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Latency Requirements and Analysis

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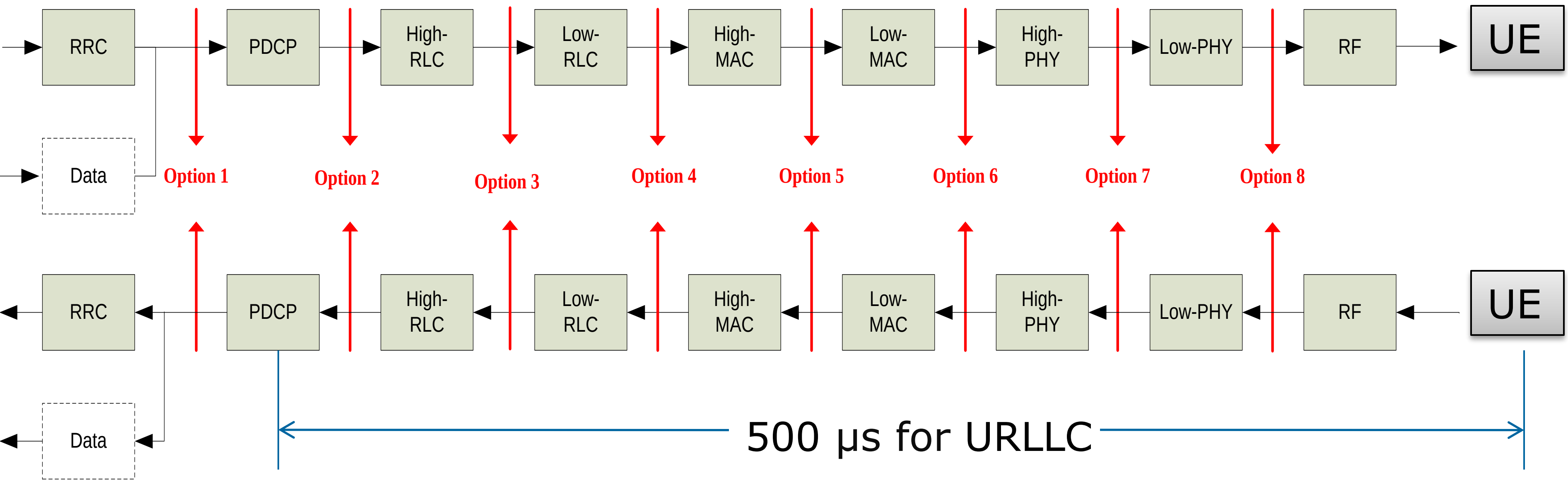
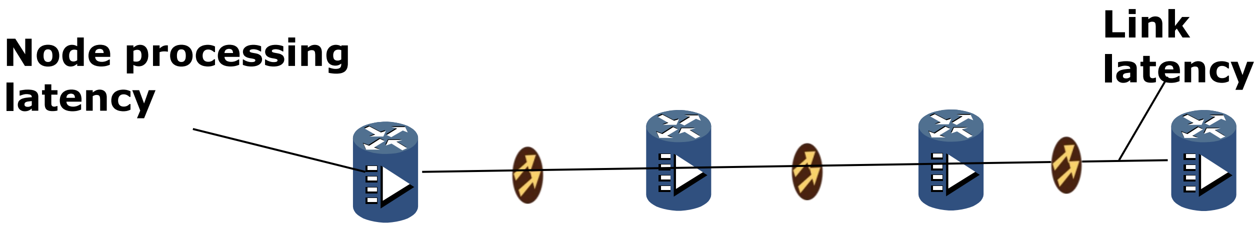
Function Split between central and distributed unit in 3GPP



- 3GPP is studying the function split between central unit and distributed unit now.
- 8 possible options for split.
- Considering the latency limitation for URLLC, most options have strict latency requirements for transport network, for example less than 20 μs, only option 1 has no this limitation.

Latency in Transport network



Latency in transport network= Node processing latency + Link latency

- Node processing latency:
  - ✓ Now in 20 μs to 100 μs
  - ✓ Expecting optimization to a few microseconds in the future
- Link latency: 5 μs/1 km (can't be optimized)

Latency example: suppose the node processing latency is 8 μs
1) 4km distance: 4*5 μs=20 μs
2) 6 nodes and 10 km distance
Latency in transport network= 6*8 μs + 10*5 μs = 98 μs
3) 8 nodes and 20 km distance:
Latency in transport network= 8*8 μs + 20*5 μs = 164 μs

Latency limits the transport network scale.

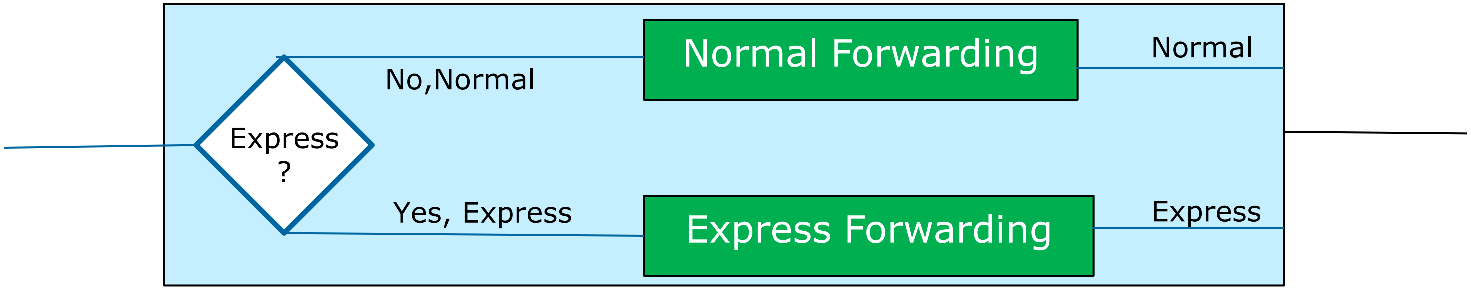
Different usecase different latency

Table 1: User Experience Requirements

Use case category	User Experienced Data Rate	E2E Latency	Mobility
Broadband access in dense areas	DL: 300 Mbps UL: 50 Mbps	10 ms	On demand, 0-100 km/h
Indoor ultra-high broadband access	DL: 1 Gbps, UL: 500 Mbps	10 ms	Pedestrian
Broadband access in a crowd	DL: 25 Mbps UL: 50 Mbps	10 ms	Pedestrian
50+ Mbps everywhere	DL: 50 Mbps UL: 25 Mbps	10 ms	0-120 km/h
Ultra-low cost broadband access for low ARPU areas	DL: 10 Mbps UL: 10 Mbps	50 ms	on demand: 0-50 km/h
Mobile broadband in vehicles (cars, trains)	DL: 50 Mbps UL: 25 Mbps	10 ms	On demand, up to 500 km/h
Airplanes connectivity	DL: 15 Mbps per user UL: 7.5 Mbps per user	10 ms	Up to 1000 km/h
Massive low-cost/long-range/low-power MTC	Low (typically 1-100 kbps)	Seconds to hours	on demand: 0-500 km/h
Broadband MTC	See the requirements for the Broadband access in dense areas and 50+Mbps everywhere categories		
Ultra-low latency	DL: 50 Mbps UL: 25 Mbps	<1 ms	Pedestrian
Resilience and traffic surge	DL: 0.1-1 Mbps UL: 0.1-1 Mbps	Regular communication: not critical	0-120 km/h
Ultra-high reliability & Ultra-low latency	DL: From 50 kbps to 10 Mbps; UL: From a few bps to 10 Mbps	1 ms	on demand: 0-500 km/h
Ultra-high availability & reliability	DL: 10 Mbps UL: 10 Mbps	10 ms	On demand, 0-500 km/h
Broadcast like services	DL: Up to 200 Mbps UL: Modest (e.g. 500 kbps)	<100 ms	on demand: 0-500 km/h

For transport network , we need identify the low latency service to allocate the special resource to forward with high priority.

Transport nodes optimization for latency processing



- Indentify the low latency services and forward them with express forwarding processing.
- If treat all the services as low latency services, transport nodes will be high cost.

Suggestions

1. Latency limits the transport network scale. So if we need a middle scale fronthaul network (10km, 6 transport nodes), the transmission latency is no less than 100 μs.

2. For better processing, the transport network nodes need to be told which service is the low latency.