



5G

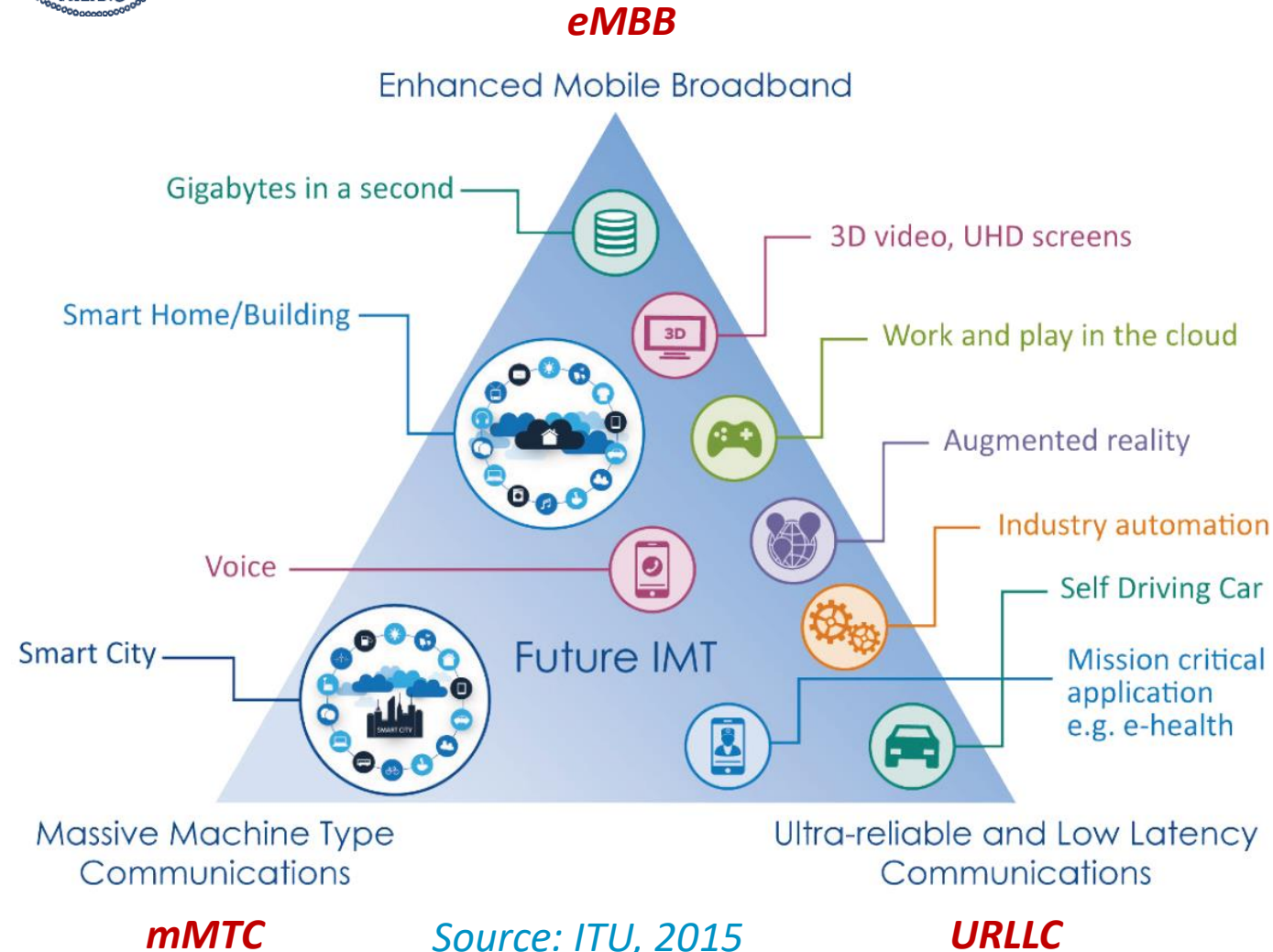
Network Architecture

Maurizio Dècina
Politecnico di Milano

5G Italy, 2019
CNIT Conference, Rome, December 3-5, 2019



5G Application Clusters

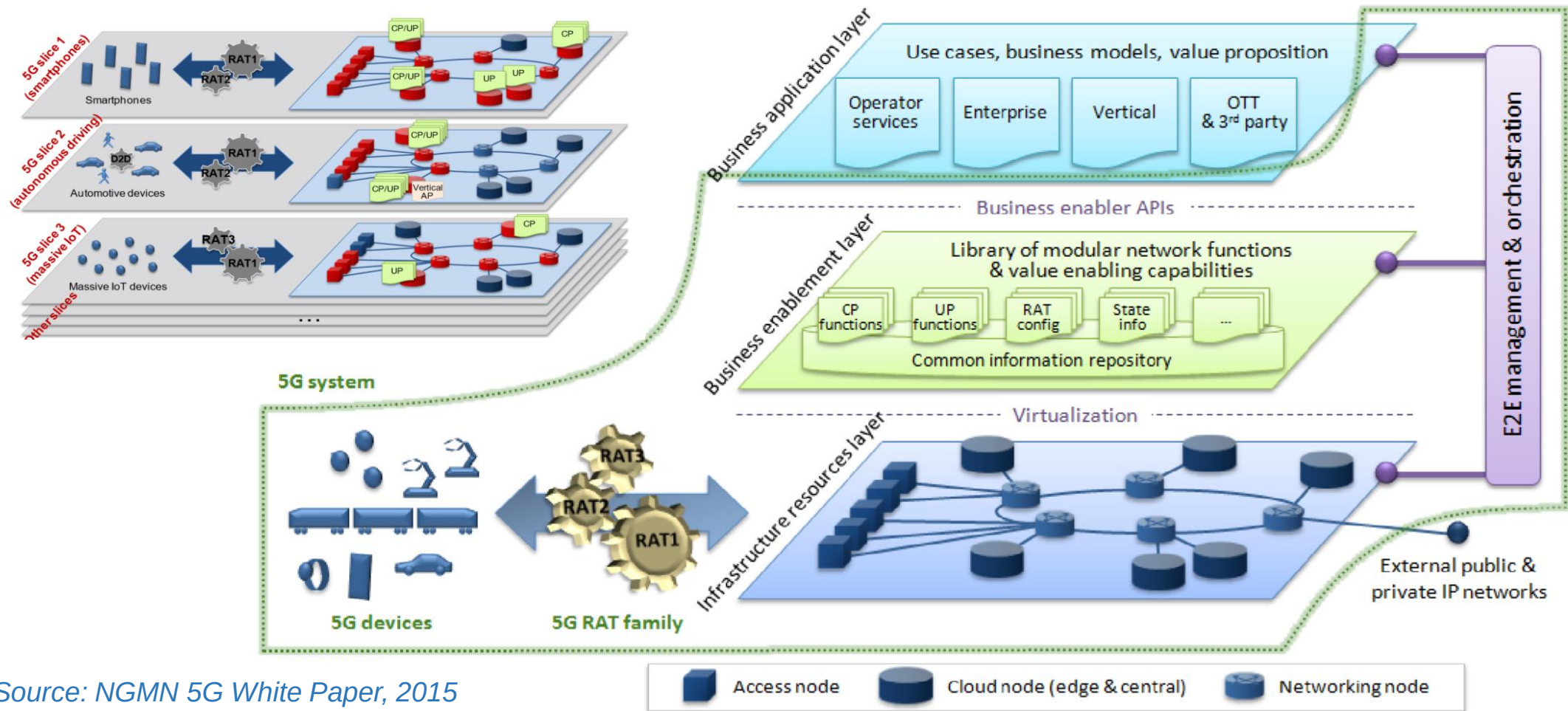


5G ARCHITECTURE KEY FEATURES

- Control & User Plane Separation
- Multi-access Edge Computing
- Massive MIMO
- Evolved vRAN (Protocol Separation)
- Full Virtualization (SDN/NFV)
- Service Based Architecture (Network Slicing)
- New Radio Spectrum (mmWave)



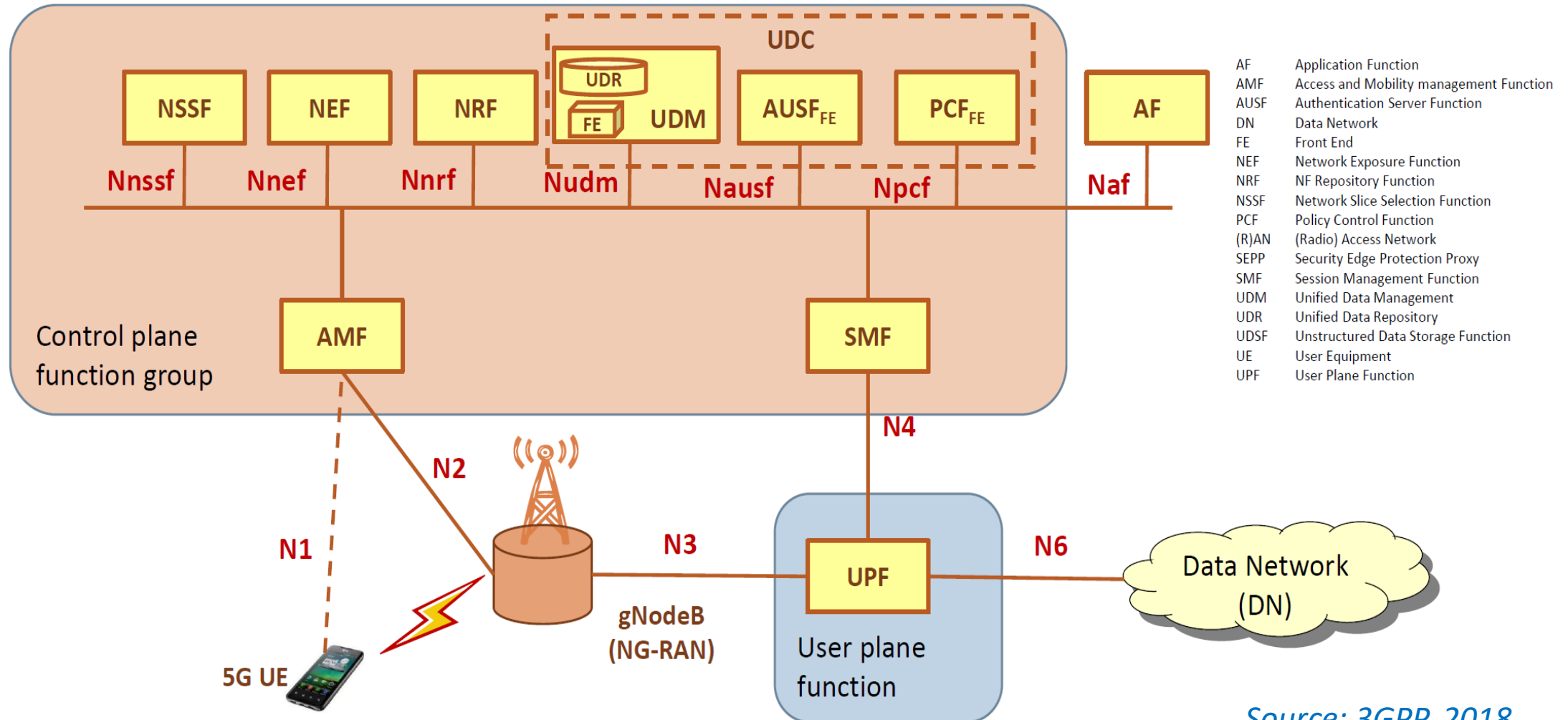
5G Network Architecture & Slicing



Source: NGMN 5G White Paper, 2015



5G Service Based Architecture (SBA)

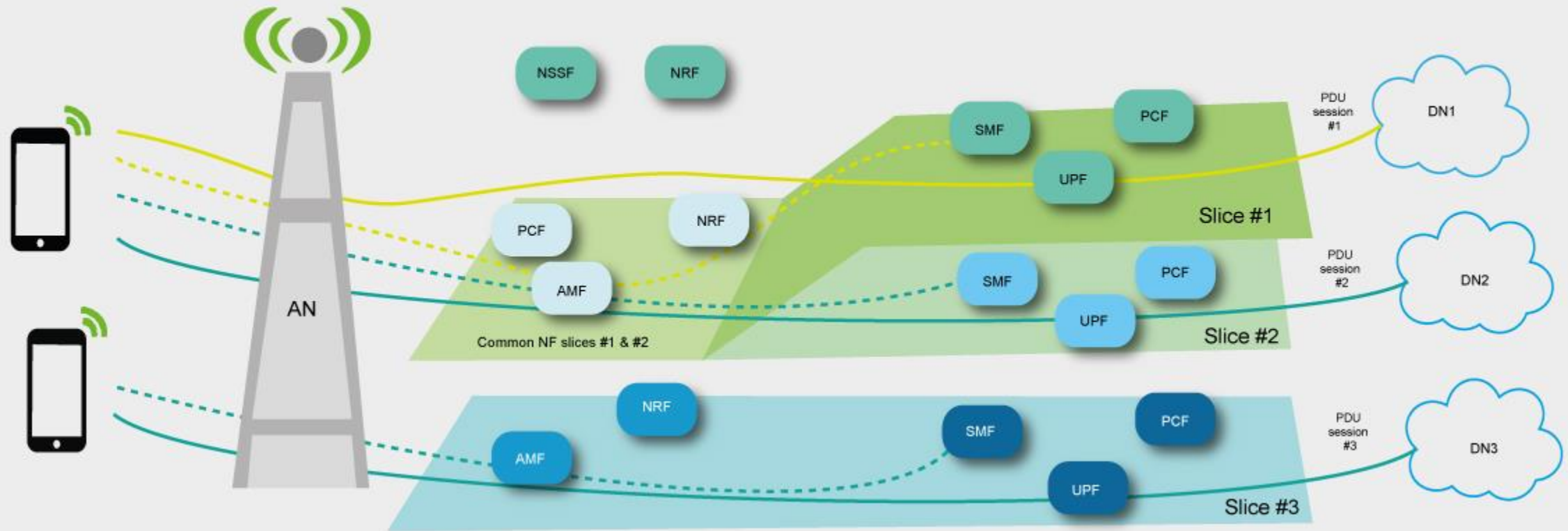


Source: 3GPP, 2018



5G Network Slicing

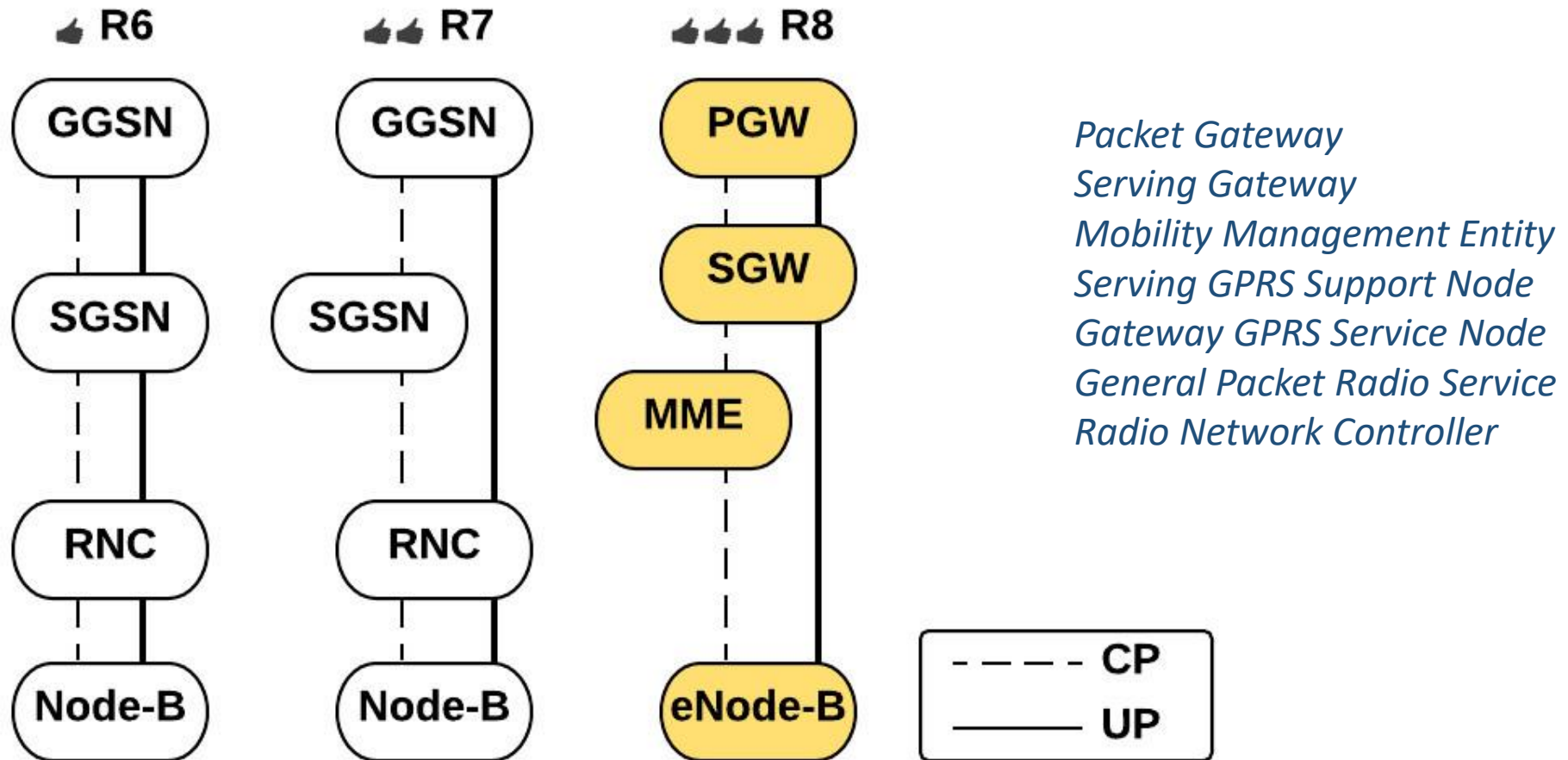
3GPP deployments using network slicing



Source: 3GPP, 2018



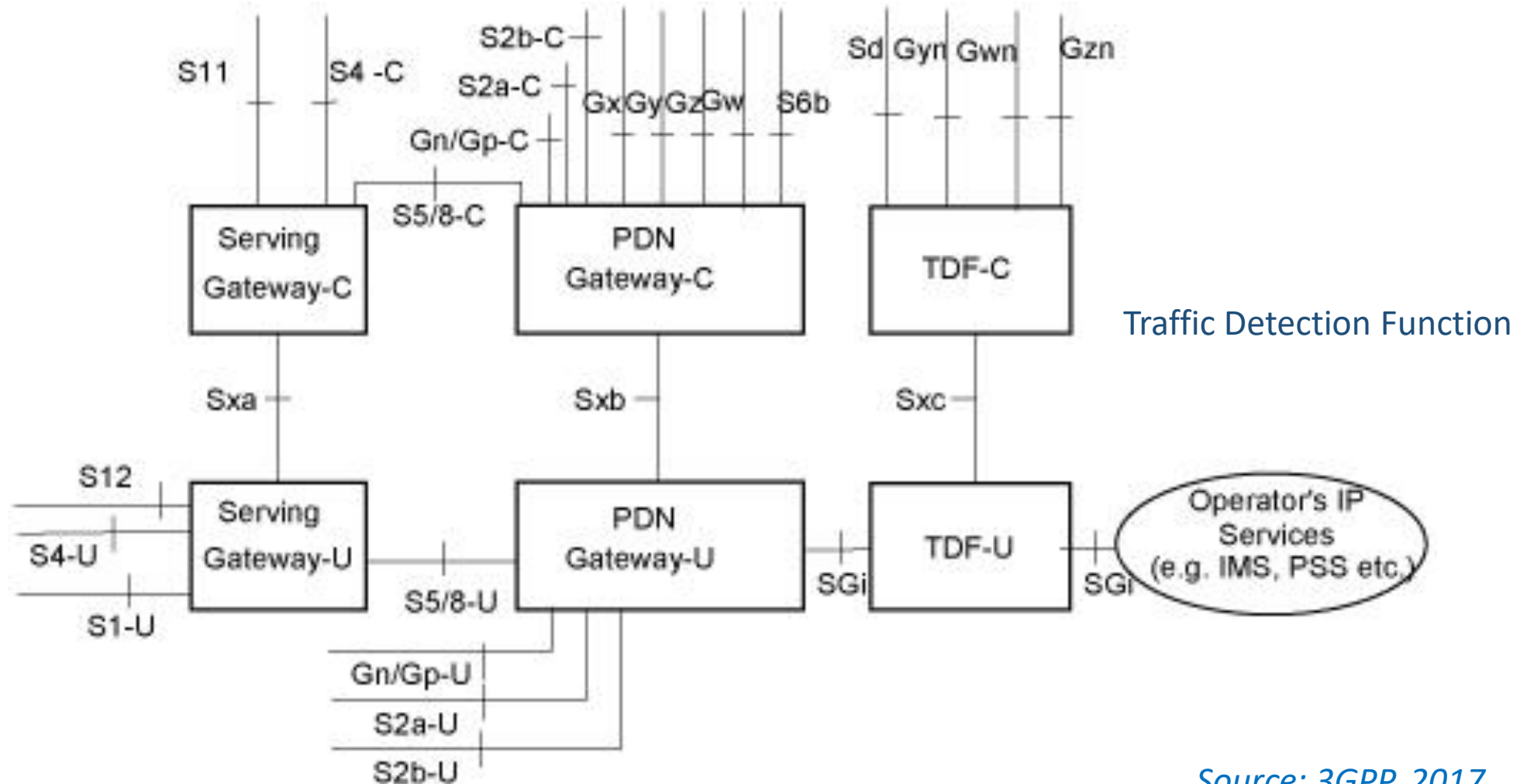
4G Evolved Packet Core: Control & User Plane Split



Source: 3GPP, 2016



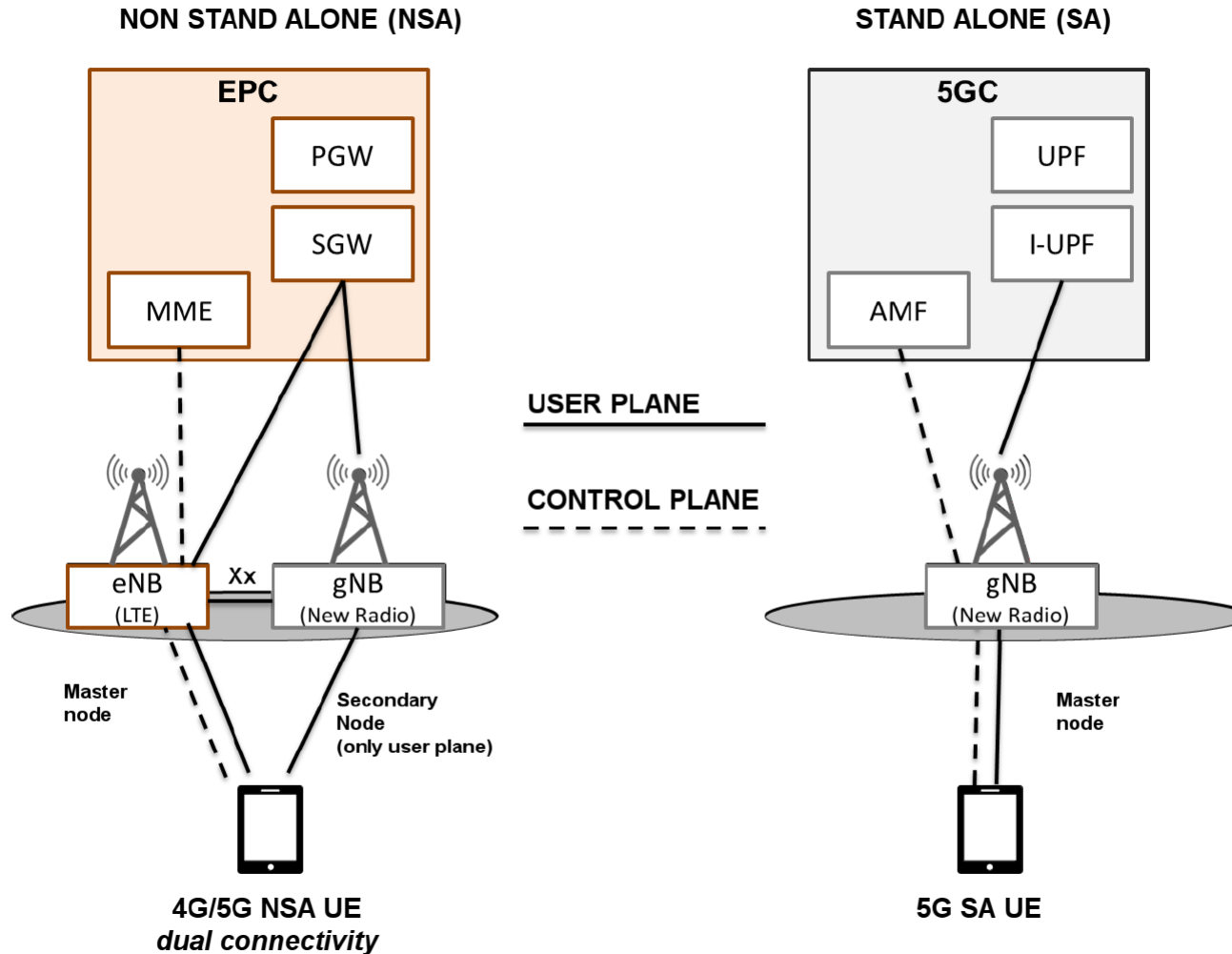
CUPS: Control & User Plane Separation



Source: 3GPP, 2017



5G Architecture: NSA & SA

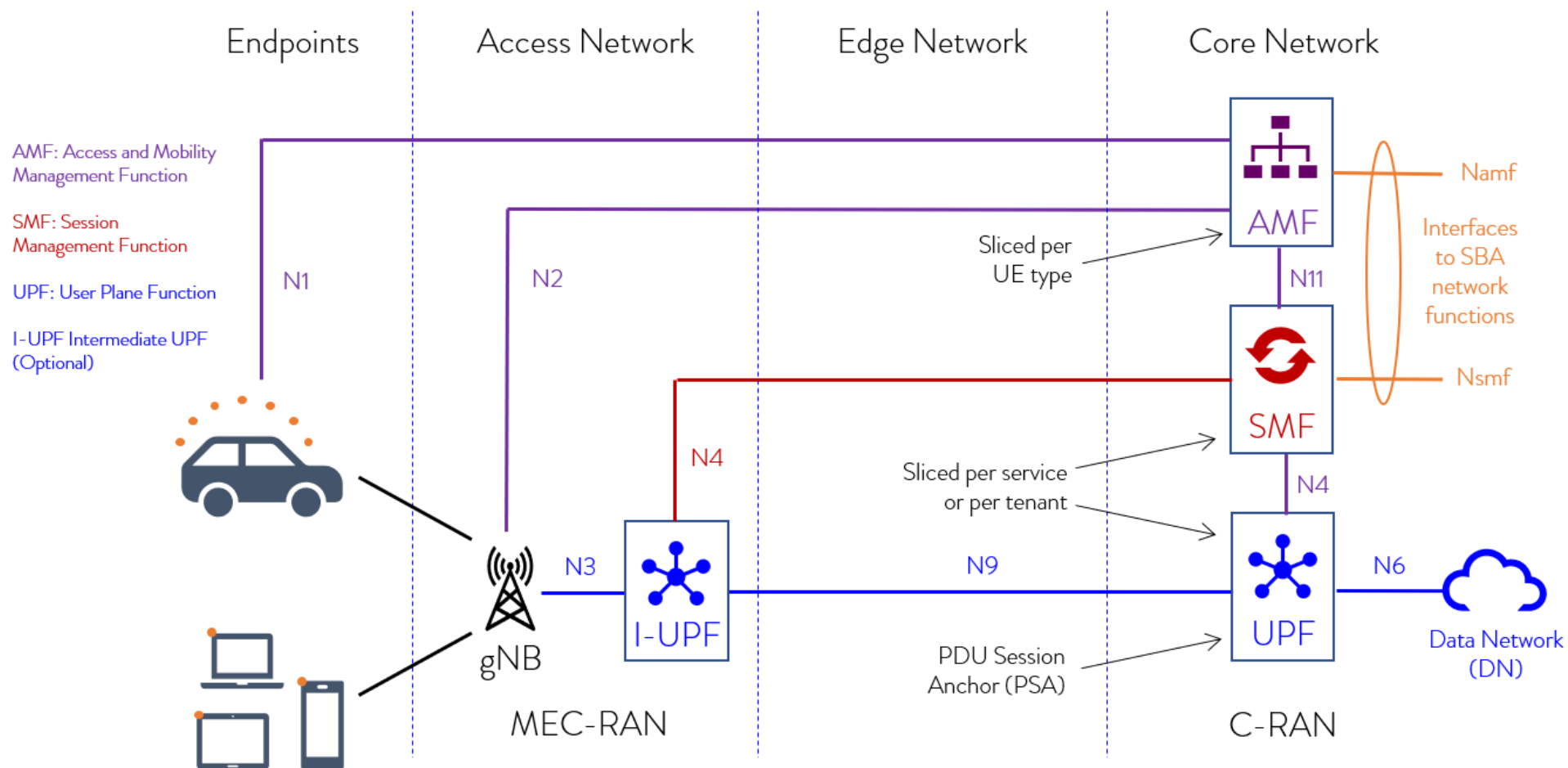


Non Stand Alone
Stand Alone
Evolved Packet Core
Packet Gateway
Serving Gateway
Mobility Management Entity
5G Core
Access & Mobility Function
User Plane Function
Intermediate User Plane Function
Next generation Node B

Source: 3GPP, 2017



5G Core Reference Point Architecture

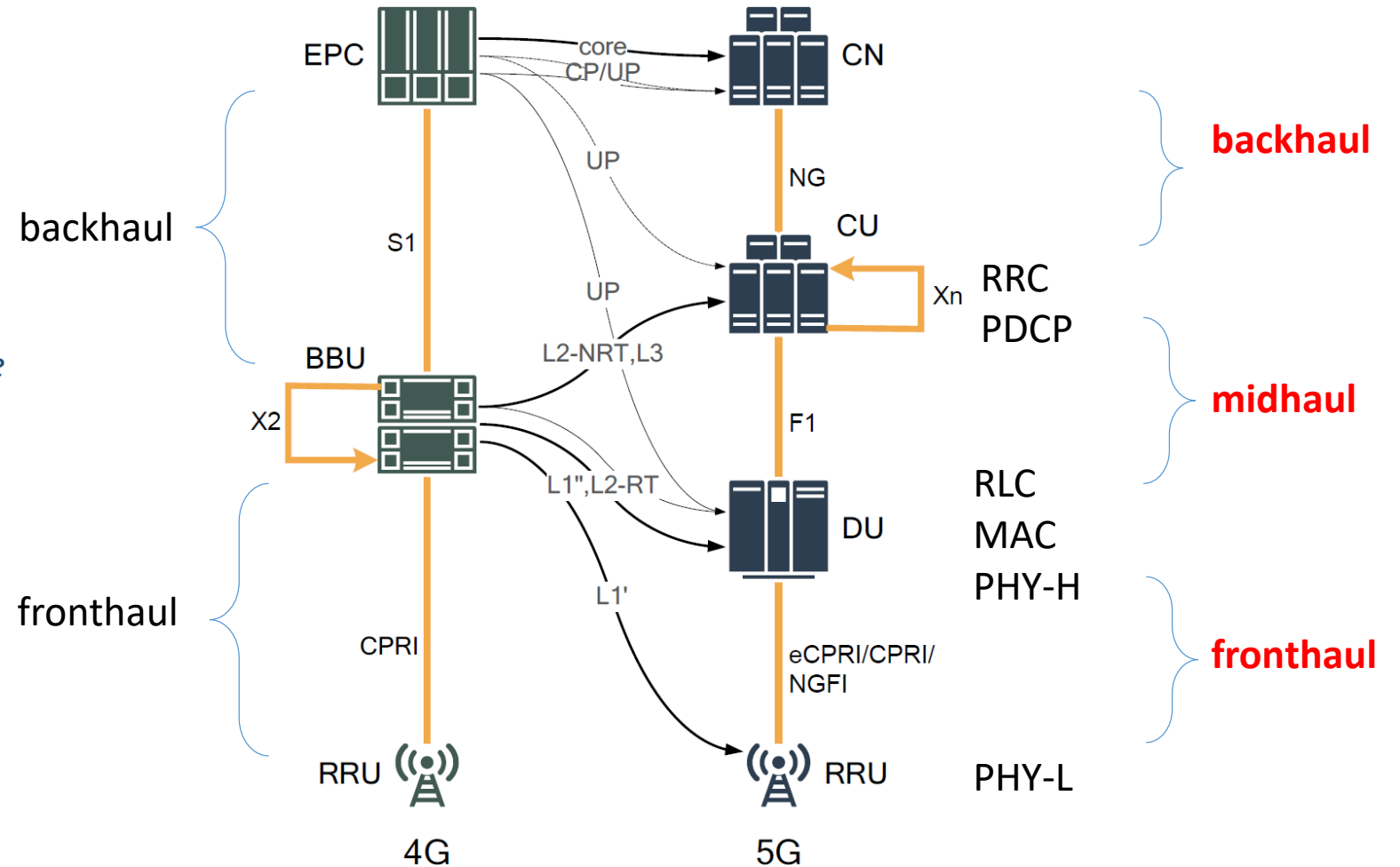


Source: Metaswitch, 2019



Evolved vRAN, from 4G to 5G

- **Physical Lower & Higher**
- **Medium Access Control**
- **Radio Link Control**
- **Packet Data Convergence Control**
- **Radio Resource Control**
- *Common Public Radio Interface*
- *Evolved CPRI*
- *Next Generation Fronthaul Interface*
- *Core Network*
- *Centralized Unit*
- *Distributed Unit*
- *Evolved Packet Core*
- *Base Band Unit*
- *Remote Radio Unit*
- *Control Plane/User Plane*
- *Real Time*
- *Near Real Time*

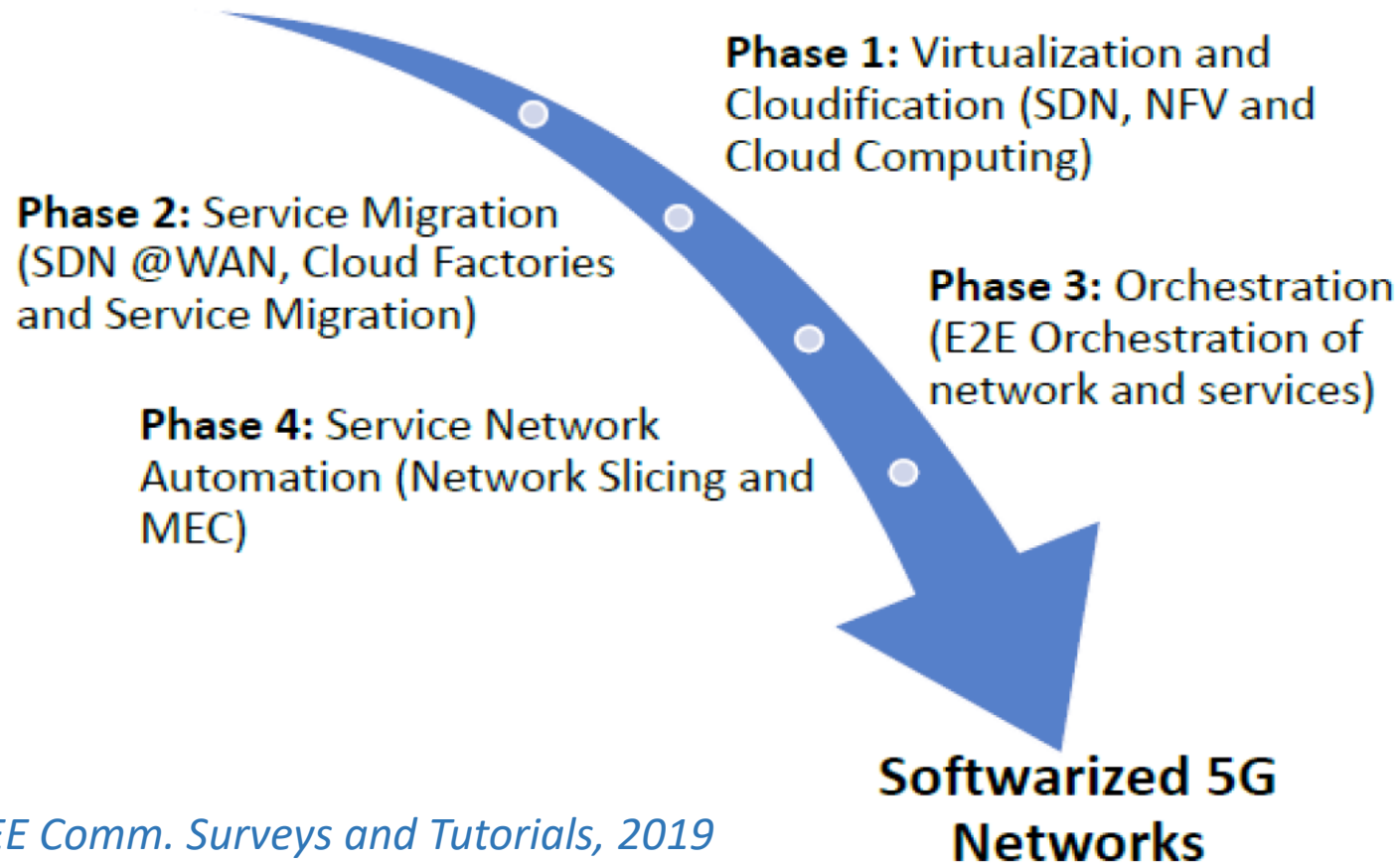


Source: 3GPP, 2016



Network Softwarization Phases in 5G

Traditional Mobile Networks



R- Kahn et alii, IEEE Comm. Surveys and Tutorials, 2019



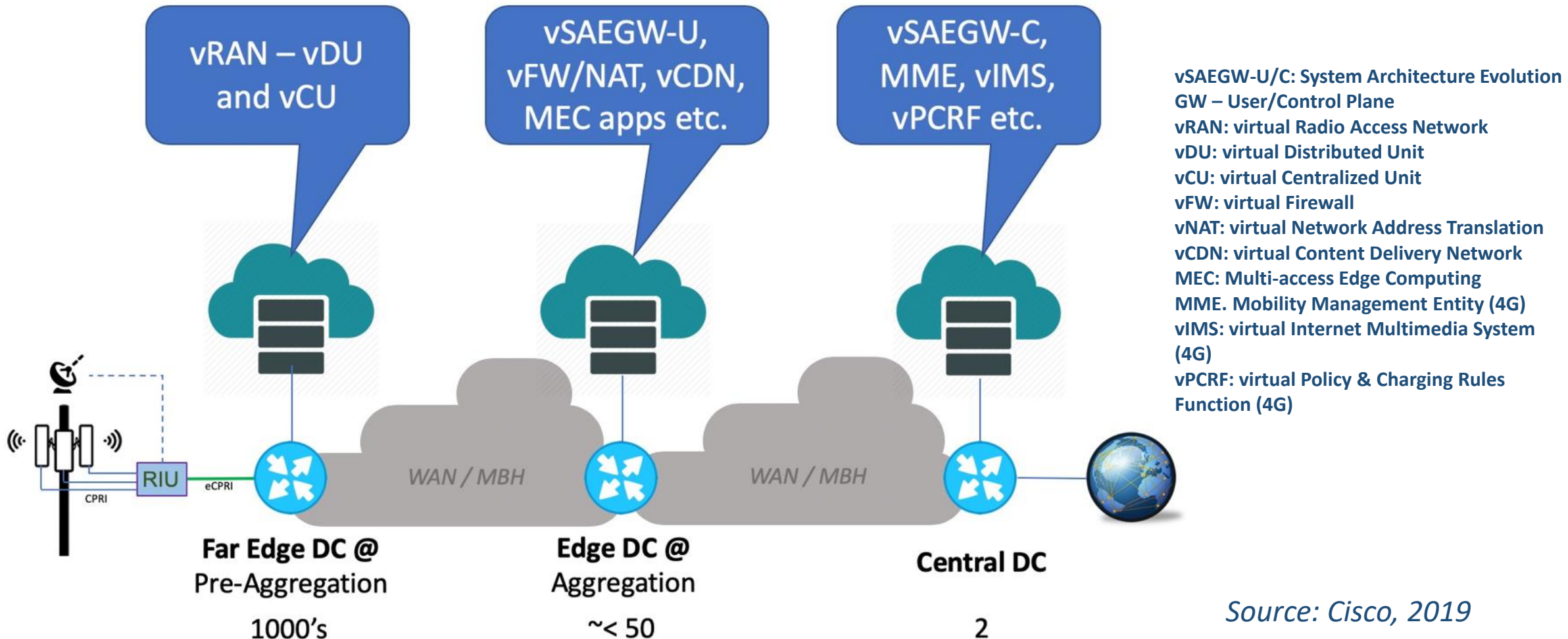
Edge Computing Applications

- Network Performance and QoE improvements
 - Content/DNS Caching (**high QoE**)
 - **Performance Optimization: Protocol Accelerators** (**lower network bandwidth cost**)
- Consumer-oriented services
 - Augmented and Virtual Reality (**low latency, high performance**)
 - Gaming (**low latency, high performance**)
- Operator and third party services
 - **Big Data & Artificial Intelligence services** (**local data storage –via blockchain records- & AI processing towards core application**)
 - Enterprise services (**managed services**)
- 5G IoT Vertical Market Services
 - **IoT Gateways**
 - IoT Connected Cars (**low latency**)
 - IoT Smart Environment (**big data volumes**)
 - IoT Industry 4.0 (**low latency**)
 - IoT Drones (**low latency**), etc.





Distributed Cloud Networking



Source: Cisco, 2019