

## **Question 2/15 – Optical systems for fibre access networks**

(Continuation of Question 2/15)

### **1 Motivation**

Recommendations for point-to-point and point-to-multi point optical access systems, such as the G-PON (G.984 series), XG-PON (G.987 series), XGS-PON (G.9807 series), and NG-PON2 (G.989 series), have allowed telecommunications manufacturers to develop inter-operable optical access equipment, by which Fibre To The X (FTTx) has become reality. Practical experience with the design and deployment will necessitate revision of these Recommendations to include, for example, enhanced services, better interoperability, higher split ratios, longer reach, and increased capacity.

To provide new features in optical access, such as wavelength division multiple access (WDMA) and hybrid xDMA/yDMA systems, will necessitate the development of new Recommendations.

Fibre access systems need to support a range of service capabilities at the edge. Wireless, wireline and fibre (e.g., G.65x and Plastic Optical Fibre (POF)) will be needed. Economies are needed for fibre access deployment to become prevalent as a mass-market solution. Demand will be driven by factors such as: the ability to carry interactive and broadcast services (e.g. residential video, HDTV, AR, VR), managed bandwidth to multiple Internet Service Providers (ISPs), together with higher quality of service and improved resilience. Solutions are required for a wide range of market segments and situations including: business, small-to-medium-enterprise, small-office-home-office, residential, mobile backhaul and fronthaul, as well as green field and network upgrade.

To support current and/or future wireless/mobile services, optical access systems are expected to provide flexible broadband communication channels for plural base stations/remote units in some cases, and to support digital and/or analogue transmission of Radio Frequency signals for remote base stations/remote units in some other cases. Optical access systems are also expected to coordinate with external systems. This is to facilitate end-to-end service provisioning. Necessary information exchange between an optical access system and an external system should be considered to improve network performance. Such coordination and control are key to low-latency services in the IMT-2020/5G era.

The various optical access technologies are expected to serve a wider range of networking applications that are not access networks. In these new application areas, fibre technology brings many advantages compared to current means. By the same token, these new applications can present new requirements for the technology, such as revised loss budgets, fibre reach, topology, and media access control. Coordination with relevant other groups (e.g., Q3/15) and joint projects can help to leverage the existing technology for these new applications. Demand for dedicated GbE, 10GbE, and higher-speed Ethernet services initially to business users is increasing. New techniques are needed to increase performance and reduce costs for both dedicated and shared bearer services. Both access and metro networks should be considered when offering such access services, because currently, access nodes are sometimes bypassed to minimize overall network cost. Both Point-to-point and point-to-multi-point solutions will be considered.

Integration of all services onto a single backhaul fibre network is an important economic consideration for network operators.

To be successful, Q2/15 needs to harmonize with other bodies which have a strong optical access industry role, such as IEEE and IEC. The following major Recommendations in force fall under its responsibility: G.981, G.982, G.983 series, G.984 series, G.985, G.986, G.987 series, G.988, G.989 series, G.9801, G.9802, G.9803, G.9806, and G.9807 series.

## 2 Question

- What new architecture, technologies and protocols are needed to:
  - Enable next generation PON architecture and technology to offer broader bandwidth as well as improved services and economics in optical access networks?
  - Integrate access and metro/backhaul networks into one seamless optical access and aggregation networks?
  - Allow individual customers on a live legacy PON to be upgraded to higher capacity next generation systems without impacting on other users' traffic?
  - Allow systems to evolve to higher split ratios physically and logically in optical access networks?
  - Improve resiliency in optical access networks?
  - Serve a mixture of optical, copper and radio (broadband) final customer connections to the same optical access system, with simplified remote electronics?
  - Support digital and/or analogue transmission of radio frequency signals for current and future wireless/mobile services?
  - Coordinate optical access systems and external systems in an end-to-end fashion for low-latency services?
  - Support non-access applications of optical access technology through coordination with or joint projects with other groups?
- What enhancements to existing Recommendations are needed to improve interoperability between optical network unit (ONU) and optical line terminal (OLT)?
- What new or enhancements to existing Recommendations are needed to:
  - Provide energy savings directly or indirectly in Information and Communication Technologies (ICTs) or in other industries?
  - Realize mobile fronthaul/backhaul with optical access technologies?
  - optical access network systems and services in the concept of software define network (SDN) / network function virtualization (NFV)?
  - Secure information transmission over optical access systems?
- Study items to be considered include, but are not limited to:
  - Next generation PON architecture and technology.
  - New long-reach access system(s) for access/metro-integrated applications based on WDM access and/or enhanced TDM access technologies.
  - How to specify ONUs for the consumer market?
  - Impact of new component technology on optical access networks.
  - How to ensure the optical systems contribute to the end-end QoS for packet services?
  - How to ensure the maximum service capability for Ethernet and wireless local area network (WLAN) edge networks?
  - How to provide for multimedia and low-latency services?
  - Interoperability and physical interconnect conformance.
  - The definition of access demarcation point, in the light of consumer-owned optical network terminations.
  - Modulation schemes over fibre access.
  - What is the service capacity and requirements outlook for access?

- How to ensure efficient inter-connection between fibre access systems and other technologies?
- How to manage wavelength channels in optical access?
- How to provide coexistence and migration of generations of optical access systems
- How to improve energy savings?
- How to mitigate rogue ONUs?
- How to coordinate with external systems and provide end-to-end services?

### **3 Tasks**

Tasks include, but are not limited to:

- Maintenance and enhancements of G.981, G.982, G.983 series, G.984 series, G.985, G.986, G.987 series, G.988, G.989 series, G.9801, G.9802, G.9803, G.9804, G.9806, and G.9807 series Recommendations and associated Supplements with regard to capacity, interoperability, management and control interfaces, survivability, spectral management, split ratios or other requirements
- Draft one or more new Recommendation series to describe the next generations of optical access systems
- Liaison and co-work with other groups to explore new applications of optical access systems

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=2/15](https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=2/15)).

### **4 Relationships**

#### **Recommendations:**

- None.

#### **Questions:**

- All Questions in SG15.

#### **Study Groups:**

- ITU-T SG2 on management aspects
- ITU-T SG5 on energy consumption and efficiency
- ITU-T SG9 on television and sound transmission
- ITU-T SG13 on Multi-Protocol Label Switching (MPLS) layer characteristics

#### **Other bodies:**

- IEC TC86 and its sub-committees on devices and other topics
- Broadband Forum on network architectures, fibre access, and management
- IETF on MIB
- IEEE 802 on optical access systems, Ethernet and WLAN
- IEEE 1904.1 on service interoperability in ethernet passive optical networks
- ATIS Committee STEP
- O-RAN Alliance WG4