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RP-220613

Views on Outstanding Issues of NR Rel-17 RedCap UE Features

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5G

Outstanding Issues of NR R17 RedCap UE Features*

- FFS Components of FG 28-1
- Reporting Type/Granularity of FG 28-1 and FG 28-3

Features	Index	Feature group	Components	Prerequisite feature groups	Need for the gNB to know if the feature is supported	Applicable to the capability signalling exchange between UEs (Sidelink WI only)".	Consequence if the feature is not supported by the UE	Type (the 'type' definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)	Need of FDD/TDD differentiation	Need of FR1/FR2 differentiation	Capability interpretation for mixture of FDD/TDD and/or FR1/FR2	Note	Mandatory/ Optional
28. NR_redcap	28-1	RedCap UE	1. Maximum FR1 RedCap UE bandwidth is 20 MHz. 2. Maximum FR2 RedCap UE bandwidth is 100 MHz. 3. Early indication of RedCap UE in Msg.1 for 4-step RACH 4. Separate initial UL BWP for RedCap UEs - It includes the configuration(s) needed for RedCap UE to perform random access - Enabling/disabling of frequency hopping for common PUCCH resources 5. Separate initial DL BWP for RedCap Ues - It includes CSS/CORESET for random access - FFS: For separate initial DL BWP used for paging, CD-SSB is included - For separate initial DL BWP only used for RACH, SSB may or may not be included FFS whether to add any other basic features for RedCap UE		Yes		[Network assumes the UE is not a RedCap UE]	[Per UE]	[No]	[No]		[RedCap UEs do not support carrier aggregation or dual connectivity.] It is up to RAN2 whether/how to capture the capabilities for early indication of RedCap UE in Msg 3 and Msg A	Optional with capability signaling RedCap UE must indicate this FG is supported
28. NR_redcap	28-3	Half-duplex FDD operation type A for RedCap UE	1. Half-duplex FDD operation (instead of full-duplex FDD operation) type A for RedCap UE	28-1	Yes		[UE is assumed to support FD-FDD in FDD bands]	[Per band]	[FDD only]	[FR1 only]			Optional with capability signaling

*Source: R1-2202928, "Updated RAN1 UE Features List for Rel-17 NR after RAN1#108e"

Operating Bands of R17 RedCap UE

- Requirements in WID of Rel-17 RedCap UE (RP-211574)
  - ➢System should support all FR1/FR2 bands for FDD and TDD for deployment of RedCap UE
- RAN#93 Agreements on Operating Bands of Rel-17 RedCap UE (RP-212634)
  - ➢The specification will not contain any explicit restriction to prevent implementation of RedCap UEs on n47 band
- NR Bands Supporting Channel BW No More than 20 MHz (TS 38.101-1, V17.4.0)

Table 5.3.5-1 Channel bandwidths for each NR band

NR Band	SCS (kHz)	UE Channel bandwidth (MHz)														
		5	10	15	20	25	30	35	40	45	50	60	70	80	90	100
n12	15	5	10	15												
	30		10	15												
	60															
n13	15	5	10													
	30		10													
	60															
n14	15	5	10													
	30		10													
	60															
n18	15	5	10	15												
	30		10	15												
	60															
n20	15	5	10	15	20											
	30		10	15	20											
	60															
n24	15	5	10													
	30		10													
	60		10													
n26	15	5	10	15	20											
	30		10	15	20											
n30	15	5	10													
	30		10													
	60															
n34	15	5	10	15												
	30		10	15												
	60		10	15												

- In FR1 below 2.5 GHz, there are FDD and TDD bands with CBW no more than 20 MHz and requiring a R15/16 eMBB UE to have a minimum of 2 RX branches
- On these bands, a “high-end” Rel-17 RedCap device supporting the envelope of radio and upper layer capabilities (2 RX, FD-FDD, 256 QAM, and etc.) will behave the same way as a Rel-15/16 eMBB UE, without using capabilities not intended for RedCap UE

➔ Such high-end RedCap UEs can access the legacy cells supporting R15/16 eMBB UE without requesting NW to upgrade its HW/SW

R17 RedCap UE Capabilities for MAC and Upper Layer

- **MAC and Upper Layer UE Capabilities for Rel-17 RedCap UE**
  - Reduced upper-layer capabilities are all optional with capability signaling
    - e.g.16 DRBs, 18-bit SN in RLC/PDCP header and ANR functionality are all optional for Rel-17 RedCap UE
  - Hence a RedCap UE implementation may choose to meet the mandatory capabilities of Rel-15/Rel-16 UE
- **Mobility Support for Rel-17 RedCap UE**
  - Option 1: based on UE capability match procedure
    - There is no issue if the target cell is a suitable legacy cell or RedCap-supporting cell
    - If the target cell has higher capability requirement, it would recognize that the RedCap UE not having sufficient capability to access
  - Option 2: based on RAT frequency selection priority (RFSP) ID assigned for RedCap UEs (assuming homogeneous deployment per band)
    - Network can configure a RFSP ID specific for RedCap UEs
    - AMF can send the RedCap-specific RFSP ID to RAN. RAN then can configure separate inter-RAT/frequency priority based the RFSP ID, i.e. network configures RedCap-supporting bands as high-priority frequency for the RFSP ID associated with RedCap

Reporting Type/Granularity of FG 28-1

Proposals

- Reporting type of FG 28-1 should be “per band” instead of “per UE”
- If a R17 UE indicates FG 28-1 for at least one band, it will NOT be allowed in any band to support features restricted for RedCap UEs, including CA, DC, wider CBW and more than 2 Rx branches

- Benefits of “Per Band” Reporting for FG 28-1
  - Improve deployment flexibility of Rel-15/16/17 NR UEs
  - Reduce cost/latency to roll-out Rel-17 RedCap UEs
  - Better co-existence with legacy NR UEs without causing market fragmentation
  - Simplify IODT testing and avoid negative interaction with UE testing on NTN and unlicensed spectrum
  - No need for xDD and FR differentiation
  - Compliant with WID requirements and previous agreements in Plenary/WGs
- “Per band” reporting will NOT violate the restrictions on R17 RedCap UE, including CA, DC, wider CBW, more than 2 Rx branches, and etc.
- The mandatory restrictions imposed on RedCap UEs will prevent a non-RedCap UE (supporting CA/DC/wider CBW/more than 2 Rx branches/advanced upper layer functionalities) to declare itself as “RedCap UE”

Reporting Type/Granularity of FG 28-3

Proposal: Reporting type of FG 28-3 should be “per band” instead of “per UE”

- **Rationale of “Per Band” Reporting for FG 28-3**
  - According to TR of Rel-17 RedCap SI, RF cost saving of HD-FDD is accumulative across FDD bands supporting RedCap UE
  - Duplexer is NOT shared among FDD bands that allow RedCap UE to access
  - If a RedCap UE is equipped with duplexer for a FDD band, it will report “FD-FDD” when operating on the FDD band; otherwise, it will report “HD-FDD”
  - If a RedCap UE has reported “FD-FDD” when operating on a FDD band, the UE is not allowed to fallback to “HD-FDD” on this band

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