3GPP TSG RAN Meeting #80
La Jolla, USA, June 11 - 14, 2018

RP-181055

Document for: Discussion
Agenda Item: 9.2.2

Motivation for New WI

Service Oriented RAN Support of Network Slicing

Huawei, HiSilicon

Opportunities and Challenges of Vertical Services

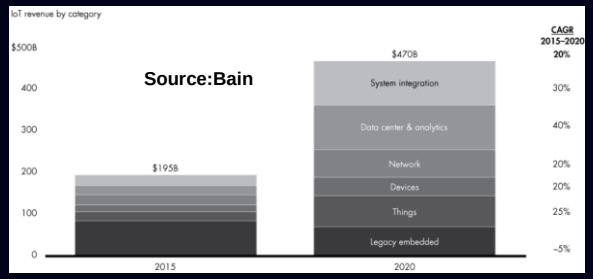
Vertical services market forecast

Strong demand in wireless communication has been expected in vertical markets, as connectivity and mobility empowers the transformation and innovation in industries such as manufacturing, transportation, energy and civil services, healthcare, and many more.

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



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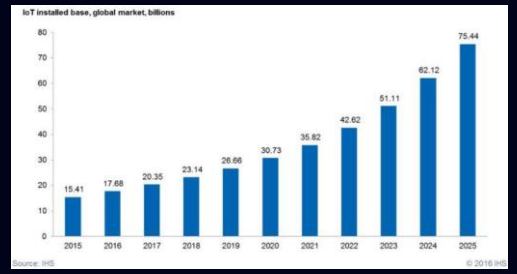
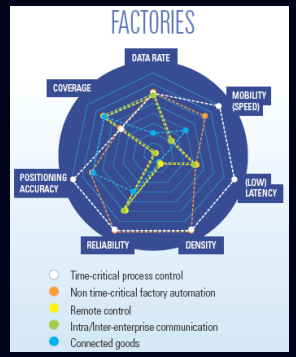
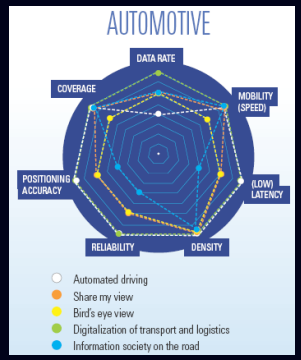


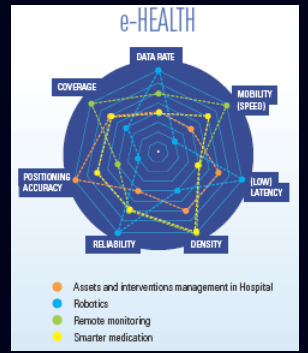
Source: IHS

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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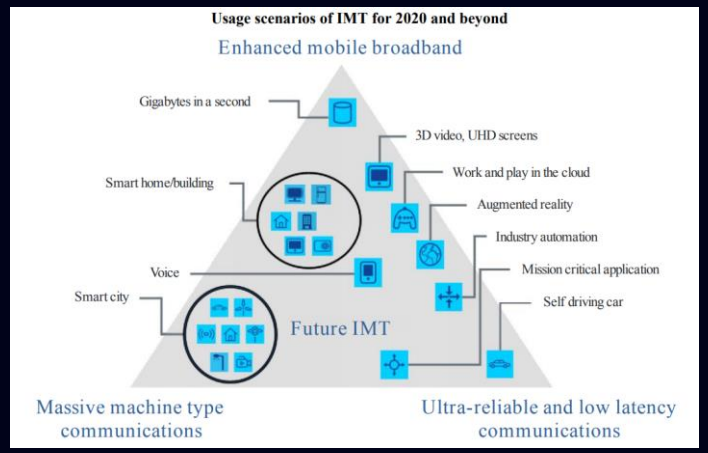
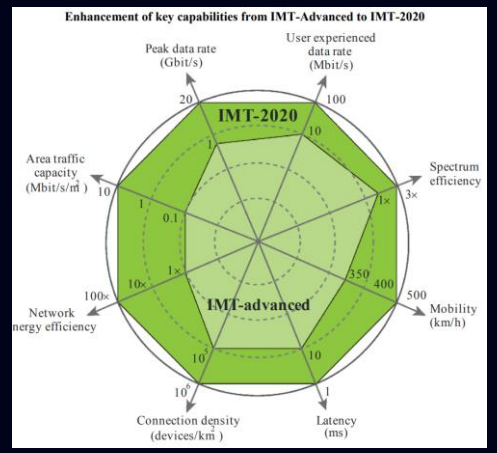
Promising 5G RAN

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 99.99999% reliability for 32 bytes with a user plane latency of 1ms
  - For MTC, 1 000 000 device/km^2 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
  - Multi-RAT dual connectivity
  - ……





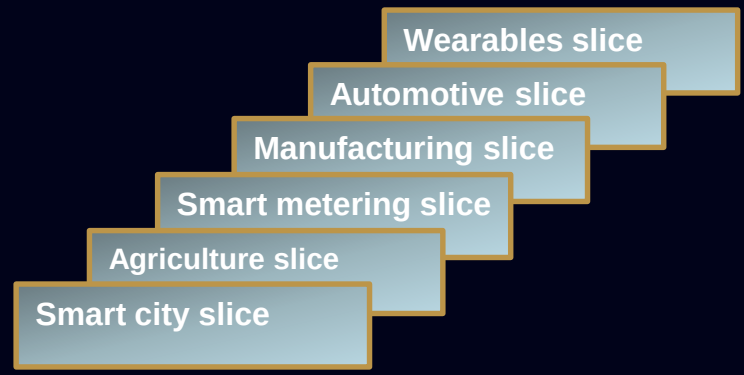
Source: ITU

Prospects of Vertical Services on 5G RAN

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 provides vertical service segments with end to end logically 'private network' including RAN part and CN part

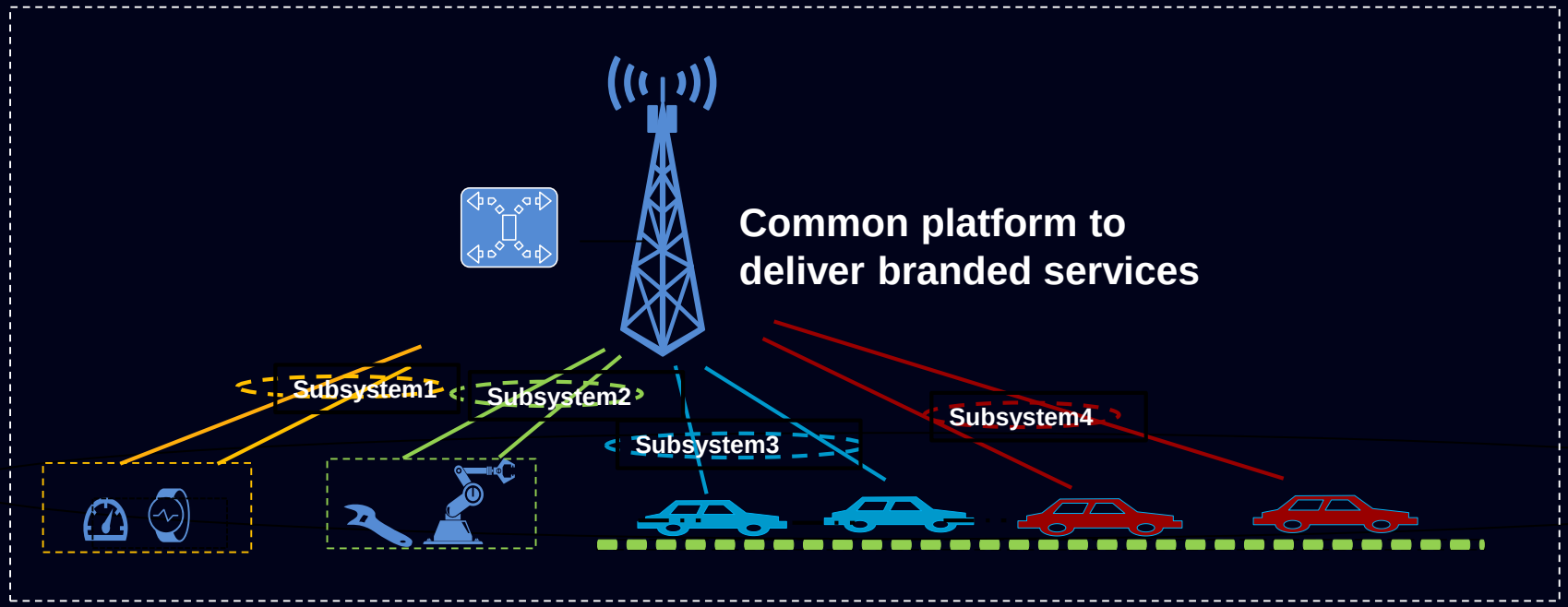


Network slicing enabled 'service sub-network' can bring new business opportunities from vertical services to mobile network operators

RAN Sub-System Branding

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

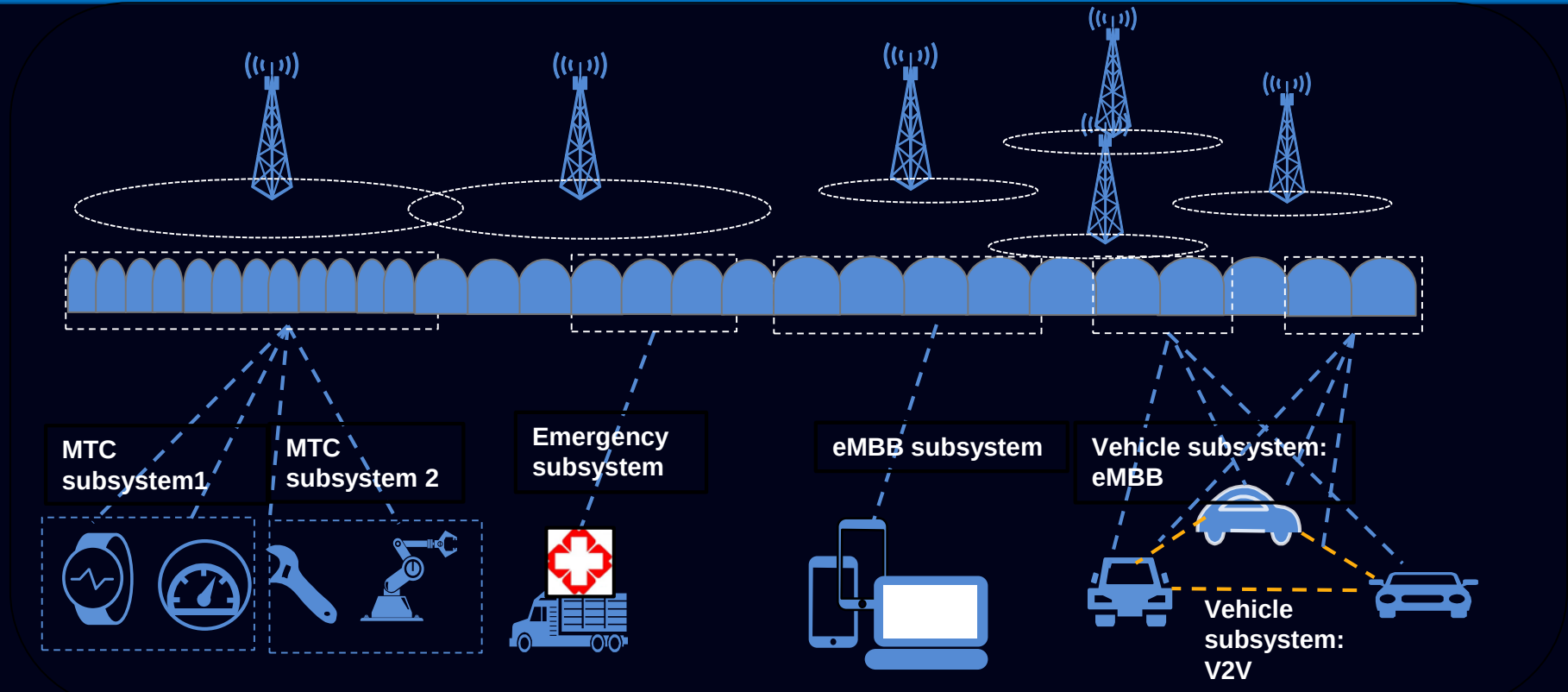
- A service device accesses 3GPP network as if it connects to the service provider's network, sharing the same branding value.
- Branded subsystem is characterized by service specific network topology, protocol configuration, connection control and mobility management etc.



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

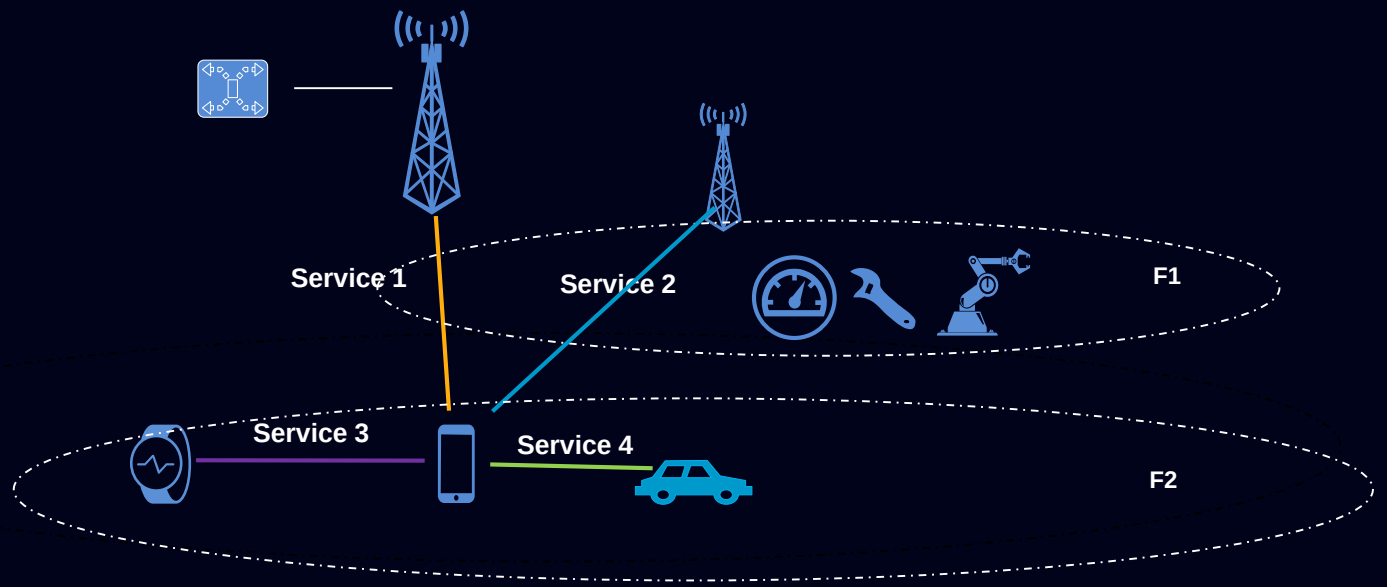
Dedicated network slice (with separate resources)

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 applications 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.

Source:3GPP

R15 Progresses

- UE can send network slice instance information in RRC to help RAN establish connection with corresponding core functions;
- UE can’t use network slice information in establishing and managing connection with corresponding RAN nodes;
- UE can’t have simultaneous connections to multiple RAN parts of network slices of disparate topologies.

Service Oriented RAN Support of Network Slicing

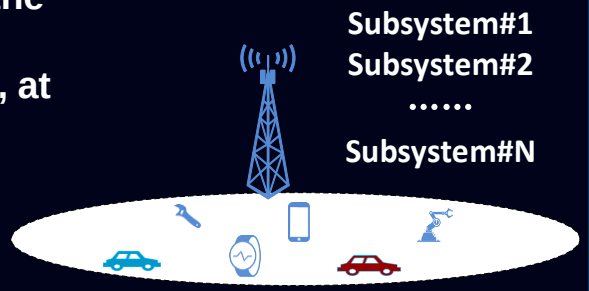
- A new tool for network operators to get service providers involved in customizing RAN's design, deployment and operation:
  - Targeting at certain well established vertical services of large customer base and abundant financial means;
  - enabling network operators to make value propositions directly to service providers, as advanced features are rolled out in networks;
  - generating monetary revenue not "passively" from the amount of data traffic hit on the network, but directly from the business success of vertical services.

- Work scope is well suited to RAN WGs' experience and expertise:
  - to let UE know the availability of a vertical service on NR RAN, so branding differentiation is maintained while service provider's communication channel is brought on 5G RAN;
  - To allow customized architecture topology and connection management for a vertical service to meet its requirements;
  - to support simultaneous connections of a UE to multiple vertical services, and to enable resource sharing/aggregation between the sub-networks carrying these vertical service.

Issues to Be Addressed

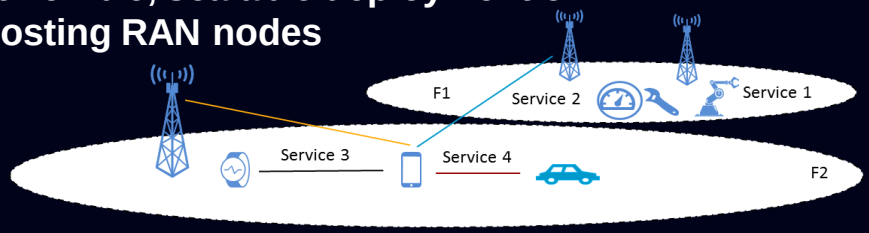
Device awareness of RAN part of network slice

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



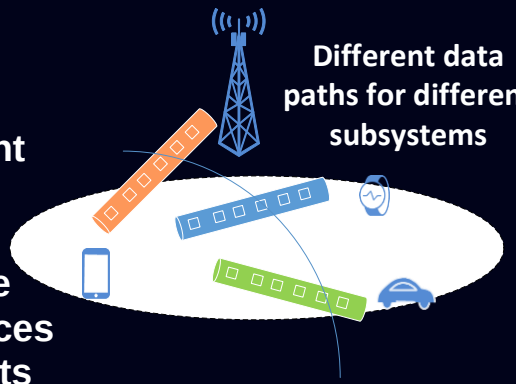
Service oriented heterogeneous network

- To enable service oriented network topology and over-the-air protocol configuration
- To support flexible, scalable deployment of service-boosting RAN nodes



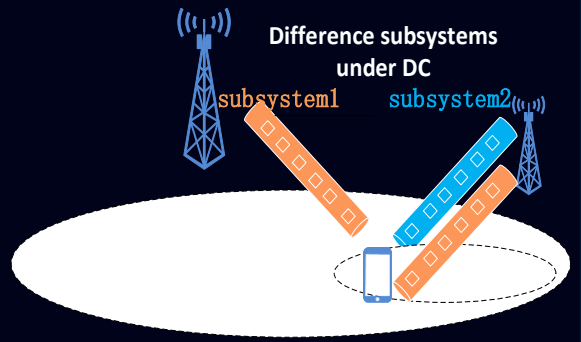
Service based data path configuration

- 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 RAN based inter-slicing data forwarding for service continuity.



Potential WI Objectives

1. To enable device awareness of RAN part of network slice [RAN2]:
   a. To study and specify broadcast and/or unicast signaling mechanisms for the availability of RAN support of a service;

Different KPIs for different vertical services

2. To support slice-specific connection management [RAN2, RAN3]:
   a. To study and specify slice dependent access control and mobility mechanisms in idle/inactive/connected states;
   b. To study and specify slice specific configuration of air interface protocols and data paths;
3. To support dual-connectivity for simultaneous connections to multiple network slices, and network controlled resource utilization, sharing and aggregation [RAN2, RAN3]:
   a. To study and specify the support of UE having multiple data paths to separate gNBs for various services;
   b. To study and specify intra-RAN data forwarding between gNBs supporting different network slices;
4. To provide support in RAN specifications requested by SA2 Rel-16 works on network slicing, if there are any.

THANK YOU

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