3GPP TSG-RAN WG5 Meeting #96-e
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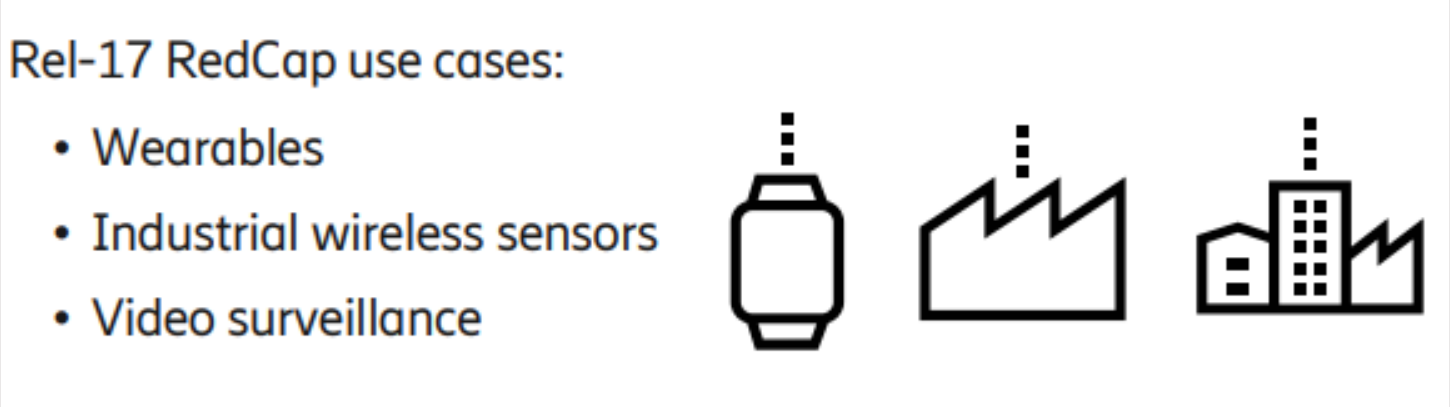
R5-225621

WF for RedCap UE testing of SUL

Huawei, HiSilicon, China Unicom, China Telecom, China Mobile

Background

- The RAN1 leading WI of RedCap was approved in RAN#90 [1] aiming to specify a UE feature with lower end capabilities.
- According to the motivation paper[2], the targeted RedCap use cases are as below



- For the second and third use cases, the UL payload might be higher than downlink, which is different from typical eMBB scenario.
- The UL transmission of RedCap is limited by up to 20MHz channel bandwidth for FR1. Furthermore, CA can’t be used to expand the UL bandwidth as it’s not supported by R17 RedCap UEs.
- In order to improve UE’s UL transmission capacity, additional SUL carrier could be an effective supplementary.

RAN plenary discussion

- The discussion on whether RedCap UE could support SUL has taken place in several RAN meetings.
- Based on the major agreements from RAN we can get following observations:
- **Observation 1**: RedCap supporting SUL is not restricted/precluded.
- **Observation 2**: No RedCap specific update to enable SUL.

RP-220836 → **RAN2 endorsed CRs on Introduction of RedCap** → *RAN2*

MCC: RAN2 CRs were only endorsed because RAN2 could not decide about which of the 2 alternative CRs should be used; so TSG RAN will have to decide this

handled in [95e-31-R17-RedCap-WI]

conclusion:

CR R2-2204267 is approved (with the understanding that SUL operation for RedCap is not precluded by this CR)

CR R2-2204268 is not pursued

The document was partially approved.

RAN#95

RP-212634 → **Moderator's summary for discussion [93e-16-RedCap-WI]**

Type: report → *For: discussion*
Source: Intel

(Replaces RP-212631)

Discussion:

conclusion: slide 1 and slide 2 of moderator's proposal are endorsed

Decision: → The document was **noted**.

RAN#93

- Summary for RP-212138 (2/2):
- No consensus on whether a RedCap UE can support V2X/PC5 on n47, unlicensed bands, SUL bands.
- **Moderator's proposal for discussion in Friday GTW:**
  - In Rel-17, there will be no work on any RedCap specific specification update for any of the following:
    1. RedCap UEs also supporting V2X/PC5 on n47
    2. RedCap UEs operating in unlicensed bands
    3. RedCap UEs supporting SUL
  - The specification will not contain any explicit restriction to prevent implementation of RedCap UEs with these features.
  - Note: The consequence of this agreement would be:
    1. If any spec change/addition is found necessary in order to enable one of the options above then it will not happen in Rel-17.

RAN plenary discussion ctd.

- At RAN#95, a CR RP-220462 was submitted to adding a dedicated section for RedCap operating bands in RAN4 specification, where SUL/V2X/NR-U bands are excluded.

5.2I → Operating bands

RedCap UE is designed to operate in the FR1 operating bands defined in Table 5.2I-1.

Table 5.2I-1: RedCap UE operating bands in FR1

RedCap operating band	Uplink (UL) operating band BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) operating band BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
n12	699 MHz – 716 MHz	729 MHz – 746 MHz	FDD
n13	777 MHz – 787 MHz	746 MHz – 756 MHz	FDD

- After discussion, the CR was concluded as 'Not pursued' and following conclusion was made.

conclusion:
- "FG 28-1 is reported per UE, and FG 28-3 is reported per band" is agreed
- RP-220462 is not pursued, no further RAN4 discussion on these bands, in case of ambiguity problems, they can be addressed under essential cat.F CR maintenance
- slide 6 2 main bullets are endorsed
- RP-220964 is noted, RP-220965 and RP-220966 are approved
- It is not pursued to support RRM relaxation for non-RedCap UE in Rel-17

- Based on the conclusion, following observations could be made:
- **Observation 2a**: SUL bands are not excluded from RedCap operation.
- **Observation 2b**: Ambiguity problems could be addressed under essential cat.F CR maintenance.

- Based on the industry needs and RAN conclusion, the SUL supporting by RedCap UE should not be preclude in RAN5 testing WI.
- **Proposal 1**: SUL supporting by RedCap UE is not precluded by RAN5 testing WI.

RAN2 signaling aspect

- RAN2 specified the definition of RedCap UE in TS 38.306
- **Observation 3**: CA, MR-DC, DAPS, CPAC and IAB are explicitly excluded by RedCap UE
- **Observation 4**: All other feature groups in TR 38.822 and capabilities specified in TS 38.306 are applicable for RedCap UEs unless indicated otherwise.

4.2.21.1 Definition of RedCap UE

RedCap UE is the UE with reduced capability:

- The maximum bandwidth is 20 MHz for FR1, and is 100 MHz for FR2. UE features and corresponding capabilities related to UE bandwidths wider than 20 MHz in FR1 or wider than 100 MHz in FR2 are not supported by RedCap UEs;
- The maximum mandatory supported DRB number is 8;
- The mandatory supported PDCP SN length is 12 bits while 18 bits being optional;
- The mandatory supported RLC AM SN length is 12 bits while 18 bits being optional;
- For FR1, 1 DL MIMO layer if 1 Rx branch is supported, and 2 DL MIMO layers if 2 Rx branches are supported; for FR2, either 1 or 2 DL MIMO layers can be supported, while 2 Rx branches are always supported. For FR1 and FR2, UE features and corresponding capabilities related to more than 2 UE Rx branches or more than 2 DL MIMO layers, as well as UE features and capabilities related to more than 2 UE Tx branches or more than 2 UL MIMO layers are not supported by RedCap UEs;
- CA, MR-DC, DAPS, CPAC and IAB (i.e., the RedCap UE is not expected to act as IAB node) related UE features and corresponding capabilities are not supported by RedCap UEs. All other feature groups or components of the feature groups as captured in TR 38.822 [24] as well as capabilities specified in this specification remain applicable for RedCap UEs same as non-RedCap UEs, unless indicated otherwise.

- To operate as **RedCap** UE, following signaling are needed as a minimal set:
  - UE indicates support of RedCap by *supportOfRedCap-r17*
  - *intraFreqReselectionRedCap-r17* is set to 'allowed' in SIB1
  - SN-FieldLength of *PDCP-config* and *RLC-config* are configured to 12 bits
- To operate with **SUL** configuration, following signaling are needed as a minimal set:
  - UE reports any supported SUL configuration throught *BandCombinationList*
  - gNB configures the SUL carrier by *supplementaryUplink* in SIB1 message

There is no dependency between above signaling. Neither is any conflict with each other.

Observation 5: A RedCap UE could operate with SUL configuration with above signaling process.

Reference

- [1] RP-202933, New WID on support of reduced capability NR devices, Ericsson, Nokia, RAN#90, December 2020
- [2] RP-202702, Motivation for New WID on support of reduced capability NR devices, Ericsson, RAN#90, December 2020
- [3] RP-213550, Meeting Report for TSG RAN meeting #93e
- [4] RP-221776, Meeting Report for TSG RAN meeting #95e