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| ITU-T Study Group 13 |
| Future networks including cloud computing, mobile and next-generation networks |
| REPORT of ITU-T SG13 TO THE WORLD TELECOMMUNICATION STANDARDIZATION ASSEMBLY (WTSA-16), Part II: QUESTIONS PROPOSED FOR STUDY DURING THE NEXT STUDY PERIOD (2017-2020) |

Note by the TSB:

The report of Study Group 13 to the WTSA-16 is presented in the following documents:

Part I: **Document 13** – General

Part II: **Document 14** – Questions proposed for study during the study period 2017-2020

# 1 List of Questions proposed by Study Group 13

| Question number | Question title | Status |
| --- | --- | --- |
| A/13 | IMT-2020: Network requirements & functional architecture | New Question |
| B/13 | NGN evolution with innovative technologies including SDN and NFV | Continuation of Q2/13 and Q3/13 |
| C/13 | Software-defined networking, network slicing and orchestration | Continuation of Q14/13 and Q12/13 |
| D/13 | QoS aspects including IMT-2020 networks | Continuation of Q6/13 |
| E/13 | Upcoming network technologies for IMT-2020 & Future Networks | Continuation of Q13/13 and Q15/13 |
| F/13 | Fixed-Mobile Convergence including IMT-2020 | Continuation of Q4/13, Q9/13 and Q10/13 |
| G/13 | Knowledge-centric trustworthy networking and services | Continuation of Q11/13 and Q16/13 |
| H/13 | Innovative services scenarios, deployment models and migration issues based on Future Networks | Continuation of Q1/13 |
| I/13 | Applying networks of future and innovation in developing countries | Continuation of Q5/13 |
| J/13 | Big data driven networking (bDDN) and Deep packet inspection (DPI) | Continuation of Q7/13 |
| K/13 | Requirements, ecosystem, and general capabilities for cloud computing and big data | Continuation of Q17/13 |
| L/13 | Functional architecture for cloud computing and big data | Continuation of Q18/13 |
| M/13 | End-to-end Cloud computing management and security | Continuation of Q19/13 |

# 2 Wording of Questions

Draft Question A/13

IMT-2020: Network requirements & functional architecture

(New Question)

### 1 Motivation

The objective of the development of IMT-2020 is to address the anticipated needs of users of mobile services in the years 2020 and beyond. The vision and service scenarios will have been identified by related SDOs (ITU-R, 3GPP, NGMN, etc.), e.g., Enhanced Mobile Broadband, ultra-reliable and low latency communications, massive machine type communications.

IMT-2020 systems will differentiate themselves from fourth generation (4G) systems not only through further evolution in radio-interfaces but also through greatly increased flexibility end-to-end. On one hand, requirements on service scenarios should be met by IMT-2020 function design. On the other hand, this end-to-end flexibility will bring the challenge to architecture and functional design of IMT-2020 considering diverse service requirement. And it comes in large part from the incorporation of network softwarization into every component. Well known techniques such as NFV, SDN will together allow unprecedented flexibility in the IMT-2020 system. Such flexibility will enable many new capabilities including network slicing.

This question focuses on the study of the requirements, capabilities, architecture and key technologies to realize the IMT-2020 network. And the ecosystem from business models and use cases should be promoted to build and realize the better cooperation with mobile customers. Open source projects should also be utilized and guide to meet the requirement of IMT-2020 network.

### 2 Question

Study items to be considered include, but are not limited to:

• What are the key requirements and capabilities of IMT-2020 networks based on the service scenarios of IMT-2020?

• What framework and architecture are required to realize networks of IMT-2020 based on the identified requirements and capabilities?

• What key technologies related to IMT-2020 are required to realize networks of IMT-2020?

• How to build and/or guide the ecosystem on IMT-2020 taking into account business models and use cases

• How to utilize and guide the open source software related to IMT-2020 to meet the requirements of IMT-2020

### 3 Tasks

Tasks include, but are not limited to:

• Development of Recommendations on the requirements and capabilities for the networks of IMT-2020 based on the service scenarios of IMT-2020

• Development of Recommendations on the framework and architecture design of IMT-2020 based on, not limited to, the above identified requirements, capabilities and the gap analysis identified by FG on IMT-2020

• Development of Recommendations and other relevant documents describing technologies related to IMT-2020 including network softwarization, network slicing, orchestration, capability exposure, etc.

• Development of Recommendations on the interworking with current networks including IMT-Advanced, etc.

• Study of potential utilization and guide of open source software activities in IMT-2020 networks

• Development of Recommendations on ecosystem aspects taking into account business models and use cases

An up-to-date status of work under this Question is contained in the SG13 Work Programme.

<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Recommendations:**

• Y-series in SG13

**Questions**:

• All SG13 related Questions, such as QD, QE, QF, QG/13

**Study Groups:**

• ITU Study Groups involved with IMT-2020 studies

**Standardization bodies:**

• ITU-R

• 3GPP

• NGMN

• IETF

Draft Question B/13

NGN evolution with innovative technologies including SDN and NFV

(Continuation of Q2/13 and Q3/13)

### 1 Motivation

With the ever increasing number of services and applications, demand has been continuously increasing for enhancing the capabilities of the networks and evolving their infrastructure. Considering the evolution path of NGNs towards IMT-2020&FN, the increasing possibilities of integration of advanced communication technologies (e.g., SDN, NFV and CDN) with advanced information technologies (e.g., cloud computing, Web technologies) are paving the way for evolution of NGNs, and are making available a large set of advanced capabilities for the support of innovative and promising services, applications and technologies in the various business domains and social communities.

Meanwhile, to satisfy the requirements and overcome potential challenges raised by NGNs evolution towards IMT-2020&FN, it is appropriate to consider some innovative technologies such as SDN and NFV in order to provide the network with flexibility, agility and programmability and other advanced characteristics. As a result, the importance of the requirements and architecture studies of NGNs evolution with these technologies is obtaining more and more extensive approval and acceptance.

Furthermore, as NGN has established its position as an underlying network infrastructure for a large number of services and applications, it is critical to study how innovative services and applications meeting the industry demands can be realized by incremental enhancements of the capabilities of NGNs and evolved versions of NGNs such as network intelligence capability enhancement (NICE).

Last but not least, the study of requirements and architecture for these incremental realizations of innovative services, applications and technologies requires that relevant NGN specifications be maintained and updated.

### 2 Question

The Question addresses the support of emerging services and applications in NGNs evolving in a phased network evolution approach. Based on the use cases and related ecosystem aspects, this Question will study the requirements and capabilities imposed on evolving NGNs.

Based on these requirements and capabilities, Recommendations on architectures for NGNs evolving in a phased network evolution approach will be specified.

The study of requirements, capabilities and architectures will consider the integration and usage of enabling information and communication technologies.

### 3 Tasks

Tasks include, but are not limited to:

• Development of Recommendations on use cases and ecosystem aspects (taking into account business models) for NGNs evolving in a phased network evolution approach

• Development of Recommendations on the requirements and architectures for NGNs evolving in a phased network evolution approach with the support of emerging technologies, including but not limited to:

− SDN technologies, e.g. for issues like centralized control and orchestration;

− NFV technologies, e.g. for issues like resource management and orchestration;

− CDN technologies, e.g. for issues like content delivery optimization;

− technologies for network intelligence enhancements, e.g. data in-network processing, mining, analytics and reasoning; dynamic policy control and traffic scheduling;

• Development of Recommendations on the specific capability sets for NGNs in a phased network evolution approach for the support of given emerging service features and the usage/integration of given emerging information and communication technologies

• Maintenance and update of existing Recommendations on NGN, NGNe, IPTV, emergency communications including development of new Recommendations on these subjects as appropriate.

An up-to-date status of work under this Question is contained in the SG13 Work Programme: <http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Recommendations:**

• Y-series

**Questions:**

• Relevant Questions of SG13 on network evolution aspects

**Study Groups:**

• Other ITU-T Study Groups as appropriate, ITU-R Study Groups as appropriate

**Standardization bodies:**

• IETF

• OMA

• IEEE

• ATIS

• ETSI

• ISO/IEC

• 3GPP/3GPP2

• those involved in network evolution matters

Draft Question C/13

Software-defined networking, network slicing and orchestration

(Continuation of Q14/13 and Q12/13)

### 1 Motivation

With the emergence of various new services such as industrial control, self-automated driving, mission critical communications, cloud-based services and others, Software Defined Networking (SDN), network slicing and orchestration are considered as key technological enablers for networks of the future, and have been studied in Y.3000 and Y.3300 series. Coming from the SDN technological perspectives these recommendations describe the logically isolated network partition (LINP)/network slice, orchestration and data plane programmability as enabler for network operators to control their networks in unified, flexible and programmable manner. Ability to orchestrate various functions and applications in a programmatic manner helps the integrated operation and simplifies the operational complexity of underlying networks. In other words, SDN and orchestration contribute to easier operation through integrating management and control into management-control continuum, and enabling autonomous operation. Since these are key technologies for networks of the future including IMT-2020, various SDOs and open source activities have started to study these technologies in intensive manner. But industry’s understandings of these technologies, in particular orchestration, its management-control continuum, their applicability to distributed networking technologies varies between each community and industry-wide, generic understandings applicable to telecommunication industry still needs to be studied.

The Recommendations that specifies framework, service scenarios, requirements, and architecture of SDN, network virtualization, network slicing, orchestration and data plane programmability technologies, their management-control continuum, fall under the responsibility of this question.

### 2 Question

Study items to be considered, but not limited to:

• What are the requirements and architecture of SDN and data plane programmability to support functions such as network virtualization and network slicing necessary for exploding and diversifying services taking into account scalability, security and distribution of functions?

• What are the key requirements and architecture of orchestration and related management-control continuum capability exposure, especially on distributed networks, softwarized network and network slices, taking into account energy saving, high efficient resource utilization and others?

• What are the gaps in standardization effort for SDN, network virtualization, network slicing approach and orchestration as well as in open source activities?

### 3 Tasks

Tasks include, but are not limited to:

• Considering open source activities, Development and maintenance of Recommendations on requirements, functional architecture and mechanisms of generic SDN and their profiles including network virtualization, network slicing, its application to networks

• Development of Recommendations on the orchestration and related management-control continuum capabilities/policies of network function components, slices and infrastructure including enhancement and support of distributed networking capabilities

• Development of Recommendations on the capability of network slicing and related management-control continuum

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Recommendations:**

• Y-series Recommendations, in particular Y.3000 and Y.3300 series

• SDN, network virtualization, network slicing, orchestration-related G, H, Q and X‑series Recommendations

**Questions:**

• All SDN including network virtualization, network slicing and orchestration related Questions

**Study Groups:**

• ITU-T Study Groups involved in SDN including network virtualization, network slicing and orchestration studies and testing

**Standardization bodies, fora and consortia:**

• ISO/IEC JTC1 SC 6

• ETSI ISG Network Functions Virtualization (NFV)

• Open Networking Foundation

• 3GPP

• IETF/IRTF

• TMF

• BBF

• Open-source activities involved in SDN including network virtualization, network slicing and orchestration studies

Draft Question D/13

QoS aspects including IMT-2020 networks

(Continuation of Questions 6/13)

### 1 Motivation

A key characteristic of existing and emerging networks is the use of a smart transport including its softwarization for supporting all applications and services. Different types of applications/services (e.g. IMT-2020 applications/services, Web Services, IP telephony, IPTV and Context/Content-aware services), however, have varied QoS/QoE requirements, all of which must be supported by this smart transport. Hence appropriate mechanisms are needed to achieve the required levels of QoS/QoE, especially for applications that are delay- and loss-sensitive in the emerging networks like IMT-2020. Such applications may also require a large amount of bandwidth and strict quality assurance under the softwarized network environment, which makes the support for QoS/QoE challenging.

To support QoS/QoE in a consistent, efficient, dynamic and secure fashion, considerations need to be given to the following aspects:

• QoE and Application QoS requirements

• Varied types of transport technology including evolutionary and especially, revolutionary technologies (e.g. Ethernet, IP, MPLS, OTN, and IMT-2020 core in the core network; DSL, UMTS, WiFi, WiMAX, LTE, LTE-advanced, and 5G access in the access network) and endpoints (e.g. smart phone/tablet, laptop, and set-top box), and multiple administrative domains (e.g. home networks, enterprise networks, provider networks, and private/public/distributed clouds) in an end-to-end path

• Availability and accuracy of network topology and load information

• Use of multicast and other emerging content distribution mechanisms (e.g., Content‑Centric Networking (CCN))

• QoS/QoE for Softwarized networks

• Network resource optimization and orchestration for QoS/QoE enablement

• Granularity of QoS control

• User nomadicity and mobility from QoS perspective

• Service level agreement between providers or between a provider and a customer

• QoS related policy taking into account the policy continuum (e.g. business policy, system policy, administrator policy, and device policy, and the mapping relationship among them)

• Use of overlay technology (peer-to-peer or otherwise) for routing around network congestion, reliable multicast support, etc.

### 2 Question

Study items to be considered include, but are not limited to:

• What new Recommendations or enhancements to existing Recommendations are needed to enable QoS/QoE support in the Softwarized Networks, especially for performance-sensitive and bandwidth-demanding applications/services (e.g. IMT-2020 applications/services)?

• What new Recommendations or enhancements to existing Recommendations are needed to leverage NGN QoS mechanisms in overlay and content centric networks, such as those for intelligent content delivery and reliable multicast?

• What new Recommendations or enhancements to existing Recommendations are needed to provide safeguards to QoS mechanisms (e.g. mitigation of denial-of-service and theft-of-service attacks)?

• What new Recommendations or enhancement to existing Recommendations are needed for QoS/QoE mechanisms to support autonomic and optimal resource control and management for softwarized networks?

• What new Recommendations are needed to provide the optimal resource control and management for achieving end-to-end QoS in a heterogeneous environment involving different QoS mechanisms, network orchestrations, and multiple provider domains?

• What new Recommendations or enhancement to existing Recommendations are needed for QoS/QoE mechanisms to support softwaredefined networking capabilities?

• What new Recommendations or enhancement to existing Recommendations are needed for QoS/QoE support for providing energy savings?

• What new Recommendations or enhancement to existing Recommendations are needed for deep packet inspection?

• What guidance is needed for ensuring that QoS/QoE matters raised by other Questions in Study Group 13 are addressed satisfactorily?

NOTE − Question will not overlap with existing works in SG12 and other SDO’s (e.g. IETF and 3GPP.

### 3 Tasks

Tasks include, but are not limited to:

• Maintenance and update of the Recommendations on QoS/QoE

• Development of new Recommendations or enhancement to existing Recommendations on QoS/QoE support for autonomic and/or optimal resource control and management for softwarized networks

• Development of new Recommendations or enhancement to existing Recommendations on QoS/QoE support for softwaredefined networks

• Development of new Recommendations or enhancement to existing Recommendations on QoS/QoE support for network function virtualization

• Development of new Recommendations or enhancement to existing Recommendations QoS/QoE support for deep packet inspection

• Guidance and collaboration to/with other Questions on QoS/QoE matters, especially to a potential new Question(s) responsible for IMT-2020 applications QoS/QoE, IMT-2020 softwarized network optimal resource control and management and their orchestration

• Determine network technologies and architectures that can efficiently achieve the desired QoS/QoE requirements in IMT-2020

• Development of new Recommendations or enhancement to existing Recommendations on definition of end-to-end QoS

• Development of new Recommendations or enhancement to existing Recommendations on overall QoS study applicable to IMT-2020

• Development of new Recommendations or enhancement to existing Recommendations on end-to-end connectivity for D2D/D2N – integrity and supervision

• Development of new Recommendations or enhancement to existing Recommendations on performance objectives and QoS budget allocation for mobile and fixed networks

• Development of new Recommendations or enhancement to existing Recommendations on additional QoS parameters Measurement and monitoring

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Recommendations:**

• Y-series and Q-series

**Questions:**

• All IMT-2020, Future Networks, cloud computing, IoT, IPTV and QoS related Questions

**Study groups:**

• All IMT-2020, Future Networks, cloud computing, IoT, IPTV and QoS related study groups

**Standardization bodies, fora and open source consortia:**

• 3GPP

• ATIS CSF, IIF, PTSC and PRQC

• Broadband Forum

• ETSI NFV ISG

• ETSI NTEC AFI

• IEEE 802 LAN/MAN

• IETF

• ODL

• ONF

• ONOS

Draft Question E/13

Upcoming network technologies for IMT-2020 & Future Networks

(Continuation of Questions 13/13 and 15/13)

### 1 Motivation

The IMT-2020 network and Future Network handling various services, such as Internet of Things (IoT), machine-to-machine (M2M) communication, social networking services (SNS), Mobile Internet, cloud computing (CC), Content Delivery Network (CDN) and user-generated massive amount of multimedia contents, will be targeting to achieve high performance in terms of high bandwidth, ultra-low latency, low energy consumption, massive number of connected devices, flexible network virtualization, high security and high efficient manageability. The conventional host-centric, location-based, server-client model of the networking would not be capable to meet these requirements.

So an increasing demand for network technologies innovation is strong motivation for architecture, framework, functions, candidate solutions and network migration policies, which focus on upcoming network technologies that are still at initial stage and need further encouragement, such as Information Centric Networking (ICN) and Public packet Telecom Data Network (PTDN).

For ICN, also known as Data-Aware Networking (DAN), it has been considered as an emerging technology for the IMT-2020 network to achieve its performance goals. ICN is also considered as a potential networking scheme to be deployed and operated by software-defined networking (SDN) on network slices created and programmed by network function virtualization (NFV), network softwarization and in-network processing. ITU-T Y.3031 specifying the ID-based communication framework for future networks and Y.3033 specifying the framework of Data-Aware Networking (DAN) have been produced. Various promising use case scenarios have been specified in ITU-T Supplement 35 to Y.3033.

PTDN, which focuses on the evolution of packet based networks, defines the potential candidate mechanisms and corresponding frameworks that meet future requirements (specified in ITU-T Y.2601) and supports smooth evolution from current IP networks to future networks. Recommendations, including the requirements (Y.2601) and high level architecture (Y.2611, Y.2612), of Future Packet Based Network (FPBN) had been developed. Candidate technologies of FPBN, including PTDN and independent Scalable Control Plane (iSCP), had been studied and several Recommendations of PTDN and iSCP have been published.

The objectives of this Question are to create a network technology innovation pool, to encourage the combination of different ideas, to push the convergence of new technologies, and to hatch innovative solutions that can be applied in the near future. So in this study period, on one hand, this Question focuses on standardization of ICN and PTDN, and on the other hand, this Question collects and studies new network technologies and emerging network solutions, and develops them to a mature state for future standardization.

### 2 Question

Study items to be considered include, but are not limited to:

• What are the ICN general requirements, functional architecture and use-case specific mechanisms including interworking, security, billing/charging, discover, routing and caching issues?

• To what extent is ICN applicable to IMT-2020?

• How can packet data network evolve to support the requirements of emerging use cases and services including IoT, cloud computing and CDN?

• How can packet based network evolve to meet the requirements of diversified services, such as 5G services, IoT, cloud computing, mobile Internet, and CDN, etc.?

• What are the new possible candidate technologies of packet based network evolution?

• What is the identification scheme of data objects, including structure of identifiers and their mapping to location and other entities, header compression?

• What are new mobility models to be realized by ICN?

### 3 Tasks

Tasks include, but are not limited to:

• Produce document(s) on analysis of ICN applicability to IMT-2020 and future networks.

• Produce new Recommendations on ICN general requirements, functional architecture and mechanisms of ICN networking and use-case specific mechanism and architectures including identifiers.

• Develop Recommendations on packet data network based on the study of requirements, frameworks and candidate mechanisms.

• Develop Recommendations on architecture, network virtualization, resource control and other technical issues of Future Packet Based Network (FPBN) including migration from the conventional IP-based network to FPBN.

• Develop the requirements and roadmap of packet based network evolution.

• Study and standardize other relevant upcoming network technologies.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=15/13> and
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=13/13>

### 4 Relationships

**Recommendations:**

• Y.3031, Y.3032, Y.3033, Y.3034, Y.2601, Y.2611, Y.2612, Y.2613, Y.2614, Y.2615, Y.2621, and Y.2622

• IMT-2020 and Future Networks related Recommendations

**Questions:**

• IMT-2020 and Future Networks related Questions

**Study Groups:**

• ITU-T Study Groups involved with IMT-2020 and Future Networks studies

**Standardisation bodies:**

• ISO/IEC JTC1 SC 6

• IETF

• ONF

• ETSI relevant ISGs

Other ICN/CDN communities

Draft Question F/13

Fixed-Mobile Convergence including IMT-2020

(Continuation of Questions 4/13, 9/13 and 10/13)

### 1 Motivation

Current usages of different access technologies provide users with different user experiences, such as broad bandwidth, low time delay, and high security. The main purpose of fixed-mobile convergence for multiple access technologies is to federate all means of access technologies including fixed and mobile accesses in order to access the network ubiquitously (from everywhere and at any time). Users and operators will benefit from harmonization of multiple connections, such as the efficient use of network resources, load balancing, reliability of connection, and continuity of services, among others.

In some use cases, fixed access networks will be considered as an access network of IMT-2020 to interwork with other radio access networks. A converged access-agnostic core (i.e., where identity, mobility, security, etc. are decoupled from the access technology), which integrates fixed and mobile core, is envisioned as a direction of IMT-2020. Therefore, this question focuses on the study of functional requirements, architecture enhancement and innovative technologies to support fixed mobile convergence ensuring a seamless user experience within the fixed and mobile domains.

### 2 Question

Study items to be considered include, but are not limited to:

• What requirements and functional architecture are needed to support Fixed-Mobile Convergence including IMT-2020 environment?

• What requirements and functional architecture are needed to support global roaming, seamless mobility and service continuity?

• What are the impacts of Fixed-Mobile Convergence for IMT-2020 network?

• Which innovative network technologies and techniques are required to support Fixed-Mobile Convergence for IMT-2020?

• What is needed to enhance FMC and mobility management from the perspective of network efficiency (i.e., resource management, energy savings, etc.) in information and telecommunications or in other industries?

### 3 Tasks

Tasks include, but are not limited to:

• Develop Recommendations based on the study of Fixed-Mobile Convergence in IMT-2020 using fixed and mobile accesses and their components in the context of the questions above

• Determine scenarios for Fixed-Mobile Convergence to support multimedia services, especially for real-time services such as VoIP, gaming, video streaming, real time text and Video on Demand.

• Develop network architecture enhancements to support Fixed-Mobile Convergence and mobility management.

• Study the innovative network technologies and techniques related to Fixed-Mobile Convergence in IMT-2020, such as mobility management, intelligent access selection, unified registration mechanism, service continuity, unified access control, unified data forwarding, flexible mobility, etc.

• Develop Recommendations on allocation of the FEs to physical entities and interfaces between these physical entities in order to determine which interfaces can use or enhance existing protocols and which interfaces need development of new protocols for the necessary FMC and mobility management capabilities.

• Although, it is foreseen that new Recommendations may be required, the outputs produced under this question will generally progress through, or in coordination with other related questions.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Recommendations:**

• Y-series in SG13

**Questions:**

• All SG13 related Questions, such as QA, QD, QE, QF/13

**Study Groups:**

• ITU Study Groups involved with IMT-2020 studies

**Standardization bodies:**

• ITU-R

• 3GPP

• 3GPP2

• IEEE

• IETF

Draft Question G/13

Knowledge-centric trustworthy networking and services

(Continuation of Question 11/13 and 16/13)

### 1 Motivation

Considering future ICT infrastructures and services, knowledge about the status of environments (in terms of services/applications and communication capabilities) and trust are becoming important and essential.

A new paradigm for knowledge-centric trustworthy networking and services enables in-network knowledge generation and distribution in order to develop the necessary network intelligence for handling complexity and uncertainty/risks of future ICT services. To support this paradigm, ICT infrastructures and services must be enhanced to make better use of knowledge and trust for creation, dissemination and utilization of knowledge in an open and collaborative manner as well as for taking into account trustworthy autonomous networking and services.

This question will investigate such importance of knowledge-centric trustworthy networking and services, and identify requirements and functions to support building of trusted ICT infrastructures.

Furthermore, this question will consider environmental and socio-economic awareness in order to minimize environmental impact as well as to reduce the barriers to entry for various actors involved in the network ecosystem.

In addition, as a continuation of previous study period, interworking aspects between different networks and services should be studied, and this study should be focused on the interworking between other networks whenever necessity of interworking is identified.

Thus the focus of this Question will include activities related to knowledge-centric trustworthy networking and services including interworking. In addition, the work to specify the procedure, requirements, properties, and mechanisms of environmental and socio-economic awareness for knowledge and trust issues are the responsibility of this question.

Recommendations under responsibility of this Question include:

• Y.1911, Y.2062, Y.2064, Y.2070, Y.2281, Y.2291, Y.3043, Y.3013, Y.3022, Y.3035, Y.3041, Y.3044, Y.3045

### 2 Question

Study items to be considered include, but are not limited to:

• What new Recommendations should be developed for knowledge centric trustworthy networks, including their ability to support specific applications/services?

• What new Recommendations should be developed to support knowledge centric trustworthy services?

• What new Recommendation should be developed to support environment-awareness (e.g., for energy saving)?

• What new Recommendation should be developed to support socio-economic awareness (e.g., for trusted ICT infrastructures)?

• What enhancements to the existing Recommendations should be made to enable interworking between other networks including end user networks (e.g., customer premises networks)?

### 3 Tasks

Tasks include but are not limited to:

• Development of new Recommendations related to knowledge-centric trustworthy networking and services;

• Development of new Recommendations related to environment-aware networking and services for reducing energy consumption and energy efficiency management;

• Development of new Recommendations related to socio-economic aware networking and services for trusted ICT infrastructures;

• Development of new Recommendations related to interworking between other networks (including specific networks, e.g., networks for vehicular, smart grid and healthcare, etc.) and services considering heterogeneous and constraint networking environments in end user side;

• Development of new Recommendations related to end user networks and their specific applications/services in end users perspective (e.g., enhancement of home networks, personal area networks, etc.).

• Maintenance and enhancements of Recommendations ITU-T Y.1911, Y.2062 Y.2064, Y.2070, Y.2281, Y.2291, Y.3043, Y.3013, Y.3022, Y.3035, Y.3041, Y.3044, Y.3045

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=11/13> and
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=16/13>

### 4 Relationships

**Recommendations:**

• I-, Q-, X- and Y-series

**Questions:**

• All SUN, SDN, FNs, environment and climate change, socio-economic awareness and home network related Questions

**Study groups:**

• All SUN, SDN, FNs, environment and climate change, socio-economic awareness and home network related study groups

**Standardization bodies, fora and consortia:**

• ISO/IEC JTC 1/SC 6, JTC 1/SC 39

• IETF

• ETSI

• Online Trust Alliance (OTA)

• Trusted Computing Group (TCG)

• ONF

• 3GPP

• DSL Forum

• HGI (Home Gateway Initiative)

• OMA (Open Mobile Alliance)

Draft Question H/13

Innovative services scenarios, deployment models and migration issues based on Future Networks

(Continuation of Question 1/13)

### 1 Motivation

The continuing migration of the telecommunications network and the ongoing service between information technologies and trust network technologies has prepared opportunities for new services to be created. It is important that awareness be developed of not only the potential application service (described by service use case) that may be developed but also the anticipated operating migration scenarios and the related implementation of service models (described by deployment model) as well. This information can be used to assist in planning for the continuing application service of the network and may possibly even accelerate the availability and automation of commercial products which will rely on the emerging network.

Migration scenario is a modelling of service procedure taking into account IMT-2020 and trust network technologies. Service deployment models based on trust network technologies could be designed to enable new service provider to support key networking environments and contribute to business innovation. In each case these use cases should be initiated from the user point of view. Service deployment model is a modelling of service functions taking into account trust network technologies.

Service providers have expressed concerns related to their capital investments over the last few years of ongoing migration The solutions to effect this transition, i.e., migration plans, should protect as much as possible the investments of provider in the existing network infrastructure.

Recommendations and supplements under responsibility of this Question include:

• Service framework and scenario for smart learning

• Service and Device Independent Screen-free service

• Service framework and scenario for Use cases of service chaining models

• Supplement on Convergence Services Classification and scenarios on Networks

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp1_search.aspx?Q=1/13>

### 2 Question

The study of this Question is to establish and develop the new Service deployment models and migration for the efficient creation of such services including innovative aspects of artificial intelligent knowledge and automations based network technologies.

Study items to be considered include new service model of creative conception, but are not limited to:

• Service deployment models and migration issues for new efficient creation of innovative services such as monitoring and recovery of problems on the social issues based on IMT-2020 and trust network

• Identification service models related to new application services stemming from trust network

• Identification of migration issues as the evolution of information and telecommunications technologies continues

• Use case which result from the consideration of innovative services to appear

• Identification as to how these service scenarios and deployment models could impact directly or indirectly other industries.

### 3 Tasks

Documents produced under this Question will normally be published as Supplements or will progress through, or in coordination with, other related Questions.

Tasks include, but are not limited to:

• Development of documents that present service use case scenarios and deployment models that may contribute to intelligent aspect of innovative services;

• Application services and guides for network provider with innovative service plan in the fields of convergence services;

• Identification frameworks of Service and network provider for covering logistics service under IMT-2020 and trust network environments;

• Development of documents on emerging migration to IMT-2020 and trust network.

### 4 Relationships

**Recommendations:**

• Y-series Recommendations

 **Questions:**

• QB/13, QD/13, , QE/13, QG/13, QK/13, QL/13, QM/13

**Study groups:**

• ITU-T Study Groups 5, 9, 11, 16, 17, 20

• ITU-D Study Groups 1 and 2

**Standardization bodies, fora and consortia:**

• ISO, IEC, ETSI

• IEEE, IETF

• OMA , W3C

• APT

• GS1

Draft Question I/13

Applying networks of future and innovation in developing countries

(Continuation of Question 5/13)

### 1 Motivation

The telecom industry continues to evolve at very high speed; characterised by disruptive evolution of the current networks systems like IMT-Advanced towards IMT-2020, Cloud computing, SDN, M2M and so on. The developing world is facing the challenge of ensuring that its technological requirements are taken into consideration as well as to contribute and influence international ICT standards.

The importance of future networks, NGN, cloud computing, trust, big data, SDN and so on for developing countries will continue to grow for the foreseeable future. New technologies continue to make networks more accessible, more efficient, more cost effective, more adaptive and more versatile. For developing countries’ networks to continue to be relevant, they need to adapt relatively quickly to new technologies.

This question will aim at reducing the standardization gap in the scope of SG13 activities by allowing developing countries to follow, contribute and implement international standards as appropriate to their context.

The activities of this question will focus on Recommendations, Technical Papers and Supplements which study the needs of the eco-system as a whole of developing country telecom networks in terms of applying IMT-2020, cloud computing, big data, trust and other emerging technologies as they deal with the shift towards convergence of previously discrete areas, namely telecoms, data and entertainment under their own specific circumstances.

This Question provides a highly useful forum for developing countries to describe their infrastructure circumstances, their needs, and thus form a basis for work in other SG13 Questions as well as in relevant organizations within and outside ITU toward meeting their needs.

It has been sensed that there is a desire from the least developed countries to be more involved and to help steer the work towards better meeting their needs, but that it is difficult for them to find a suitable home for such inputs. This work would feed relevant organizations within and outside ITU whose aim would be to meet the needs identified.

This Question also provides an easier and automatic entry in SG13 work, for developing countries new to SG13.

This work should be conducted in close cooperation with relevant organizations within and outside ITU.

### 2 Question

Study items to be considered include, but are not limited to:

• What scenarios and requirements in terms of services and deployments are needed for applying future networks, NGN, cloud computing, Trust, big data, SDN and so on and other emerging technologies in Developing Countries telecom networks?

• What enhancements to existing Recommendations are required to provide energy savings directly or indirectly in Information and Communication Technologies (ICTs) and services or in other industries?

• What enhancements to developing or new Recommendations are required to provide such energy savings?

### 3 Tasks

Tasks include, but are not limited to:

• Prepare documents summarizing the findings of a gap analysis on the current status and trends of IMT, future networks, NGN evolution implementation, cloud computing, trust in ICT, big data, SDN and other new technologies, from a view point of developing country telecom networks.

• Develop scenarios in terms of services and deployments for applying IMT, future networks, NGN, cloud computing, Trust, big data, SDN and other new technologies in Developing Country telecom networks.

• Examine possibility of evolution of existing equipment and other new technologies.

• Develop requirements in terms of services and deployments for applying IMT, future networks, NGN, cloud computing, Trust, big data, SDN and other new technologies in Developing Country telecom networks.

• Provide guidance on how best developing countries can implement emerging technologies.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Study Groups:**

• ITU-D Study Groups 1 and 2, ITU-R WP 5D

**Standardization bodies:**

• 3GPP

• 3GPP2

• IEEE

• IETF

Draft Question J/13

Big data driven networking (bDDN) and Deep packet inspection (DPI)

(Continuation of Question 7/13)

### 1 Motivation

Deep packet inspection is essential for network operators to know the distribution of service/application traffic in the network. Moreover, deep packet inspection is a generic core technology and a common building block for future networks. Based on deep packet inspection, operators can optimize service/application traffic on their networks by managing bandwidth, improve quality of service (QoS) and quality of experience (QoE), they can also make efficient use of network resources, reduce costs, and capital investment by avoiding the need to upgrade the network capacity.

It is necessary to identify the requirements, capabilities and solutions for service/application identification/awareness/visibility based on deep packet inspection in future networks (including Software Defined Networking, Network Function Virtualization, Internet of Things, Information Centric Network/Content Centric Network and other candidate future network architecture and technology (e.g., IMT-2020 network)). Moreover, with wide application of the big data related technologies, deep packet inspection related technologies will play an important role in collecting data from network and pre-processing the data.

On the other hand, the big data generated by DPI technology implies a great deal of valued information for network management, operation, control and optimization etc. Such valuable and tremendous amount of information, should be used effectively. This can be achieved by big data driven networking (bDDN, bDDN is a synonym of DDN). bDDN is a group of technologies and methods to facilitate network operation, administration, maintenance, control and optimization etc. based on the big data generated by the network and a series of methods and tools. That is to say, big data generated by the network are used to serve for the network and make the network better. bDDN solves this problem by introducing and applying the big data technology to the framework of future network. bDDN provides the data intelligence to facilitate network management, operation, control and optimization etc. based on the big data generated by the network itself.

It should be emphasized that bDDN can be used in any kind of network architecture. Furthermore, bDDN doesn’t change or overlay with the network architecture to which it is applied.

### 2 Question

Study items to be considered including, but are not limited to:

• What enhancements to existing Recommendations are needed to enable services/applications identification/awareness/visibility, to enable traffic and resource optimization based on deep packet inspection in future networks (including Software Defined Networking, Network Function Virtualization, Internet of Things, Information Centric Network/Content Centric Network and other candidate future network architecture and technology (e.g., IMT-2020))?

• What new Recommendations are needed to provide a mechanism for deep packet inspection in future networks from the perspective of emerging application context?

• What new Recommendations are needed to provide performance models of deep packet inspection in future networks?

• What new Recommendations are needed to support functional requirements of deep packet inspection in future networks?

• What new Recommendations are needed to support functional architecture of deep packet inspection in future networks?

• What new Recommendations are needed to provide framework for data driven networking?

• What new Recommendations are needed to provide requirements for data driven networking?

• What new Recommendations are needed to provide mechanism for data driven networking application?

### 3 Tasks

Tasks include, but are not limited to:

• Enhancements of Y.2770 (DPI requirements) and Y.2771(DPI framework) in future networks (including Software Defined Networking, Network Function Virtualization, Internet of Things , Information Centric Network/Content Centric Network and other candidate future network architecture and technology(e.g., IMT-2020)).

• Development of new Recommendations on DPI mechanism for future networks in the emerging application context.

• Development of new Recommendations on DPI performance model.

• Development of new Recommendations on DPI functional requirements for future networks.

• Development of new Recommendations on DPI functional architecture for future networks.

• Development of new Recommendations on framework of data driven networking.

• Development of new Recommendations on requirements of data driven networking.

• Development of new Recommendations on mechanism of data driven networking application.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/itu-t/workprog/wp_search.aspx?sg=13>

### 4 Relationships

**Questions:**

• All big data related Questions.

• Application awareness, QoS and network OAM related Questions.

• SDN, NFV related Questions.

**Study groups:**

• All QoS, OAM and Future Networks related study groups.

**Standardization bodies, forums and consortia:**

• IETF

Draft Question K/13

Requirements, ecosystem, and general capabilities for cloud computing and big data

(Continuation of Question 17/13)

### 1 Motivation

Cloud computing is a model for enabling service user’s ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services), that can be rapidly provisioned and released with minimal management effort or service provider interaction. The cloud computing model is composed of five essential characteristics (on-demand, delivery over a broad network access, resource pooling, rapid elasticity, self and measured services), five cloud computing service categories, i.e., Software as a Service (SaaS), Communication as a Service (CaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Network as a Service (NaaS), and different deployment models (public, private, hybrid…).

Cloud computing can support several other technologies like Big Data, IoT etc. Identification of the requirements for cloud computing to be able to effectively support other technologies is important element of work in this Question.

Big data is a category of technologies and services where the capabilities provided to collect, store, search, share, analyse and visualize data are characterized by volume, variety, and velocity. Big data related challenges cannot be covered by traditional data processing and analytics.

Telecommunication industry has an important role to play in the emerging cloud computing and big data ecosystems. The telecommunication network is a central element for multi-tenant cloud computing and big data architecture delivering services for customers with performance, QoS and optimal resource utilization.

The primary focus of this Question is to provide the necessary overall frameworks, definitions, and ecosystems including requirements, capabilities related to the integration or support of the cloud computing, big data model and technologies in telecommunication ecosystem. Also relationships between cloud computing and big data are developed. This Question is intended to develop new Recommendations for:

• cloud computing and big data definitions, overview, ecosystem, and use cases;

• cloud computing and big data requirements, and capabilities;

• requirements for interoperability, data portability, and exchange information in cloud computing and big data;

• relationship between cloud computing and big data.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

• Y.3500, Y.3501, Y.3503, Y.3504 and Y.3600

### 2 Question

Study items to be considered include, but are not limited to:

• What new Recommendations should be developed for cloud computing and big data definitions, ecosystem, use cases, and capabilities from telecommunication perspectives?

• What new Recommendations should be developed for cloud computing and big data high-level requirements and general capabilities?

• What new Recommendations should be developed for requirements for cloud computing interoperability and data portability between cloud service providers that are appropriate and achievable for cloud use cases?

• What new Recommendations should be developed for big data, including Big Data as a Service?

• What collaboration is necessary to minimize duplication of efforts with other SDOs?

### 3 Tasks

Tasks include, but are not limited to:

• Developing Recommendations for cloud computing and big data definitions, overview, ecosystem, use cases, business roles and benefits from telecommunication perspectives

• Developing Recommendations for cloud computing and big data high-level requirements and general capabilities

• Developing Recommendations for cloud computing interoperability and data portability

• Developing Recommendations for emerging cloud and big data technology overview, requirements aspects such as distributed cloud, and cloud/big data to support artificial intelligence including machine learning

• Developing Recommendations for cloud computing based big data, big data exchange framework

• Providing the necessary collaboration for the work in the ITU-T Q17/13 with relevant SDOs, consortia and fora

• Maintenance and enhancement of the Recommendations for which the Question is responsible

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?isn_sg=1756&isn_qu=2000>

### 4 Relationships

**Recommendations:**

• Y-series and cloud computing and big data related Recommendations

**Questions:**

• Other relevant Questions of ITU-T SG13

**Study Groups:**

• ITU-T Study Groups 5, 9, 11, 16 and 17, ITU-D Study Groups as appropriate

**Standardization bodies, fora and consortia including, but not limited to:**

• ISO/IEC JTC 1/SC 38

• ISO/IEC JTC 1 SC 32 and SC 27

• ISO/IEC JTC 1 WG 9

• National Institutes of Standards and Technology (NIST)

• Distributed Management Task Force (DMTF)

• Storage Networking Industry Association (SNIA)

• Cloud Security Alliance (CSA)

• ETSI NFV SG

• OCP

• Linux Foundation projects

• OASIS

• W3C

Draft Question L/13

Functional architecture for cloud computing and big data

(Continuation of Question 18/13)

### 1 Motivation

Cloud computing is a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand. The cloud computing paradigm is composed of six essential characteristics (broad network access, measured services, multi-tenancy, on-demand self-service, rapid elasticity and scalability and resource pooling), multiple cloud computing service categories, including Software as a Service (SaaS), Communication as a Service (CaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Network as a Service (NaaS), and different deployment models (e.g. public, private, hybrid).

Big data is a paradigm for enabling the collection, storage, management, analysis and visualization, potentially under real-time constraints, of extensive datasets with heterogeneous characteristics. Big Data as a Service (BDaaS) is cloud service category in which the capabilities provided to the cloud service customer are the ability to collect, store, analyze, visualize and manage data using big data.

Cloud computing can provide the architectural, infrastructural and networking support for providing big data based services as well as internet of things (IoT) applications, etc. Specification of the architecture for cloud computing to be able to effectively support new emerging services is an important element to study in this Question.

Telecommunication players have an important role to play in the cloud computing and big data markets and ecosystems. The telecommunication network is a central part for multi-tenant cloud computing and big data architecture delivering services for customers with performance QoS and optimal resource utilizations.

The main focus of this Question is to provide cloud computing architectures, cloud computing infrastructure and cloud networking views related to the integration and support of the cloud computing paradigm and technologies in telecommunication ecosystems.

Another focus of this Question is to provide big data architectures related to the integration and support of the big data paradigm and technologies in telecommunication ecosystems

This Question is intended to develop new Recommendations for:

• cloud computing functional architectures supporting cloud service categories (e.g. NaaS, IaaS, PaaS, BDaaS and XaaS);

• cloud computing functional architectures of inter-cloud;

• cloud computing infrastructure including cloud networking aspects (e.g. for the support of network slicing);

• big data functional architectures including big data exchange functional architecture and cloud computing based big data architecture.

### 2 Question

Study items to be considered include:

• What new Recommendations should be developed regarding the cloud computing functional architectures, including the specification of corresponding functions, functional components, and their inter relations?

• What new Recommendations should be developed regarding the infrastructure and networking aspects of cloud computing?

• What new Recommendations should be developed for the big data architectures, including big data exchange functional architecture and BDaaS functional architecture?

• What collaboration is necessary to minimize duplication of efforts with other SDOs?

### 3 Tasks

Tasks include, but are not limited to:

• Developing Recommendations for cloud computing functional architectures (including inter-cloud), covering the identification of architectural functions, functional components, and their inter-relation required to provide cloud services.

• Developing Recommendations for cloud computing infrastructure and networking aspects, covering the identification of functions, functional components for computing, storage and networking (intra-cloud network, inter-cloud network and core transport).

• Developing Recommendations for cloud computing based big data functional architecture, big data exchange functional architecture.

• Providing the necessary collaboration with external SDOs, consortia and forums.

• Maintenance and enhancement of the Recommendations for which the Question is responsible.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=18/13>

### 4 Relationships

**Questions:**

• All cloud computing related SG13 Questions (in particular QK/13, QM/13)

**Study groups:**

• ITU-T Study Group 9, 11, 16 and 20, ITU-D Study Groups as appropriate

**Standardization bodies, forums and consortia:**

• ISO/IEC JTC 1/SC 38, ISO/IEC JTC 1 WG9

• IETF

• IEEE

• ETSI including MEC (Mobile Edge Computing)

• ATIS

• Metro Ethernet Forum (MEF)

• Distributed Management Task Force (DMTF)

• Storage Networking Industry Association (SNIA)

• National Institute of Standards and Technology (NIST)

Draft Question M/13

End-to-end Cloud computing management and security

(Continuation of Question 19/13)

### 1 Motivation

Cloud computing is a model for enabling service user's ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services), that can be rapidly provisioned and released with minimal management effort or service provider interaction. The cloud computing model is composed of five essential characteristics (on-demand, delivery over a broad network access, resource pooling, rapid elasticity, self and measured services), five cloud computing service categories, i.e., Software as a Service (SaaS), Communication as a Service (CaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Network as a Service (NaaS), and different deployment models (public, private, hybrid…).

The term multi-cloud is used to refer to cloud services where their applications (components) may be deployed on one or more Cloud Provider. In such scenarios inter-cloud exchange between the two Cloud Providers may occur. The actual architecture is specific to the application to each design.

Due to convergence of telecommunication and Information Technology services in the area of cloud computing, telecommunication players have an important role to play in the emerging cloud computing market and ecosystem. The telecommunication network is a central part for multi-tenant cloud computing architecture delivering composite -services with high QoS and optimal resource allocation.

With the adoption of cloud services, the network, computing, storage and application boundary of an organization will extend into the Cloud Service Provider domain. As a result an organization's trust boundary will become dynamic and will move beyond their internal control. The organization's loss of control over who has access to what information and resources, regardless of where those resources reside is an area of concern in cloud computing and a challenge to the management and security of cloud services and resources. This challenge can be addressed by sharing identity information with the Cloud Service Provider (CSP) through the use of cloud specific identity management solutions, including cloud identity federation. This work will be done in close collaboration with the security related Questions.

The primary focus of this Question is cloud service and infrastructure management and the management of composite cloud services and components that use a variety of telecom and IT infrastructure resources. These cloud services are typically composed of individual services elements that may be acquired from or exposed to third parties. This is a very complex management environment and requires the study of standards that provide a means to enable consistent end-to-end, multi-cloud management and monitoring of services exposed by and across different service providers' domains and technologies. This Question also includes the study of security mechanisms and methods to stream line and manage service delivery mechanisms across the service life cycles so that services can be created and delivered efficiently.

It should be noted that the term "end-to-end" is used here in information technology context, and does not refer to the management of endpoints or user devices, as it would have otherwise been implied if the telecommunication technology context were used. The term end-to-end simply refers to a holistic, multi-layer, multi-component, and multi-cloud management and security, which is in the scope of this Question.

### 2 Question

Study items to be considered include what new Recommendations should be developed regarding:

• Cloud service management (in cooperation with SG2) as well as cloud infrastructure and resource management, utilizing ideally common underlying principles, best practices, fundamentals, frameworks and design, a requirement demanded by telecom operators and service developers.

• The scope includes multi-cloud management, end-to-end management scenarios for cloud services and cloud infrastructure/resources.

• Study (in cooperation with SG17) of cloud specific identity, access and security mechanisms that enable effortless trusted access to cloud resources in multi-provider scenarios, to the extent that such cloud specific scenarios do exist (not yet established)

### 3 Tasks

Tasks include:

• Developing Recommendations for high level requirements and capabilities for end-to-end cloud computing service management including cloud infrastructure and resource management.

• Developing Recommendations for cloud federated identity and access management if deemed necessary.

• Developing Recommendations required for cloud computing security as defined in the Cloud Computing security collaboration between SG13 and SG17 (COM 13-R 10, Annex 6).

• Providing the necessary collaboration with external SDOs, consortia and forums working on cloud computing architectures and infrastructures to minimize duplication of efforts.

An up-to-date status of work under this Question is contained in the SG13 Work Programme:
<http://www.itu.int/ITU-T/workprog/wp_search.aspx?Q=19/13>

### 4 Relationships

**Questions:**

• All cloud computing related SG13 Questions (QD/13, QK/13, QL/13 and QC/13, QE/13, QG/13), SG2 (QE/2, QG/2), SG17 (QH/17, QJ/17)

**Standardization bodies, forums and consortia:**

• ISO/IEC JTC 1/SC 38

• Distributed Management Task Force (DMTF)

• Storage Networking Industry Association (SNIA)

• TM Forum

• OASIS

• IETF

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