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SERIES Y: GLOBAL INFORMATION  
INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS,  
NEXT-GENERATION NETWORKS, INTERNET OF  
THINGS AND SMART CITIES

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**ITU-T Y.3500-series – Cloud computing  
standardization roadmap**

ITU-T Y-series Recommendations – Supplement 49

ITU-T



ITU-T Y-SERIES RECOMMENDATIONS

**GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES**

GLOBAL INFORMATION INFRASTRUCTURE

|   |             |
|---|-------------|
| General                                   | Y.100–Y.199 |
| Services, applications and middleware     | Y.200–Y.299 |
| Network aspects                           | Y.300–Y.399 |
| Interfaces and protocols                  | Y.400–Y.499 |
| Numbering, addressing and naming          | Y.500–Y.599 |
| Operation, administration and maintenance | Y.600–Y.699 |
| Security                                  | Y.700–Y.799 |
| Performances                              | Y.800–Y.899 |

INTERNET PROTOCOL ASPECTS

|  |               |
|--|---------------|
| General  | Y.1000–Y.1099 |
| Services and applications  | Y.1100–Y.1199 |
| Architecture, access, network capabilities and resource management | Y.1200–Y.1299 |
| Transport  | Y.1300–Y.1399 |
| Interworking   | Y.1400–Y.1499 |
| Quality of service and network performance                         | Y.1500–Y.1599 |
| Signalling   | Y.1600–Y.1699 |
| Operation, administration and maintenance                          | Y.1700–Y.1799 |
| Charging   | Y.1800–Y.1899 |
| IPTV over NGN  | Y.1900–Y.1999 |

NEXT GENERATION NETWORKS

|   |               |
|---|---------------|
| Frameworks and functional architecture models                     | Y.2000–Y.2099 |
| Quality of Service and performance                                | Y.2100–Y.2199 |
| Service aspects: Service capabilities and service architecture    | Y.2200–Y.2249 |
| Service aspects: Interoperability of services and networks in NGN | Y.2250–Y.2299 |
| Enhancements to NGN   | Y.2300–Y.2399 |
| Network management  | Y.2400–Y.2499 |
| Network control architectures and protocols                       | Y.2500–Y.2599 |
| Packet-based Networks   | Y.2600–Y.2699 |
| Security  | Y.2700–Y.2799 |
| Generalized mobility  | Y.2800–Y.2899 |
| Carrier grade open environment                                    | Y.2900–Y.2999 |

FUTURE NETWORKS

CLOUD COMPUTING

|  |               |
|--|---------------|
|  | Y.3000–Y.3499 |
|  | Y.3500–Y.3999 |

INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES

|   |               |
|---|---------------|
| General   | Y.4000–Y.4049 |
| Definitions and terminologies                           | Y.4050–Y.4099 |
| Requirements and use cases                              | Y.4100–Y.4249 |
| Infrastructure, connectivity and networks               | Y.4250–Y.4399 |
| Frameworks, architectures and protocols                 | Y.4400–Y.4549 |
| Services, applications, computation and data processing | Y.4550–Y.4699 |
| Management, control and performance                     | Y.4700–Y.4799 |
| Identification and security                             | Y.4800–Y.4899 |
| Evaluation and assessment                               | Y.4900–Y.4999 |

*For further details, please refer to the list of ITU-T Recommendations.*

## Supplement 49 to ITU-T Y-series Recommendations

### ITU-T Y.3500-series – Cloud computing standardization roadmap

#### Summary

Supplement 49 to ITU-T Y-series Recommendations provides a summary of the cloud-computing-related deliverables of ITU-T study groups and other standards development organizations (SDOs). For this purpose, the Supplement collects all the information from ITU and other SDOs on their work and understanding related to cloud computing.

#### History

| Edition | Recommendation    | Approval   | Study Group | Unique ID*   |
|---------|-------------------|------------|-------------|--|
| 1.0     | ITU-T Y Suppl. 49 | 2018-11-02 | 13          | <u><a href="http://handle.itu.int/11.1002/1000/13829">11.1002/1000/13829</a></u> |

#### Keywords

Analysis matrix, cloud computing, Recommendation, roadmap, standard

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\* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

## FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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## Table of Contents

|   | <b>Page</b> |
|---|-------------|
| 1 Scope .....   | 1           |
| 2 References .....  | 1           |
| 3 Definitions .....   | 1           |
| 3.1 Terms defined elsewhere .....   | 1           |
| 3.2 Terms defined in this Supplement.....   | 1           |
| 4 Abbreviations and acronyms .....  | 1           |
| 5 Conventions .....   | 4           |
| 6 Landscape of cloud computing from ITU-T perspective .....   | 4           |
| 7 Overview of cloud computing standard roadmap.....   | 5           |
| 7.1 Introduction to standards development organizations (SDOs) for cloud<br>computing .....                 | 5           |
| 7.2 Analysis of deliverable to provide its category.....  | 9           |
| 8 ITU-T SG13.....   | 10          |
| 8.1 Q17 .....   | 10          |
| 8.2 Q18 .....   | 13          |
| 8.3 Q19.....  | 15          |
| 8.4 Analysis of ITU-T SG13 deliverables .....   | 17          |
| 9 ITU-T JRG-CCM (Joint Rapporteur Group on Cloud Computing Management) of<br>ITU-T SG13 and ITU-T SG2 ..... | 18          |
| 10 ITU-T SG17.....  | 20          |
| 11 ITU-T SG5.....   | 23          |
| 12 ITU-T SG11.....  | 29          |
| 13 ITU-T SG16.....  | 30          |
| 14 ITU-T SG2.....   | 32          |
| 15 ISO/IEC JTC 1 SC 38 .....  | 33          |
| 16 DMTF.....  | 38          |
| 17 TM Forum .....   | 41          |
| 18 ATIS.....  | 41          |
| 19 Broadband Forum .....  | 43          |
| 20 Metro Ethernet Forum.....  | 45          |
| Bibliography .....  | 47          |



# Supplement 49 to ITU-T Y-series Recommendations

## ITU-T Y.3500-series – Cloud computing standardization roadmap

### 1 Scope

This Supplement provides a summary of cloud-computing-related deliverables in ITU-T study groups (SGs) and other standards development organisations (SDOs). Also, this supplement provides a common matrix for mapping these deliverables to different cloud-related categories. With the common matrix, this supplement provides analysis for cloud-computing-related deliverables in ITU-T SGs and other SDOs.

### 2 References

- [ITU-T Y.3500] Recommendation ITU-T Y.3500 (2014), *Cloud computing – Overview and vocabulary*.
- [ITU-T Y.3501] Recommendation ITU-T Y.3501 (2016), *Cloud computing – Framework and high-level requirements*.
- [ITU-T Y.3502] Recommendation ITU-T Y.3502 (2014), *Information technology – Cloud computing – Reference architecture*.

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

**3.1.1 cloud computing** [ITU-T Y.3500]: 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.

**3.1.2 cloud service** [ITU-T Y.3500]: One or more capabilities offered via cloud computing invoked using a defined interface.

**3.1.3 cloud service category** [ITU-T Y.3500]: Group of cloud services that possess some common set of qualities.

**3.1.4 cloud service customer** [ITU-T Y.3500]: Party which is engaged in support of, or auxiliary to, activities of either the cloud service provider, or the cloud service customer, or both.

**3.1.5 cloud service provider** [ITU-T Y.3500]: Party which makes cloud services available.

#### 3.2 Terms defined in this Supplement

None.

### 4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

|      |   |
|------|---|
| AC   | Alternating Current                               |
| API  | Application Programming Interface                 |
| ATIS | Alliance for Telecommunications Industry Solution |
| BBF  | Broadband Forum                                   |
| C&I  | Conformance and Interoperability                  |

|       |   |
|-------|---|
| CADF  | Cloud Auditing Data Federation                          |
| CCF   | Cloud Computing Fundamentals                            |
| CCRA  | Cloud Computing Reference Architecture                  |
| CDN   | Content Distribution Network                            |
| CIM   | Cloud Infrastructure Management                         |
| CIMI  | Cloud Infrastructure Management Interface               |
| CMP   | Cloud Management Platform                               |
| CO    | Central Office  |
| CP    | Cloud Provider  |
| CSA   | Cloud Service Agreement                                 |
| CSB   | Cloud Services Brokerage                                |
| CSC   | Cloud Service Customer                                  |
| CSDL  | Common Schema Description Language                      |
| CSN   | Cloud Service Partner                                   |
| CSP   | Cloud Service Provider                                  |
| CSU   | Cloud Service User                                      |
| DaaS  | Desktop as a Service                                    |
| DC    | Direct Current  |
| DMTF  | Distributed Management Task Force                       |
| DSF   | Data Storage Federation                                 |
| EMF   | Metro Ethernet Forum                                    |
| ETSI  | European Telecommunications Standards Institute         |
| FCAPS | Fault, Configuration, Accounting, Performance, Security |
| FN    | Future Network  |
| GHG   | Greenhouse Gas  |
| GNS   | Goods, Networks and Services                            |
| HTTP  | Hypertext Transfer Protocol                             |
| IaaS  | Infrastructure as a Service                             |
| ICP   | Internet Content Provider                               |
| ICT   | Information and Communication Technology                |
| IEC   | International Electrotechnical Commission               |
| IoT   | Internet of Things                                      |
| IPTV  | Internet Protocol Television                            |
| ISO   | International Organization for Standardization          |
| ISP   | Internet Service Provider                               |
| IT    | Information Technology                                  |
| LCA   | Life Cycle Assessment                                   |



|       |  |
|-------|--|
| MIB   | Management Information Base                        |
| NaaS  | Network as a Service                               |
| NERG  | Network Enhanced Residential Gateway               |
| NFV   | Network Function Virtualization                    |
| NFVI  | Network Function Virtualization Infrastructure     |
| NGN   | Next Generation Network                            |
| NNI   | Network-Network Interconnect                       |
| OB    | Open Broadband                                     |
| OBL   | Open Broadband Laboratories                        |
| OS    | Operating System                                   |
| OVF   | Open Virtualization Format                         |
| PaaS  | Platform as a Service                              |
| PII   | Personally Identifiable Information                |
| PKI   | Public Key Infrastructure                          |
| PNF   | Physical Network Function                          |
| REST  | Representational State Transfer                    |
| RFID  | Radio Frequency Identification                     |
| RG    | Residential Gateway                                |
| SaaS  | Software as a Service                              |
| SDF   | Service Delivery Framework                         |
| SDN   | Software-Defined Networking                        |
| SDO   | Standards Development Organization                 |
| SLA   | Service Level Agreement                            |
| SLO   | Service Level Objective                            |
| SMASH | System Management Architecture for Server Hardware |
| SMI   | Service Management Interface                       |
| SNMP  | Simple Network Management Protocol                 |
| SPMF  | Scalable Platform Management Forum                 |
| SQO   | Service Qualitative Objective                      |
| UPS   | Uninterruptible Power Supply                       |
| ViLTE | Video over Long-Term Evolution                     |
| VM    | Virtual Machine                                    |
| VNF   | Virtualized Network Function                       |
| VoLTE | Voice over Long-Term Evolution                     |
| XML   | Extensible Markup Language                         |

## 5 Conventions

None.

## 6 Landscape of cloud computing from ITU-T perspective

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.

Below are the key characteristics of cloud computing described in [ITU-T Y.3500]:

- **Broad network access:** a feature where the physical and virtual resources are available over a network and accessed through standard mechanisms that promote use by heterogeneous client platforms. The focus of this key characteristic is that cloud computing offers an increased level of convenience in that users can access physical and virtual resources from wherever they need to work, as long as it is network accessible, using a wide variety of clients including devices such as mobile phones, tablets, laptops and workstations.
- **Measured service:** a feature where the metered delivery of cloud services is such that usage can be monitored, controlled, reported and billed. This is an important feature needed to optimize and validate the delivered cloud service. The focus of this key characteristic is that the customer may only pay for the resources that they use. From the customers' perspective, cloud computing offers the users value by enabling a switch from a low efficiency and asset utilization business model to a high efficiency one.
- **Multi-tenancy:** a feature where physical or virtual resources are allocated in such a way that multiple tenants and their computations and data are isolated from and inaccessible to one another. Typically, and within the context of multi-tenancy, the group of cloud service users that form a tenant will all belong to the same cloud service customer organization. There might be cases where the group of cloud service users involves users from multiple different cloud service customers, particularly in the case of public cloud and community cloud deployments. However, a given cloud service customer organization might have many different tenancies with a single cloud service provider representing different groups within the organization.
- **On-demand self-service:** a feature where a cloud service customer can provision computing capabilities, as needed, automatically or with minimal interaction with the cloud service provider. The focus of this key characteristic is that cloud computing offers users a relative reduction in the costs, time and effort needed to take an action, since it grants the user the ability to do what they need, when they need it, without requiring additional human user interactions or overheads.
- **Rapid elasticity and scalability:** a feature where physical or virtual resources can be rapidly and elastically adjusted, in some cases automatically, to quickly increase or decrease resources. For the cloud service customer, the physical or virtual resources available for provisioning often appear to be unlimited and can be purchased in any quantity at any time automatically, subject to the constraints of service agreements. Therefore, the focus of this key characteristic is that cloud computing means that customers no longer need to worry about limited resources and might not need to worry about capacity planning.
- **Resource pooling:** a feature where a cloud service provider's physical or virtual resources can be aggregated in order to serve one or more cloud service customers. The focus of this key characteristic is that cloud service providers can support multi-tenancy while at the same time using abstraction to mask the complexity of the process from the customer. From the customer's perspective, all they know is that the service works, while they generally have no control or knowledge over how the resources are being provided or where the resources are located. This offloads some of the customer's original workload, such as maintenance requirements, to the provider. Even with this level of abstraction, it should be pointed out

that users might still be able to specify locations at a higher level of abstraction (e.g., country, state, or data centre).

The general requirements for cloud computing described in [ITU-T Y.3501] are as follows:

- **Service life-cycle management:** It is required that the cloud service provider (CSP) supports automated service provisioning, modification and termination during the service life-cycle.
- **Regulatory:** It is required that all applicable laws and regulations be respected, including those related to the protection of personally identifiable information (PII).
- **Security:** It is required that the cloud computing systems provided by a CSP be appropriately secured to protect the interests of all involved parties (e.g., persons and organizations).
- **Accounting and charging:** It is recommended that the cloud services provided by a CSP support various accounting and charging models and policies.
- **Efficient service deployment:** It is recommended that the cloud services provided by a CSP enable the efficient use of resources for service deployment.
- **Interoperability:** It is recommended that the cloud services provided by a CSP comply with appropriate specifications and/or standards for allowing these systems to work together.
- **Portability:** It is recommended that the cloud services provided by a CSP support the portability of software assets and data of cloud service customers (CSCs) with minimum disruption.
- **Service access:** A CSP is recommended to provide CSCs with access to cloud services from a variety of user devices. It is recommended that CSCs be provided with a consistent experience when accessing cloud services from different devices.
- **Service availability, service reliability and quality assurance:** It is recommended that the CSP provides end-to-end quality of service assurance, high levels of reliability and continued availability of cloud services according to the service level agreement (SLA) with the CSC.

## 7 Overview of cloud computing standard roadmap

### 7.1 Introduction to standards development organizations (SDOs) for cloud computing

#### 7.1.1 ITU-T SG13

Study Group 13 is responsible for studies relating to the requirements, architectures, capabilities and mechanisms of future networks including studies relating to service awareness, data awareness, environmental awareness and socio-economic awareness of future networks. It is responsible for studies relating to cloud-computing technologies, big data, virtualization, resource management, reliability and security aspects of the considered network architectures.

- Q17/13 (Requirements, ecosystem, and general capabilities for cloud computing and big data)

The primary focus of this Question is to provide the necessary overall frameworks, definitions and ecosystems, including requirements and capabilities, related to the integration or support of cloud computing and big data models and technologies in telecommunication ecosystems. Also the relationship between cloud computing and big data is 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;

- Q18/13 (Cloud functional architecture, infrastructure and networking)
 

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.
- Q19/13 (End-to-end cloud computing management and security)
 

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 telecommunication and IT infrastructure resources. These cloud services are typically composed of individual service 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 the 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 streamline and manage service delivery mechanisms across service life cycles so that services can be created and delivered efficiently. The second focus of this Question is big data governance including data management, data preservation, as well as life-cycle management of big data to provide the necessary overall frameworks, definitions and ecosystems including requirements, capabilities related to the integration or support of the big data model and technologies in telecommunication ecosystems.

### 7.1.2 ITU-T SG17

ITU-T Study Group 17 (SG17) coordinates security-related work across all ITU-T Study Groups. Often working in cooperation with other standards development organizations (SDOs) and various ICT industry consortia, SG17 deals with a broad range of standardization issues.

To give a few examples, SG17 is currently working on cybersecurity; security management; security architectures and frameworks; countering spam; identity management; the protection of personally identifiable information; and the security of applications and services for the Internet of Things (IoT), smart grids, smartphones, software-defined networking (SDN), web services, big data analytics, social networks, cloud computing, mobile financial systems, IPTV and telebiometrics.

One key reference for security standards in use today is Recommendation ITU-T X.509 for electronic authentication over public networks. Recommendation ITU-T X.509, a cornerstone in designing applications relating to public key infrastructure (PKI), is used in a wide range of applications; from securing the connection between a browser and a server on the web, to providing digital signatures that enable e-commerce transactions to be conducted with the same confidence as in a traditional system. Without wide acceptance of the standard, the rise of e-business would have been impossible.

Cybersecurity remains high on SG17's agenda. Additionally, SG17 is coordinating security standardization work covering combating counterfeit and mobile device theft, IMT-2020, cloud-based event data technology, e-health, open identity trust framework, radio frequency identification (RFID), and child online protection.

### **7.1.3 ITU-T SG5**

ITU-T Study Group 5 (SG5) is responsible for studies on methodologies for evaluating ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way. Under its environmental mandate, SG5 is also responsible for studying design methodologies to reduce ICTs and e-waste's adverse environmental effects, for example, through the recycling of ICT facilities and equipment.

In addition to its climate-focused activities, the ITU-T Recommendations, Handbooks and other publications produced by SG5 have four main objectives. The first is to protect telecommunication equipment and installations against damage and malfunction due to electromagnetic disturbances, such as those from lightning. In this field, SG5 is one of the world's most experienced and respected standardization bodies.

The second is to ensure the safety of personnel and users of networks against current and voltages used in telecommunication networks. The third is to avoid health risks from electromagnetic fields (EMFs) produced by telecommunication devices and installations. The fourth is to guarantee a good quality of service (QoS) for high-speed data services by providing requirements on characteristics of copper cables and on the coexistence of services delivered by different providers.

### **7.1.4 ITU-T SG11**

Study Group 11 is responsible for developing test specifications for testing conformance and interoperability (C&I) for all types of networks, technologies and services, a testing methodology and test suites for standardized network parameters in relation to the framework for Internet-related performance measurement, as well as for existing technologies (e.g., NGN) and emerging technologies (e.g., FN, cloud, SDN, NFV, IoT, VoLTE/ViLTE, IMT-2020 technologies, flying ad hoc networks, tactile Internet, augmented reality, etc.).

SG11 has been designated Lead study group for establishing test specifications, conformance and interoperability testing for all types of networks, technologies and services that are the subject of study and standardization by all ITU-T study groups.

### **7.1.5 ITU-T SG16**

ITU-T SG16 is advancing in its IPTV Recommendations, which have been successfully deployed in various countries. However, bearing in mind that the business ecosystem is continuously changing and video-oriented services became prosperous also out of an IPTV domain, SG16 pursues more dynamic and adaptable features for IPTV specifications.

### **7.1.6 ITU-T SG20**

ITU-T SG20 does not have any ongoing work item directly related to "Cloud Computing" at this stage. However, SG20's activities may be linked to the activities in the area of cloud computing in the context of IoT and smart cities and communities. As an example, Q4/20 "*e/Smart services, applications and supporting platforms*" activities on supporting platform technologies for e/Smart services, applications are related to cloud computing.

### **7.1.7 ITU-T SG2**

One of the mandates of ITU-T SG2 is "operational and management aspects of networks, including network traffic management, designations and transport-related operations procedures". ITU-T SG2 is also developing cloud-computing-management-related Recommendations. ITU-T SG2 has developed "Overview of end-to-end cloud computing management" and "Requirements for service management in cloud-aware telecommunication management system" Recommendations. Currently ITU-T SG2 is developing "Requirements for resource management in cloud-aware telecommunication management system" and "Cloud-based network management functional architecture".

### **7.1.8 JTC 1 SC 38 (Cloud Computing and Distributed Platforms)**

SC 38 is a standardization subcommittee in ISO/IEC JTC 1 of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Currently, there are two working groups under SC 38, listed below [b-JTC 1 SC 38].

- WG 3 (Cloud Computing Fundamentals (CCF))
  - Projects related to cloud computing service agreements;
  - projects related to fundamental concepts, terminology and definitions for cloud computing;
  - projects related to guidance on use of international standards in the development of policies that govern or regulate cloud service providers and cloud services, and policies that govern the use of cloud services in enterprise organizations;
  - establish liaisons and collaborate with other entities within JTC 1, SDOs and consortia performing work related to cloud computing.
- WG 5 (Data in cloud computing and related technologies)
  - Standardization in the area of data in cloud computing, distributed platforms, connected devices and related technologies;
  - establish liaisons and collaborate with other entities within and external to JTC 1 as appropriate.

### **7.1.9 DMTF (Distributed Management Task Force)**

The DMTF is an industry standards organization working to simplify the manageability of network-accessible technologies through open and collaborative efforts by leading technology companies. DMTF creates and drives the international adoption of interoperable management standards, supporting implementations that enable the management of diverse traditional and emerging technologies including cloud, virtualization, network and infrastructure [b-DMTF].

The DMTF working groups that deliver standards used in cloud computing are [b-DMGF-WG]:

- Cloud Management Working Group (CMWG)
- Cloud Auditing Data Federation Working Group (CADF)

The DMTF working groups that deliver standards which may be used in cloud data centres are:

- CIM Profile for Platforms and Service Working Group (CPPSWG)
- Open Virtualization Format Working Group (OVF)
- Scalable Platform Management Forum (SPMF)
- Virtualization Management Working Group

### **7.1.10 TM Forum**

TM Forum is the global member association for digital business. It provides a platform for hundreds of global members across a wide range of industries: communications, technology, cities and municipal government, finance, healthcare and so on, to collaborate and partner to co-create, prototype, deliver, and monetize innovative digital services for their billions of customers [b-TMF].

### **7.1.11 ATIS**

ATIS is where leading ICT companies come for solutions when seeking industry alignment to advance their most critical priorities [b-ATIS].

### 7.1.12 Broadband Forum

The Broadband Forum, a non-profit industry organization, is focused on engineering smarter and faster broadband networks. Their work defines best practices for global networks, enables service and content delivery, establishes technology migration strategies, engineers critical device and service management tools, and is key to redefining broadband. Free technical reports and white papers can be found at [broadband-forum.org](http://broadband-forum.org) [b-Broadband].

The Cloud-based Central Office (CloudCO) project is the core of a number of BBF activities applying the design principles of software-defined networking (SDN) and network functions virtualization (NFV) techniques enabling the decentralization of what has traditionally been monolithic networking elements. CloudCO enables dramatically faster and more efficient provisioning of new, cloud-based services.

For management in an SDN&NFV architecture, NETCONF/YANG is expected to play a key role. The CloudCO project is leveraging the work done by the Broadband Forum Common YANG Work Area, which defines the YANG models required for the management of ultrafast broadband networks based on copper and fibre access.

The Open Broadband (OB) programme is a collaborative space for integration, interop, testing of open source, vendor and standards-based implementations. The migration to cloud-based, programmed, virtualized systems and coexistence with existing infrastructure drove OB. OB provides alignment with open source techniques and focus on interoperability to mitigate deployment risks. It provides value to service providers, integrators and suppliers.

Open Broadband Laboratories (OBL) is a collaborative resource for the integration, staging and testing of open source, commercial software, standards-based and vendor implementations where suppliers, integrators and operators can work together on new and coexisting solutions for CloudCO. OBLs are a common hardware and software platform with regional laboratories in Asia, Europe and USA that are open to members and non-members.

### 7.2 Analysis of deliverable to provide its category

For the analysis of deliverables from clause 7, this supplement provides an analysis template in the form of a matrix table (see table 7-1).

**Table 7-1 – Matrix for analysis of deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b> | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|----------------------------|-------------------------------|---------------------|--------------------------------|-----------------------------------|---------------|
| <b>Fundamental</b>            |                            |                               |                     |                                |                                   |               |
| <b>Cloud service category</b> |                            |                               |                     |                                |                                   |               |
| <b>Security</b>               |                            |                               |                     |                                |                                   |               |
| <b>Management</b>             |                            |                               |                     |                                |                                   |               |
| <b>Inter-cloud, CSB</b>       |                            |                               |                     |                                |                                   |               |
| <b>SLA, metering</b>          |                            |                               |                     |                                |                                   |               |
| <b>Testing</b>                |                            |                               |                     |                                |                                   |               |
| <b>Others</b>                 |                            |                               |                     |                                |                                   |               |

The vertical axis describes the sub- or related technology. The horizontal axis describes the document category which covers the following applicable subjects:

- General, definition: the standard which provides a general description or terms and definitions of the technology;
- Requirements, use cases: the standard which provides use cases and derived general/functional requirements;
- Architecture: the standard which provides reference architecture;
- API, interface, profile: the standard which provides a common interface, API and/or its profile;
- Data model, format, schema: the standard which provides a data model or protocol including scheme and/or its encoding format;
- Others (e.g., guidelines, technical reports, etc.).

NOTE 1 – The items on the horizontal axis are not subordinate to the different technologies.

NOTE 2 – The items of vertical axis can be modified with technology changes.

NOTE 3 – A standard has more than one location on a matrix. If a standard includes multiple document (horizontal axis) categories or related technologies (vertical axis), it should be mapped multiple times.

## 8 ITU-T SG13

### 8.1 Q17

Table 8-1 provides a list of ITU-T Q17/ SG13 deliverables associated with cloud computing.

**Table 8-1 – ITU-T Q17/13 deliverables**

| <b>Title of deliverable</b>  | <b>Current status</b>                           | <b>Starting date</b> | <b>Target date</b> |
|--|---|----------------------|--------------------|
| <b>ITU-T Y.3500 ISO/IEC 17788</b><br>Information technology – Cloud computing – Overview and vocabulary  | Recommendation   IS                             | 09/2012              | 08/2014            |
| <b>ITU-T Y.3501</b> , Cloud computing – Framework and high-level requirements                            | Recommendation<br>2nd Edition<br>Recommendation | 06/2012<br>05/2015   | 05/2013<br>06/2016 |
| <b>ITU-T Y.3503</b> , Requirement for desktop as a service   | Recommendation                                  | 06/2012              | 05/2014            |
| <b>ITU-T Y.3600</b> , Big data – cloud computing based requirements and capabilities                     | Recommendation                                  | 06/2013              | 11/2015            |
| <b>ITU-T Y.3504</b> , Functional architecture for Desktop as a Service                                   | Recommendation                                  | 07/2014              | 06/2016            |
| <b>ITU-T Y.cccm-reqts</b> , Cloud Computing – Requirements for Containers and Micro-services             | Draft Recommendation                            | 05/2016              | 2019-Q4            |
| <b>ITU-T Y.3505</b> , Cloud computing – Overview and functional requirements for data storage federation | Recommendation                                  | 05/2016              | 05/2018            |
| <b>ITU-T Y.ccdc-reqts</b> , Distributed cloud overview and high-level requirements                       | Draft Recommendation                            | 10/2016              | 2019-Q2            |
| <b>ITU-T Y.3507</b> , Cloud computing – Functional requirements of physical machine                      | Recommendation                                  | 10/2016              | 11/2018            |



**Table 8-1 – ITU-T Q17/13 deliverables**

| Title of deliverable   | Current status       | Starting date | Target date |
|--|----------------------|---------------|-------------|
| <b>ITU-T Y.3506</b> , Cloud computing – Functional requirements for cloud service brokerage              | Recommendation       | 10/2016       | 05/2018     |
| <b>ITU-T Y.MLaaS-reqts</b> , Cloud computing – Functional requirements for machine learning as a service | Draft Recommendation | 01/2018       | 12/2020     |
| <b>ITU-T Y.BaaS-reqts</b> , Cloud computing – Functional requirements for blockchain as a service        | Draft Recommendation | 11/2017       | 12/2020     |

- **ITU-T Y.3500 | ISO/IEC 17788:** This Recommendation | International Standard provides an overview of cloud computing along with a set of terms, definitions and concepts. It is a terminology foundation for the cloud computing standardization work. This Recommendation | International Standard is applicable to all types of organizations (e.g., commercial enterprises, government agencies, not-for-profit organizations).  
URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12210>
- **ITU-T Y.3501:** This Recommendation provides a cloud computing framework by identifying high-level requirements for cloud computing. The Recommendation addresses the general requirements and use cases for:
  - cloud computing;
  - Infrastructure as a Service (IaaS), Network as a Service (NaaS), and Desktop as a Service (DaaS) cloud services;
  - inter-cloud, end-to-end resource management, and cloud infrastructure.

The first release of this Recommendation addresses a set of use cases and related requirements which are included in Appendix I. The second release of this Recommendation provides an update of this set of use cases and requirements. The release concept is described in Appendix II.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11917>
- **ITU-T Y.3503:** This Recommendation provides use cases, general requirements and functional requirements for Desktop as a Service (DaaS).  
URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12167>
- **ITU-T Y.3600:** This Recommendation provides an approach to use cloud computing to meet the challenges which exist in the use of big data. It addresses the following subjects:
  - overview of big data;
    - introduction to big data;
    - big data ecosystem and roles;
  - relationship between cloud computing and big data;
  - cloud-computing-based big data system context and benefits;
  - cloud-computing-based big data requirements;
  - cloud-computing-based big data capabilities.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12584>
- **ITU-T Y.3504:** This Recommendation provides the functional architecture for Desktop as a Service (DaaS) to specify the detailed functional components and their relationships based

on the general and functional requirements of [ITU-T Y.3503]. It addresses the following subjects:

- DaaS functionalities related with DaaS components;
- DaaS functional architecture;
- mapping DaaS functional architecture to the cloud computing reference architecture.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12889>

- **ITU-T Y.cccm-reqts:** This Recommendation provides an overview of the container concept describing its main characteristics and their support of micro-services. The document also identifies typical use cases related to the usage of containers and micro-services in cloud computing identifying use cases related to the support of the Containers as a Service cloud service category by the CSP. Based on the identified use cases, requirements and capabilities are derived regarding the support of the Containers as a Service category. This Recommendation will consider the work as an open source activity initiated by Linux Foundation projects (Open Container Initiative, and Cloud Native Computing Foundation), and ETSI NFV. The scope of this Recommendation consists of:

- overview of the containers concept;
- requirements of containers and micro-services;
- use cases of containers and micro-services.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13641](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13641)

- **ITU-T Y.3505:** This Recommendation provides an overview and functional requirements of data storage federation. Data storage federation provides a single virtual volume from multiple data sources in heterogeneous storage. In this Recommendation, configuration for logical components, and ecosystem of data storage federation as well as cloud-computing-based data storage federation are introduced for data storage federation. Functional requirements are derived from use cases.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13616>

- **ITU-T Y.ccdc-reqts:** This Recommendation provides an overview of the distributed cloud with the main objective of highlighting this important area for future standardization.

- More specifically, this Recommendation covers the following:
- definition of distributed cloud;
- concept and scope of distributed cloud;
- characteristics of distributed cloud;
- high-level requirements of distributed cloud;
- distributed cloud use cases is provided in Appendix I.

URI: [http://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13649](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13649)

- **ITU-T Y.3507:** This Recommendation provides the functional requirements of the physical machine for cloud computing based on cloud computing infrastructure requirements in [ITU-T Y.3510]. It addresses the following subjects: (i) overview of the physical machine; (ii) functional requirements of the physical machine. The functional requirements provided in this Recommendation are derived from use cases.

URI: [http://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13652](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13652)

- **ITU-T Y.3506:** Cloud service brokerage is a service that arbitrates, delivers and manages cloud services provided by cloud service providers for cloud service customers. This Recommendation provides the functional requirements of cloud service brokerage. To provide functional requirements for cloud service brokerage, this Recommendation specifies

an overview and includes a service model and configuration of cloud service brokerage. Various use cases are also identified to derive the functional requirements.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13612>

- **ITU-T Y.MLaaS-reqts:** This Recommendation provides cloud computing requirements for machine learning as a service, which addresses capabilities, and requirements from use cases. Machine learning as a service (MLaaS) is a cloud service category to support the development and applications of machine learning in the cloud computing environments. On the perspective of cloud computing service provisioning, this Recommendation defines the capabilities and functional requirements for MLaaS to identify functionalities such as data gathering, machine learning modelling and computing resources, etc. This is fundamentally aligned with the cloud computing reference architecture of [ITU-T Y.3502].

NOTE – Developments of machine learning algorithms and methodology are out of the scope of this Recommendation.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14484](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14484)

- **ITU-T Y.BaaS-reqts:** Recommendation ITU-T Y. BaaS-reqts provides the functional requirements for blockchain as a service (BaaS) in the cloud computing environment. Blockchain technologies use decentralized, shared, immutable ledgers to store data and record transactions history, by which the trust, accountability, transparency and efficiency can be achieved. Blockchain technologies include p2p networking, consensus mechanism, smart contract and cipher algorithms, which are now driving various emerging applications across a wide range, such as digital cryptocurrency, finance, insurance, banking, healthcare, government, manufacturing, retail, legal, media and entertainment, supply chain and logistics, accounting, notarization and certification.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14485](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14485)

## 8.2 Q18

Table 8-2 provides a list of ITU-T Q18/ SG13 deliverables associated with cloud computing.

**Table 8-2 – ITU-T Q18/13 deliverables**

| Title of deliverable   | Current status                | Starting date      | Target date        |
|--|-------------------------------|--------------------|--------------------|
| <b>ITU-T Y.3502   ISO/IEC 17789</b><br>Information technology – Cloud computing – Reference architecture | Recommendation   IS           | 09/2012            | 08/2014            |
| <b>ITU-T Y.3510</b> , Cloud computing infrastructure requirements  | Recommendation<br>2nd Edition | 06/2012<br>05/2015 | 05/2013<br>02/2016 |
| <b>ITU-T Y.3511</b> , Framework of inter-cloud computing   | Recommendation                | 06/2012            | 03/2014            |
| <b>ITU-T Y.3512</b> , Cloud computing – Functional requirements of Network as a Service                  | Recommendation                | 06/2012            | 06/2013            |
| <b>ITU-T Y.3513</b> , Cloud computing – Functional requirements of Infrastructure as a Service           | Recommendation                | 02/2013            | 08/2014            |
| <b>ITU-T Y.3515</b> , Cloud computing – Functional Architecture of Network as a Service                  | Recommendation                | 07/2014            | 02/2017            |
| <b>ITU-T Y.3516</b> , Cloud computing – Functional Architecture of inter-cloud computing                 | Recommendation                | 05/2015            | 07/2017            |

**Table 8-2 – ITU-T Q18/13 deliverables**

| Title of deliverable  | Current status       | Starting date | Target date |
|---|----------------------|---------------|-------------|
| <b>ITU-T Y.3519</b> , Cloud computing – Functional architecture of Big Data as a Service        | Recommendation       | 05/2015       | 11/2018     |
| <b>ITU-T Y.dsf-arch</b> , Cloud computing – Functional architecture for data storage federation | Draft Recommendation | 05/2018       | 12/2019     |

- **ITU-T Y.3502 | ISO/IEC 17789:** This Recommendation | International Standard specifies the cloud computing reference architecture (CCRA). The reference architecture includes the cloud computing roles, cloud computing activities, as well as the cloud computing functional components and their relationships.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12209>
- **ITU-T Y.3510:** This Recommendation identifies requirements for cloud infrastructure capabilities to support cloud services. The scope of this Recommendation includes:

  - overview of cloud infrastructure;
  - requirements for compute resources;
  - requirements for network resources;
  - requirements for storage resources;
  - requirements for resource abstraction and control.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12713>
- **ITU-T Y.3511:** This Recommendation describes the framework for interactions of multiple cloud service providers (CSPs) that is referred to as inter-cloud computing. Based on several use cases and consideration of different types of service offerings, this Recommendation describes the possible relationship between multiple CSPs, which are peering, federation and intermediary. By introducing the concept of the primary CSP and /secondary CSPs, the Recommendation further describes CSP interactions in the cases of federation and intermediary patterns. The Recommendation also considers the network significance and its issues. Finally, relevant functional requirements are derived.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12078>
- **ITU-T Y.3512:** This Recommendation provides use cases and functional requirements of Network as a Service (NaaS), one of the representative cloud service categories. This Recommendation covers the following:

  - high-level concept of NaaS;
  - functional requirements of NaaS;
  - typical NaaS use cases.
  - This Recommendation provides use cases and functional requirements of NaaS application, NaaS platform and NaaS connectivity.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12285>
- **ITU-T Y.3513:** This Recommendation provides the functional requirements and use cases of Infrastructure as a Service (IaaS), one of the representative cloud service categories. This Recommendation covers the following:

  - general description of IaaS;
  - functional requirements of IaaS;
  - typical IaaS use cases.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12286>

- **ITU-T Y.3515:** This Recommendation specifies NaaS functional architecture, including functionalities, functional components as well as reference points and procedures, based on the functional requirements specified in [ITU-T Y.3512]. The scope of this Recommendation consists of:
  - overview of NaaS functional architecture;
  - functionalities of NaaS;
  - functional components of NaaS;
  - reference points between functional components of NaaS;
  - procedures for typical NaaS use cases.

URI: <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13255>

- **ITU-T Y.3516:** This Recommendation specifies inter-cloud computing functional architecture, including functions and functional components, based on the inter-cloud computing framework specified in [ITU-T Y.3511]. The Recommendation builds upon the functional view of the cloud computing reference architecture [ITU-T Y.3502] and makes extensions to functional components with inter-cloud functions. This Recommendation also describes the mapping between functions and functional requirements of inter-cloud computing and examples of inter-cloud related reference points.

URI: <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13352>

- **ITU-T Y.3519:** This Recommendation provides an overview of the big data as a service (BDaaS) functional architecture and defines the BDaaS functional architecture and its cross-cutting aspects by specifying the functional components for the support of BDaaS.

URI: [https://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13627](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13627)

- **ITU-T Y.dsf-arch:** This Recommendation describes the functional architecture for data storage federation (DSF). The DSF functions based on DSF logical components identified in Y.35XX (ex Y.dsf-reqts) are introduced. The DSF functional architecture, including DSF functions and DSF functional components, is specified. This Recommendation also provides the relationship between the DSF functional architecture and the cloud computing reference architecture.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14623](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14623)

### 8.3 Q19

Table 8-3 provides a list of ITU-T Q19/ SG13 deliverables associated with cloud computing.

**Table 8-3 – ITU-T Q19/13 deliverables**

| Title of deliverable  | Current status                                  | Starting date      | Target date        |
|---|---|--------------------|--------------------|
| <b>ITU-T Y.3520</b> , Cloud computing framework for end to end resource management                | Recommendation<br>2nd Edition<br>Recommendation | 06/2012<br>05/2015 | 06/2013<br>09/2015 |
| <b>ITU-T Y. 3514</b> , Cloud computing – Trusted inter-cloud computing framework and requirements | Recommendation                                  | 05/2015            | 05/2017            |
| <b>ITU-T Y.3518</b> , Cloud computing – Functional requirements of inter-cloud data management    | Recommendation                                  | 07/2016            | 11/2018            |

**Table 8-3 – ITU-T Q19/13 deliverables**

| Title of deliverable  | Current status       | Starting date | Target date |
|---|----------------------|---------------|-------------|
| <b>ITU-T Y.3517</b> , Cloud computing – Overview of inter-cloud trust management  | Recommendation       | 07/2016       | 11/2018     |
| <b>ITU-T Y.ccsdaom-reqts</b> , Cloud computing – Requirements of cloud service development and operation management                         | Draft Recommendation | 08/2018       | 09/2020     |
| <b>ITU-T Y.ccm-reqts</b> , Cloud computing maturity requirements and framework  | Draft Recommendation | 01/2018       | 12/2019     |
| <b>ITU-T Y.cslm-metadata</b> , Metadata framework for cloud service life-cycle management   | Draft Recommendation | 03/2017       | 01/2019     |
| <b>ITU-T Y.e2efapm</b> , Cloud Computing – End-to-end fault and performance management framework of virtual network services in inter-cloud | Draft Recommendation | 08/2018       | 09/2020     |

- **ITU-T Y.3520:** This Recommendation provides a framework for end-to-end cloud computing resource management. This Recommendation includes:
  - general concepts of end-to-end cloud computing resource management;
  - a vision for adoption of cloud computing resource management in a telecommunication rich environment;
  - end-to-end management of cloud resource and services across multiple platforms, i.e., management of any hardware and software used in support of the delivery of cloud services.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12585>

- **ITU-T Y.3514:** This Recommendation specifies the framework of trusted inter-cloud computing and relevant use cases, based on the framework specified in [ITU-T Y.3511]. The scope of this Recommendation includes:
  - objectives of trusted inter-cloud computing;
  - requirements for security of trusted inter-cloud;
  - requirements for governance of trusted inter-cloud;
  - requirements for resiliency of trusted inter-cloud.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13254>

- **ITU-T Y.3518:** This Recommendation specifies the functional requirements for inter-cloud data management. It provides an overview of inter-cloud data management and inter-cloud data classification in aspects of categories, identification qualifiers and dependency. This Recommendation proposes a set of requirements for inter-cloud data annotation, processing and usage to enable the justification of use of network data plane mechanisms for data protection and traffic isolation. The scope of this Recommendation includes:
  - overview of inter-cloud data management;
  - inter-cloud data classification;
  - requirements for inter-cloud data annotation, processing and usage;
  - requirements for inter-cloud data isolation and protection;
  - requirements for inter-cloud data management.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13645](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13645)

- **ITU-T Y.3517:** This Recommendation specifies a global overview of inter-cloud trust management including an inter-cloud trust management model and functionalities for managing isolation and security mechanisms needed to guarantee both trust management and/or isolation in an inter-cloud environment. The scope of this Recommendation includes:
  - overview of inter-cloud trust management;
  - inter-cloud trust management model;
  - functionalities for managing isolation and security mechanism;
  - inter-cloud trust management requirements and use cases.
 URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13644](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13644)
- **ITU-T Y.ccsdaom-reqts:** This proposed draft Recommendation aims to provide the functional requirements of cloud service development and operation management. It covers the following aspects:
  - overview of cloud service development and operation management;
  - functional requirements of cloud service development and operation management;
  - typical use cases of cloud service development and operation management.
 URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14746](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14746)
- **ITU-T Y.ccm-reqts:** This Recommendation specifies cloud computing maturity requirements and framework and relevant use cases. The scope of this Recommendation includes:
  - overview of cloud computing maturity;
  - cloud computing maturity requirements;
  - cloud computing maturity framework;
  - relationship with cloud computing reference architecture;
  - typical use cases of cloud computing maturity.
 URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14486](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14486)
- **ITU-T Y.cslm-metadata:** This Recommendation specifies the metadata framework for cloud service life-cycle management in the closed-loop automation environment.
 URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14077](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14077)
- **ITU-T Y.e2efapm:** This Recommendation specifies an end-to-end fault and performance management framework and relevant use cases of virtual network services in inter-cloud computing. The scope of this Recommendation includes:
  - overview of end-to-end fault and performance management of virtual network services;
  - functional requirements of end-to-end fault and performance management of virtual network services;
  - use cases relevant to end-to-end fault and performance management of virtual network services.
 URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14745](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14745)

#### 8.4 Analysis of ITU-T SG13 deliverables

Table 8-4 gives an analysis of ITU-T SG13 deliverables.

**Table 8-4 – Analysis of ITU-T SG13 deliverables**

|                               | <b>General, definition</b>          | <b>Requirements use cases</b>  | <b>Architecture</b>  | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|-------------------------------------|--|--|--------------------------------|-----------------------------------|---------------|
| <b>Fundamental</b>            | ITU-T Y.3500   ISO/IEC 17788        | ITU-T Y.3501, ITU-T Y.3510, ITU-T Y.3600   | ITU-T Y.3502   ISO/IEC 17789                               |                                |                                   |               |
| <b>Cloud service category</b> |                                     | ITU-T Y.3503, ITU-T Y.ccm-reqts, ITU-T Y.3512, ITU-T Y.3513, ITU-T Y.MLaaS-reqts, ITU-T Y.BaaS-reqts, ITU-T Y.ccdc-reqts, ITU-T Y.3507, ITU-T Y.3505 | ITU-T Y.3504, ITU-T Y.3515, ITU-T Y.3509, ITU-T Y.dsf-arch |                                |                                   |               |
| <b>Security</b>               |                                     |  |  |                                |                                   |               |
| <b>Management</b>             | ITU-T Y.3520, ITU-T Y.cslm-metadata | ITU-T Y.cccsdaom-reqts, ITU-T Y.ccm-reqts, ITU-T Y.e2efapm   |  |                                |                                   |               |
| <b>Inter-cloud, CSB</b>       |                                     | ITU-T Y.3506, ITU-T Y.3511, ITU-T Y.3514, ITU-T Y.3518, ITU-T Y.3517   | ITU-T Y.3516   |                                |                                   |               |
| <b>SLA, metering</b>          |                                     |  |  |                                |                                   |               |
| <b>Testing</b>                |                                     |  |  |                                |                                   |               |
| <b>Others</b>                 |                                     |  |  |                                |                                   |               |

**9 ITU-T JRG-CCM (Joint Rapporteur Group on Cloud Computing Management) of ITU-T SG13 and ITU-T SG2**

Table 9-1 provides a list of ITU-T JRG-CCM deliverables associated with cloud computing.



**Table 9-1 – ITU-T JRG-CCM deliverables**

| Title of deliverable   | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| <b>ITU-T Y.3521/M.3070</b> , Overview of end-to-end cloud computing management                               | Recommendation | 02/2013       | 03/2016     |
| <b>ITU-T Y.3522</b> , End-to-end cloud service lifecycle management requirements                             | Recommendation | 06/2013       | 09/2016     |
| <b>ITU-T M.3371</b> , Requirements for service management in cloud-aware telecommunication management system | Recommendation | 01/2013       | 09/2016     |

- ITU-T Y.3521/M.3070:** Recommendation ITU-T Y.3521 presents the conceptual view and the common model of end-to-end (E2E) cloud computing management based on the service management interface (SMI) and cloud computing reference architecture, from the perspective of the telecommunications industry.  
 URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12714>
- ITU-T Y.3522:** This Recommendation specifies the functional requirements of end-to-end (E2E) cloud service life cycle management. This Recommendation consists of the following:

  - cloud service life cycle metadata;
  - cloud service life cycle management framework;
  - cloud service life cycle management stages;
  - relationship with cloud computing reference architecture;
  - functional requirements and typical use cases of cloud service life cycle management.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13020>
- ITU-T M.3371:** This Recommendation defines the general and functional management requirements that support the service management in cloud-aware telecommunication management systems, see [ITU-T M.3070], and provides a functional framework for services management in cloud-aware telecommunication management systems.  
 URI: <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13064>

Table 9-2 provides an analysis of ITU-T JRG-CCM deliverables.

**Table 9-2 – Analysis of ITU-T JRG-CCM deliverables**

|                               | General, definition     | Requirements use cases        | Architecture | API, interface, profile | Data model, format, schema | Others |
|-------------------------------|-------------------------|-------------------------------|--------------|-------------------------|----------------------------|--------|
| <b>Fundamental</b>            |                         |                               |              |                         |                            |        |
| <b>Cloud service category</b> |                         |                               |              |                         |                            |        |
| <b>Security</b>               |                         |                               |              |                         |                            |        |
| <b>Management</b>             | ITU-T M.3070/<br>Y.3521 | ITU-T M.3371,<br>ITU-T Y.3522 |              |                         |                            |        |
| <b>Inter-cloud, CSB</b>       |                         |                               |              |                         |                            |        |
| <b>SLA, metering</b>          |                         |                               |              |                         |                            |        |
| <b>Testing</b>                |                         |                               |              |                         |                            |        |
| <b>Others</b>                 |                         |                               |              |                         |                            |        |

## 10 ITU-T SG17

Table 10-1 provides a list of ITU-T SG17 deliverables associated with cloud computing.

**Table 10-1– ITU-T SG17 deliverables**

| Title of deliverable  | Current status       | Starting date | Target date |
|---|----------------------|---------------|-------------|
| <b>ITU-T X.1601</b> , Security framework for cloud computing  | Recommendation       | 04/2010       | 10/2015     |
| <b>ITU-T X.1631   ISO/IEC 27017</b> , Information technology – Security techniques – Code of practice for information security controls based on ISO/IEC 27002 for cloud services | Recommendation       | 05/2013       | 07/2015     |
| <b>ITU-T X.1642</b> , Guidelines of operational security for cloud computing  | Recommendation       | 03/2012       | 03/2016     |
| <b>ITU-T X.1602</b> , Security requirements for software as a service application environments  | Recommendation       | 04/2011       | 03/2016     |
| <b>ITU-T X.1641</b> , Guidelines for cloud service customer data security   | Recommendation       | 09/2014       | 09/2016     |
| <b>ITU-T X.1603</b> , Data security requirements for the monitoring service of cloud computing  | Recommendation       | 09/2015       | 03/2018     |
| <b>ITU-T X.SRIaaS</b> , Security requirements of public infrastructure as a service (IaaS) in cloud computing   | Draft Recommendation | 03/2016       | 09/2019     |
| <b>ITU-T X.SRNaaS</b> , Security requirements of Network as a Service (NaaS) in cloud computing   | Draft Recommendation | 09/2016       | 09/2019     |
| <b>ITU-T X.SRCaaS</b> , Security requirements for Communication as a Service application environments   | Draft Recommendation | 09/2016       | 10/2019     |
| <b>ITU-T X.GSBDaaS</b> , Guidelines on security of Big Data as a Service  | Draft Recommendation | 09/2016       | 09/2019     |
| <b>ITU-T X.sgcc</b> , Security guidelines for container in cloud computing environment  | Draft Recommendation | 09/2018       | Q4/2020     |

- **ITU-T X.1601:** This Recommendation provides guidelines for cloud service customer data security in cloud computing, for those cases where the cloud service provider (CSP) is responsible for ensuring that the data is handled with proper security. This is not always the case, since for some cloud services the security of the data will be the responsibility of the cloud service customers (CSCs) themselves. In other cases, the responsibility may be mixed.

For example, in some cases the CSP may be responsible for restricting access to the data, while the CSC remains responsible for deciding which cloud service users (CSUs) should have access to it, and the behaviour of any scripts or applications with which the CSU processes the data.

This Recommendation identifies security controls for cloud service customer data that can be used in different stages of the full data life cycle. These security controls may differ when the security level of the cloud service customer data changes. Therefore, the Recommendation provides guidelines on when each control should be used for best security practice.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?id=12613>

- **ITU-T X.1631 | ISO/IEC 27017:** Recommendation ITU-T X.1631 | ISO/IEC 27017 provides guidelines for information security controls applicable to the provision and use of cloud services by providing:
  - additional implementation guidance for relevant controls specified in ISO/IEC 27002;
  - additional controls with implementation guidance that specifically relate to cloud services.

This Recommendation | International Standard provides controls and implementation guidance for both cloud service providers and cloud service customers.  
 URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12490>
- **ITU-T X.1642:** This Recommendation provides guideline of operational security for cloud computing, which includes guidance on service level agreements (SLAs) and daily security maintenance for cloud computing. The target audiences of this Recommendation are cloud service providers, such as traditional telecommunication operators, ISPs and ICPs.  
 URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12616>
- **ITU-T X.1602:** This Recommendation provides a generic functional description for a secure service oriented Software as a Service (SaaS) application environment that is independent of network types, operating systems, middleware, vendor specific products or solutions. In addition, this Recommendation is independent of any service or scenarios-specific model (e.g., web services, Parlay X or REST), assumptions or solutions. This Recommendation describes a structured approach for defining, designing and implementing secure and manageable service-oriented capabilities in telecommunication cloud computing environments.  
 URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12615>
- **ITU-T X.1641:** This Recommendation provides generic security guidelines for cloud service customer (CSC) data in cloud computing. It analyses the CSC data security life cycle and proposes security requirements at each stage of the data life cycle. Furthermore, the Recommendation provides guidelines on when each control should be used for best security practice.  
 URI: <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12853>
- **ITU-T X.1603:** Recommendation ITU-T X.1603 analyses data security requirements for the monitoring service of cloud computing which includes monitoring data scope requirements, monitoring data life cycles, security requirements of monitoring data acquisition and security requirements of monitoring data storage. Monitoring data scope requirements include the necessary monitoring scope that CSPs should provide to maintain cloud security and the biggest monitoring scope of CSPs. Monitoring data life cycles includes data creation, data store, data use, data migrate, data present, data destroy and data backup. Monitoring acquisition determines the security requirements of the acquisition techniques of a monitoring service. Monitoring data storage determines the security requirements for CSPs to store the monitoring data.  
 URI: [https://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13562](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13562)
- **ITU-T X.SRIaaS:** Infrastructure as a Service (IaaS) is one of the representative categories of cloud services, in which the cloud capabilities service provided to the CSC is an infrastructure capabilities type. IaaS environments and virtualized services are facing more challenges and threats than traditional information technology infrastructure and applications. Platforms that share computing, storage and network services need protections specific to the threats in the IaaS environment. If these threats are not carefully addressed, it will have very negative impacts on the development of IaaS services. This Recommendation aims to document the security requirements of public IaaS. This will be helpful for IaaS CSPs to improve the overall security level throughout the planning, constructing and operating

stages of IaaS platform and services. This work also complements the security standardization activity related to software-defined networks, especially X.sdnsec.

URI: [https://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13578](https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13578)

- **ITU-T X.SRNaaS:** Network as a Service (NaaS) is one of the representative cloud service categories, in which the capability provided to the cloud service customer (CSC) is transport connectivity and related network capabilities. NaaS services can provide any of three cloud capabilities: NaaS application service, NaaS platform service and NaaS connectivity service. All three kinds of NaaS service face particular security challenges such as application security vulnerabilities, security risks of network virtualization, eavesdropping, etc. Recommendation ITU-T X.SRNaaS analyses the security challenges and security requirements of NaaS application, NaaS platform and NaaS connectivity. This Recommendation could help NaaS service providers to address security issues. The capabilities provided by this Recommendation will take into account the national legal and regulatory obligations in individual Member States in which the NaaS services operate. The methodology of this proposal would follow the recommendations of clause 10 in Recommendation ITU-T X.1601.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13590](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13590)

- **ITU-T X.SRCaaS:** Recommendation ITU-T X.SRCaaS recommends the security requirements of communication as a service (CaaS) application environments with the identification of the risks. The Recommendation describes the scenarios and the features of CaaS, into which multi-communication capabilities are plugged. Moreover, some special /unique risks are identified, which are caused by the unique features of CaaS. The corresponding security requirements are recommended for the following aspects: identity fraud, orchestration security, multi-device security, countering spam, privacy protection, infrastructure attack, attack from infrastructure, Intranet attack and so on. The Recommendation refers to the common security requirements of Recommendation ITU-T X.1602 to avoid duplicated work. These measures in the requirements take into account the national legal and regulatory obligations in individual Member States in which the platforms operate. The work applies the methodology standardized in clause 10 of Recommendation ITU-T X.1601.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13589](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13589)

- **ITU-T X.GSDBaaS:** The Recommendation analyzes security challenges faced by Big Data as a Service, and provides the componentized security framework of big data platform services, specifies that security protection measures should be satisfied for the activities/components related to BDaaS and roles participated in the big data activities, etc.

URI: [http://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13591](http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13591)

- **ITU-T X.sgcc:** This Recommendation analyses security threats and challenges on containers in the cloud computing environment, and provides the security guidelines and reference security framework for containers in cloud.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14788](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14788)

Table 10-2 provides an analysis of ITU-T SG17 deliverables.

**Table 10-2 – Analysis of ITU-T SG17 deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b>   | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b>   |
|-------------------------------|----------------------------|---|---------------------|--------------------------------|-----------------------------------|---|
| <b>Fundamental</b>            |                            |   |                     |                                |                                   |   |
| <b>Cloud service category</b> |                            |   |                     |                                |                                   |   |
| <b>Security</b>               | ITU-T X.1601               | ITU-T X.1602, ITU-T X.1603, ITU-T X.SRIaaS, ITU-T X.SRNaaS, ITU-T X.SRCaaS, |                     |                                |                                   | ITU-T X.1642, ITU-T X.1631, ITU-T X.1641, ITU-T X.GSBD BaaS, ITU-T X.sgcc |
| <b>Management</b>             |                            |   |                     |                                |                                   |   |
| <b>Inter-cloud, CSB</b>       |                            |   |                     |                                |                                   |   |
| <b>SLA, metering</b>          |                            |   |                     |                                |                                   |   |
| <b>Testing</b>                |                            |   |                     |                                |                                   |   |
| <b>Others</b>                 |                            |   |                     |                                |                                   |   |

## 11 ITU-T SG5

Table 11-1 provides a list of ITU-T SG5 deliverables associated with cloud computing.

**Table 11-1– ITU-T SG5 deliverables**

| <b>Title of deliverable</b>   | <b>Current status</b> | <b>Starting date</b> | <b>Target date</b> |
|---|-----------------------|----------------------|--------------------|
| <b>ITU-T L.1200</b> , Direct current power feeding interface up to 400V at the input to telecommunication and ICT equipment                               | Recommendation        | 10/2010              | 05/2012            |
| <b>ITU-T L.1300</b> , Best practices for green data centres   | Recommendation        |                      | 06/2014            |
| <b>ITU-T L.1410</b> , Methodology for the assessment of the environmental impact of information and communication technology goods, networks and services | Recommendation        |                      | 12/2014            |
| <b>ITU-T L.1301</b> , Minimum data set and communication interface requirements for data centre energy management   | Recommendation        |                      | 05/2015            |
| <b>ITU-T L.1201</b> , Architecture of power feeding systems of up to 400 VDC  | Recommendation        |                      | 03/2014            |
| <b>ITU-T L.1202</b> , Methodologies for evaluating the performance of an up to 400 VDC power feeding system and its environmental impact                  | Recommendation        |                      | 04/2015            |

**Table 11-1– ITU-T SG5 deliverables**

| <b>Title of deliverable</b>  | <b>Current status</b> | <b>Starting date</b> | <b>Target date</b> |
|--|-----------------------|----------------------|--------------------|
| <b>ITU-T L.1420</b> , Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations | Recommendation        |                      | 02/2012            |
| <b>ITU-T L.1430</b> , Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects            | Recommendation        |                      | 12/2013            |
| <b>ITU-T L.1302</b> , Assessment of energy efficiency on infrastructure in data centres and telecommunication centres  | Recommendation        |                      | 11/2015            |
| <b>ITU-T L.1320</b> , Energy efficiency metrics and measurement for power and cooling equipment for telecommunications and data centres                                | Recommendation        |                      | 03/2014            |
| <b>ITU-T L.1205</b> , Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems  | Recommendation        | 12/2013              | 12/2016            |
| <b>ITU-T L.green_mgm_DC</b> , Functionality requirements and framework of green data centre energy-saving management system  | WI approved           | 12/2014              | 2018               |
| <b>ITU-T L.1440</b> , Methodology for environmental impact assessment of information and communication technologies at city level                                      | Recommendation        |                      | 10/2015            |
| <b>ITU-T L.1204</b> , Extended architecture of power feeding systems of up to 400 VDC  | Recommendation        |                      | 06/2016            |
| <b>ITU-T L.1220</b> , Innovative energy storage technology for stationary use – Part 1: Overview of energy storage   | Recommendation        |                      | 05/2017            |
| <b>ITU-T L.1206</b> , Impact on ICT equipment architecture of multiple AC, –48 VDC or up to 400 VDC power input  | Recommendation        |                      | 05/2017            |
| <b>L.se_DC</b> , smart energy solutions for data centre and telecommunication centre   | Draft Recommendation  | 05/2017              | 12/2018            |

- ITU-T L.1200**: This Recommendation specifies the direct current (DC) interface between the power feeding system and ICT equipment connected to it. It also describes normal and abnormal voltage ranges, and immunity test levels for ICT equipment to maintain the stability of telecommunication and data communication services. The specified interface is operated from a DC power source of up to 400 V to allow increased power consumption and equipment power density, in order to obtain higher energy efficiency and reliability with less material usage than using a lower voltage such as –48 VDC or AC UPS power feeding solutions.  
 URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11638>
- ITU-T L.1300**: This Recommendation specifies best practices aimed at developing green data centres. A green data centre can be defined as a repository for the storage, management and dissemination of data in which the mechanical, lighting, electrical and computer systems are designed for maximum energy efficiency and minimum environmental impact. The

construction and operation of a green data centre includes advanced technologies and strategies. The Recommendation provides a set of rules to be referred to when undertaking improvement of existing data centres, or when planning, designing or constructing new ones.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12204>

- **ITU-T L.1410:** Recommendation ITU-T L.1410 deals with environmental life cycle assessments (LCAs) of information and communication technology (ICT) goods, networks and services. It is organized in two parts:
  - Part I: ICT life cycle assessment: framework and guidance
  - Part II: Comparative analysis between ICT and reference product system (Baseline scenario); framework and guidance.

Part I deals with the life cycle assessment (LCA) methodology applied to ICT goods, networks and services. Part II deals with comparative analysis based on LCA results of an ICT goods, networks and services product system, and a reference product system.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12207>

- **ITU-T L.1301:** Recommendation ITU-T L.1301 establishes a minimum data set necessary to manage data centres and telecommunication rooms in an environmentally responsible manner.

The Recommendation specifies the communication interface and defines the parameters to be communicated depending on the equipment used in data centres, such as power systems (alternating current (AC)/direct current (DC) and uninterruptible power supply (UPS) and energy distribution), cooling systems and information and communication technology (ICT) equipment.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12428>

- **ITU-T L.1201:** Recommendation ITU-T L.1201 describes the architecture of power feeding systems of up to 400 VDC for information and communication technology (ICT) equipment in telecommunication centres, data centres and customer premises. It describes aspects such as configuration, redundancy, power distribution and monitoring, in order to construct safe, reliable and manageable power feeding systems. It can be used also as an architecture reference model for further Recommendations e.g., on the performance of DC power feeding systems.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12135>

- **ITU-T L.1202:** Recommendation ITU-T L.1202 is provided as a complement to Recommendation ITU-T L.1201, which describes the architecture of direct current (DC) power systems with an up to 400 VDC information and communication technology (ICT) equipment interface. The up to 400 VDC ICT equipment interface is described in Recommendation ITU-T L.1200.

Recommendation ITU-T L.1202 provides a framework for assessing performances of up to 400 VDC power feeding systems and the savings incurred when compared to other power feeding systems such as the –48 VDC power system and the AC uninterruptible power system (UPS) commonly used in information and communication technology (ICT) sites.

This Recommendation deals with performance factors such as efficiency, reliability/availability and environmental impact.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?id=12427>

- **ITU-T L.1420:** Recommendation ITU-T L.1420 presents the methodology to be followed if an organization intends to claim compliance with this Recommendation when assessing its information and communication technology (ICT) related energy consumption and/or greenhouse gas (GHG) emissions.

This Recommendation can be used to assess energy consumption and GHG emissions generated over a defined period of time for the following purposes: for assessment of related impact from ICT organizations or for assessment of impact from ICT related activities within non-ICT organizations.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11431>

- **ITU-T L.1430:** Recommendation ITU-T L.1430 is intended as a complement to ISO standard ISO 14064-2 and the Project Protocol of the Greenhouse Gas Protocol (GHG Protocol).

This Recommendation provides guidance for the application of a specific methodology to assess the environmental impact of information and communication technology (ICT) greenhouse gas (GHG) and energy projects. This assessment methodology is specifically directed at quantifying and reporting GHG emission reductions, GHG removal enhancements, energy consumption reductions, and enhancement of energy generation and storage in ICT GHG and energy projects.

An ICT GHG project uses mainly ICT goods, networks and services (GNS) and is designed to reduce GHG emissions or increase GHG removals that are quantified by comparison between the environmental impact of a project activity and a corresponding baseline scenario.

An ICT energy project uses mainly ICT goods, networks and services to reduce energy consumption and improve energy efficiency.

From the ICT perspective, this Recommendation takes into account considerations based on existing project quantification guidelines and aims at covering ICT GHG and energy project activities within both the ICT and non-ICT sectors.

This Recommendation recognizes the importance of project validation and verification for the credibility of project results but does not enforce the validation and verification procedures to be applied. It is expected that such procedures will be determined by the selected GHG programme, national regulations, the project proponent's internal policy or the intended user's request.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11904>

- **ITU-T L.1302:** Recommendation ITU-T L.1302 contains the energy efficiency assessment methodology for data and telecommunication centres, test equipment accuracy requirements, assessment periods, assessment conditions and calculation methods.

For data and telecommunication centres, the document was divided into assessment methods for whole data centre /telecommunication centre efficiency and for partial data centre/telecommunication centre efficiency.

As the main energy consuming infrastructure in data centres/telecommunication centres are power feeding systems (power supply system) and cooling systems, both system energy efficiency measurement methodologies are covered in this Recommendation.

It takes advantage of methodologies and best practices currently in use or in development in networks and data centres/telecommunication centres.

This Recommendation aims to reduce the negative impact of data and telecommunication centres through providing the methodologies of energy efficiency assessments. It is commonly recognized that data and telecommunication centres will have an ever-increasing impact on the environment in the future. The application of the assessment methods defined in this Recommendation can help owners and managers to build future data centres/telecommunication centres, or improve existing ones, to operate in an environmentally responsible manner.

URI: <http://www.itu.int/itu-t/recommendations/rec.aspx?rec=12630>



- **ITU-T L.1320:** Recommendation ITU-T L.1320 contains the general definition of metrics, test procedures, methodologies and measurement profiles required to assess the energy efficiency of power and cooling equipment for telecommunication and data centres. More detailed measurement procedures and specifications can be developed in future related ITU-T Recommendations.

Metrics and measurement methods are defined for power equipment, alternating current (AC) power feeding equipment (such as AC uninterruptible power supply (UPS), direct current (DC/AC) inverters), DC power feeding equipment (such as AC/DC rectifiers, DC/DC converters), solar equipment, wind turbine equipment and fuel cell equipment.

In addition, metrics and measurement methods are defined for cooling equipment such as air conditioning equipment, outdoor air cooling equipment and heat exchanging cooling equipment.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?id=12136>

- **ITU-T L.renewable:** This draft document defines the interface and architecture for injecting renewable energy and distributed power sources into an up to 400 V power system as defined in Recommendation ITU-T L.1201.

URL: [http://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=10018](http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=10018)

- **ITU-T L.green\_mgm\_DC:** This Recommendation describes the functionality requirements and framework of green data centre energy-saving management systems. The energy saving will be realized through performance to increase the energy efficiency of data centres. The scope of this Recommendation includes:

- characteristics and operation flow of green data centre energy-saving management systems;
- functionality requirements of green data centre energy-saving management systems (e.g., real-time energy consumption data acquisition; energy consumption data analysis and chart show; energy consumption data query; energy consumption monitoring and early warning; strategy optimization, etc.);
- capability needs of green data centre energy-saving management systems (e.g., collect data from different communication interfaces; secure storage; control management, etc.)
- framework of green data centre energy-saving management systems.

Sensor definition, interface and protocol are not included in the scope of this Recommendation.

URL: [http://web.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=10367](http://web.itu.int/ITU-T/workprog/wp_item.aspx?isn=10367)

- **ITU-T L.1440:** Recommendation ITU-T L.1440 gives general guidance for city-level environmental assessments related to ICTs, and provides a description of methodologies to be used for the assessment of the environmental impact of ICTs in cities.

In this first edition of this Recommendation, the assessment is limited to energy consumption and GHG emissions.

The Recommendation is divided in two parts.

- Part I relates to the first order effects from the use of ICT goods and networks in a city's organizations and households.
- Part II relates to the first and second order effects from ICT projects and services applied in the city.

This Recommendation provides specific guidance in setting the city boundaries, preparing and performing the assessment of ICT-related GHG emissions and energy consumption at the city level.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?id=12431>

- ITU-T L.1204:** Recommendation ITU-T L.1204 describes the extended architecture of power feeding systems of up to 400 volts DC (VDC) for information and communication technology (ICT) equipment in telecommunication centres, data centres and customer premises. It describes aspects such as configuration, redundancy, power distribution and monitoring, in order to construct safe, reliable and manageable power feeding systems. This Recommendation can be used also as an architecture reference model for future Recommendations, e.g., on the performance of DC power feeding systems. This Recommendation describes extended power feeding architectures using up to 400 VDC, e.g., hybrid redundant DC and AC power feeding based on Recommendation ITU-T L.1201.

URI: <http://www.itu.int/itu-t/recommendations/rec.aspx?rec=12882>
- ITU-T L.1220:** This Recommendation provides an overview of evolution of energy storage for stationary use for ICT/telecommunication equipment. Global results of investigations from laboratory and field tests of solutions for site, network, data centre and CPE resilience in smart sustainable cities. Mobile and portable batteries are out of the scope of this Recommendation.

URI: [http://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=10713](http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=10713)

**ITU-T L.1206:** The document discusses multiple power interfaces to ICT equipment operated by standardized –48V direct current, alternating current source and direct current source up to 400 V in line with the interfaces, operational voltage and characteristics detailed within ITU-T Recommendation and ETSI relevant standards. It also includes some details on the power architecture within the ICT equipment between the ICT power interface and the ICT end load.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=13938](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=13938)

**ITU-T L.se\_DC:** Recommendation "smart energy solutions for data centre and telecommunication centre" defines established clear requirements on data centre and telecommunication centre smart energy system performance, safety, energy efficiency and environmental impacts.

URI: [https://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14153](https://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14153)

Table 11-2 provides an analysis of ITU-T SG5 deliverables.

**Table 11-2 – Analysis of ITU-T SG5 deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b>                | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b>   |
|-------------------------------|----------------------------|--|---------------------|--------------------------------|-----------------------------------|-----------------|
| <b>Fundamental</b>            |                            |  |                     |                                |                                   |                 |
| <b>Cloud service category</b> |                            |  |                     |                                |                                   |                 |
| <b>Security</b>               |                            |  |                     |                                |                                   |                 |
| <b>Management</b>             |                            | ITU-T L.1301,<br>ITU-T<br>L.green_mgm<br>_DC |                     |                                |                                   | ITU-T<br>L.1410 |
| <b>Inter-cloud, CSB</b>       |                            |  |                     |                                |                                   |                 |
| <b>SLA, metering</b>          |                            |  |                     |                                |                                   |                 |

**Table 11-2 – Analysis of ITU-T SG5 deliverables**

|                | General, definition | Requirements use cases | Architecture               | API, interface, profile | Data model, format, schema | Others   |
|----------------|---------------------|------------------------|----------------------------|-------------------------|----------------------------|--|
| <b>Testing</b> |                     |                        |                            |                         |                            | ITU-T L.1202, ITU-T L.1420, ITU-T L.1430, ITU-T L.1302, ITU-T L.1320, ITU-T L.1440 |
| <b>Others</b>  |                     |                        | ITU-T L.1201, ITU-T L.1204 | ITU-T L.renewable       |                            | ITU-T L.1200, ITU-T L.1300, ITU-T L.1220, ITU-T L.1206, L.se_DC                    |

## 12 ITU-T SG11

Table 12-1 provides a list of ITU-T SG11 deliverables associated with cloud computing.

**Table 12-1– ITU-T SG11 deliverables**

| Title of deliverable  | Current status | Starting date | Target date |
|---|----------------|---------------|-------------|
| <b>ITU-T Q.4040</b> , The framework and overview of cloud computing interoperability testing  | Recommendation | 02/2013       | 02/2016     |
| <b>ITU-T Q.4041.1</b> , Cloud computing infrastructure capabilities interoperability testing – part 1: Interoperability testing between the CSC and CSP | Recommendation | 04/2015       | 11/2017     |
| <b>ITU-T Q.4042.1</b> , Cloud interoperability testing for web applications   | Recommendation | 04/2016       | 03/2018     |
| <b>ITU-T Q.3914</b> , Set of parameters of cloud computing for monitoring   | Recommendation | 07/2014       | 11/2017     |

- **ITU-T Q.4040**: This Recommendation describes the framework and provides an overview of cloud computing interoperability testing. According to the identified target areas of testing, the framework Recommendation includes overview of cloud computing interoperability testing with common confirmed items, infrastructure capabilities type, platform capabilities type and application capabilities type interoperability testing.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12703>

- **ITU-T Q.4041.1:** This Recommendation specifies the cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP, including interoperability testing of computing services, storage services, network services and related management functions based on the functional requirements specified in Recommendation ITU-T Y.3513. The test cases of cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP have also been introduced.  
URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13492&lang=en>
- **ITU-T Q.4042.1:** This document focuses on the cloud interoperability testing for web applications.  
URI: [http://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13839](http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13839)
- **ITU-T Q.3914:** This Recommendation provides a set of parameters that indicate the status and event of a cloud computing system, including resource layer, service layer and access layer.  
URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13487>

Table 12-2 provides an analysis of ITU-T SG11 deliverables.

**Table 12-2 – Analysis of ITU-T SG11 deliverables**

|                               | General, definition | Requirements use cases | Architecture | API, interface, profile | Data model, format, schema | Others                                       |
|-------------------------------|---------------------|------------------------|--------------|-------------------------|----------------------------|--|
| <b>Fundamental</b>            |                     |                        |              |                         |                            |  |
| <b>Cloud service category</b> |                     |                        |              |                         |                            |  |
| <b>Security</b>               |                     |                        |              |                         |                            |  |
| <b>Management</b>             |                     |                        |              |                         |                            |  |
| <b>Inter-cloud, CSB</b>       |                     |                        |              |                         |                            |  |
| <b>SLA, metering</b>          |                     |                        |              |                         |                            |  |
| <b>Testing</b>                | ITU-T Q.4040        |                        |              |                         |                            | ITU-T Q.4041.1, ITU-T Q.4042.1, ITU-T Q.3914 |
| <b>Others</b>                 |                     |                        |              |                         |                            |  |

### 13 ITU-T SG16

Table 13-1 provides a list of ITU-T SG16 deliverables associated with cloud computing.

**Table 13-1– ITU-T SG16 deliverables**

| Title of deliverable   | Current status       | Starting date | Target date |
|--|----------------------|---------------|-------------|
| <b>ITU-T H.248.CLOUD</b> , Gateway control protocol: Cloudification of packet gateways | Draft Recommendation | 07/2014       | 12/2018     |
| <b>ITU-T F.743.2</b> , Requirements for cloud storage in visual surveillance           | Recommendation       | 03/2015       | 07/2016     |
| <b>ITU-T H.626.2</b> , Architecture for cloud storage in video surveillance            | Recommendation       | 12/2015       | 12/2017     |

- ITU-T H.248.CLOUD:** This Recommendation does not define any new signalling extensions for the ITU-T H.248 gateway control protocol. The purpose of this Recommendation is to provide some kind of guidance to the specification of ITU-T H.248 profiles for ITU-T H.248 gateways in cloud-based network solutions.

URI: [http://www.itu.int/ITU-T/workprog/wp\\_item.aspx?isn=13278](http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=13278)
- ITU-T F.743.2:** The purpose of this Recommendation is to define the cloud storage service requirements in visual surveillance. Cloud storage enables the service users to have ubiquitous, convenient and on-demand network access to a shared pool of configurable storage resources, which can be rapidly provisioned and released with minimal management effort or service-provider interaction. Cloud storage can realize flexible and reliable data storage for large-scale visual surveillance, and its components are modularized and allocated dynamically based on real usage. This Recommendation provides the application scenarios and the requirements for cloud storage in visual surveillance.

URI: <http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12895>
- ITU-T H.626.2:** This Recommendation defines a cloud storage architecture in visual surveillance. Cloud storage enables the service users to have ubiquitous, convenient and on-demand network access to a shared pool of configurable storage resources, which can be rapidly provisioned and released with minimal management effort or service-provider interaction. Cloud storage can realize flexible and reliable data storage for large-scale visual surveillance, and its components are modularized and allocated dynamically based on real usage. This Recommendation provides the architecture, entities, reference points and service control flow for cloud storage in visual surveillance.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13436>

Table 13-2 provides an analysis of ITU-T SG16 deliverables.

**Table 13-2 – Analysis of ITU-T SG16 deliverables**

|                               | General, definition | Requirements use cases | Architecture  | API, interface, profile | Data model, format, schema | Others |
|-------------------------------|---------------------|------------------------|---------------|-------------------------|----------------------------|--------|
| <b>Fundamental</b>            |                     |                        |               |                         |                            |        |
| <b>Cloud service category</b> |                     | ITU-T F.743.2          | ITU-T H.626.2 |                         |                            |        |
| <b>Security</b>               |                     |                        |               |                         |                            |        |
| <b>Management</b>             |                     |                        |               | ITU-T H.248.CLOUD       |                            |        |
| <b>Inter-cloud, CSB</b>       |                     |                        |               |                         |                            |        |

**Table 13-2 – Analysis of ITU-T SG16 deliverables**

|               | General, definition | Requirements use cases | Architecture | API, interface, profile | Data model, format, schema | Others |
|---------------|---------------------|------------------------|--------------|-------------------------|----------------------------|--------|
| SLA, metering |                     |                        |              |                         |                            |        |
| Testing       |                     |                        |              |                         |                            |        |
| Others        |                     |                        |              |                         |                            |        |

**14 ITU-T SG2**

Table 14-1 below provides a list of ITU-T SG2 deliverables associated with cloud computing.

**Table 14-1 – ITU-T SG2 deliverables**

| Title of deliverable   | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| ITU-T M.3071, Cloud-based network management functional architecture                                   | Recommendation | 04/2016       | 12/2017     |
| ITU-T M.3372, Requirements for resource management in cloud-aware telecommunication management systems | Recommendation | 04/2017       | 12/2018     |

- ITU-T M.3071:** This Recommendation introduces a new network management functional architecture with cloud-computing technology. In this Recommendation, the background and basic concept of cloud-based network management are provided. This Recommendation also provides details of a cloud-based network management functional architecture, including its basic components, functionalities and the relationship between its components.

URI: <https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13479>
- ITU-T M.3372:** This document provides the functional framework and functional requirements for resource management in cloud-aware telecommunication management systems, describes the composition of a functional framework and explains the functions of each component in the framework.

URI: [http://www.itu.int/itu-t/workprog/wp\\_item.aspx?isn=14193](http://www.itu.int/itu-t/workprog/wp_item.aspx?isn=14193)

Table 14-2 provides an analysis of ITU-T SG2 deliverables.

**Table 14-2 – Analysis of ITU-T SG2 deliverables**

|                        | General, definition | Requirements use cases | Architecture | API, interface, profile | Data model, format, schema | Others |
|------------------------|---------------------|------------------------|--------------|-------------------------|----------------------------|--------|
| Fundamental            |                     |                        |              |                         |                            |        |
| Cloud service category |                     |                        |              |                         |                            |        |
| Security               |                     |                        |              |                         |                            |        |
| Management             |                     | ITU-T M.3372           | ITU-T M.3071 |                         |                            |        |

**Table 14-2 – Analysis of ITU-T SG2 deliverables**

|                         | <b>General, definition</b> | <b>Requirements use cases</b> | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------|----------------------------|-------------------------------|---------------------|--------------------------------|-----------------------------------|---------------|
| <b>Inter-cloud, CSB</b> |                            |                               |                     |                                |                                   |               |
| <b>SLA, metering</b>    |                            |                               |                     |                                |                                   |               |
| <b>Testing</b>          |                            |                               |                     |                                |                                   |               |
| <b>Others</b>           |                            |                               |                     |                                |                                   |               |

**15 ISO/IEC JTC 1 SC 38**

Table 15-1 provides a list of ISO/IEC JTC 1 SC 38 deliverables associated with cloud computing.

**Table 15-1 – ISO/IEC JTC 1 SC 38 deliverables**

| <b>Title of deliverable</b>  | <b>Current status</b> | <b>Starting date</b> | <b>Target date</b> |
|--|-----------------------|----------------------|--------------------|
| <b>ITU-T Y.3500 ISO/IEC 17788</b> , Information technology – Cloud computing – Overview and vocabulary   | Recommendation   IS   | 09/2012              | 08/2014            |
| <b>ITU-T Y.3502 ISO/IEC 17789</b> , Information technology – Cloud computing – Reference architecture  | Recommendation   IS   | 09/2012              | 08/2014            |
| <b>ISO/IEC 19086-1</b> , Cloud Computing – Service Level Agreement (SLA) Framework – Part 1 : Overview and Concepts                                  | IS                    | 02/2013              | 09/2016            |
| <b>ISO/IEC 19086-2</b> , Information Technology – Cloud Computing – Service Level Agreement (SLA) Framework – Part 2 : Metric Model                  | DIS                   | 10/2014              | 10/2017            |
| <b>ISO/IEC 19086-3</b> , Information Technology – Cloud Computing – Service Level Agreement (SLA) Framework – Part 3 : Core Conformance Requirements | IS                    | 10/2014              | 07/2017            |
| <b>ISO/IEC 19086-4</b> , Information Technology – Cloud Computing – Service Level Agreement (SLA) Framework – Part 4 : Security and Privacy          | IS                    | 10/2014              | 01/2018            |
| <b>ISO/IEC 19941</b> , Information Technology – Cloud Computing – Interoperability and Portability   | IS                    | 10/2014              | 10/2017            |
| <b>ISO/IEC 19944</b> , Information Technology – Cloud Computing - Cloud services and devices: data flow, data categories and data use                | IS                    | 10/2014              | 10/2017            |
| <b>ISO/IEC 22123</b> , Information Technology – Cloud Computing – Concepts and terminology   | WD                    | 01/2017              | 01/2020            |
| <b>ISO/IEC 22624</b> , Information Technology – Cloud Computing - Taxonomy based data handling for cloud services                                    | WD                    | 10/2017              | ongoing            |

**Table 15-1 – ISO/IEC JTC 1 SC 38 deliverables**

| Title of deliverable   | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| <b>ISO/IEC TR 22678</b> , Information Technologies – Cloud Computing – Guidance for Policy Development                         | WD             | 04/2017       | ongoing     |
| <b>ISO/IEC TR 23186</b> , Information Technologies – Cloud Computing – Framework of trust for processing of multi-sourced data | WD             | 04/2017       | ongoing     |
| <b>ISO/IEC TR 23187</b> , Information technology – Cloud computing – Interacting with cloud service partners (CSNs)            | WD             | 10/2017       | ongoing     |
| <b>ISO/IEC TR 23188</b> , Information technology – Cloud computing – Edge computing landscape                                  | WD             | 10/2017       | ongoing     |
| <b>ISO/IEC TS 23167</b> , Information technology – Cloud computing – Common Technologies and Techniques                        | WD             | 12/2017       | ongoing     |

- ITU-T Y.3500|ISO/IEC 17788**: This Recommendation | International Standard provides an overview of cloud computing along with a set of terms, definitions and concepts. It is a terminology foundation for the cloud computing standardization work.

This Recommendation | International Standard is applicable to all types of organizations (e.g., commercial enterprises, government agencies, not-for-profit organizations).

URI: <https://www.iso.org/standard/60544.html>
- ITU-T Y.3502|ISO/IEC 17789**: This Recommendation | International Standard specifies the cloud computing reference architecture (CCRA). The reference architecture includes the cloud computing roles, cloud computing activities, as well as the cloud computing functional components and their relationships.

URI: <https://www.iso.org/standard/60545.html>
- ISO/IEC 19086-1**: This document seeks to establish a set of common cloud SLA building blocks (concepts, terms, definitions, contexts) that can be used to create cloud service level agreements (SLAs). This document specifies: a) an overview of cloud SLAs; b) identification of the relationship between the cloud service agreement and the cloud SLA; c) concepts that can be used to build cloud SLAs; and d) terms commonly used in cloud SLAs. This document is for the benefit and use of both cloud service providers and cloud service customers. The aim is to avoid confusion and facilitate a common understanding between cloud service providers and cloud service customers. Cloud service agreements and their associated cloud SLAs vary between cloud service providers, and in some cases different cloud service customers can negotiate different contract terms with the same cloud service provider for the same cloud service. This document aims to assist cloud service customers when they compare cloud services from different cloud service providers. This document does not provide a standard structure that can be used for a cloud SLA or a standard set of cloud service level objectives (SLOs) and cloud service qualitative objectives (SQOs) that will apply to all cloud services or all cloud service providers. This approach provides flexibility for cloud service providers in tailoring their cloud SLAs to the particular characteristics of the offered cloud services. This document does not supersede any legal requirement.

URI: <https://www.iso.org/standard/67545.html>



- ISO/IEC 19086-2:** This part of ISO/IEC 19086 defines a model for specifying metrics for cloud service level agreements (SLAs) and includes applications of the model with examples. This part of ISO/IEC 19086 establishes a common terminology and approach for specifying metrics.

This standard is for the benefit and use of both cloud service providers and cloud service customers.

This standard is intended to complement ISO/IEC 19086-1, ISO/IEC 19086-3 and ISO/IEC 19086-4.

This part of ISO/IEC 19086 does not mandate the use of a specific set of metrics for cloud SLAs.

This part of ISO/IEC 19086 does not supersede any legal requirement.

URI: <https://www.iso.org/standard/67546.html>
- ISO/IEC 19086-3:** This international standard specifies core conformance requirements for service level agreements (SLAs) for cloud services for ISO/IEC 19086. This standard is for the benefit and use for providers and customers.

This standard does not provide a standard structure that would be used for cloud SLA contracts.

This document does not supersede any legal requirement.

URI: <https://www.iso.org/standard/67547.html>
- ISO/IEC 19086-4:** This document specifies security and protection of personally identifiable information components, SLOs and SQOs for cloud service level agreements (cloud SLAs) including requirements and guidance. This document is for the benefit and use of both CSPs and CSCs.

NOTE – ISO/IEC 19086-4 is initiated in JTC 1/SC 38 and transferred to JTC 1/SC 27.

URI: <https://www.iso.org/standard/68242.html>
- ISO/IEC 19941:** This document specifies cloud computing interoperability and portability types, the relationship and interactions between these two cross-cutting aspects of cloud computing, and common terminology and concepts used to discuss interoperability and portability and particularly relating to cloud services. This document is related to other standards namely ISO/IEC 17788, ISO/IEC 17789, ISO/IEC 19086-1, ISO/IEC 19944, and in particular references the cross-cutting aspects and components identified in ISO/IEC 17788 and ISO/IEC 17789 respectively. The goal of this document is to ensure that all parties involved in cloud computing, particularly CSCs, CSPs and CSNs acting as cloud service developers, have a common understanding of interoperability and portability for their specific needs. This common understanding helps to achieve interoperability and portability in cloud computing by establishing common terminology and concepts.

URI: <https://www.iso.org/standard/66639.html>
- ISO/IEC 19944:** This document extends the existing cloud computing vocabulary and reference architecture in ISO/IEC 17788 and ISO/IEC 17789 to describe an ecosystem involving devices consuming cloud services, describes the various types of data flowing within the devices and cloud computing ecosystem, describes the impact of connected devices on the data that flows within the cloud computing ecosystem, describes flows of data between cloud services, cloud service customers and cloud service users, provides foundational concepts, including a data taxonomy, identifies the categories of data that flow across the cloud service customer devices and cloud services. This document is applicable primarily to cloud service providers, cloud service customers and cloud service 56 users, but also to any person or organization involved in legal, policy, technical or other implications of data 57 flows between devices and cloud services.

URI: <https://www.iso.org/standard/66674.html>

- **ISO/IEC 22123:** This document provides a consolidated set of terms and definitions extracted from the ISO/IEC cloud computing standards, including, but not limited to, ISO/IEC 17788, ISO/IEC 17789, ISO/IEC 19086, ISO/IEC 19941 and ISO/IEC 19944. In addition, relevant and stable terminology from non-cloud computing ISO sources (e.g., Information technology – Security techniques) and external organization are also included. This document also contains terms and definitions that are not necessarily contained in other works. This document also addresses discrepancies and inconsistencies that have been identified in the consolidated terms and definitions to further enhance the usability of the ISO cloud computing terminology. This document includes additional descriptions and clarifications of cloud computing vocabulary terms, concepts and their inter-relationships.

URI: <https://www.iso.org/standard/72627.html>

- **ISO/IEC 22624:** This document:
  - describes a framework for the structured expression of data-related policies and practices in the cloud computing environment, based on the data taxonomy in ISO/IEC 19944;
  - covers expression of data-related policies and practices including, but not limited to, the following:
    - data geolocation: location of data in various jurisdictions, as it applies to data at rest;
    - cross-border control of data: control of data that resides in different jurisdictions or under different sovereign control depending on their data categorization (ISO/IEC 19944), and/or classification hierarchy and data use statement structure (ISO/IEC 19944);
    - cross-border flow of data: flow of data across borders and in general across various jurisdictions;
    - data portability: portability requirements of data in the cloud computing environment;
    - data classification: policies and practices which vary depending on the classification of the data;
    - data processing: processing of the data either by the CSP or by a 3rd party;
    - data management: management of the data either by the CSP or by a 3rd party;
    - data governance: governance of the data;
  - describes how the framework can be used in code(s) of conduct for practices regarding data at rest and in transit, including cross-border transfer of data, as well as remote access to data;
  - provides guiding principles on application of the taxonomy for the handling of data based on data subcategory and classification, including the processes that are needed for data in different levels of categorization and classification;
  - provides use cases for data sovereignty challenges, i.e. control, access and location of data according to data categories just in-time elevations in data access for people in various roles (e.g., data centre operators and administrators, and other roles in cloud computing).

This document is applicable primarily to cloud service providers, cloud service customers and cloud service users, but also to any person or organization involved in legal, policy, technical or other implications of taxonomybased data management in cloud services.

URI: <https://www.iso.org/standard/73614.html>

- **ISO/IEC TR 22678:** This document provides guidance on the use of international standards as a tool in the development of those policies that govern or regulate cloud service providers (CSPs) and cloud services, and those policies and practices that govern the use of cloud services in enterprise organisations. This includes material that explains cloud computing concepts and the role of cloud computing international standards in formulating policies and practices. The document makes reference to various international standards. Where possible,

these standards are ISO/IEC documents. Where a suitable ISO/IEC standard is not available, references are made to documents published by other WTO-registered standards bodies. As explained in the WTO "Technical Barriers to Trade" (TBT) Agreement, standards play a vital role in supporting technical regulations and conformity assessment, however this document does not cover matters of trade.

URI: <https://www.iso.org/standard/73642.html>

- **ISO/IEC TR 23186:** This document describes a framework of trust for the processing of multi-sourced data that includes data use obligations and controls, data provenance, chain of custody, security and immutable proof of compliance as elements of the framework.

URI: <https://www.iso.org/standard/74844.html>

- **ISO/IEC TR 23187:** This document provides an overview and discussion of interactions between cloud service partners (CSNs), specifically cloud service brokers, cloud service developers and cloud service auditors, and other cloud service entities. In addition, the document describes how cloud service agreements (CSAs) and cloud service level agreements (SLAs) should be used to address those interactions including the following:
  - define terms and concepts and provide an overview for interactions between cloud service partners (CSNs) and cloud service customers (CSCs) and cloud service providers (CSPs);
  - description of types of CSN interactions;
  - description of interactions between CSNs and CSCs;
  - description of interactions between CSNs and CSPs;
  - elements of CSAs and cloud SLAs for CSN interactions, both with CSPs and with CSCs.

URI: <https://www.iso.org/standard/74845.html>

- **ISO/IEC TR 23188:** The scope of this technical report is to investigate and report on the concept of edge computing, its relationship to cloud computing and IoT, and the technologies that are key to the implementation of edge computing. This report will explore the following topics with respect to edge computing:
  - concept of edge computing systems;
  - architectural foundation of edge computing;
  - edge computing terminology;
  - software classifications in edge computing – for example: firmware, services, applications;
  - supporting technologies such as containers, serverless, microservices;
  - networking for edge systems, including virtual networks;
  - data – data flow, data storage, data processing in edge computing;
  - management – of software, of data and of networks, resources, quality of service;
  - virtual placement of software and data, and metadata;
  - security and privacy;
  - real time;
  - mobile edge computing, mobile devices.

URI: <https://www.iso.org/standard/74846.html>

- **ISO/IEC TR 23167:** This document describes a series of technologies and techniques commonly used to build applications and systems using cloud computing. These include:
  - virtual machines (VMs) and hypervisors;
  - containers and container management systems;
  - "Serverless" computing;
  - Microservices architecture and automation;
  - platform as a service systems and their architecture;
  - storage services;
  - security, scalability and networking as applied to the above cloud computing technologies.

URI: <https://www.iso.org/standard/74845.html>

Table 15-2 provides an analysis of JTC 1 SC 38 deliverables.

**Table 15-2 – Analysis of JTC 1 SC 38 deliverables**

|                               | <b>General, definition</b>   | <b>Requirements use cases</b> | <b>Architecture</b>               | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b>                        |
|-------------------------------|------------------------------|-------------------------------|-----------------------------------|--------------------------------|-----------------------------------|--------------------------------------|
| <b>Fundamental</b>            | ISO/IEC 17788, ISO/IEC 22123 |                               | ISO/IEC 17789                     |                                |                                   |                                      |
| <b>Cloud service category</b> |                              |                               |                                   |                                |                                   |                                      |
| <b>Security</b>               | ISO/IEC 19086-4              |                               |                                   |                                |                                   |                                      |
| <b>Management</b>             |                              |                               |                                   |                                |                                   |                                      |
| <b>Inter-cloud, CSB</b>       | ISO/IEC TR 23187             |                               |                                   |                                |                                   |                                      |
| <b>SLA, metering</b>          | ISO/IEC 19086-1              | ISO/IEC 19086-3               |                                   |                                |                                   | ISO/IEC 19086-2                      |
| <b>Testing</b>                |                              |                               |                                   |                                |                                   |                                      |
| <b>Others</b>                 | ISO/IEC 19941, ISO/IEC 19944 |                               | ISO/IEC 22624<br>ISO/IEC TR 23186 |                                |                                   | ISO/IEC TR 23188<br>ISO/IEC TS 23167 |

## 16 DMTF

Table 16-1 provides a list of DMTF deliverables associated with cloud computing.

**Table 16-1 – DMTF deliverables**

| Title of deliverable   | Current status                | Starting date | Target date |
|--|-------------------------------|---------------|-------------|
| DSP0217, System Management Architecture for Server Hardware (SMASH) Implementation Requirements Version 2.1.0    | DMTF Standard                 |               | 12/2014     |
| DSP0243, Open Virtualization Format Specification – Version 1.1.0  | DMTF Standard (INCITS & ISO)  |               | 08/2015     |
| DSP0243, Open Virtualization Format Specification – Version 2.1.1  | DMTF Standard (INCITS)        |               | 08/2015     |
| DSP0262, Cloud Auditing Data Federation (CADF) Data Format and Interface Definitions Specification Version 1.0.0 | DMTF Standard                 |               | 07/2014     |
| DSP0263, Cloud Infrastructure Management Interface (CIMI) Model and REST Interface over HTTP e Version 2.0.0     | DMTF Standard (ISO) [Chinese] |               | 08/2016     |
| DSP0264, Cloud Infrastructure Management Interface – Common Information Model (CIMI-CIM) Version 1.0.0           | DMTF Standard [Chinese]       |               | 01/2013     |
| DSP0266, Redfish Scalable Platform Management API Specification Version 1.1.0                                    | DMTF Standard [Chinese]       |               | 01/2017     |
| DSP0270, Redfish Host Interface Specification Version 1.0.0  | DMTF Standard                 |               | 01/2017     |
| DSP8009, CIMI XML Schema   | DMTF Standard                 |               | 02/2014     |
| DSP8010, Redfish Schema  | DMTF Standard                 |               | 01/2017     |
| DSP8023, Open Virtualization Format XSD  | DMTF Standard                 |               | 01/2013     |

- DSP0217:** The "System Management Architecture for Server Hardware (SMASH) Implementation Requirements" specifies the CIM profile implementation requirements needed for conformance with SMASH 2.0.

URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0217\\_2.1.0.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0217_2.1.0.pdf)
- DSP0243:** The "Open Virtualization Format (OVF) Specification" describes an open, secure, portable and extensible format for the packaging and distribution of software for execution in virtual machines across multiple virtualization platforms. This specification is recognized by INCITS (469-2010) and ISO/IEC (17203:2011).

URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0243\\_1.1.0.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0243_1.1.0.pdf)

Version 2.1.1 of this document extends the format definition to support network ports, scaling at deployment time, basic placement policies, encryption of OVF packages, runtime disk sharing, advanced boot order, advanced data transfer to Guest OS, improved Internationalization – I18N, improved HASH and CIM schema.

URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0243\\_2.1.1.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0243_2.1.1.pdf)
- DSP0262:** The "Cloud Auditing Data Federation (CADF) Data Format and Interface Definitions Specification" document specifies a data model and associated schema definitions to format event records, logs and reports that can be federated and are suitable for audit purposes.

URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0262\\_1.0.0.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0262_1.0.0.pdf)

- **DSP0263:** The "Cloud Infrastructure Management Interface (CIMI) Model and REST Interface over HTTP" specifies the model and protocol for management interactions between the provider of a cloud infrastructure as a service (IaaS) and a consumer of that service. The model includes machines, storage and networks within the IaaS provider which the IaaS consumer can perform life cycle management.  
URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0263\\_1.0.1.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0263_1.0.1.pdf)
- **DSP0264:** The "Cloud Infrastructure Management Interface - Common Information Model" specifies a CIM representation for the logical model contained in the "Cloud Infrastructure Management Interface" document (DSP0263).  
URI: [http://dmtf.org/sites/default/files/standards/documents/DSP0264\\_1.0.0.pdf](http://dmtf.org/sites/default/files/standards/documents/DSP0264_1.0.0.pdf)
- **DSP0266:** The "Redfish Scalable Platform Management API Specification" document specifies RESTful interface semantics to access the data defined in model format to perform out-of-band systems management. It is suitable for a wide range of servers, from standalone servers to rack mount and bladed environments but scales equally well for large-scale cloud environments.  
URI: [http://www.dmtf.org/sites/default/files/standards/documents/DSP0266\\_1.1.0.pdf](http://www.dmtf.org/sites/default/files/standards/documents/DSP0266_1.1.0.pdf)
- **DSP0270:** The "Redfish Host Interface Specification" document specifies the functional requirements for Redfish host interfaces. The term "host interface" refers to interfaces that can be used by software running on a computer system to access the Redfish Service that is used to manage that computer system.  
URI: [http://www.dmtf.org/sites/default/files/standards/documents/DSP0270\\_1.0.0.pdf](http://www.dmtf.org/sites/default/files/standards/documents/DSP0270_1.0.0.pdf)
- **DSP8009:** The "CIMI XML Schema" contains the XML schema for representing CIMI interface. (DSP0263).  
URI: [http://schemas.dmtf.org/ovf/envelope/2/dsp8009\\_1.0.2.xsd](http://schemas.dmtf.org/ovf/envelope/2/dsp8009_1.0.2.xsd)
- **DSP8010:** The "Redfish Schema" document contain the schema definitions for managing compute platforms. The schema are provided in two formats: json-schema format and OData CSDL (Common Schema Description Language) format.  
URI: [http://www.dmtf.org/sites/default/files/standards/documents/DSP8010\\_2016.3.zip](http://www.dmtf.org/sites/default/files/standards/documents/DSP8010_2016.3.zip)
- **DSP8023:** The "Open Virtualization Format XSD" contains the XML schema for representing DMTF OVF files (DSP0243).  
URI: [http://schemas.dmtf.org/ovf/envelope/2/dsp8023\\_2.0.0.xsd](http://schemas.dmtf.org/ovf/envelope/2/dsp8023_2.0.0.xsd)

Table 16-2 provides an analysis of DMTF deliverables.

**Table 16-2 – Analysis of DMTF deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b> | <b>Architecture</b> | <b>API, interface, profile</b>                          | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|----------------------------|-------------------------------|---------------------|---|-----------------------------------|---------------|
| <b>Fundamental</b>            |                            |                               |                     |   |                                   |               |
| <b>Cloud service category</b> |                            |                               |                     |   |                                   |               |
| <b>Security</b>               |                            |                               |                     |   | DSP0262                           |               |
| <b>Management</b>             |                            |                               |                     | DSP0217,<br>DSP0263,<br>DSP0264,<br>DSP0266,<br>DSP0270 | DSP8009,<br>DSP8010,<br>DSP8023   |               |

**Table 16-2 – Analysis of DMTF deliverables**

|                  | General, definition | Requirements use cases | Architecture | API, interface, profile | Data model, format, schema | Others |
|------------------|---------------------|------------------------|--------------|-------------------------|----------------------------|--------|
| Inter-cloud, CSB |                     |                        |              |                         |                            |        |
| SLA, metering    |                     |                        |              |                         |                            |        |
| Testing          |                     |                        |              |                         |                            |        |
| Others           |                     |                        |              |                         |                            |        |

**17 TM Forum**

Table 17-1 lists a TM Forum deliverable associated with cloud computing.

**Table 17-1 – TM Forum deliverables**

| Title of deliverable   | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| <b>TMF061 Release 1.0</b> , Service Delivery Framework (SDF) Reference Architecture, Release 1.0 | Published      |               | 07/2009     |

- TMF061 Release 1.0:** The SDF RA Release 1 defines the scope and characteristics of the essential elements which constitute the patterns that the SDF architecture must support.  
 URI: <http://www.tmforum.org/TechnicalSpecifications/TMF061ServiceDelivery/39341/article.html>

Table 17-2 provides an analysis of ITU-T SG11 deliverables.

**Table 17-2 – Analysis of TM Forum deliverables**

|                        | General, definition | Requirements use cases | Architecture       | API, interface, profile | Data model, format, schema | Others |
|------------------------|---------------------|------------------------|--------------------|-------------------------|----------------------------|--------|
| Fundamental            |                     |                        |                    |                         |                            |        |
| Cloud service category |                     |                        |                    |                         |                            |        |
| Security               |                     |                        |                    |                         |                            |        |
| Management             |                     |                        |                    |                         |                            |        |
| Inter-cloud, CSB       |                     |                        |                    |                         |                            |        |
| SLA, metering          |                     |                        |                    |                         |                            |        |
| Testing                |                     |                        |                    |                         |                            |        |
| Others                 |                     |                        | TMF061 Release 1.0 |                         |                            |        |

**18 ATIS**

Table 18-1 provides a list of ATIS deliverables associated with cloud computing.

**Table 18-1 – ATIS deliverables**

| Title of deliverable   | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| ATIS-0200005, Cloud Framework for Telepresence Service   | Published      |               | 02/2012     |
| ATIS-0200008, Trusted Information Exchange (TIE)   | Published      |               | 10/2012     |
| ATIS-0200009, Cloud Service Lifecycle Checklist  | Published      |               | 11/2012     |
| ATIS-0200006, Virtual Desktop Requirements   | Published      |               | 05/2012     |
| ATIS-0200010, CDN Interconnection Use Cases and Requirements in a Multi-Party Federation Environment | Published      |               | 12/2012     |
| ATIS-0200011, Multicast Delivery of Content to Mobile End User Devices                               | Approved       |               | 02/2014     |

- ATIS-0200005:** This specification establishes a foundation for continuing ATIS work efforts on unified visual communications. The specification explores a provider-agnostic and product-agnostic implementation. It will consider two primary aspects of the telepresence service. The first is use cases such as immersive telepresence that are deployed today. The second are future cases resulting from the application of the cloud and service evolution in the future.

URI: <http://www.atis.org/docstore/product.aspx?id=26079>
- ATIS-0200008:** This document describes the Trusted Information Exchange as an aggregated service and lists the high level requirements.

URI: <http://www.atis.org/docstore/product.aspx?id=26798>
- ATIS-0200009:** The cloud service life cycle checklist establishes a baseline of expectations between providers who are interoperating cloud services. The document will also be referenced in cloud service standards to provide a reference model for requirements development. Each enterprise has an existing governance model. The life-cycle checklist provides a way to extend the process model between participating companies.

URI: <http://www.atis.org/docstore/product.aspx?id=27854>
- ATIS-0200006:** This document addresses hosted virtual desktop services for medium and large enterprises. It specifies a federation framework to allow service providers to support high-performance virtual desktops beyond their normal coverage areas. The document also identifies an initial set of infrastructure-service interfaces and related requirements. This is a logical basis for the work on cloud infrastructure federation.

URI: <http://www.atis.org/docstore/product.aspx?id=26147>
- ATIS-0200010:** ATIS Standard ATIS-0200003 provided initial use cases and requirements for content distribution network (CDN) interconnection between two CDN providers via cache-based unicast delivery method. ATIS Standard ATIS-0200004 developed use cases and requirements for content distribution via multicast-based delivery. This standard, ATIS-0200005, extends the use cases and requirements for an environment involving multiple CDN providers joining together to form a CDN federation. The interconnection life-cycle use cases and requirements developed in the previous two ATIS standards are re-examined for the impact arising from a federation of multiple CDN providers. Additional emphasis is placed on the interconnection domain functionality such that guidance on the eventual development of network-network interconnect (NNI) architectures and supporting protocol requirements can be derived.

URI: <http://www.atis.org/docstore/product.aspx?id=27860>



- **ATIS-0200011:** This document extends previous ATIS work on multicast-based content delivery methods to mobile end user devices. Three use cases describe potential situations where such devices can receive multicast-based broadcasts of specific live events/video content via the 3GPP Evolved Multimedia Broadcast Multicast System (eMBMS). Delivery processes, assumptions, content delivery network interconnection implications and supporting requirements are also provided.

URI: <https://www.atis.org/docstore/product.aspx?id=28155>

Table 18-2 provides an analysis of ITU-T SG11 deliverables.

**Table 18-2 – Analysis of ATIS deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b> | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|----------------------------|-------------------------------|---------------------|--------------------------------|-----------------------------------|---------------|
| <b>Fundamental</b>            |                            |                               |                     |                                |                                   |               |
| <b>Cloud service category</b> | ATIS-0200005               | ATIS-0200006                  |                     |                                |                                   |               |
| <b>Security</b>               |                            |                               |                     |                                |                                   |               |
| <b>Management</b>             |                            | ATIS-0200008                  |                     |                                |                                   |               |
| <b>Inter-cloud, CSB</b>       |                            |                               |                     |                                |                                   | ATIS-0200009  |
| <b>SLA, metering</b>          |                            |                               |                     |                                |                                   |               |
| <b>Testing</b>                |                            |                               |                     |                                |                                   |               |
| <b>Others</b>                 |                            | ATIS-0200010,<br>ATIS-0200011 |                     |                                |                                   |               |

## 19 Broadband Forum

Table 19-1 provides a list of Broadband Forum deliverables associated with cloud computing.

**Table 19-1 – Broadband Forum deliverables**

| <b>Title of deliverable</b>  | <b>Current status</b> | <b>Starting date</b> | <b>Target date</b> |
|--|-----------------------|----------------------|--------------------|
| <b>TR-317</b> , Network Enhanced Residential Gateway (NERG)  | Published             |                      | 06/2016            |
| <b>TR-328</b> , Virtual Business Gateway   | Published             | 09/2013              | 06/2017            |
| <b>TR-345</b> , Broadband Network Gateway and Network Function Virtualization                            | Published             |                      | 10/2016            |
| <b>WT-359</b> , A Framework for Virtualization   | Published             |                      | 10/2016            |
| <b>TR-384</b> , Cloud based Central Office Architectural Framework (CloudCO)                             | Published             | 09/2016              | 01/2018            |
| <b>WT-411</b> , Functional module Interface definitions  | Draft                 | 09/2017              | 03/2019            |
| <b>WT-412</b> , Test cases and application notes for Cloud CO system (collaborating with Open Broadband) | Draft                 | 05/2017              | 05/2018            |
| <b>WT-413</b> , SDN Management and Control Interfaces for CloudCO Network Functions                      | Draft                 | 09/2017              | 05/2018            |

**Table 19-1 – Broadband Forum deliverables**

| Title of deliverable                     | Current status | Starting date | Target date |
|--|----------------|---------------|-------------|
| TR-416, CloudCO: Use Cases and Scenarios | Published      | 09/2016       | 05/2018     |

- **TR-317:** Network Enhanced Residential Gateway. This document specifies the network enhanced residential gateway (NERG) architecture. NERG consists in shifting some of the functionality of a residential gateway (RG), as defined in TR-124 to the operator's network.  
URI: <https://www.broadband-forum.org/technical/download/TR-317.pdf>
- **TR-328:** Virtual Business Gateway. This technical report specifies architecture and requirements for the virtual business gateway. The virtual business gateway architecture supports the migration of functionalities running on a business gateway to the network service provider's infrastructure to enable network-based features and services. Such migration is expected to simplify the deployment and management of the network and business services.  
URI: <https://www.broadband-forum.org/technical/download/TR-328.pdf>
- **TR-345:** This technical report describes how virtualized network functions (VNFs) and their supporting network function virtualization infrastructure (NFVI) can be integrated with these Broadband Forum architectures. This includes scenarios where NFVI is connected directly to a TR-101 access network and also where VNFs are deployed behind an MS-BNG as part of a service graph.  
URI: <https://www.broadband-forum.org/technical/download/TR-345.pdf>
- **TR-359:** A Framework for Virtualization. This document significantly enhances the architectural modelling of the management and control of the multi-service broadband network (MSBN). This document combined with TR-384 provides foundational underpinning of BBF work.  
URI: <https://www.broadband-forum.org/technical/download/TR-359.pdf>
- **TR-384:** Cloud-based Central Office (CloudCO) Reference Architectural Framework. This document specifies the recasting of a central office hosting infrastructure utilizing SDN, NFV and cloud technologies and aligned with the Forum's Open Broadband (OB) vision. CloudCO enables significantly faster and more efficient provisioning of new cloud-based services to provide rapid availability of new revenue generating services. Collectively the transformational nature of the CloudCO structure and defined functions facilitate choice, adaptability, migration/coexistence and implementation with 'Open Source' to enable agility and a differentiation at the functional level.  
URI: <https://www.broadband-forum.org/technical/download/TR-384.pdf>
- **WT-411:** Definition of interfaces between Cloud CO functional modules. It defines the interfaces between the functional modules in the Cloud CO architectural framework, as well as the Cloud CO northbound API. Network transport protocols, the data models, schemas or APIs that are signalled across them will be defined as well. Existing open interface works, as described in standards and open source work is being leveraged as much as possible.
- **WT-412:** Test Cases for Cloud CO Applications. This work defines test cases for Cloud CO applications. Cloud CO scenarios are described in Cloud CO application notes. The Cloud CO application notes will detail how a certain service is instantiated, maintained and consumed across the Cloud CO architecture. The test cases will be consumed by the Open Broadband Labs, effectively validating the Cloud CO application note.

- **WT-413:** SDN Management and Control Interfaces for CloudCO Network Functions. This work primarily enables the migration from SNMP/MIB towards NETCONF/YANG interfaces and potentially other protocols to exercise not only traditional FCAPS management functions but also fine grained flow control across VNFs and physical network functions (PNFs) network service graphs. This is an essential step towards software networking introduction, automation and orchestration of PNFs and VNFs in a Cloud CO type of architecture. The development of this Working Text shall also shape the thinking on the way Cloud CO interfaces, especially for VNFs, are modelled and the opportunity to reuse/extend existing YANG work for that.
- **WT-416:** CloudCO Use Cases and Scenarios. This Working Text complements the CloudCO architectural framework specified in TR-384 by describing existing broadband service scenarios supported by the CloudCO architectural framework as well the use cases that can be established using this CloudCO architectural framework.

Table 19-2 provides an analysis of Broadband Forum deliverables.

**Table 19-2 – Analysis of Broadband Forum deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b> | <b>Architecture</b> | <b>API, interface, profile</b> | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|----------------------------|-------------------------------|---------------------|--------------------------------|-----------------------------------|---------------|
| <b>Fundamental</b>            | TR-359                     | TR-317, TR-328                |                     |                                |                                   |               |
| <b>Cloud service category</b> |                            | WT-416                        | TR-384              | WT-411                         |                                   |               |
| <b>Security</b>               |                            |                               |                     |                                |                                   |               |
| <b>Management</b>             |                            |                               |                     | WT-413                         |                                   |               |
| <b>Inter-cloud, CSB</b>       |                            |                               |                     |                                |                                   |               |
| <b>SLA, metering</b>          |                            |                               |                     |                                |                                   |               |
| <b>Testing</b>                |                            | WT-412                        |                     |                                |                                   |               |
| <b>Others</b>                 |                            |                               | TR-345              |                                |                                   |               |

## 20 Metro Ethernet Forum

Table 20-1 provides a list of Metro Ethernet Forum deliverables associated with cloud computing.

**Table 20-1 – Metro Ethernet Forum deliverables**

| <b>Title of deliverable</b>                                      | <b>Current status</b> | <b>Starting date</b> | <b>Target date</b> |
|--|-----------------------|----------------------|--------------------|
| Carrier Ethernet Services for Cloud Use Cases                    | Working Drafts        | 03/2012              | 04/2014            |
| Carrier Ethernet Services for Cloud Management Interface Profile | Working Drafts        | 03/2012              | 04/2014            |

- **Carrier Ethernet Services for Cloud Use Cases:**
  - includes both single and multiple Ethernet cloud carrier domain cases;
  - Part1: for Cloud Provider Interconnect (CP to CP);
  - Part2: for Enterprise Access to CP.

- **Carrier Ethernet Services for Cloud Management Interface Profile:**
  - identify relevant Protocol Neutral MEF 7.x objects (and attributes);
  - operational use cases and information requirements for CP to ECC management interface;
  - focus on reconfiguration of specific service attributes (e.g., CIR);
  - Phase 1 approach: changes to service attributes occur only when EVC/OVC is inactive or during a maintenance interval;
  - explore scheduled reconfiguration and configuration durations;
  - provide interface operational requirements: number of changes allowed over time (how long change should last); lead time for request fulfilment;
  - describe SLSs for management interactions (performance metrics).

Table 20-2 provides an analysis of Metro Ethernet Forum deliverables.

**Table 20-2 – Analysis of Metro Ethernet Forum deliverables**

|                               | <b>General, definition</b> | <b>Requirements use cases</b>                 | <b>Architecture</b> | <b>API, interface, profile</b>                                   | <b>Data model, format, schema</b> | <b>Others</b> |
|-------------------------------|----------------------------|---|---------------------|--|-----------------------------------|---------------|
| <b>Fundamental</b>            |                            |   |                     |  |                                   |               |
| <b>Cloud service category</b> |                            | Carrier Ethernet Services for Cloud Use Cases |                     |  |                                   |               |
| <b>Security</b>               |                            |   |                     |  |                                   |               |
| <b>Management</b>             |                            |   |                     | Carrier Ethernet Services for Cloud Management Interface Profile |                                   |               |
| <b>Inter-cloud, CSB</b>       |                            |   |                     |  |                                   |               |
| <b>SLA, metering</b>          |                            |   |                     |  |                                   |               |
| <b>Testing</b>                |                            |   |                     |  |                                   |               |
| <b>Others</b>                 |                            |   |                     |  |                                   |               |

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