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RWS-210010

3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28 - July 2, 2021
Agenda Item: 4.2

On XR Improvement for NR

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5G

Background and Motivation

- eXtended Reality (XR) and Cloud Gaming (CG) are some of the most important media applications to be served in 5G networks.
- Compared to conventional eMBB services, e.g., email, web-browsing, video streaming, voice call, XR/CG generally requires much tighter requirements in terms of throughput, latency, reliability, and UE power consumption.
- XR evaluations for NR are being studied in Rel-17 in terms of the following key factors:
  - UE power consumption
  - Capacity (max number of XR UEs supported per cell while meeting QoS requirements)
  - Mobility
  - Coverage
- It is highly desired to enhance NR specifications in Rel-18 to better support XR services in 5G networks, based on findings and learnings from the Rel-17 XR studies.

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Proposed RAN1 led study

- Enhancements to UE power consumption
  - CDRX enhancements
    - Address the periodicity mismatch
  - Enhancements to tackle jitter
  - Further enhancements to L1 based signaling
    - Depending on Rel-17 outcome
  - UL & DL alignment
  - UE assistance info for UL XR traffic
- SPS/CG enhancements
- RAN awareness of traffic information for optimizing lower layer operation
- Extension of DAPs HO
- Application awareness at RAN
- RAN awareness at application

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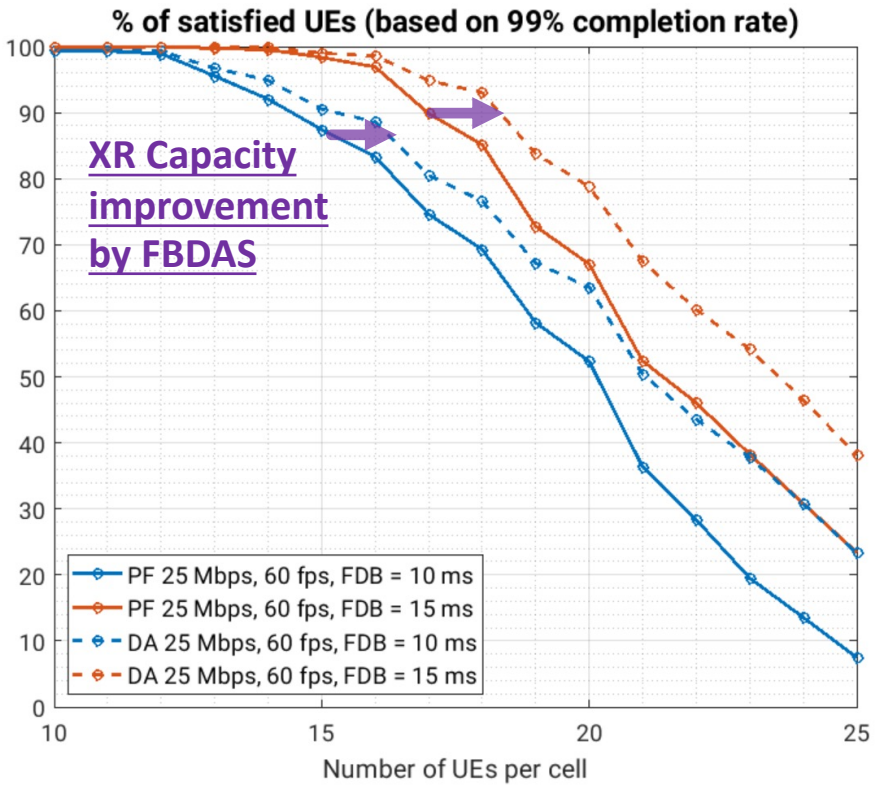
FR1:XR Performance Improvement by Proposed Solutions

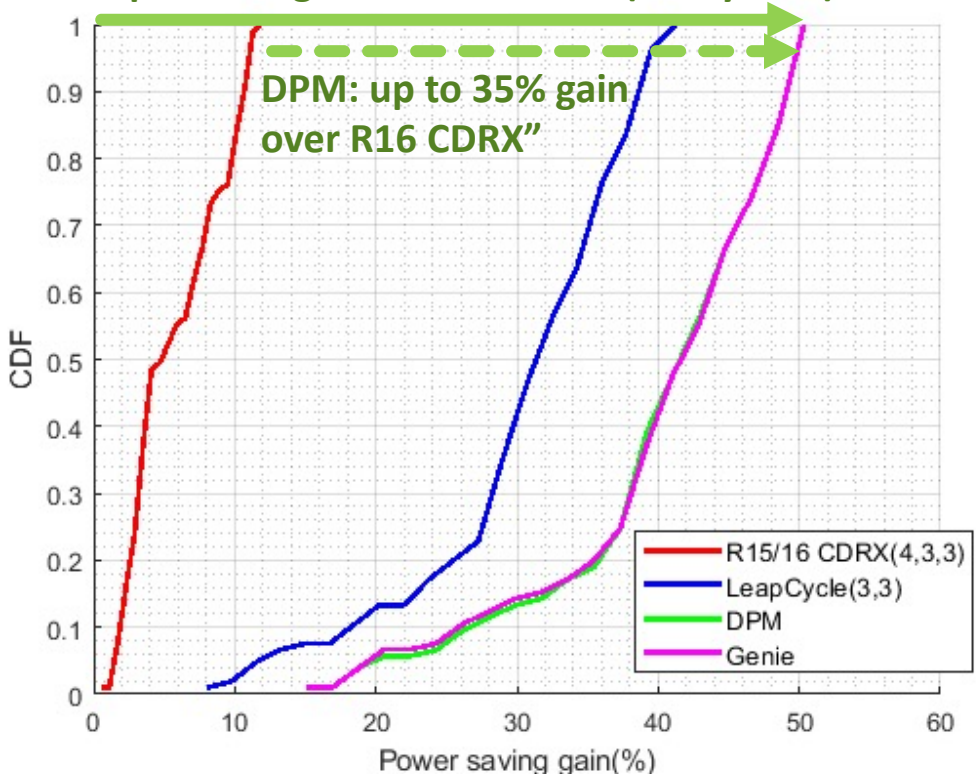
XR Network Capacity Enhancement



"File Boundary & Delay Aware Scheduling (FBDAS)" can substantially improve the XR capacity by prioritizing users that are closer to the file transfer deadline

XR UE Power Saving Enhancement

DPM: up to 50% gain over Baseline (always ON)



Newly introduced power saving technique, "Discontinuous PDCCH Monitoring (DPM)" can save UE power up to 50% over baseline (always ON) and up to 35% over Rel-15/16 CDRX

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FR2: Summary of Network Coding Observations

Scenario	Parameters	Conclusions / Technical Insight

• URLLC traffic w/ mini slot	• 48 Bytes(2cc); 72 Bytes(3cc)
	• 1 ms arrival, 1 ms expiry
	• High NC redundancy (100%) + NC header Overhead
		• PDCP duplication achieves the best performance for 2 CCs
		  • PDCP dup. reliability is greater than baseline
		  • PDCP dup. overhead is less than network coding and NC segments are highly correlated due to limited diversity
		• NC and PDCP duplication achieves the best performance for 3 CCs
		  • Multi-carrier diversity gain for NC

• Small packet	• Avg 6.4 Kbyte(2cc); Avg 9.6 Kbyte(3cc) • ~83 ms arrival, 2 ms expiry • Moderate NC redundancy (< 100%)	• NC achieves the best performance • NC uses smaller and better utilized redundancy compared to PDCP dup. • Short time deadline (2 ms) takes away ReTx. opportunities from the baseline
• Medium packets	• Avg 32 Kbyte(2cc); Avg 48 Kbyte(3cc) • 50 ms arrival, <= 10 ms expiry • Moderate NC redundancy (< 100%)	• NC achieves the best performance • NC uses smaller and better utilized redundancy compared to PDCP dup. • NC achieves highest reliability due to efficient redundancy to recover packets experiencing loss
• Large packets	• Avg 64 Kbyte(2cc); Avg 96 Kbyte(3cc) • 50 ms arrival, >= 10ms expiry (including no expiry) • Low NC redundancy (25%,50%)	• Baseline and NC are comparable • PDCP duplication incurs a large overhead and hence greater delays
• Cloud Gaming/XR-Like Traffic	• Avg 19.2 Kbyte(2cc); Avg 28.8 Kbyte(3cc) • 8.33 ms arrival, 10ms expiry • Moderate NC redundancy (< 100%)	• NC achieves the best performance • Similar concept as small packet case with larger packet sizes → NC uses smaller and better utilized redundancy than PDCP duplication • Achieving reliability while keeping instantaneous loading low is important, especially with deadlines

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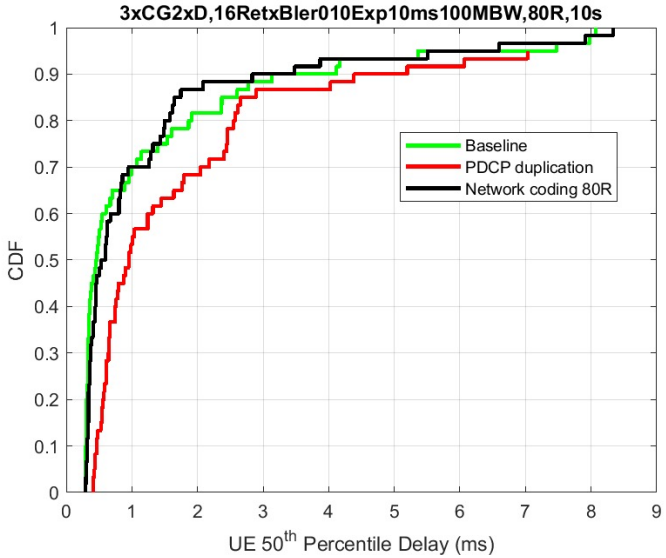
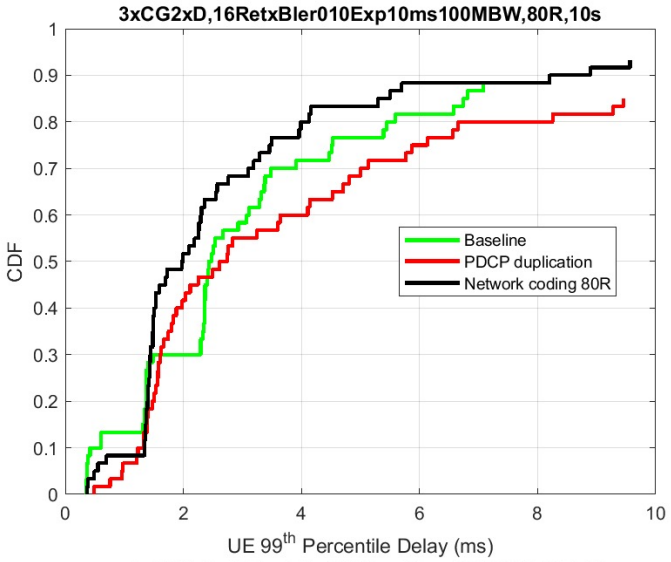
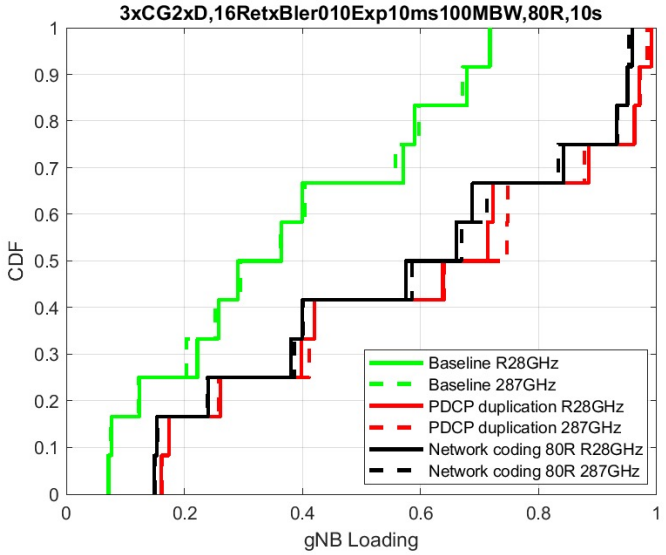
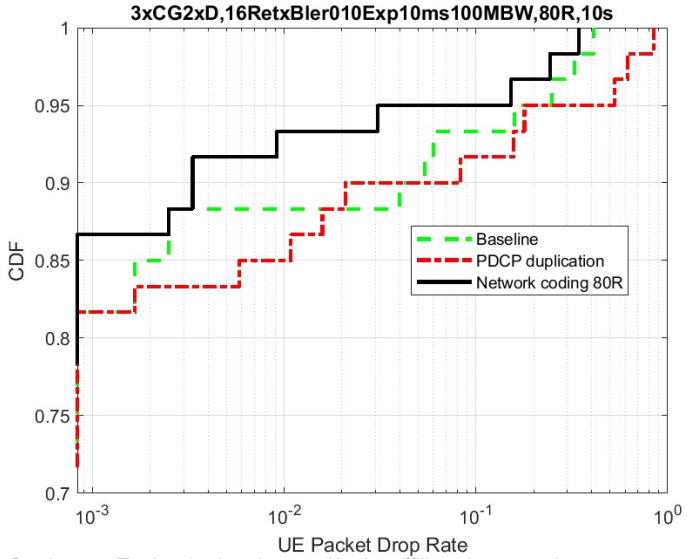
FR2: Cloud Gaming/XR-Like Traffic (Network Coding)

- Assumptions
  - Traffic: file size 19.2KBytes, arrival interval 8.33 ms
  - Available bandwidth 100MHz
  - CA w/ 28GHz and 28.7GHz CCs
  - Raptor codes, number of sub-packets 100
  - 80% redundancy
    - Note: NC incurs additional 4 byte per segment overhead
  - Delay budget 10ms
  - Target BLER 10%
- Observations
  - NC significantly outperforms PDCP duplication
    - Smaller and better utilized redundancy
  - With appropriate redundancy (80%), NC has better performance than baseline for 50th% and 99th% delay
  - NC achieves lowest drop rate









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