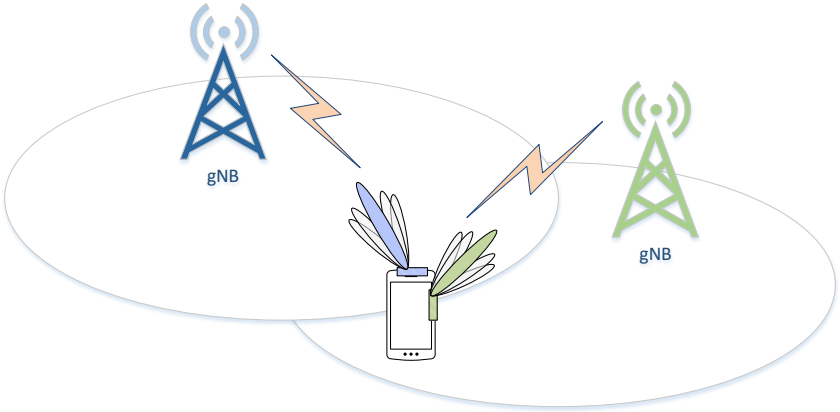
See next slides for detailed views on candidate scope for different areas

Device Enhancements (cross-area)

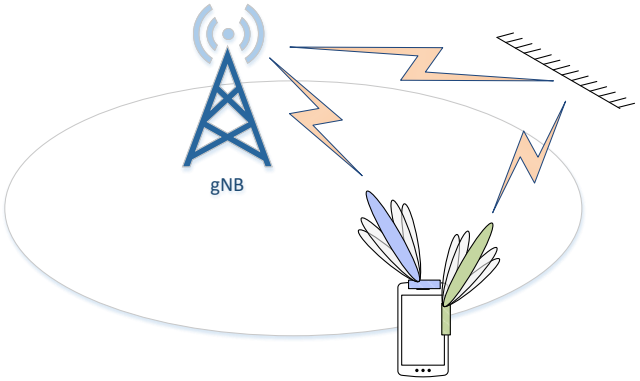
FR2 UEs with multi-beam/chain simultaneous DL reception capabilities [see RP-213314 and draft WID RP-213317]

- Enhanced FR2 UEs with multi-beam simultaneous reception and multiple RX chains can provide a meaningful performance improvement in FR2 improving both demodulation performance (4-layer DL MIMO), RRM performance and improve RF spherical coverage.
- Key objectives: *Define requirements for FR2 UEs capable of multi-beam/chain simultaneous DL reception on a single component carrier*
  - *Enhanced RF requirements: spherical coverage requirements for devices with 2 panels*
  - *Enhanced RRM requirements: measurement delay reduction, FR2-FR2 DAPS HO*
  - *UE demodulation requirements: simultaneous reception from different directions, 4 DL MIMO layers.*
  - *Study OTA test methodology*

Multi-TRP TX + Multi-beam RX



Single TRP + Multi-beam RX



Device Enhancements (cross-area)

FR1 UEs with 6RX and 8RX antennas

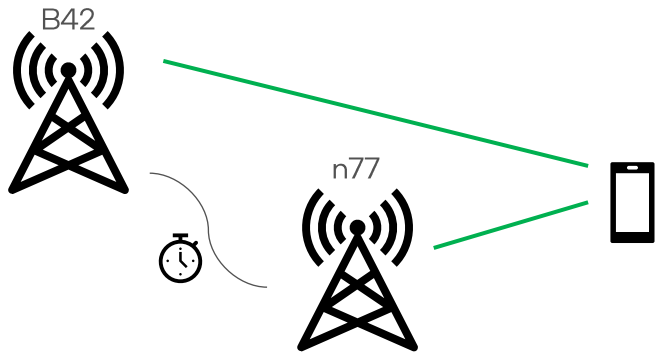
- LTE support operation with up to 8RX antennas for CPE/FWA type of devices. Further enhancement of the number of RX antennas at the UE side for NR can be considered to meet the market requests. To allow more flexibility for UE implementations both 6RX and 8RX shall be considered.
- Key objectives
  - *Enable 8Rx for FWA/CPE on higher frequency bands*
    - *Specify the UE RF requirements to support 8Rx*
    - *Specify RLM test cases with 8Rx*
    - *Specify UE demodulation performance and CSI requirements to support 8Rx (up to 4 MIMO layers)*
  - *Enable 6Rx targeting at support of smartphone/CPE/FWA form factors on higher frequency bands*
    - *Specify the UE RF requirements to support 6Rx*
    - *Specify RLM test cases with 6Rx*
    - *Specify UE demodulation performance and CSI requirements to support 6Rx*

Use Case Enhancements (cross-area)

Non-co-located scenario for FR1 intra-band non-contiguous EN-DC and NR-CA

Background

- Different coexistence conditions apply for different part of the same frequency band, so collocated Tx is not always available even for intra-band EN-DC and CA
- RAN concluded MRTD or MTTD are not specified in Rel-16 or Rel-17
- RRM requirements are missing for type 2 UE (Rel-16 RAN4 UE feature 2-19) when it supports intra-band NC MR-DC with the same assumption that it handles well MRTD larger than 3us



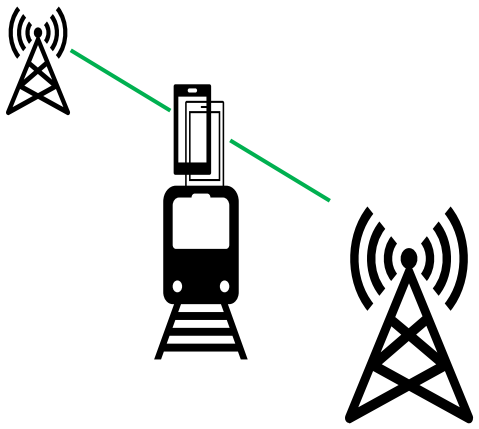
Candidate objectives

- *Study and if feasible, support non-co-located scenario for FR1 intra-band non-contiguous EN-DC/NR-CA*
  - *MRTD/MTTD requirements*
  - *PDSCH demodulation performance requirement based on the applicable MRTD and power imbalance*
  - *Consider UEs capable and not capable of supporting intra-band non-contiguous NR-CA and EN-DC in the same way to support inter-band CA, i.e., UE indicating / not capable of interBandMRDC-WithOverlapDL-Bands-r16*

Use Case Enhancements (cross-area)

NR FR2 HST enhancements

- Further evolution of FR2 HST requirements is recommended to allow improved NR operation under a new promising scenario
- Key objectives:
  - *Support HST velocity of up to a maximum of 500km/h, with carrier frequency up to 30GHz (RRM/Demod)*
  - *Enable HST FR2 multi-panel reception CPEs (RF/RRM/Demod)*
  - *Requirements for FR2 HST tunnel deployment scenario*
  - *Enhanced UL timing adjustment mechanisms with large propagation delays from different TRPs to UE (if not supported in Rel-17)*



NR ATG (Air-to-Ground)

- New scenario to extend 5G technology reach.
- Extensive scope discussion in Rel-17 timeframe with stable objectives.
- WI objectives in RP-212682 can be used as baseline

UE RF Enhancements

Further UE RF technology evolution shall be considered with a focus on enabling new use cases and performance improvement

FR2 RF enhancements

- FR2-2 intra-band DL/UL CA based on CBM/IBM and FR2-1/FR2-2 inter-band CA based on IBM
  - CA support for FR2-2 may not be introduced in Rel-17 and can be considered for Rel-18. Comparing to FR2-1 the max frequency separation in FR2-2 band is much larger and IBM can be considered for intra-band CA on top of CBM.
- FR2 ON/ON switching time enhancements
  - ON/ON transient time has a big impact on the overall spectral efficiency of FR2-1 and FR2-2. Further tightening of RF requirements can be beneficial to improve the performance and enable operation with high order modulations.
- *Note: Rel-17 WI is ongoing and additional objectives can be considered subject to RAN4 progress*

FR1 RF enhancements

- MSD improvement
  - Improved MSD performance will have a positive impact on the overall network performance and can be considered as one of the key improvements in Rel-18. The work is expected to have relatively large scope and recommended to be performed in Rel-18 (rather than in Rel-17)
- > 2 TX antennas
  - Further enhancement of UE antenna performance is possible including 3TX and/or 4TX

RRM and MG Enhancements

RRM performance improvements are critical to ensure optimized UE in-field performance. Potential RRM enhancements scope of Rel-18 items shall balance between Rel-15/16/17 RRM "leftovers" (i.e., items deprioritized in previous releases due to TU constraints) and new RRM areas

Candidate enhancements (see details in RP-213315 and draft WIDs RP-213318, RP-213319)

FR2 enhancements

- FR2 delay reduction
- Network controlled gaps for UE Rx beam switching
- FR2-FR2 DAPS HO
- FR2-2 enhancements & leftovers (e.g., NR-DC and FR2-1 - FR2-2 NR CA/DC)

General/leftovers

- FR1 + FR1 NR-DC RRM requirements
- CMTC
- RLM enhancements
- TCI state switch enhancements

MG related

- NeedForGap requirements
- Per-FR gap UE capability enhancement
- MG sharing enhancements
- Rel-17 leftovers (MG Enhancements and MUSIM)

Demodulation Enhancements

Demodulation performance improvements are required to optimize UE/BS performance under practical scenarios. Recommend to focus enhancements on UE/BS receiver evolution

Candidate enhancements (see details in RP-213316 and draft WID RP-213320)

UE advanced receivers

- MMSE-IRC for time-selective inter-cell interference
- Enhanced DL MU-MIMO receivers based on E-MMSE-IRC or R-ML
- Enhanced DL multi-DCI multi-TRP receivers
- Soft IC receivers for DL SU-MIMO

BS advanced receivers

- MMSE-IRC for inter-cell interference

OTA Testing Enhancements

Further OTA testing enhancements can be considered to ensure proper UE device testing.

The following areas can be considered:

- FR2 OTA test methods for new device types
  - Current FR2 OTA test methods are focused on PC3 handheld type of devices and further extension to additional device types is beneficial to ensure proper testing of FR2 devices including PC1/PC5 FWA devices, PC3 UEs with large form factors
- FR2 OTA test methods for UEs with multi-beam/chain simultaneous DL RX
- FR2 dynamic OTA testing method

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