Question 6/15 – Characteristics of optical components, subsystems and systems for optical transport networks

(Continuation of Question 6/15 and Question 7/15)

1 Motivation

Optical fibre networks are deployed in telecommunication systems worldwide. Structural reforms leading to increased privatisation of telecommunications networks create an operating environment requiring optical networking and interconnection among different carriers.

Developments are being fuelled by the need for improved network efficiency, customer demand for ever higher bit rate data services, high-speed Internet access, and other innovative services.

This leads to a push for higher bit-rate (Terabit/s) optical transport systems in the intra-office, inter-office, metro and long-distance networks of the various network operators.

The Question defines specifications needed for physical layer interfaces of point-to-point and WDM systems, to enable the evolution of optical networks to support the ubiquitous availability of next-generation high-bandwidth services. To the greatest extent possible, these specifications should enable transverse compatibility (black-box and/or black-link) in a multi-vendor, multi-network-operator environment.

Furthermore, the increasing complexity of optical networks has brought about an increasing diversity of active, passive and hybrid or dynamic/adaptive optical components and subsystems with functions differing with the application. This Question also addresses the high-level need for specifications expressed by the system Recommendations and network operators. It serves as an interface to the component level standards generated outside of ITU-T in organizations such as IEC.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility: G.640, G.661, G.662, G.663, G.664, G.665, G.666, G.667, G.671, G.672, G.680, G.691, G.692, G.693, G.694.1, G.694.2, G.695, G.696.1, G.697, G.698.1, G.698.2, G.698.3, G.698.4, G.955, G.957, G.959.1 and G.911.

2 Question

– What system aspects and physical layer characteristics are necessary to enable longitudinally compatible and transversely compatible optical systems in intra-office, inter-office, metro and long-distance networks?

– What components aspects and desirable characteristics need to be specified to support intra-office, inter-office, metro and long-distance networks, and additionally, local access networks and submarine networks?

– What enhancements to existing draft or published Recommendations and what new Recommendations are necessary to specify interfaces for optical transport systems, employing both direct detect and coherent technologies, with bit rates at 25 Gbit/s and above, and, if necessary, taking account of the flexible DWDM grid?

– What systems and physical layer considerations are necessary for optical transport systems optimized for new applications for example metro applications, including mobile fronthaul and backhaul?

– What enhancements should be made to existing draft or published Recommendations to reflect technological developments, further reduce the cost and power consumption of optical fibre communication systems?

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

– General considerations for optical systems used to transport OTN, Ethernet, CPRI and other protocols using several types of single-mode fibre. Statistical and semi-statistical power budget approaches:
  - Specifications to enable transverse and longitudinal compatibility in single-channel and multichannel optical systems.
  - System models, reference configurations and reference points to support optical interface specification methodologies.
  - Specifications of interfaces inside a DWDM link, taking the flexible grid into account.
  - Evaluation of the quality of an optical channel end-to end enabling routing decisions in all optical networks (e.g., transmitter's quality metric, such as error vector magnitude, accumulated effects of degradations, transients, etc.).
  - Physical layer architectures including new technologies to increase optical transmission systems capacity.
  - Linear and nonlinear propagation effects.
  - Performance monitoring.
  - Application of forward error correction (FEC) techniques to terrestrial optical transmission systems (e.g., to enhance system margin or to relax optical parameter specifications).
  - Enhanced statistical design approaches.
  - Availability/reliability aspects of optical systems.
– Further study items:
  - Active devices and sub-systems such as optical amplifiers (OAs), including parameter definitions and measurement, classification of devices and sub-systems, optical nonlinearities, polarization, dispersion, noise and transients.
  - Passive components such as splices and connectors, attenuators and terminators, M-by-N branching components (such as splitters and combiners), wavelength optical multiplexers and demultiplexers, optical filters, optical isolators and circulators and dispersion compensators.
  - Worst-case transmission parameter values (for all environments and to end-of-life) for passive components in digital applications.
  - Components and subsystems for use in bi-directional transmission systems on a single fibre.
  - Specification of fixed optical add/drop multiplexers (OADMs) and re-configurable optical add/drop multiplexers (ROADMs) and optical cross-connects (OXCs).
  - Safety aspects of considered components, including aspects of operation at high optical power levels.

3 Tasks

Tasks include, but are not limited to:

– Enhance Recommendations G.640, G.661, G.662, G.663, G.664, G.665, G.666, G.667, G.671, G.672, G.680, G.691, G.692, G.693, G.694.1, G.694.2, G.695, G.696.1, G.697, G.698.1, G.698.2, G.698.3, G.698.4, G.955, G.957 and G.959.1.

– Develop new Recommendations, Supplements and/or combine existing Recommendations from progress on the above study points.

– Enhance the text of G Suppl.39.

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).

4 Relationships

Recommendations:

– G.6xx and G.9xx Series

Questions:

– Q2/15, Q5/15, Q16/15, Q8/15, Q10/15, Q11/15, Q12/15, Q13/15, Q14/15

Study Groups:

– ITU-T SG5

– ITU-T SG13

– ITU-T SG12 network performance objectives

Other bodies:

– IEC SC86B on optical passive components

– IEC SC86C on active components and dynamic components including all types of optical amplifiers, on system measurement test methods and on optical amplifier test methods

– IEC TC76 on laser safety and aspects of safe laser operation

– OIF on optical systems interfaces

– IEEE 802.3 on optical systems interfaces

– IETF CCAMP working group