Towards RAN Slicing in 5G

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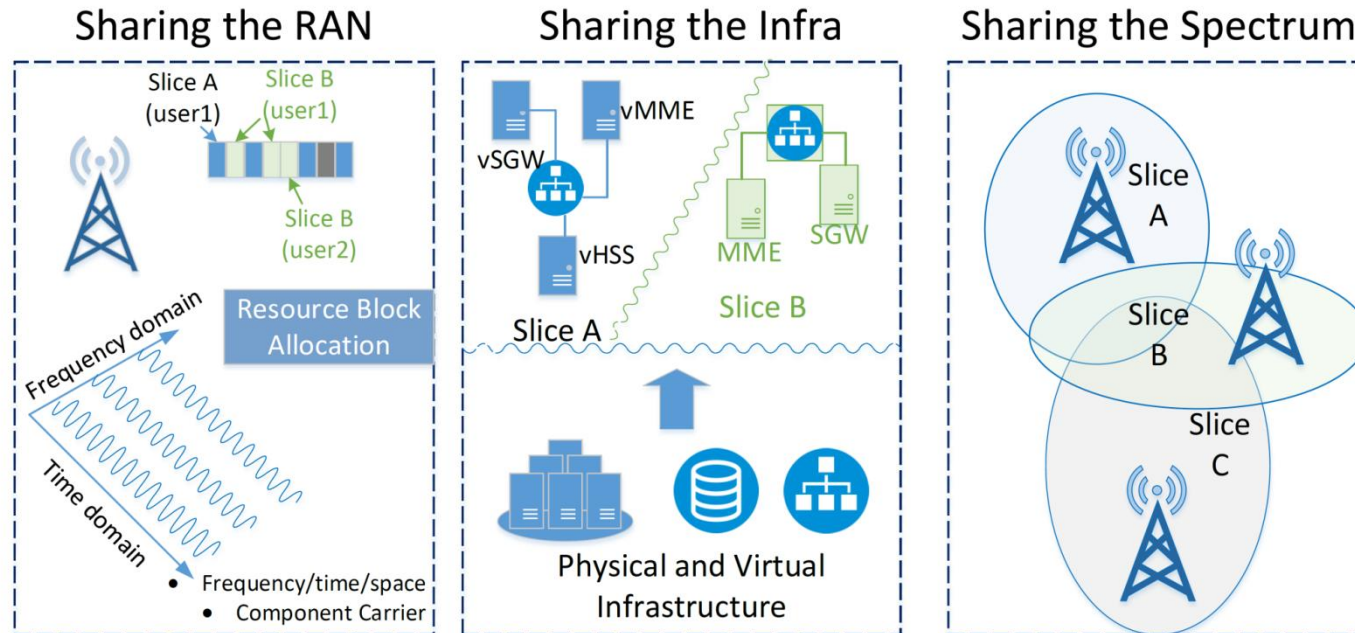
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RAN Slicing and Sharing

Sharing the RAN · Sharing the Infra · Sharing the Spectrum

- **Sliceable elementary resources**
  - ➢ [RRU/Antenna, Fronthaul, CRAN, Backhaul]
  - ➢ [CPU/MEM/NET, Radio resources, spectrum]
  - ➢ [configuration, chain, placement]

- **Resource abstraction and network programmability is a key to achieve the required flexibility in slicing**

RAN Slicing and Sharing

- **Slice strategy (two extremes)**
  - Isolation
    - + Dedicate elementary resources to the slice
    - – Reduce slices elasticity/scalability
  - Resource Sharing:
    - + Exploit the statistical multiplexing gain
    - – No hard performance guarantee

- **Tradeoff between slice isolation and resource sharing**
  - Radio resource isolation → group-based scheduling (multi-dimensional)
  - Service (QCI/TFT) and user isolation → slice-to-DRB mapping, regular scheduling
  - Slice-based KPI → smart scheduling (multi-dimensional)

- **Multi-service network function chaining**
  - change the network service definition on the fly on per slice basis

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- **Multi-service network function chaining**
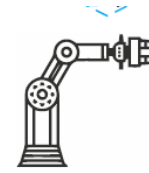 - change the network service definition on the fly on per slice basis
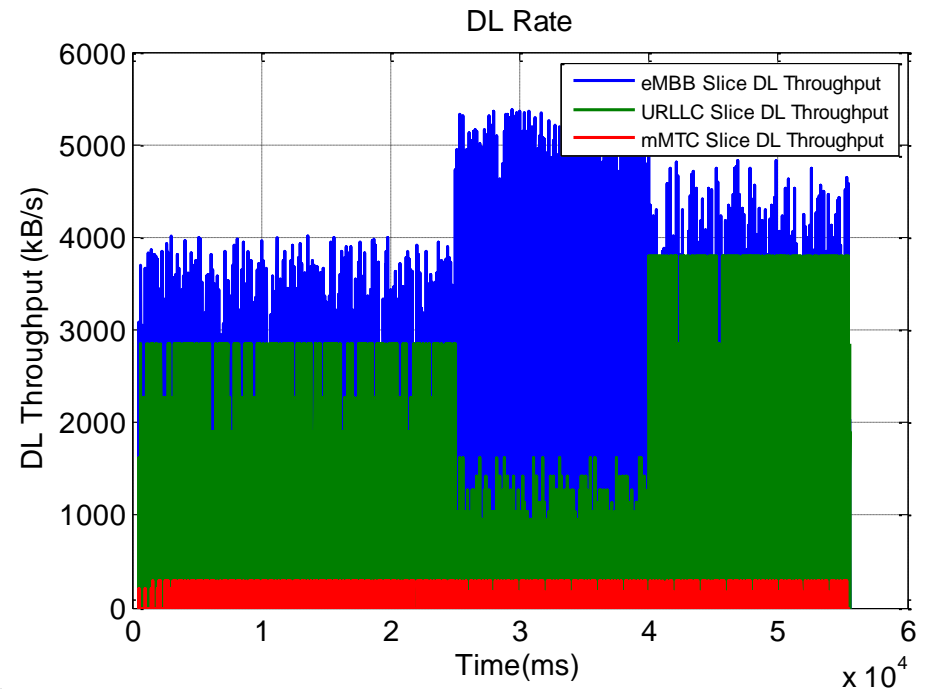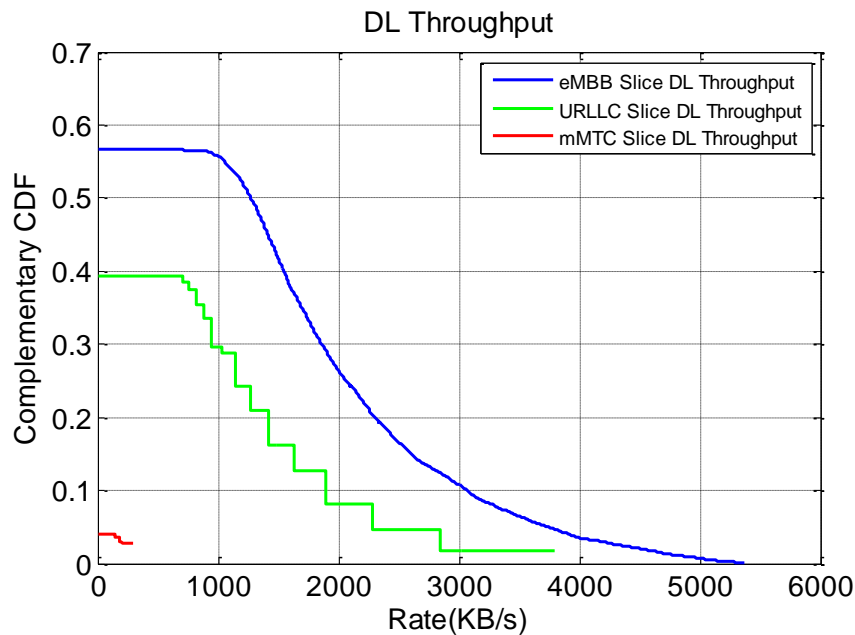
Demo Setup
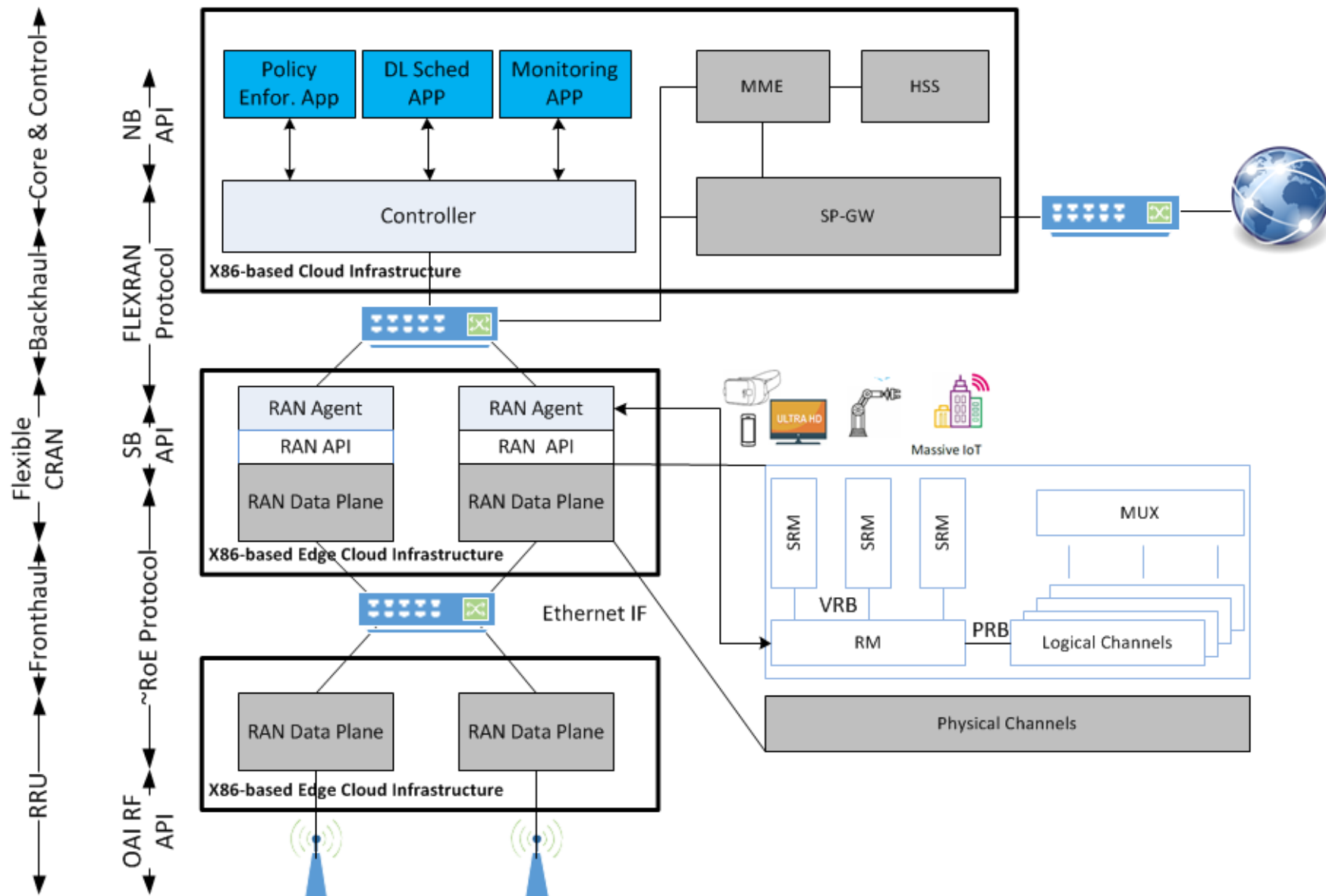
RAN Slicing and Sharing Sample Results

- **3 slices:**
  - ➢ Slice-specific scheduling
  - ➢ Dynamic Slice Resource management
    - – Enforce different policies over time

ULTRA HD

Massive IoT

DL Throughput

Legend:
- eMBB Slice DL Throughput
- URLLC Slice DL Throughput
- mMTC Slice DL Throughput

X-axis: Rate(KB/s), Y-axis: Complementary CDF

DL Rate

Legend:
- eMBB Slice DL Throughput
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X-axis: Time(ms) x 10^4, Y-axis: DL Throughput (kB/s)
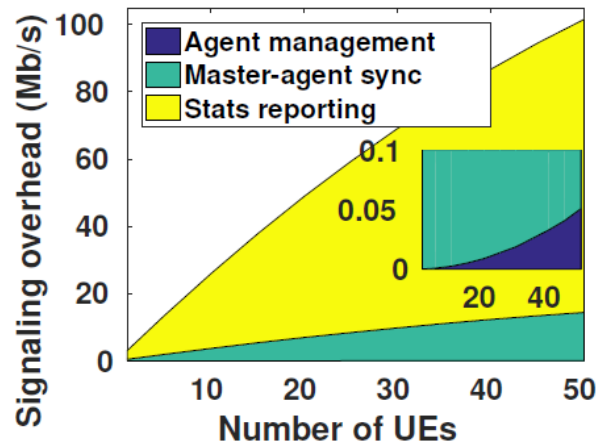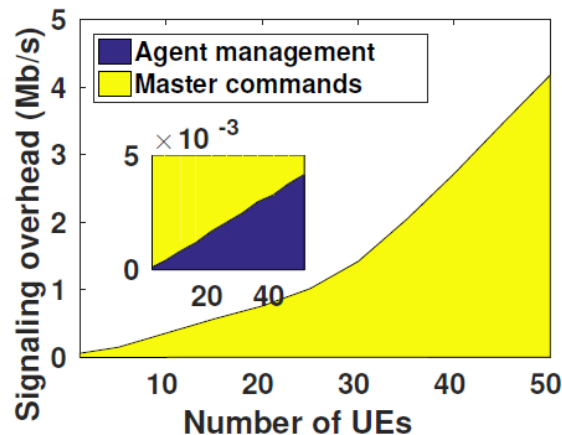
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MOSAIC-5G
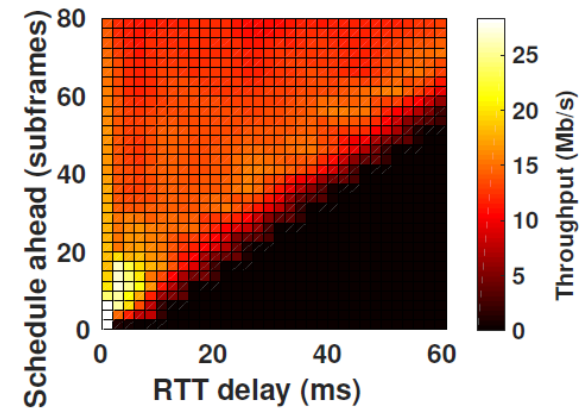
Backhaul Control Channel Requirements Measurement Results

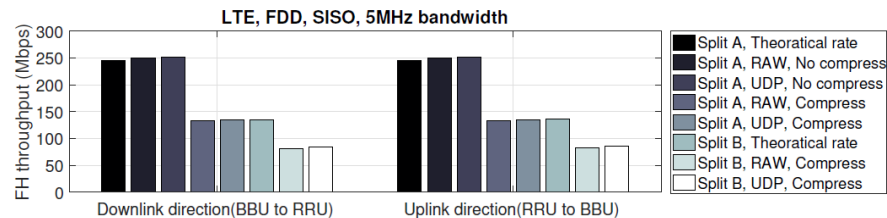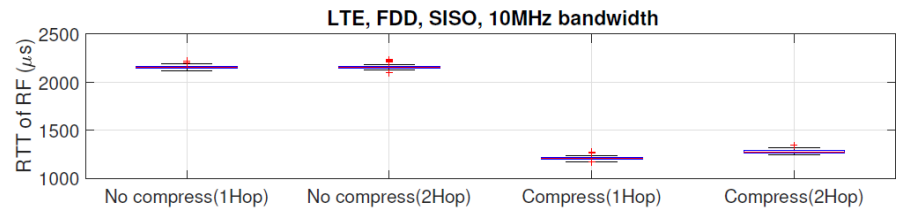| Agent-to-controller	Controller-to-agent	Control-channel-latency

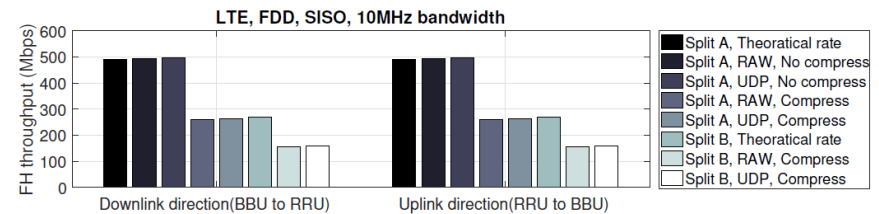
- **Realtime Control requires low-latency high capacity backhaul**

Fronthaul Requirements Measurement results

5MHZ, SISO, FDD	10MHZ, SISO, FDD

LTE, FDD, SISO, 5MHz bandwidth

Legend: Split A, Theoretical rate; Split A, RAW, No compress; Split A, UDP, No compress; Split A, RAW, Compress; Split A, UDP, Compress; Split B, Theoretical rate; Split B, RAW, Compress; Split B, UDP, Compress

LTE, FDD, SISO, 10MHz bandwidth

Legend: Split A, Theoretical rate; Split A, RAW, No compress; Split A, UDP, No compress; Split A, RAW, Compress; Split A, UDP, Compress; Split B, Theoretical rate; Split B, RAW, Compress; Split B, UDP, Compress

LTE, FDD, SISO, 10MHz bandwidth

LTE, FDD, SISO, 10MHz bandwidth

- ## **Fronthaul capacity depends on many factors**
  - ➤ Split, compression, protocol, BW, #RE/UE/RRU, #Antenna/Sectors, #CC

Converged Flexhaul for 5G

- **Two type of xhaul**
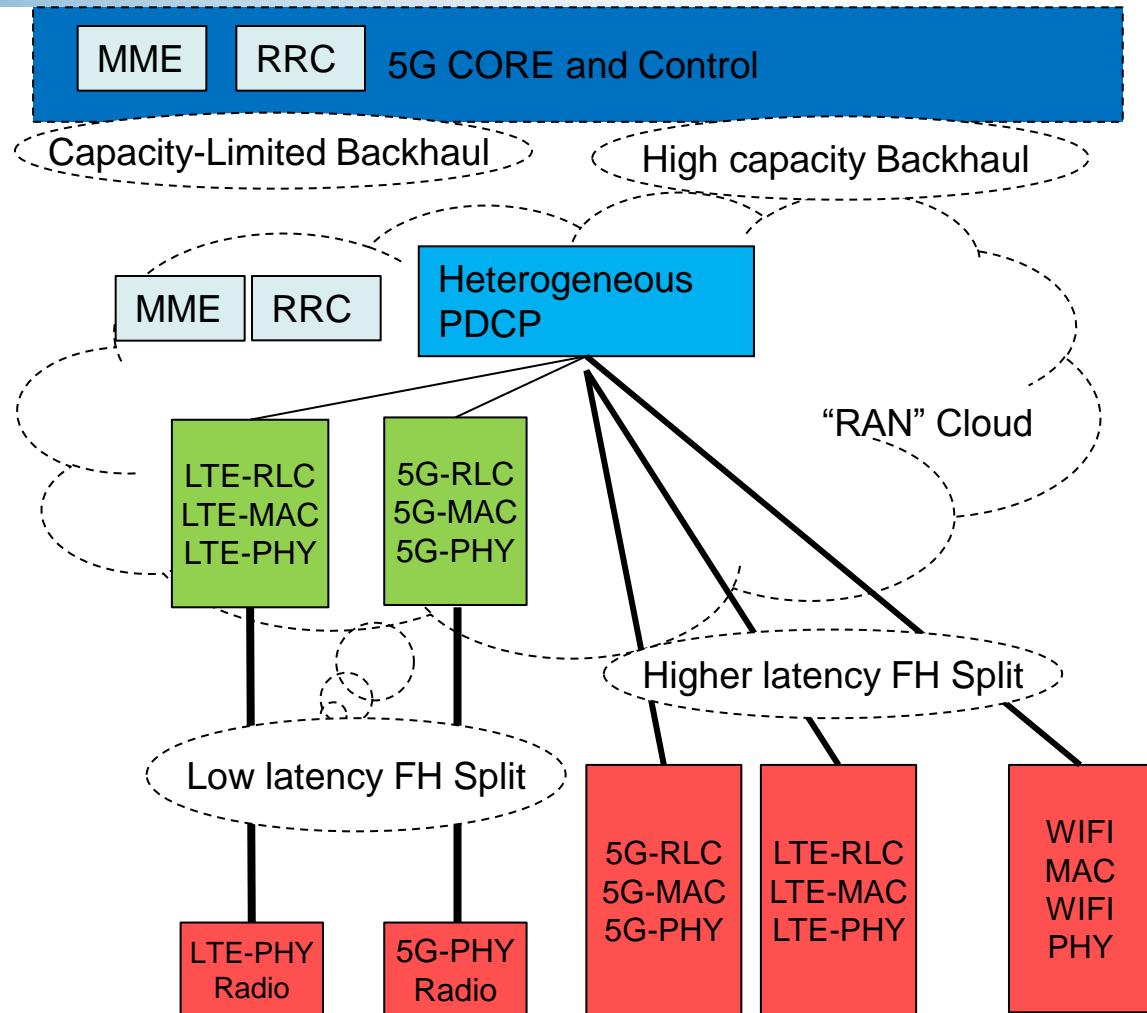 - Low latency
  - High latency

- **Various topologies**
  - multi-tier – flat
  - Mesh – tree

- **Switching vs routing**
  - Aggregation
  - Distribution

- **Data-plane accelerations**
  - DPDK, NETMAP

5G CORE and Control
MME RRC

Capacity-Limited Backhaul   High capacity Backhaul

MME RRC   Heterogeneous PDCP

"RAN" Cloud

LTE-RLC LTE-MAC LTE-PHY
5G-RLC 5G-MAC 5G-PHY

Higher latency FH Split

Low latency FH Split

LTE-PHY Radio
5G-PHY Radio

5G-RLC 5G-MAC 5G-PHY
LTE-RLC LTE-MAC LTE-PHY
WIFI MAC WIFI PHY

Want to know more about RAN slicing demo?

Please feel free to come and checkout the demo

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