

3GPP TSG RAN Meeting #78  
Lisbon, Portugal, December 18 - 21, 2017

RP-172487

Document for: Discussion  
Agenda Item: 9.1.2

Motivation for New WI

# Service Oriented RAN Support of Network Slicing



# Motivations

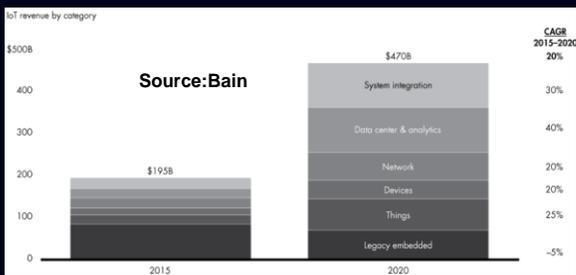
## Vertical services market forecast

A rapidly growing demand for vertical market segments includes **Factories, Oil, Gas and Energy, Construction, Agriculture, Mining, Utilities, Transportation, Defense, Public Safety, Education and Distance Learning, Healthcare etc**

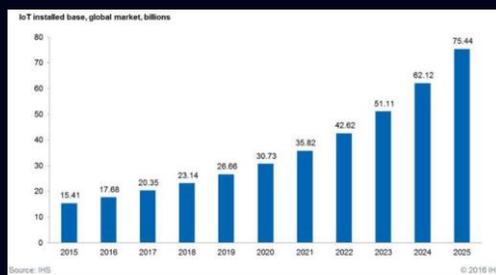
Bain predicts that by 2020 annual revenues could exceed **\$470B** for the IoT vendors selling the hardware, software and comprehensive solutions.

McKinsey estimates the total IoT market size in 2015 was up to \$900M, growing to **\$3.7B** in 2020 attaining a **32.6%** CAGR.

IHS forecasts that the IoT market will grow from an installed base of 15.4 billion devices in 2015 to **30.7 billion** devices in 2020 and 75.4 billion in 2025



Source: Bain



Source: IHS

## Vertical services presenting different requirements

**Reliability:** from best effort to 99.99999%

**Mobility :** from 0 to 1000 Km/h

**Data Rate:** from the order of kbs to Gbs

**E2E latency:** from 100us to 10ms

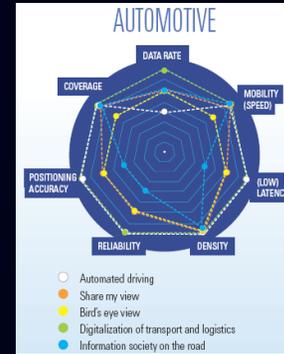
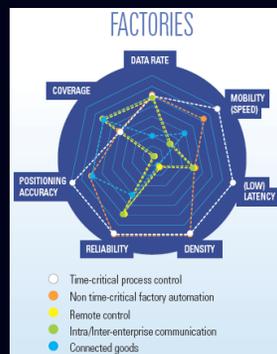
**Density:** up to 100/m2

**position accuracy:** in the order of 0.3m for automotive

**Security:** authentication, integrity...

**Data volume:** from 0 to 10Tb/s/Km2

**Service deployment time:** from minutes to days



Source: 5GPPP

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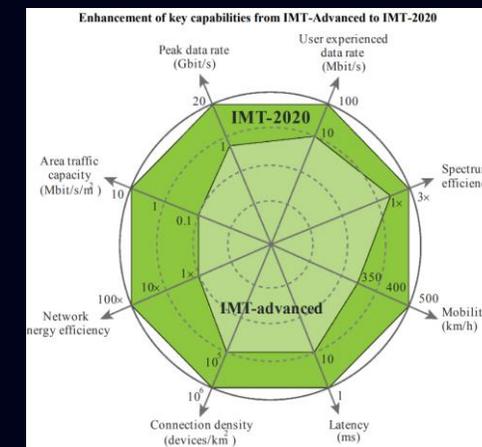
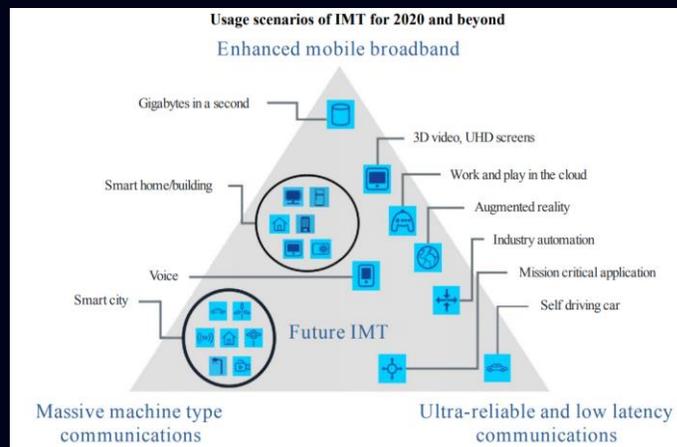
# Motivations

## 5G Empowering Diverse Vertical Services

- 5G is envisioned to become a stakeholder driven, holistic ecosystem
- 5G targets the following KPIs for diverse vertical services
  - For eMBB, 20Gbps and 30bps/Hz for DL and 10Gbps and 15bps/Hz for UL
  - For URLLC, 0.5ms UP latency for UL, and 0.5ms for DL, and  $1-10^{-5}$  reliability for 32 bytes with a user plane latency of 1ms
  - For MTC, 1 000 000 device/km<sup>2</sup> density in urban environment.

- Rel-15 introduces the following techniques to support vertical services

- Scalable Numerology
- Flexible frame structure
- Multiple-antenna techniques
- Channel coding (polar and LDPC)
- PDCP Packet duplication
- Preprocessing and concatenation removal from RLC
- Multi-RAT dual connectivity
- .....



Source: ITU

# Motivations

## Vertical services driving network operators and service providers to form eco-system

- Bringing diverse services onto operators' networks expands the reach of operators' business and open new sources of revenue.
- Utilizing operators' network as underlining communication system in vertical services afford the service provider a quick, economic deployment with high quality.

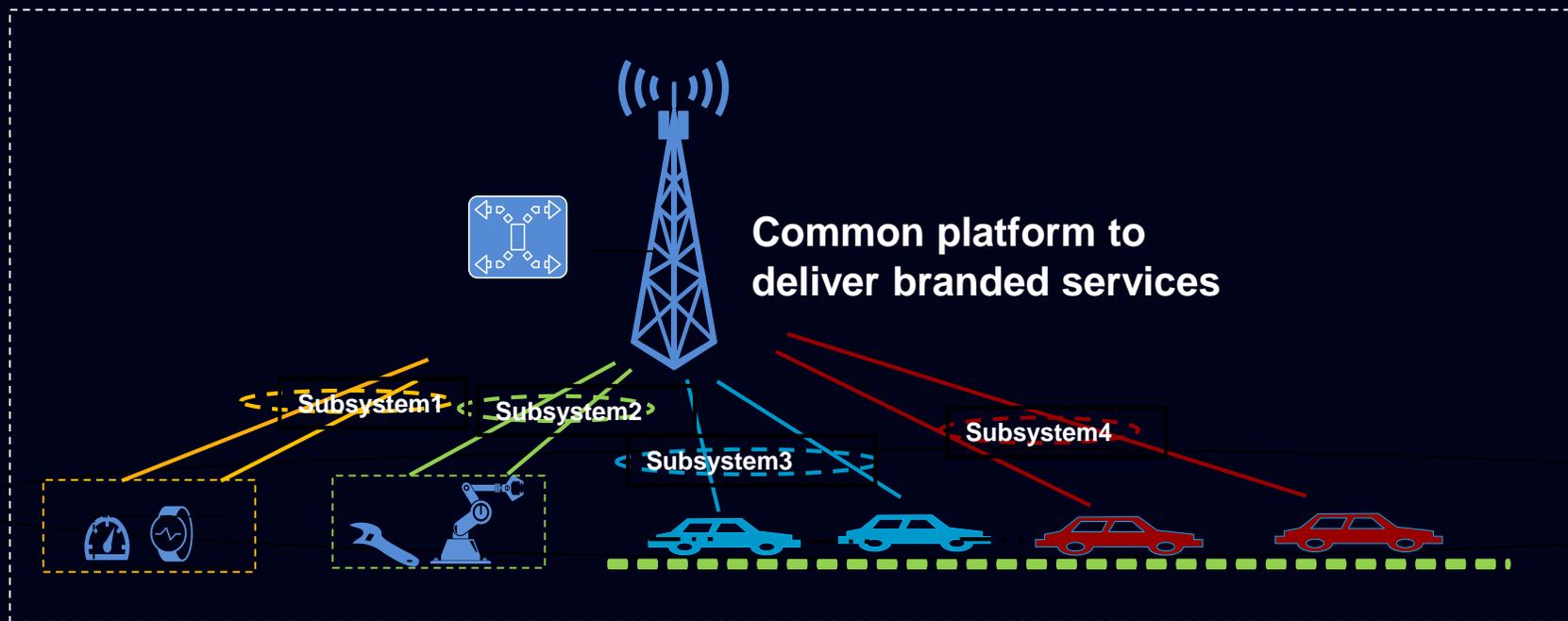


Network slicing enabled '**private network**' can bring new business opportunities from vertical services to mobile network operators

# RAN Sub-System Branding

RAN subsystem branding provides service providers incentives to use 3GPP networks

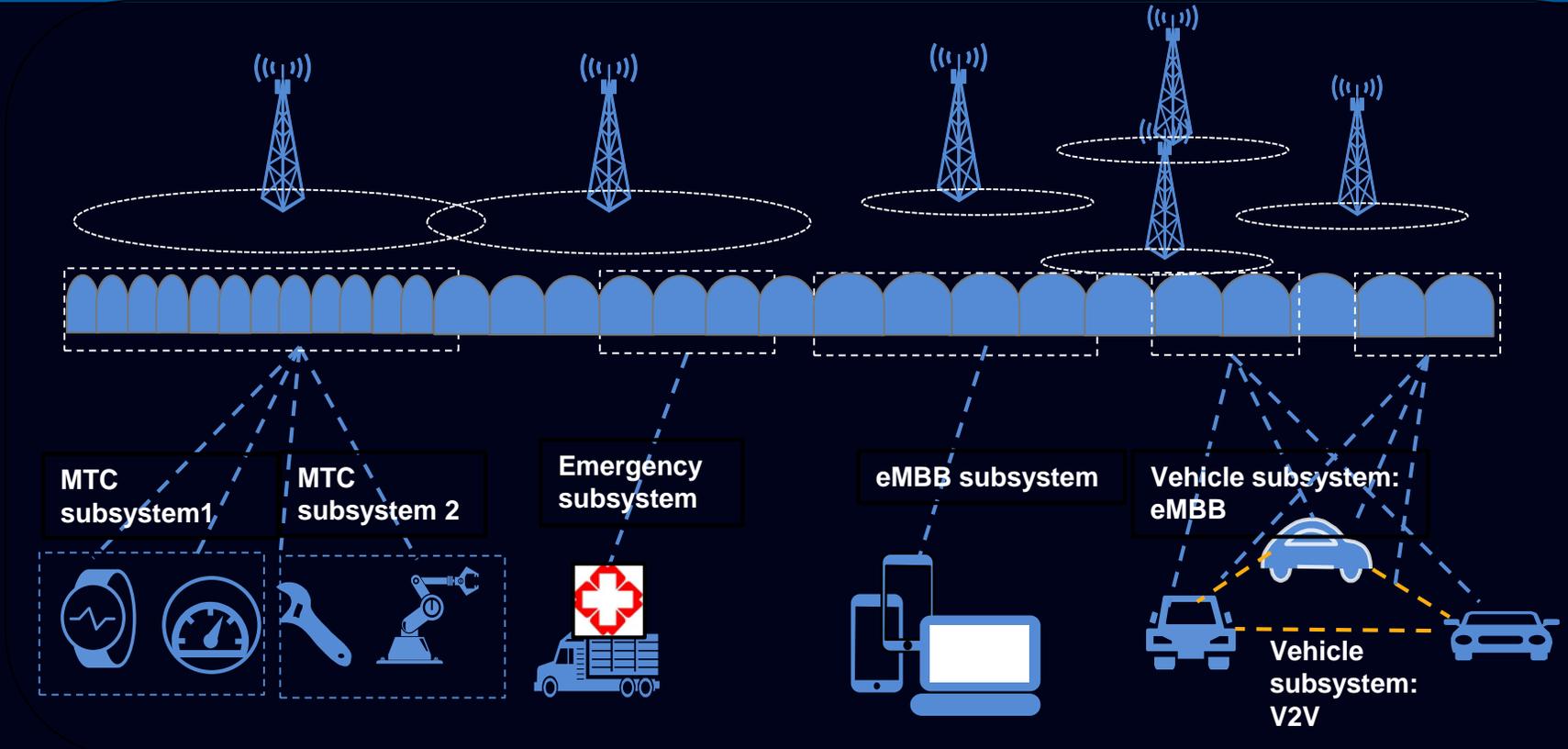
- A service device accesses 3GPP network as if it connects to the service provider's network.
- Branded subsystem is characterized by service specific network topology, protocol configuration, connection control and mobility management etc.



Source: ITU

# Deployment Scenarios of RAN Parts of Network Slice

Diverse vertical services presenting different topology and different deployment scenarios



utility (or MTC application) network slice with shared resources

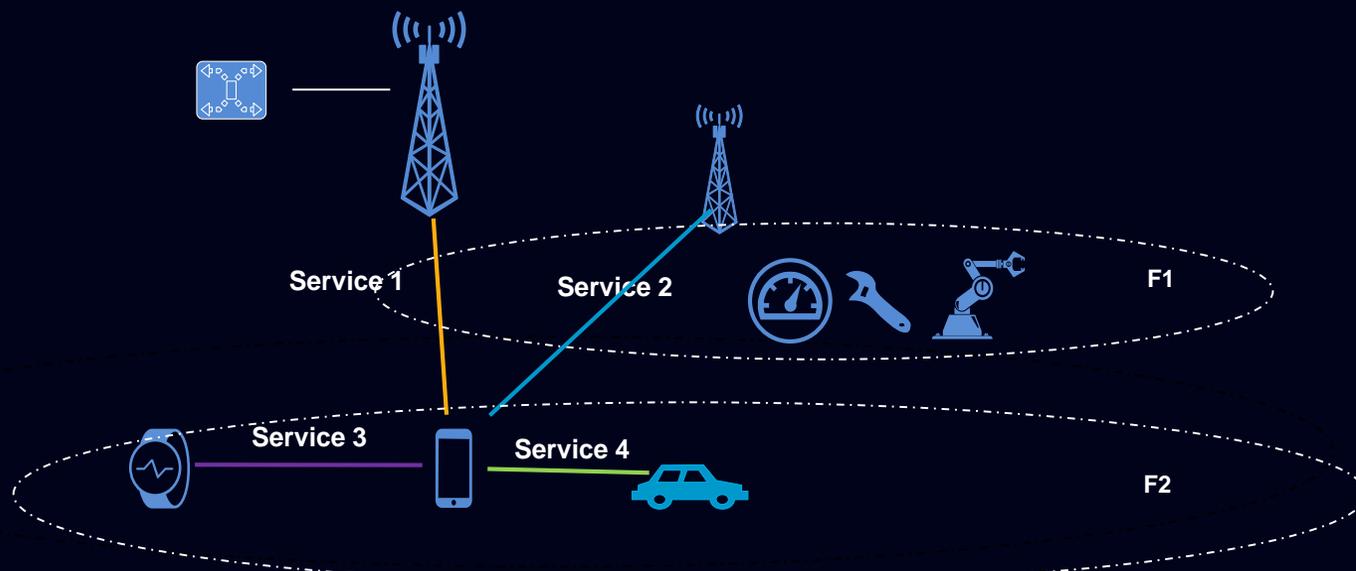
Dedicated network slice (with separate resources)

Vehicular slice with both V2V and eMBB services

# Service Oriented RAN Topology

Multi-layer connection hierarchy to meet requirements of different services

- UE with service subscriptions to multiple providers connects to corresponding network slices.
- Multiple data paths are supported for various services based on SLA/QoE requirements



# RAN Support of Emerging Network Management Models

## New Business models for network slicing are discussed in SA1

There are 4 potential management models for outlined below

- Model a: MNO provides the virtual/physical infrastructure and V/NFs, a 3rd party uses the dedicated functionality provided by the MNO
- Model b: MNO provides the virtual/physical infrastructure and V/NFs, a 3rd party manages some V/NFs via APIs provided by the MNO
- Model c: MNO provides virtual/physical infrastructure, a 3rd party provides some of the V/NFs
- Model d: a 3rd party provides some of the virtual/physical infrastructure and V/NFs and manages them



## Service oriented RAN operation based on network slicing

Different KPIs for different vertical services  
To provide different levels of utilization of the NR network to the service provider based on SLA requirements

- To support branded sub-system over an NR RAN;
- To allow customized architecture and protocols in connecting devices of different service providers.

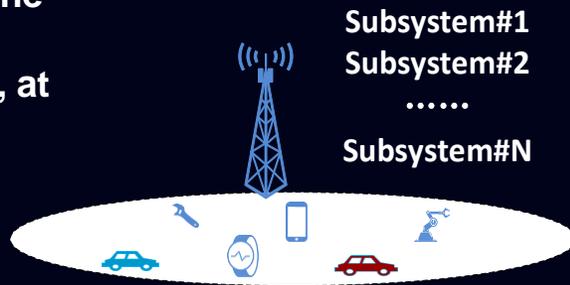
# Service Oriented RAN Support of Network Slicing

- **Service-oriented RAN support of network slicing will fulfill the following objectives:**
  - **Allowing service branding over NR RAN;** Different KPIs for different vertical services
  - **Provisioning common platform to accommodate diverse vertical service requirements;**
  - **Supporting customized architecture and protocol for particular vertical services.**
  
- **Scope of service-oriented RAN support of network slicing:**
  - **UE AS aware of RAN part of network slicing;**
  - **Slice-specific network topology and air interface protocol adaptation;**
  - **Service oriented multi-layer connection hierarchy and multiple data paths;**
  - **Mission driven resource sharing and aggregation in multi-connectivity.**

# Issues to Be Addressed

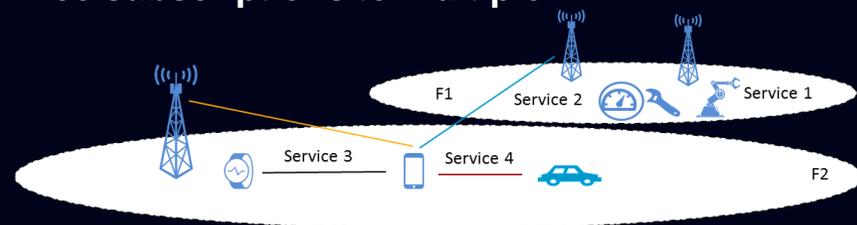
## Device awareness of RAN part of network slice

- To enable device to detect the availability of the corresponding service, e.g., at cell/TA level
- To support service specific connectivity control and service continuity in mobility.



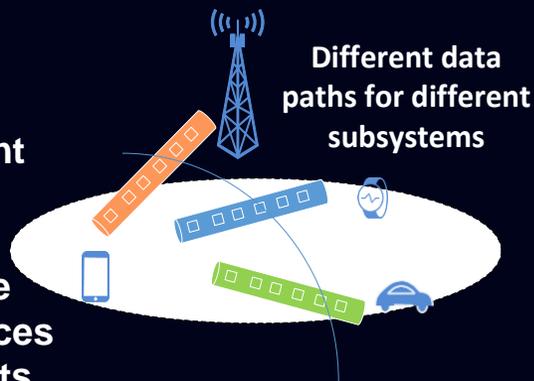
## Service oriented heterogeneous network

- To enable service oriented network topology
- To support multi-layer connection hierarchy, to UE with service subscriptions to multiple providers.



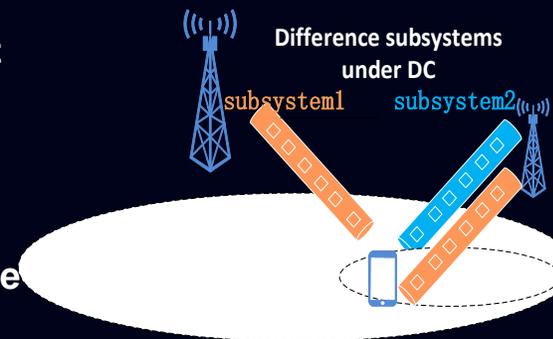
## Service based data path configuration

- To enable devices to be connected to multiple sub-systems branded by different services providers.
- To allow UE to have multiple data paths for various services based SLA/QoE requirements



## Mission driven resource sharing and aggregation

- To allow multiple-connectivity across different sub-systems to achieve system efficiency.
- To support inter-slicing data forwarding to support service continuity.



# Potential WI Objectives

**To specify service oriented RAN support of network slicing with the following functions:**

*Different KPIs for different vertical services*

- ❑ **To enable device awareness of RAN part of network slice;**
- ❑ **To support slice-specific**
  - L1/L2 configuration, access control, and mobility;
  - Network topology and air interface protocol adaptation;
- ❑ **To support mission driven resource utilization, sharing and aggregation**
  - To support multi-layer connection hierarchy, to UE with service subscriptions to multiple providers;
  - To allow UE to have multiple data paths for various services based on SLA/QoE requirements;
  - To support dual connectivity across RAN parts of different network slices.

# THANK YOU

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