

Question 11/15 – Signal structures, interfaces, equipment functions, protection and interworking for optical transport networks

(Continuation of Question 11/15)

1 Motivation

The explosive growth of the Internet and other packet-based traffic including data centre connectivity, wireless networks such as IMT-2020/5G and new high-definition video formats are the key drivers for the development of new transport network equipment and network node interface (NNI) related standards for optical networks. This rapidly growing traffic will be supported by the anticipated standardization of new Ethernet interfaces for rates beyond 400 Gbit/s, including the range of logical interfaces provided by FlexE. In addition, the development of optical transport network (OTN) specifications provides the ability to dramatically increase the bandwidth, and thus traffic carrying capacity, of optical networks. Furthermore, ODUflex has enabled efficient data traffic transport over OTN, and flexible OTN interfaces with FlexO have enabled more efficient use of physical interfaces for higher bit rate clients. Circuit-based transport networks must also continue to provide the operation, administration and maintenance (OAM) capabilities that are essential to enabling carrier-class performance. Moreover, information security is a growing concern, and transport networks must be enhanced in order to support this application need. In order to ensure that circuit-based transport networks based on these new technologies maintain carrier-class performance, it is essential that network protection techniques continue to evolve and relevant Recommendations are updated. These and other enhanced capabilities, as well as the need to support any new management capabilities, have resulted in a need for the revision of existing equipment Recommendations as well as the development of new Recommendations for transport equipment. Increased utilization of OTN technology for a wider set of applications has driven the demand for support of new client signals, including high speed Ethernet, storage area network (SAN) interfaces (such as fibre channel flows), as well as finer granularity channelization. Further work is expected to enhance the OTN Recommendations to carry future Ethernet and other data client interfaces. Further work to define new transport technology related to IMT-2020/5G is also expected.

The area of responsibility under this Question includes:

- Specification of transport signal structures, (including any forward error correction codes used with those signal structures), such as OTN (including SyncO and FlexO) and metro transport network (MTN).
- Specification of adaptations of client signals into server transport layers.
- Specification of interface characteristics for the transport and supervision of client signals.
- Specification of all protection switching processes related to OTN and MTN networks.
- Specification of all equipment functions, supervision related to the OTN and MTN networks including equipment functions related to access networks
- Specification of fundamental transmission parameters and determination of the effect of various transmission impairments. This includes transmission error and availability performance objectives and allocation methods for efficient design of digital networks and associated transmission equipment.
- Specification of survivability capabilities and development of a strategy for multi-domain and/or multi-layer survivability interactions (including those where different transport technologies are used at different layers).
- Investigation of IMT-2020/5G mobile front haul and backhaul transport network requirements.

- Investigation of power saving mechanisms for transport network equipment in the wider context of ICTs (Information and Communications Technologies).
- Investigation of how transport networks can be enhanced to support security

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility: G.703, G.704, G.707/Y.1322, G.709/Y.1331, G.709.1/Y.1331.1, G.709.2/Y.1331.2, G.709.3/Y.1331.3, G.709.4, G.7041/Y.1303, G.7042/Y.1305, G.7043/Y.1343, G.7044/Y.1347, G.8023, G.8040/Y.1340, X.85/Y.1321, X.86/Y.1323, G.705, G.783, G.798, G.798.1, G.806, G.808, G.808.1, G.808.2, G.808.3, G.841, G.842, G.873.1, G.873.2, G.873.3, G.821, G.826, G.827, G.828, G.829, G.8201, and G.8312.

2 Question

- Study items to be considered include, but are not limited to:
 - What enhancements should be made to the existing NNI related Recommendations or what new Recommendations should be developed:
 - for the networks employing Optical Transport Network (OTN) to accommodate new Ethernet clients?
 - to enable OTN interfaces at rates beyond 400 Gbit/s such that they can be carried over single or multiple wavelength interfaces?
 - to enable OTN interfaces with optical lane rates of 100 Gbit/s in 100G, 200G, 400G and (future) B400G FlexO interfaces?
 - for OTN and MTN support of the radio fronthaul / backhaul networks in line with IMT2020/5G mobile, network virtualization, high-definition video (4K, etc.)?
 - to reflect additional transport network applications and interworking scenarios?
 - for networks optimized for transport of packet data?
 - for WAN transport of Optical Interworking Forum (OIF) flexible Ethernet (FlexE) over OTN for data centre connectivity and other applications?
 - Clarification of generic OAM principles for circuit-switched networks.
 - Clarification of generic OAM principles under interworking of different network technologies. This includes network interworking and service interworking scenarios.
 - What additional protection mechanisms for transport equipment should be recommended to provide enhanced survivability capabilities and a cohesive strategy for multi-domain and/or multi-layer survivability interactions?
 - Network protection Recommendations to provide enhanced survivability capabilities and a cohesive strategy for multi-layer survivability interactions.
 - Enhancements required to the network protection Recommendations in order to meet the needs, including support of disaster recovery, of:
 - Access networks
 - Data Centre networks
 - Cloud computing
 - Mobile networks including IMT-2020/5G
 - Future networks
 - What transport equipment functions must be specified to enable compatible transport equipment in inter-office and long-distance networks, including evolution to the optical transport network?

- What transmission error performance parameters and objectives need to be recommended?
- What enhancements should be made to the existing equipment function Recommendations or what new Recommendations should be developed in order to meet the needs, including synchronization of:
 - Data Centre networks
 - Cloud computing
 - IMT-2020/5G
 - Future networks
- What should be specified for the definition of new transport networks, while ensuring transverse compatibility and interworking with previously specified technologies?
- What enhancements to existing Recommendations are required to provide energy savings directly or indirectly in Information and Communication Technologies (ICTs) or in other industries? What enhancements to developing or new Recommendations are required to provide such energy savings?
- What new Recommendations or enhancements to existing Recommendations are required to provide secure transport networks?

3 Tasks

Tasks include, but are not limited to:

- Development of relevant Recommendations related to IMT-2020/5G transport (including G.8312, G.8321, and G.8331)
- Enhancement to relevant Recommendations for transport networks (including G.709, G.709.x, G.798, and G.8023) to increase network transport capacity and accommodate greater than 400 Gbit/s Ethernet services.
- Enhancement to Recommendations for transport networks to support access applications, including IMT-2020/5G mobile radio fronthaul / backhaul applications.
- Enhancements to OTN protection mechanisms.
- Clarification of relationships between survivability function of circuit-based transport and survivability function in other layers or other transport technologies (e.g., SDH, OTN, etc.).
- Clarification of interworking between different protection schemes within a layer network (e.g., interworking linear and ring protection).
- Maintain and update, as necessary, the error performance Recommendations G.821, G.826, G.827, G.828, G.829 and G.8201.
- Maintain and update, as necessary, PDH, SDH, OTN, FlexO and LAPS Recommendations.
- Maintain and update, as necessary, GFP, LCAS, and HAO related Recommendations.
- Development of new Recommendation G.osu
- Further development of the OTN Interface Recommendations (including selection of new forward error correction codes based on emerging application needs).

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=11/15).

4 Relationships

Recommendations:

- G.693, G.694, G.695, G.698.x, G.784, G.800, G.805, G.807, G.825, G.872, G.874, G.957, G.959.1, G.993.x, G.7710, G.7712, G.8010, G.8021, G.8080, G.8110, G.8110.1, G.8121, G.8251, G.8261, G.8262, G.8264, G.8310, and G.8350

Questions:

- Q2/15, Q4/15, Q6/15, Q10/15, Q12/15, Q13/15, and Q14/15

Study Groups:

- ITU-T SG2 on network maintenance
- ITU-T SG13 responsible for future networks, with focus on IMT-2020, cloud computing and trusted network infrastructure
- ITU-T SG17 on security

Other bodies:

- MEF on Ethernet services and Ethernet interfaces, Layer 1 services
- IEEE 802.1, 802.3 on Ethernet
- T11 on SAN flows transport
- Optical Interworking Forum (OIF) on flexible Ethernet (FlexE) and optical interfaces that leverage FlexO frame formats
- Broadband Forum (BBF)