

[x-area] System Energy Enhancements

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)

eMBB

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.

Sidelink LLeMBB

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

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

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)

POS (NR, SL, RedCap)

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

SID NTN f sharing

- Study scenarios, target spectrum and regulation status

SID gNB Full Duplex

- Partitioning, scenarios, interf.

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.

System Energy Enhancements

RAN1-led

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

Objective I: Enable DCI-based power saving adaptation for multi-TRP and multi-panel [RAN1, RAN4]
TRP-specific DCI-based power saving configurations and UE adaptation behaviors for multi-TRP and multi-panel operations

Objective II: Dynamic network power saving via gNB/TRP/beam dormancy [RAN1, (RAN2)]

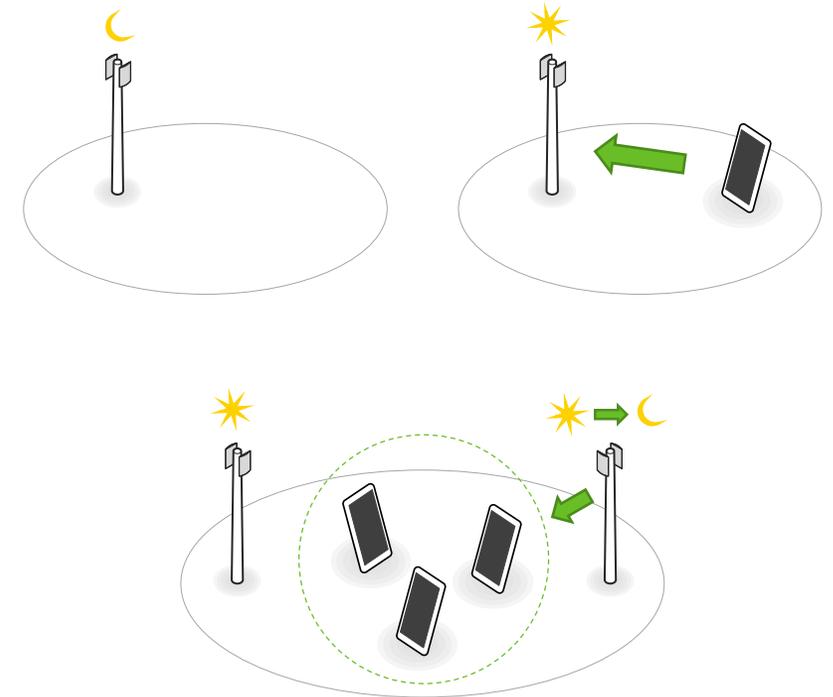
- gNB wake-up mechanism (triggered by UE) for gNB/TRP/beam dormancy
- Dynamic group indication for gNB/TRP/beam dormancy

Objective III: Evaluation methodology for system energy efficiency [RAN1]

- Develop gNB/TRP/beam power consumption model
- UE power consumption model extension for multi-TRP and multi-panel operations

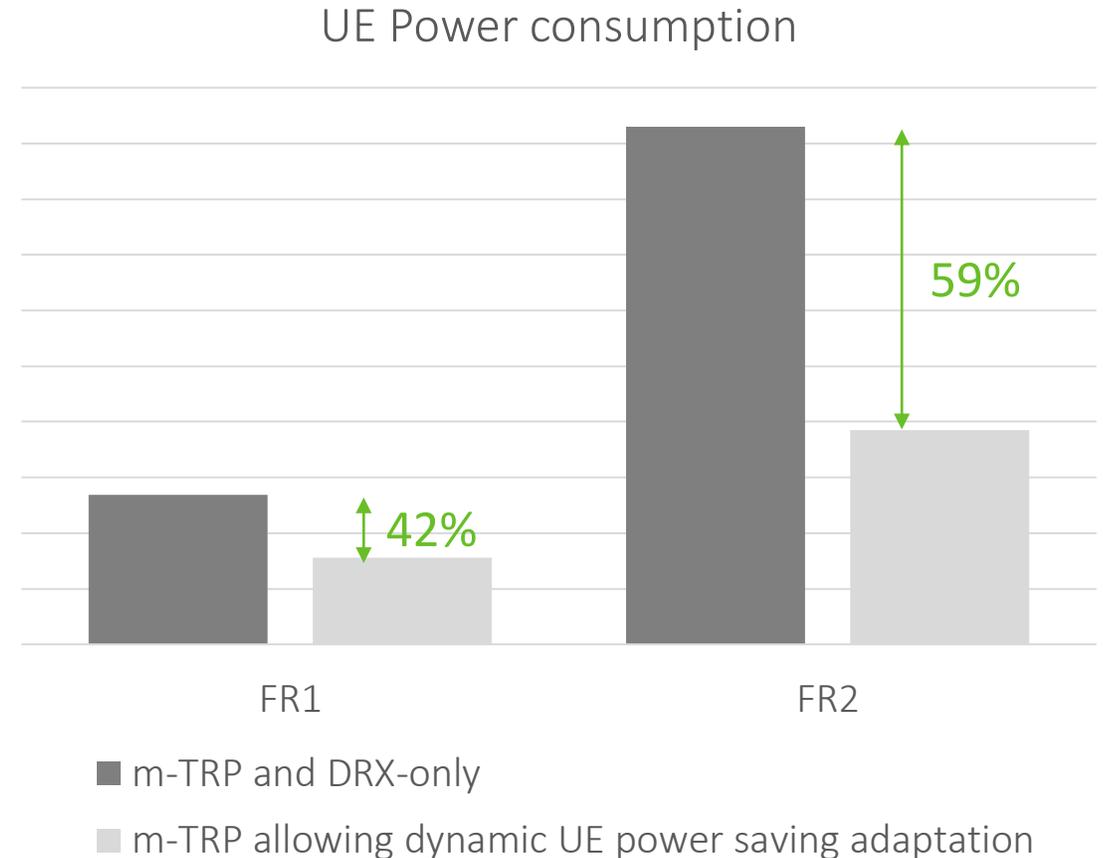
3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
13.5	[-]	-	4.5

SA/CT Dependency: No



UE Power Saving with Multi-TRP

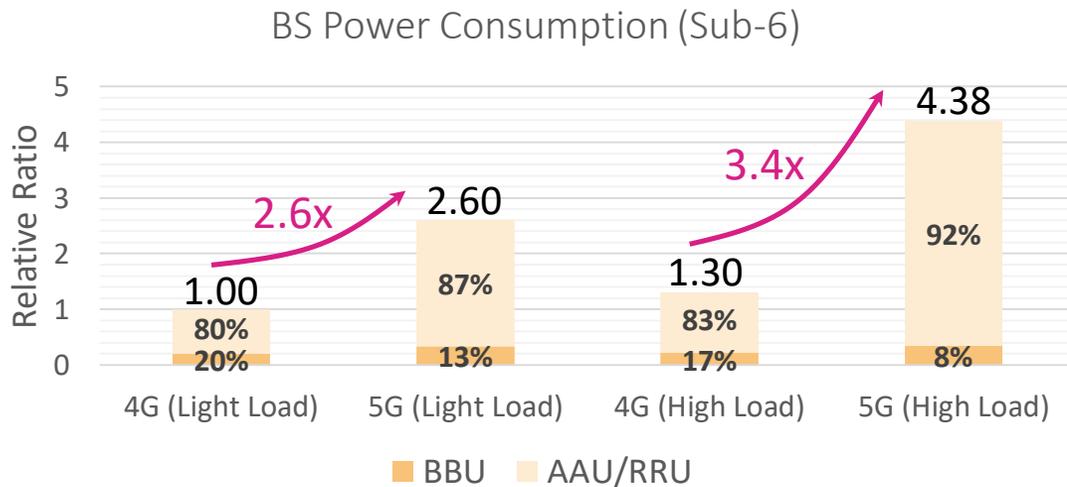
- Issue: Multi-TRP can apply DRX only
 - Multi-TRP: A common fixed BWP
 - UE power saving: Dynamic BWP switch
 - Conflict example : [Multi-TRP vs. SCell dormancy](#)
- Feasible power saving gain
 - 42% and 59% of power saving gains in FR1 and FR2, respectively, can be achieved if dynamic power saving adaptation can be enabled with multi-TRP
- Proposal
 - Enable *TRP-specific* DCI-based power saving adaptation for multi-TRP and multi-panel



Network Power Saving

- Observations

- 5G network power consumption leads to high OPEX, especially due to gNB's AAU
- Network power consumption can be improved significantly if gNB/TRP/beam dormancy can be accommodated for data inactivity time durations



Source: BS power consumption measurement in China in 2019

⇒ gNB/TRP/beam dormancy: Target “second-wise” and “(10) ms-wise”

⇒ Dormancy: No UE DL and UL activities: needs UE cooperation

BS power consumption (W)

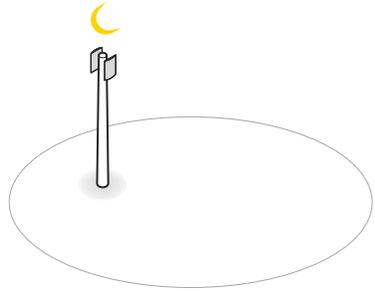
BS Type	Sleep mode			
	71.4 μ s	1 ms	10 ms	1 s
2x2 macro	76.5 $\times 14$	8.6 $\times 10$	6.0 $\times 100$	5.3
4x4 macro	86.3 $\xrightarrow{-/9}$	12.4	7.3	6.2
pico	1.5 $\xrightarrow{-/4}$	0.4	0.3	0.2
femto	0.6 $\xrightarrow{-/3}$	0.2	0.2	0.1

Source: B. Debaillie, C. Desset and F. Louagie, "A Flexible and Future-Proof Power Model for Cellular Base Stations," 2015 IEEE 81st Vehicular Technology Conference (VTC Spring), Glasgow, 2015, pp. 1-7

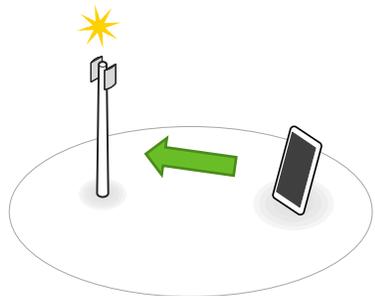
Network Power Saving

Enable gNB/TRP/Beam Long Dormancy and Short Dormancy

Case 1: gNB/TRP/Beam wake-up mechanism to accommodate gNB/TRP/beam long dormancy

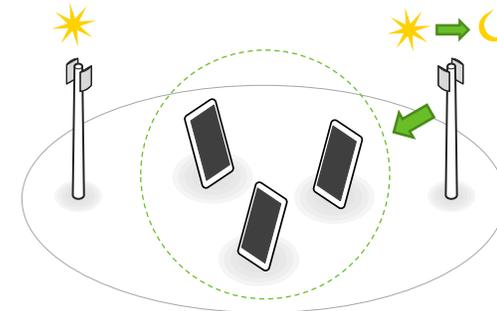


gNB/TRP/Beam **OFF** if no UE in its responsible area



gNB/TRP/Beam **ON** upon receiving wakeup notification from UE (conditioned on network rule(s))

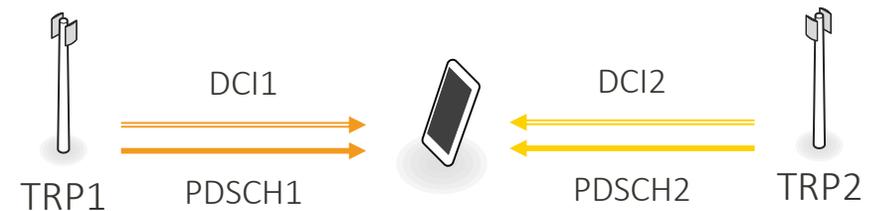
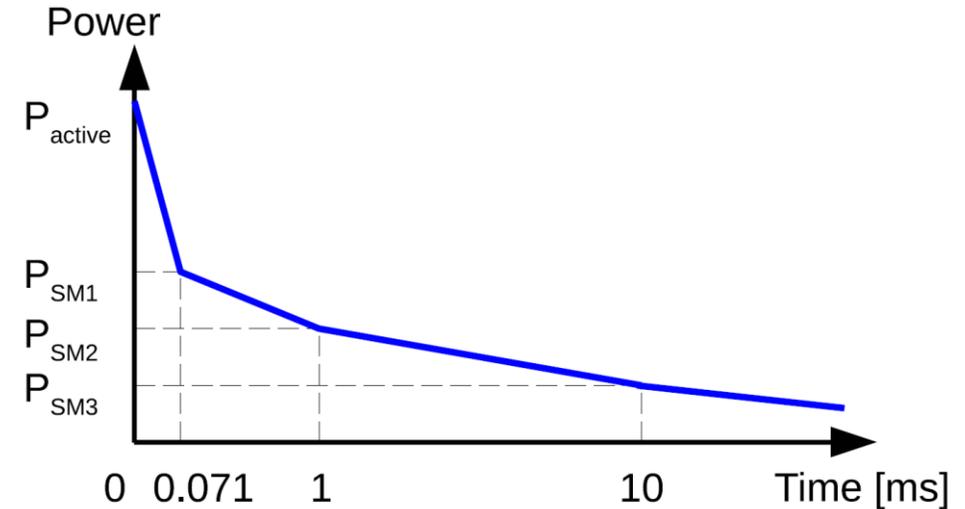
Case 2: Dynamic group indication for gNB/TRP/beam short dormancy



TRP2/Beam **OFF** after sending sleep indication for UE group

Evaluation methodology

- Develop gNB/TRP/beam power consumption model
 - gNB/TRP/beam Sleep Modes (SMs)
 - Transition time and energy and average power level for each of the sleep modes
 - gNB/TRP/beam operations model
 - Power scaling for RF and baseband adaptations, etc.
- UE power consumption model ext. for mTRP and mPanel operations
 - UE operations for multi-TRP and multi-panel
 - Power scaling for multi-panel and multi-panel operations, etc.
- Fundamental for quantitative evaluations and justification on the potential solutions



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.
RWS-210108	[non-eMBB] URLLC Enhancements	MediaTek Inc.
RWS-210109	[non-eMBB] NR RedCap Enhancements	MediaTek Inc.
RWS-210098	[x-area] Sidelink Relay Enhancements	MediaTek Inc.
RWS-210099	[x-area] Smart Repeaters Enhancements	MediaTek Inc.
RWS-210102	[x-area] NTN/TN Spectrum Sharing	MediaTek Inc.
RWS-210103	[x-area] AI/ML Integration	MediaTek Inc.
RWS-210104	[x-area] AI/ML Traffic	MediaTek Inc.
RWS-210105	[x-area] Mobility Enhancements	MediaTek Inc.
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.
RWS-210112	Draft WID: DC/CA Enhancements	MediaTek Inc.
RWS-210113	Draft WID: NTN IoT Evolution	MediaTek Inc.