Fixed-Mobile Convergence in F5G-Advanced

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UE: User Equipment (~cell phone)
eNB: e-Node Bay
RU: Radio unit
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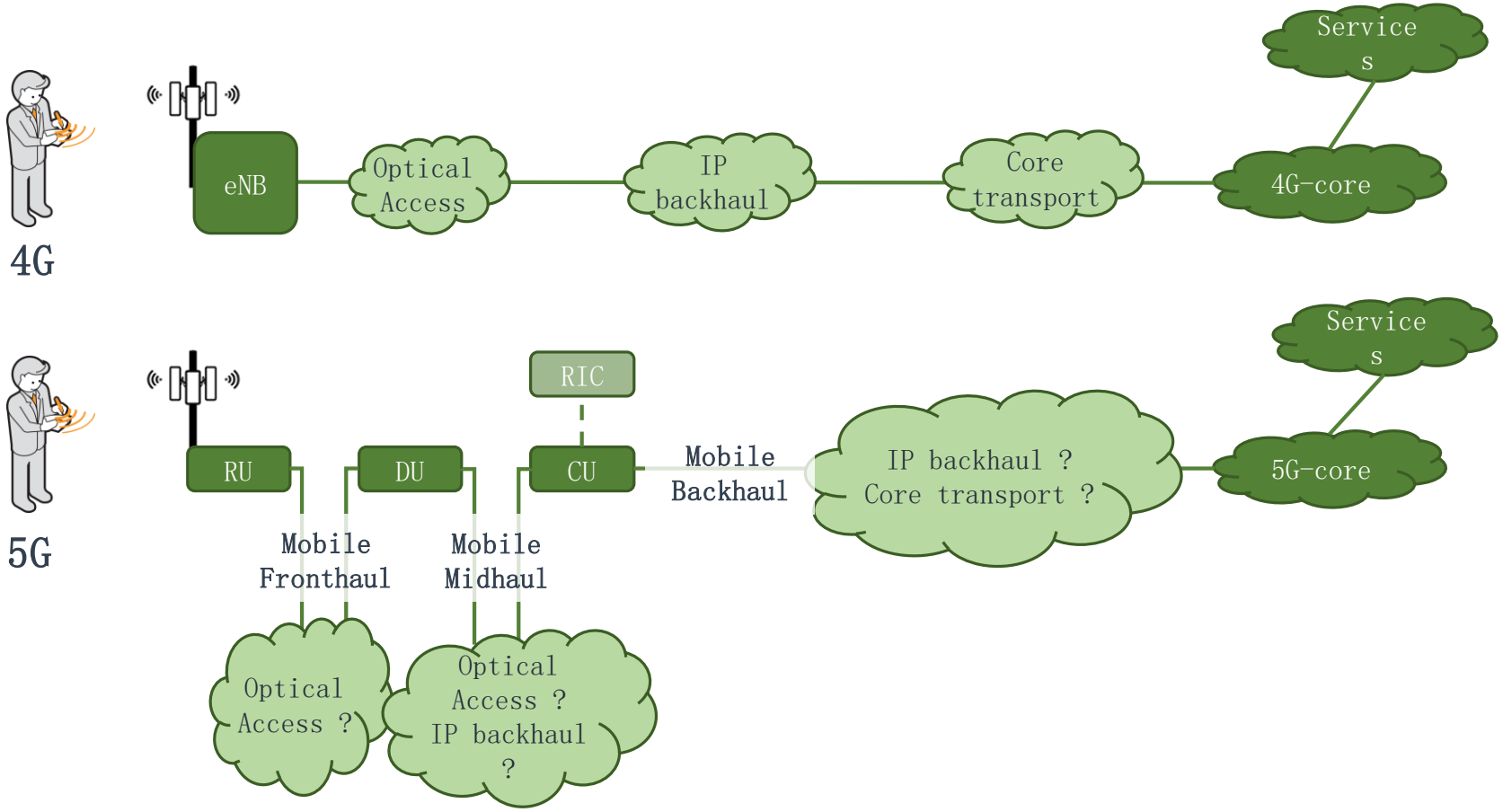
INTRODUCTION

› Operators have two main wealth: infrastructure and information system

› 5G and RAN evolution requires both to evolve



RAN splits introduce new entities and segments (x-haul)

› Mobile X-hauls need to be transported
- Important throughput
- Latency/Jitter sensitivity
- Interoperability
- Infrastructure sharing
- Automated deployment
- New services (network slicing)

F5G USE CASES

› **UC#8: Multiple Access Aggregation over PON**

"Improve 5G overage in exploiting PON low cost per client/cell site"

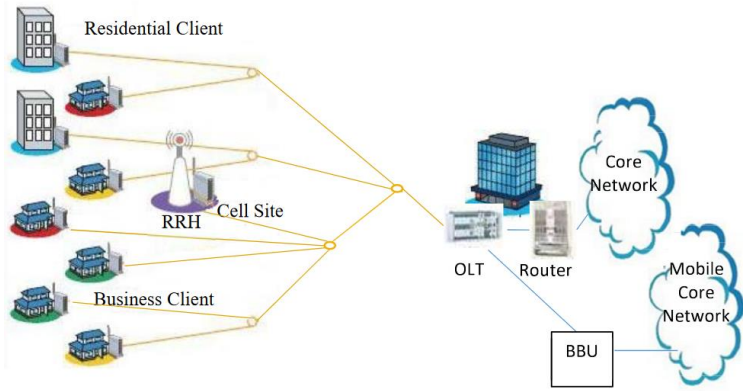


Figure 29: Overview of the multiple access aggregation over PON

› **UC#6: PON for Industrial Manufacturing**

Requirements include:

- Low latency: below 1 ms in some applications,
- Time Sensitive Networking as a solution

5G-COMPLETE Project in a Nutshell

Combine cloud and edge computing over unified, ultra-high capacity, secure and converged digital/analog Fiber-Wireless Network

European call H2020-ICT-2019

https://5gcomplete.eu/

INTRODUCTION (CONT.)

RAN: Radio Access Network
TSN: Time-Sensitive Networking
PON: Passive Optical Network
FTTH: Fiber to The Home

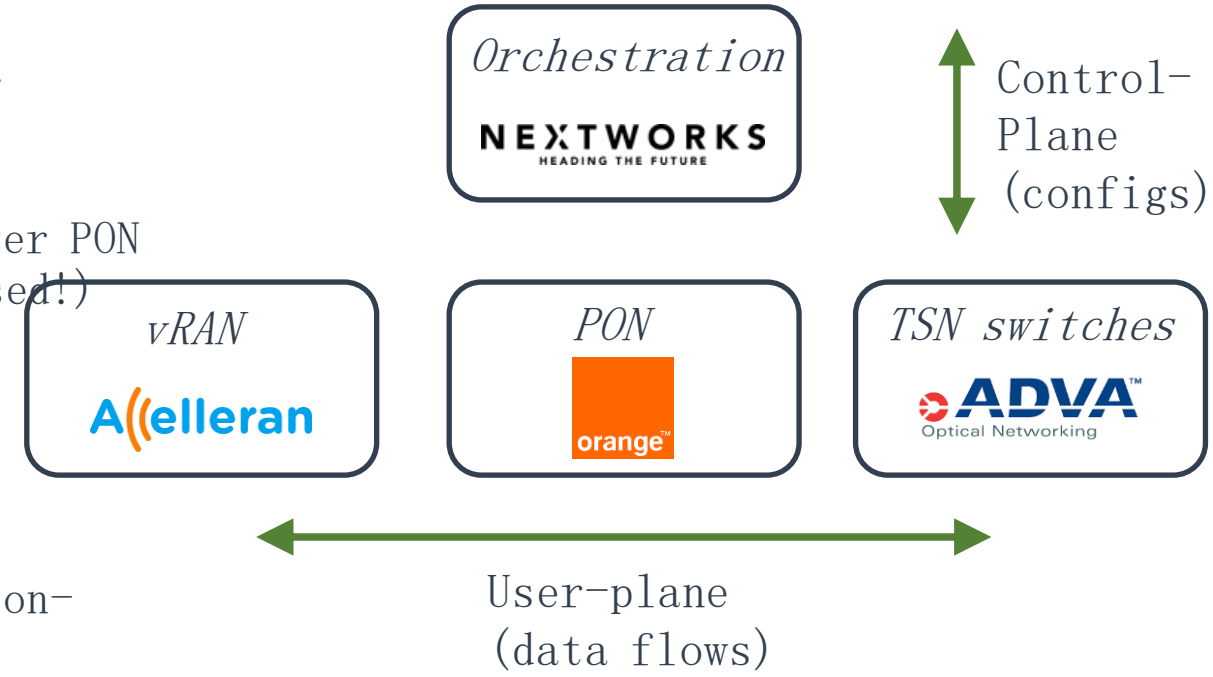
› We show transport of X-haul over multi-domain transport infrastructure

› vRAN
  - Generic hardware deployment (on servers)
  - O-RAN aligned interfaces (standard)

› TSN switches
  - Low jitter, low latency for Fronthaul transport
  - Enables infrastructure sharing

› PON
  - F5G Use case #8: Multiple Access Aggregation over PON
  - Low-cost solution for FTTH (1 Billion home passed!)
  - Enables infrastructure sharing
  - Pluggable PON (no need for proprietary chassis)

› Orchestration
  - Make a coherent system out of a multi-domain technology
  - Enables network slice deployment on-demand and on-scale



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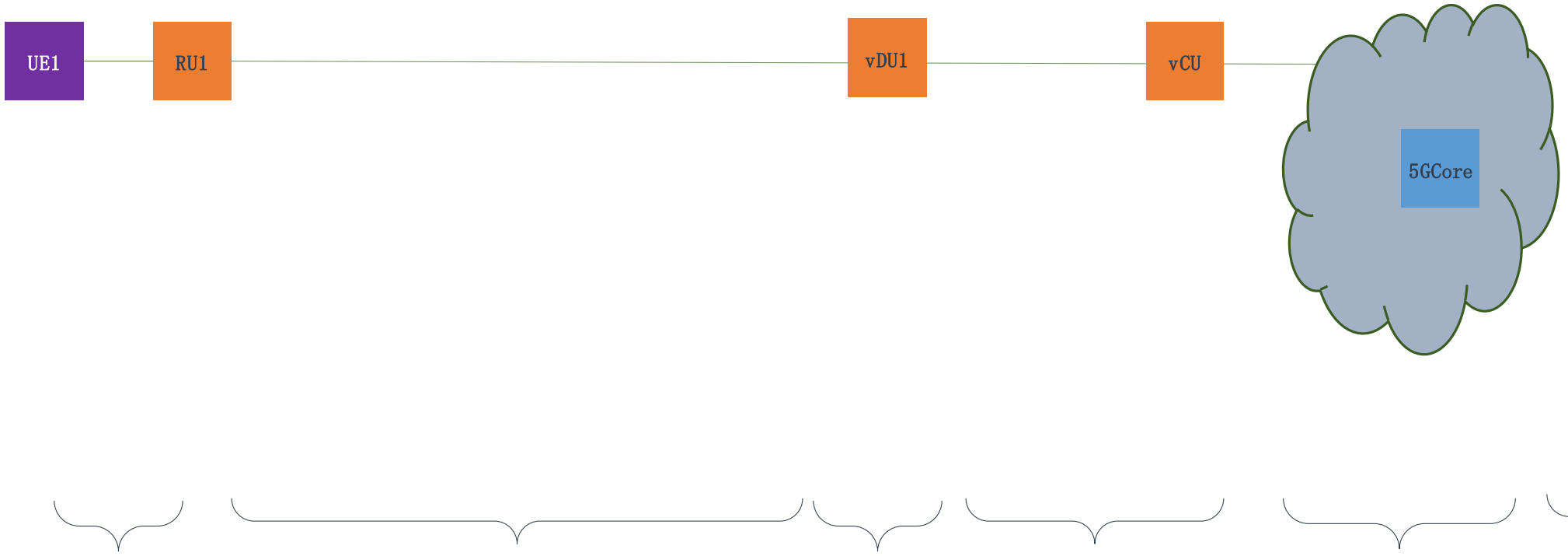

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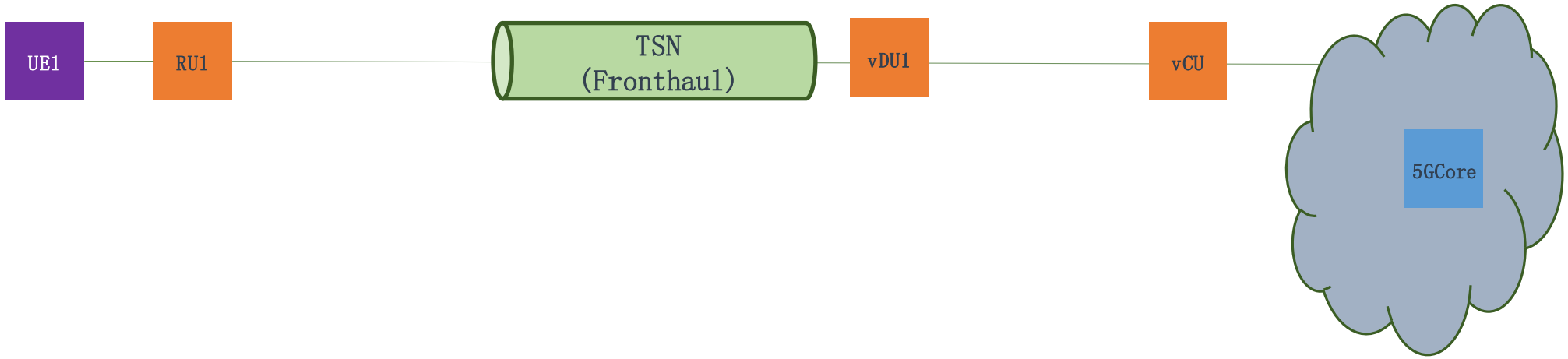

« air » interface

Optical transport (tier 1,

Edge

Optical transport (tier 2, metro)

Core

Applications

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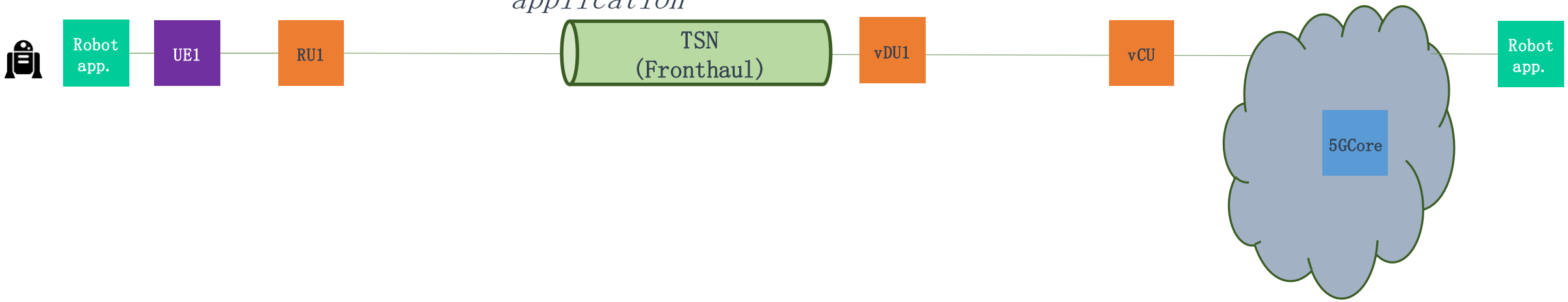
Slice 1: mobile robots application



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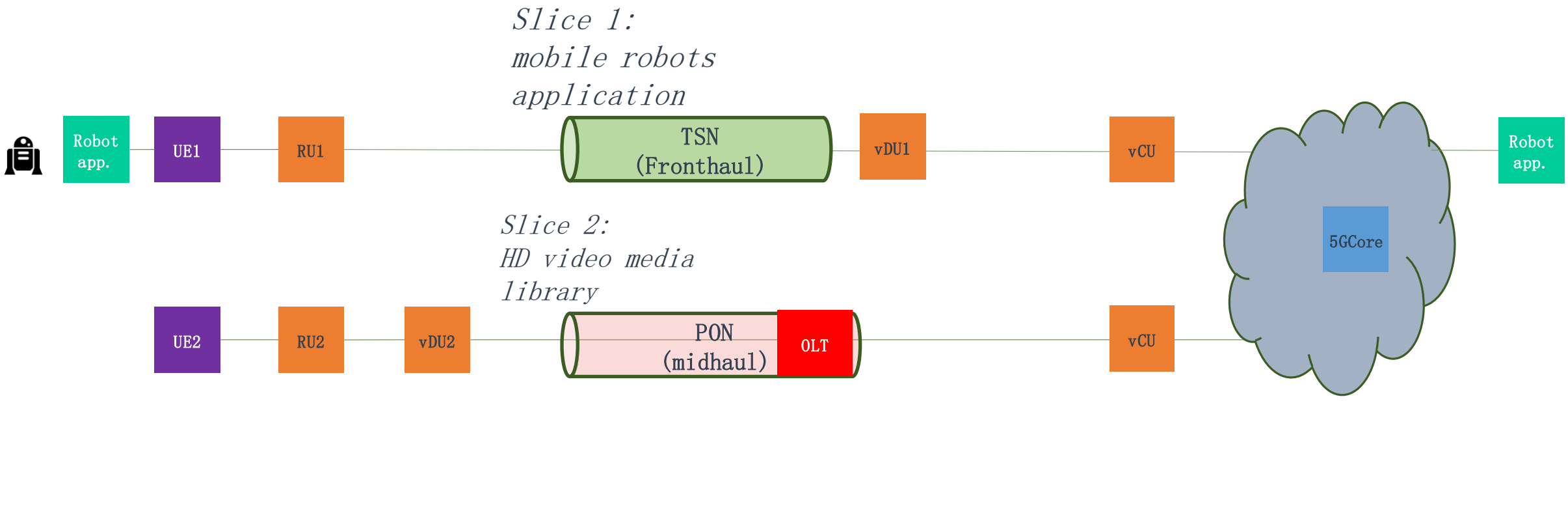
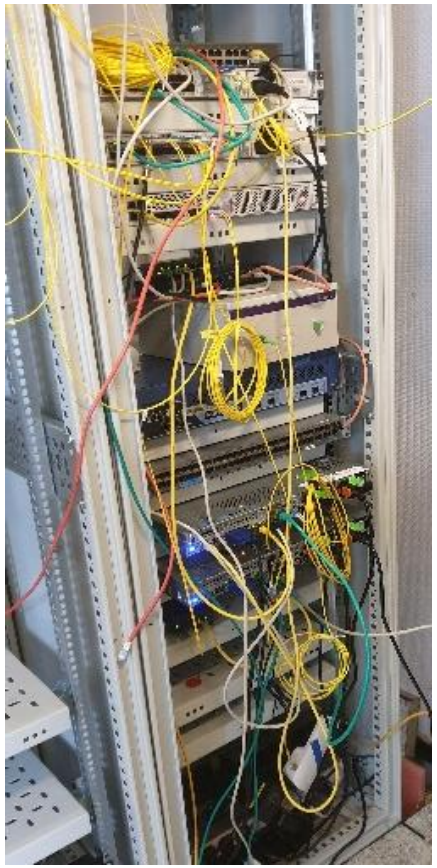


CPE (UE)

Pluggable PON OLT

Lab mess



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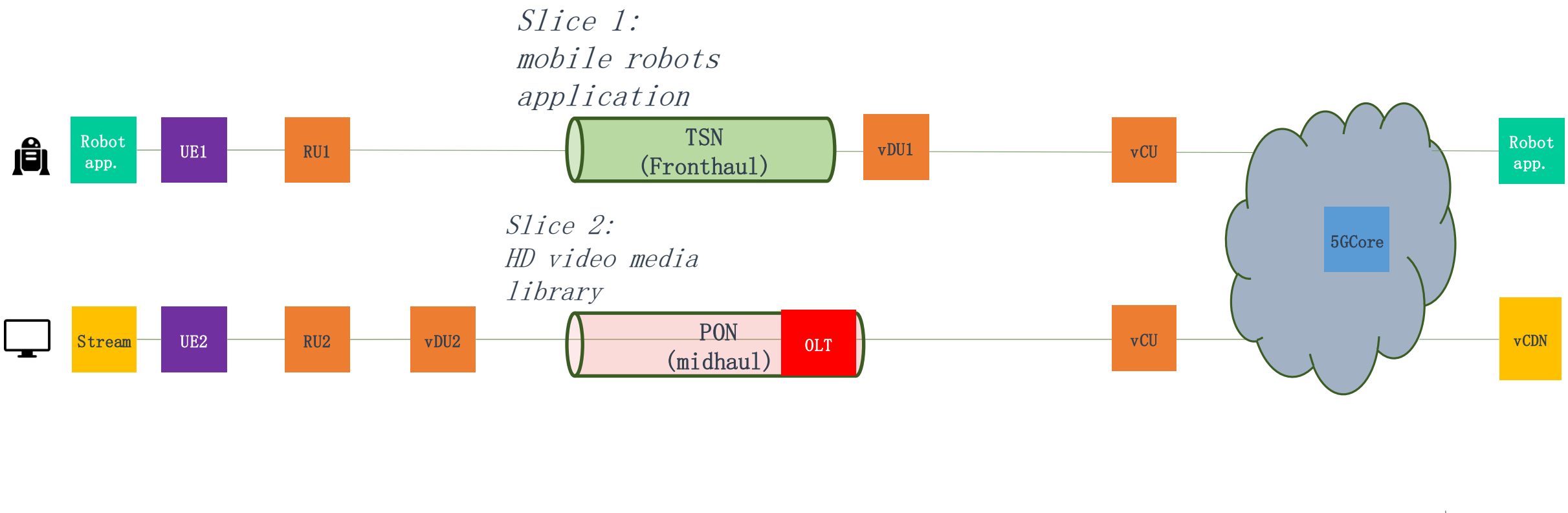

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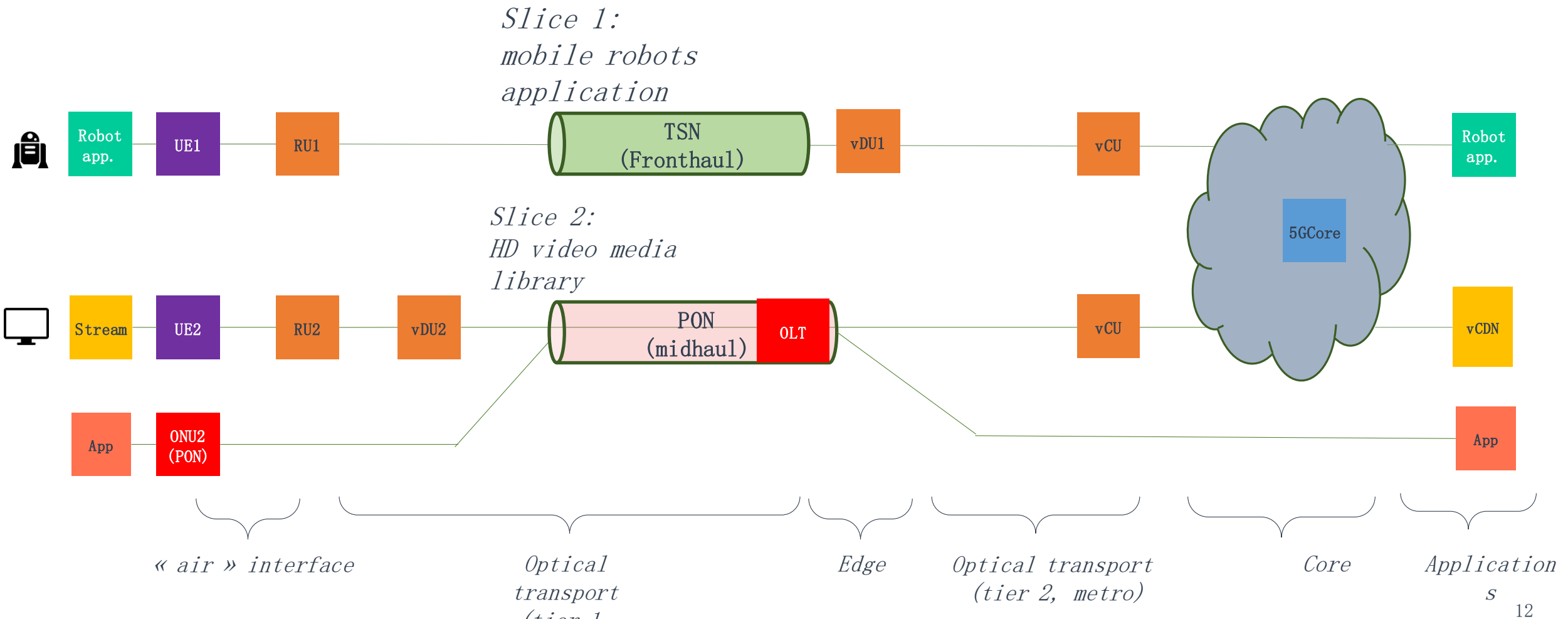

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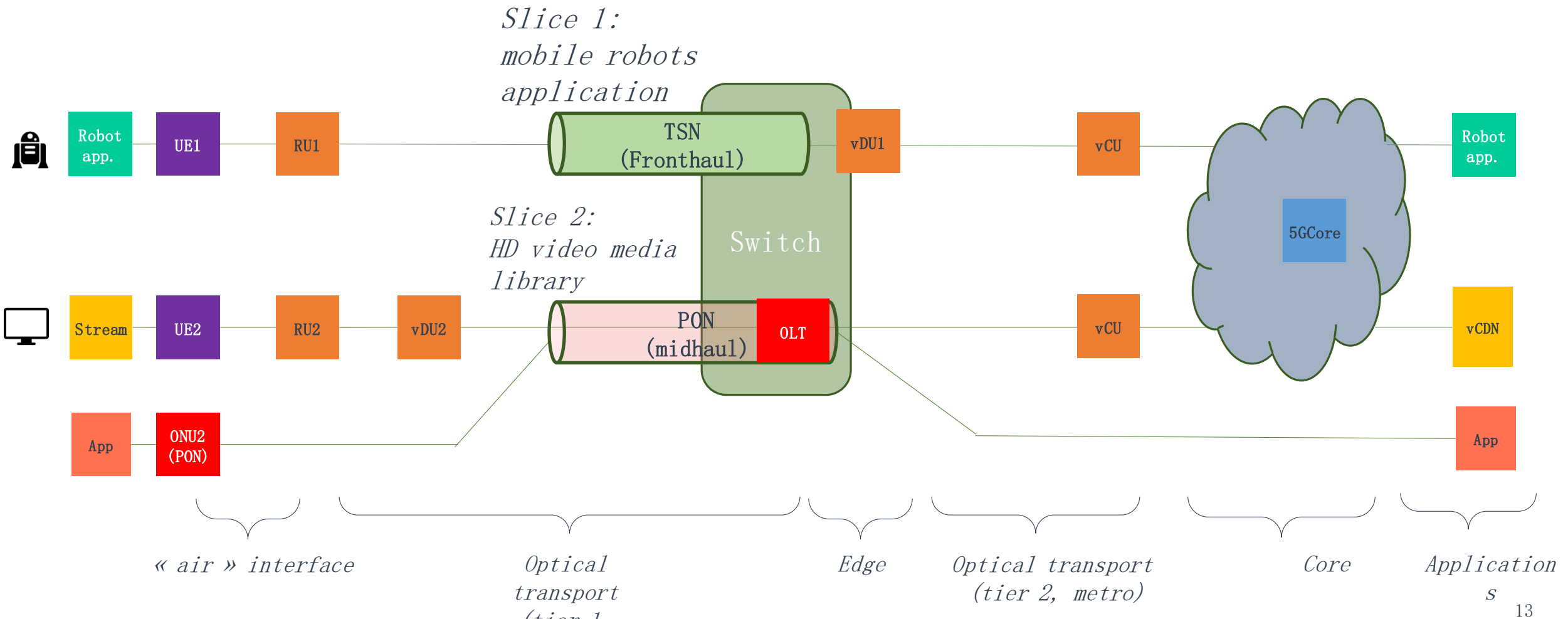

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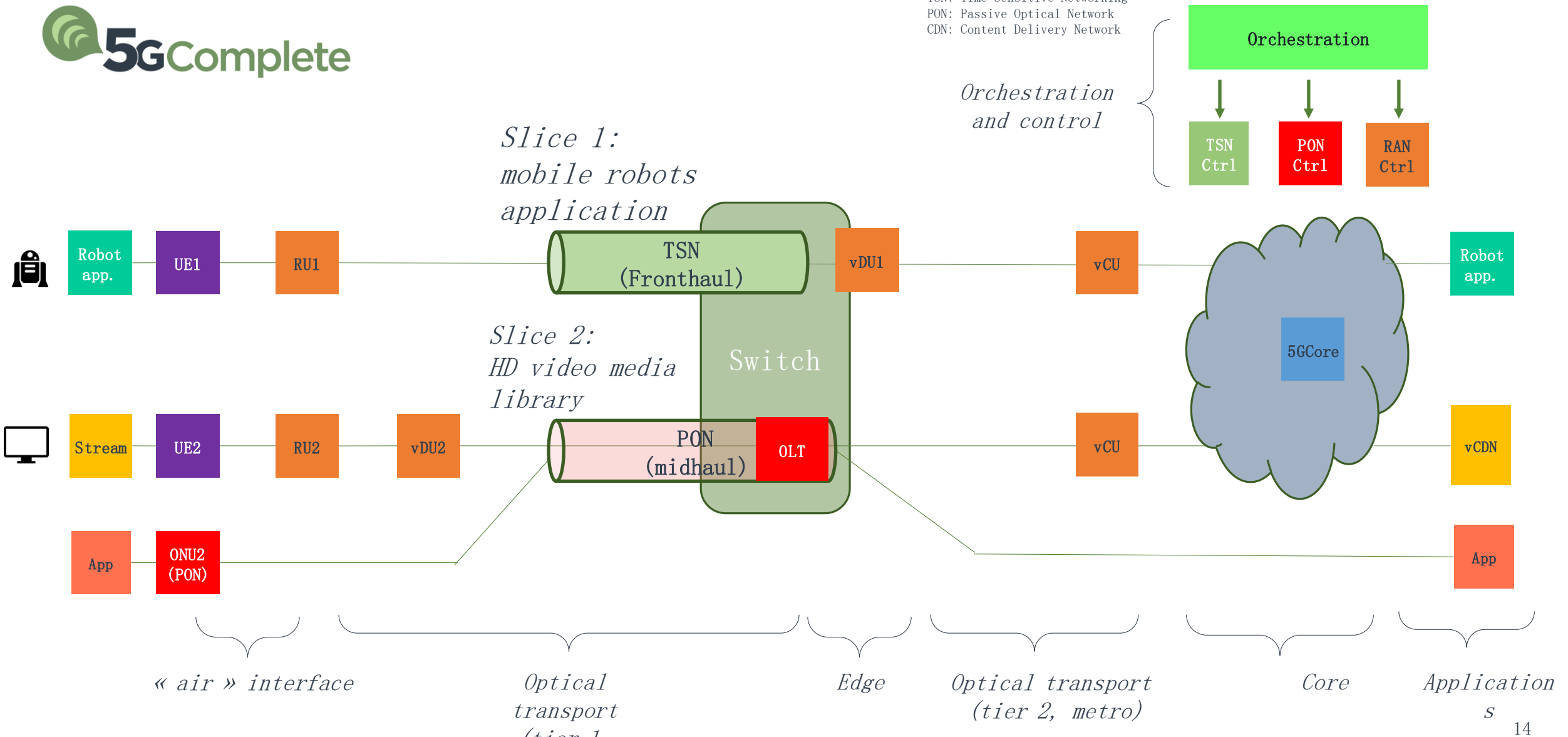


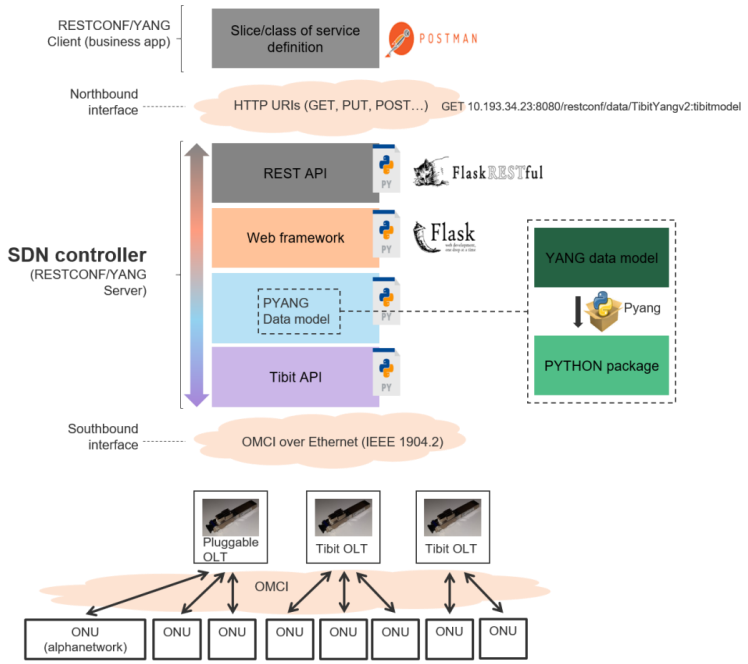
DEMO WORKFLOW

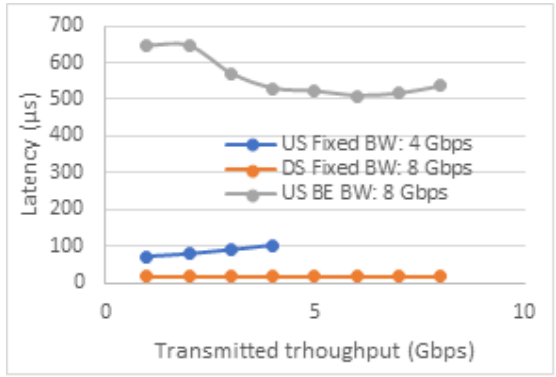
1. Slice 1 (mobile robots app) is deployed, up and running
   - TSN path configuration (pre-provisioned through the 5G-COMPLETE orchestrator)
   - RAN CU deployment (pre-provisioned through the 5G-COMPLETE orchestrator)

2. Deployment of slice 2:
   vCU, PON, TSN switch using the controllers and orchestrator
   - RAN reconfiguration
   - PON SLA creation and path configuration
   - vCDN application deployment through OSM

3. Both slices (services) are deployed, up and running

FOCUS ON PON





› A REST-API was exposed to the orchestrator:
  - SLA management
  - Service creation/edition/deletion

› Optimizing the SLA can improve PON latency and Jitter:
  - Fixed bandwidth: preemption
  - Best effort: low perf, but optimized bandwidth

KEY OUTCOMES

1 - Transport of commercial vRAN using multi-domain interfaces

2 - Deployment of “slices”
taking infrastructure into account

3 - Transport solution must not be neglected

4 - Fixed and mobile must coordinate
Open & standard management interfaces are required (through F5G ?)

NEXTWORKS
HEADING THE FUTURE

Aelleran

orange™

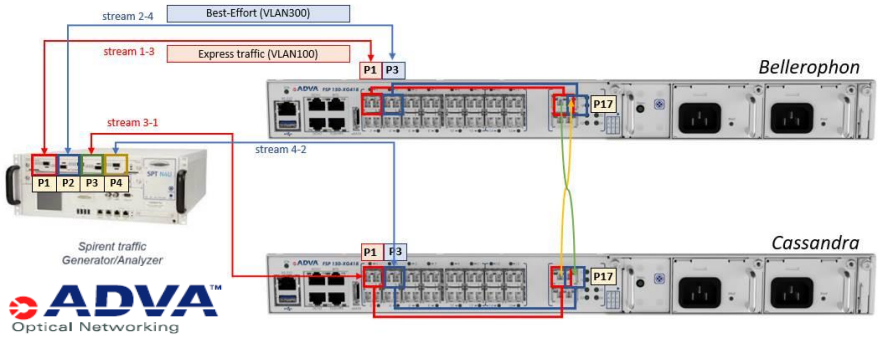
ADVA™
Optical Networking

› Backups

FOCUS ON TSN SWITCH

› Configurable FPGA implementation of TSN IEEE 802.1Qbu
  compliant 100G Ethernet aggregation
  for mobile FH
  ultra-low PDV
  frame pre-emption of best-effort traffic
  applying a dynamic 802.1Qbu protocol aware PDV correction mechanism

	Avg Latency (µs)	Min latency (µs)	Max latency (µs)	Avg Jitter (µs)	Max Jitter (µs
P1-P3 (express)	3, 65	3, 57	3, 73	0, 03	0, 12
P2-P4 (best-effort)	10, 9	10, 42	11, 5	0, 08	1
P3-P1 (express)	3, 65	3, 58	3, 74	0, 03	0, 12
P4-P2 (best-effort)	10, 99	10, 33	11, 4	0, 09	0, 93



5.3.7.6 Potential requirements

Reference number	Requirement text	Application / transport	Comment
Factories of the Future 7.1	The 5G system shall support a cyclic data communication service, characterised by at least the following parameters: Cycle time of 1 ms for precise cooperative robotic motion control 1 ms to 10 ms for machine control 10 ms to 50 ms for cooperative driving 10 ms to 100 ms for video operated remote control 40 ms to 500 ms for standard mobile robot operation and traffic management Jitter < 50% of cycle time Communication service availability > 99,9999% Max. number of mobile robots: 100	A	The size of messages at the application layer are 15kbyte to 150 kbyte for video frames in video-operated remote control. The size of all other messages in all use cases, e.g., control messages to an actuator, is 40 byte to 250 byte.
Factories of the Future 7.2	For certain applications, the 5G system shall support real-time streaming data transmission (video data) from each mobile robot to the guidance control system by at least the following parameter: Data transmission rate per mobile robot: > 10 Mbit/s Number of mobile robots: 100	A	
Factories of the Future 7.3	The 5G system shall support seamless mobility such that there is no impairment of the application in case of movements of a mobile robot within a factory or plant.	A	
Factories of the Future 7.4	The 5G system shall support user equipment ground speeds of up to 50 km/h.	A	
Factories of the Future 7.5	The 5G system shall support uniform and unequivocal parameters for interfaces to allow dependability monitoring (see Clause 4.3.4).	T	
Factories of the Future 7.6	Communication complying with the above requirements shall be available over a service area of 1 km^2 and less.	T	

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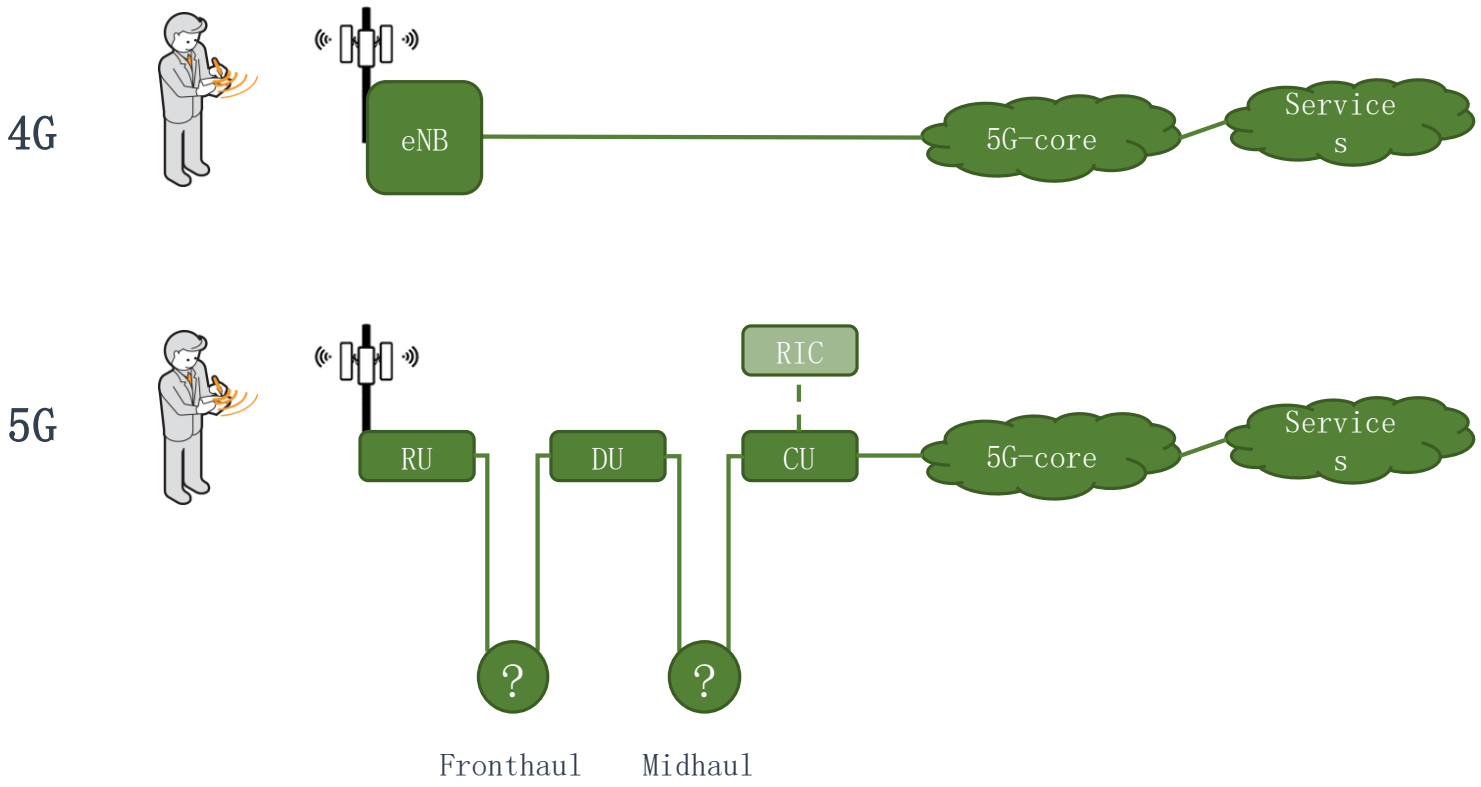

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