5G – Un nuovo concetto di rete TLC

5G IA
INFRASTRUCTURE ASSOCIATION

The voice of the European industry for the developement, deployment and evolution of 5G

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TIM Board Member 5G PPP

Università «La Sapienza» – 30 Aprile 2019

Un pò di Storia

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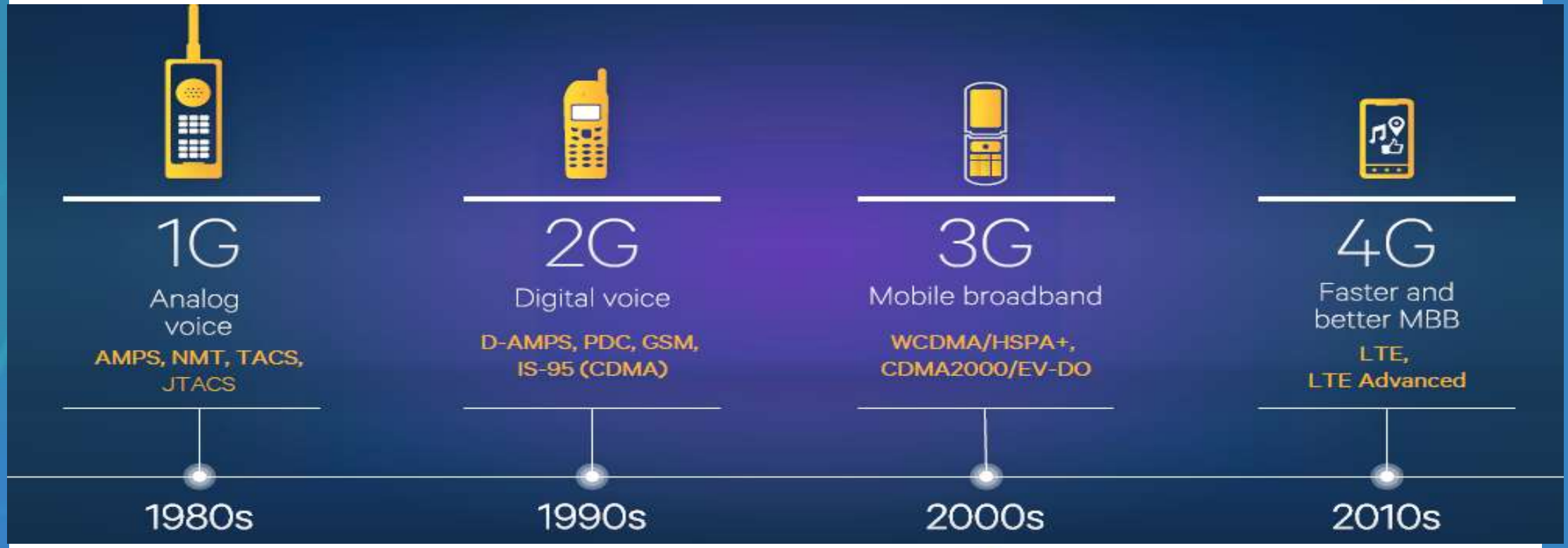

GSMA

ITALIA'90

WAP

Arriva il 5G

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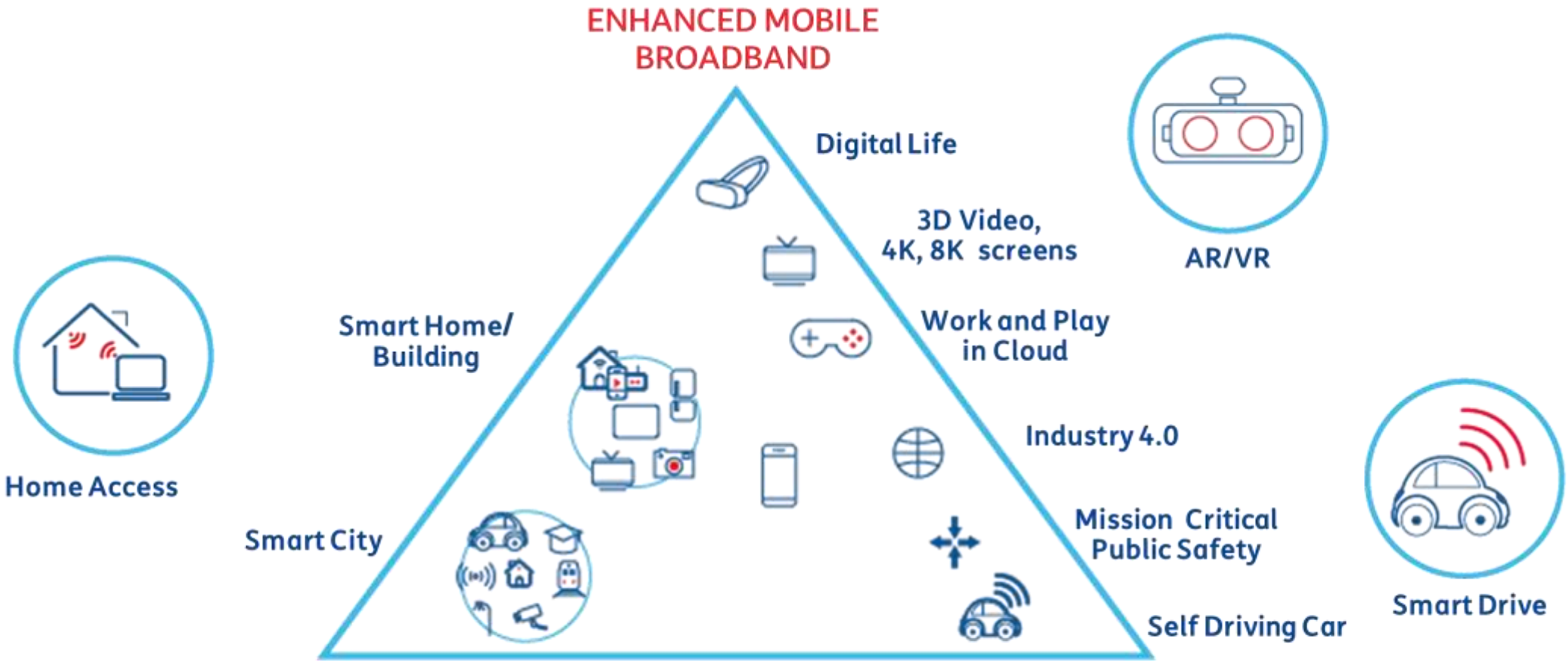
Generation	Primary services	Key differentiator	Weakness (addressed by subsequent generation)
1G	Analogue phone calls	Mobility	Poor spectral efficiency; major security issues
2G	Digital phone calls and messaging	Security, roaming, mass adoption	Limited data rates – difficult to support internet/e-mail demand
3G	Phone calls, messaging, data	Better internet experience	Real performance failed to match hype; failure of WAP for internet access
3.5G	Phone calls, messaging, broadband data	Broadband internet, applications	Tied to legacy, mobile-specific architecture and protocols
4G	All-IP services (including voice, messaging)	Fast broadband internet, lower latency	Not optimised for IoT scaling; limited flexibility to support bespoke services across industry verticals; inadequate for next generation services
5G	All-IP services, new technology sectors, verticals and end-users	Faster and higher-capacity broadband internet, lower (real time) latency, multi-access, multi-layered	M2M

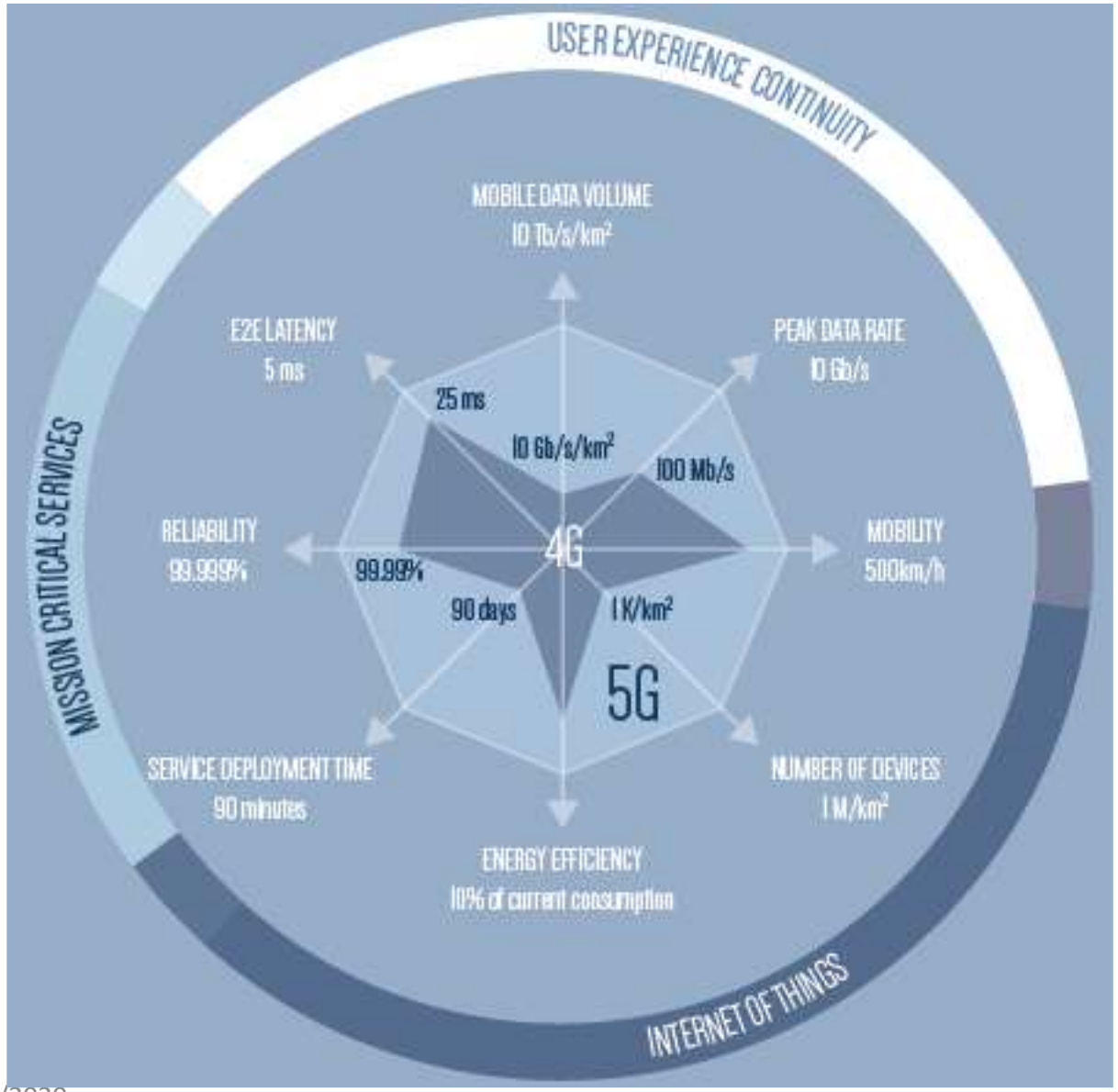
Source: GSMA

- Le generazioni pre 5G sono nate Human Centric
- 5G è la prima generazione di rete Machine oriented

5G – scenari di servizio



5G – Specifiche tecniche



- Prestazioni migliorate per un fattore x (x=10,10,1000) rispetto al 4G

- Per ottenere queste prestazioni bisogna usare nuove tecnologie ed architetture di rete:
  - SDN/NFV
  - New Radio
  - MEC
  - Cloud RAN/Small Cells
  - Antenne intelligenti
  - Network Slicing
  - MANO
  - AI

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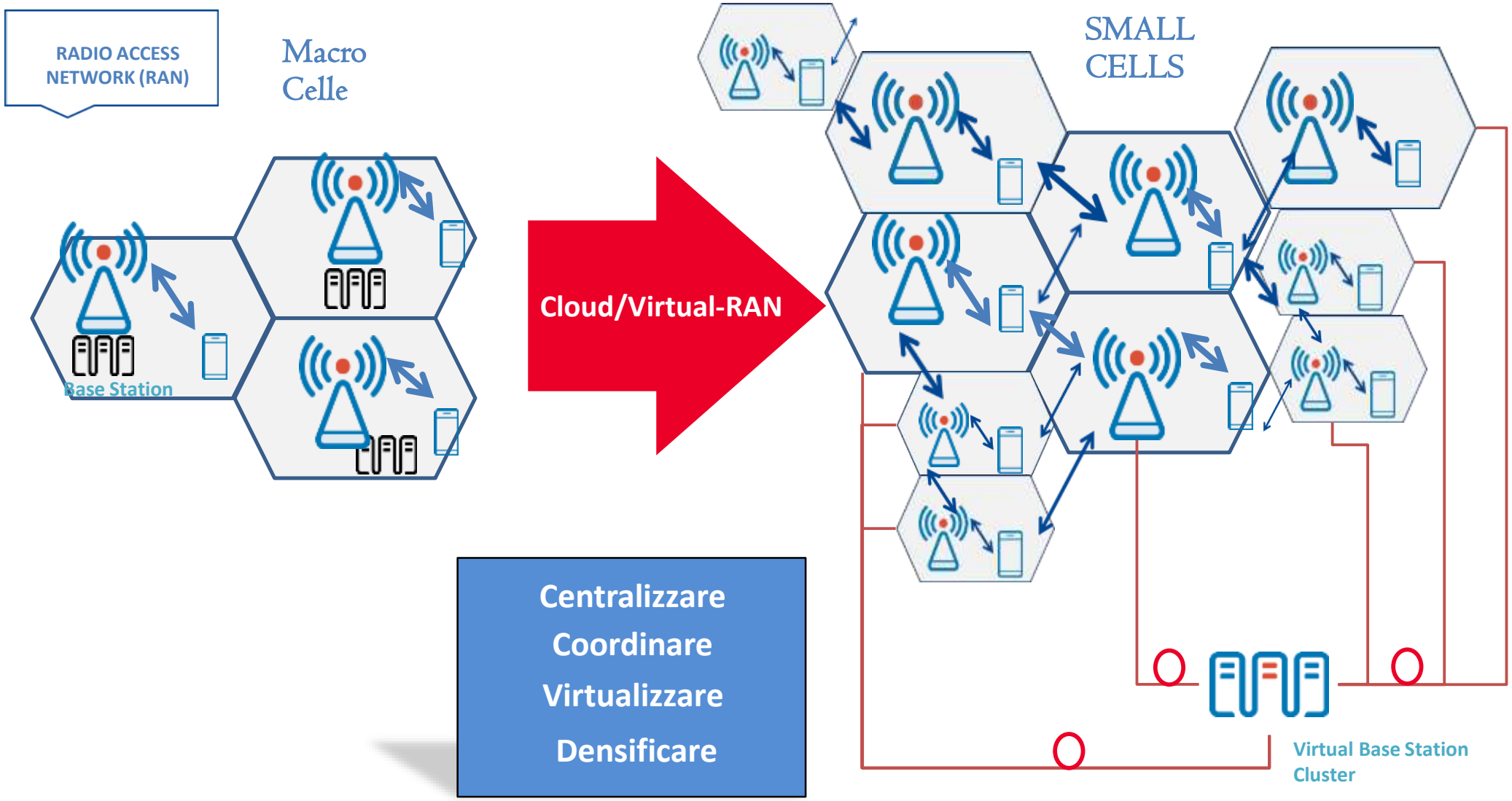
5G – Cloud RAN



Centralizzare
Coordinare
Virtualizzare
Densificare

5G – Antenne Attive

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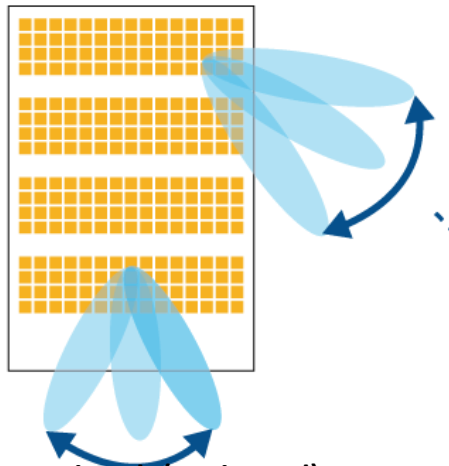
Dettaglio antenna attiva



Tecniche di beamforming

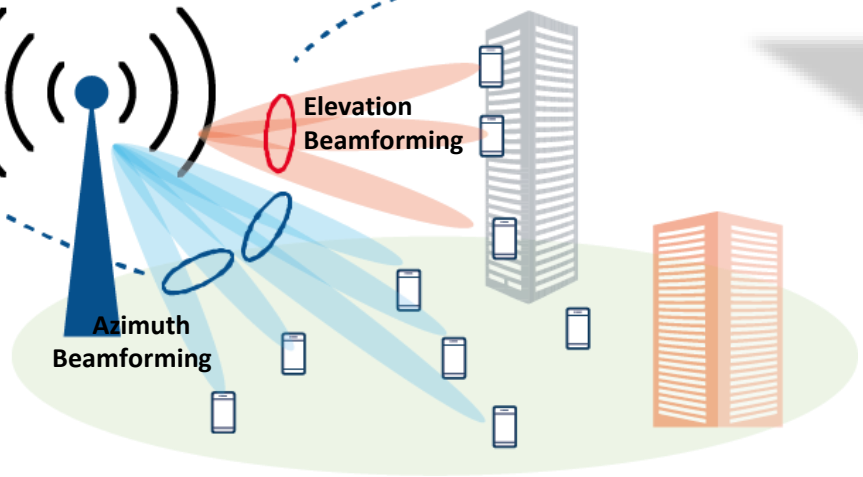
- Multi User
- Full Dimensional/3D
- Massive MIMO

Sistemi Smart Antenna

- Antenna a schiera con centinaia di elementi radianti e sistemi attivi
- Crescono
  - Capacità
  - Efficienza spettrale

Onde millimetriche (mmWaves)

Alte frequenze radio
Elevate larghezze di banda



5G – NFV/SDN (Virtualizzazione)

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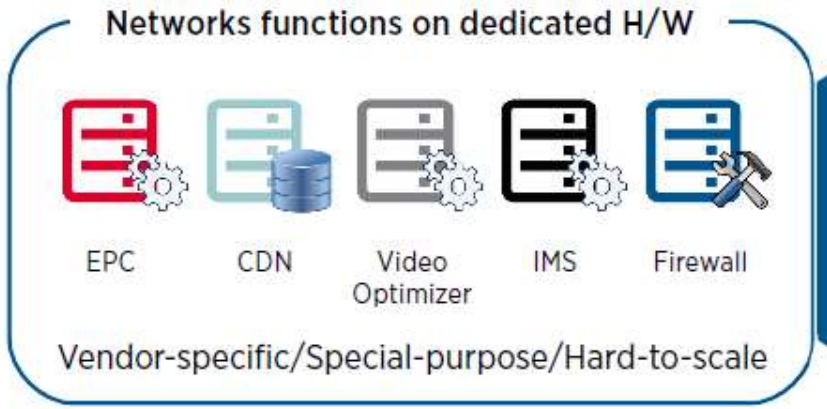
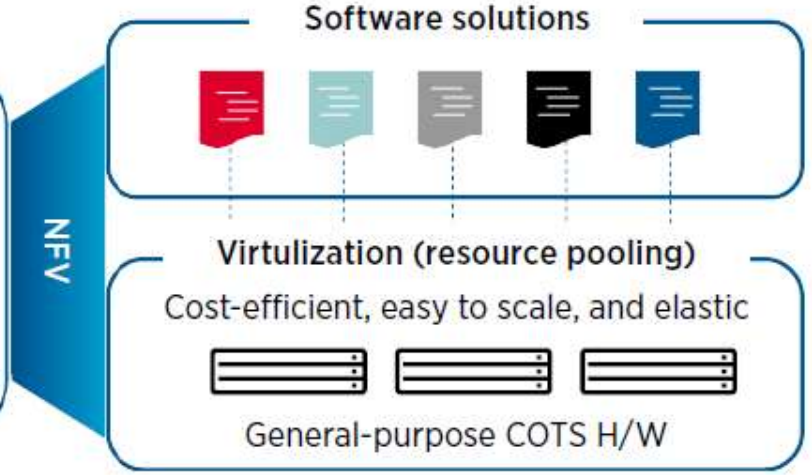
Traditional Networks



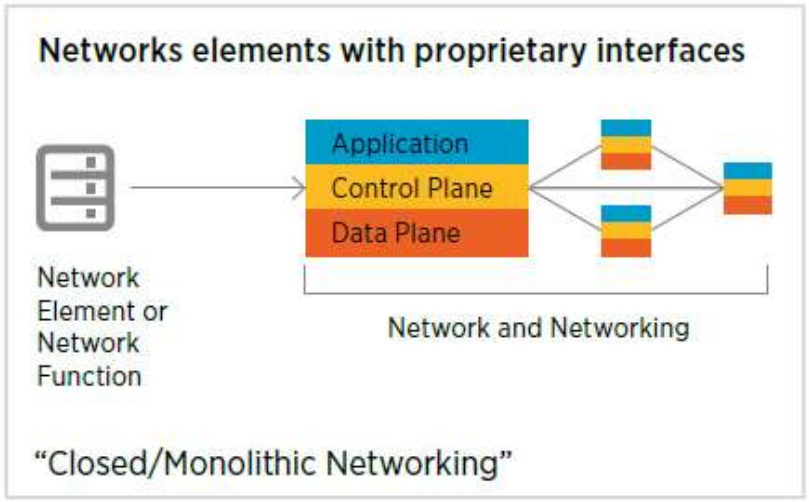
Networks with NFV



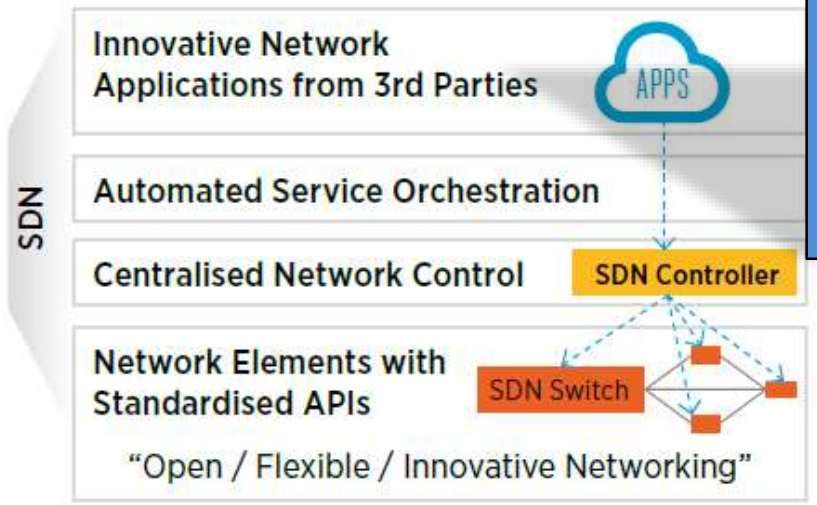
Cambi di paradigma

- Funzioni di rete: da HW dedicato a SW Open Source
- Architettura di Rete: da rete rigida monolitica a «rete di reti» programmabili specializzate per servizi verticali, da rete a nodi a Cloud Network (Network Data Centres)

Traditional Networks



Networks with SDN



5G – Network Slicing

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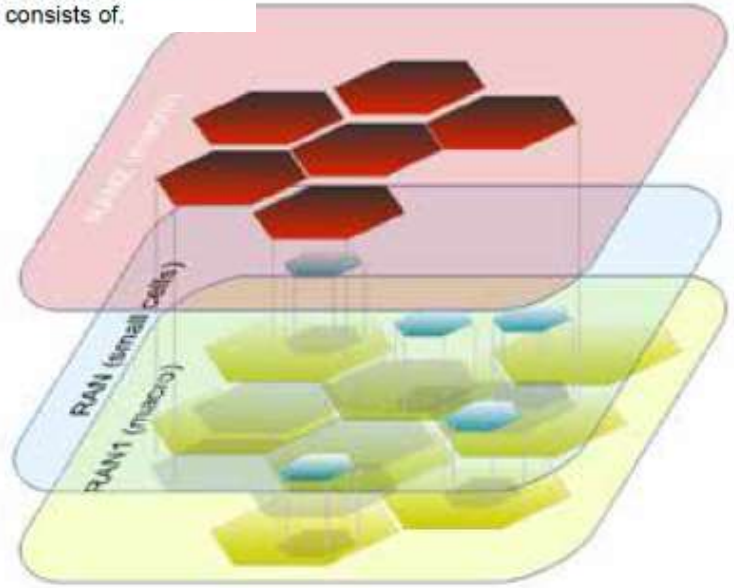
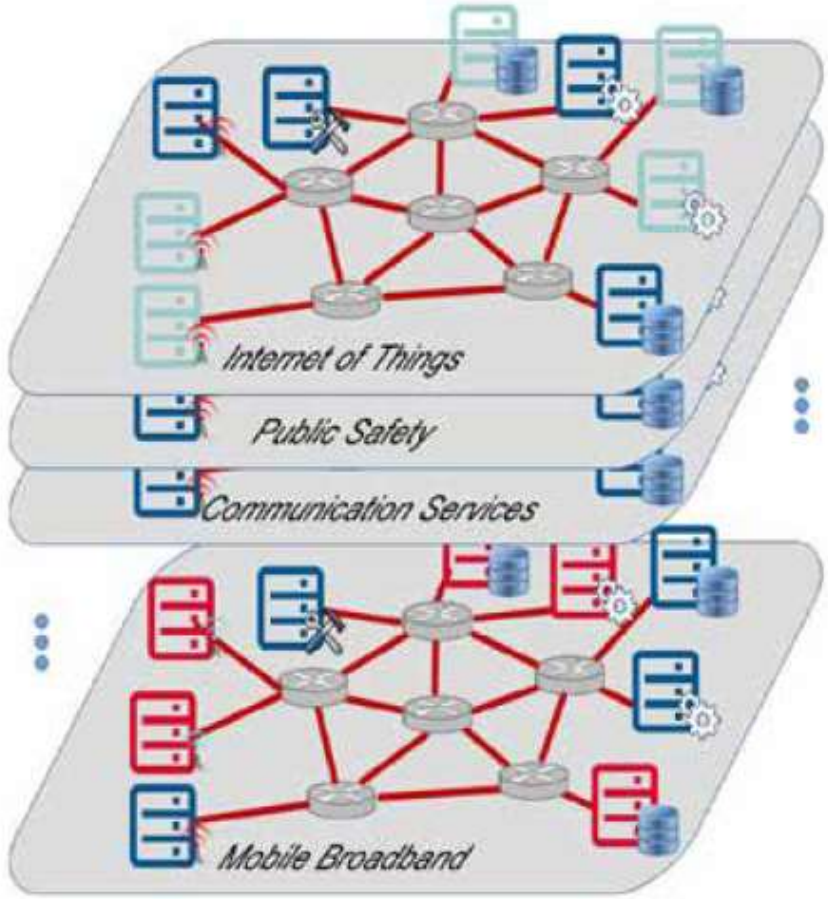
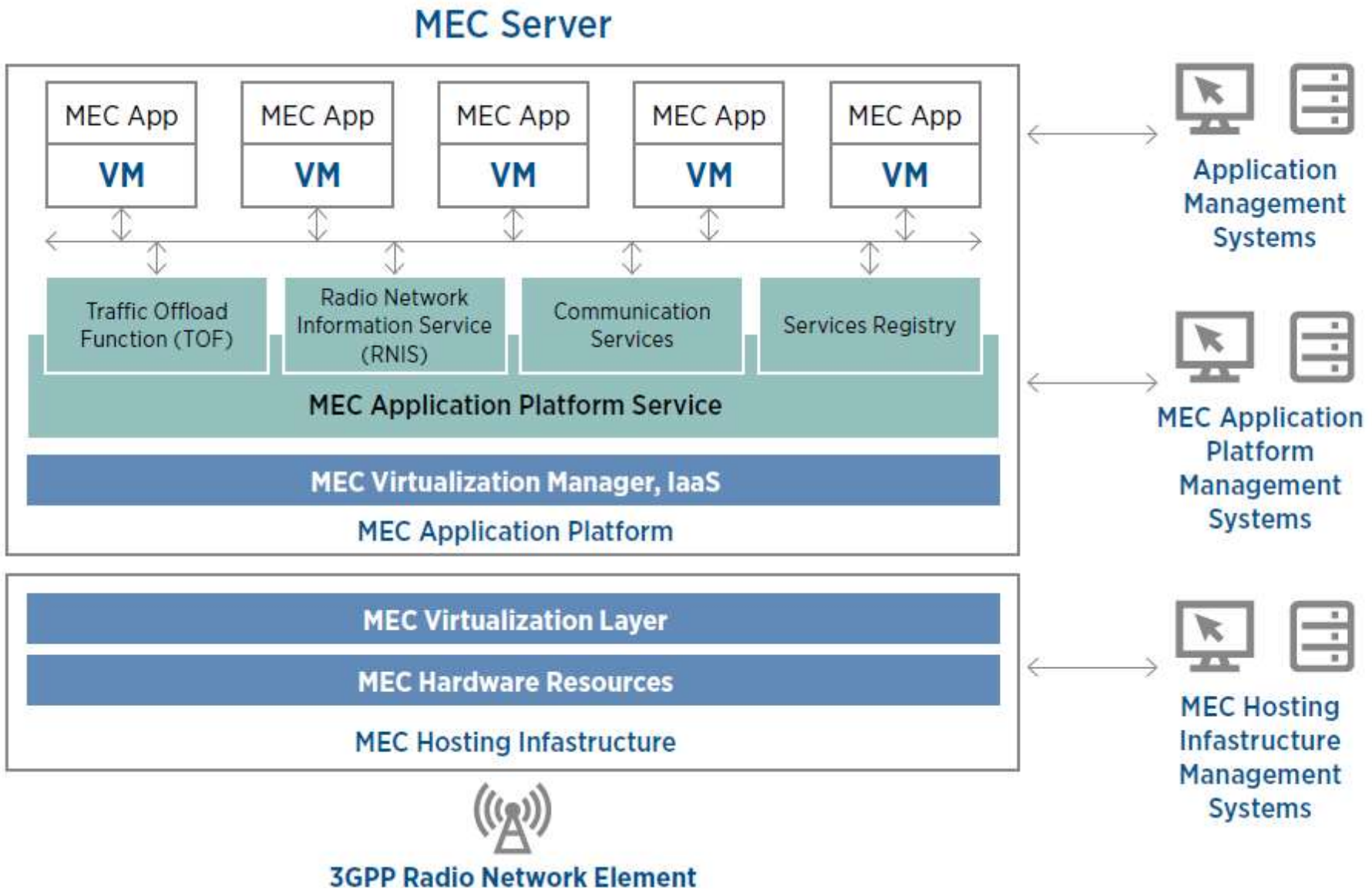
Network Slicing provider: Typically a telecommunication service provider, is the owner or tenant of the network infrastructures from which network slices are created. The Network Slicing provider takes the responsibilities of managing and orchestrating corresponding resources that the Network Slicing consists of.





Network Slice: A network slice is a logical network that provides specific network capabilities and network characteristics in order to serve a defined business purpose of a customer. Network Slicing allows multiple virtual networks to be created on top of a common shared physical infrastructure. A network slice consists of different subnets, example: Radio Access Network (RAN) subnet, Core Network (CN) subnet, Transport network subnet.

5G – Mobile Edge Computing



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Killer Application Industriale - Automotive

- L'Automotive rappresenta il campo di applicazione 5G con maggior hype nel campo industriale – latenza e affidabilità 5G sono chiave per:
  - Automazione crescente della guida («CAD»)
  - Servizi di mobilità intelligente («C-ITS»)
  - Limiti delle soluzioni basate su WiFI («G5»)
  - Aumento della Sicurezza: mortalità degli incidenti ha raggiunto un limite inferiore naturale per la guida umana

- **5G Action Plan (UE)**: prevede la copertura 5G di tutte le città e le vie di trasporto terrestri al 2025

- Stanziati ingenti fondi strutturalo europei («CEF») per la copertura dei principali corridors europei di connettività 5G (tra cui il Brennero)

Progetto 5GCAR

- Progetto Europeo **5G PPP** Fase 2 partecipato da players del mondo Automotive (PSA, Volvo, Bosch), Telco (Orange) e Manifatturiero (Ericsson, Huawei)

- Definiti principali Scenari & **Use Cases** 5G per il mondo automotive:
  - Manovre Collaborative: cambio/inserimento in corsia coordinato
  - Percezione Collaborativa: trasmissione visuale all'indietro
  - Sicurezza Collaborativa: protezioni utenti vulnerabili (pedoni)
  - Guida Autonoma: mappe ad alta definizione
  - Guida teleassistita: parcheggio automotico

- Definiti dei **KPI automotivi** per delineare i KPI di rete 5G necessari (es. latenza, banda, affidabilità ecc)

Use Cases 5G per Automotive

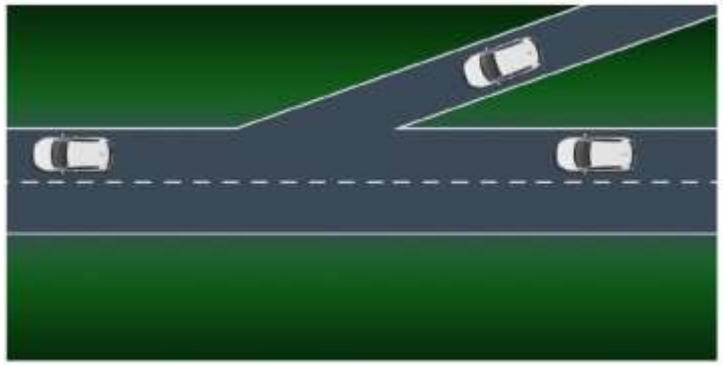


Figure 3.1: The 5GCAR Lane merge use case (UC1)

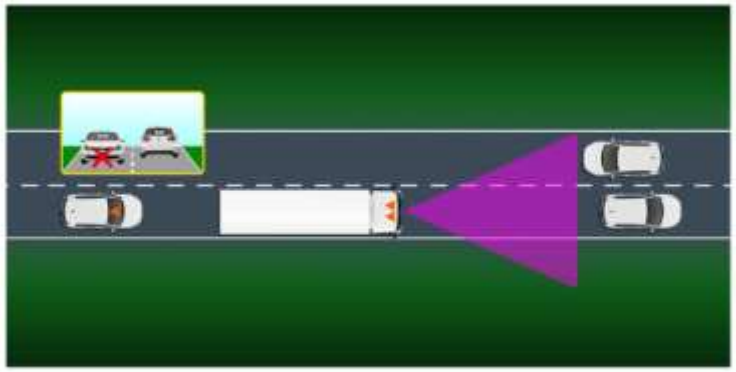


Figure 3.2: The 5GCAR See-through use case (UC2)

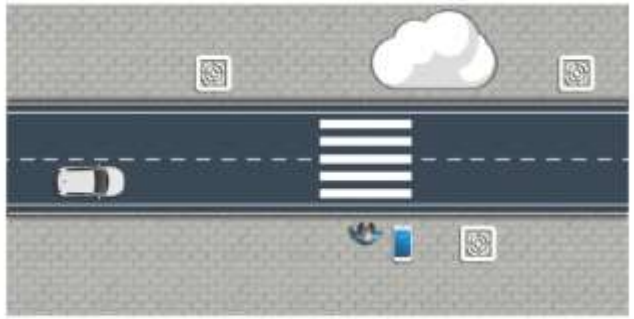


Figure 3.3: The 5GCAR Network assisted vulnerable pedestrian protection use case (UC3)

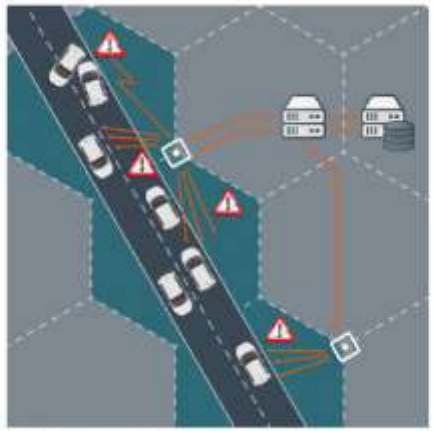
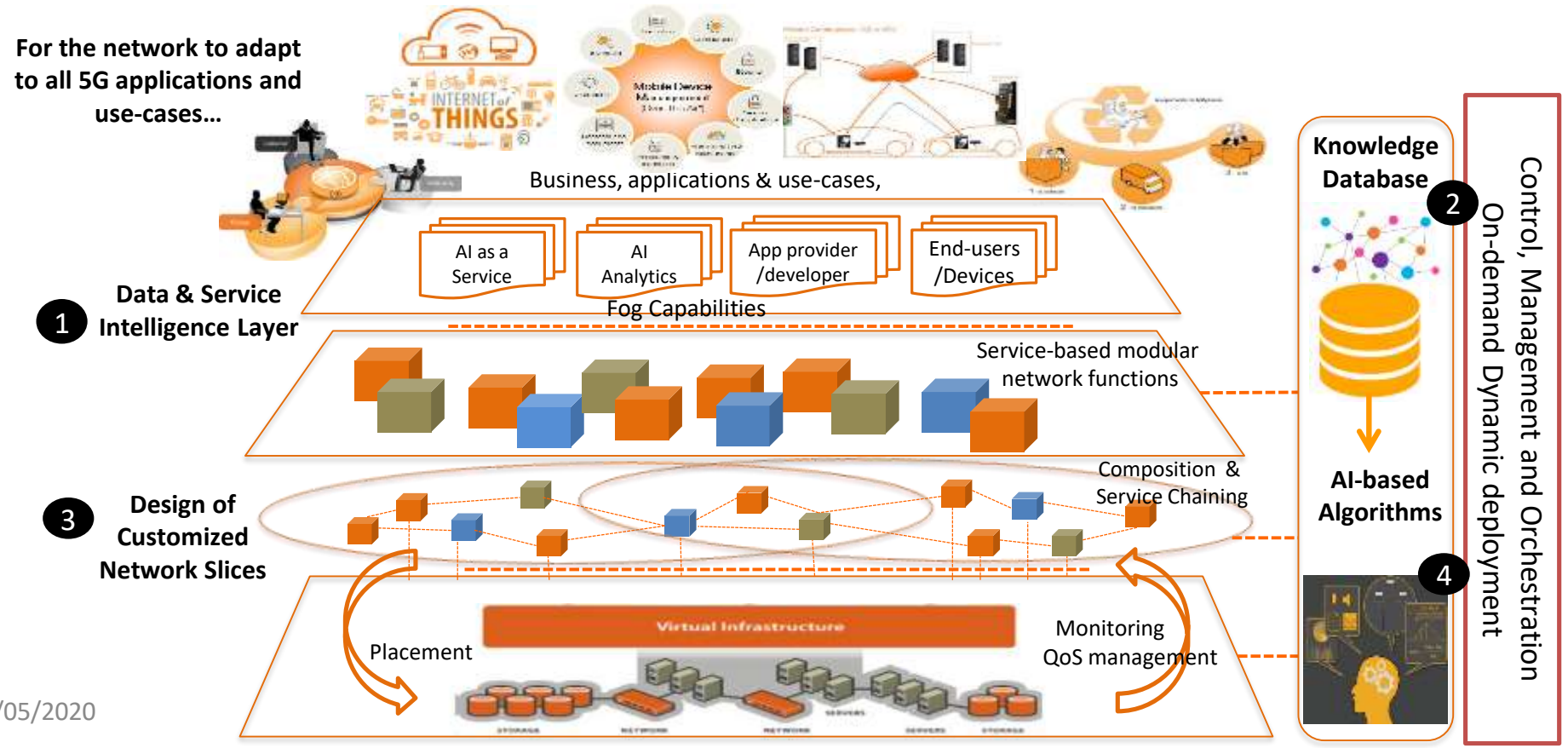


Figure 3.4: The 5GCAR HD local map acquisition use case (UC4)

Figure 3.5: The 5GCAR Remote driving for automated parking use case (UC5)

5G: Challenges Tecnologiche

- Le reti 5G presentano alcune *challenges* tecnologiche di forte interesse accademico – es. uso di schema a retroazione :
  - Automazione & Orchestrazione di rete attraverso uso di ML/AI
  - Network Slicing dinamico per ottimizzazione UX
  - …



Grazie per l'Attenzione

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BACK-UP MATERIAL & SLIDES