

3GPP TSG RAN Meeting #90-e
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Agenda Item: 9.1.1

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Document for: Discussion and decision



Scoping for R17 RedCap WI

FUTUREWEI



Discussion points for WID objectives

- Complexity reduction techniques
 - Should RedCap UEs in FR1 TDD bands that currently support 4RX support only 2RX, or also be allowed to support 1RX?
 - Should the secondary techniques of half-duplex and doubling of processing times be supported?
- Coverage recovery
 - What coverage compensation to include in the WID?
 - Should enhancements of PDCCH not motivated by the SI evaluations be included?
- Power Savings
 - Should any reduced PDCCH monitoring be included?
- Other possibilities for “tightening” of scope
 - Should RedCap UEs support CA? Bandwidth in (20,100]MHz?
 - Early identification or not?

Should RedCap UEs in FR1 TDD bands that currently support 4RX support only 2RX, or also be allowed to support 1RX?

- Very large performance impacts for 4RX to 1RX
 - 75% reductions in peak data rate
 - ~10dB PDSCH degradations per agreed evaluations (from TR38.875 Table C.1-1 and C.1-3)
 - The TR evaluations include a 3dB loss for small form factor which is FFS for application to FR1 TDD
- Impact on network capacity is very dependent on traffic and loading (see section 12)
 - Fewer UEs or RedCap UEs “behaving” (i.e., trying to maximize battery life) → less impact
 - General more loaded situation or unknown traffic → big impact
- More specification impacts if PDCCH enhancements included OR special handling desired during initial access
- Both 2RX and 1RX may have a benefit for size reduction over 4RX, however...
 - Size reduction is *not* an objective of the redcap SID; a “compact” form factor can of course be provided with “normal” NR (see RAN1 agreement & section 7.2.2 in the TR)
 - Device size was already taken into account when requiring either 2RX or 4RX in different bands for NR; for current 4RX bands reducing to 2RX already may provide a size reduction
- The key issue is whether to accommodate 1RX devices that can work in both FR1 FDD and TDD
- RAN1 will NOT be able to resolve → **RAN should decide**
- **Recommendation:** Only support 2RX for these bands

Should the secondary techniques of half-duplex and doubling of processing times be supported?

- Analysis in the TR is very similar for both (see sections 7.4 and 7.5)
 - Modest gains (~7% for HD-FDD, ~6% for processing time)
 - Both could increase latency
 - Both could make a scheduler more complicated
- Specification impacts
 - New processing time capability
 - RAN1 could not agree on whether existing RAN1 specifications can be reused for HD-FDD
- Main concerns
 - HD-FDD is not applicable to TDD bands, more related to LPWA
 - Processing time design impact → can only be an optional feature
- **Recommendation:** Consider only as second priority optional features

What coverage compensation to include in the WID?

- Only coverage compensations motivated by the RedCap study should be included
- Msg 2/3/4 compensation is closely tied to RedCap early identification
- **Recommendation**
 - RedCap identification and Msg 2/4 compensation handled in RedCap
 - Whether and how RedCap UEs use CE features is discussed later in the WI along with RedCap UE capabilities

Ch. / Msg	FR1 (dB)	FR2 (dB)	Notes
PUSCH & Msg3	~3		Existing techniques may be sufficient Focus of CE
PDSCH		~2.5-3	Existing techniques are sufficient
PDCCH	~1		Existing techniques are sufficient
Msg2	~5-6	~1	Nothing in CE
Msg4	~2-3	~1	RedCap includes lower MCS table and excludes early CSI

The limiting scenarios are:
FR1 4GHz 24dBm/MHz 1RX
FR2 23dBm 1RX

Should enhancements of PDCCH not motivated by the SI evaluations be included?

- Evaluation results show
 - Minor loss (0.8dB) in Urban 4GHz for 1RX and 24 dBm/MHz
 - Small loss (~1dB) for indoor FR2 50MHz
 - No coverage loss for every other case
- The list of techniques in the RedCap TR to be studied and possibly specified is *enormous* (like a stand-alone URLLC WI) and not motivated by the evals
- Existing techniques (e.g., compact DCI) or implementation (e.g., power boosting) can be used
- **Recommendation:** PDCCH enhancement is not included in the WI scope

9.4.3 Analysis of specification impacts

If PDCCH repetition is supported, the potential specification impacts include:

- Repetition configuration (e.g. intra-slot or inter-slot)
- DMRS design among PDCCH repetitions
- Search space design for PDCCH repetition

If compact DCI is supported, the potential specification impacts include:

- DCI format with a small payload size
- Reuse existing format by fixing some DCI bits

If new AL is supported, the potential specification impacts include:

- Mechanism for codeword generation and mapping to CCEs
- CORESET duration extension
- Related signaling design

If PDCCH transmission via CORESET bundling is supported, the potential specification impacts include:

- CORESET bundling configuration
- DMRS design among CORESET bundling

If PDCCH-less is supported, the potential specification impacts include:

- Mechanism or resource allocation for indicating scheduling information for SIB1 and/or SI message in L1 signals(s)/channels(s) other than PDCCH

Should any reduced PDCCH monitoring be included?

- Extensive evaluations done by RAN1
- Power saving gains are limited
 - E.g., for 1RX: *For the instant message traffic model, with reducing maximum PDCCH blind decoding (i.e. 36) by 25% and 50%, the power saving gains are in the range of approximately [0.32%~5.7%] and [0.59%~11.4%], respectively. With excluding the smallest and the largest values among sources, the mean value of power saving gain with reducing maximum PDCCH blind decoding (i.e. 36) by 25% and 50% are approximately 2.81% and 5.82%, respectively.*
- Some techniques have significant increase in blocking probability, others have no impact
 - Reducing the number of blind decodings per aggregation level significantly increases the blocking probability
 - Reducing the number of blind decoding sizes to monitor has no impact on blocking probability
- Feasibility and standardization are not a factor since the effort is limited
- **Recommendation:** standardize a reduced PDCCH monitoring solution that targets zero increase of blockage probability

Other possibilities for “tightening” of scope

- Should RedCap UEs support CA? Bandwidth in (20,100]MHz?
 - Currently, these may be discussed at the end of the WI as part of capability discussion
 - Discussing bandwidth in (20,100]MHz has been a significant and unproductive time sink
 - Not motivated by use cases (c.f., “up to” 150Mbps use case discussion)
 - 2RX RedCap UEs will be available in both FR1 and FR2 (RAN1 decision)
 - CA is clearly not a low complexity use case, danger of market fragmentation
- Early identification or not?
 - As identified, in the TR, early identification of RedCap UE type(s) during transmission of Msg1 may be necessary for:
 - Coverage recovery (including link adaptation) for one or more of: Msg2 PDCCH/PDSCH, Msg3 PUSCH and PDCCH scheduling Msg3 retransmission, Msg4 PDCCH/PDSCH or PUCCH in response to Msg4, Msg5 PUSCH and associated PDCCH, if it is determined that coverage recovery for RedCap UEs is necessary for one of more of these channels
 - Identifying UE max bandwidth capability for Msg3 and Msg5 scheduling and PUCCH in response to Msg4

Thank You.

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