

3GPP TSG-RAN Meeting #90e
December 7-11, 2020
Agenda Item: 9.7.4

RP-202745

Qualcomm

Views on scope of NR Coverage Enhancements WI

Qualcomm

Outline

- Status after 103-e
- Qualcomm perspectives on bottleneck channels & potential enhancements
- Coverage enhancements for NTN
- Qualcomm recommendation on WID scope

Status after R1-103e

Potential bottleneck channels (TR 38.830)

FR1

- 1st priority
 - PUSCH for eMBB (for FDD and TDD with DDDSU, DDDSUDDSUU and DDDDDDDDSUU)
 - PUSCH for VoIP (for FDD and TDD with DDDSU, DDDSUDDSUU)
- 2nd priority
 - PRACH format B4
 - PUSCH of Msg.3
 - PUCCH format 1
 - PUCCH format 3 with 11bit
 - PUCCH format 3 with 22bit
 - Broadcast PDCCH

FR2 (Urban 28 GHz)

- PUSCH eMBB (DDDSU and DDSU)
- PUSCH VoIP (DDDSU and DDSU)
- PUCCH F3 11bits
- PUCCH F3 22bits
- PRACH B4
- PUSCH of Msg3

PUSCH Enhancements

	Technique	Description
PUSCH Enhancements with consensus	PUSCH repetition type A	Two options (potential down-selection during the WI phase): <ul style="list-style-type: none"> - Option 1: Increasing the maximum number of repetitions, e.g., up to 32. - Option 2: The number of repetitions counted on the basis of available UL slots.
	TB processing over multi-slot PUSCH	TBS determined based on multiple slots and transmitted over multiple integer slots
	DM-RS bundling	<ul style="list-style-type: none"> - Joint channel estimation over consecutive PUSCH transmissions - Inter-slot frequency hopping with inter-slot bundling
PUSCH Enhancements with majority support but no consensus	Sub-PRB transmission with multi-slot aggregation	Sub-PRB transmission with multi-slot aggregation for PUSCH targeting VoIP services in Rel-17.
	Power boosting for pi/2 BPSK for PUSCH for PC2 UEs	RAN plenary to decide whether to support power boosting for pi/2 BPSK for PUSCH for PC2 UEs.

PUCCH Enhancements (no consensus)

Channel	Technique	Description
PUCCH	<ol style="list-style-type: none"> 1. DMRS-less sequence based 2. Dynamic indication of repetitions 3. PUSCH repetition type-B like PUCCH repetition 4. DMRS bundling 	No conclusion or recommendation from RAN1

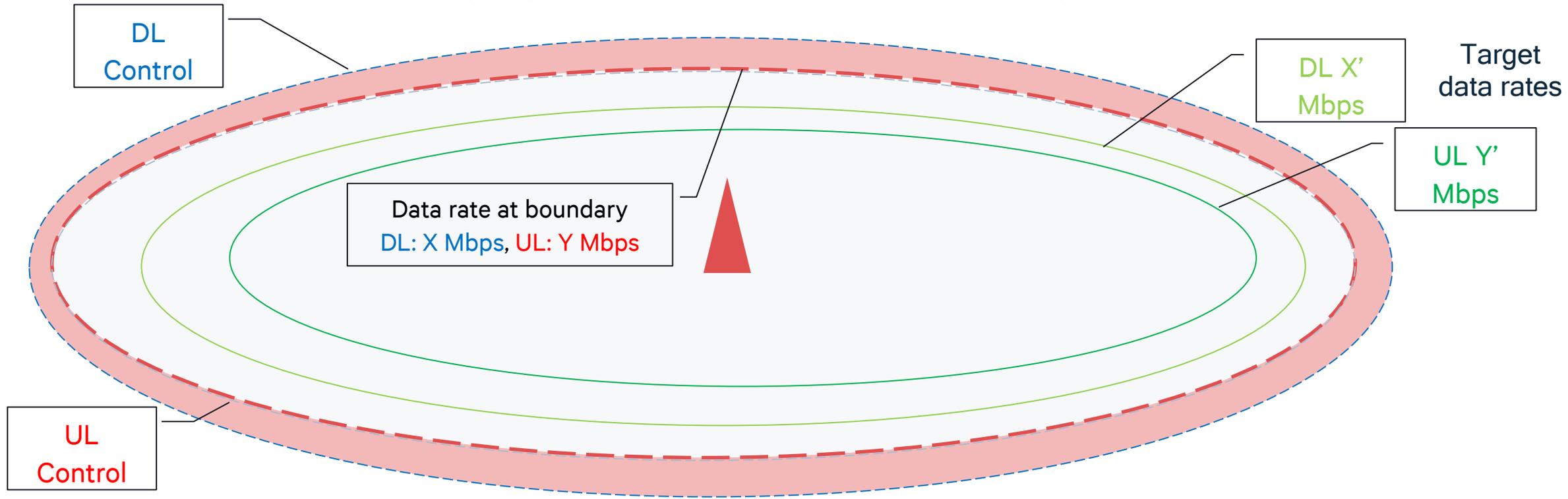
Enhancements to Other Channels (no consensus)

Channel	Technique	Description
Msg3 (majority view; no consensus)	Repetition	Support Msg3 PUSCH repetition in Rel-17
PRACH (majority view; no consensus)	Repetition and/or beam sweeping	Multiple PRACH transmissions with the same beam and multiple PRACH transmissions with different beams

Qualcomm Perspective on Bottleneck Channels & Potential Enhancements

Importance of Control Coverage

- Target data rates determine service rate boundary and not true cell coverage
 - Target UL data rates used for identifying bottleneck may be too high and may not reflect practical deployments
 - Downlink data coverage determined by uplink control coverage
- Furthermore, it is always valuable to close the gap between uplink control and downlink control.
- **Proposal: Rel-17 cov. enh. WI should specify enhancements to extend PUCCH coverage for both FR1 and FR2.**



Key Takeaway: treat PUSCH and PUCCH with equal priority

Qualcomm Perspectives on PUSCH Enhancements

- The three enhancements with consensus present a diverse set of schemes to enhance PUSCH coverage.
 - No further enhancements are critical enough to be included in the WID
- We make the following proposal for PUSCH:
 - Support the three enhancements with consensus to be included in the WID
 - PUSCH repetition type A
 - At least Option 1 (increasing maximum number of repetitions) needs to be included
 - TB processing over multi-slot PUSCH
 - DM-RS bundling

Qualcomm Perspectives on PUCCH Enhancements

- Repetitions vs. no-repetitions
 - Enhancements must balance both use cases
 - Repetitions are a simple means of expanding coverage but require additional network resources
 - Repetitions are tough to accommodate in TDD systems where uplink resources are scarce
 - The HARQ-ACK payload also grows with repetitions, negating the benefits for HARQ-ACK UCI
 - PUCCH repetitions also reduce resources available for PUSCH
- **Proposal: All four high priority enhancements should be included in the WID**
 - One scheme does not require repetitions
 - DMRS-less PUCCH
 - Three out of four schemes require repetitions
 - PUSCH-Type-B-repetition-like schemes for PUCCH
 - Dynamic repetition indication
 - DMRS bundling

Background information for PUCCH

- PUCCH payload consists of HARQ-ACK/NACK, CSI, L1 beam report, or a combination thereof
- Typical payload size for a cell-edge UE is 4-20 bits
 - 4-8 bits HARQ bits typical in TDD systems
 - L1 beam report varies from 11 to 23 bits
 - CSI payloads (RI, PMI, CQI for wideband) is 7-20 bits
- Reliability requirements
 - HARQ-ACK/NACK payloads require higher reliability with tighter constraints on NACK->ACK rates
 - L1 beam report is a sensitive payload for FR2; erroneous reception can lead to radio link failures
 - RAN4 performance requirements: 1% BLER and 1% false alarm rates

Qualcomm Perspectives on Other Channels

- Initial access or RACH procedure enhancements are a critical element determining cell coverage
 - Msg3 and PRACH are identified as bottlenecks in certain scenarios
- We make the following proposal for the other channels (other than PUCCH and PUSCH) :
 - Support enhancements to Msg3 in the WID
 - Specify mechanism to support Msg3 PUSCH repetition
 - Support enhancements to PRACH in the WID
 - Specify multiple PRACH transmissions for FR2

Coverage enhancements for NTN

Coverage enhancements for NTN

- Extending NTN coverage to smartphones opens up a wide range of new use cases
 - Aimed at providing support for basic services such as short message service and voice
- Uplink channels are the bottleneck
 - Primarily due to limited transmit power, polarization loss and antenna gain loss (compared to handheld)
- Given the overlap of issues between NTN and the coverage enhancement SI (intended for terrestrial networks), it is desirable to also take NTN into consideration when considering potential enhancements
- With NTN considerations in mind, when drafting the NR coverage enhancement work item, we support the addition of the following
 - **In the justification clause, add:**
 - **NTN scenarios should also benefit from the NR coverage enhancement techniques**
 - **NR coverage enhancements should be generic and thus implicitly applicable to the widest number of scenarios e.g. MBB, VoIP, NTN, etc.**
 - **When defining the objectives of the NR coverage enhancement WID, consider at least PUSCH/PUCCH/Msg-3 enhancements**

Qualcomm Perspective on WID Scope

Rel-17 Coverage enhancements WID scope

- PUSCH enhancements [RAN1]
 - Specify PUSCH repetition type A enhancement
 - Increasing the maximum number of repetitions
 - Specify mechanism to support TB processing over multi-slot PUSCH
 - TBS determination based on multiple slots and transmitted over multiple integer slots.
 - Specify mechanism to support joint channel estimation
 - Mechanism to enable joint channel estimation over consecutive PUSCH transmissions
 - Inter-slot frequency hopping with inter-slot bundling to enable joint channel estimation
 - Power consistency and phase continuity
- PUCCH enhancements [RAN1]
 - Specify DMRS-less PUCCH
 - Specify mechanism to support PUSCH-repetition-Type-B like PUCCH repetition
 - Specify signaling mechanism to support dynamic PUCCH repetition factor indication
 - Specify mechanism to support DMRS bundling across PUCCH repetitions
- Enhancements for other channels [RAN1, RAN2]
 - Specify mechanism to support Msg3 PUSCH repetition
 - Specify multiple PRACH transmissions for FR2



Thank you

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