3GPP TSG RAN Rel-18 Workshop
June 28th – July 2nd 2021

RWS-210092
Agenda Item 4

MediaTek Views on Rel-18

MediaTek Inc.

Rel-18 Key Drivers

- eMBB Consumer
  - **Drivers:** LLeMBB services e.g Cloud Gaming, XR; FR2
  - **Reach:** WAN to PAN; Uu, SL
  - **Devices:** Smartphone (incl. hub, gateway), Wearables, Computers & Peripherals, Home
  - **Spectrum:** Licensed, Unlicensed
- Network Topology
  - **Drivers:** Coverage build (incl. C-band, FR2), Data consumption models
  - **Reach:** WAN to PAN; Uu and SL
  - **Devices:** All
  - **Spectrum:** Licensed, Unlicensed
- NTN Evolution
  - **Drivers:** Service versatility, Capacity, Mobility
  - **Reach:** NTN Uu
  - **Devices:** Smartphone, IoT
  - **Spectrum:** Licensed, Licensed Shared (TN, NTN)
- Long-term Technology Exploration
  - AI/ML integration
  - Spectrum >71GHz
- Common aspects
  - **Drivers:** (FR2) mobility, Carbon footprint, Positioning
  - **Reach:** WAN to PAN; Uu and SL (Pos.)
  - **Devices:** All
  - **Spectrum:** Licensed, Unlicensed

eMBB consumer

MIMO
- CSI enh.
- BM: [subject to R17]
- Stationary: 8Rx, overhead redux
- UL sub-band precod.
- UL 4+ layers

DC/CA Enh.
- X-carrier HARQ: feedback & re-Tx
- Fast re-Tx split bearer
- Temporal RS PScell act
- Scalable x-carrier sch.

XR/CG Enh.
- QoS+, x-layer opt

MBS
- SFN+
- QoS+ (Tput, reliab.)
- TV (ATSC3.0 ref)

NW Topology

Sidelink LLeMBB
- SL-U esp. <7GHz, FR2
- Low latency 1Gbps
- SL-U RedCap

Sidelink Relay
- U2U relay
- UE scheduling UE
- mPath, mHop
- Mobility (Remote, Relay)
- Network coding

Smart Repeaters
- Beamforming
- Interf. Mgmt (T/F DD)
- Integration (UE authorization)

NTN Evolution

NTN NR
- Mobility
- Regenerative arch
- HD-FDD, VoNR, MBS
- R17 leftovers

NTN IoT
- Mobility (connected)
- R17 leftovers

SID Spectr. sharing
- Study scenarios, target spectrum and regulation status

Long-term explor.

SID AI/ML integr.
- NG-RAN/AS integrat.
- DMRS ch. est., Rx noise suppress, CSI-RS overhead, CSI feedback
- (UE-based) Mobility predict., Pos. enh.
- NW functions (load balancing, radio resource planning..)

SID AI traffic
- Traffic and arch.
- Overhead optim.

SID >71GHz
- Spectrum charac.

Common tech.

[FR2] Mobility
- L1/L2 trig. CHO
- Inter-/intra-cell beam switching delay redux
- RRC DAPS HO mPanel

System Energy
- DCI-based pwr sav mTRP and mPanel
- gNB/TRP dormancy (UE -trig. / -imposed)
- Eval. Methodology (Pwr. Cons. Models)

POS (NR, SL, RedCap)
- cm-level (Tx + meas related to signal ϕ)
- SL (-based, -assisted)
- RedCap UE
- R17 leftovers

SID gNB Full Duplex
- Partitioning, scenarios, interf.

Verticals

URLLC
- DL control efficiency
- NR-U enh

RedCap
- PA-less
- (POS)
- NO LPWA

(UAV: neutral)

SID = SID only Others: SI+WI / WI

Sorting for 3GPP RAN#92e Rel-18 Workshop

eMBB

MIMO
- CSI enh.
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- Stationary: 8Rx, overhead redux
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- SL-U RedCap

XR/CG Enh. [SA-led]
- QoS+, x-layer opt.

NTN NR
- R17 leftovers
- Mobility
- Regenerative arch
- VoNR, MBS, HD-FDD

MBS
- SFN+
- QoS+ (Tput, reliab.)
- TV (ATSC3.0 ref)

(may also be seen as non-eMBB)

Non-eMBB

URLLC
- DL control efficiency
- NR-U enh

RedCap
- PA-less
- (POS)
- NO LPWA

NTN IoT
- R17 leftovers
- Mobility (connected)

(UAV: neutral)

X-areas New areas

System Energy
- DCI-based pwr sav mTRP and mPanel
- gNB/TRP dormancy (UE -trig. / -imposed)
- Eval. Methodology (Pwr. Cons. Models)

[FR2] Mobility
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SID AI traffic
- Traffic and arch.
- Overhead optim.

SID = SID only Others: SI+WI / WI

Detailed Proposals

- Motivations
- SI/WI objectives
- Initial TU assessment (RAN1~4) – 18-month Release

MIMO Enhancements

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
36	9	-	9

SA/CT Dependency: No

High resolution, low overhead CSI for MIMO evolution toward > 2 mTRP and coherent JT.
Continued FR2 enhancement for link robustness.
Continued parametric optimization.

Objective I: CSI enhancement [RAN1, 2, 4]
- Increased CSI feedback resolution with limited overhead (using time-domain i.e. Doppler compression)
- Support for high mobility
- PDSCH/DMRS-based

Objective II: Beam management [RAN1, 4]
- L1/L2 mobility and UE-initiated beam change (TCI state activation) >> See mobility enhancements

Objective III: Enhancements for stationary devices [RAN1, 4]
- Support for 8Rx UE
- Overhead reduction

Objective IV: Uplink enhancements [RAN1, 4]
- Sub-band precoding
- 4+ layers

DC/CA Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
18	9	TBD	9

SA/CT Dependency: No

Efficient spectrum utilization with robust user experience.
Address capacity shortage due to LL eMBB (XR, CG).

Objective I: Enhancement of latency-constrained capacity for FR1 TDD with inter-band CA [RAN1, 2, (4)]
- Enable cross-carrier HARQ feedback (if not specified in R17 eURLLC) and cross-carrier HARQ retransmission

Objective II: Reduction of data interruption due to SCG blockage or SCG change [RAN2, 1, 4]
- Fast retransmission mechanism for split bearer (i.e. leg 1 to leg 2)
- Temporal Reference Signal for PSCell activation

Objective III: Full scheduling flexibility for massive carrier aggregation under limited UE blind decoding complexity [RAN1, 4]
- Scalable cross-carrier scheduling with 2-stage control (i.e. all scheduling info for 2nd cell provided in 2nd stage)

XR/CG Enhancements
SA-led

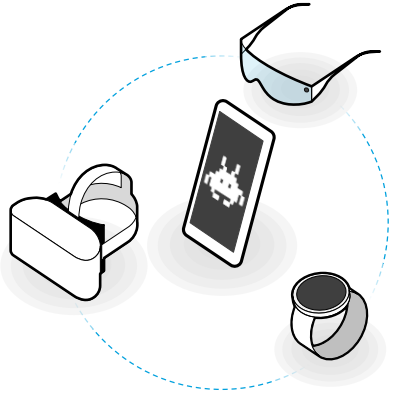
3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
-	-	-	-

SA/CT Dependency: Yes

Optimized support for Low-latency throughput-intensive applications esp. CG, XR

Objective I: QoS improvements for LLeMBB traffic
- Investigate issues pertaining to data rates fluctuation, jitter, congestion and packet dropping
- Mutual awareness between application and 5GS through cross-layer optimization

Objective II: Radio-related optimizations >> see: DC/CA, Mobility, SL enh



MBS Enhancements
RAN2-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
10	12	3	6

SA/CT Dependency: [TBC]

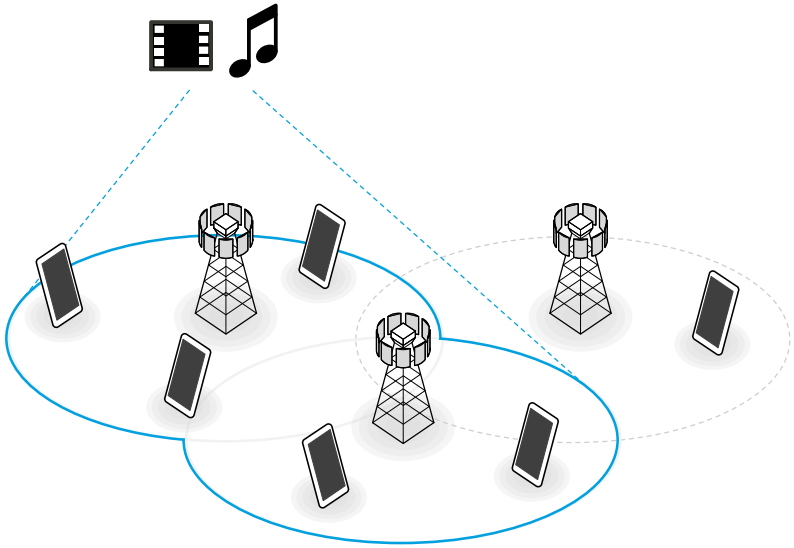
Improved MBS service quality, reliability and diversity via service continuity and wider QoS support
Improve deployment flexibility, efficiency and coverage via wider SFN (i.e. across DUs)

Objective I: Enable SFN type operation to support multiple cell x-DU transmission [RAN2, 1, 3, 4]
- New configuration (e.g. via system information) for service continuity
- Evaluate the need for extended CP

Objective II: Reliability Improvement (continuation) [RAN2, 1]
- Support MBS applications with more stringent QoS requirements e.g. public safety
- L2 feedback and retransmission at PDCP
- [L1 leftovers]

Objective III: Efficiency enhancement for broadcast [RAN1, 2, 4]
- Simultaneous transmission of ≥2 MBS services over the same frequency resources
- Simultaneous transmission between unicast and MBS service over the same frequency resources

NOTE: Same efficiency as for ATSC3.0



NOTE: R17 limited to intra-DU SFN

Sidelink Enhancements
RAN1-led

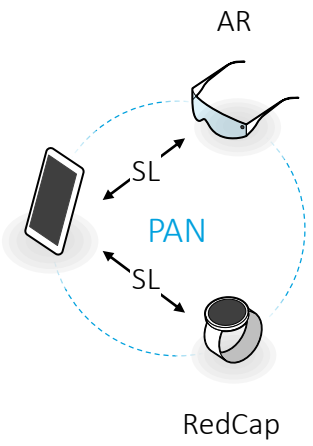
3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
16-18	10-11	-	6

SA/CT Dependency: No

Support for Sidelink operation in any spectrum i.e. licensed and unlicensed.
Performance improvements enabling low-latency 1Gbps.

Objective I: Support for SL-U sub-7GHz, FR2, SL-U Sub-71GHz [RAN1, 4]
Focus on 5/6GHz unlicensed spectrum leveraging NR-U design.

Objective II: Enable Low-latency 1Gbps Sidelink [RAN1, 2, 4]
1. MIMO: a) CSI enhancement (PMI support, CSI reporting) b) >2layers
2. CA support: Sidelink + Sidelink incl. licensed + unlicensed
3. Reduced latency: mode 2d enhancements (UE scheduling UE) without redesign of PHY structure



Sidelink Relay Enhancements
RAN2-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
6	21	3	12

SA/CT Dependency: Yes

Ensure service coverage & availability where service is to be consumed
Enable new service consumption models with optimal routing e.g. local gaming, local data exchange
Improve reliability. Full mobility support.

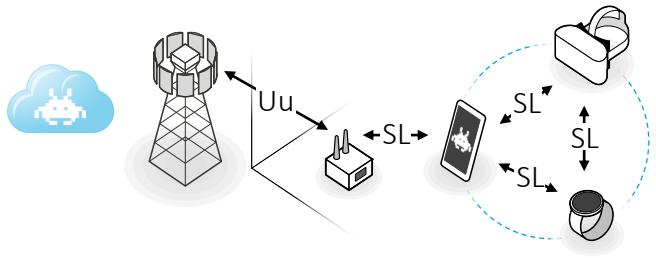
Objective I: Rel-17 left-overs [RAN1, 2, 4]
1. L2 UE-to-UE Relay
2. UE scheduling other UE

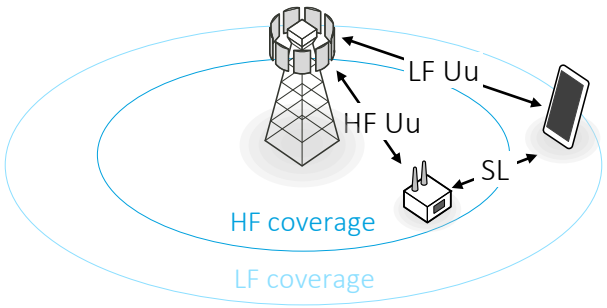
NOTE: no relay-specific impact anticipated for supporting unlicensed spectrum (see SL enhancements)

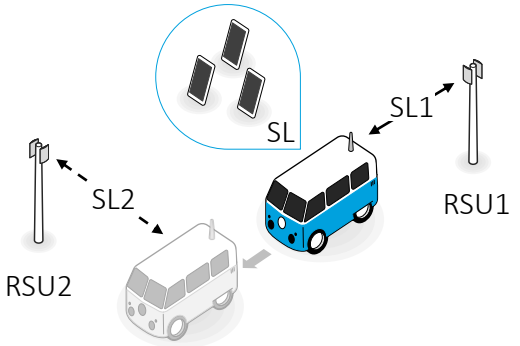
Objective II: Topology Enhancements [RAN2, 4]
1. Support for multi-hop
2. Support for multi-path (incl. PC5+PC5 and PC5+Uu)
3. Mobility of Remote UE between Relay UEs

Ojective III: Mobile Sidelink Relays e.g. vehicle-mounted relays [RAN2, 3]
1. Group handover of Remote UEs with U2N Relay UE
2. “Resume in different cell” case for Relay UE in RRC_INACTIVE

Objective IV: Network Coding Transmission by Relay UE [RAN2, 4]
Relevance esp. for multi-hop/multi-path







Note: RSU node does not imply C-V2X

Smart Repeaters Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
15	6	-	2

SA/CT Dependency: Yes (authorization)

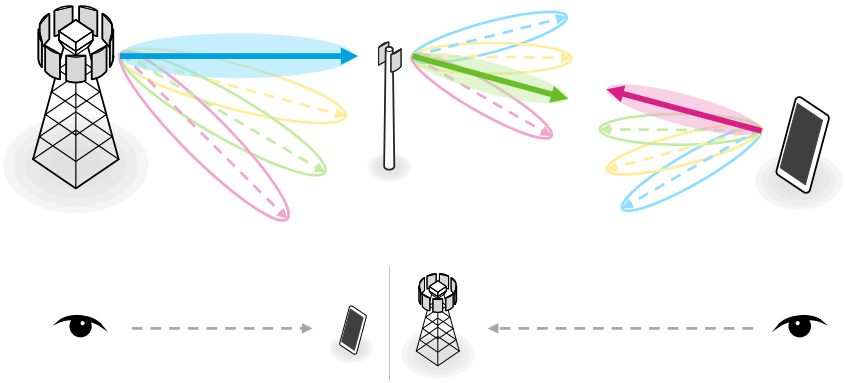
Ensure service coverage & availability where service is to be consumed
Limit additional interference via Tx power control at the repeater (i.e. Repeater to gNB/UE)

Objective I: Support for beamforming (Tx/Rx aspects) [RAN1]
- SSB beam
- System information
- CSI-RS beam for PDCCH/PDSCH
- SRS beam for PUCCH/PUSCH
- Control information and dynamicity

Objective II: Interference Management [RAN1]
- Support *both* TDD and FDD
  - For TDD: consider same TDD pattern only (i.e. no cross-link interference) and semi-static TDD
- Control mechanism for Repeater Tx power i.e. to gNB/UE to reduce same link interference

Objective III: Repeater Integration and Operation [RAN2]
- Integration: Repeater as a UE with OAM integration
  - Initial access, capability reporting, registration & authorization (+ notification to RAN), normal IP connectivity followed by OAM incl. set-up
- Operation: necessary signaling to support Objectives I & II

NOTE: necessary backwards compatibility with legacy NR UEs



NTN NR Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
TBD	TBD	TBD	TBD

SA/CT Dependency: Yes

Increase the viability and versatility of NTN NR access: mobility, coverage, services
Enable single device availability to cover all NTN bands (half-duplex FDD)

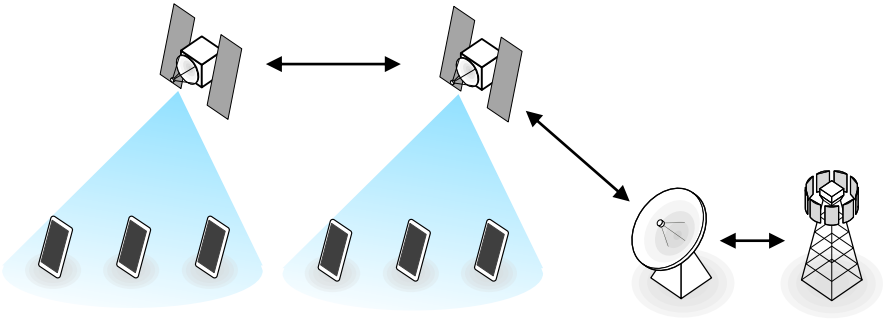
Objective I: Rel-17 Leftovers [RAN1, 2] *[subject to R17 status]*

Objective II: Mobility enhancements [RAN2, 1] *[subject to R17 status]*
- Scope would depend on whether Release-17 NTN NR can significantly benefit from additional enhancements in some scenarios and use cases

Objective III: Regenerative architecture [RAN3, 2]
- Support very dense LEO satellite deployment where the number of LEO satellite greatly outnumbers the number of GateWay stations on the ground, and also where it is not possible to locate GateWay stations – i.e. in the middle of vast oceans

Objective IV: HD-FDD [RAN1, 2]
- Re-use RedCap work while avoiding BW/antenna restrictions

Objective V: VoNR Enh., MBS support [RAN1, 2]



NTN IoT Enhancements
RAN1-led

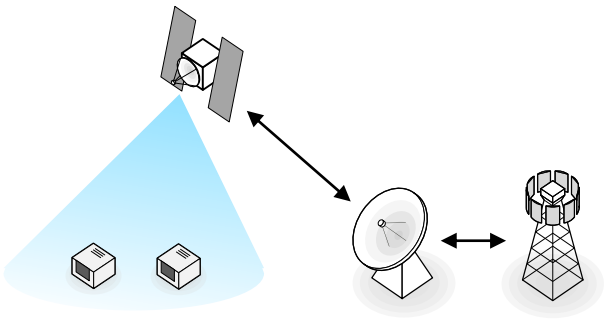
3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
TBD	TBD	TBD	TBD

SA/CT Dependency: Yes

Additional enhancements for NTN IoT access: data rates, long connection, mobility

Objective I: Rel-17 Leftovers [RAN1, 2] *[subject to R17 status]*
- HARQ enhancements to support higher UE data rates
- Enhancements to support long connection times

Objective II: Mobility enhancements [RAN2, 1]
- Connected mode mobility: Scope depends on whether Release-17 NTN IoT can significantly benefit from additional enhancements in some scenarios and use cases



NTN – TN Spectrum Sharing

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
-	-	-	-

SA/CT Dependency: No

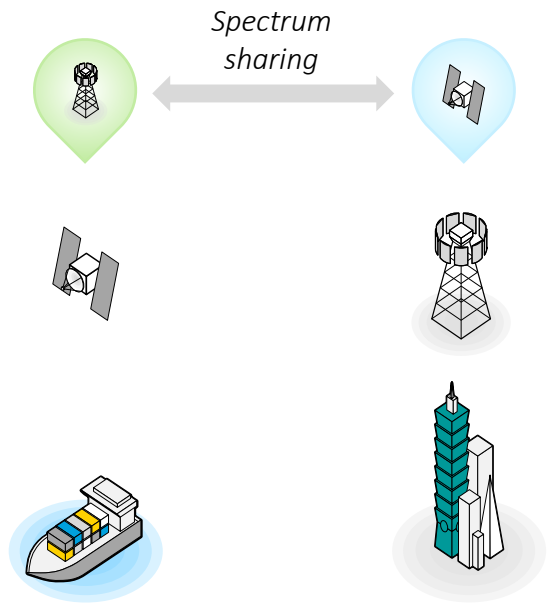
Enabling controlled sharing of TN/NTN spectrum to address location-specific connectivity demand

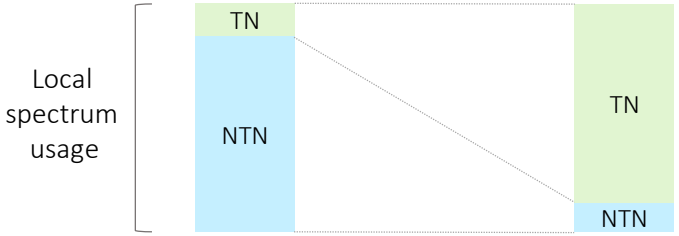
Motivation
- Acute shortage of FR1 spectrum for both TN and NTN, esp. in low bands.
- Opportunity for operators to provide global service across TN/NTN with multimode devices

Observation: Complementary demand for TN/NTN spectrum across geographic locations
- Populated areas: acute TN spectrum demand, poorly utilized NTN spectrum
- Remote areas: no TN coverage – TN spectrum unused, acute NTN spectrum shortage

Objective: Study NTN – TN spectrum sharing scenario [RAN]
- Explore benefits of network integration between TN/NTN networks to maximize spectrum utilization
    1. NTN spectrum used by TN networks in densely populated areas.
    2. TN spectrum used by NTN in remote areas with no TN coverage.
- Multimode TN/NTN UEs can roam between NTN/TN depending on location.
- Identify target spectrum and regulation status
- Scope RAN and core architecture impact
- Scope required NTN/TN co-existence effort

3GPP - best place to trigger cross-ecosystem discussion
- 3GPP is the only standards body where NTN and TN co-exist under the same system framework
- All ecosystem key players can contribute to balanced 3GPP consensus view for regulators to consider





Mobility Enhancements
RAN2-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
12	18	3	9

SA/CT Dependency: No

Low-performance FR2 mobility is a show-stopper for key services (capacity-hungry low latency): XR, CG. Robustness and latency to be improved.

Objective I: L1/L2-triggered CHO [RAN2, 1, 4] *[subject to R17 status]*

- Pre-configuration of candidate cell(s) i.e. Intra-CU, incl. intra- and inter-DU, candidate set
- UE-initiated cell switching with L1/L2 trigger, i.e. UE activation of inter-cell TCI states

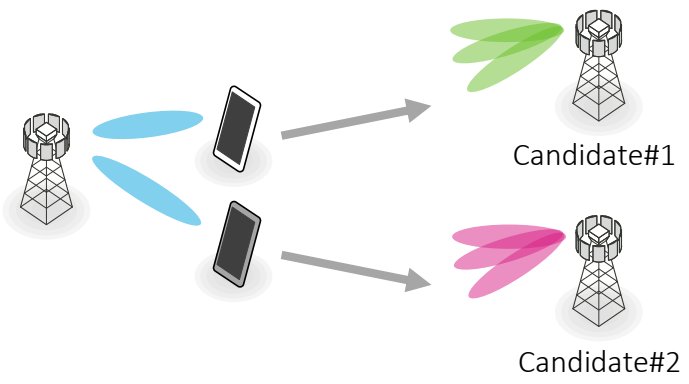
NOTE: R17 FeMIMO addressing *NW-initiated* L1/L2 mobility

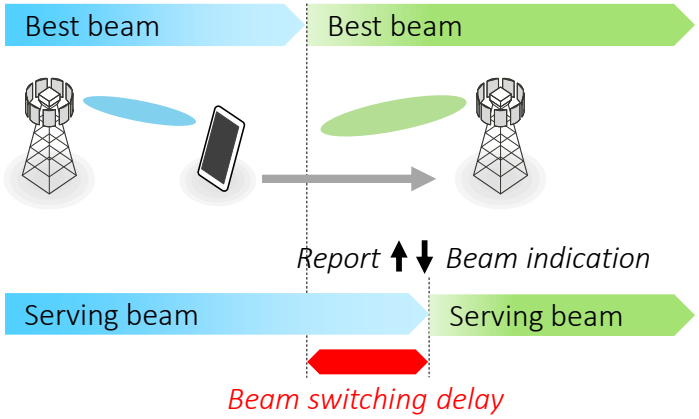
Objective II: Inter-cell, Intra-cell beam switching delay reduction [RAN1, 2, 4]

1. Active set (i.e. several cells) for fast inter-cell beam switching
2. RACH-less inter-cell beam switching
3. (NW) Predictive beam management [Link with AI/ML]

Objective III: DAPS enhancement [RAN2, 4]

- Enable RRC-based DAPS handover in FR2 for multiple-panel UE





System Energy Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
13.5	[-]	-	4.5

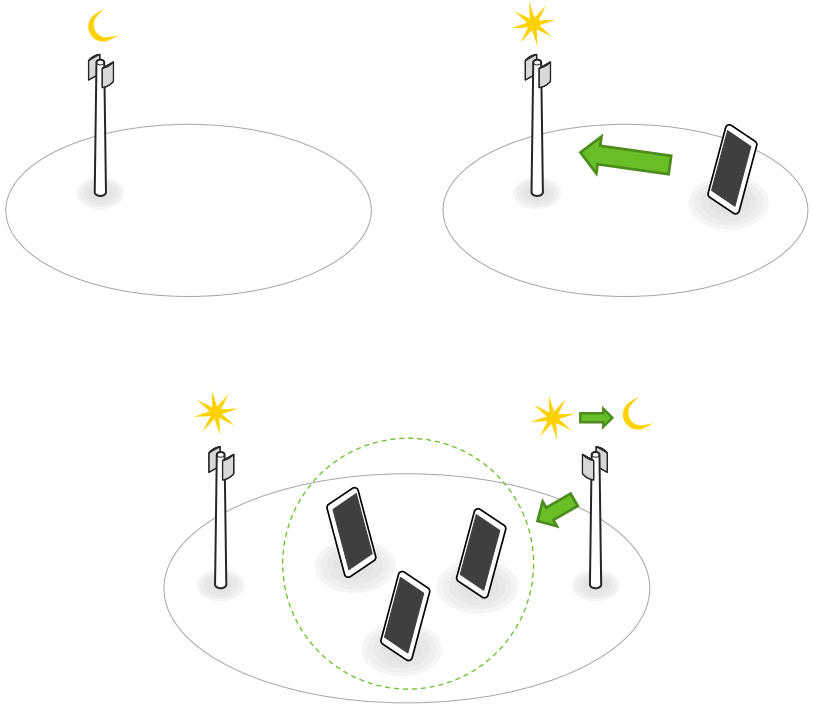
SA/CT Dependency: No

Balance system capacity and energy efficiency
UE/NW cooperation for improved system-wide energy efficiency

Objective I: Enable DCI-based power saving adaptation for m-TRP and multi-panels [RAN1, 4]
TRP-specific DCI-based power saving indication and UE adaptation behaviors for m-TRP and multi-panels

Objective II: Dynamic network power saving via gNB/TRP dormancy [RAN1, (2)]
- gNB wake-up mechanism (by UE) to accommodate gNB/TRP long dormancy
- Dynamic group indication for m-TRP for gNB/TRP short dormancy

Objective III: Evaluation methodology for system-wise energy efficiency and power saving [RAN1]
- Develop gNB consumption model
- UE consumption model extension for m-TRP and multi-panel scenario



Positioning Enhancements (NR, RedCap, SL)

RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
12~	9~	1	2

SA/CT Dependency: No

Improved positioning accuracy. Support for Sidelink. Support for Redcap UEs

Objective I: NR cm-level accuracy [RAN1, 2, 4]
Transmission and measurement related to signal phase for determining angle and distance, without much wider signal bandwidth

Objective II: Sidelink-assisted positioning [RAN1, 2, 4]
- Enable transmission of positioning assistance information from a Ref UE to neighboring UEs using SL
- Augment Uu PRS with SL PRS

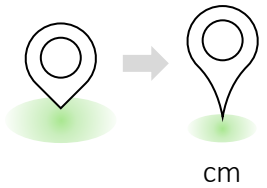
Objective III: Sidelink-based positioning [RAN1, 2, 4]

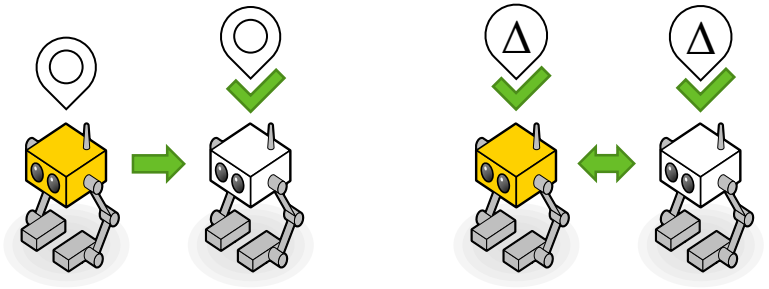
Objective IV: RedCap support [RAN1, 4]
PRS over 20MHz BW with algorithm improvements

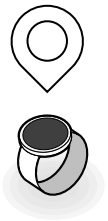
Subject to R17 Status:
Phase rotation mechanism for staggered SRS structure [RAN1]
- Define phase rotation mechanism for cyclic shift operation (staggered SRS) [currently missing]

CA for accuracy enhancement [RAN1, 2, 3, 4]
- Improved accuracy via larger bandwidth (CA) without mandating gNB to further minimize TAE

Self-calibration for group delay for accuracy enh. [RAN1, 2, 3, 4]
- Resolve inter-gNB timing offset issues via UE/gNB round-trip delay calibration







SID Sub-band Full-duplex for gNB
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
2~4	1~2	-	4.5

SA/CT Dependency: No

Study sub-band full-duplex in TDD bands

Objective: Study sub-band full-duplex for gNB [RAN1, 2, 4]
- Identify RB partitioning scenarios i.e. where FD operates
- Identify band/FR specific implications e.g. FR1 vs FR2
- Study UE-UE interference aspects incl. e.g. guard bands, geo separation, UE ACS, UE ACLR
- Study gNB-gNB interference aspects intra/inter MNOs
- Study impact to legacy UEs

URLLC Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
8	5.5	-	2

SA/CT Dependency: No

Capacity enhancements for latency-critical applications

Objective I: Improved DL control efficiency [RAN1, 2]: Due to the high reliability and small packet size, the control-to-data overhead ratio is larger compared to eMBB services

- CSI feedback for PDCCH:
  - Different coding scheme used for PDCCH
  - The observed interference on the PDCCH resources is different from PDSCH resources
  - CSI reported for PDSCH doesn't represent well the CSI for PDCCH
- Introducing intermediate aggregation levels:
  - Limited link adaptation for PDCCH (only 5 aggregation levels) compared to PDSCH

Objective II: NR-U Enhancements [RAN1, 2]

- Increase UL Tx opportunities (PUSCH, PUCCH, SR) in frequency/time domain: to reduce the impact of channel access blockage
- PDCCH monitoring enhancements across LBT bands: Splitting the CCEs/BDs budget across LBT BWs including the unsuccessful LBTs compromises the reliability of control channel
- Enable NR-U features via compact DCI

Objective III: UE processing time reduction for FR2 [RAN1]

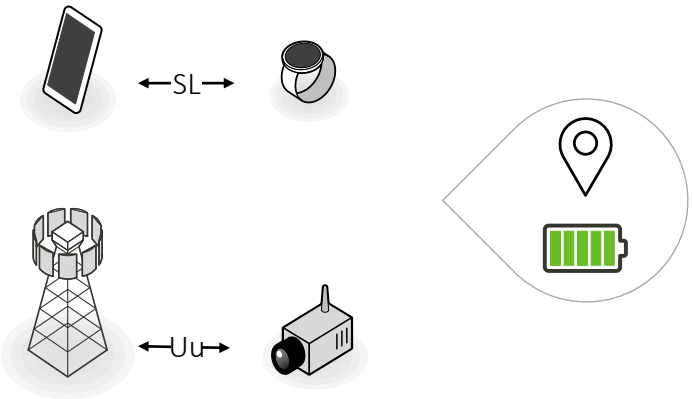
RedCap Enhancements
RAN4-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
2	1	-	9 (RF)

SA/CT Dependency: No

Support higher energy and cost efficiency through PA-less operation for energy-efficient SL operation
Enable Positioning (in corresponding WI)
No NR LPWA

Objective I: PA less operation [RAN4, 1, 2]
Define lower power class



Study AI/ML Integration
RAN2-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
4	8	6	-

SA/CT Dependency: No

To investigate the benefits of selective AI/ML integration into NG-RAN/AS functions

Objective I: Study AI-assisted AS layer functions for decision quality and/or overhead redux [RAN2, 1]
- RS overhead reduction and optimization with AI-assisted algorithms [RAN1]
- Mobility predictions, Positioning enhancements [RAN2]

Objective II: Study AI-assisted network functions [RAN3, 2]
- Predictive traffic management for load balancing across the network
- Network energy saving
- Radio resource planning and optimizations

Study AI/ML Traffic
RAN2-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
-	8	TBD	-

SA/CT Dependency: Yes

To characterize AI traffic and investigate AI traffic management
Efficient encoding of AI model and messages ("AI-Encoding")

Objective I: AI traffic and required architecture [RAN2, (3)]
- Study learning method and analyze data redundancy associated with AI/ML models
- Study model splitting between UE and Server, especially for federated learning

Objective II: AI/ML overhead optimization [RAN2, (3)]
- Model coding for combination of different model compression schemes, e.g. lossy/lossless, quantization, sparsification, and encoding.
- Traffic compression in both training and inference

Thank You!

MediaTek TDocs to RAN Rel-18 Workshop

RWS-210092	MediaTek Views on Rel-18 content	MediaTek Inc.
RWS-210093	[eMBB] MIMO Enhancements	MediaTek Inc.
RWS-210094	[eMBB] DC/CA Enhancements	MediaTek Inc.
RWS-210095	[eMBB] XR/CG Enhancements	MediaTek Inc.
RWS-210096	[eMBB/Other] MBS Enhancements	MediaTek Inc.
RWS-210097	[eMBB] Sidelink Enhancements - LLeMBB	MediaTek Inc.
RWS-210100	[eMBB] NTN NR Enhancements	MediaTek Inc.
RWS-210101	[non-eMBB] NTN IoT Enhancements	MediaTek Inc.
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RWS-210098	[x-area] Sidelink Relay Enhancements	MediaTek Inc.
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RWS-210106	[x-area] System Energy Enhancements	MediaTek Inc.
RWS-210107	[x-area] Positioning Enhancements	MediaTek Inc.
RWS-210197	[x-area] Sub-band Full-duplex for gNB	MediaTek Inc.
RWS-210110	Draft WID: System Energy Enhancements	MediaTek Inc.
RWS-210111	Draft WID: Mobility Enhancements	MediaTek Inc.
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