

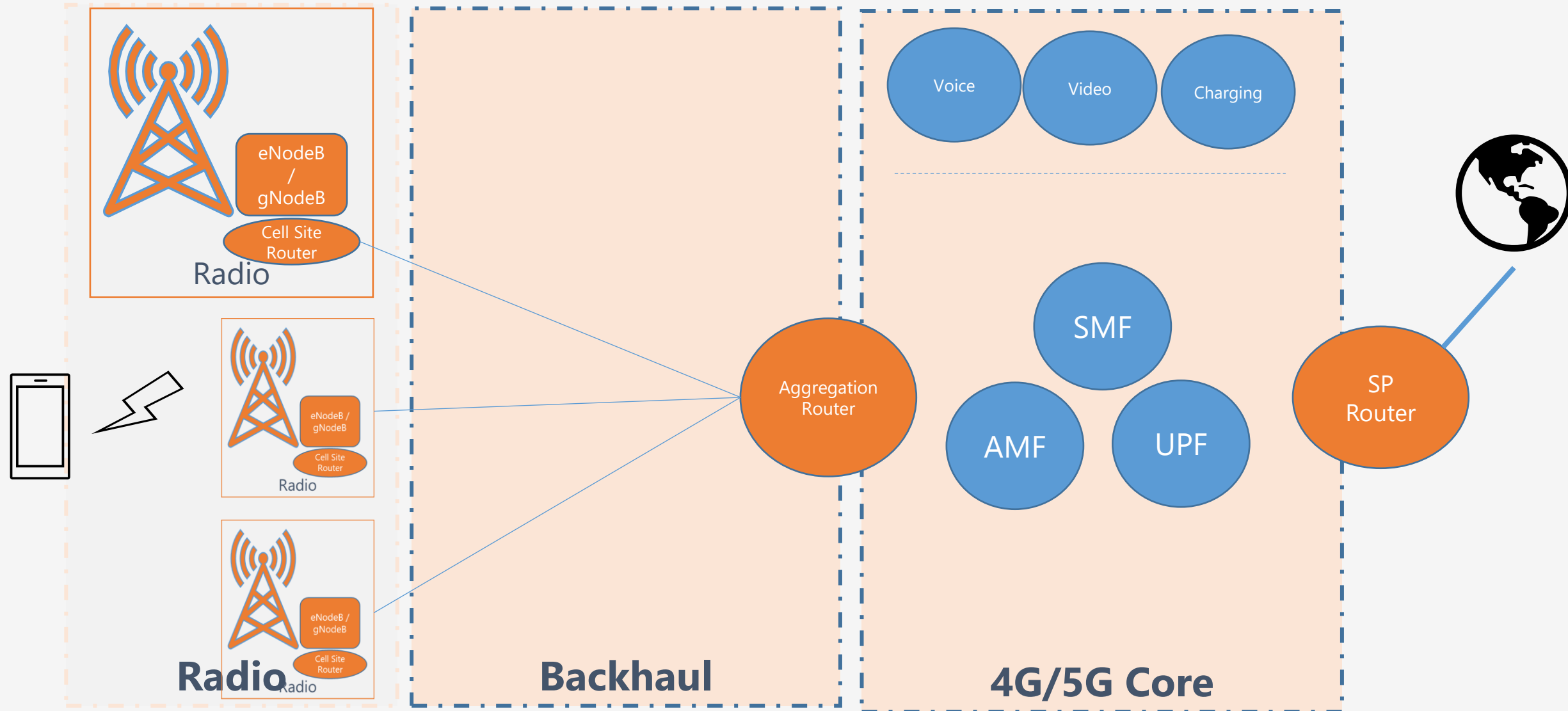
# Mobile Computing Architecture

UW Bothell, WA

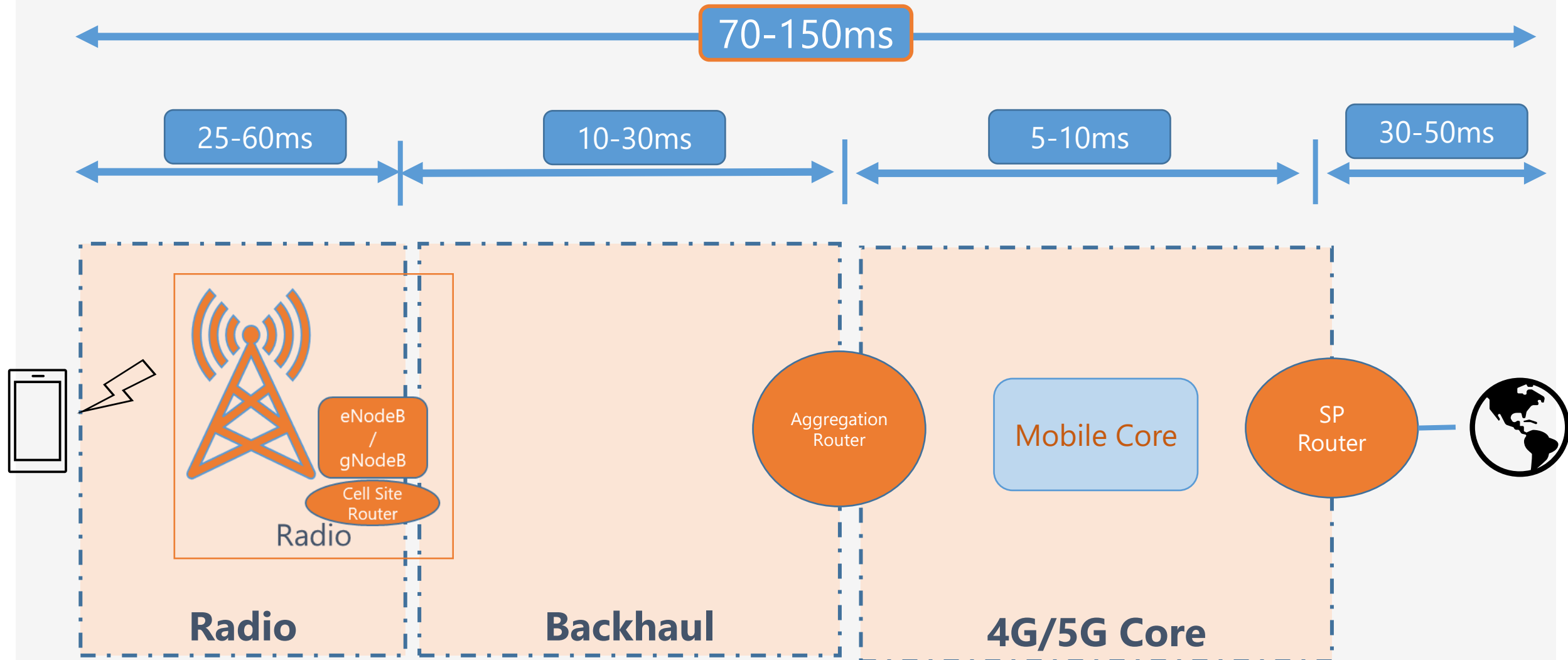
Lecture 8: Mobile Edge Computing



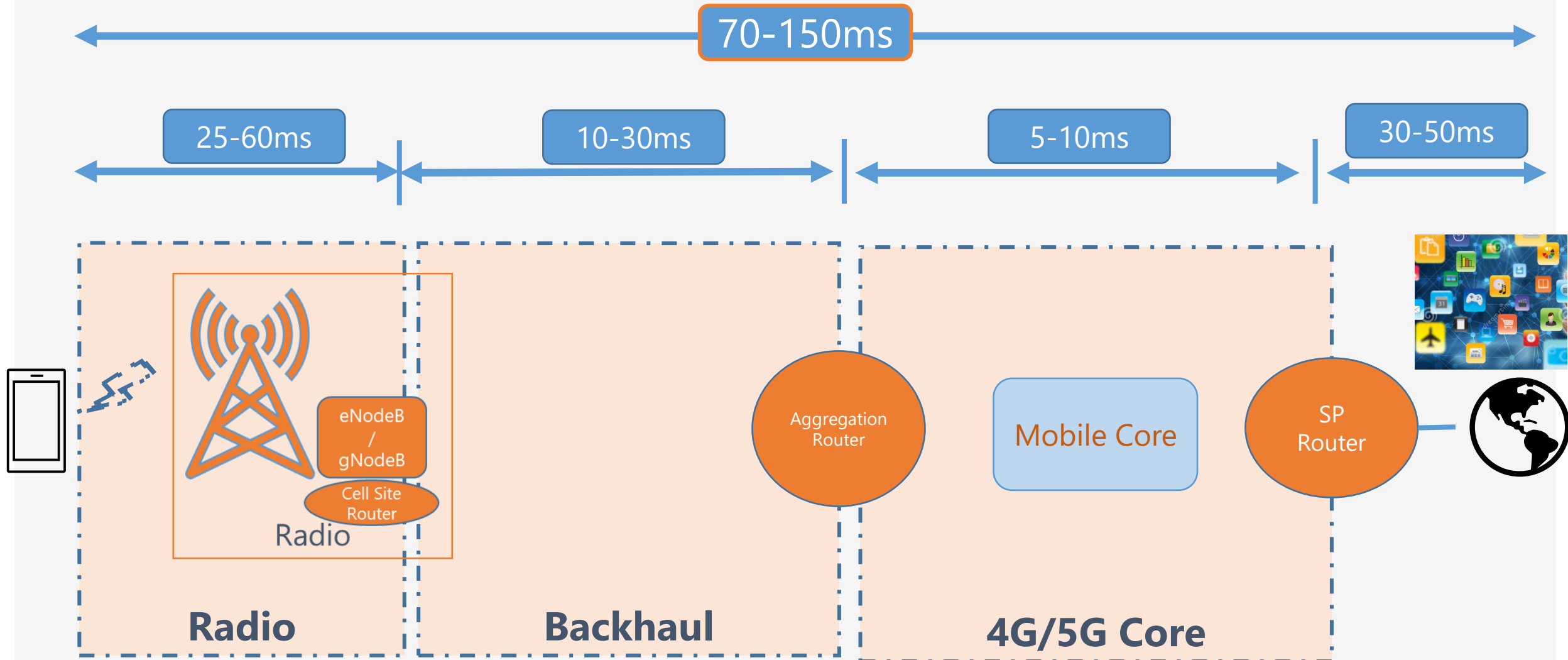
# Network Simplified



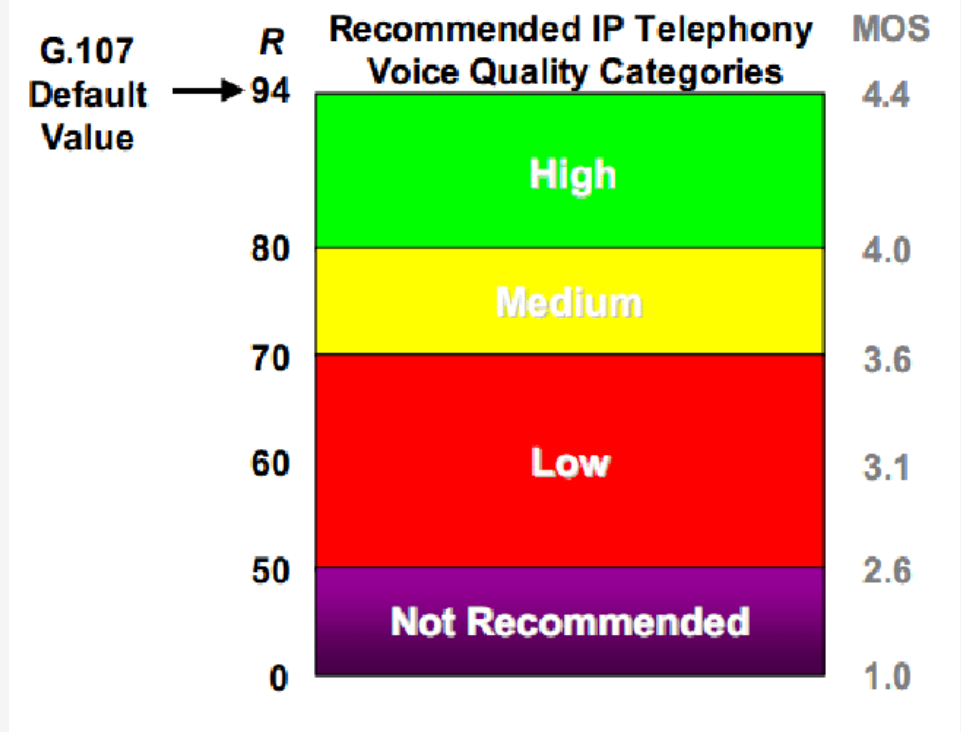
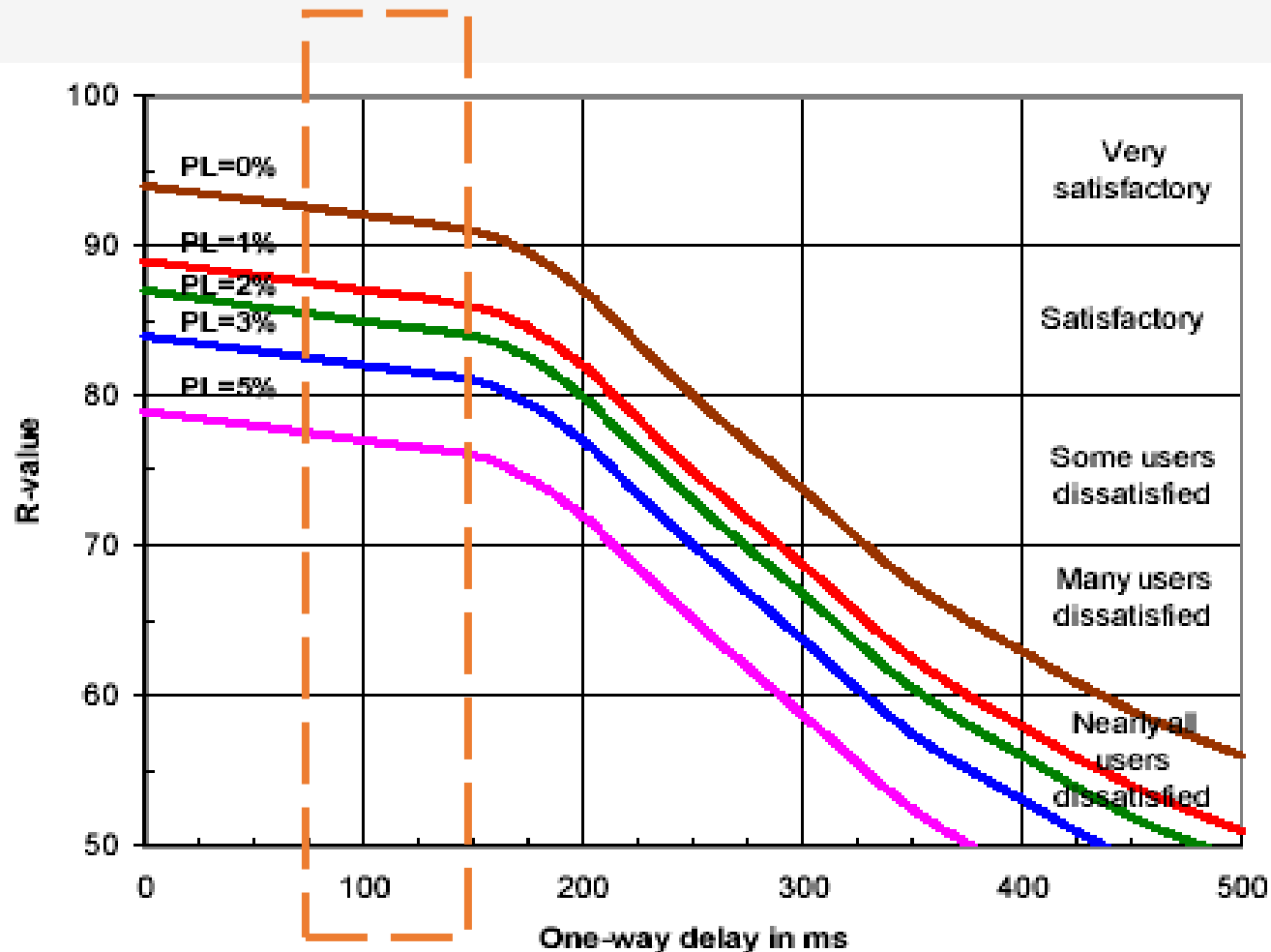
# Typical 4G Round Trip Latency



# Typical 4G Round Trip Latency – Will a Skype Voice Call work over this Network?



# Voice – Mean Opinion Score (MOS) | R-Value

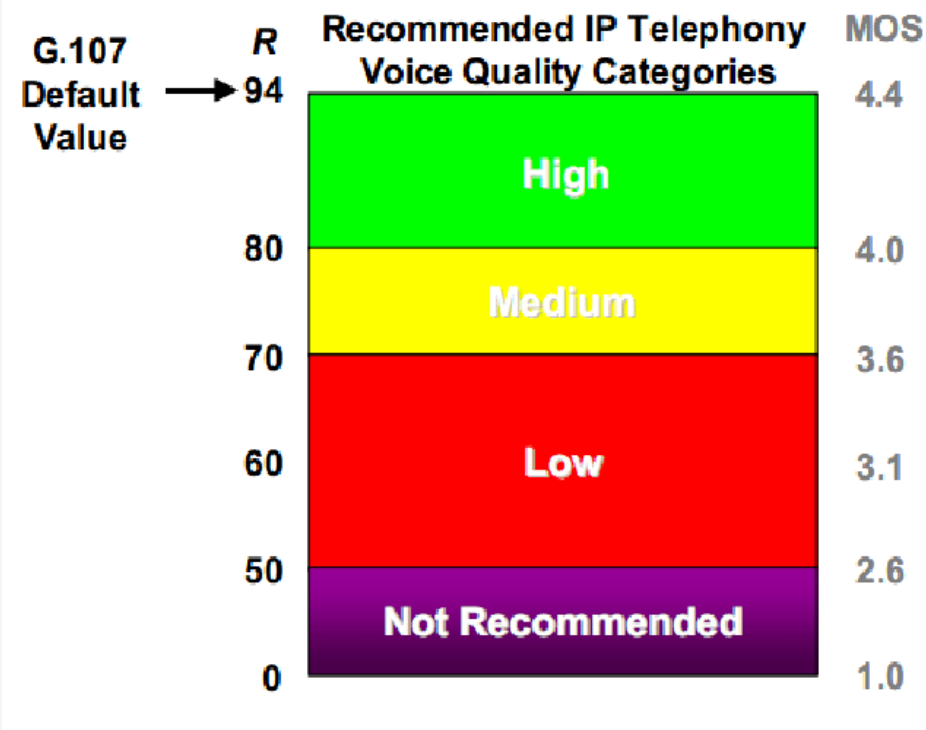
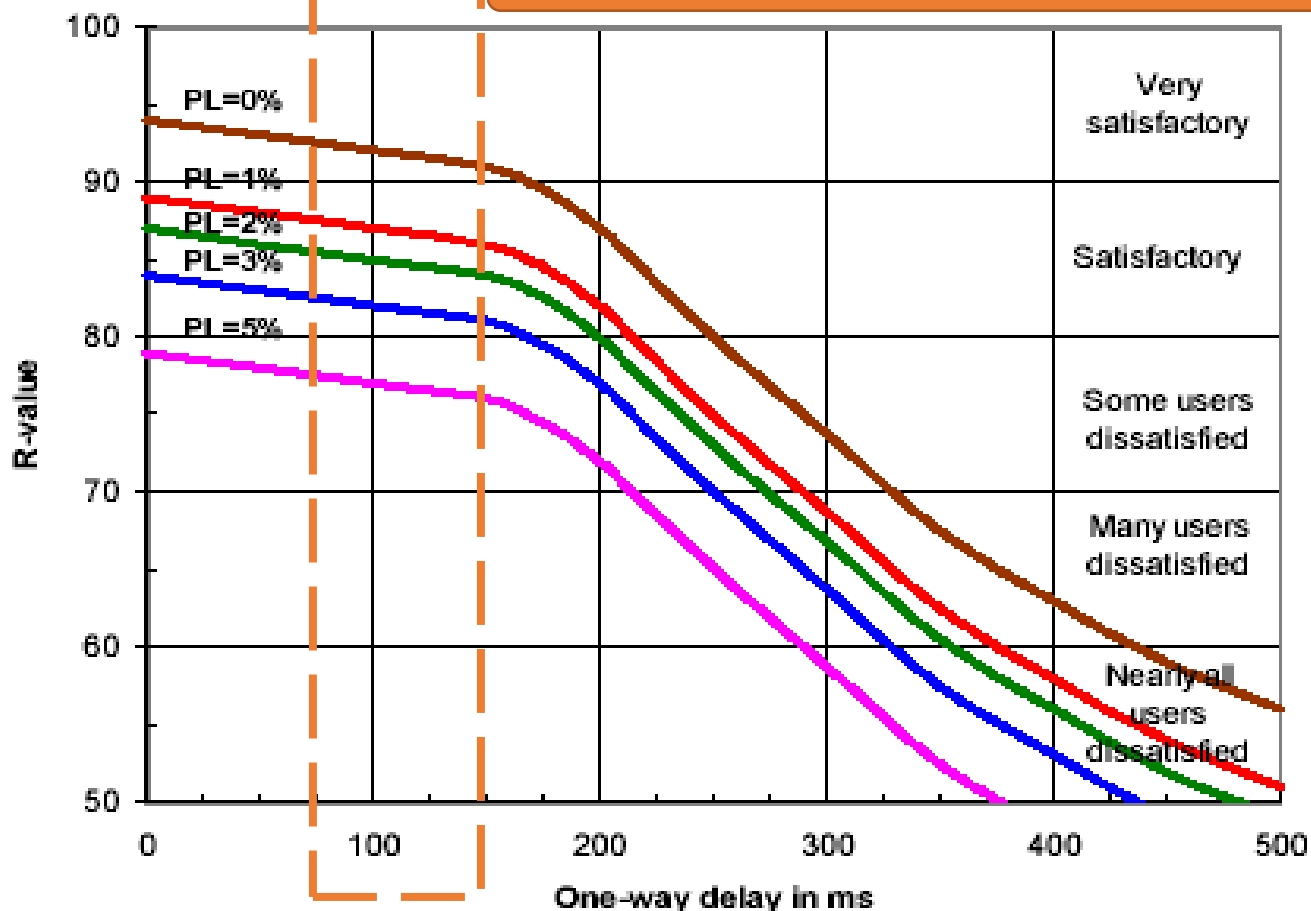


PL = Packet Loss

# Voice Quality of Experience (QoE) - Mean Opinion Score (MOS) | R-Value

What can you do to improve the Voice QoE?

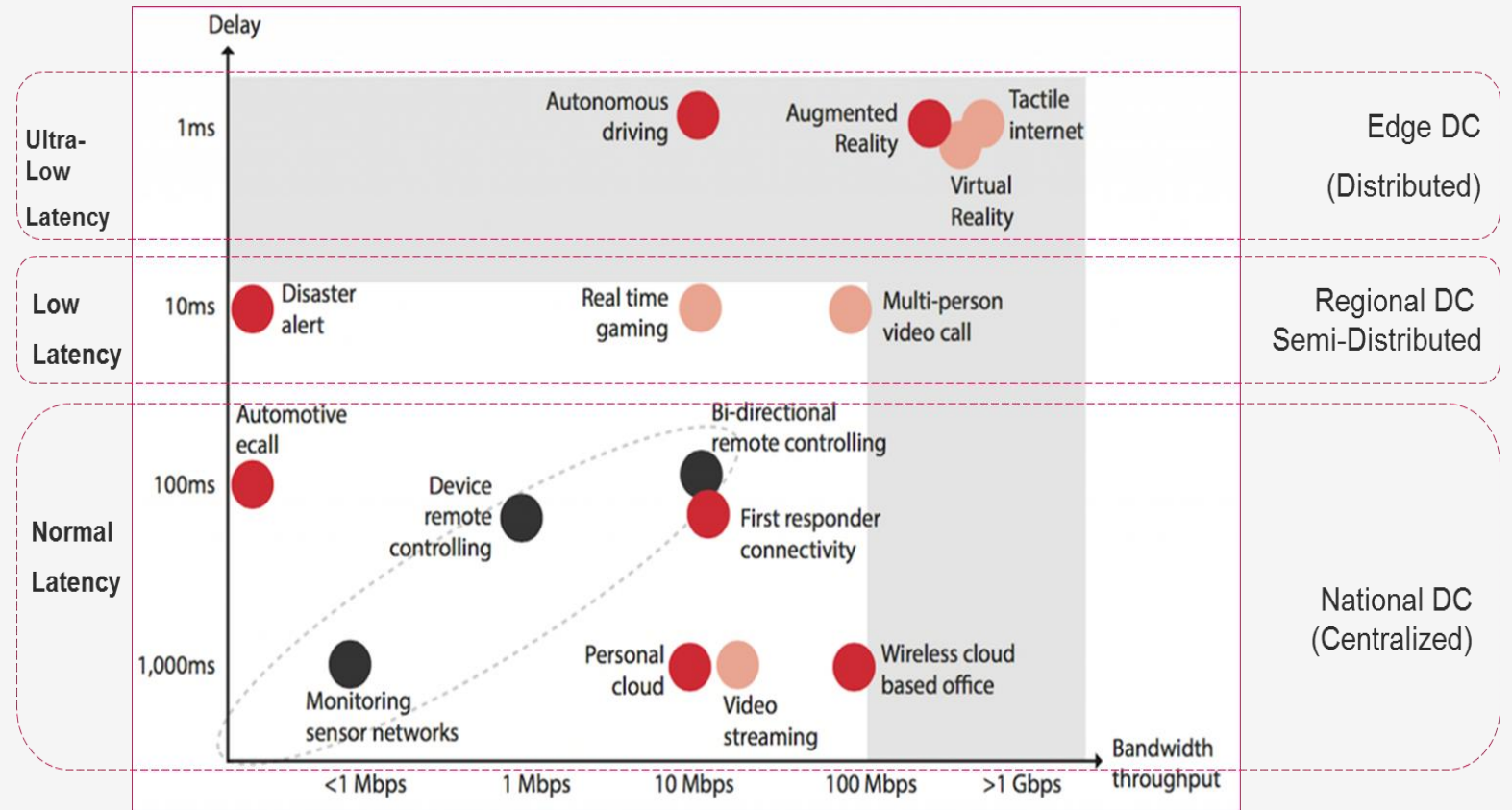
Reduce Latency (and Packet Loss)



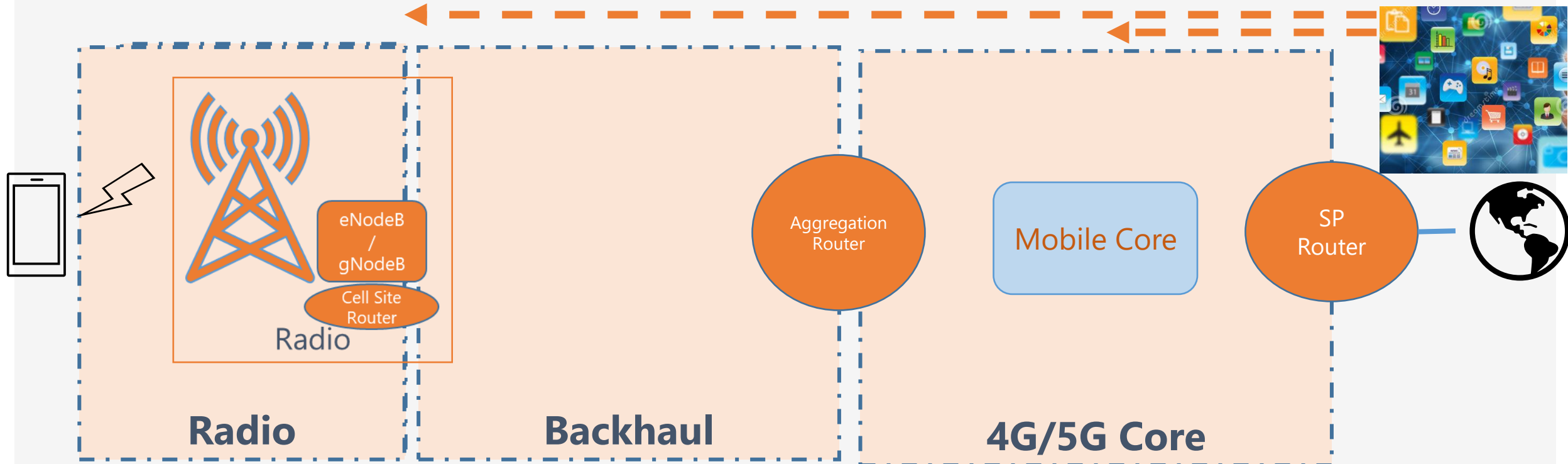
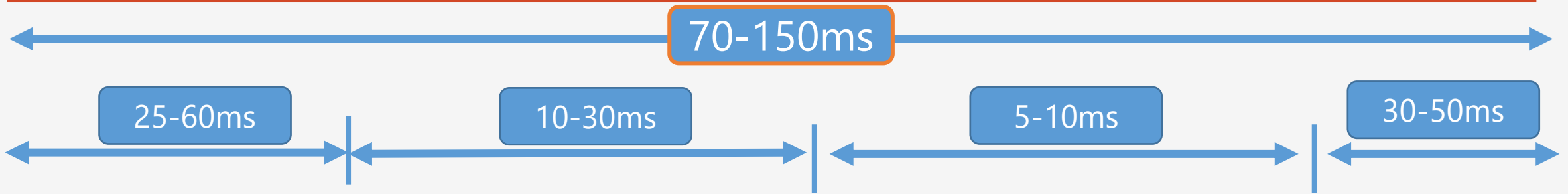
PL = Packet Loss

# Application Requirements

- Ultra-low latency: 1 to 5ms
- Low latency: 5 to 20ms
- Normal latency: 20ms or more



# How can we achieve 1 to 5ms for AR/VR, Driving,...?

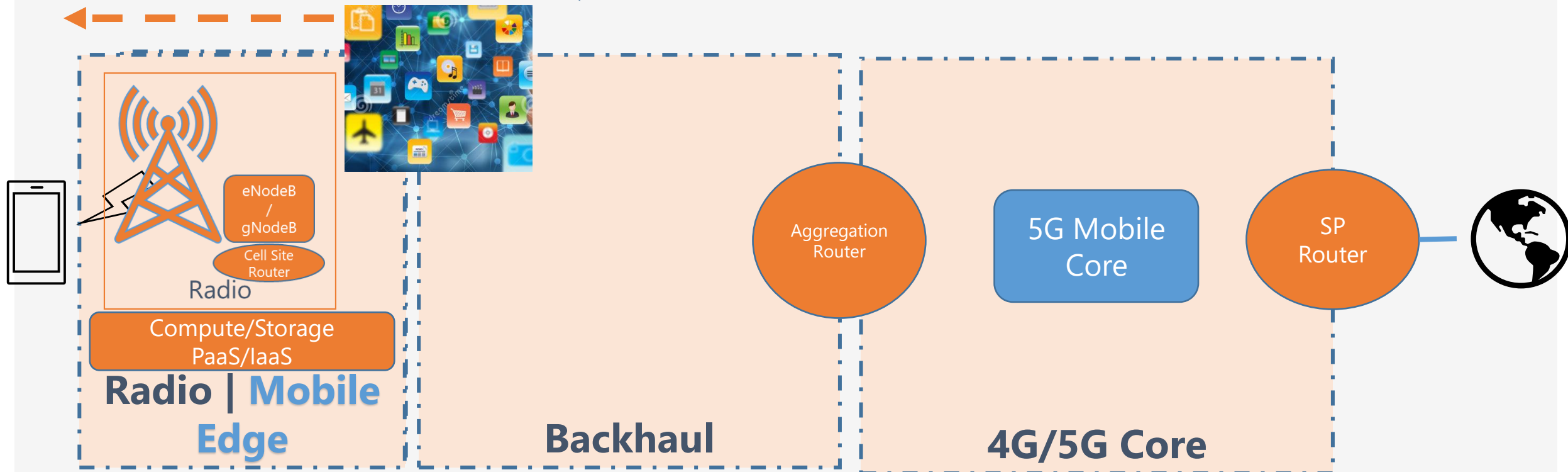




# Mobile Edge Computing (MEC)

5G Target: 1ms-5ms

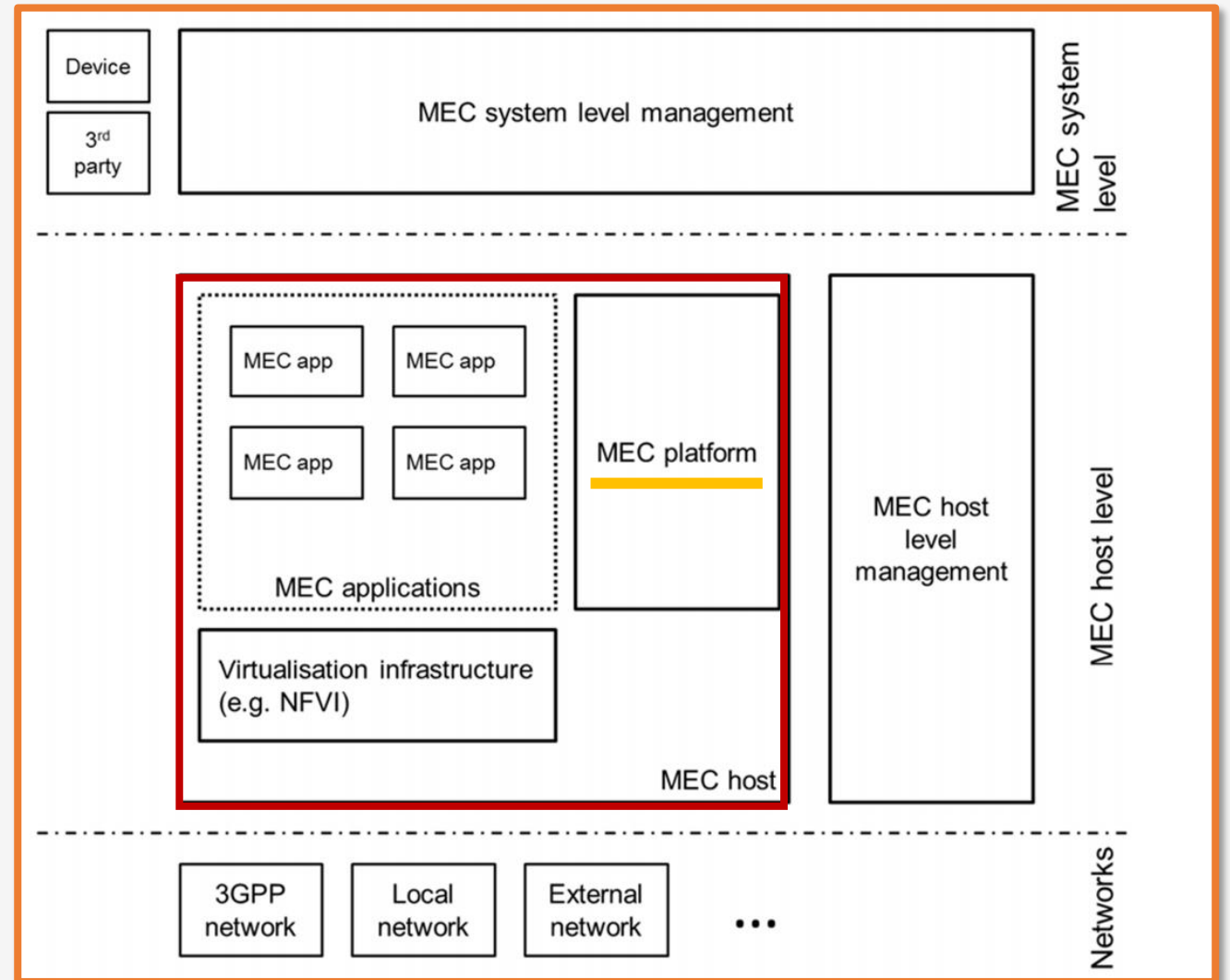
Applications move to Network Edge  
Need Ultra-Low Latency Radio: 5G (1ms)



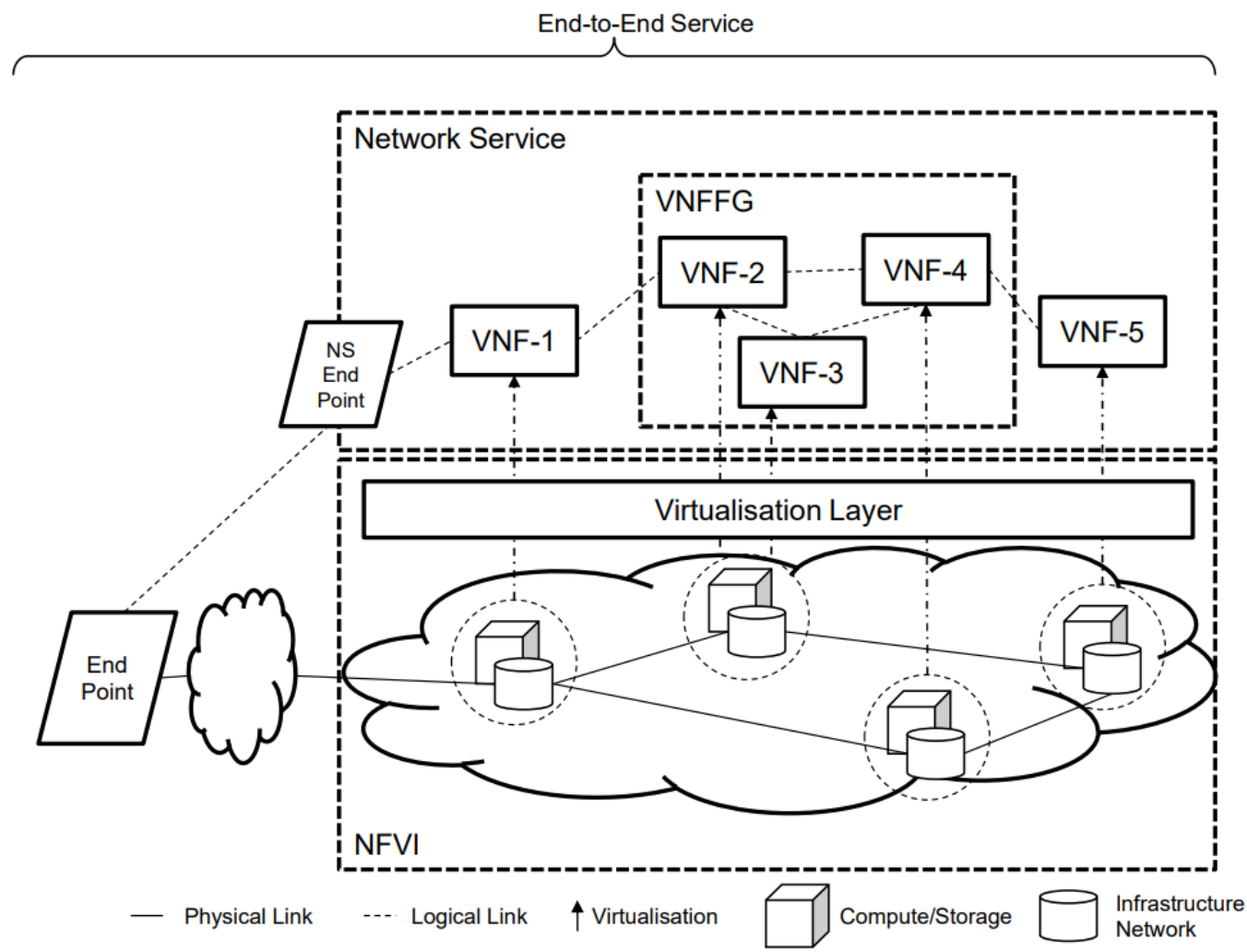
# Mobile Edge Computing (MEC) - Framework

## ETSI GS MEC 003

- Network: Mobile Network
- MEC Host (compute/storage)
- MEC Management



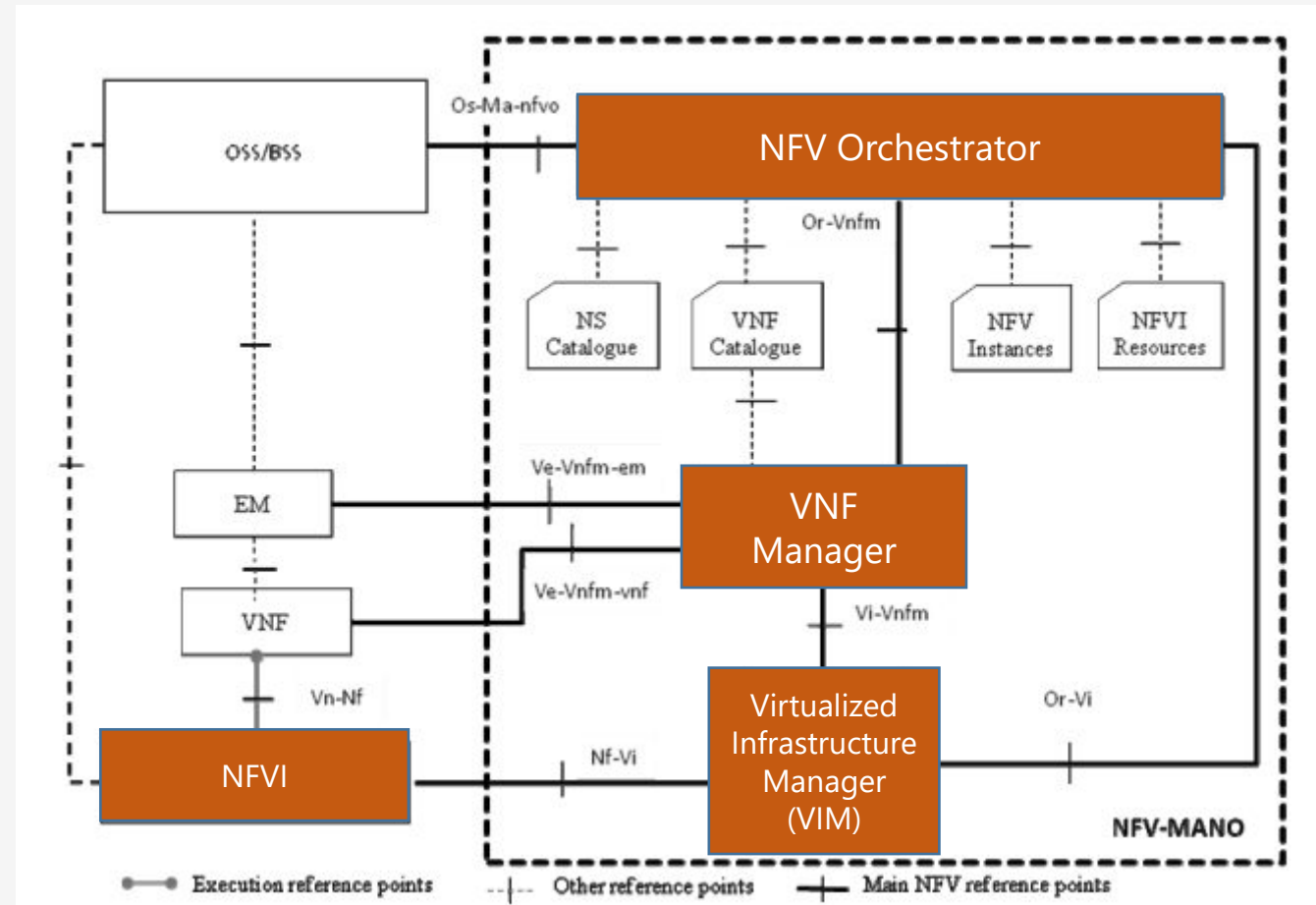
# Deploying Network End to End (E2E) Service



How do we automate/orchestrate this E2E service?

# Remember NFV – MANO!

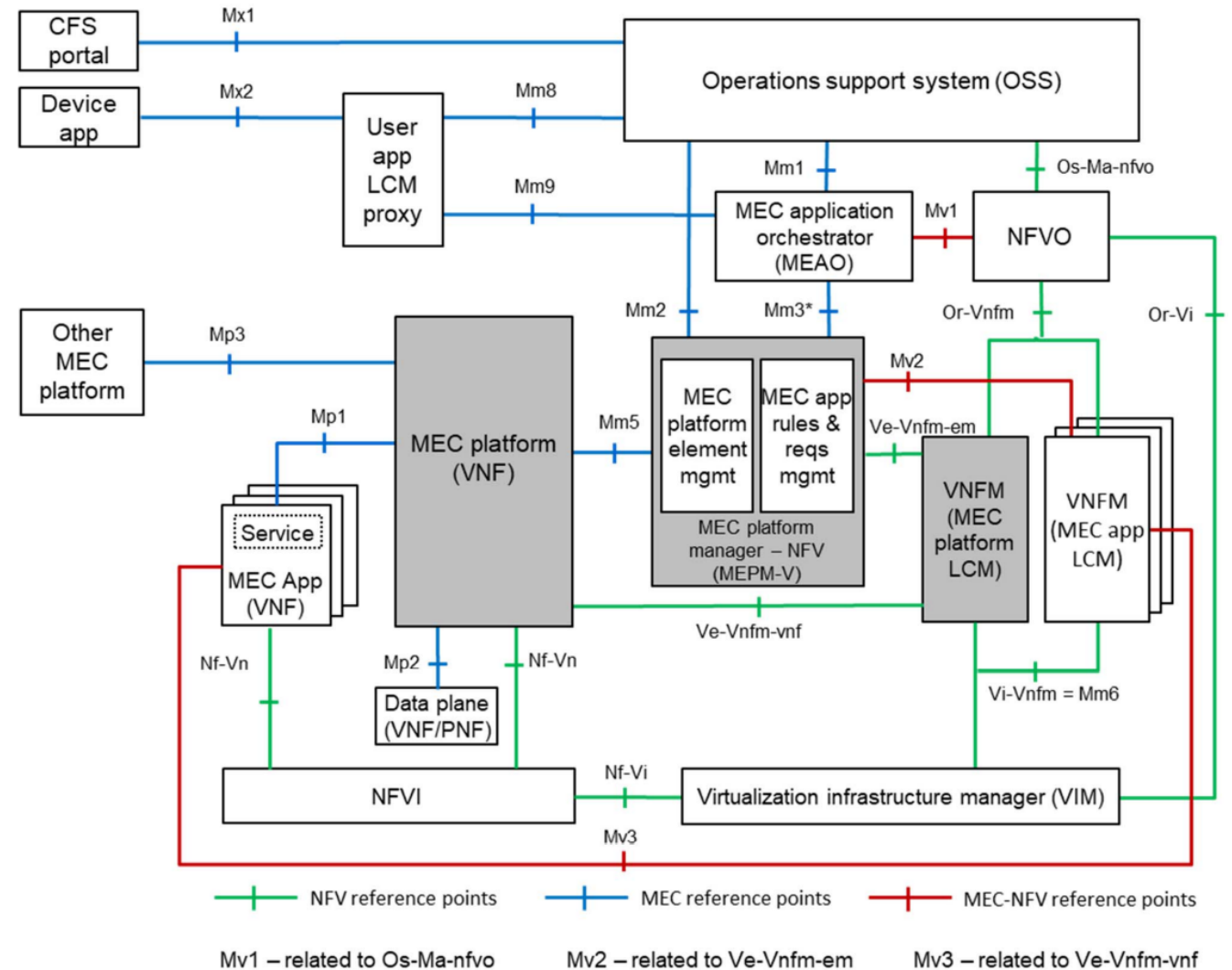
- **NFV Orchestrator:** on-boarding of new Network Service (NS), VNF-FG and VNF Packages
  - NS lifecycle management including instantiation, scale-out/in, performance measurements, event correlation, termination
  - global resource management, validation and authorization of NFVI resource requests
  - policy management for NS instances
- **VNF Manager**
  - lifecycle management of VNF instances
  - overall coordination and adaptation role for configuration and event
  - reporting between NFVI and the E/NMS
- **Virtualized Infrastructure Manager (VIM)**
  - controlling and managing the NFVI compute, storage and network
  - resources, within one operator's infrastructure sub-domain
  - collection and forwarding of performance measurements and events



# MEC in NFV

## ETSI GS MEC 003

- The MEC platform is deployed as a VNF
- The MEC applications appear as VNFs towards the ETSI NFV MANO components
- The **virtualization infrastructure is deployed as an NFVI and is managed by a VIM** as defined by ETSI GS NFV 002
- The MEC platform manager (EPM) is replaced by a MEC platform manager - NFV (MEPM-V) that delegates the VNF lifecycle management to one or more VNF managers (VNFM)
- The MEC orchestrator (MEO) is replaced by a **MEC application orchestrator (MEAO)** that relies on the NFV orchestrator (NFVO) for resource orchestration and for orchestration of the set of MEC application VNFs as one or more NFV network services (NSS)

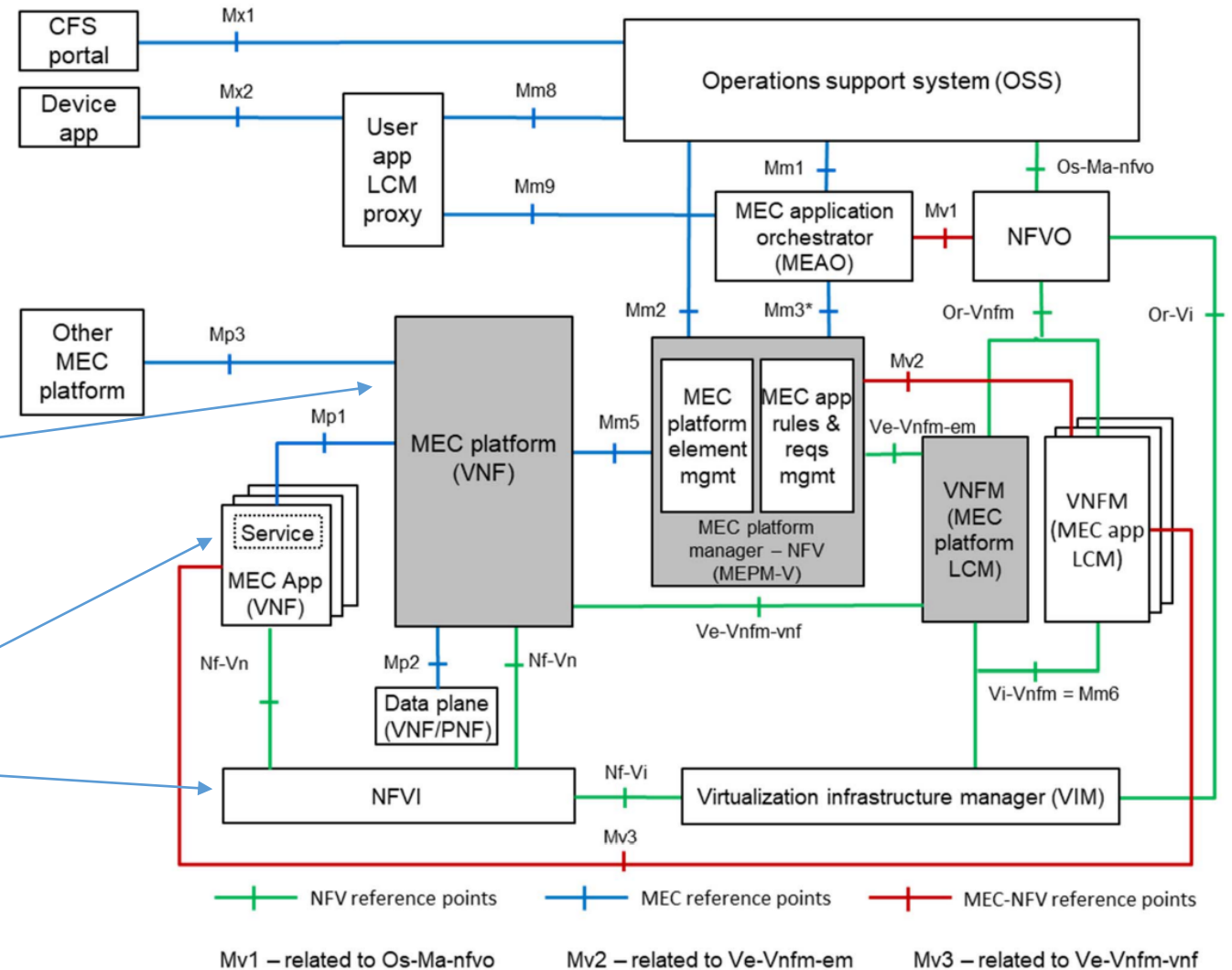


# MEC Functional Elements - I

## ETSI GS MEC 003

**MEC Host** is an entity that contains the **MEC platform** and a **virtualization infrastructure** which provides compute, storage, and network resources for the MEC applications

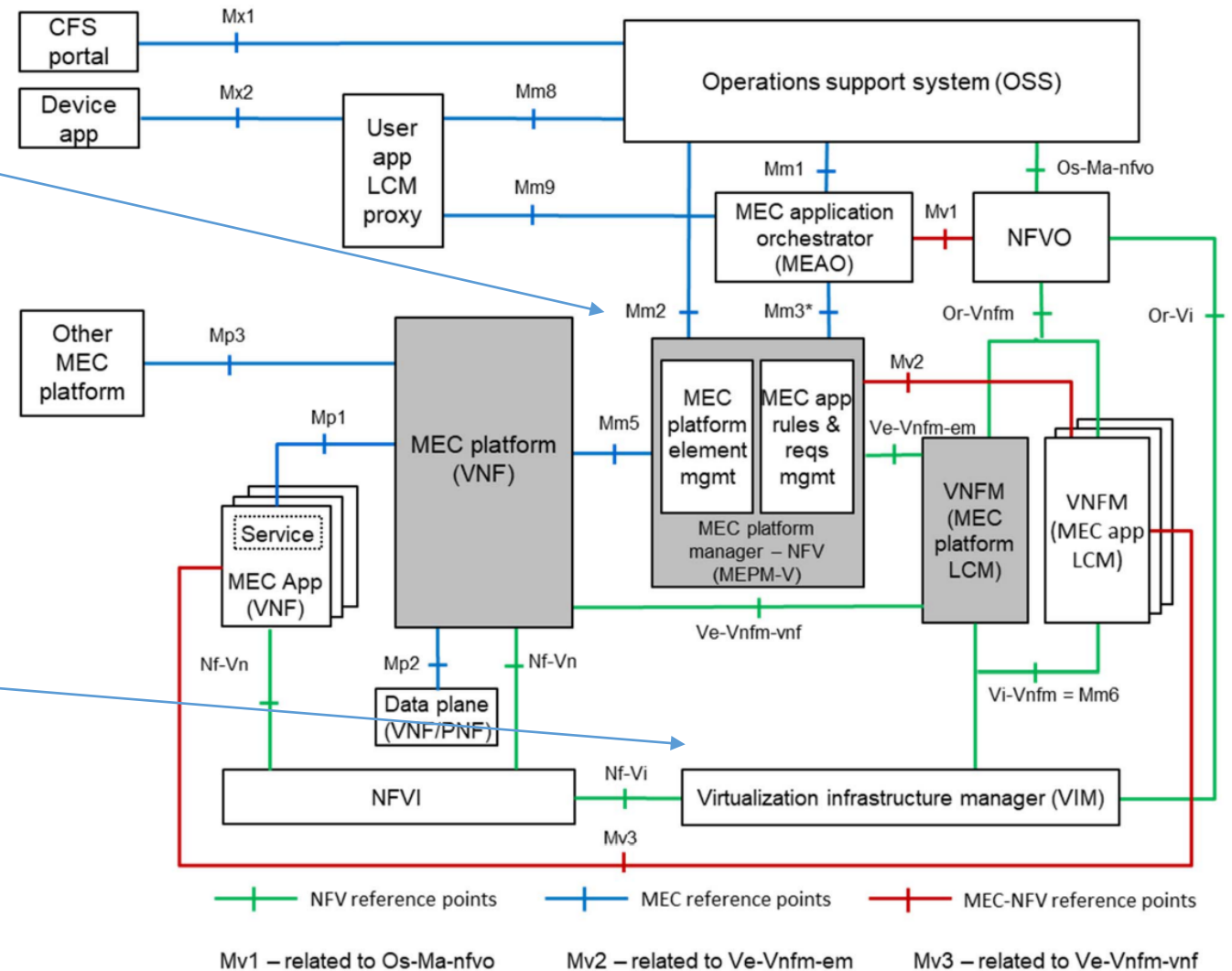
- **MEC Platform** responsible for offering an environment where the MEC applications can discover, advertise, consume and offer MEC services
- **MEC Application** are running as virtual machines (VM) on top of the **virtualization infrastructure** provided by the MEC host, and can interact with the MEC platform to consume and provide MEC services



# MEC Functional Elements - II

## ETSI GS MEC 003

- **MEC Platform Manager** responsible for managing the life cycle of applications including informing the multi-access edge orchestrator of relevant application related events, and providing element management functions to the MEC platform
- **MEC Virtualization Infrastructure Manager (VIM)** is responsible for allocating, managing and releasing virtualized (compute, storage and networking) resources of the virtualization infrastructure; preparing the virtualization infrastructure to run a software image





# MEC Functional Elements - III

## ETSI GS MEC 003

- Multi-access Edge Orchestrator (MEO) maintains an overall view of the MEC system based on deployed MEC hosts, available resources, available MEC services, and topology; on-boarding of application packages; preparing the virtualization infrastructure manager(s)
- MEC Application Orchestrator (MEAO) has the same responsibilities as the MEO, however, it delegates the management of the set of MEC apps to an NFVO. Similarly, it can delegate the management of the MEC app VNF packages to the NFVO.
- Other functions:
  - NFV – Orchestrator (NFVO)
  - MEC platform manager – NFV
  - VNFM (MEC Platform LCM)
  - VNFM (MEC App LCM)

