Synopsis

The advent of 5G brings dramatic improvements to both the radio access network (RAN) and its core network. 5G brings significant change in the radio technology, such as using millimeter wave spectrum (mmWave) for better throughput of and less latency in data transmission.
Additionally, 5G network architectures of Core and RAN have transitioned to make use of the latest innovations of cloud-native software technologies such as microservices, containerized, service-based, and stateless architecture.
In this presentation, Minh Bui, Telco solution architect at AWS, will be sharing his view on 5G telco networks, the new possibilities brought by 5G, the impacts on the transport domain and generally how 5G can re-invent telco networks using cloud native technology.

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Reinventing 5G Cloud Native Networks, together

Minh Bui – Senior Solutions Architect Telecom, ASEAN, WWPS, AWS

May 24th, 2022

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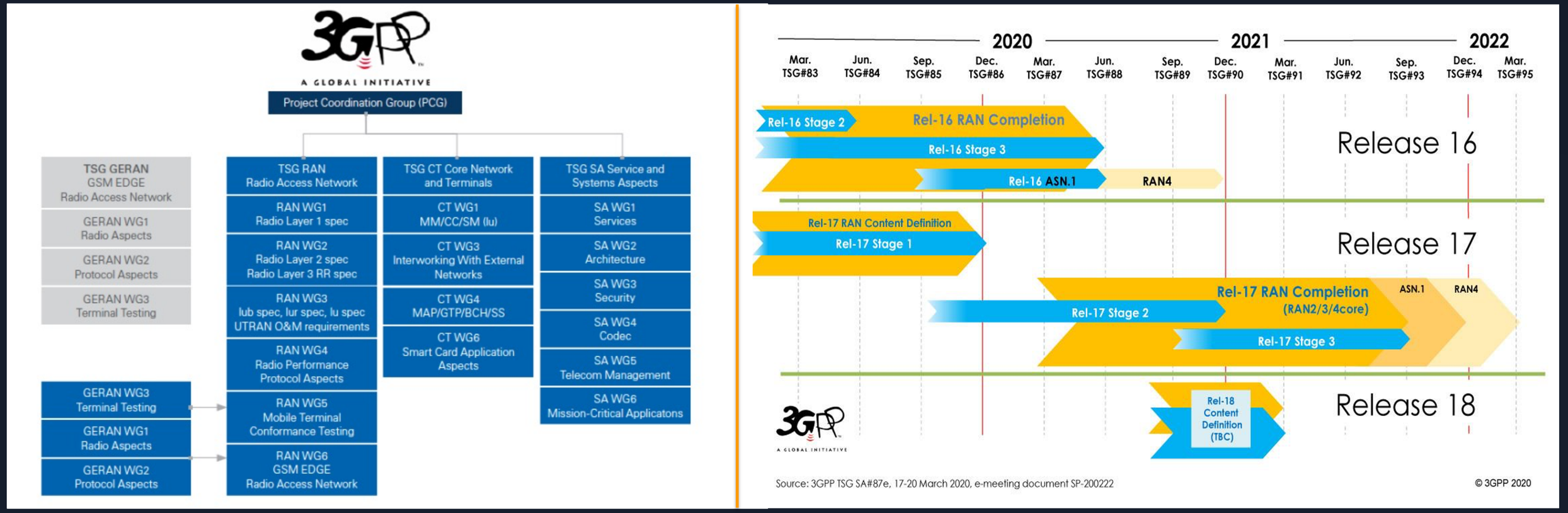
Standardization



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aws telecom

5G key areas of opportunity identified

Enhanced mobile broadband (eMBB)

Progression with faster connections, higher throughput, and more capacity than 4G

Critical Machine Type Communication (cMTC)

Mission-critical apps that require uninterrupted operations and data exchange

Massive machine-type communications (mMTC)

Massive IoT connectivity and support for billions of connected IoT devices

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Cross-industry 5G use cases

Deliver streaming content, gaming, and VR experiences

Build smarter products and user experiences in homes, buildings, and cities

Remotely monitor patient health, and wellness applications

Transform transportation with connected and autonomous vehicles

Grow healthier crops with greater efficiencies

Track inventory levels and manage warehouse operations

Improve the performance and productivity of industrial processes

Manage energy resources more efficiently

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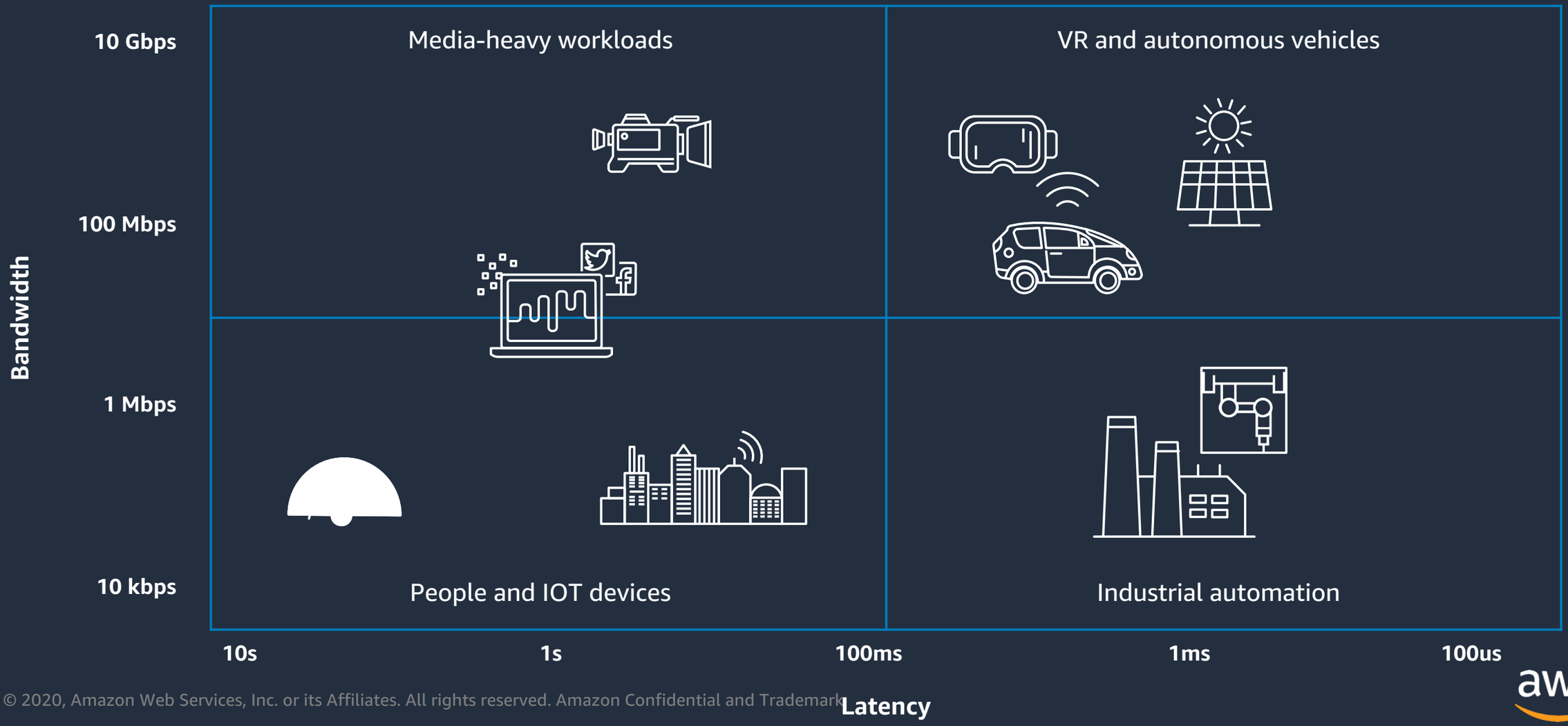
Evolving with latency and bandwidth

Network requirements in different dimensions: Throughput, latency but also number of devices, coverage, mobility, QoS, battery life, etc



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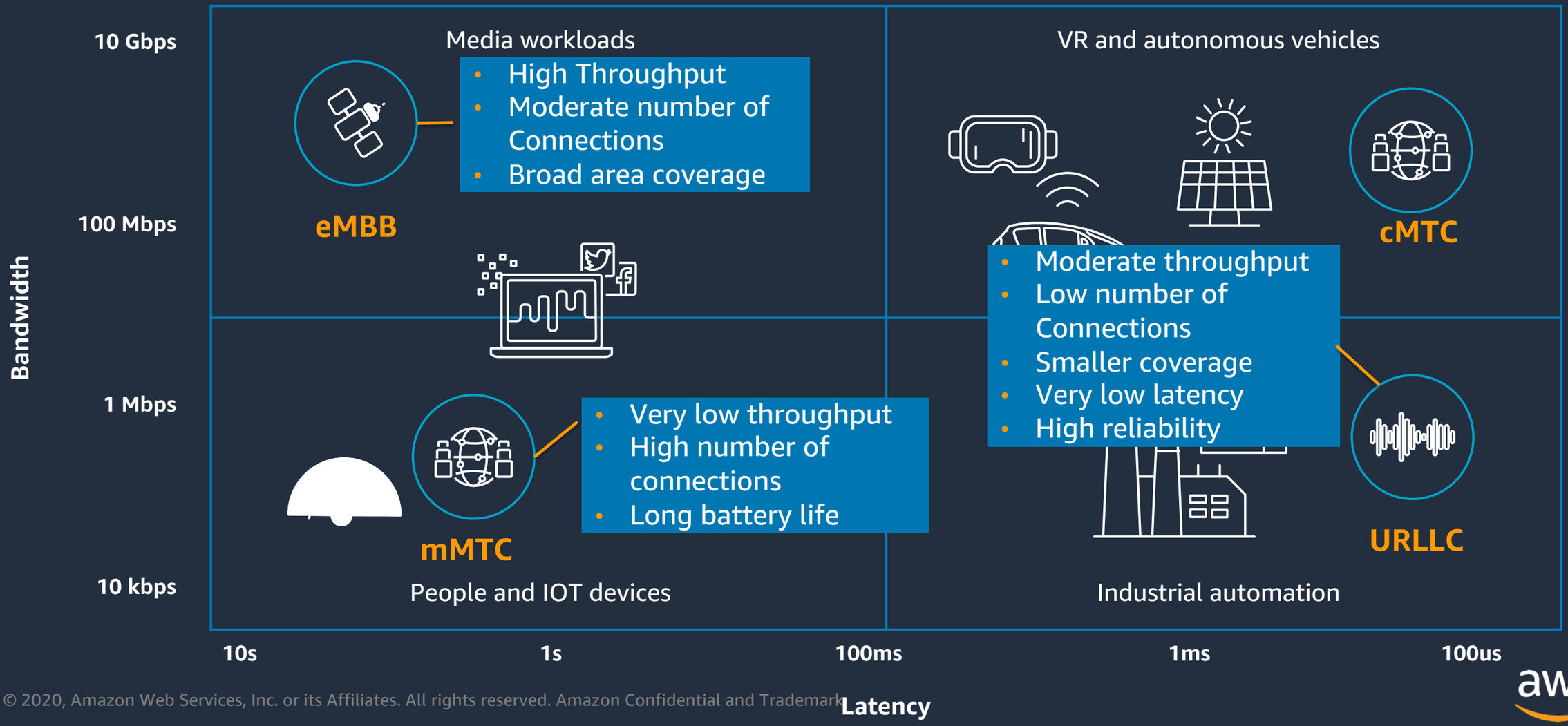
Evolving with latency and bandwidth

Network requirements in different dimensions: Throughput, latency but also number of devices, coverage, mobility, charging characteristics



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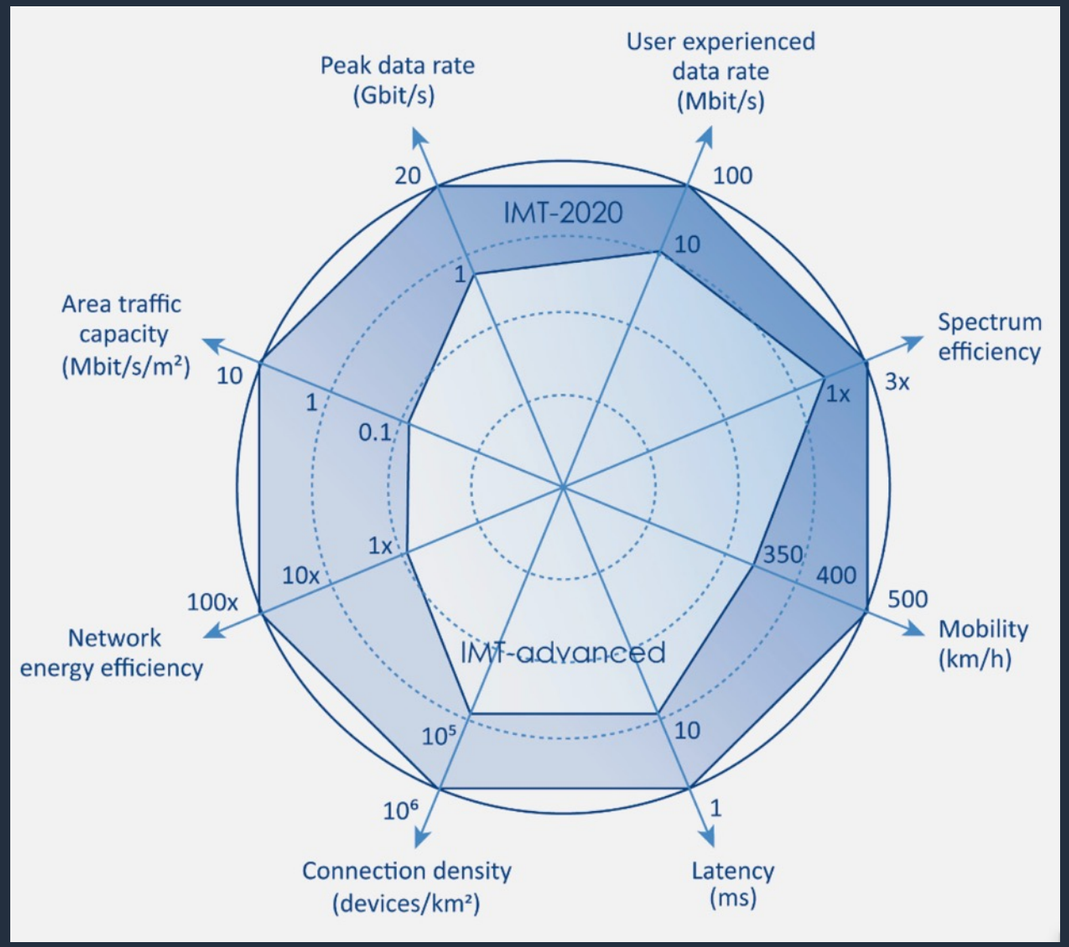
Raw Performance : 5G vs 4G



10x

Decrease in latency:
Delivering latency as low as 1 ms.

10x

Connection density:
Enabling more efficient signaling for IoT connectivity.

3x

Spectrum efficiency:
Achieving even more bits per Hz with advanced antenna techniques.

100x

Traffic capacity:
Driving network hyper-densification with more small cells everywhere.

10x

Experienced throughput:
Bringing more uniform, multi-Gbps peak rates.

100x

Network efficiency:
Optimizing network energy consumption with more efficient processing.

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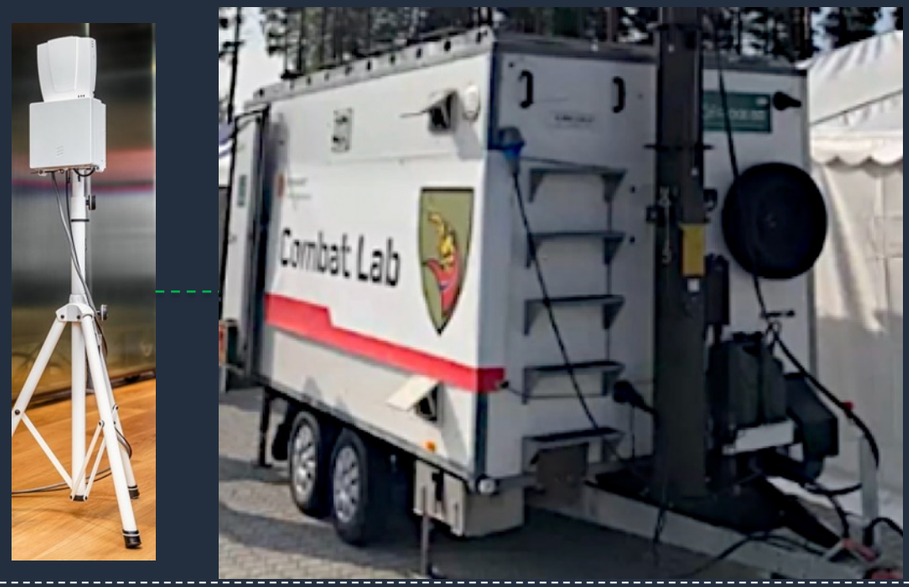
What it means

Traditional Telecom infrastructure exchange center

Telco infrastructure in Cloud



Telco infra in small footprint

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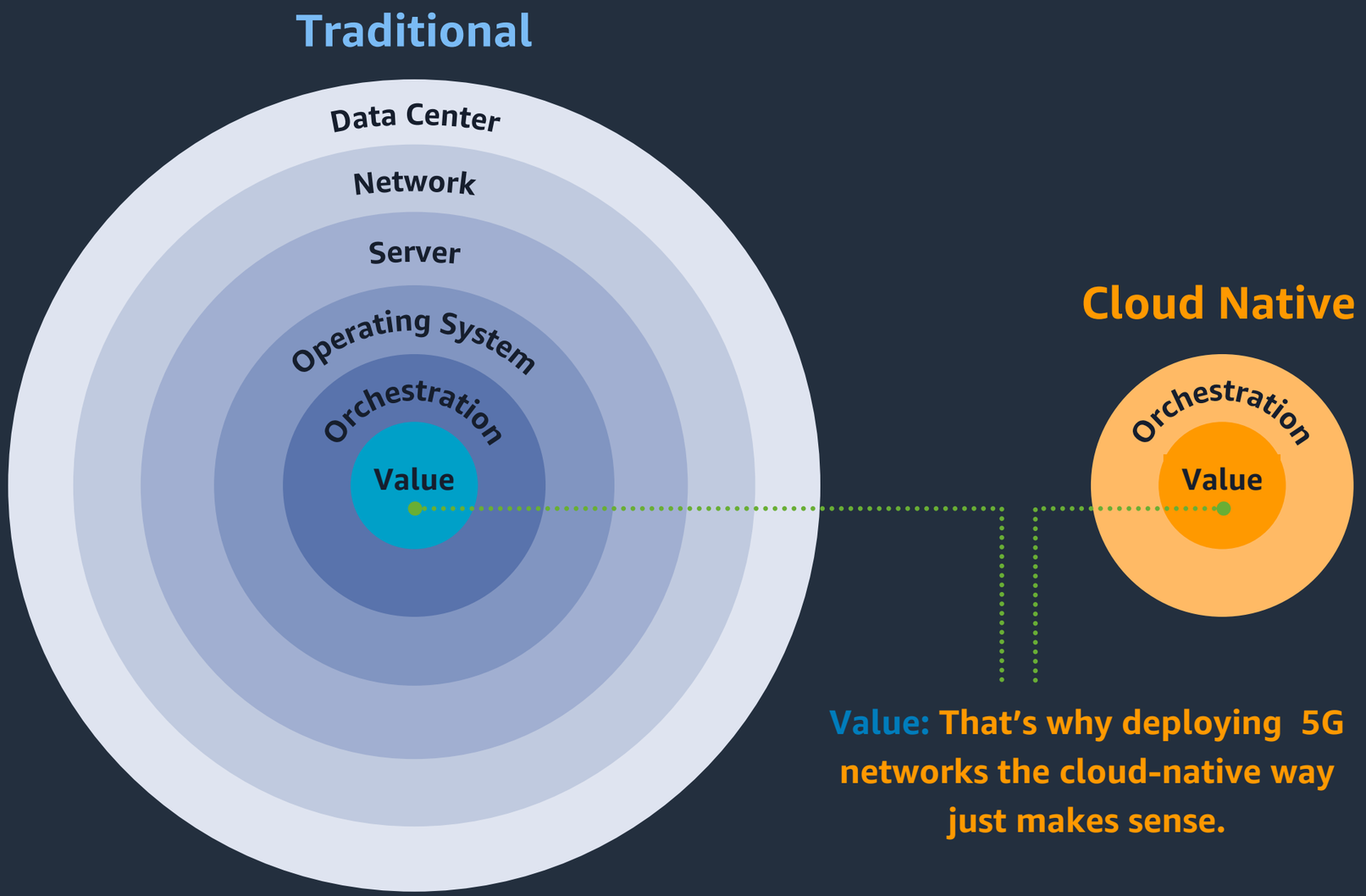
Cloud native networks



Value: That's why deploying 5G networks the cloud-native way just makes sense.

- Peel away the complexity and get straight to delivering **Value**
- Spin up as much infrastructure as you need (servers, databases, operating systems, all of it!) in seconds.
- All the developer has to worry about is orchestrating the infrastructure they need (via code) and the application code itself.

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Cloud native enables 5G economies of scale and scope

Mature and automated 5G solution to scale quickly and focus on capturing user base with innovation

CI/CD	• Full 5G Network CI/CD code pipeline
Observability	• Dashboard detects system-wide performance changes, optimizes resource utilization, gets a unified view of operational health
Closed Loop Automation	• Closed loop automation integration of cloud infrastructure, CNF& test logs
Network Slicing	• Integration of Orchestrator with AWS CI/CD pipeline (network slicing)
Hybrid Cloud Deployment	• Same code pipeline: deploy CNF in Region, Edge, CSPs On Prem Cloud
Edge Analytics	• Inference at the Edge: Location, Context Awareness, Social Behaviour & Anomaly Detection and Incident Prediction
Predictive Automation	• Forecast based scaling/Predictive Maintenance using AI/ML

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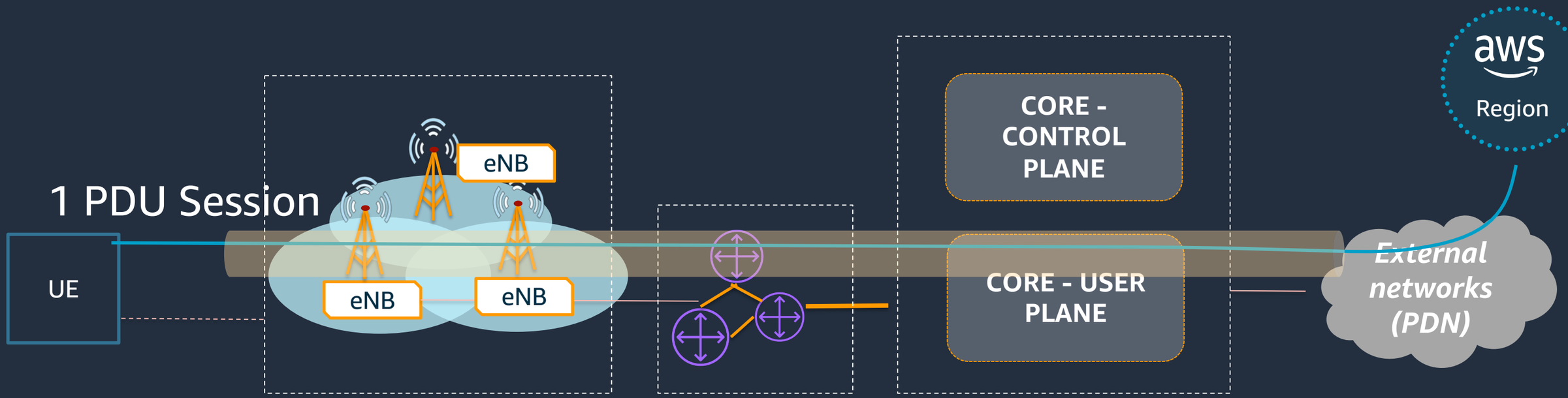

User Equipment (UE) | **Radio Access Network (RAN)** | **Backhaul Network** | **Core Network**

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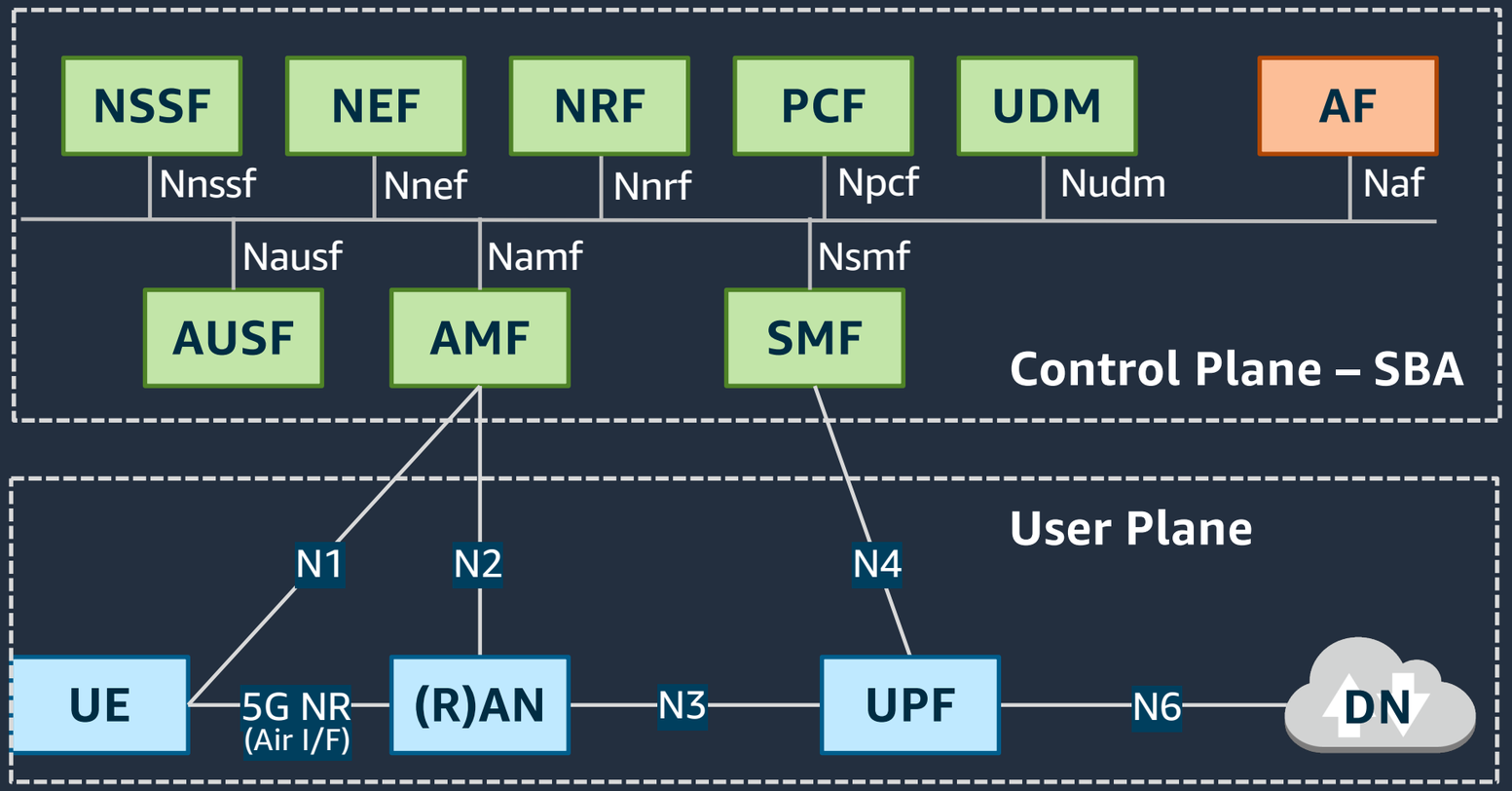
3GPP 5G reference architecture



AF: Application Function

AMF: Access & Mobility Management Function
SMF: Session Management Function
AUSF: Authentication Server Function
UDM: Unified Data Management
PCF: Policy Control Function
NRF: Network Repository Function
NEF: Network Exposure Function
NSSF: Network Slice Selection Function

UE: User Equipment
(R)AN: Radio Access Network/5G Access Network
UPF: User Plane Function

DN: Data Network

25+ Network functions defined as per 3GPP rel16

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Network slicing

Differnece SLA on same infra that could not be done

Agility

Show network slicing

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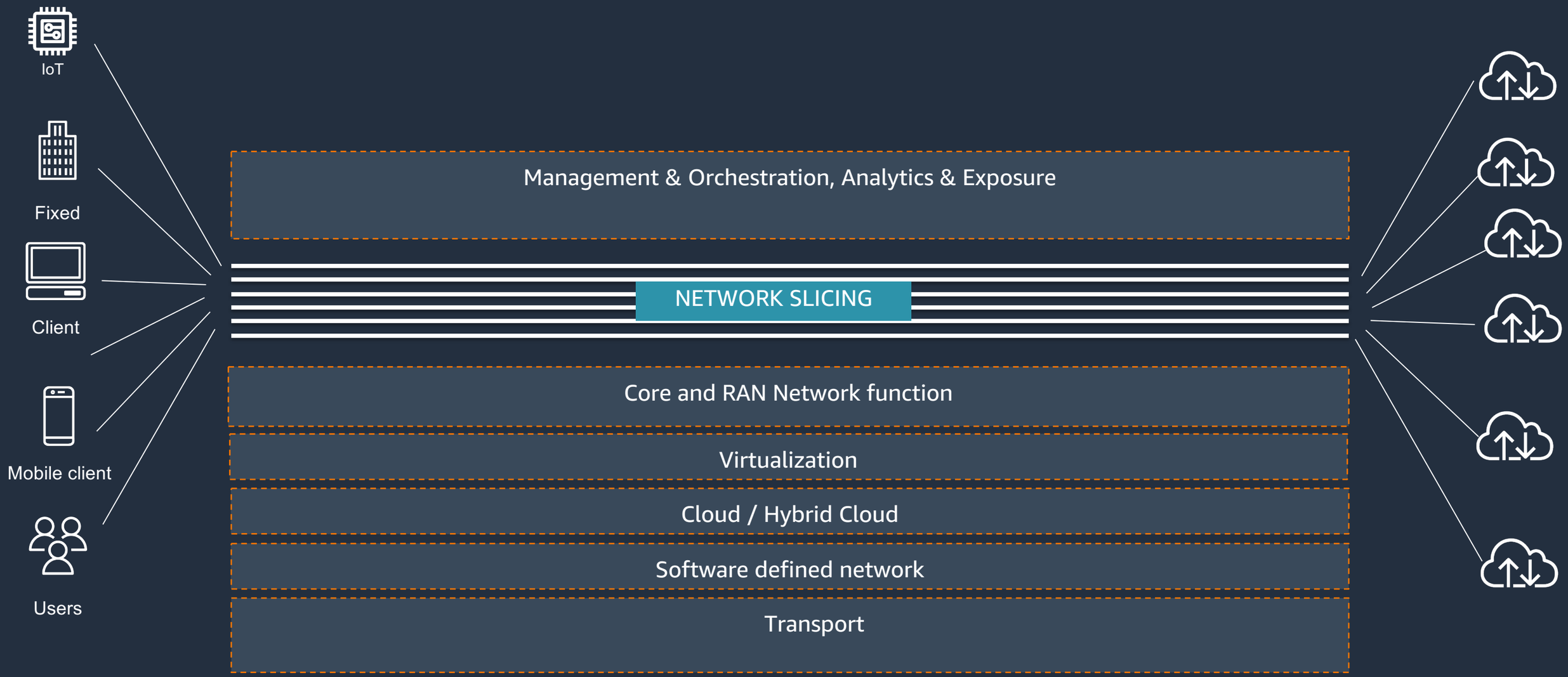
Network slicing



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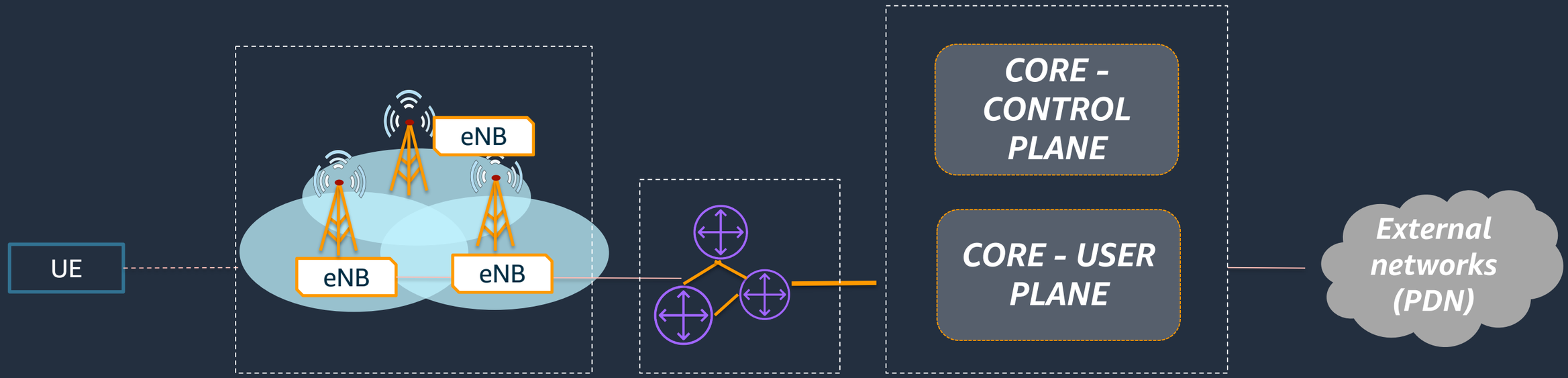
Legacy networks (1G -> 4G): one size fits all



User Equipment (UE) *Radio Access Network (RAN)* *Backhaul Network* *Core Network*

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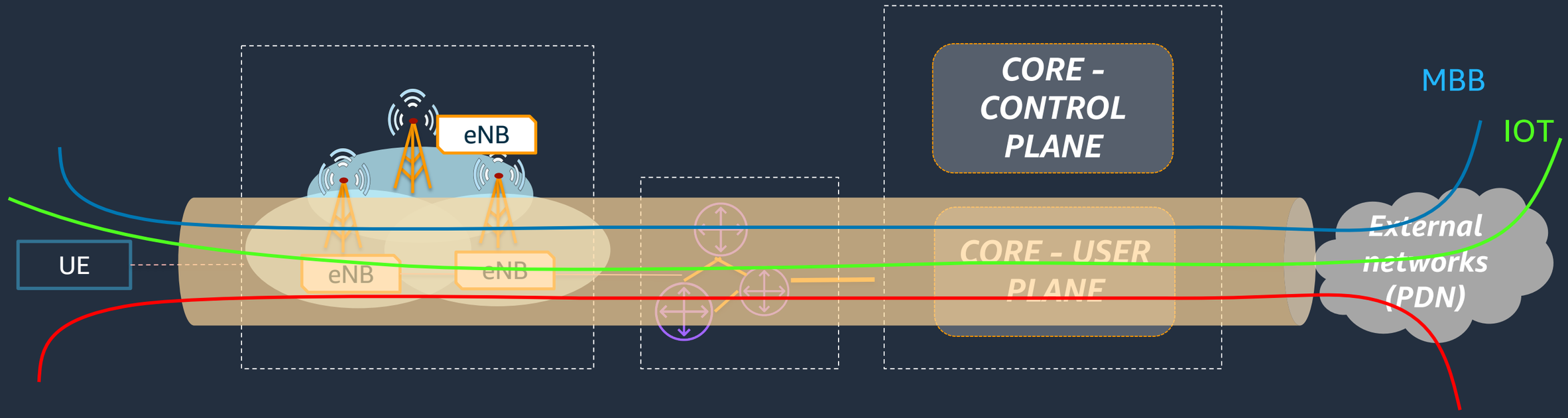

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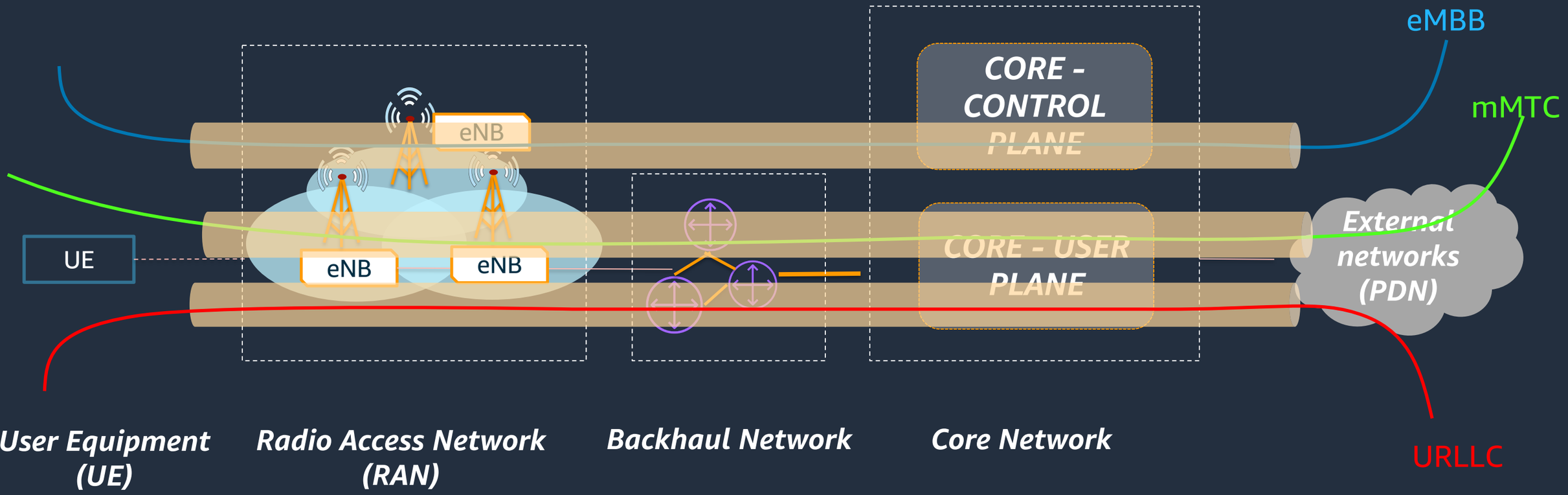
5G network Slicing

Network Slice is a **logical network** serving a defined **business purpose** or **customer**, consisting of **all** required network resources **configured** together and **isolated** from other slice.



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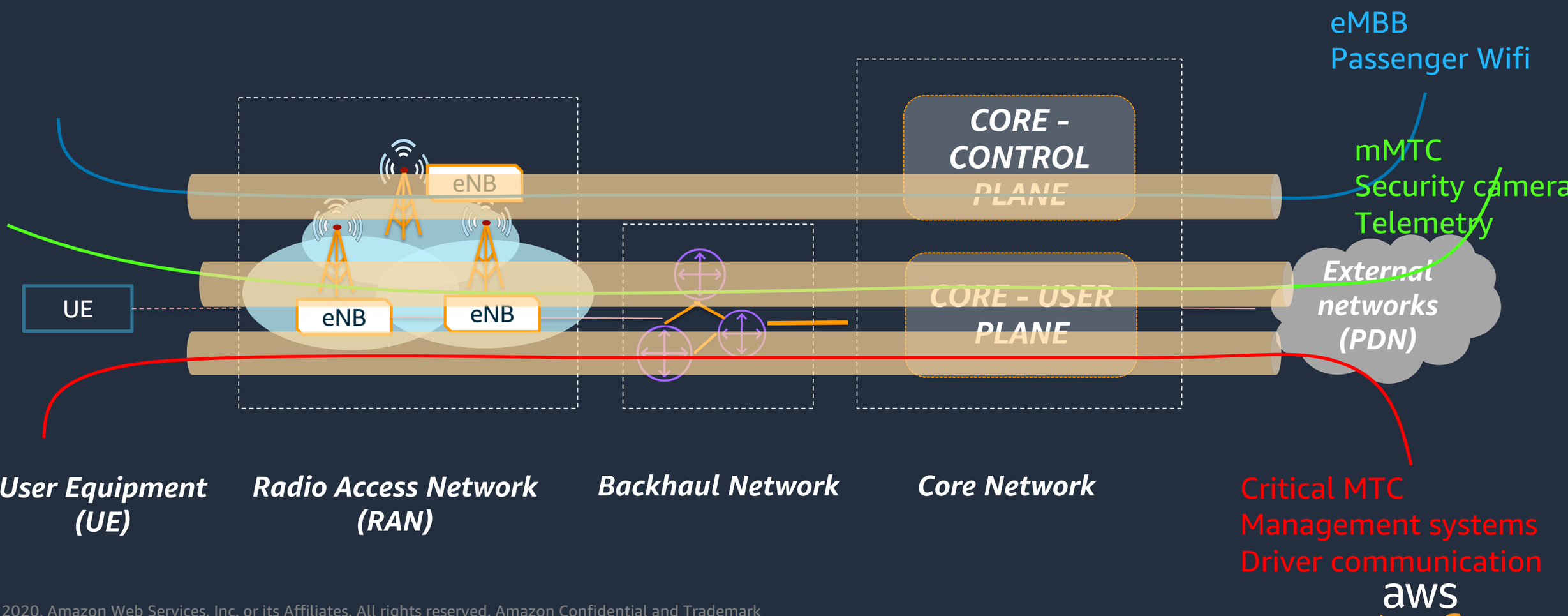
Example: Network slice for transportation



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5G network slicing mechanisms

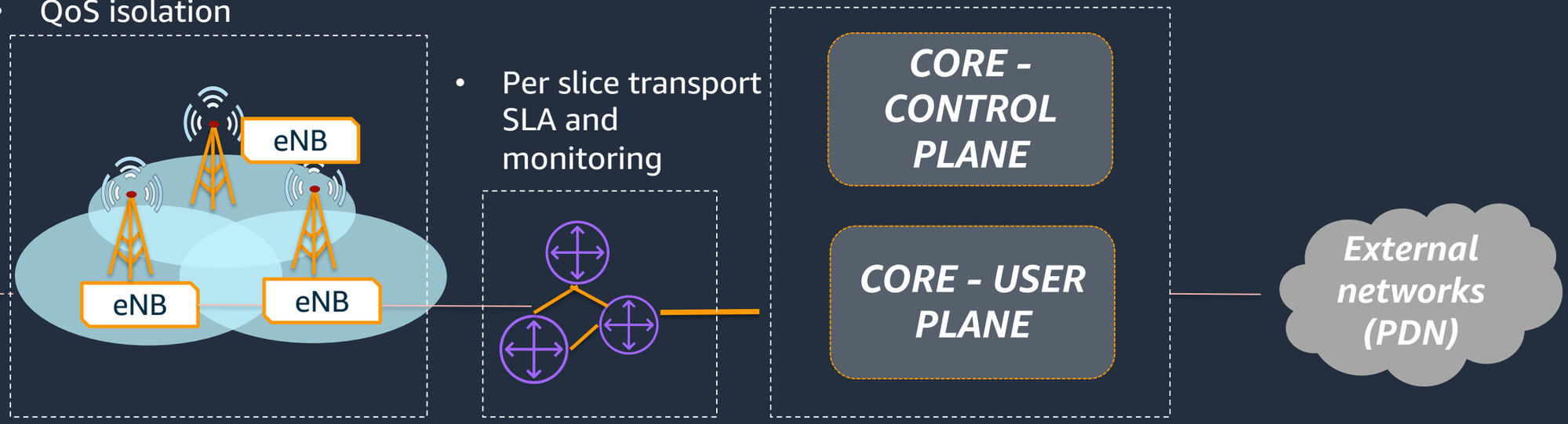
End-to-End slice awareness via a Network Slice ID (S-NSSAI)

- Network Slice support
- Support of selection rules

- Slice aware and dynamic resource partitioning
- QoS isolation

- Per slice transport SLA and monitoring

- Core Network divided into Network slice instances which can be common or dedicated
- Network slice selection mechanism



User Equipment (UE) | *Radio Access Network (RAN)* | *Backhaul Network* | *Core Network*

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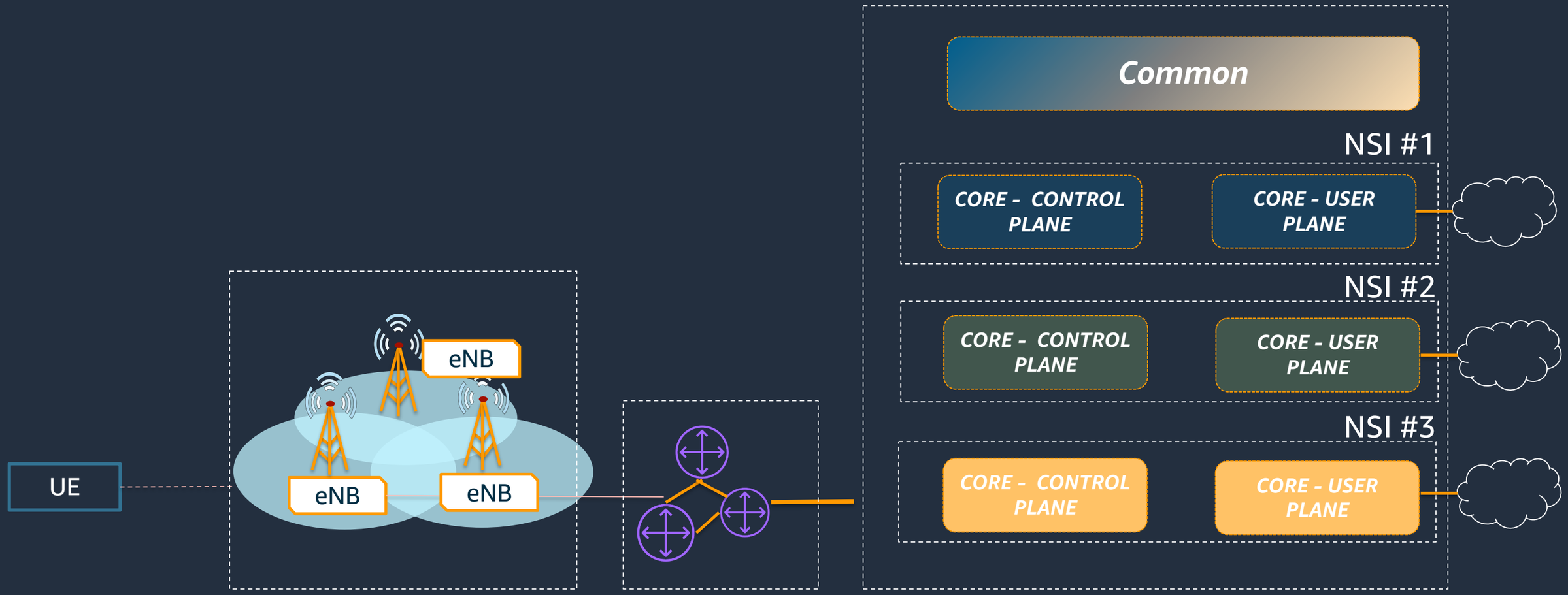
Core Slicing



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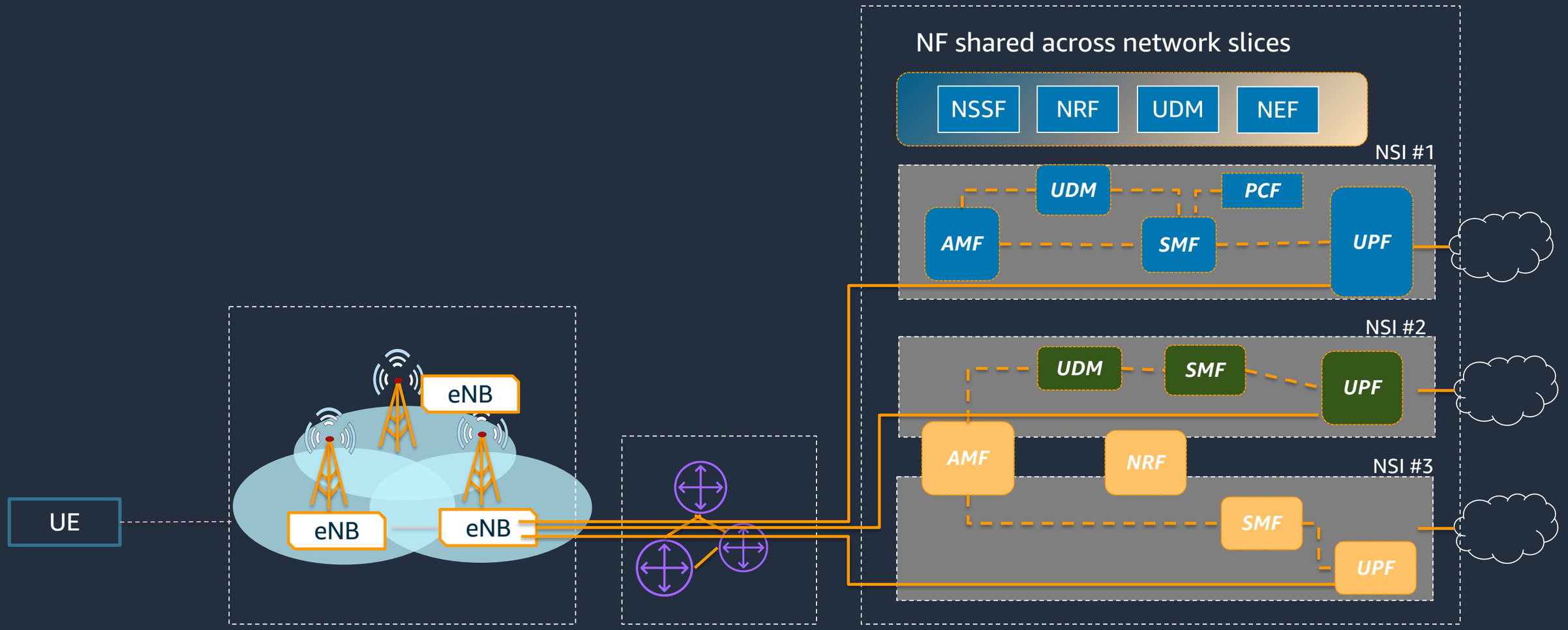
Core Slicing



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Transport for 5G

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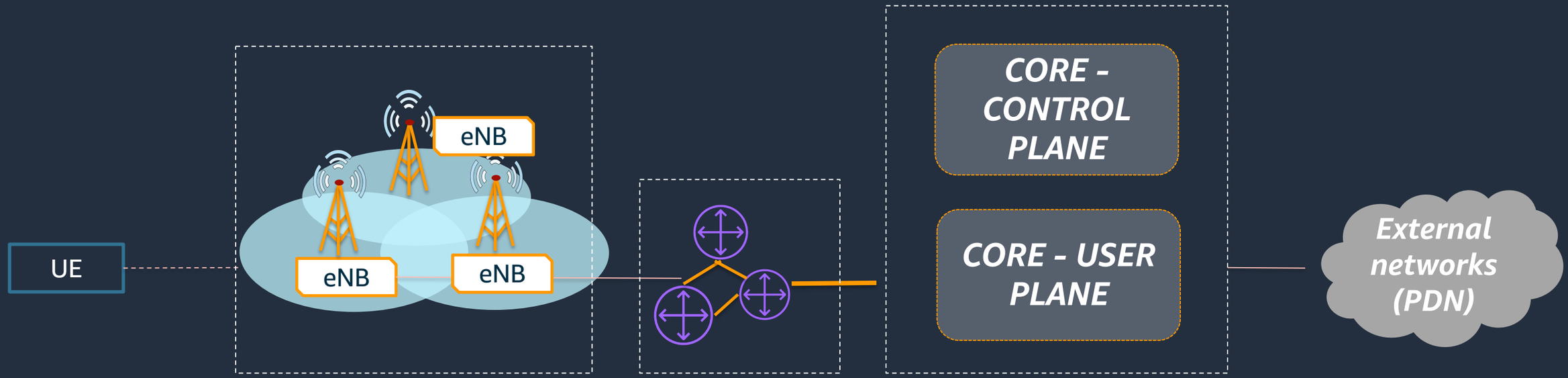

User Equipment (UE)

Radio Access Network (RAN)

Backhaul Network

Core Network

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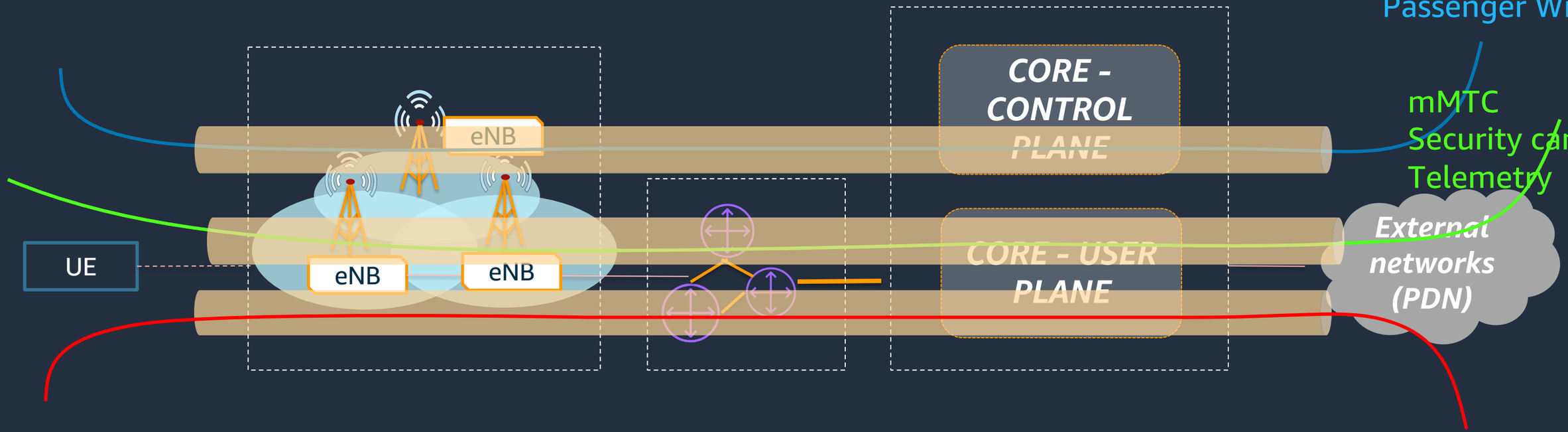
Transport slicing

The transport network must maintain the properties of the network slice(s)



User Equipment (UE) *Radio Access Network (RAN)* *Backhaul Network* *Core Network*

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Network slicing in the transport domain Requirements and Solutions

Requirements	Solutions
Transport resource partitioning and monitoring	Packet principles to ensure resource partitioning and isolation
Transport resource isolation	Traffic engineering for optimal transport path selections
Resource alignment with RAN and Core	E2E traffic control for transport configuration & optimization
Managed set-up and removal of transport resources	Transport set-up and management thru joint transport, RAN & Core E2E orchestration

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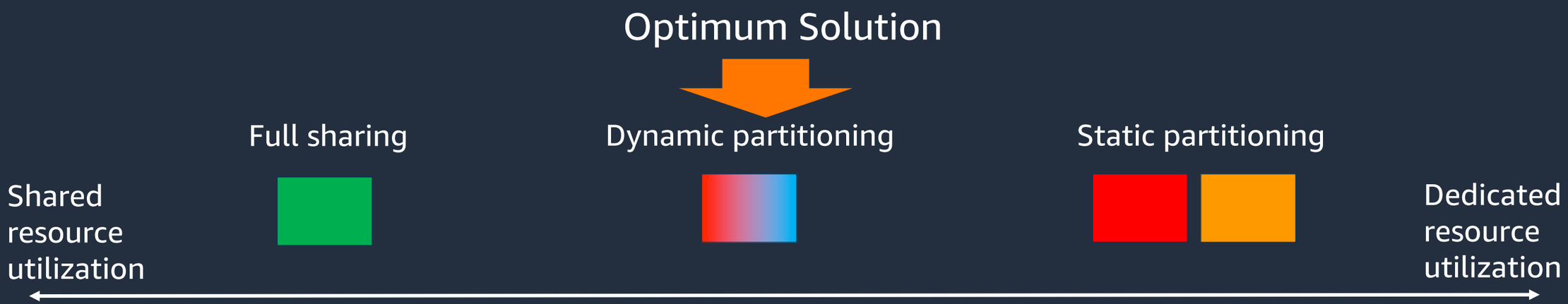
Transport resource sharing



Non-controlled resources

- Over-provisioned networks or if very difficult/expensive to manage better
- Does not scale if traffic increases -> congested network
- Not true slicing when congested

Shared resources

- Efficient use of resources
- Packet based technologies
- Mechanisms to guarantee share
- Managed on level of pooling of resource
- Covers the vast majority of use-cases

Fully separated resources

- Inefficient use of resources
- TDM, FlexE
- Fork-lift of networks (E2E)

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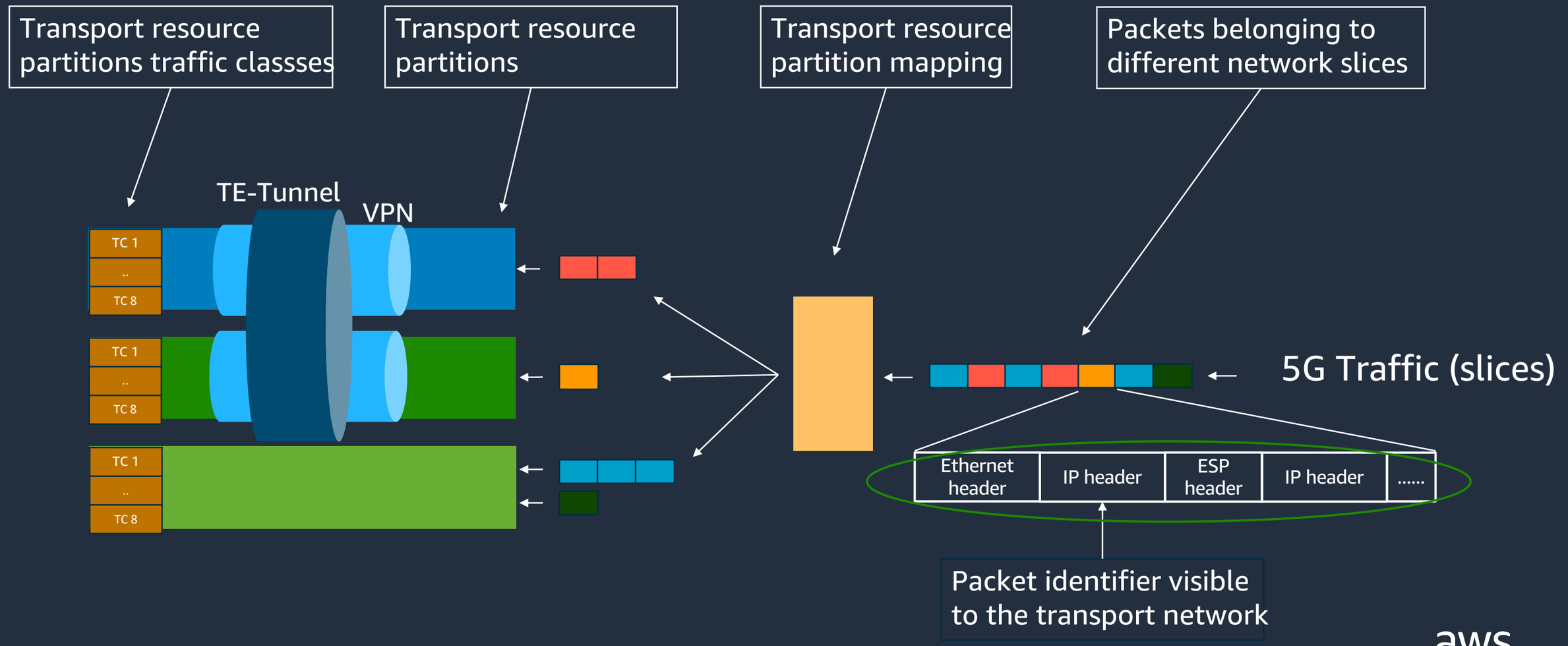
Transport resource partitions



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EDGE COMPUTING

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Enterprises are rapidly moving to the cloud

Most workloads can easily be migrated to the cloud, allowing organizations to accelerate their digital transformations

Operate on premises or at edge notes
Drivers : low latency, local data processing or have data residency requirements,

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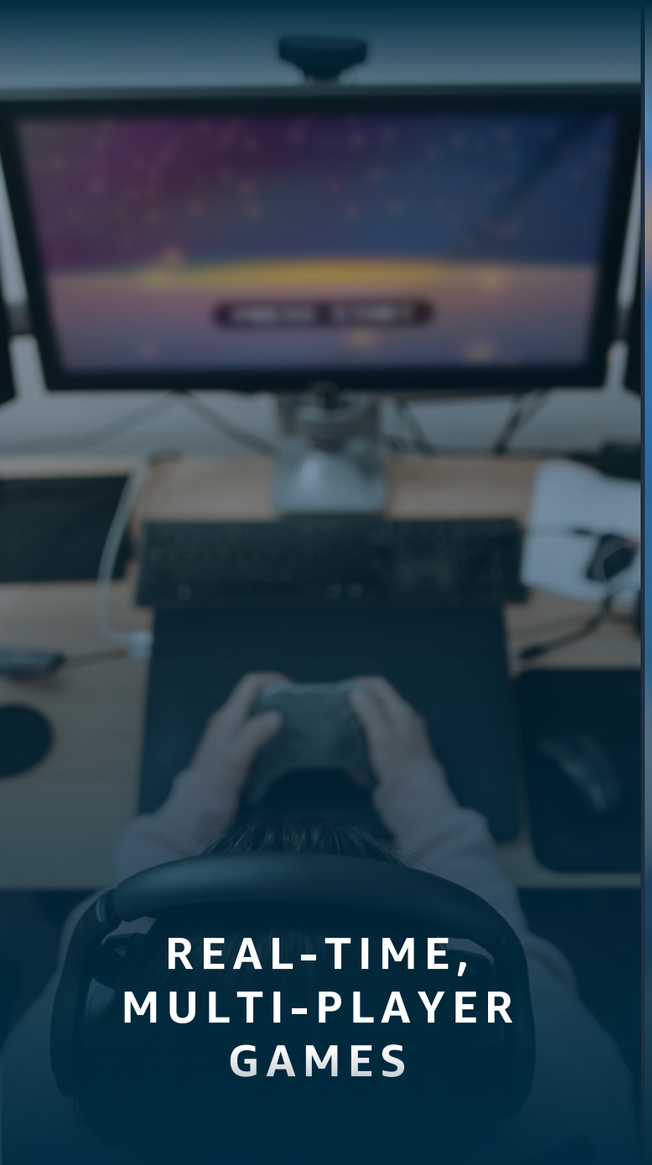
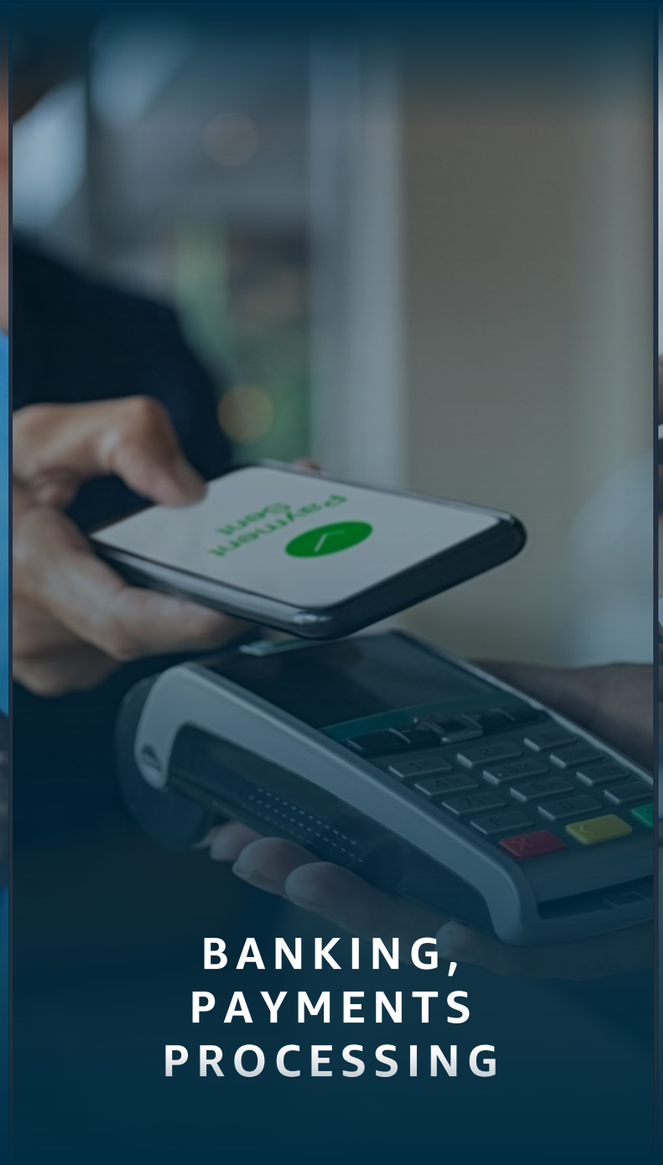


REAL-TIME, MULTI-PLAYER GAMES

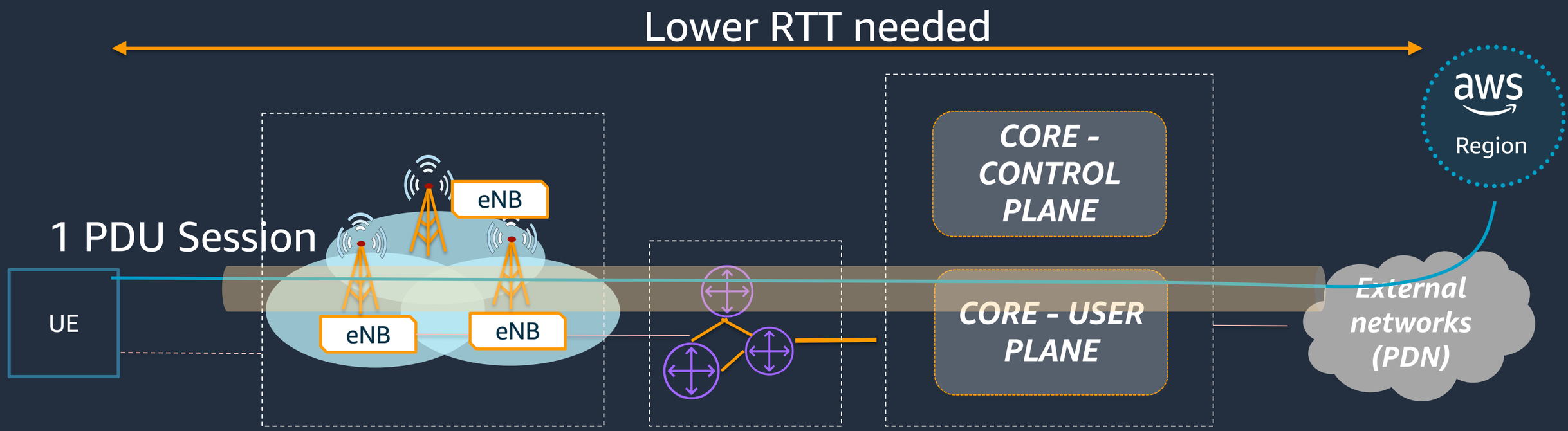
HEALTH MANAGEMENT SYSTEM



BANKING, PAYMENTS PROCESSING

GOVERNMENT REGULATIONS

Telecom architecture



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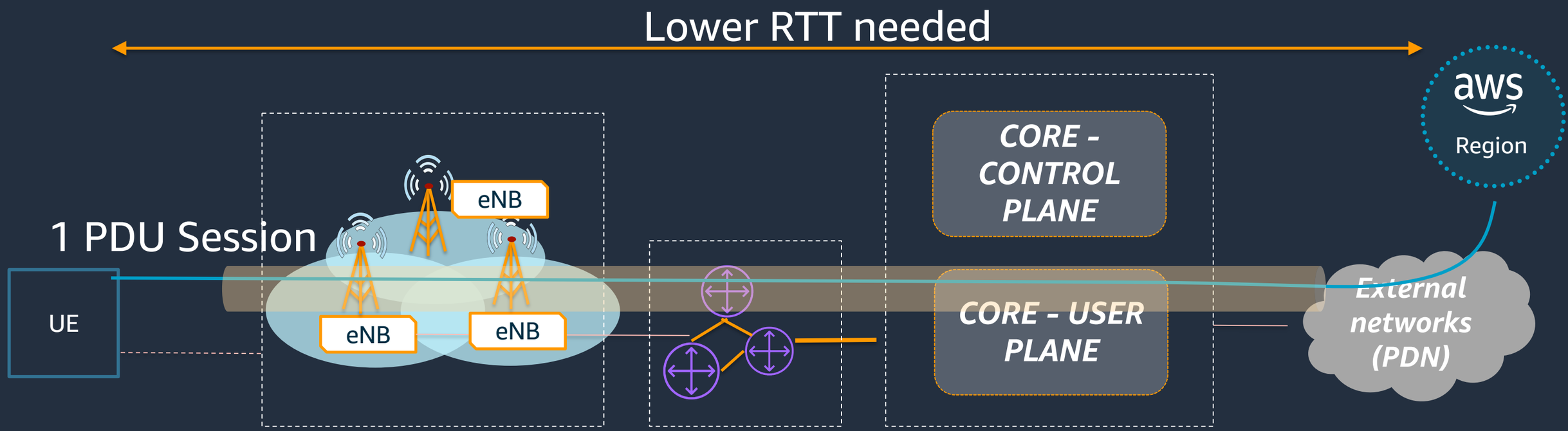
Telecom architecture



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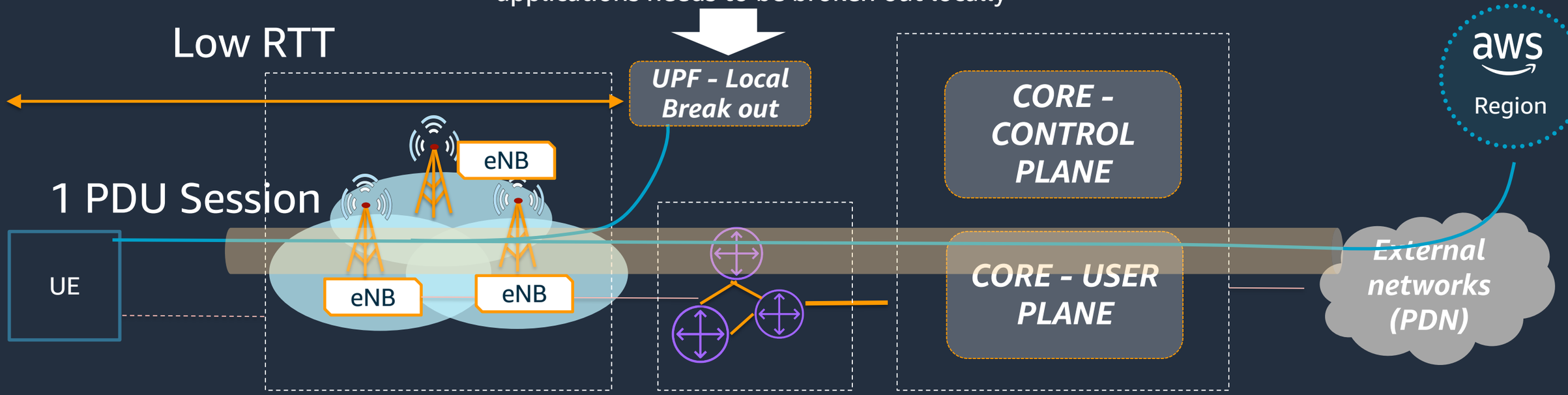
Local break out within the same session

Uses 5G Features (ex: ULCL, URSP rules, slices selection mechanisms, etc) to determine if certain traffic flows or applications needs to be broken out locally



User Equipment (UE) | *Radio Access Network (RAN)* | *Backhaul Network* | *Core Network*

Slice 2

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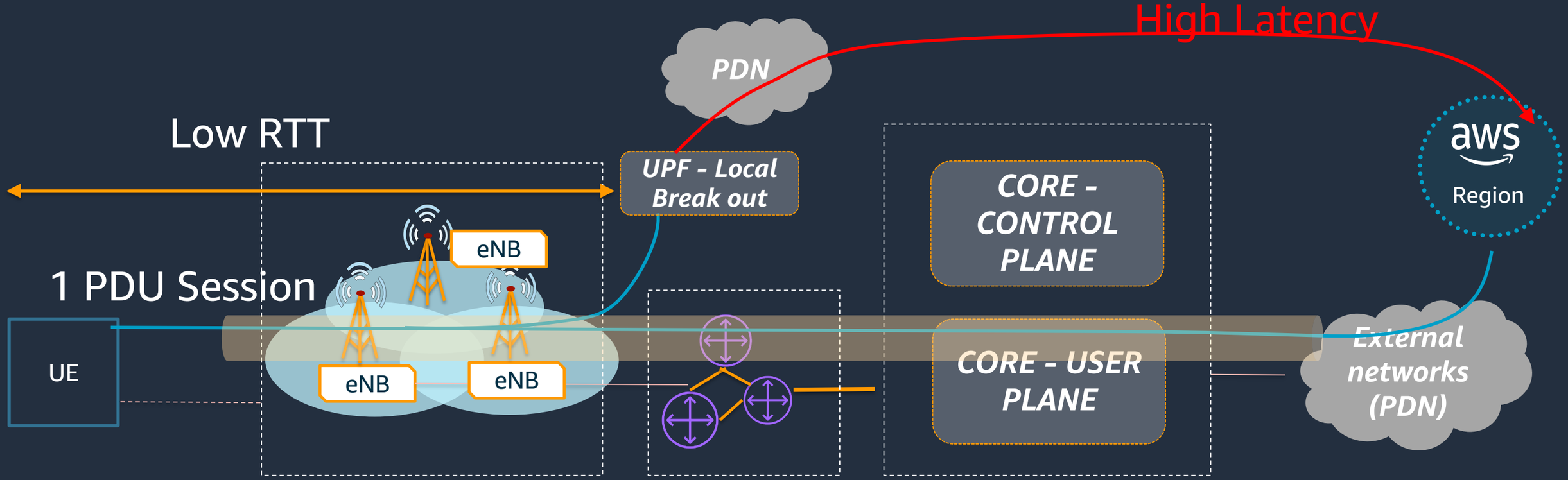
Distribute the UPF



User Equipment (UE) | *Radio Access Network (RAN)* | *Backhaul Network* | *Core Network*

Slice 2

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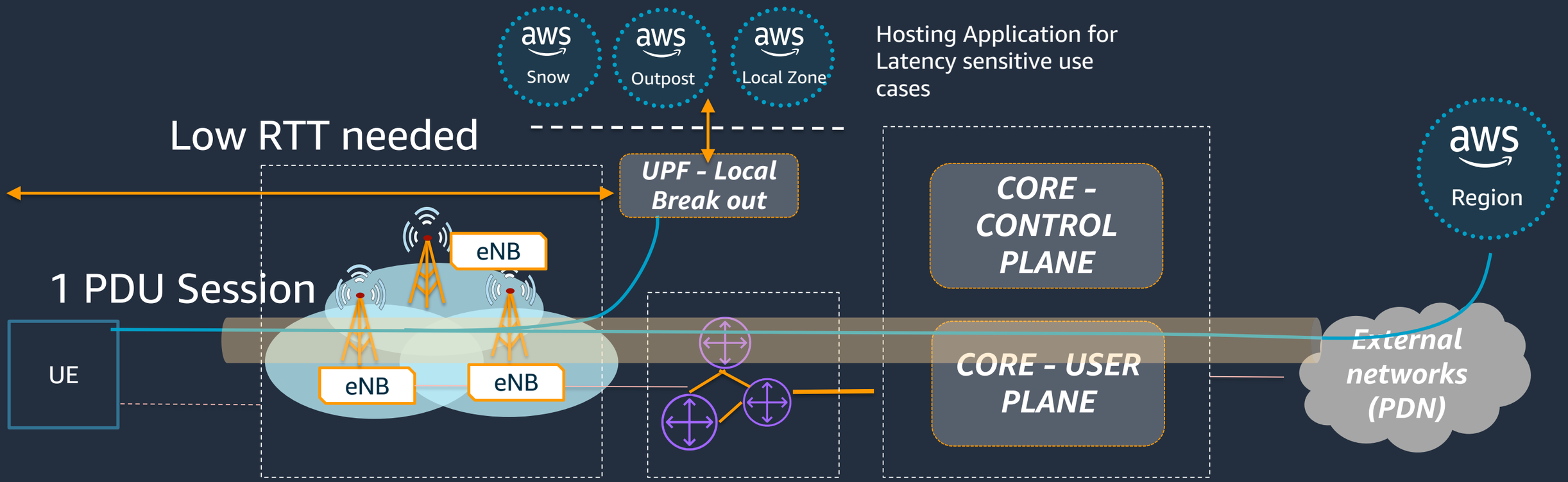
Distribute the Application (MEC)



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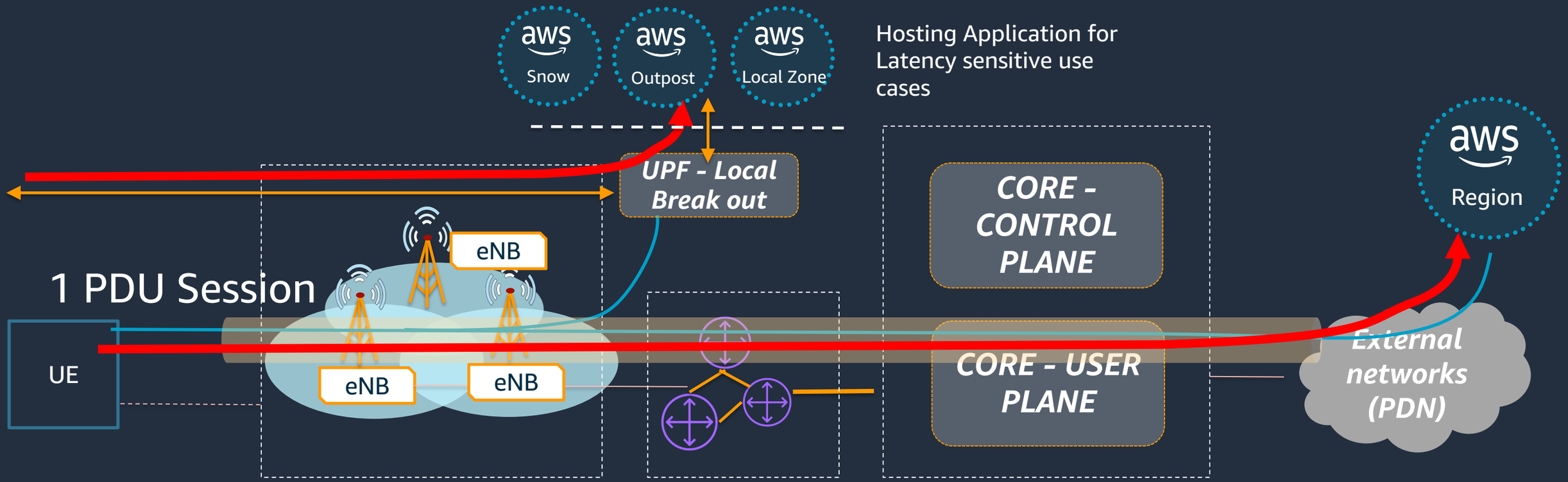
Local break out within the same session



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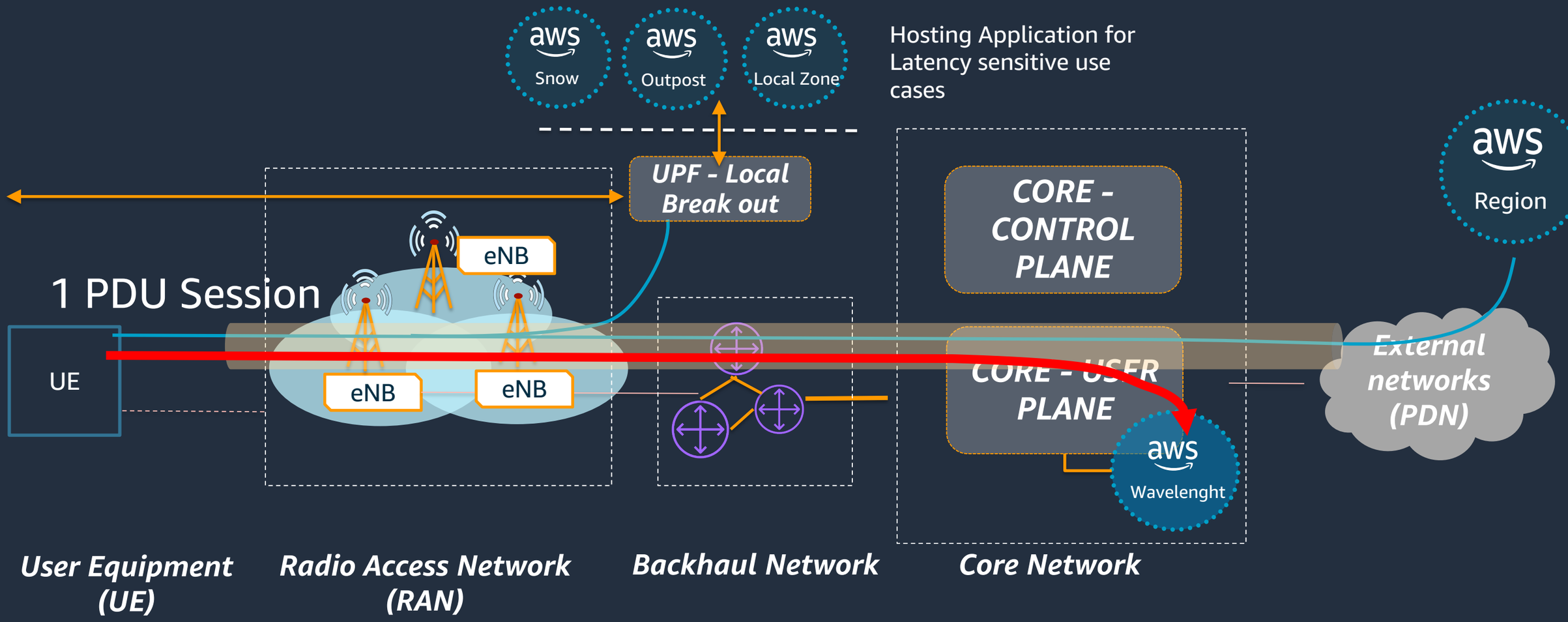
At the 5G Edge



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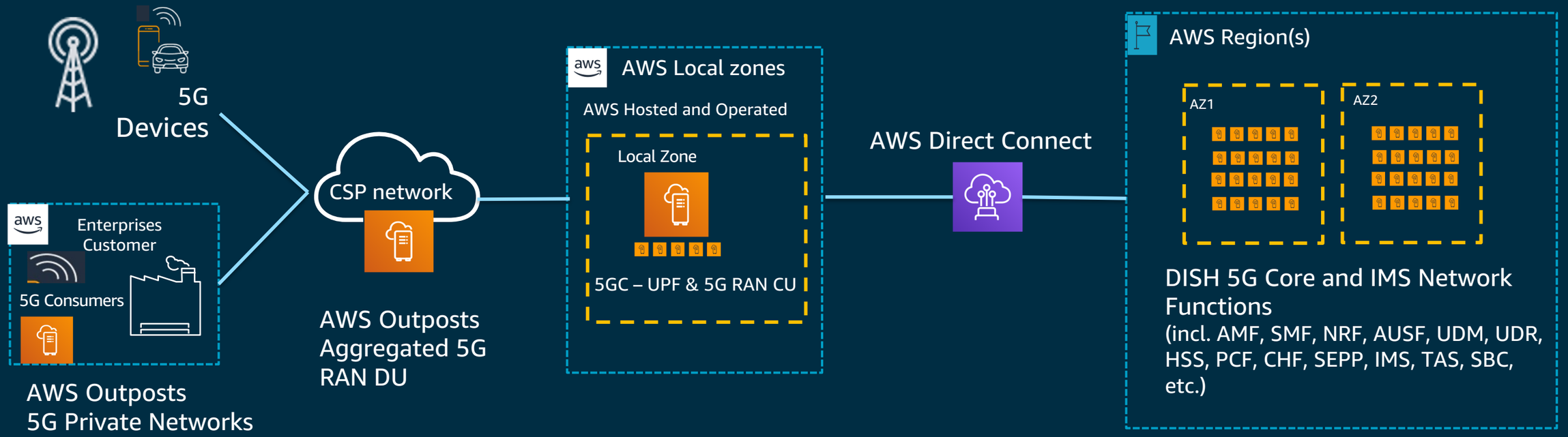
Dish - Utilizing AWS's Infrastructure



5GC = 5G Core
UPF = User Plane Function
RAN = Radio Access Unit
CU = Centralized Unit

DU = Distributed Unit
AZ = Availability Zone
CSP = Communications Service Provider
CGW = Carrier Gateway

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Private 5G network

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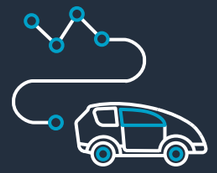
Private 5G traction

Venues and stadiums

Smart energy management

Smart factories



Autonomous vehicle

Surgical robotics

AR/VR augmented services

Public sector

Smart surveillance

Smart agriculture

Transportation

Smart traffic light road congestion

Smart devices

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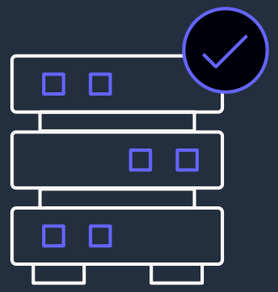
aws

Benefits of 5G network in the cloud

AWS Private 5G **AWS managed service for private cellular networks**



Set up a private **network faster with preintegrated hardware and software**

Scale your network dynamically to add more devices or change throughput capacity

Single pane of management and granular access control for all your connected devices

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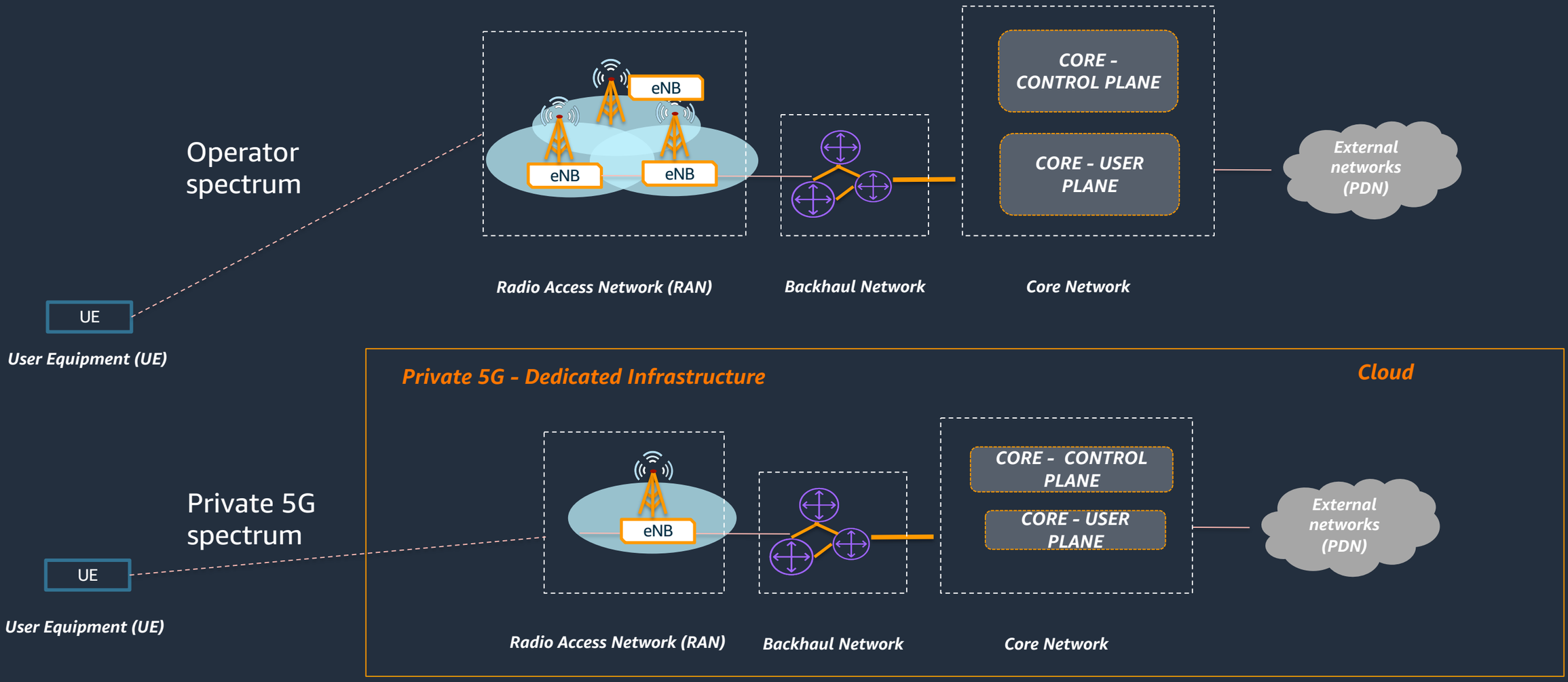
Private 5G



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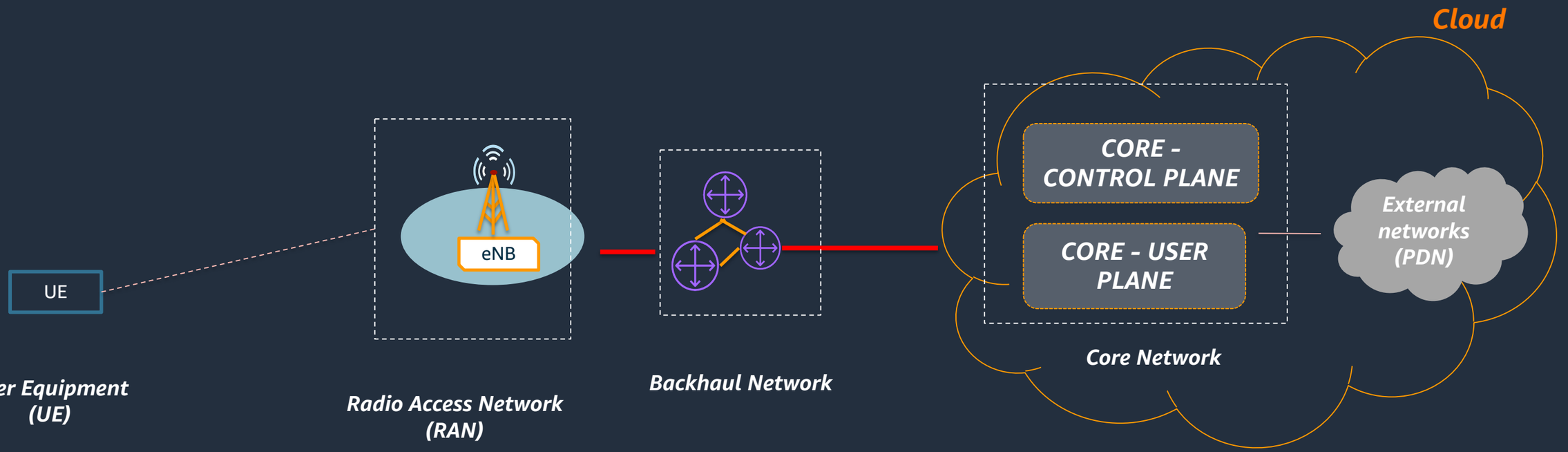
Private 5G Infra in the cloud



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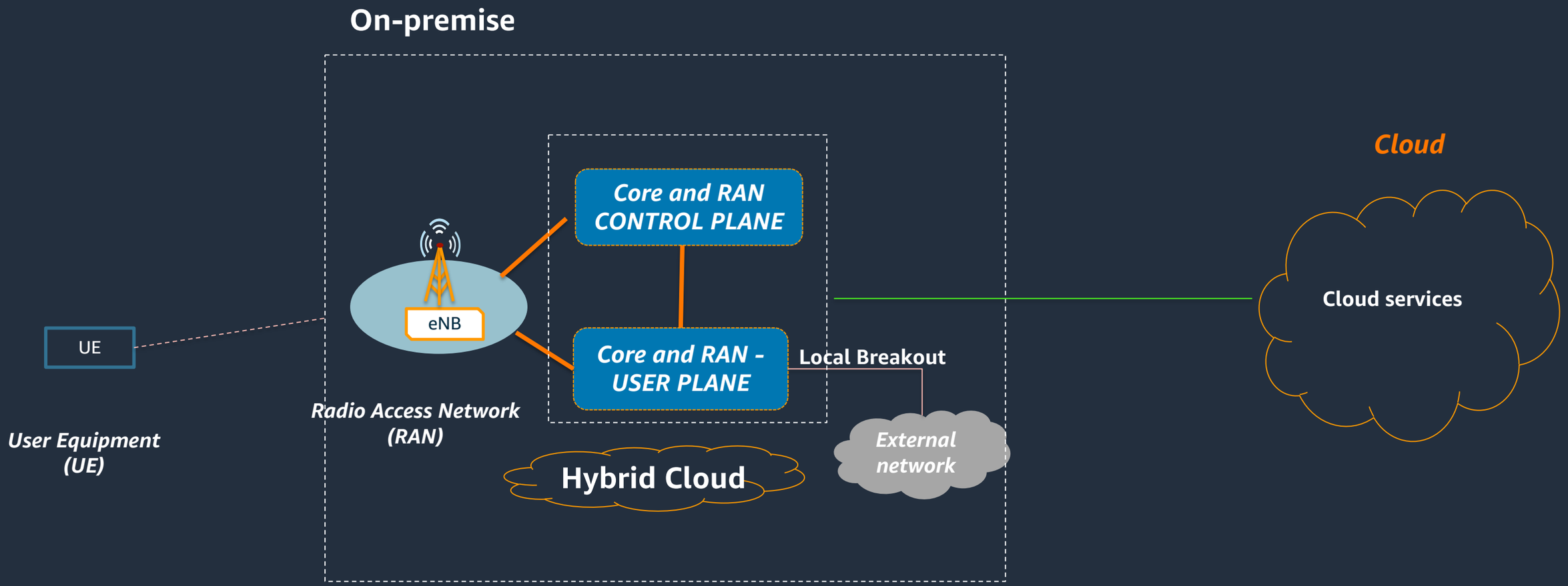
Private 5G Infra on premises



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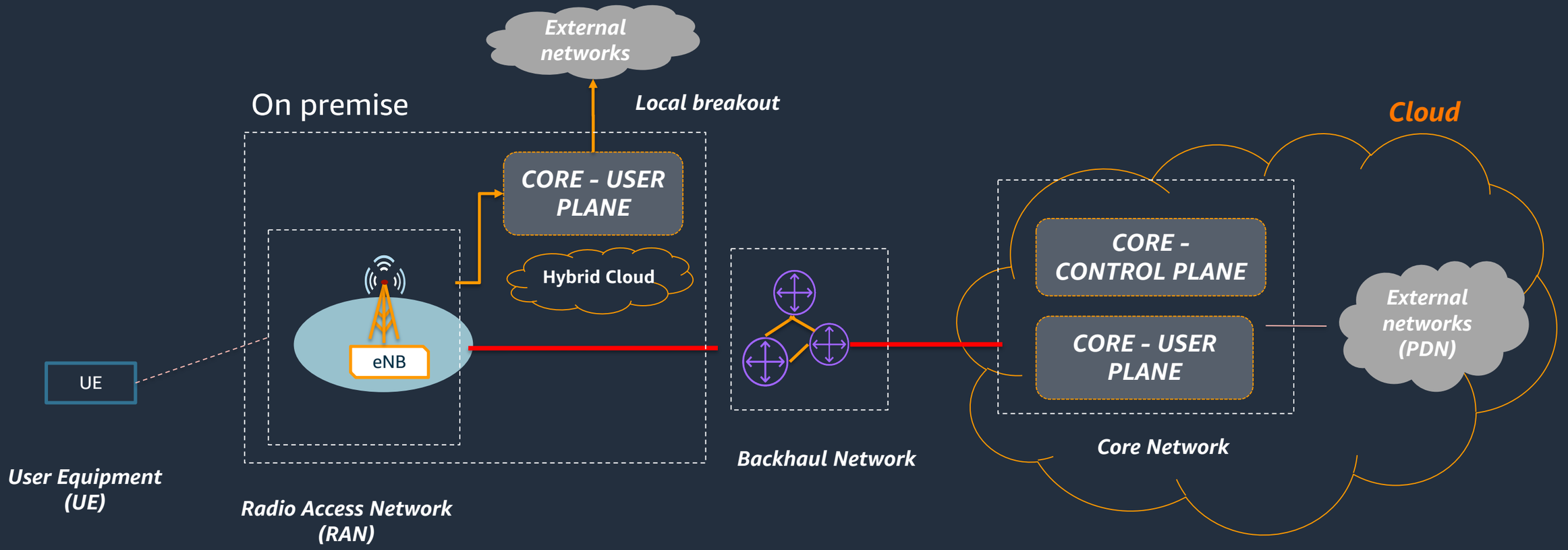
Combination on premise and Cloud



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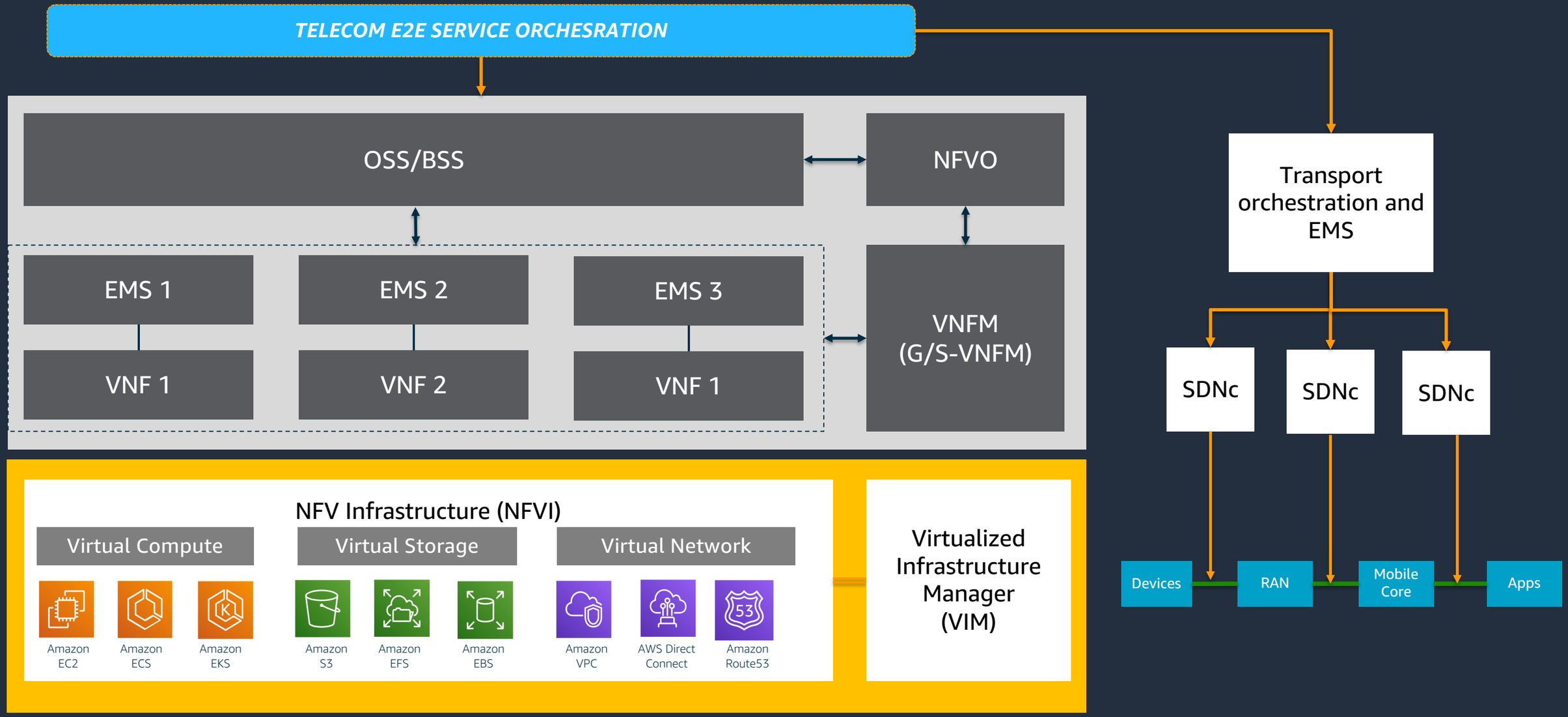
Orchestration



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Take Aways

- 5G networks designed for consumer use cases but mainly for enterprise / industry use cases with requirements beyond previous tech: Ultra reliable low latency, Extremely high throughput, Exposure of network capabilities though APIs
- 5G is cloud native and have expanded deployment possibilities: Cloud, on premise, distributed cloud, edge cloud solution, small footprint, portable hardware
- Concept of Network slices – resource partitioning to create private, isolated slice of networks for use cases, or customers
- Private 5G – dedicated spectrum and infra for enterprise customers
- To support the increased traffic and maintain the service differentiation of the traffic it carries, the Transport Domain need to evolve and implement efficient mechanisms to enforce SLAs and performance and traffic isolation per slice – dynamic resource partitioning, QoS, TC, Queues, etc mechanisms
- E2E Service Orchestration is key to provide a real end-to-end network as a service and will need to coordinate domains together: 5G network functions, Cloud resources, and Transports needs to be

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Thank you!

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