3GPP TSG RAN meeting #102
Edinburgh, December 11-15, 2023
Agenda item: 9.1.2.2 XR Evolution

RP-232874

# Further XR enhancements

NEC

© NEC Corporation 2023

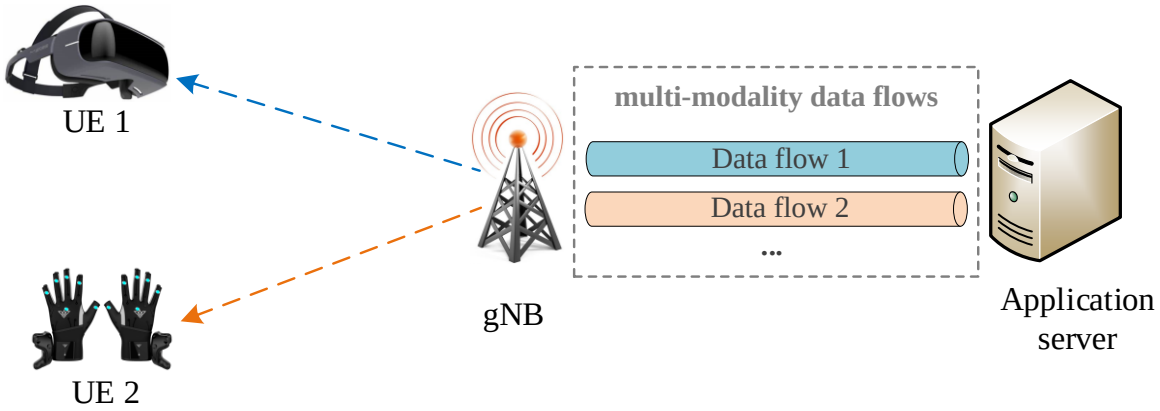
# Motivation for further XR enhancements

- RAN WGs have completed Rel-18 WI “XR Enhancements for NR”, which provides enhancements on various aspects, such as XR awareness, power saving, and capacity enhancement.
- According to the moderator's XR summary of RANP#101 (RP-232619) and guidance from the chair (RP-232745), potential objects for XR evolution in Rel-19 are listed below:
  - Multi-modality.
  - Measurement Gaps / Scheduling Restrictions enhancement.
  - UTO-UCI extension to support multiple CG configurations.
  - CQI/CSI link adaption enhancement.
  - Delay aware / Delay adaptive scheduling.
  - Other topics: Power saving, PDCP discard based on inter-PDU Set dependency.


© NEC Corporation 2023

# Multi-modal XR traffic

- **Justification:**
  - Immersive multi-modal applications for single/multiple UEs may require synchronization and coordination of multiple data flows. However, current framework doesn't support such operation between different flows.
  - The study of multi-modality in RAN depends on the requirements of SA WGs. However, it may take a long time to wait for the conclusions of SA. So we suggest RAN to study multi-modal flows in parallel with SA.
- **Objectives:**
  - Study and, if needed, coordinate with SA WGs to specify the aspects related to multi-modal flows:
    - Specify the QoS parameters and signaling etc., to enable the synchronization/coordination of multiple flows/UEs.
    - Specify user plane enhancements, e.g., enhance PDU sets/LCHs mapping to support synchronous transmission.




*Immersive multi-modal application with multiple UEs*


© NEC Corporation 2023

# Delay-awareness scheduling/LCP

- **Justification :**
  - Delayed data or the LCH that triggers the DSR won't be prioritized during the LCP procedure since the current LCP mechanism doesn't take any delay information into account.
  - The network has no knowledge of delay information upon reception of an SR, the allocated UL grant may not be large enough to accommodate all the delayed data, thus causing extra delay.
  - Moreover, the smooth interaction between the user activity and the content is also a key to providing truly immersive experiences, this requires very tight coordination between dependent UL/DL traffic flows. For bi-directional traffic flows, the interaction delay between UL and DL should be minimized.

- **Objectives:**
  - Specify delay-sensitive scheduling enhancements to further improve the capacity, including:
    - Delay-awareness LCP.
    - SR transmission with prior knowledge of delayed buffer size.
    - Awareness of interaction delay between UL and DL.


© NEC Corporation 2023

# Other topics

- **Justification:**
  - **Power saving**: Due to the limited battery power capacity, power saving is essential for XR UE. However, The scope of Rel-18 power saving is limited to DRX enhancement to support non-integer periodicities. More power-saving techniques, which were studied in Rel-17, should be further discussed in Rel-19.
  - **PDCP discard**: Successful transmission of a PDU Set may depend on the decoding of another PDU Set. However, discarding based on inter-PDU set dependency is not fully discussed in Rel-18.
  - **New BSR trigger**: Additional BSR triggering conditions to allow timely availability of buffer status information can help the network make a better scheduling decision and hence improve the capacity.
- **Objectives :**
  - Specify the necessary enhancements for power saving:
    - Specify enhancements on SSSG switching or PDCCH monitoring skipping.
    - Specify enhancements on C-DRX to support adaptive DRX and multiple DRX configurations.
  - Specify enhancements on PDCP discard based on inter-PDU set dependency.
  - Specify enhancements on new BSR trigger(s) to report the timely buffer status.


© NEC Corporation 2023

# Summary

- In summary, we identify the following proposals for XR evolution in Rel-19:
  - Study and, if needed, coordinate with SA WGs to specify the aspects related to multi-modal flows:
    - Specify the QoS parameters, signaling etc., to enable the synchronization/coordination of multiple flows/UEs.
    - Specify user plane enhancements, e.g., enhance PDU sets/LCHs mapping to support synchronous transmission.
  - Specify delay-sensitive scheduling enhancements to further improve the capacity, including:
    - Delay-awareness LCP.
    - SR transmission with prior knowledge of delayed buffer size.
    - Awareness of interaction delay between UL and DL.
  - Other topics：
    - Specify the necessary enhancements for power saving:
      - Specify enhancements on SSSG switching or PDCCH monitoring skipping.
      - Specify enhancements on C-DRX to support adaptive DRX and multiple DRX configurations.
    - Specify enhancements on PDCP discard based on inter-PDU set dependency.
    - Specify enhancements on new BSR trigger(s) to report the timely buffer status.


© NEC Corporation 2023

\Orchestrating a brighter world

NEC