Network slicing e nuovi paradigmi di rete nei sistemi cellulari di 5a generazione

Stefano Tomasin
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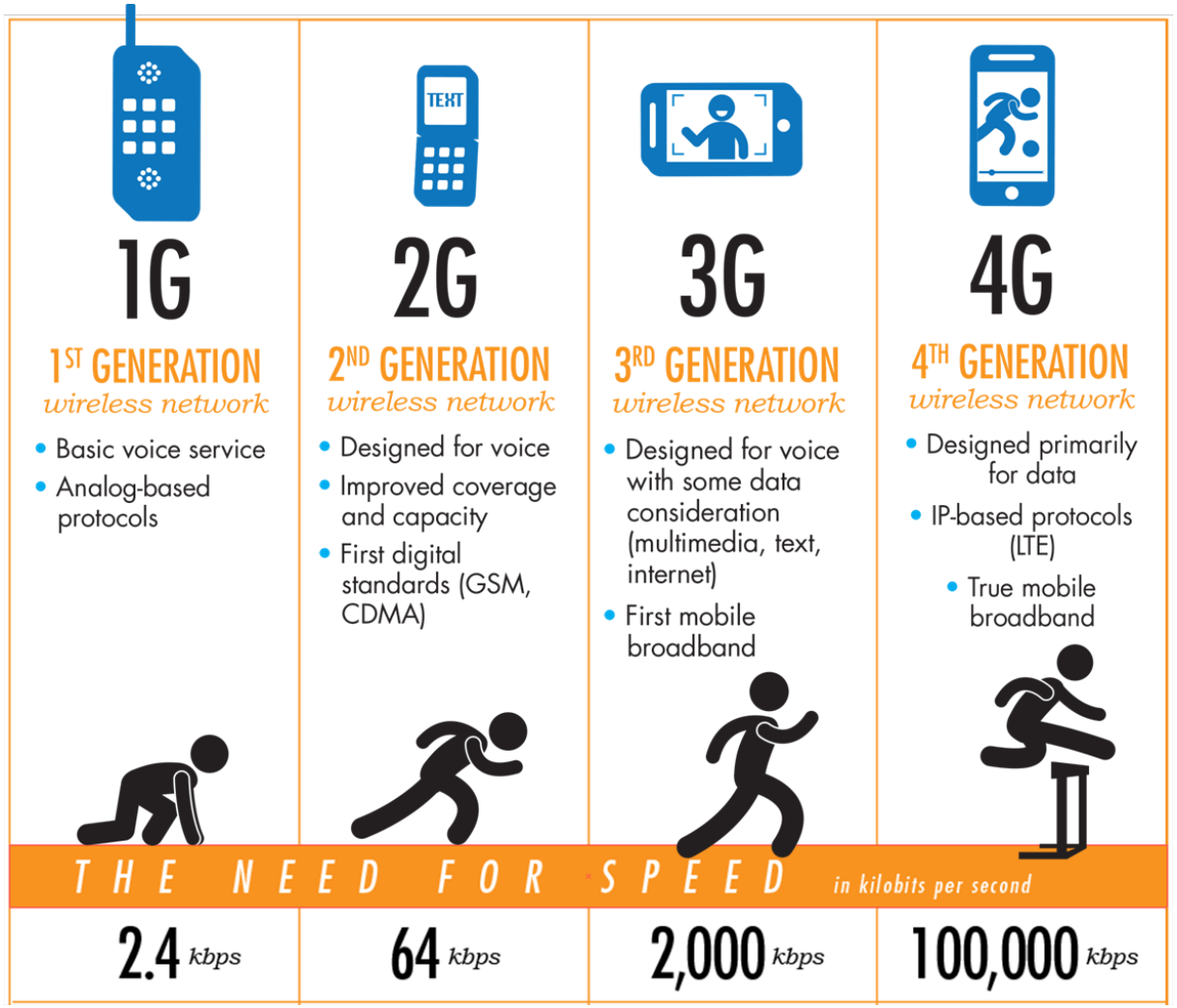
UNIVERSITÀ
DEGLI STUDI
DI PADOVA

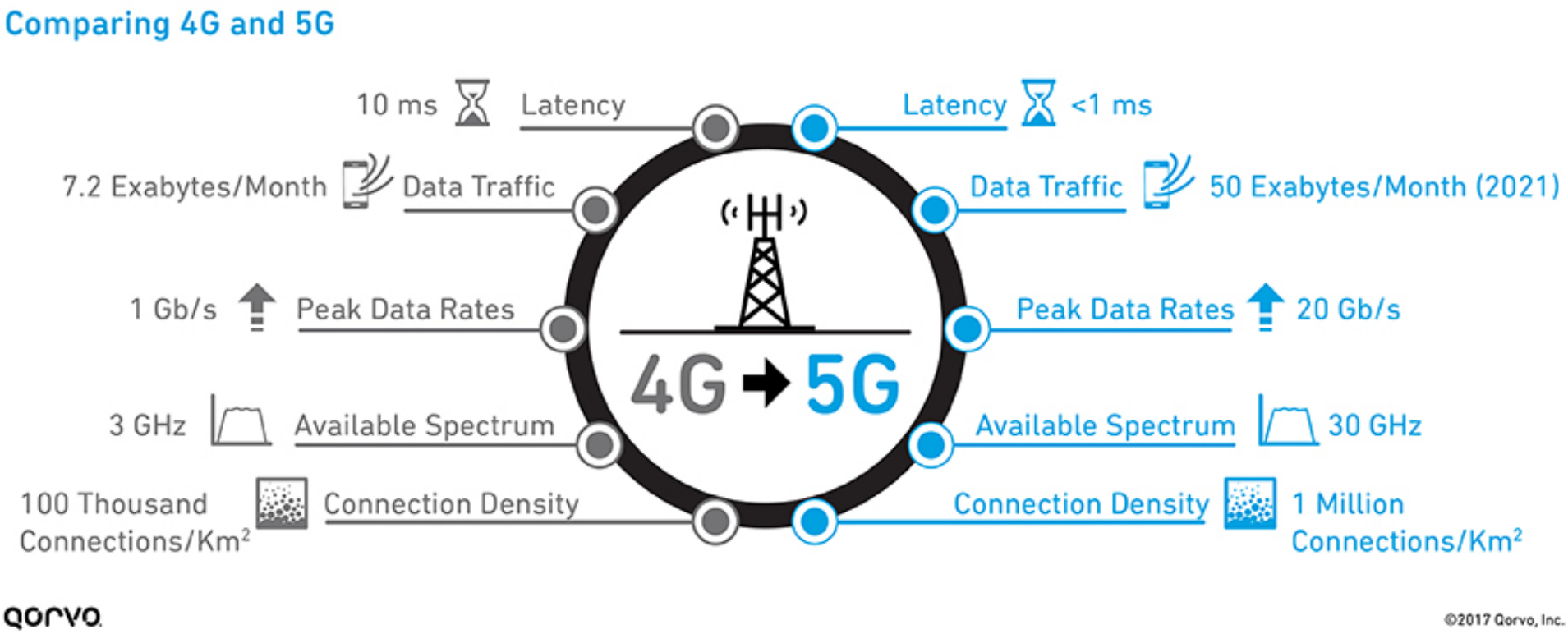
Cellular System Evolution



5G

Releases and Specifications

- The cellular communications systems are continuously evolving by releases produced by 3GPP
- Examples:
  - Release 8 LTE Introduced
  - Release 9 Enhancement to LTE
  - Release 10 LTE Advanced
  - Release 11 Enhancement to LTE Advanced
  - Release 12 Further enhancement to LTE Advanced
  - Release 13 Meeting the growing throughput demand
  - Release 14 The start of 5G standardization
  - Release 15 First release of 5G
- Technical Specification (TS) collects the system feature and are the first official document for a release


Comparing 4G and 5G
10 ms
Latency
Latency
<1 ms
7.2 Exabytes/Month
Data Traffic
Data Traffic
50 Exabytes/Month (2021)
1 Gb/s
Peak Data Rates
Peak Data Rates
20 Gb/s
3 GHz
Available Spectrum
Available Spectrum
30 GHz
100 Thousand Connections/Km²
Connection Density
Connection Density
1 Million Connections/Km²
4G → 5G
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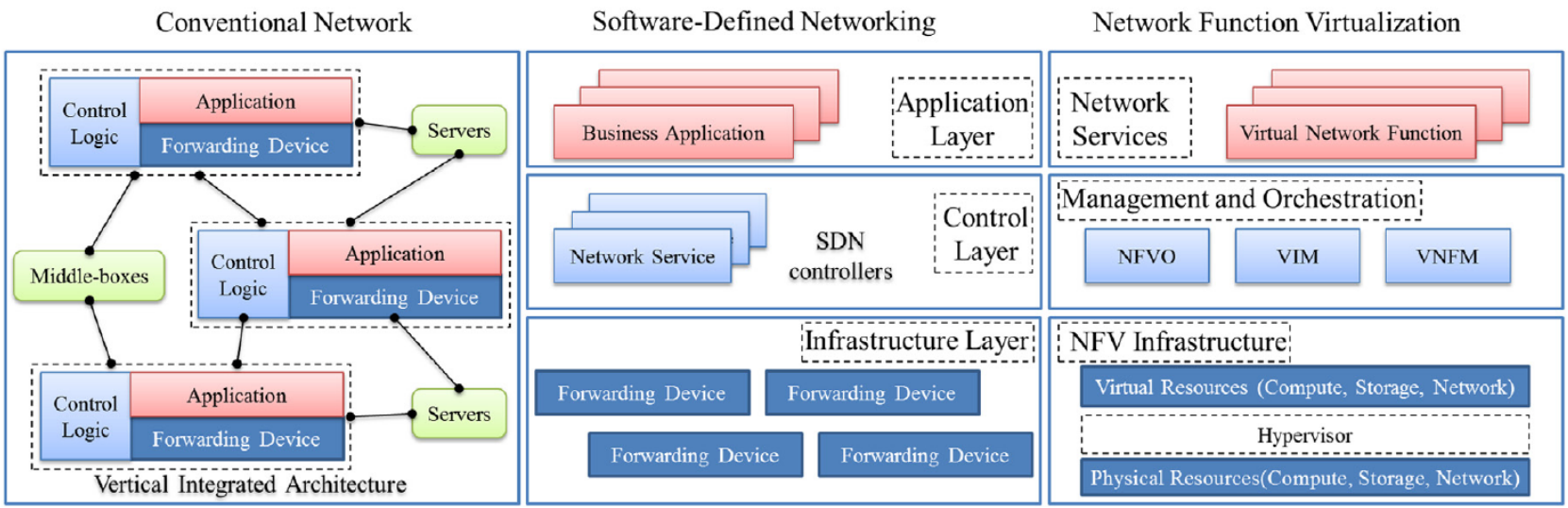
What is 5G?

- Technically the IMT-2020 is a program of the ITU, the United Nations specialized agency for ICT
- IMT-2020 was started by ITU in 2008

Targets:

- **Enhanced Mobile Broadband**: data rates up to Gbit/s to the end users
- **Critical Communications**: self-driving cars, mission critical broadband application, industrial and vehicular automation, and augmented reality
- **Massive Machine Type Communications**: Internet of Things
- **Network Operations**: operational requirements of 5G networks

Three Network Philosophies

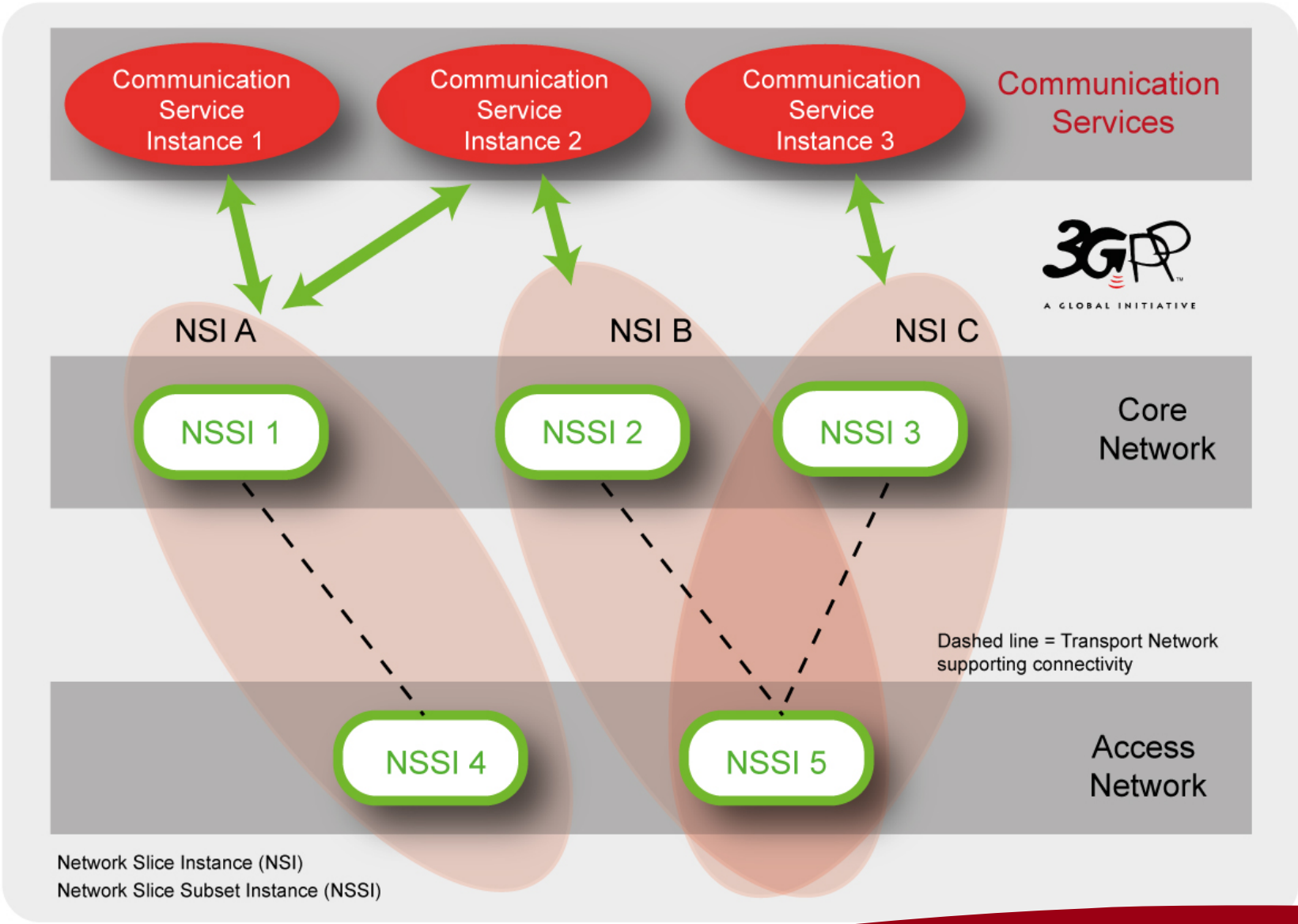


Network Slicing

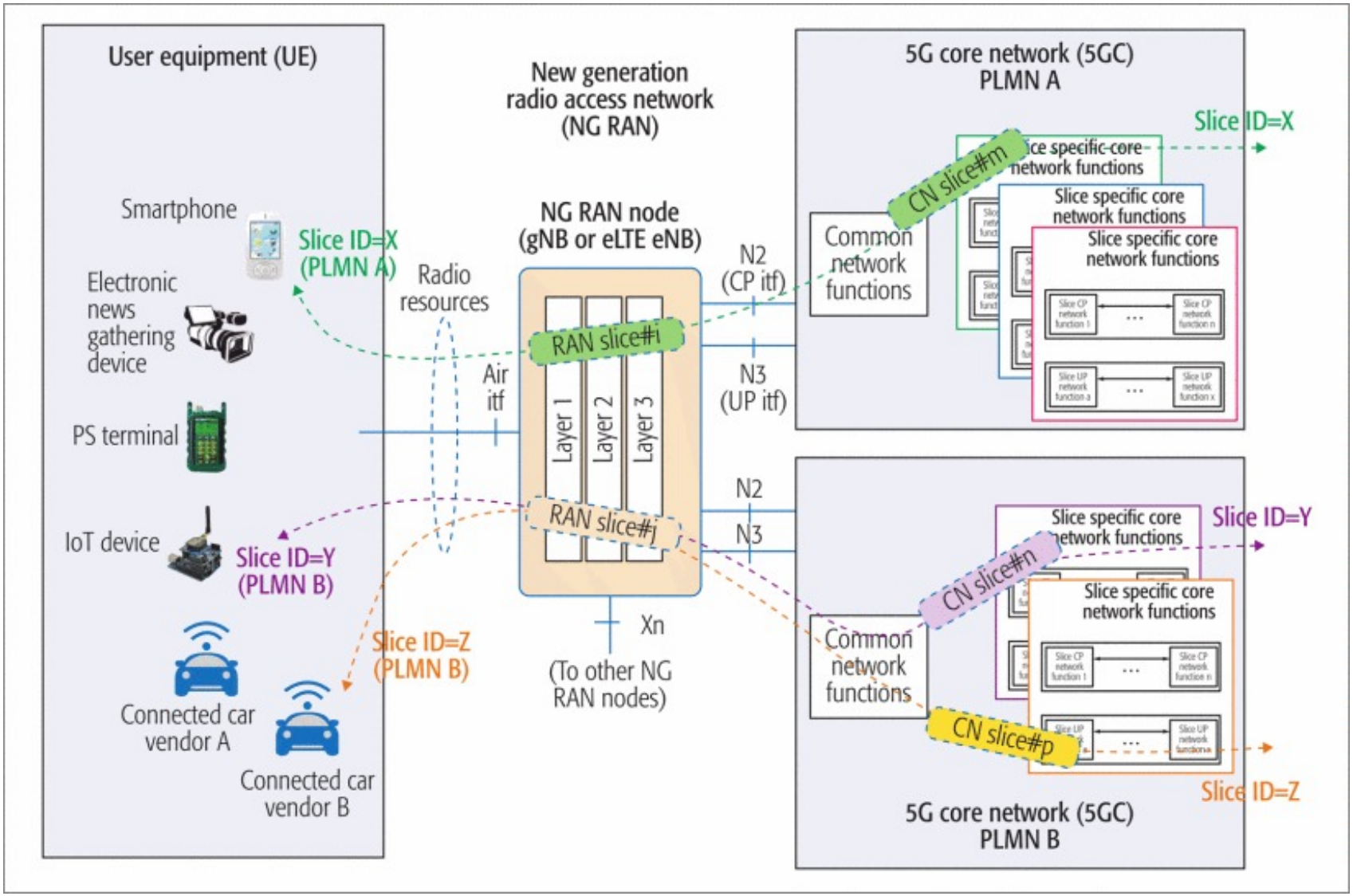
Network slicing is a fundamental capability for future Fifth Generation (5G) networks to facilitate the cost-effective deployment and operation of multiple logical networks over a common physical network infrastructure in a way that each logical network (i.e. network slice) can be customized and dimensioned to best serve the needs of specific applications (e.g. mobile broadband, smart city, connected car, public safety, fixed wireless access) and users (e.g. general public, enterprise customers, virtual operators, content providers).

R. Ferrus, O. Sallent, J. Perez-Romero and R. Agusti, "On 5G Radio Access Network Slicing: Radio Interface Protocol Features and Configuration," in IEEE Communications Magazine, vol. 56, no. 5, pp. 184-192, May 2018.

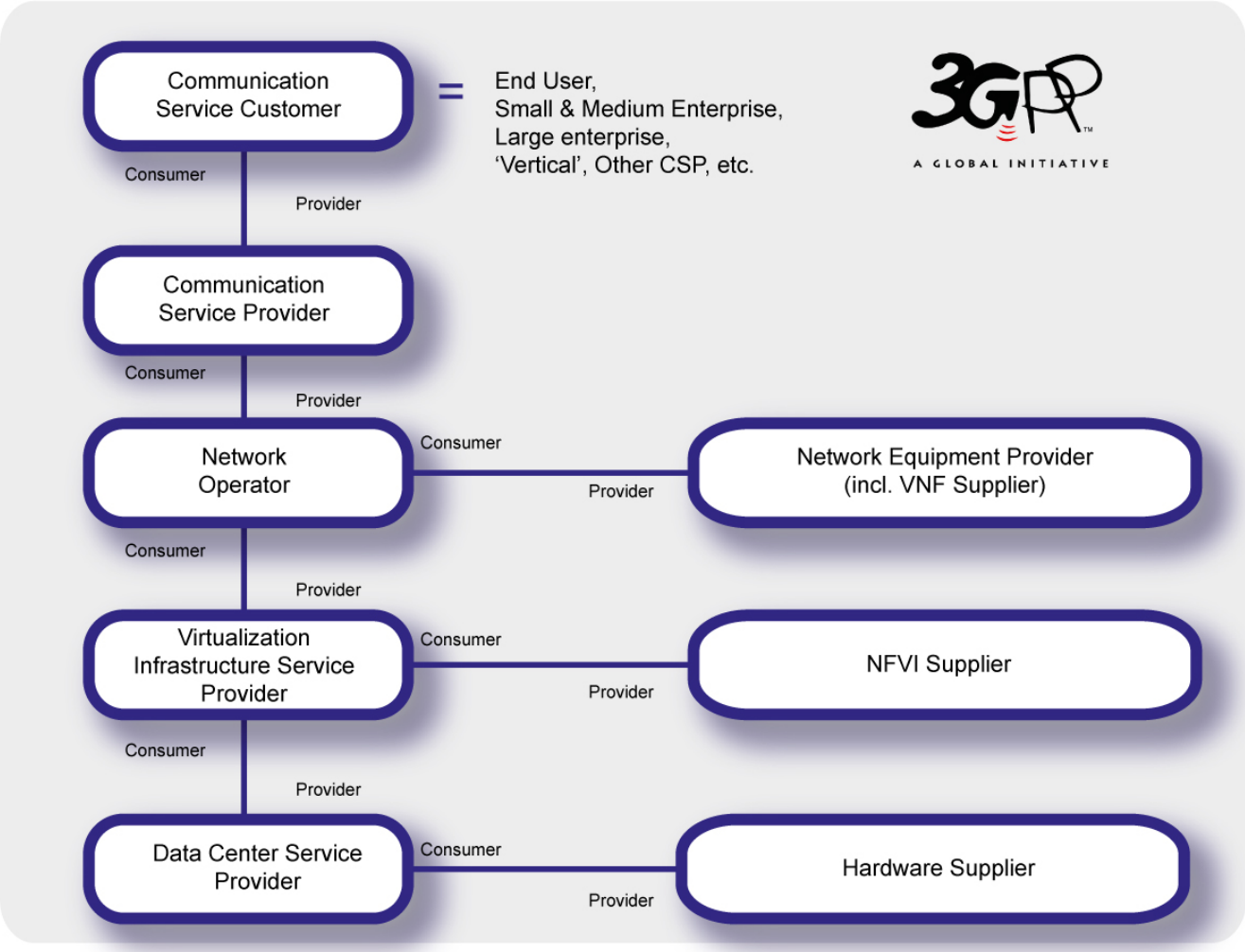
5G Network Slicing Architecture



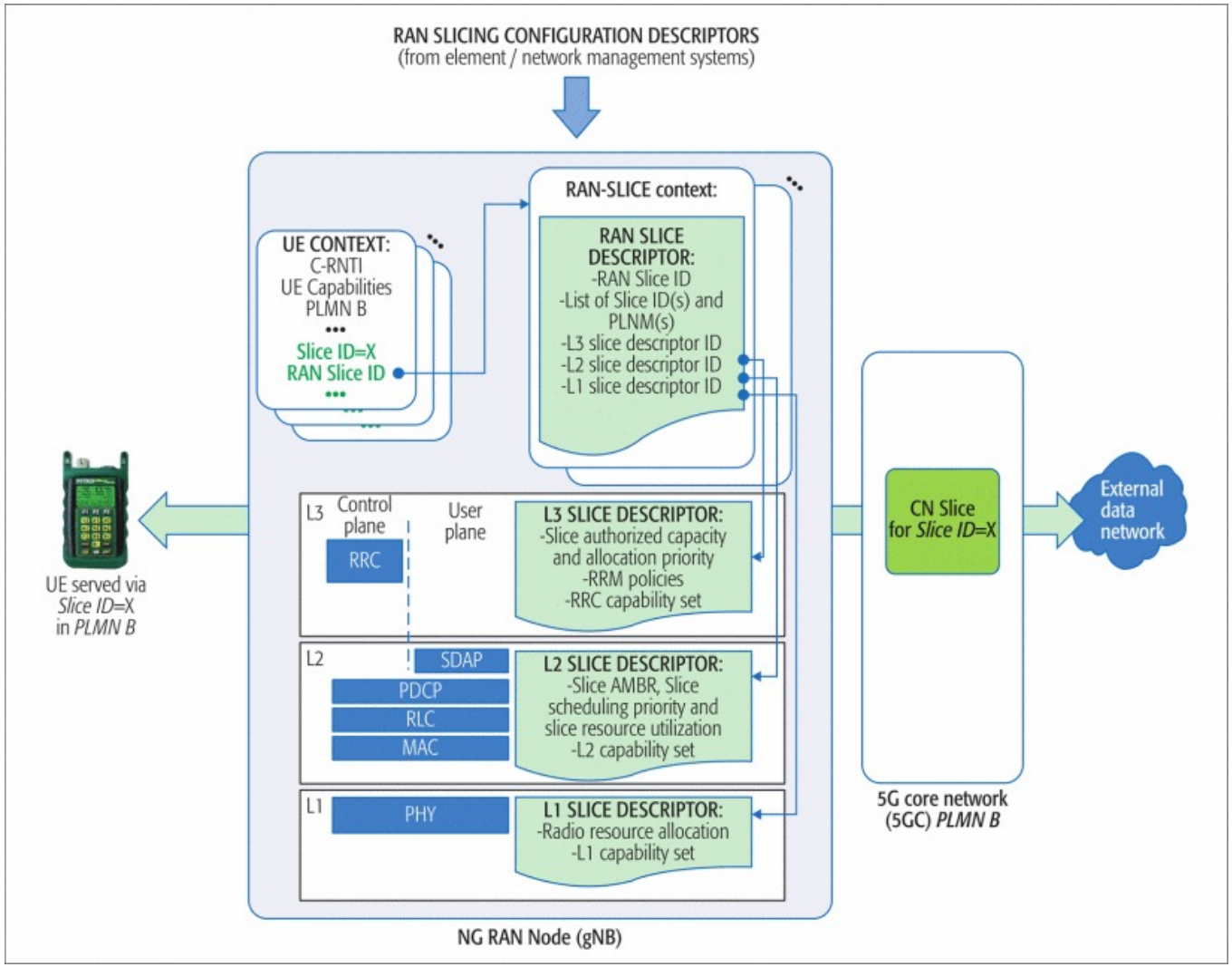
5G NS Example



Roles in Network Slicing



RAN Slice Configuration



Each UE can be associated to many slices
Lx: layer x; PLMN: public land mobile network

- From a functional perspective, operation of each slice through a set of configuration descriptors that parametrizes the features, policies and resources put in place across the radio protocol layers of the RAN node.

NS Type	Characteristics
eMBB (enhanced Mobile Broadband)	Slice suitable for the handling of 5G enhanced Mobile broadband, useful, but not limited to the general consumer space mobile broadband applications including - streaming of High Quality Video, - Fast large file transfers etc. It is expected this SST to aim at supporting High data rates and high traffic densities
URLLC (ultra- reliable low latency communications)	Supporting ultra-reliable low latency communications for applications including, - industrial automation, - (remote) control systems.
MIoT (massive IoT)	Allowing the support of a large number and high density of IoT devices efficiently and cost effectively

Future Trends

- Softwarization of resources is spreading
- Flexibility in management and fast application developments are key success factors
- 5G systems have yet to define many network function and fully deploy network slicing