

The background features a large, light blue watermark of the ITU-T logo. It consists of a globe with latitude and longitude lines, overlaid with the letters 'ITU' in a stylized font. A lightning bolt symbol is positioned at the bottom right of the globe.

# Overview of ITU-T activities on 5G/IMT-2020

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# Terms & Definition

- IMT-2020 [ITU-R M-2083-0]: systems, system components, and related aspects that support to provide far more enhanced capabilities than those described in Recommendation ITU-R M.1645 (IMT-2000)
- IMT-2020 Radio:= IMT evolution + new RAT revolution
- IMT-2020 Network:= flat architecture + white-box-hardware + Virtualization + LAMP/ Slices + Softwarization + MEC + DAN (ICN/ CCN) + e-2-e VoLTE enabling + ...

# Terms & Definition (cont.)

- **Slice:** Logically isolated set of programmable infrastructure resources (i.e., physical and/or logical resources) to enable functions and services of IMT-2020 network
- **Network Softwarization:** Automation mechanism for the configuration deploying, managing and maintaining of network equipment and network components
- **FMC:** Capabilities that provide services and application to the end user regardless of the fixed or mobile access technologies being used and independent of the user's location

# Service Trends

## Everything connected by wireless

Monitor/collect information & control devices

### Multiple personal devices



Interaction across multiple devices

### Transportation (Car/Bus/Train)



Entertainment, Navigation  
Traffic information

### Consumer electronics



Remote operation using personal terminal

### Watch/jewelry/cloths



Human interface (HI) and healthcare sensors

### House



Remote control of facilities  
House security

### Sensors



Smart power grid  
Agriculture and farming  
Factory automation  
Weather/Environment

### Cloud computing



All kinds of services supported by the mobile personal cloud

## Extension/enrichment of wireless services

Deliver rich content in real-time & ensure safety

### Video streaming



4K/8K video resolutions  
Video on newspapers  
Background video

### New types of terminal/HI



Glasses/Tactile Internet

### Healthcare



Remote health check & counseling

### Education



Distance (remote) learning  
Any lesson anywhere/anytime

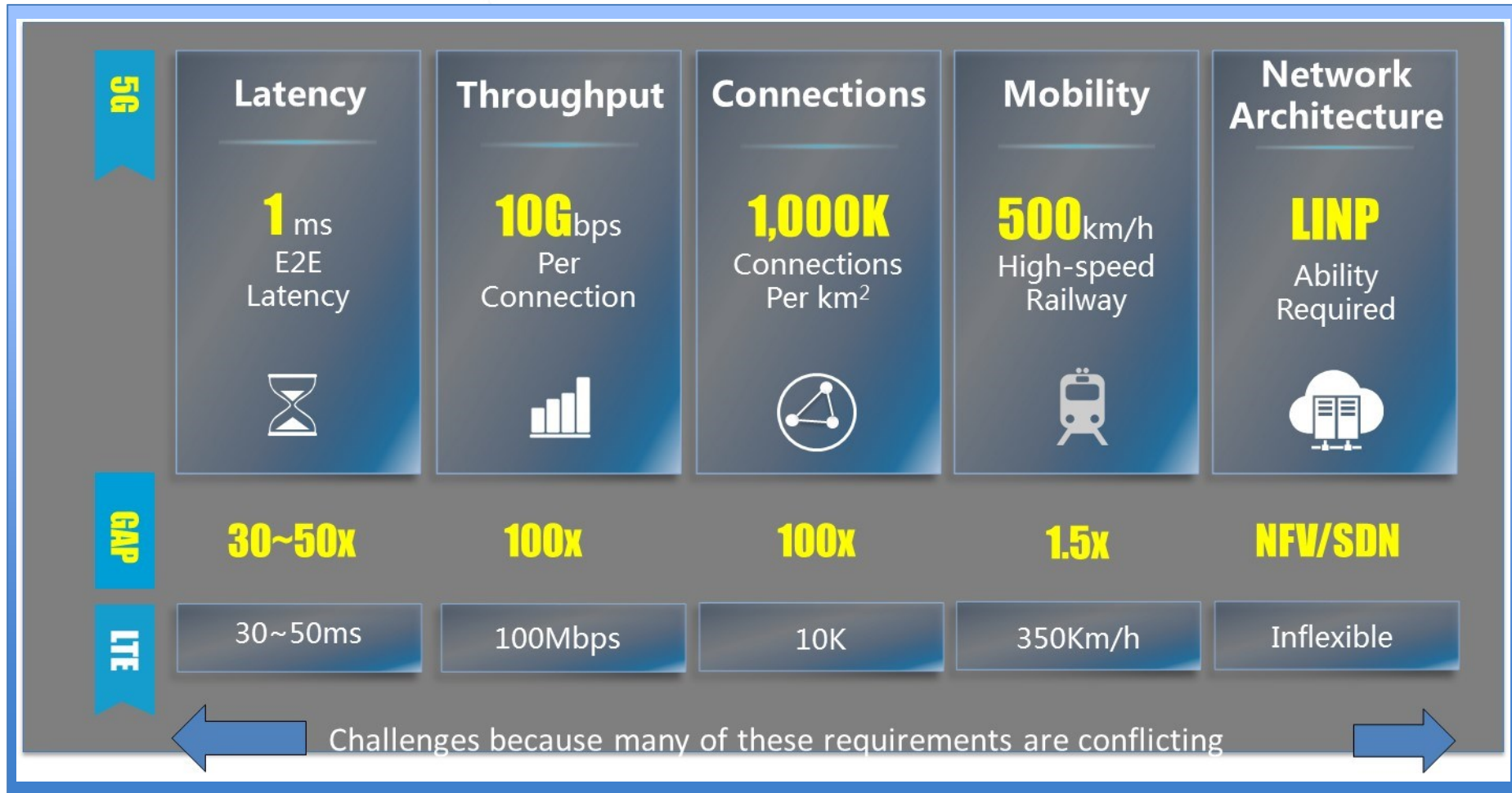
### Safety and lifeline system



Prevention of accidents  
Robustness to disasters

Source: NTTDocumo

# Challenges & Gaps



Source: Huawei

Networks are challenged by wide range of requirements

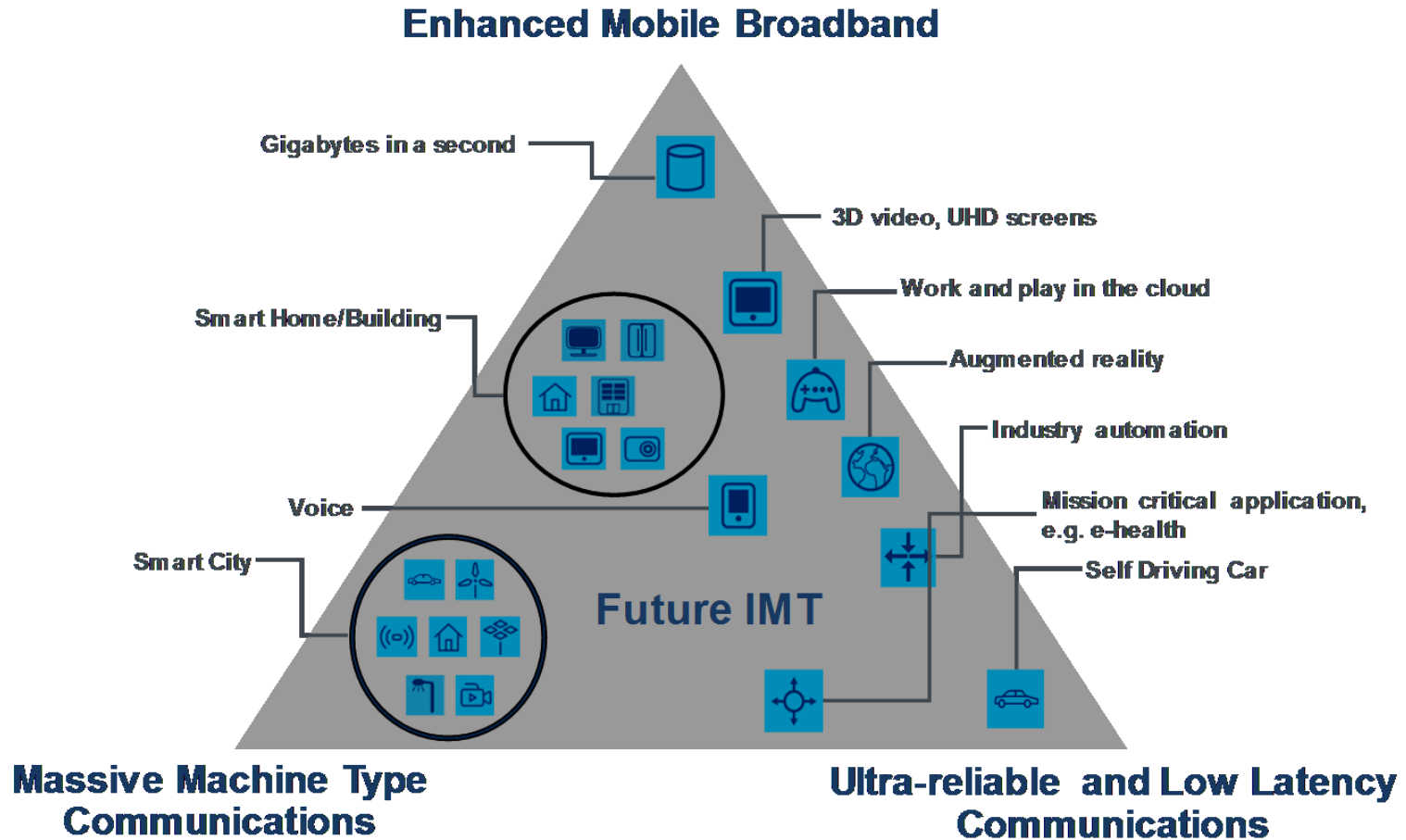


# IMT-2000, IMT-Advanced & IMT-2020

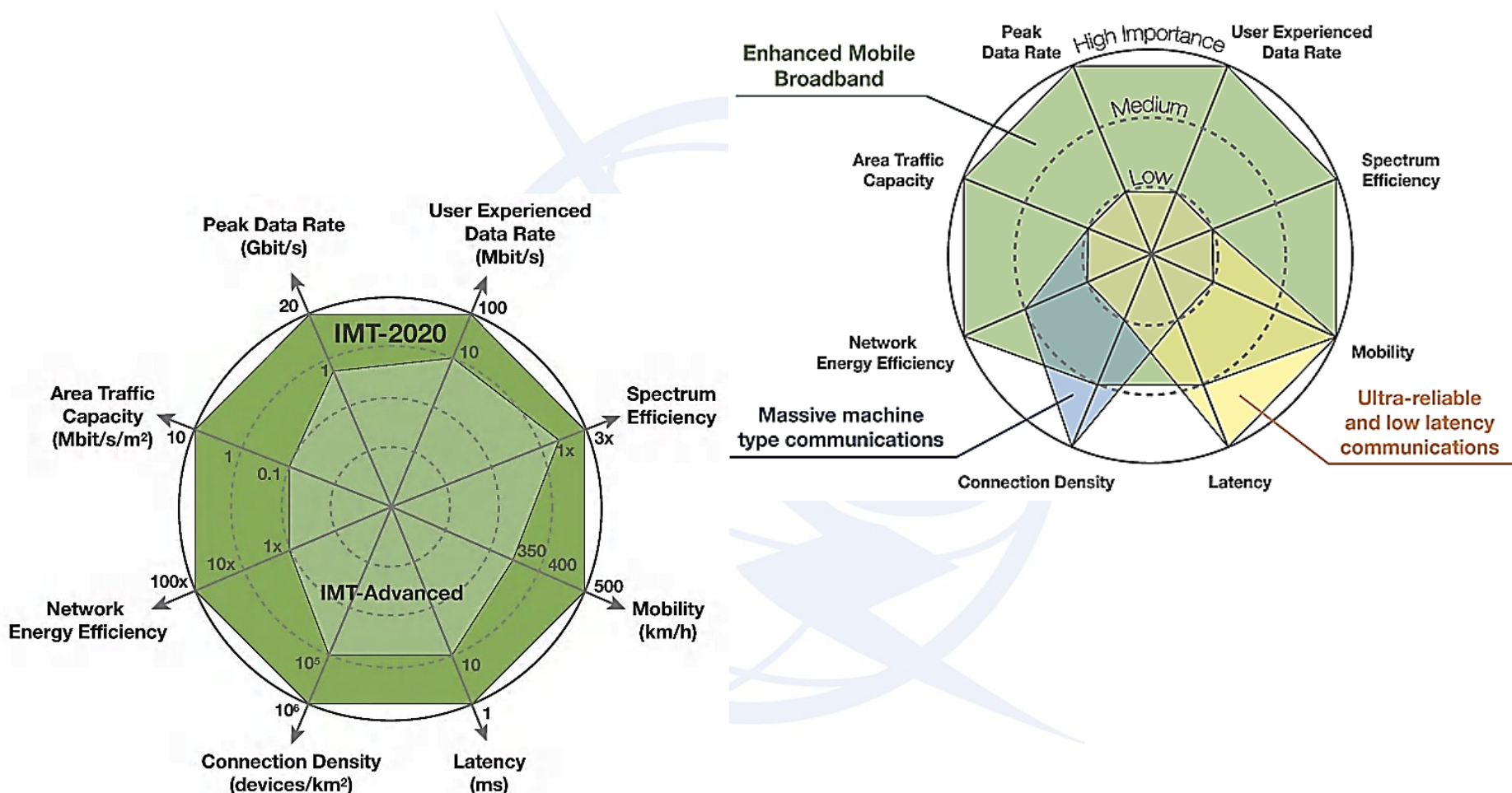
- All of today's 3G and 4G mobile broadband systems are based on the ITU's IMT standards
- IMT provides the global platform on which to build the next generations of mobile broadband connectivity
- ITU established the detailed specifications for IMT-2000 and the first 3G deployments commenced around the year 2000
- In January 2012, ITU defined the next big leap forward with 4G wireless cellular technology – IMT-Advanced – and this is now being progressively deployed worldwide
- The detailed investigation of the key elements of IMT-2020 is well underway, using the partnership ITU has with the mobile broadband industry and the wide range of stakeholders in the 5G community



# IMT-2020 vision: 5G usage scenarios



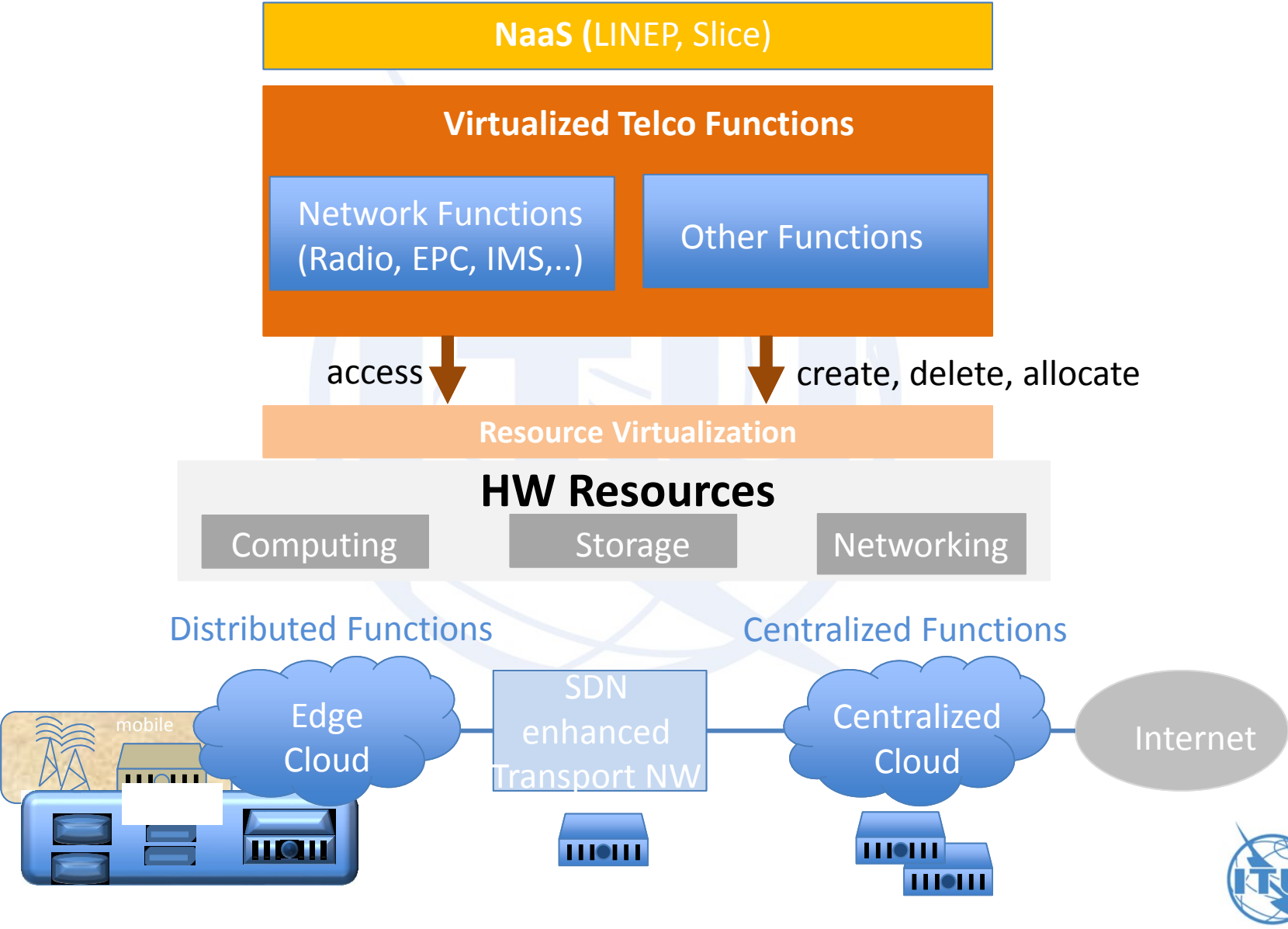
# IMT-2020 vision: 5G capability perspectives



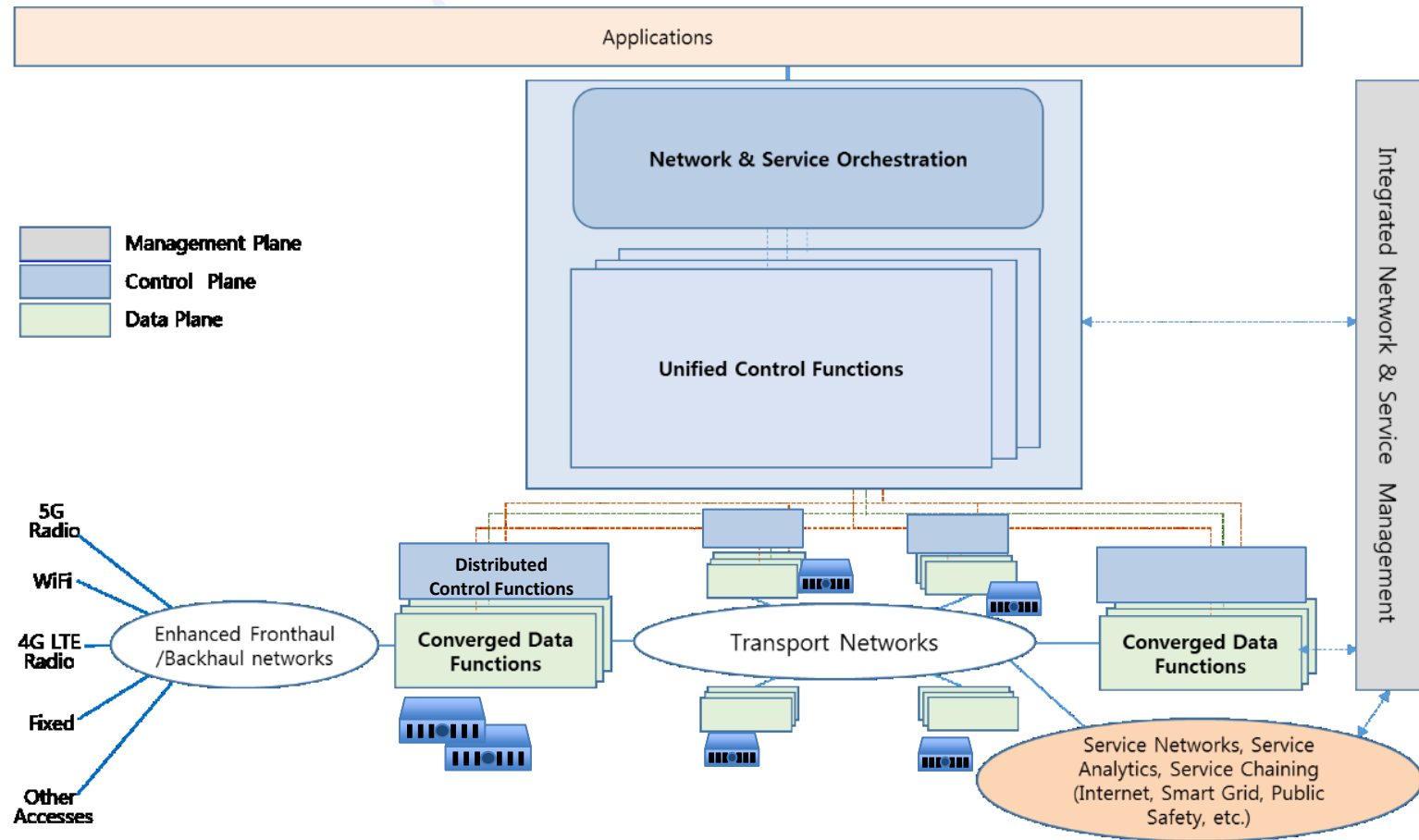
The values in the figures above are targets for research and investigation for IMT-2020 and may be revised in the light of future studies. Further information is available in the IMT-2020 Vision Recommendation (Recommendation ITU-R M.2083)



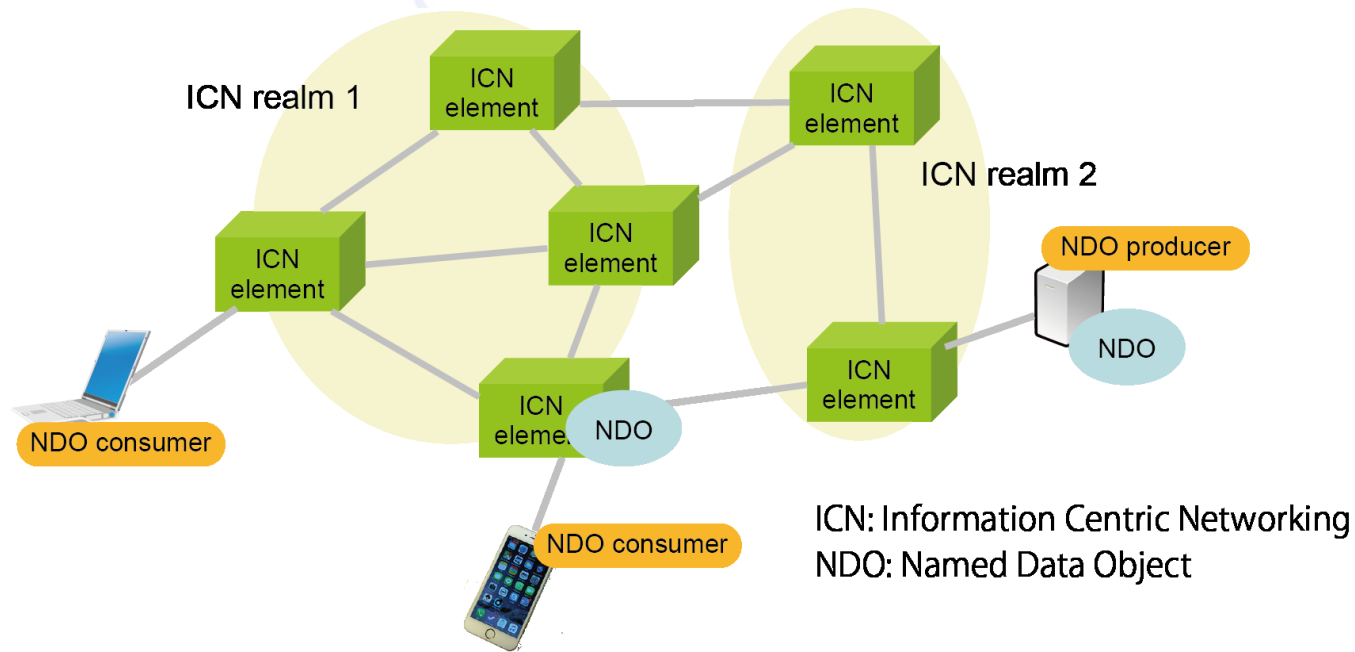
# IMT2020 Architecture Overview



# IMT2020 Basic Reference Model



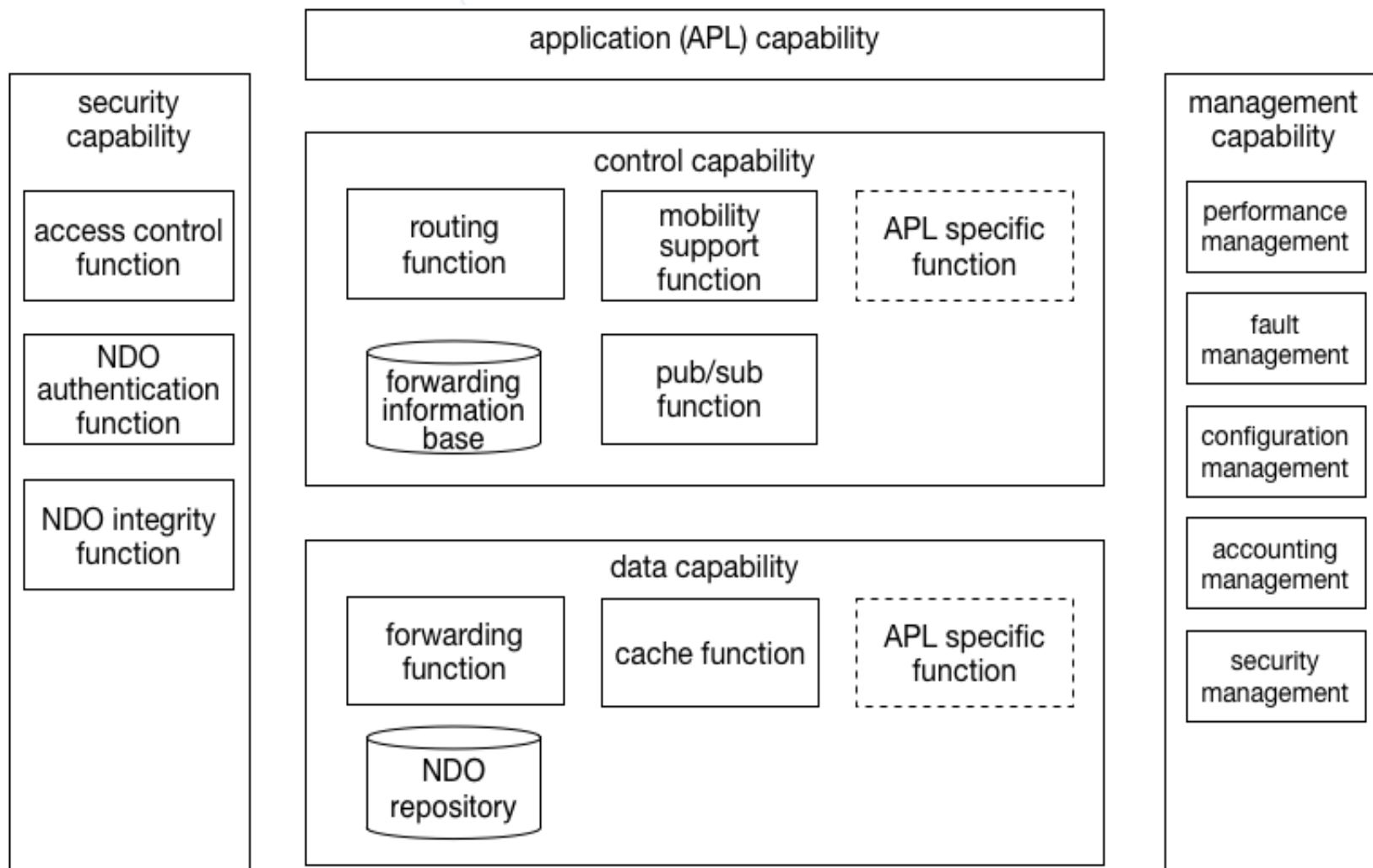
# Ultra Low Latency Broadband Communication in IMT2020 Networks



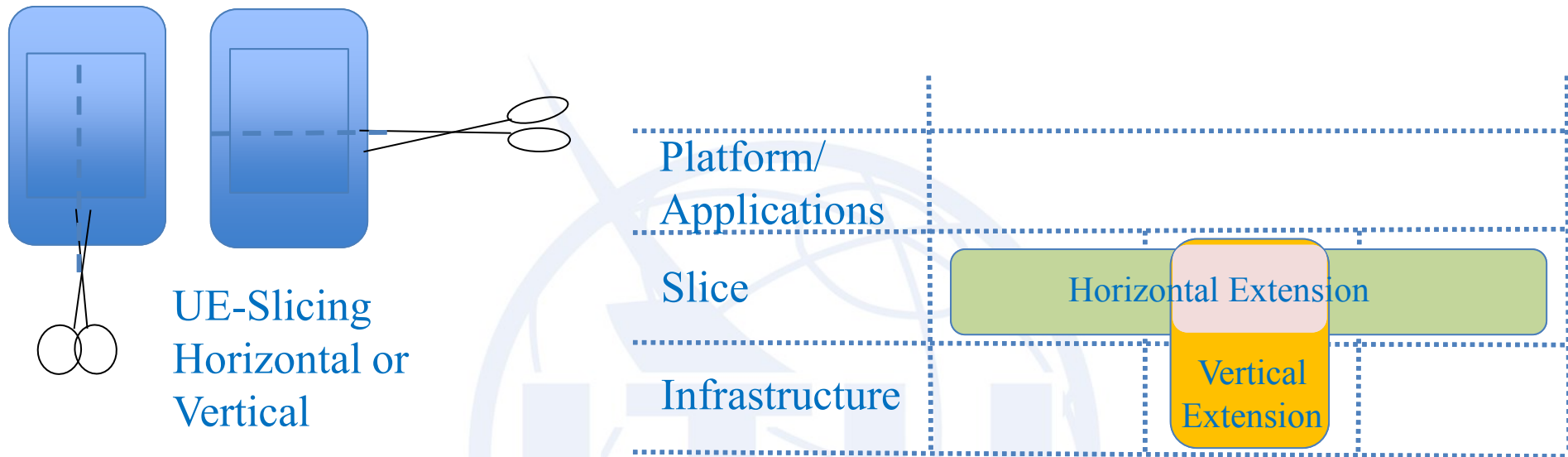
## ICN Information Centric Networking (new Y. 3071 – 03/2017)

- Recognition of user requests and their corresponding responses by networks due to its name based routing.
- Overlay/ native transport
- See also ITU-T Y.3032 “Configurations of node identifiers and their mapping with locators in future networks”

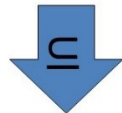
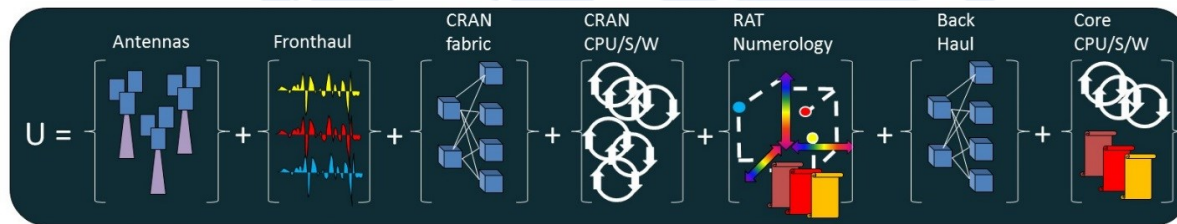
# ICN Capabilities



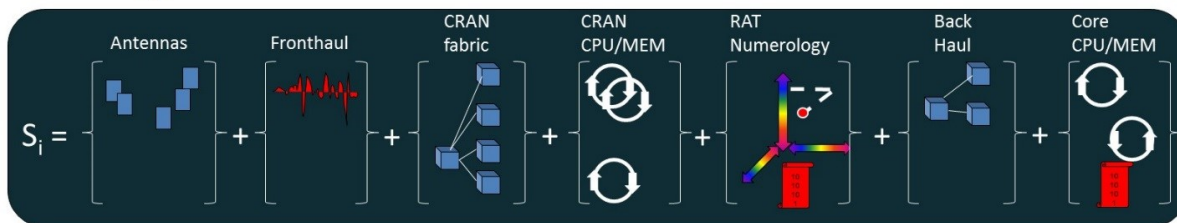
# Slicing



Example: 5G concept of end to end slice



If  $U$  is the set of all resource sets { Antennas, Fronthaul, .. } then  
Slice  $S_i$  is a set of resource subsets taken from resource sets { Antennas, Fronthaul .. }



# Key areas of study: (1) Network softwarization

- **Softwarization:** Designing, implementing, deploying, managing and maintaining networks using software
- Exploits characteristics such as flexibility and rapidity of design
- Softwarization creates conditions that enable the re-design of network and service architectures
- Optimization of costs and processes, self-management



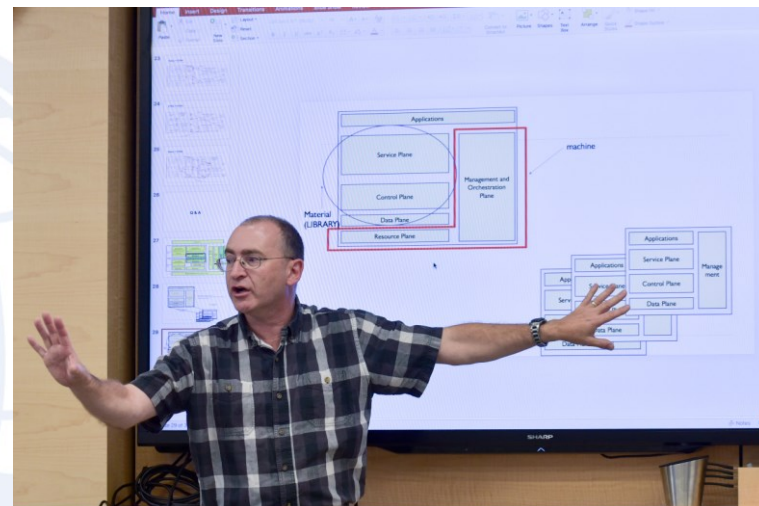
# Key areas of study: (2) Network slicing

- **Slice:** Unit of programmable resources, e.g., network, computation, storage
- Allows logically isolated network partitions
- Envisaged to cover a wide range of use cases with one network, e.g., one slice for voice communications, a separate slice for automated driving



# Key areas of study: (3) Architecture enabling convergence

- Fixed access networks to interwork with radio access networks
- Goals for IMT-2020: A converged access-agnostic core - identity, mobility, security, etc., are decoupled from the access technology
- Network architecture to support fixed / mobile convergence, with seamless user experience



*Architecture discussion at a Focus Group meeting, Palo Alto, September 2016*





# 5G, open source and IPR

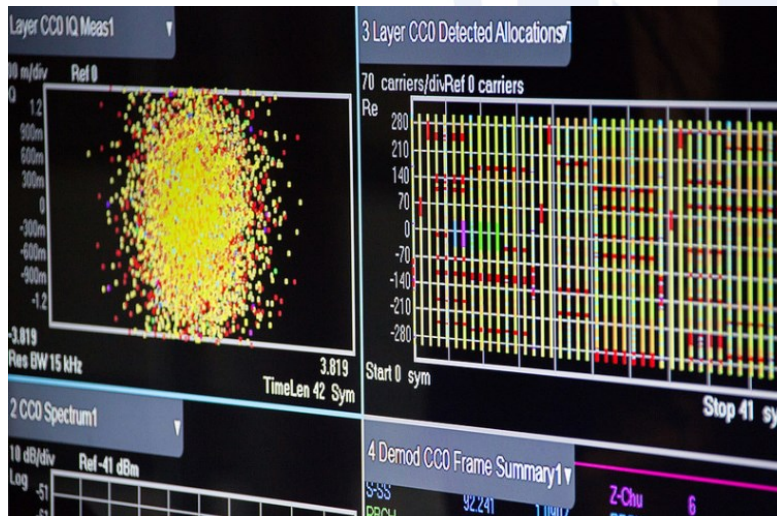
There is a collaboration of ITU-T SGs with open source initiatives to develop proofs of concept addressing technical issues identified



- [ITU-NGMN workshop](#) on "Open Source and Standards in 5G" (25 May 2016)
- Conclusions:
  - Open source needed in the context of 5G
  - Open source components will complement the development of standards in 5G
  - Open source and standards are converging and both can benefit in 5G from each other, e.g., interoperability, virtualization of network functionalities or software defined networking
  - Open source and standards are not two different worlds, they do not live in silos, and close cooperation creates opportunities for both

# FG IMT-2020 Workshop and Demo Day: Wireline Technology Enablers for 5G

(Geneva, December 2016)



# Report on Standards Gap Analysis

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[FG IMT-2020: Report on Gap Analysis](#)

(presented at SG13 meeting in December 2015)



# Deliverables of FG IMT-2020

(FG IMT-2020 achieved nine deliverables, December 2016, see [here](#))

- Draft **Terms and definitions** for IMT-2020 (IMT-O-040)
- Draft Technical Report: Report on application of **network softwarization** to IMT-2020 (IMT-O-041)
- Draft Recommendation: Requirements of IMT-2020 from **network perspective** (IMT-O-042)
- Draft Recommendation: Framework of IMT-2020 **network architecture** (IMT-O-043)
- Draft Recommendation: Requirements of IMT-2020 **Fixed and Mobile Convergence** (IMT-O-044)
- Draft Technical Report: FMC architecture based on **Unified Network Integrated Cloud** (IMT-O-045)
- Draft Recommendation: IMT-2020 **Network Management Requirements** (IMT-O-046)
- Draft Recommendation: **Network Management Framework** for IMT-2020 (IMT-O-047)
- Draft Technical Report: Application of **information centric networking** to IMT-2020 (IMT-O-048)



# Current work items of SG13 on IMT-2020

(as of June 2017)

Work item	Q	Timing	Liaison relationship	Subject / Title
<a href="#"><u>Handbook on IMT-2000 (2nd Edition)</u></a>	Q1/13	TBD	All ITU-T SGs, SDOs	The Handbook of evolving IMT-2000 Systems
<a href="#"><u>Y.IMT-2020.qos-mon</u></a>	Q6/13	2018-07	SG12/3GPP	IMT-2020 network QoS monitoring architectural framework
<a href="#"><u>Y.IMT2020-terms</u></a>	Q20/13	2017-11	-	Terms and definitions for IMT-2020
<a href="#"><u>Y.IMT2020-reqts</u></a>	Q20/13	2017-11	-	Requirements of IMT-2020 network
<a href="#"><u>Y.IMT2020-frame</u></a>	Q20/13	2017-11	-	Framework of IMT-2020 network
<a href="#"><u>Y.IMT2020-arch</u></a>	Q20/13	Q2 2018	-	Architecture of IMT-2020 network
<a href="#"><u>Y.IMT2020-CE-Req</u></a>	Q20/13	2017-11	-	Requirements of capability exposure in IMT-2020 networks
<a href="#"><u>Y.IMT2020-CEF</u></a>	Q20/13	Q2 2018	-	Capability exposure function in IMT-2020 networks
<a href="#"><u>Suppl. To Y.IMT2020 serirs</u></a>	Q21/13	2017-07	-	Standardization and open source activities related to network softwarization of IMT-2020
<a href="#"><u>Y.IMT2020-MultiSL</u></a>	Q21/13	Mid 2018	-	Framework for the support of Multiple Network Slicing
<a href="#"><u>Y.IMT2020-mgmt-frame</u></a>	Q21/13	2017-07	-	IMT-2020 Network Management Framework
<a href="#"><u>Y.IMT2020-mgmt-req</u></a>	Q21/13	2017-07	-	IMT-2020 Network Management Requirements
<a href="#"><u>Y.IMT2020-NetSoft</u></a>	Q21/13	2017-11	-	High level technical characteristic of network softwarization for IMT-2020

# Current work items of SG11 related to IMT-2020 technologies

(as of June 2017)

Work item	Q	Timing	Liaison relationship	Subject / Title
<a href="#">Q.rrp</a>	Q8/11	2017-11	ITU-T SG13	Request routing protocol for content delivery
<a href="#">X.mp2p-mssr</a>	Q8/11	2017-07	ITU-T SG13, SG16, SG17, ISO/IEC JTC1/SC6	Managed P2P communications: Multimedia streaming signalling requirements
<a href="#">X.mp2p-mspp</a>	Q8/11	2017-11	ITU-T SG 13, ISO/IEC JTC1/SC6	Managed P2P communications: Multimedia streaming peer protocol
<a href="#">X.mp2p-msomp</a>	Q8/11	2017-11	ITU-T SG 13, SG 16, SG 17, ISO/IEC JTC1/SC6	Managed P2P communications: Multimedia streaming overlay management protocol
<a href="#">Q. NEA-REQ</a>	Q7/11	2018-12	SG13, ETSI	Signalling Requirements of NFV Entity Management for Network Attachment
<a href="#">Q.SAN-MIM</a>	Q7/11	2017-11	SG13, JCA-SDN, IEEE 802.21	Signalling requirements of SDN-based access networks with media independent management capabilities
<a href="#">Q.BNG-CFS</a>	Q5/11	2019-07		Signalling requirements for control and forwarding plane separation in vBNG
<a href="#">Q.BNG-DBoD</a>	Q5/11	2017-11	SG13, JCA-SDN	Signalling requirements for dynamic bandwidth adjustment on broadband network gateway implemented by SDN technologies
<a href="#">Q.BNG-IAP</a>	Q5/11	2018-12		Signalling requirements of IP address pool based on broadband network gateway by SDN technologies
<a href="#">Q.SCO</a>	Q4/11	2017-07	SG13, JCA-SDN	Scenarios and signalling requirements for SDN based Central Office
<a href="#">Q.SD-WAN</a>	Q4/11	2019-03	ONUG, SG13	Signalling Requirement for SD-WAN service
<a href="#">Q.SMO</a>	Q4/11	2018	SG13, JCA-SDN	Signalling requirements of Software-defined Metro Orchestration
<a href="#">Q.SVDC</a>	Q4/11	2018-12	SG13, JCA-SDN	Signalling requirements of the Sew interface for Virtual Data Center



# Existing ITU-T Standards related to IMT2020

Awareness	Approved Recommendations
Service	Y.3011: Framework of network virtualization for future networks Y.3012: Requirements of network virtualization for future networks Y.3300: Framework of software-defined networking Y.3320: Requirements for applying formal methods to software-defined networking Y.3321: Requirements and capability framework for NICE implementation making use of software-defined networking technologies
Data	Y.3031: Identification framework for future networks Y.3032: Configuration of node IDs and their mapping with locators in future networks Y.3033: Framework of data aware networking Y.3034: Architecture for interworking of heterogeneous component networks in FNs
Environment	Y.3021: Framework of energy saving for future networks Y.3022: Measuring energy in networks
Socio-Economic	Y.3013: Socio-economic assessment of future networks by tussle analysis Y.3035: Service universalization in future networks
Smart Ubiquitous Net.	Y.3041, Y.3042, Y.3043, Y.3044, Y.3045
Control plane	Q.3051: Signalling architecture for the control plane of distributed service networking Supplement 67 "Framework of signalling for software-defined networking" Q.3315: Signalling requirements for flexible network service combination on broadband network gateway Q.3711: Signalling requirements for software-defined broadband access network Q.3712: Scenarios and signalling requirements of unified intelligent programmable interface for IPv6 Q.3713: Signalling requirements for Broadband Network Gateway (BNG) pool (under AAP, LC is 28.03.2017) Q.4040: The framework and overview of cloud computing interoperability testing

# Resolution 93 of WTSA-16

*“Interconnection of 4G, IMT-2020 networks and beyond”*

## Instructs the study groups

... to identify as soon as possible future ITU T Recommendations that need to be developed associated with the **interconnection of 4G, 5G/IMT-2020 networks and beyond...**

## Instructs the study group 11

... to develop ITU-T Recommendations which specify the **framework and signalling architectures** to be used for establishing **interconnection of 4G, IMT-2020 networks** and beyond to achieve interoperability worldwide...

## Instructs the study group 2

... to develop ITU-T Recommendations which specify the **ENUM architecture** to be used for networks and beyond...**interconnection of 4G, IMT-2020**

## Resolves

... that ITU-T Recommendations to address network architectures, roaming principles, numbering issues, charging and security mechanisms as well as **interoperability and conformance testing for interconnection of 4G, IMT-2020 networks** and beyond shall be progressed **as quickly as possible...**





# IMT-2020/5G Workshop and Demo Day

09:00 - 09:20	<b>Opening and Welcome</b> <ul style="list-style-type: none"><li>▸ Opening Remarks</li><li>▸ Welcome Remarks</li></ul>
09:20 - 10:20	<b>IMT-2020/5G related activities in ITU-T SGs</b>
10:20 - 10:40	<b>Coffee Break</b>
10:40 - 12:00	<b>5G Wireline Network and Aspects: a view by operators and vendors</b>
12:00 - 13:30	<b>Lunch</b>
13:30 - 14:30	<b>IMT2020/5G Demos and Proof of Concept</b>
14:30 - 15:50	<b>IMT-2020/5G Technical and Standard Progress in other groups</b>
15:50 - 16:10	<b>Coffee Break</b>
16:10 - 16:50	<b>(continuation) IMT-2020/5G Technical and Standard Progress in other groups</b>
16:50 - 17:30	<b>Demonstrations</b>
17:30 - 17:50	<b>Summary on workshop results by Study Group 13 Chairman</b>

**Geneva, Switzerland, 11 July 2017**

**Contact:** [tsbworkshops@itu.int](mailto:tsbworkshops@itu.int)

**Web page:** <https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201707/Pages/default.aspx>



# Conclusions

- The scope of **IMT-2020 is broader than previous generations** of mobile broadband communication systems
- Use cases foreseen include enhancement of the traditional mobile broadband scenarios as well as **ultra-reliable and low latency communications and massive machine-type communications**
- **ITU's work in developing the specifications for IMT-2020**, in close collaboration with the whole gamut of 5G stakeholders, is well underway, along with the associated spectrum management and spectrum identification aspects
- **IMT-2020 will be a cornerstone for all of the activities related to attaining the goals in the 2030 Agenda for Sustainable Development**
- **Academia has the unique opportunity to participate in ITU's standardization activities and to contribute to the development of future 5G systems**





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