

## **Question 14/15 – Management and control of transport systems and equipment**

(Continuation of Question 14/15)

### **1 Motivation**

Demands for ever increasing levels of desired transport networking functionality and responsiveness to its range of users' needs continue to rise. This has triggered both evolution, and introduction of new, control and management paradigms (e.g., application of software defined networking (SDN), artificial intelligence/machine learning (AI/ML), virtual network (VN), security, and quantum information technology), with a corresponding increase in variety of control/management interface protocol solutions that may be deployed in transport networks. Transport networks may be vast and complex (e.g., multi-technology/layer, multi-protocol, multi-vendor) and co-existence among control and management paradigms is essential to enable large scale operational integration. Given the underlying transport resources remain the same, independent of the paradigm(s) employed, it is increasingly essential to provide a coherent information model of transport resources to enable interoperability between the different management/control paradigms and solution data models. Such factors will drive the need for the revision of existing Recommendations as well as the development of new Recommendations relevant to the control and management of transport network resources.

Building upon the foundation architectures of transport data plane, including media, and control-management (e.g., automatically switched optical networks (ASON) and SDN) of Q12/15 (transport network architectures), Q10/15 (packet-based transport), Q11/15 (optical transport), and Q13/15 (synchronization), this Question is responsible to develop the specifications for the control and management of transport network resources, encompassing requirements, protocol-neutral Information Models (IM) and protocol-specific Data Model (DM) solutions for common transport functionality and transport technology-specific functionality (e.g., metro transport network (MTN), optical transport network (OTN), Ethernet transport, and MPLS-TP). To ensure coherent specifications and interoperability among the protocol-specific solutions, this Question is also responsible to develop guidelines for deriving protocol-specific solution DMs through pruning and refactoring of the protocol-neutral IMs to ensure coherent DM specifications and their traceability to the protocol-neutral IM. This Question is also responsible to develop the specifications of the architecture and requirements for the data communications network (DCN) encompassing control and management paradigms. These activities will be conducted in close co-operation with related ITU-T Study Groups, TM Forum, IEEE, IETF, ONF, MEF, BBF, and other SDOs as necessary.

Development and propagation of model driven tooling and the adoption of software development methodologies to enhance the creation of recommendations that include information and data models.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility: G.774-series, G.784, G.874, G.875, G.7710/Y.1701, G.7711/Y.1702, G.7712/Y.1703, G.7713/Y.1704-series, G.7714/Y.1705-series, G.7715/Y.1706-series, G.7716/Y.1707, G.7718/Y.1709, G.7718.1/Y.1709.1, G.7721 series, G.8051/Y.1345, G.8052/Y.1346 series, G.8151/Y.1374, G.8152/Y.1375 series, and I.752.

### **2 Question**

- What requirements, information models, and data models must be specified to enable control and management of transport technology specific resources including support for OTN, MTN, Ethernet, MPLS-TP, support management of transport network using the various control and management paradigms?
- How can the management of the transport network make best use of cloud computing?

- What requirements, information models, and data models must be specified to support efficient and optimized control and management of multi-technology/layer and multi-domain transport network resources, including synchronization, abstraction and virtualization.
- What requirements, information models, and data models must be specified to enable the use of AI/ML techniques applied to the management and control of the transport network?
- What requirements, information models, and data models must be specified to enable the management and control of security techniques applied to the transport network?
- What requirements, information models, and data models must be specified to enable the management and control of quantum information technology as applied to the transport network?
- What requirements, information models, and data models must be specified to use Quantum Information Technology to manage and control the transport network?
- What requirements, information models, and data models must be specified to manage the management and control (MC) components?
- What is the interaction of the transport network management and IMT-2020/5G network management?
- What management and control requirements and protocol-neutral and protocol-specific solutions should be specified to enable power efficiency of the transport equipment in the network without decreasing the reliability and availability of the network?
- What control requirements and protocol-neutral solutions must be specified to enable efficient and effective signalling, routing, and automatic discovery of transport networks?
- Study items include, but are not limited to:
  - ASON and SDN control component architecture-based protocol-neutral requirements and associated protocol-neutral and protocol-specific solutions (encompassing both technology-neutral and technology-specific aspects).
  - Management aspects of control planes, including interaction between a control plane and a management plane.
  - Management aspects of transport planes, including management support of the additional flexibility within the evolving transport network.
  - Generic control and management aspects for transport resources.
  - Multi-layer transport network, including synchronization.
  - Management of AI/ML techniques as applied to a transport network.
  - Management of security as applied to a transport network.
  - Management and use of Quantum Information Technology in transport networks.
  - Use of cloud computing infrastructure to support a management and control system (MCS)
  - Control and management aspects for specific technologies and their applications (such as protection); e.g.:
    - Optical transport network resources (encompassing photonic networking evolution).
    - Ethernet transport resources.
    - MPLS-TP transport network resources.
    - Frequency synchronization and precision time synchronization network resources.
    - Management of data communication capability.

- Power management of the equipment for energy saving.
- MTN

### 3 Tasks

Tasks include, but are not limited to:

– Active list:

- Revise Recommendation G.874.
- Revise Recommendation G.875 (ex. G.874.1) OTN management requirements and protocol-neutral information model.
- New Recommendation G.875.x "OTN Data Model".
- New Recommendation G.876 "Media management".
- Revise Recommendation G.7710/Y.1701, Common Management Requirements, including requirements for power saving modes and synchronization.
- Revise Recommendation G.7711/Y.1702, Generic Protocol-Neutral Information Model for Transport Resources.
- New Recommendation G.7711.x/Y.1702.x "Generic Data Model".
- Revise Recommendation G.7712/Y.1703, Data Communication Network.
- Revise Recommendations G.7714/Y.1705 and G.7714.1/Y.1705.1, Auto Discovery.
- Revise Recommendations G.7716/Y.1707, Architecture of control plane operations.
- Revise Recommendations G.7718/Y.1709 and G.7719 (ex. G.7718.1/Y.1709.1) Management requirements and information model for MC components and functions.
- Revise Recommendation G.8051/Y.1345 "Management aspects of the Ethernet transport network element".
- Revise Recommendation G.8052/Y.1346 "Protocol-neutral management information model for the Ethernet transport network element".
- New Recommendation G.8052.x/Y.1346.x "Management data model for the Ethernet transport network element".
- Revise Recommendation G.8151/Y.1374 "Management aspects of the MPLS-TP network element".
- Revise Recommendation G.8152/Y.1375 "Protocol-neutral management information model for the MPLS-TP network element".
- New Recommendation G.8152.x/Y.1375.x "Management data model for the MPLS-TP network element".
- Revise Recommendations G.7721 "Requirement and information model for synchronization management"
- New Recommendation G.7721.1 "Data model for synchronization management"
- New Recommendation G.8350 "Management requirement and information model for MTN"

– Maintenance list:

- Recommendations in the G.774 series
- Recommendation G.784
- Recommendations G.7713/Y.1704 and G.7713.x/Y.1704.x series, Distributed Connection Management

- Recommendations G.7715/Y.1706 and G.7715.x series, ASON Routing Requirements

An up-to-date status of work under this Question is contained in the SG15 work programme ([https://www.itu.int/ITU-T/workprog/wp\\_search.aspx?sg=15](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sg=15)).

## **4 Relationships**

### **Recommendations:**

- M series (ITU-T SG2), G.800, G.805, G.806, G.808 series, G.783, G.798, G.807, G.873 series, G.7044, G.7701, G.7702, G.8010, G.8013, G.8021, G.8031, G.8032, G.8110.1, G.8113.1, G.8113.2, G.8121 series, G.8131, G.8132, G.8080 and Y.1563, AI/ML, and Quantum recommendations.

### **Questions:**

- Q2/15, Q4/15, Q6/15, Q10/15, Q11/15, Q12/15 and Q13/15

### **Study Groups:**

- ITU-T SG2 on telecommunication management, including AI/ML
- ITU-T SG12 for performance, QoS, and QoE
- ITU-T SG13 on SDN, IMT-2020, and AI/ML
- ITU-T SG17 on security, including Quantum
- ITU-T SG20 on IoT
- ITU-R on transport management related issues

### **Other bodies:**

- Broadband Forum (BBF)
- ETSI ISGs, including but not limited to, NFV, SAI, ENI, ZSM
- IEEE 802 on Ethernet management
- IEEE 1588 on synchronization management
- IETF Working Groups in operations and management, transport, and routing
- MEF on Ethernet management
- OIF (Networking & Operations and Carrier WGs)
- OMG on UML
- ONF on SDN and generic information model
- TM Forum on network-level management interface specifications (MTNM, MTOSI, TIP, and ZOOM aspects)
- W3C on XML