

[RAN2-led] Study on a lean protocol stack

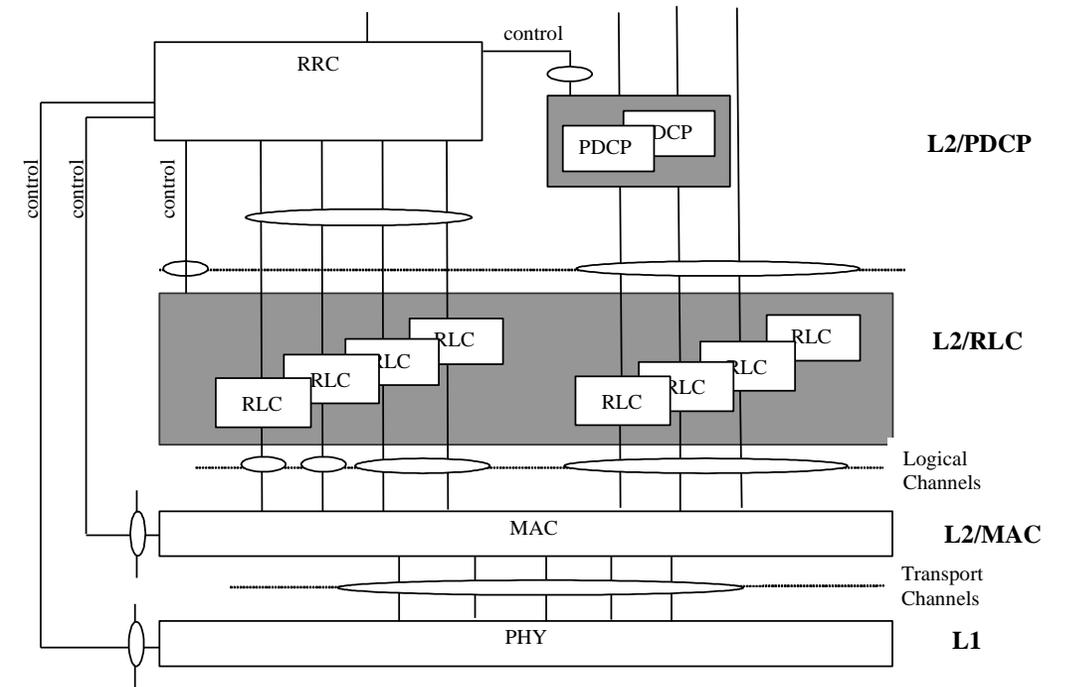
[SI]

Motivation

Problem Statement

[1/3]

- Figure alongside is of the **3G stack from 1999** (25.301)
- From an architectural and functional point of view, the protocol stack has largely stayed the same since 3G
- Over the last two decades, the world around us has changed significantly
 - Increasing data rate expectations (Kbps to Gbps)
 - Shrinking delay expectations (seconds to <20ms)
 - Services migrating to the edge
 - Changing transport layer protocols (TCP to RTP, QUIC)
 - Wireless access has become the norm



Motivation

Problem Statement

- We are seeing an increasing need to enhance the stack to match emerging use-cases
 - Immersive services such as XR introduce latency-sensitive high-throughput data¹
 - Earlier discussions indicated a need to bring down stack processing overhead²
 - Other proposals indicated a need to improve reliability of delay-constrained traffic³
- These pressures will only get higher in the future
- A holistic study of the current UP stack performance and its gaps is needed to identify functionality required to meet requirements for the next decade

¹ TR26.928 – 25Mbps to 10Gbps, 10-20ms one way E2E

² RWS-210182, RWS-210450

³ RWS-210368, RWS-210028

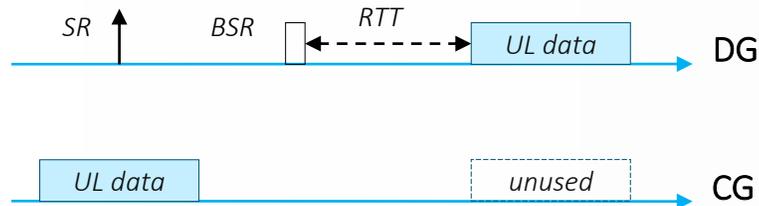
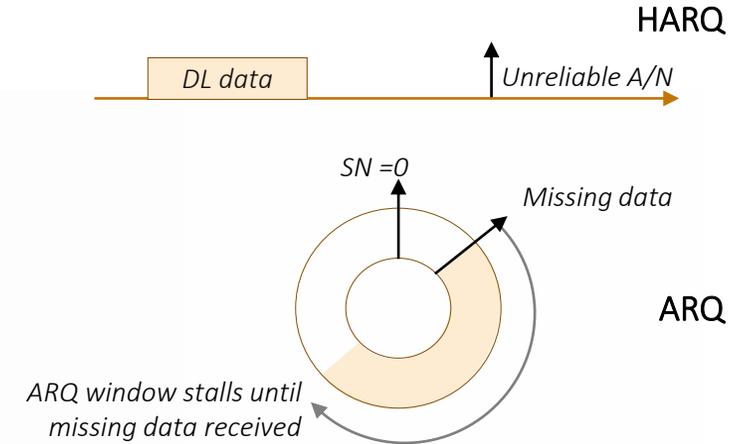
Motivation

[2/3]

Example gaps in the stack

Reliability for delay constrained traffic

- HARQ: good delay performance, faces reliability issues (e.g. feedback unreliability)
- ARQ: high reliability, poor delay performance (e.g. window stalls)



UL scheduling delays

- Dynamic grants: 2 RTTs delay (SR+BSR) for an appropriately sized grant
- Configured grants: Reduced delay, unused resources leads to capacity loss

Processing overhead in gNB and UE

- N downlink data packets \Rightarrow N uplink ack packets
- UL data rate \ll DL data rate, but UL processing \approx DL processing



Key Message: Evaluate the gaps in the current NR stack to enable lean and responsive UP operation

Objective I: Throughput performance study [RAN2]

- Evaluate processing overhead and identify gaps within the 5G stack for high-throughput traffic
- Identify areas of improvement needed to enable a lean and energy-efficient stack for high-throughput data transfer

Objective II: Delay performance study [RAN2]

- Evaluate delay performance and identify gaps within the 5G stack to serve latency-sensitive traffic
- Identify areas of improvement needed to enable a responsive stack for latency-sensitive data transfer

Objective III: Reliability study [RAN2]

- Evaluate the reliability offered by the 5G stack and its gaps to serve high-throughput latency-sensitive traffic
- Identify areas of improvement needed to meet reliability requirements for high-throughput latency-sensitive data transfer

Expected TU

| | 2024 | | | | | | | | | | | | 2025 [Calendar TBC at the time of writing] | | | | | | | | | | | | 2026 | | |
|------------|------------|-----|-----|------------|-----|-----|------------|-----|-----|------------|-----|-----|--|-----|-----|------------|-----|-----|------------|-----|-----|------------|-----|-----|------------|-----|-----|
| | Q1 | | | Q2 | | | Q3 | | | Q4 | | | Q1 | | | Q2 | | | Q3 | | | Q4 | | | Q1 | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
| RAN | 103 | | | 104 | | | 105 | | | 106 | | | 107 | | | 108 | | | 109 | | | 110 | | | 111 | | |
| R1 | 115b | 116 | | 116b | 117 | | | 118 | | 118b | 119 | | 119b | 120 | | 120b | 121 | | | 122 | | 122b | 123 | | 123b | 124 | |
| R2 | 124b | 125 | | 125b | 126 | | | 127 | | 127b | 128 | | 128b | 129 | | 129b | 130 | | | 131 | | 131b | 132 | | | | |
| R3 | 122b | 123 | | 123b | 124 | | | 125 | | 125b | 126 | | 126b | 127 | | 127b | 128 | | | 129 | | 129b | 130 | | | | |
| R4 | 109b | 110 | | 110b | 111 | | | 112 | | 112b | 113 | | 113b | 114 | | 114b | 115 | | | 116 | | 116b | 117 | | 117b | 118 | |
| R1 | N/A | | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | N/A | N/A | | | | | | | | | | |
| R2 | | | | 1 | 1 | | | 1 | | 1 | 1 | | | 2 | | 1 | 1 | | | 2 | | | | | | | |
| R3 | | | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | | | | | | |
| R4 RD | | | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | | | | | | |
| R4 RF | | | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | N/A | N/A | | | N/A | | | | | | | |



Thank you!