

[eMBB] DC/CA 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 <ul style="list-style-type: none"> • CSI enh. • BM: [subject to R17] • Stationary: 8Rx, overhead redux • UL sub-band precod. • UL 4+ layers 	DC/CA Enh. <ul style="list-style-type: none"> • X-carrier HARQ: feedback & re-Tx • Fast re-Tx split bearer • Temporal RS PScell act • Scalable x-carrier sch. 	Sidelink LLeMBB <ul style="list-style-type: none"> • SL-U esp. <7GHz, FR2 • Low latency 1Gbps • SL-U RedCap XR/CG Enh. [SA-led] <ul style="list-style-type: none"> • QoS+, x-layer opt. 	NTN NR <ul style="list-style-type: none"> • R17 leftovers • Mobility • Regenerative arch • VoNR, MBS, HD-FDD 	MBS <ul style="list-style-type: none"> • SFN+ • QoS+ (Tput, reliab.) • TV (ATSC3.0 ref) <p style="text-align: center;"><i>(may also be seen as non-eMBB)</i></p>
Non-eMBB	URLLC <ul style="list-style-type: none"> • DL control efficiency • NR-U enh 	RedCap <ul style="list-style-type: none"> • PA-less • (POS) • NO LPWA 		NTN IoT <ul style="list-style-type: none"> • R17 leftovers • Mobility (connected) 	(UAV: neutral)
X-areas New areas	System Energy <ul style="list-style-type: none"> • DCI-based pwr sav mTRP and mPanel • gNB/TRP dormancy (UE -trig. / -imposed) • Eval. Methodology (Pwr. Cons. Models) 	Sidelink Relay <ul style="list-style-type: none"> • U2U relay • UE scheduling UE • mPath, mHop • Mobility (Remote, Relay) • Network coding 	POS (NR, SL, RedCap) <ul style="list-style-type: none"> • cm-level (Tx + meas related to signal ϕ) • SL (-based, -assisted) • RedCap UE • R17 leftovers 	<i>SID</i> NTN f sharing <ul style="list-style-type: none"> • Study scenarios, target spectrum and regulation status 	<i>SID</i> AI/ML integr. <ul style="list-style-type: none"> • 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..)
	[FR2] Mobility <ul style="list-style-type: none"> • L1/L2 trig. CHO • Inter-/intra-cell beam switching delay redux • RRC DAPS HO mPanel 	Smart Repeaters <ul style="list-style-type: none"> • Beamforming • Interf. Mgmt (T/F DD) • Integration (UE authorization) 		<i>SID</i> gNB Full Duplex <ul style="list-style-type: none"> • Partitioning, scenarios, interf. 	<i>SID</i> AI traffic <ul style="list-style-type: none"> • Traffic and arch. • Overhead optim.

DC/CA Enhancements

RAN1-led

Efficient spectrum utilization with robust user experience.

Address capacity shortage due to LL eMBB (XR, CG).

Objective I: Enhancement of latency-constrained capacity for inter-band CA with TDD [RAN1, 2, (4)]

- Cross-carrier HARQ retransmission and cross-carrier HARQ feedback (leftover(s) from R17 eURLLC if any)

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)

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

SA/CT Dependency: No

Cross-Carrier HARQ Enhancements

- Latency-constrained capacity in FR1 is dominated by TDD pattern

- For low-latency eMBB, latency-constrained capacity with one single carrier can be limited under practical TDD patterns

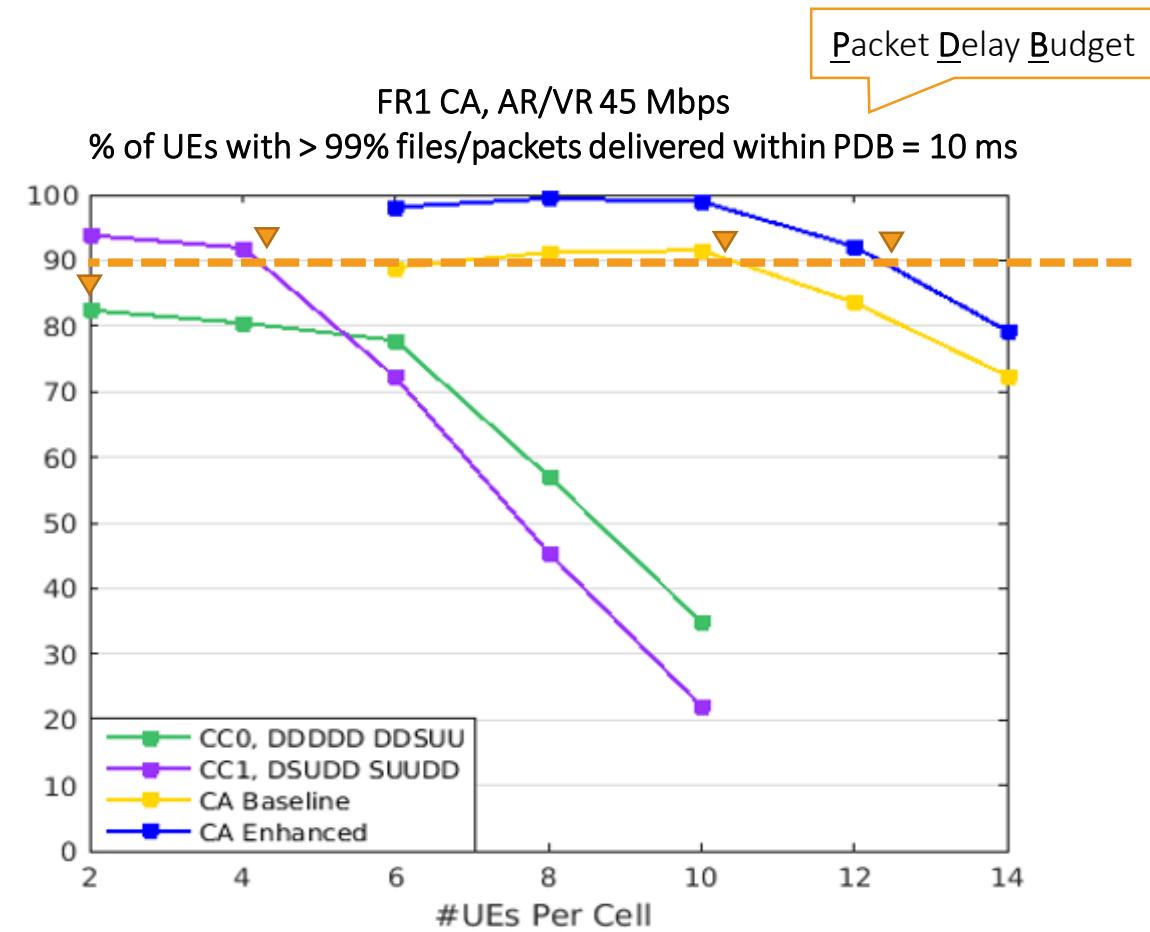
N41 (2.6 GHz, CC0) : DDDDDDDDSUU

N79 (4.9 GHz, CC1) : DSUDDSUUDD

- CA is helpful for capacity but there is **space for 20% or higher capacity improvement**
 - Increase 10-ms constrained capacity from 6-10 to 12

- Suggested R18 Enhancement for FR1 CA

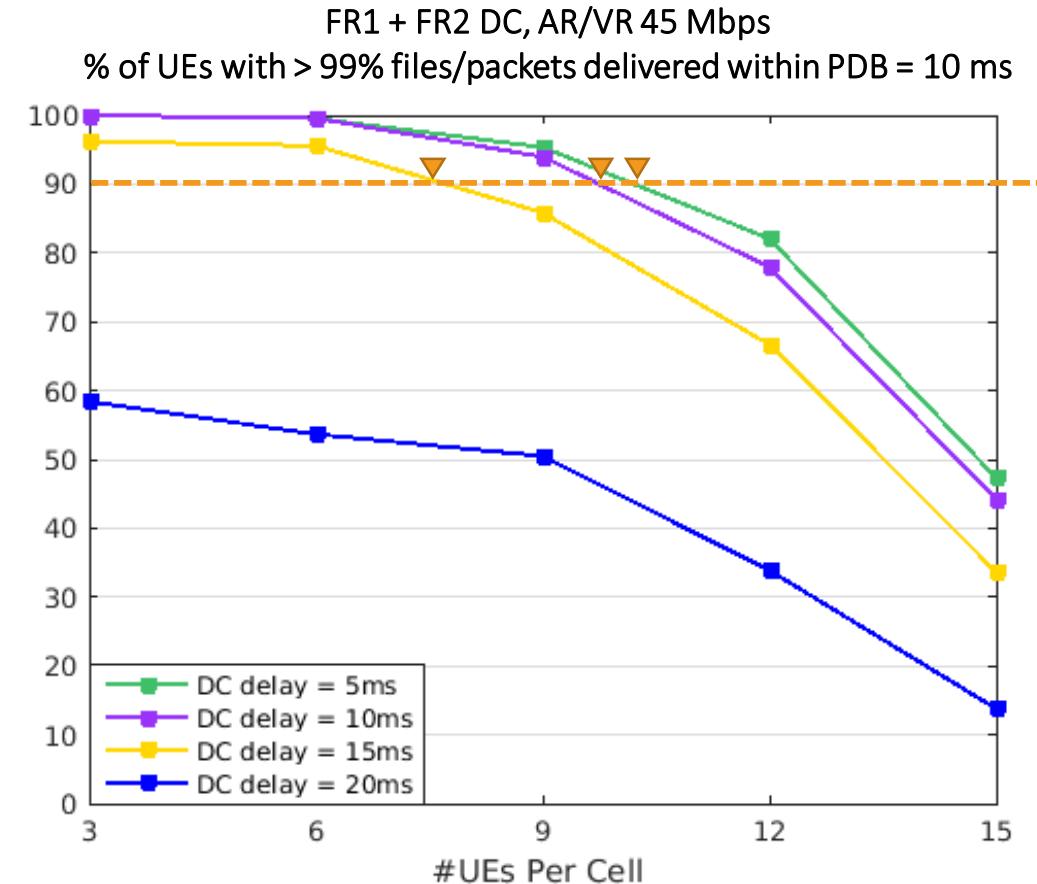
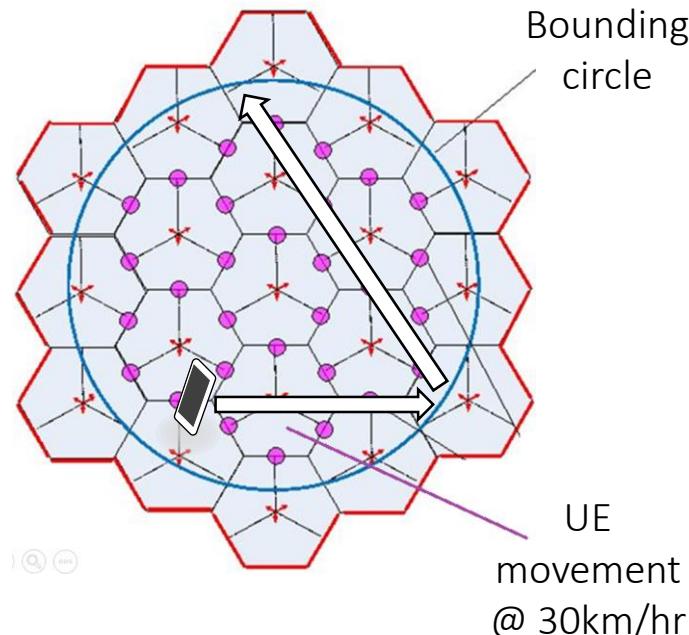
- Cross-carrier HARQ enhancement for **reduced HARQ round-trip latency** and improved latency constrained capacity for low-latency eMBB



DC Enhancement to SCG Blockage or SCG Change

- In a network with FR1 + FR2 DC (same ISD) and UE movement, **mean cell dwell time** is different in FR1 and FR2

- FR1: 2000 ms
- FR2: 1200 ms
- For low-latency eMBB, if there is **FR2 SCG blockage or change**, it is **critical to timely switch traffic to FR1**
- Confining DC switch delay \leq PDB is necessary



- Suggested R18 Enhancement for FR1+FR2 DC

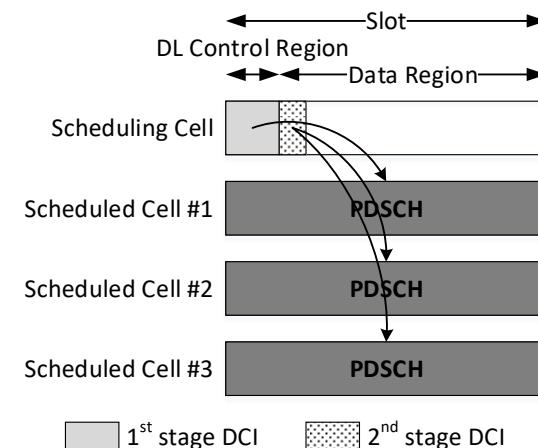
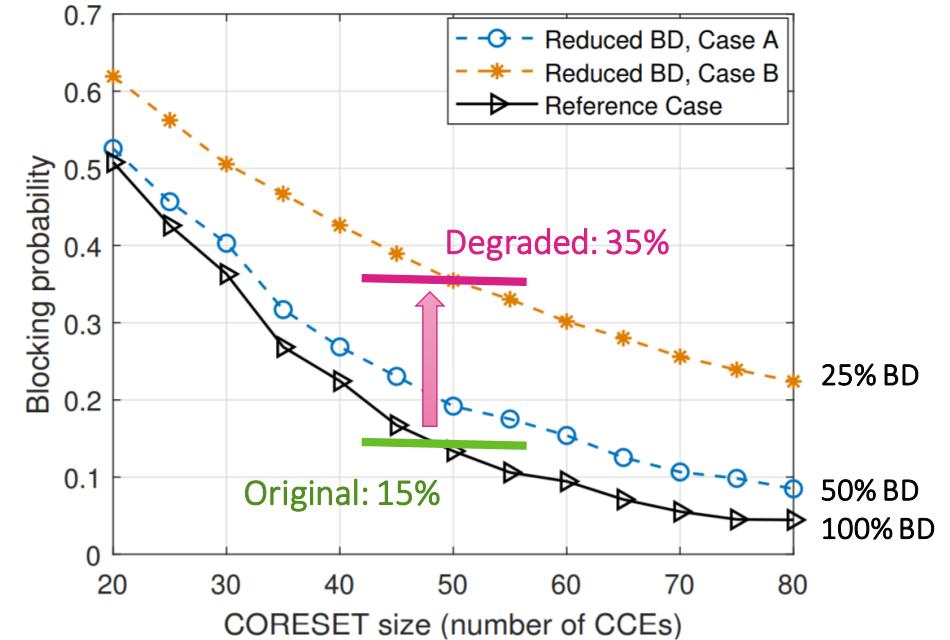
- Fast DC switching
- Target \leq 10 ms switch delay for low-latency eMBB

Latency-Constrained Capacity (PDB = 10 ms)				
DC switch delay	20ms	15ms	10ms	5ms
Average #UEs per cell @90% UE satisfaction	<3	7	9	10

Multi-Carrier Scheduling Enh

- When aggregating more FR2 CCs (up to 16 CCs), UE can report limited support of Blind Decoding (BD) complexity of 4 CCs
 - The blocking probability can increase from 15% to 35% due to limited BD budget
 - Conflict between network CA scheduling flexibility and UE CA complexity
- Suggested R18 Enhancement for FR2 CA
 - Enhancement of multi-carrier scheduling to allow
 - UE blind decoding complexity of one single CC
 - Network full scheduling flexibility for multiple CCs
 - Based on a **two-stage approach**, left figure illustrates an example where 1-CC blind decoding can accommodate scheduling of 4 CCs

Source: M. Mozaffari, Y.-P. Eric Wang, K. Kittichokechai, "Blocking Probability Analysis for 5G New Radio (NR) Physical Downlink Control Channel," 2020



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.