



3GPP TSG RAN Meeting #103  
Maastricht, Netherlands, March 18-21, 2024

RP-240271

Source: Apple  
Agenda Item: 9.7.2.7

# Views on the support of 2R XR devices

Apple Inc.

# Background

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- The discussion on 2Rx XR devices in RAN#102 led to the agreed way forward (RP-234015):
  - 1. *Task RAN2 and RAN3 to develop signaling support for '2Rx non-REDCAP XR devices', send corresponding Release-18 draft CR(s) to RAN#103:*
    - *A new dedicated UE capability indication per band and setting of corresponding existing UE capability(ies). [RAN2]*  
*Note: no need is foreseen to add an indication to Msg1 or Msg3.*
    - *Indication in SIB, to be used to re-direct to another frequency layer, or to bar the device altogether. [RAN2]*
    - *SPID indication from the Core Network to gNB. [RAN3]*
    - *N2-NGAP indication for '2Rx non-REDCAP XR devices' from gNB to Core Network to take action based on operator policy. [RAN3]*
  - 2. *Task RAN4 to develop Release-18 draft CR(s) to RAN#103 for '2Rx non-REDCAP XR devices':*
    - *Capture the definition of 2Rx non-REDCAP XR devices in [38.101-1] using the definition from RAN#101 (c.f. RP-232657)*
    - *Determine the feasibility of tightened 2Rx REFSENS requirements (in relation to existing 2Rx and 4Rx REFSENS) for the bands where 4Rx is mandatory and provide the feasible REFSENS values. RAN4 shall consider both conducted requirements as well as OTA considerations.*
- 3. *TSG-RAN#103 in March:*
  - *1) Consider approving the draft CRs from RAN2, RAN3 and RAN4 for Release-18*
  - *2) Consider approving Release-19 work to be conducted on detailed OTA work for '2Rx non-REDCAP XR devices'.*
  - *Points 1) and 2) represent a package, each one is dependent on the other moving forward.*



# RAN2 discussion and progress

- Regarding the tasks from RAN #102:
  - *A new dedicated UE capability indication per band and setting of corresponding existing UE capability(ies). [RAN2]*
  - *Indication in SIB, to be used to re-direct to another frequency layer, or to bar the device altogether. [RAN2]*
- RAN2 had discussion at RAN2 #125 and fully accomplished them, and discussed and endorsed two sets of CRs:

	The first set of CRs	The second set of CRs	Notes
CR to TS 38.304	R2-2402037	R2-2401561	Add UE behavior for 2Rx XR UEs after acquiring MIB and SIB1
CR to TS 38.331	R2-2401987	R2-2401560	Add clauses for 2Rx XR UE's initial access behaviors.
CR to TS 38.306	R2-2401988	R2-2401563	Add an exception in the field description of maxNumberMIMO-LayersPDSCH and introduce per band 2Rx XR capability
CR to TS 38.300	R2-2401989	R2-2401562	Add behaviors in access and camping.

- The only difference between two sets of CRs lies in the barring mechanism regarding 2Rx XR UEs:
  - In the first set of CRs, presence of a system indication in its system information indicates that the cell does not allow 2Rx XR UEs.
  - In the second set of CRs, absence of a system indication in its system information indicates that the cell does not allow 2Rx XR UEs.
- In our view, 2Rx XR UEs should be able to avail of services (general eMBB, IMS service etc.) from legacy networks (R17 and below). This is different from RedCap as RedCap devices are inherently dependent on NW support, as these RedCap devices cannot operate in legacy NW due to reduced capabilities. Thus the barring mechanism for 2Rx XR UEs should be different from that for RedCap and the first set of CRs meet the specific requirements for 2Rx XR UEs and we have
- **Observation:**
  - **RAN2 CRs R2-2402037, R2-2401987, R2-2401988 and R2-2401989 allow 2Rx XR UEs to avail of service (general eMBB, IMS service, etc.) from legacy networks (R17 and below).**



# RAN3 discussion and progress

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- Regarding the tasks from RAN #102:
  - *SPID indication from the Core Network to gNB. [RAN3]*
  - *N2-NGAP indication for '2Rx non-REDCAP XR devices' from gNB to Core Network to take action based on operator policy. [RAN3]*
- RAN3 had discussion at RAN3 #123 and fully accomplished them.
  - The CRs were endorsed/agreed:
    - CR to TS 38.300
      - R3-241069, Introduction of new SPID value for 2RX XR UE [2Rx\_XR\_Device]
      - *Introduces a new Reference SPID value for 2Rx XR UE.*
      - *Note: this endorsed CR needs to be merged into RAN2 TS 38.300 CR*
    - CR to TS 38.413
      - R3-241070, Introduction of 2Rx relaxation for XR devices [2Rx\_XR\_Device]
      - To support N2 indication from gNB to CN for 2Rx XR devices, TS 38.413 should be enhanced. Currently, the UE Radio Capability Indication procedure is used to provide the AMF with UE radio capability-related information. It can be extended to indicate whether the UE is a 2Rx XR device or not.
      - *Adds a new IE to indicate 2Rx XR devices in the UE RADIO CAPABILITY INFO INDICATION message.*



# RAN4 discussion and progress (1/2)

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- Regarding the tasks from RAN #102:
  - *Capture the definition of 2Rx non-REDCAP XR devices in [38.101-1] using the definition from RAN#101 (c.f. RP-232657)*
  - *Determine the feasibility of tightened 2Rx REFSENS requirements (in relation to existing 2Rx and 4Rx REFSENS) for the bands where 4Rx is mandatory and provide the feasible REFSENS values. RAN4 shall consider both conducted requirements as well as OTA considerations.*
- RAN4 had discussion at RAN4 #110 and fully accomplished them. As captured in the LS from RAN4 to RAN (R4-2403880, LS on 2Rx XR UE requirements, RAN4):
  - The agreed CR is R4-2403890, CR 38.101-1 addition of 2Rx XR exception for REFSENS [2Rx\_XR\_UE], Nokia, Meta Ireland
    - *Two Rx antenna port XR UE is defined as “A non-(e)RedCap XR UE that is equipped with only two Rx antenna ports in frequency band(s) where 4 Rx antenna ports are required. The UE is intended to be worn on human head. When in use, is intended to be supported only by/behind the ears and by a nose-bridge resulting in a constrained form factor with limited volume available for Rx chains.”*
  - On conducted receiver sensitivity and OTA performance, the WF in R4-2403878 was agreed by RAN4:
    - *On conducted receiver sensitivity, consider two options*
      - *0.5dB tightening compared to the existing 2Rx UE conducted REFSENS, which is considered feasible by some UE vendors*
      - *2Rx XR UE meets the 4Rx handheld UE conducted REFSENS*
    - *On OTA performance:*
      - *It is agreed to specify OTA TRS requirements per band for both 4Rx XR and 2Rx XR for the NR bands which are mandatorily to support 4Rx based on measurement campaign of 4Rx XR, considering the performance degradation value for 2Rx based on 4Rx measurement campaign.*



# RAN4 discussion and progress (2/2)

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- Regarding conducted receiver sensitivity, as shown by multiple companies' technical analysis, tightening sensitivity is challenging. We also understand operators' concerns should be addressed. Those two fundamentally important aspects are reflected in the two options as endorsed in the RAN4 WF. There have been multiple proposals for tightening receiver sensitivity. In R4-2402421 (Discussion on requirements for 2Rx non-RedCap XR UE) and R4-2402422, Huawei, HiSilicon, Telecom Italia, Telia Company, T-Mobile USA, Telefonica, BT plc, CMCC, Orange and Spark (NZ) proposed that
  - REFSENS Tightening at 1.5 dB for n7, n38, n41
  - REFSENS Tightening at 1.0 dB for n48, n77, n78, n79, n104
- While any tightening puts pressure on product design, to seek convergence in RAN discussions, we are open to explore an option considering all sides' positions. Thus we propose RAN to **agree on a receiver sensitivity tightening between 0.5 dB and 1.5 dB for n7 and n38, and a receiver sensitivity tightening between 0.5 dB and 1.0 dB for n41, n48, n77, n78, n79 and n104, compared to the existing 2Rx UE conducted REFSENS for conducted receiver sensitivity for 2Rx XR UEs.**



# Conclusions and Proposals

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- We have the following observation
  - **Observation: in the February 2024 working group meetings, regarding 2Rx XR UEs, RAN2, RAN3 and RAN4 concluded all the tasks assigned by RAN #102, and they agreed/endorsed CRs and options in accordance with those tasks.**
  
- With the good progress from all working groups, now it is time for RAN to move forward as agreed at RAN #102:
  - *3. TSG-RAN#103 in March:*
    - *1) Consider approving the draft CRs from RAN2, RAN3 and RAN4 for Release-18*
    - *2) Consider approving Release-19 work to be conducted on detailed OTA work for '2Rx non-REDCAP XR devices'.*
    - *Points 1) and 2) represent a package, each one is dependent on the other moving forward.*
  
- **Proposal 1: Approve the following CRs:**
  - **RAN2 endorsed CRs in R2-2402037, R2-2401987, R2-2401988 and R2-2401989**
  - **RAN3 endorsed CRs in R3-241069 and R3-241070**
  - **RAN4 agreed CRs in R4-2403890**
  
- **Proposal 2: RAN agree a receiver sensitivity tightening between 0.5 dB and 1.5 dB for n7 and n38, and a receiver sensitivity tightening between 0.5 dB and 1.0 dB for n41, n48, n77, n78, n79 and n104, compared to the existing 2Rx UE conducted REFSENS for conducted receiver sensitivity for 2Rx XR UEs.**



