Question 12/15 – Transport network architectures

(Continuation of Question 12/15)

1 Motivation

Transport network architecture Recommendations (G.800, G.805, G.807, and G.809) and technology specific network architecture Recommendations (G.803, G.872, G.8310, G.8010, G.8110, G.8110.1 and I.326) have been established and are widely used. As operating experience is gained with employing current transport network technologies and new technologies evolve (e.g., variable size packets, high-speed transport networks), new Recommendations, or enhancements to existing Recommendations need to be developed, in close cooperation with the standardization activities on transport network systems and equipment. The operational aspects of networks, including the use of ASON or SDN for restoration, are becoming more important. The operational aspects of combined packet and circuit switched optical networks should be considered to ensure that they are addressed in a way that is architecturally sound and minimizes divergent approaches.

Software defined networking (SDN) is an architectural approach to managing transport network resources. Its architecture needs to be understood in the context of the management control continuum that includes the architecture of the automatically switched optical network (G.7703). Commonality and differences with existing architectures requires study as it is applied to various transport layers. Requirements for enhanced control interfaces to and within the transport network, for example to support network slicing, need to be studied. Interfaces to configure and control programmable hardware are needed. Interfaces that enable clients to request network services beyond basic connectivity are needed.

Artificial intelligence (AI) and machine learning (ML) are emerging technologies that may benefit transport network operators by increasing the degree of automation, the operating efficiency and the flexibility of transport network operation and resource utilization. Work on AI/ML is ongoing in many other organizations with whom we collaborate, we should provide analysis and guidance on the applicability of AI/ML to the transport network for use in SG15 and in other organizations. There are two broadly distinct aspects to this work: the potential benefits AI/ML technologies might provide to the transport network; and the support (i.e., the interfaces) that those applications may need from the transport network.

As compute and storage capabilities evolve, they may impact network architecture and that should be studied (e.g., a distributed SDN controller, data centre connectivity, the use of computing hardware to flexibly provide network functions such as forwarding and adaptation).

The continued evolution of transport networks and the services they support such as, the Internet, IMT-2020/5G, datacentre-based services, and higher definition video, have resulted in drastic changes in the demands placed on transport networks. The services supported by the transport network are critical to modern society; as a key component of society's infrastructure the security of the transport network is an important consideration. Transport networks need to continuously evolve to meet these changing demands and provide a converged transport network. This rapidly evolving situation led us to recognise the need for a coordination and communication activity among the involved Questions (primarily Questions 2, 6, 10, 11, 12, 13, and 14/15) in order to avoid duplication of work and facilitate the most efficient completion of the work. Also, a standardization work plan for new optical transport network activities (the optical transport networks and technology standardization work plan, OTNT SWP) needs to be maintained. In addition, some general aspects such as terminology, need to be captured.

The following major Recommendations, in force at the time of approval of his Question, fall under its responsibility: G.800, G.803, G.805, G.809, G.807, G.872, G.8310, G.7701, G.7702, G.7703, G.8010/Y.1306, G.8110/Y.1370, G.8110.1/Y.1370.1 and I.326.

2 Question

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

- refine and enhance the specification of transport network architecture, including enhancements to G.800, G.872, G.8310, G.7701, G.7702, G.7703, G.8010, G.8110 and G.8110.1, including use of ASON or SDN for network restoration, operational aspects and implications of the evolution of photonic technologies to support additional flexibility within the transport network?
- study architectures that use G.7701 components
- explore the relationship between the transport network architecture and applications such as computing and storage?
- explore the relationship between the architecture of MC systems and the evolving compute and storage environment?
- explore the implications of multi-technology and multi-layer integration, the potential for network simplification and the consequent impact on the network architecture and existing standards?
- develop the architecture of media networks as the manner in which information layers use them is evolving?
- explore the relationship among functional architectures developed in Q12/15 and the information models developed in Q14/15?
- explore enhancements to the architecture of transport networks to address emerging requirements of IMT-2020?
- Specify requirements for enhanced control interfaces to and within the transport network. Interfaces to configure and control programmable hardware are needed. Consider impacts of AI and ML on those interfaces. For example, are new parameters to existing interfaces required to support AI/ML applications; are new interfaces required to support them?
- What, if anything, needs to be changed architecturally to allow AI/ML applications to be used in the operation of the transport network?
- Define interfaces that enable clients to request network services beyond basic connectivity?
- Reflect synchronization (as studied in Q13/15) in architecture Recommendations?
- Architecture to support the interaction between transport network management and IMT-2020/5G network management?
- Explore the security aspects of the control components of the transport network's control and management architecture
- The security aspects of management and control, and applications using it including resource allocation aspects

– Study items include, but are not limited to:

- Transport networks that offer circuit switching capability including photonic switching technology.
- Transport networks that offer packet switching capability
- Converged multi-technology and multi-layer transport networks.
- The architecture of the media network and new ways that information layers can be supported over media.
- Support of point-to-multipoint and multipoint-to-multipoint transport services.

- The dynamic behaviour of resources in the network (e.g., link speed change).
- The SDN architectural approach and its role in providing more flexible control.
- The architectural implications, if any, of providing support for the use of AI/ML technology for operational enhancements to the transport network, excluding AI/ML algorithm development.
- Use of ASON or SDN for network restoration
- What enhancements to OTNT SWP or what new Recommendation(s) or mechanisms are necessary to capture, within this framework, new or evolving aspects of optical transport networks, their general terminology, and reliability/availability characteristics?

3 Tasks

Tasks include, but are not limited to:

– Maintenance of Recommendations I.326, G.803, G.805, G.8010, G.8110, and G.8110.1.

– Refinement and enhancement of Recommendations G.800, G.807, G.8310, G.872, G.7701, G.7702, and G.7703.

– Investigate the use of ASON or SDN for network restoration and clarify the relationship between protection switching and restoration techniques.

– Use of AI and ML in the transport network.

– Facilitate discussion among questions during SG15 meetings to coordinate work on optical transport, including the harmonization of terminology.

– Develop, maintain, and regularly distribute a work plan that documents the work and time schedules of all major new optical transport network activities (OTNT SWP).

– Examine the application of existing SG17 security related Recommendations to transport network with a focus on architectural aspects.

– Facilitate discussion among questions during SG15 meetings to coordinate work on security.

– Exploring the relationship between the architecture of MC systems and the evolving compute and storage environment

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?sp=17&q=12/15).

4 Relationships

Recommendations:

– AI and ML application Recommendations (e.g., Y.3172)

Questions:

– Q2/15, Q6/15, Q10/15, Q11/15, Q13/15 and Q14/15

Study Groups:

– ITU-T SG2 on telecommunication management

– ITU-T SG13 working on SDN, AI & ML, and IMT-2020/5G

– JCA-IMT-2020 on 5G

– ITU-T SG20 requirements from IoT

– ITU-T SG17

Other bodies:

– IETF on Control Plane and security Issues
– IEEE 802 on Ethernet Issues
– OIF on optical control plane and flex Ethernet and security
– ONF on SDN and security
– ETSI ISG NFV, ISG ENI, ISG SAI
– 3GPP on IMT-2020/5G
– BBF on IMT-2020/5G