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Optical Transport Networks & Technologies Standardization Work Plan

Issue 13, June 2010

1. General

Optical Transport Networks & Technologies Standardization Work Plan is a living document. It may be updated even between meetings. The latest version can be found at the following URL.

http://www.itu.int/ITU-T/studygroups/com15/otn/

Proposed modifications and comments should be sent to:

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2. Introduction

Today's global communications world has many different definitions for optical transport networks and many different technologies that support them. This has resulted in a number of different Study Groups within the ITU-T, e.g. SG 11, 12, 13, and 15 developing Recommendations related to optical transport. Moreover, other standards development organizations (SDOs), forums and consortia are also active in this area.

Recognising that without a strong coordination effort there is the danger of duplication of work as well as the development of incompatible and non-interoperable standards, WTSA-08 designated Study Group 15 as Lead Study Group on Optical Transport Networks and Technology, with the mandate to:

- study the appropriate core Questions (Question 6, 7, 9, 10, 11, 12, 13, 14 and 15/15),
- define and maintain overall (standards) framework, in collaboration with other SGs and SDOs),
- coordinate, assign and prioritise the studies done by the Study Groups (recognising their mandates) to ensure the development of consistent, complete and timely Recommendations,

Study Group 15 entrusted WP 3/15, under Question 3/15, with the task to manage and carry out the Lead Study Group activities on Optical Transport Networks and Technology. To maintain differentiation from the standardized Optical Transport Network (OTN) based on Recommendation G.872, this Lead Study Group Activity is titled Optical Transport Networks & Technologies (OTNT).

3. Scope

As the mandate of this Lead Study Group role implies, the standards area covered relates to optical transport networks and technologies. The optical transport functions include:

- client adaptation functions
- multiplexing functions

- cross connect and switching functions, including grooming and configuration
- management and control functions
- physical media functions
- network synchronization and distribution functions
- test and measurement functions.

The outcome of the Lead Study Group activities is twofold, consisting of a:

- standardization plan
- work plan,

written as this single document until such time as the distinct pieces warrant splitting it into two.

Apart from taking the Lead Study Group role within the ITU-T, Study Group 15 will also endeavour to cooperate with other relevant organizations, including ATIS, ETSI, , ISO/IEC, IETF, IEEE, MEF, OIF and TIA, etc.

4. Abbreviations

ANSI	American National Standards Institute
ASON	Automatically Switched Optical Network
ASTN	Automatically Switched Transport Network
ATIS	Alliance for Telecommunications Industry Solutions
ETSI	European Telecommunications Standards Institute
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ISO	International Organization for Standardization
MEF	Metro Ethernet Forum
MON	Metropolitan Optical Network
MPLS	Multiprotocol Label Switching
MPLS-TP	MPLS Transport Profile
OIF	Optical Internetworking Forum
OTN	Optical Transport Network
OTNT	Optical Transport Networks & Technologies
SDH	Synchronous Digital Hierarchy
SONET	Synchronous Optical NETwork
TIA	Telecommunications Industry Association
TMF	TeleManagement Forum
T-MPLS	Transport MPLS
WSON	Wavelength Switched Optical Network

WTSA World Telecommunications Standardization Assembly

5. Definitions & Descriptions

One of the most complicated factors in coordinating work among multiple organizations in the area of OTNT is differing terminology. Often multiple different groups are utilising the same terms with different definitions. This section includes definitions relevant to this document. See Annex A for more information on how common terms are used in different organizations.

5.1 Optical Transport Networks & Technologies (OTNT)

The transmission of information over optical media in a systematic manner is an optical transport network. The optical transport network consists of the networking capabilities and the technologies required to support them. For the purposes of this standardization and work plan, all new optical transport networking functionality and the related technologies will be considered as part of the OTNT Standardization Work Plan. The focus will be the transport and networking of digital client payloads over fiber optic cables. Though established optical transport mechanisms such as Synchronous Digital Hierarchy (SDH) may fall within this broad definition, only standardization efforts relating to new networking functionality of SDH will be actively considered as part of this Lead Study Group activity.

5.2 Optical Transport Network (OTN)

An Optical Transport Network (OTN) is composed of a set of Optical Network Elements connected by optical fibre links, able to provide functionality of transport, multiplexing, routing, management, supervision and survivability of optical channels carrying client signals, according to the requirements given in Recommendation G.872.

A distinguishing characteristic of the OTN is its provision of transport for any digital signal independent of client-specific aspects, i.e. client independence. As such, according to the general functional modeling described in Recommendation G.805, the OTN boundary is placed across the Optical Channel/Client adaptation, in a way to include the server specific processes and leaving out the client specific processes, as shown in Figure 5-1.

NOTE - The client specific processes related to Optical Channel/Client adaptation are described within Recommendation G.709.

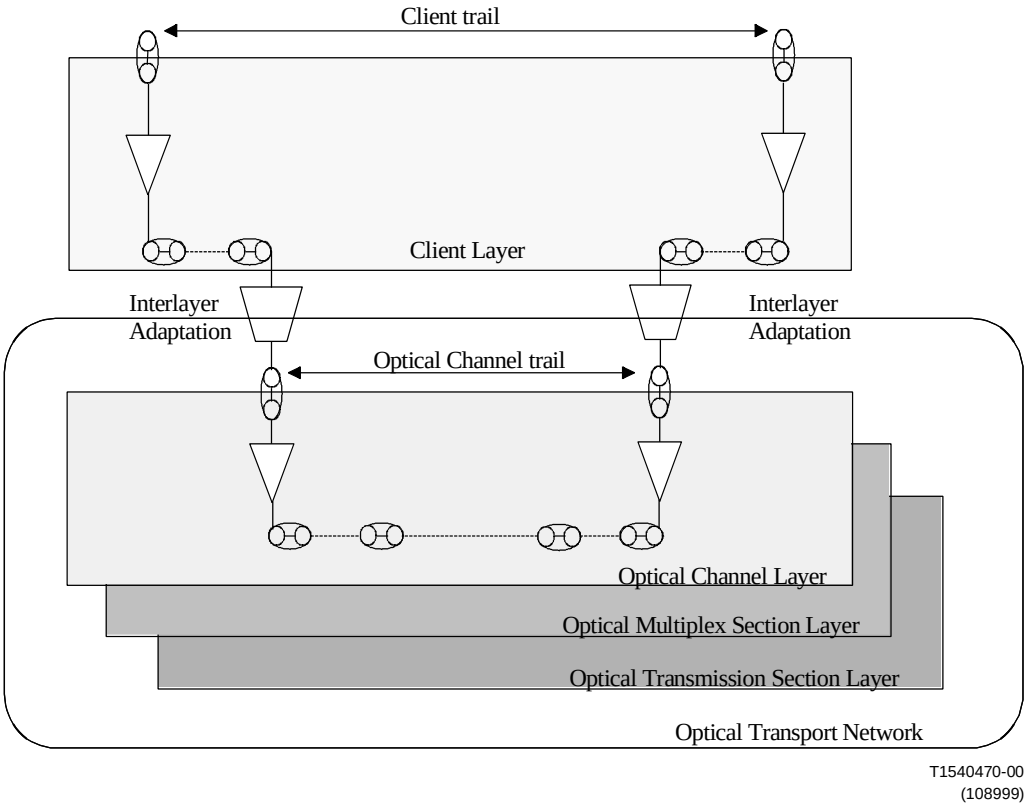

FIGURE 5-1/OTNT: Boundary Of An Optical Transport Network And Client-Server Relationship

Figure 5-2 shows a diagram of optical transport network (OTN) evolution into two separate aspects. One describes the "digital" aspects of the optical channel data unit (ODU) and the other describes the wavelength division multiplexing (WDM) and media aspects. "Digital aspects" will reflect revisions of the G.709 optical transport hierarchy. With the widespread of Ethernet, new ODU was specified such as ODU0, ODU2e and ODU4 for GbE, 10GbE and 100GbE transport, respectively. In addition to the new ODUs for Ethernet transport, ODU with flexible bit rate, ODUflex, was also specified for the client signals with any bit rate. Any CBR client signals can be mapped into ODUflex. "WDM and media aspects" are being discussed. One major effort is the architectural description of "media networks" and the other is wavelength switched optical network (WSON), which is a related extension of automatically switched optical networks (ASON).

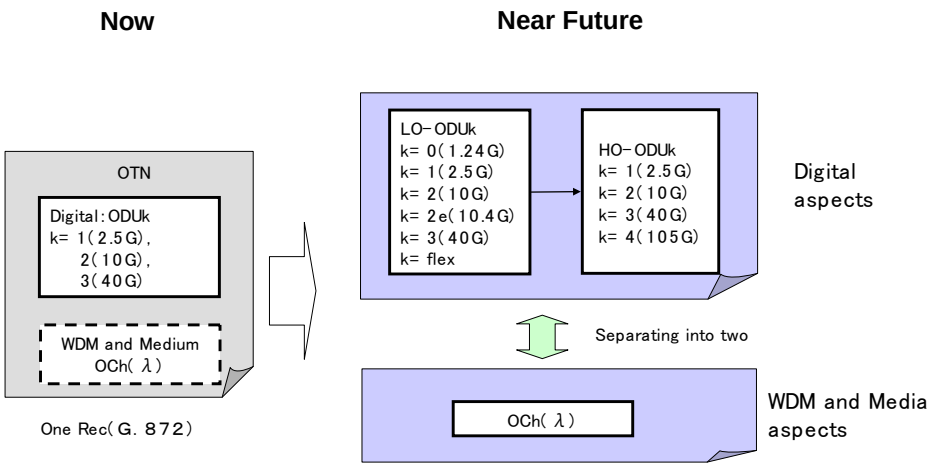

Figure 5-2: Direction of OTN evolution

5.3 Metropolitan Optical Network (MON)

A metropolitan optical network is a network subset, often without significant differentiation or boundaries. Therefore an explicit definition is under study. As a result, this section offers more of a description than a formal definition for those who wish to better understand what is commonly meant by "metropolitan optical networks."

While the existence of metropolitan networks is longstanding, the need for identification of these networks as distinct from the long haul networks in general, as well as the enterprise and access networks is recent. The bandwidth requirements from the end customers have been increasing substantially and many are implementing high bandwidth optical access connections. The resulting congestion and complexity has created a growing demand for higher bandwidth interfaces for inter office solutions. This aggregation of end customer traffic comprises a Metropolitan Optical Network (MON). MONs now have the technology to be optical based and thus, in theory, use the same technology over the fibres as other portions of the network. However, this is not always the case as there are various market forces that drive which technologies will be deployed in which part of the network. As a result, it is appropriate to describe the MON in a way that is agnostic to the various technology approaches. In spite of the many similarities, there are several distinctions between metropolitan and long haul optical networks (LHONs) that result from the aggregation of traffic from enterprise to metro to long haul networks as shown in Figure 5-2.

- The first distinction is that MONs are inherently designed for short to medium length distances in metropolitan areas. That is, typically, within the limits of a single optical span and often less than 200km distance. As a result, topics such as signal regeneration, in-line amplification and error correction are of lesser importance than in LHONs.
- Secondly, the driving requirement for MONs is maximized coverage commensurate with low cost connectivity (as opposed to grooming for performance with LHONs). As a result, for example, standardization focuses on the adaptation of local area network technologies to be effectively managed by service providers, on 'insertion loss' amplification to recover from all the connection points, and on ring deployment to leverage existing fibre plant.
- Another key difference is that of service velocity. The demand for fast provisioning results in the circuit churn rate being generally higher in MONs than LHON. That combined with the wider variety of client signals is a key driver for flexible aggregation (e.g., 100Mb-1Gb rate, all 8B/10B formats with one card).
- A final distinction is that in the MON there are service requirements (e.g., bandwidth-on-demand services, and multiple classes-of-services) that lead to further topology and technical considerations that are not a priority for LHONs.

While there are many combinations of technologies that can be used in MONs, the following are common examples:

- SONET/SDH
- DWDM, CWDM
- Optical Ethernet
- Resilient Packet Ring

- A-PON, B-PON, G-PON, and E-PON

As a result of the importance of MONs, SG15 has redefined several of its Questions work programs to specifically include metro characteristics of optical networks.

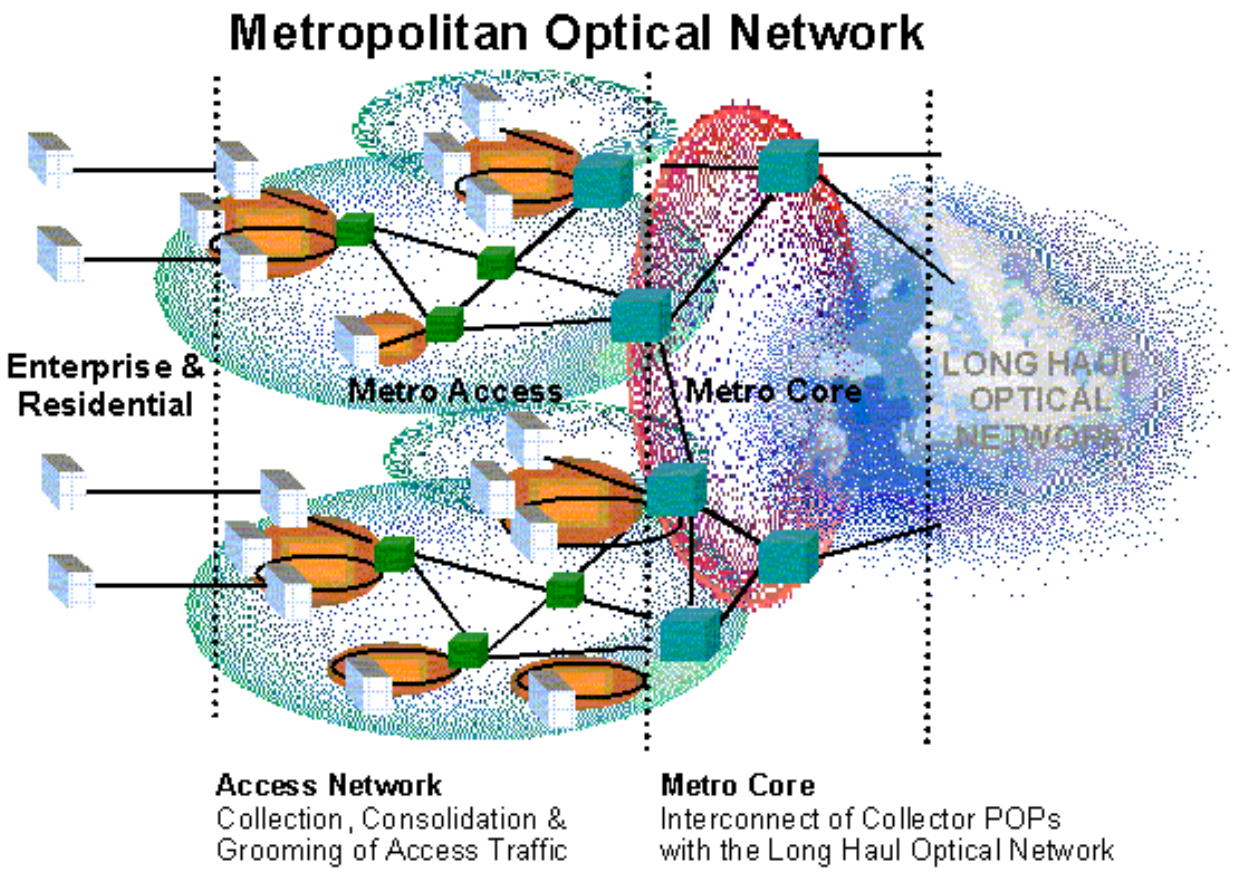

FIGURE 5-2/OTNT: Possible Relationship of MON and LHON

5.4 Ethernet Frames over Transport

Ethernet is today the dominant LAN technology in the private and enterprise sector. It is defined by a set of IEEE 802 standards. Emerging multi-protocol/multi-service Ethernet services are also offered over public transport networks. Public Ethernet services and Ethernet frames over transport standards and implementation agreements continue being developed in the ITU-T and other organizations. Specifically, the ITU-T SG15 is focused on developing Recommendations related to the support and definition of Ethernet services over traditional telecommunications transport, such as PDH, SDH, and OTN. Ethernet can be described in the context of three major components: *services aspects*, *network layer*, and *physical layer*. This description is meant to provide a brief overview of Public Ethernet considering each of the above aspects.

The Public Ethernet *services aspects* (for service providers) include the different service markets, topology options, and ownership models. Public Ethernet services are defined to a large extent by the type(s) of topologies used and ownership models employed. The topology options can be categorized by the three types of services they support: Line services, LAN services and Access services. Line services are point-to-point in nature and include services like Ethernet private and virtual lines. LAN services are multi-point-to-multi-point (such as virtual LAN services). Access services are of hub-and-spoke nature and enable single ISP/ASP to serve multiple, distinct,

customers. (Due to the similar aspects from a public network perspective, Line and Access services may be essentially the same.)

The services can be provided with different service qualities. A circuit switched technology like SDH provides always a guaranteed bit rate service while a packet switched technology like MPLS can provide various service qualities from best effort traffic to a guaranteed bit rate service. Ethernet services can be provided for the Ethernet MAC layer or Ethernet physical layer.

The Ethernet *network layer* is the Ethernet MAC layer that provides end-to-end transmission of Ethernet MAC frames between Ethernet end-points of individual services, identified by their MAC addresses. Ethernet MAC layer services can be provided as Line, LAN and Access services over circuit switched technologies like SDH VCs and OTN ODUs or over packet switched technologies like MPLS and RPR. For the Ethernet LAN service Ethernet MAC bridging might be performed within the public transport network in order to forward the MAC frames to the correct destination. Ethernet MAC services can be provided at any bit rate. They are not bound to the physical data rates (i.e. 10 Mbit/s, 100 Mbit/s, 1 Gbit/s, 10 Gbit/s) defined by IEEE.

IEEE has defined a distinct set of *physical layer* data rates for Ethernet with a set of interface options (electrical or optical). An Ethernet physical layer service transports such signals transparently over a public transport network. Examples are the transport of a 10 Gbit/s Ethernet WAN signal over an OTN or the transport of a 1 Gbit/s Ethernet signal over SDH using transparent GFP mapping. Ethernet physical layer services are point-to-point only and are always at the standardized data rates. They are less flexible compared to Ethernet MAC layer services, but offer lower latencies.

5.5 Overview of the standardization of carrier class Ethernet

5.5.1 Evolution of "carrier-class" Ethernet

Ethernet became to be used widely in network operator's backbone or metro area network. Although Ethernet was originally designed to be used in LAN environment, it has been enhanced in several aspects so that it can be used in network operators' network. In addition, Ethernet can easily realize multipoint to multipoint connectivity, which would require n*(n-1)/2 connections if an existing point to point transport technology. The following subclauses explain enhancements which have been adopted in Ethernet networks thus far.

5.5.1.1 High bit rate and long reach interfaces

Up to 10Gbit/s, up to 40km Ethernet interfaces have been standardized by IEEE 802.3 WG. In addition to LAN-PHY (10GBASE-R), WAN-PHY (10GBASE-W) has been standardized. WAN-PHY can be connected to SDH/SONET interfaces.

5.5.1.2 Ethernet-based access networks

Ethernet capabilities as access networks have been enhanced by IEEE 802.3 WG originally as IEEE 802.3ah. which has been incorporated into the base IEEE Std 802.3-2008. This includes point-to-point and point-to-multipoint (PON) optical transmission methods as well as link level Ethernet OAM. In addition, IEEE 802.3av(10G-EPON) has also been standardized.

5.5.1.3 Enhancement of scalability

VLAN technology is widely used to provide customers with logically independent networks while sharing network resource physically. However, since 12bit VLAN ID must be a unique value throughout the network, the customer accommodation is limited to 4094 (2 values, 0 and 4095, are reserved for other purposes).

In order to expand this limitation, a method which uses two VLAN IDs in a frame has been standardized by IEEE 802.1ad (Provider Bridges) in October 2005. This method allows the network to provide up to 4094 Service VLANs, each of which can accommodate up to 4094 Customer VLANs.

5.5.1.4 Scalable Ethernet-based backbone

In order to realize further scalable network, IEEE 802.1ah (Backbone Provider Bridges) specifies a method which uses B-Tag, I-Tag and C-Tag. B-Tag and C-Tag include 12 bit VLAN ID. I-Tag includes 20bit Service ID (note: the size of the Service ID under study). One VLAN ID identifies a Customer VLAN. Service ID identifies a service in a provider network. Another VLAN ID identifies a Backbone VLAN. This allows the network to use 12bit VLAN ID space and 20 bit service ID space as well as its own MAC address space. IEEE 802.1ah was approved in June 2008.

5.5.1.5 The number of MAC addresses to be learned by bridges

Bridges in a network automatically learn the source MAC addresses of incoming frames. When the number of stations is large, this learning process consumes a lot of resources of each bridge. In order to alleviate this burden, IEEE 802.1ah (Backbone Provider Bridges) is standardizing a method which encapsulates MAC addresses of user stations by backbone MAC addresses so that bridges inside the backbone network do not learn MAC addresses of user stations.

5.5.1.6 Network level OAM

In order to enable network operators to detect, localize and verify defects easily and efficiently, network level Ethernet OAM functions have been standardized by ITU-T SG13 (Q.5/13) and IEEE 802.1ag under a close cooperation. ITU-T Recommendation Y.1731 was approved in May 2006 and revised in February 2008. IEEE 802.1ag was approved in September 2007. IEEE 802.1ag covers fault management functions only while Y.1731 covers both fault management and performance management. Ethernet services performance parameters were standardized by ITU-T SG12 (Q.17/12) in Recommendation Y.1563, approved in January 2009.

It was decided to move Q.5/13 (OAM) to SG15 at the WTSA-08 in October. As such, work on Ethernet OAM will be conducted by SG15 in 2009-2012 Study Period.

5.5.1.7 Fast survivability technologies

In order to realize fast and simple protection switching in addition to Link Aggregation and Rapid Spanning Tree Protocol, a Recommendation on Ethernet linear protection switching mechanism (G.8031) was approved in June 2006. A Recommendation on Ethernet ring protection (G.8032) was approved in June 2008. The revised recommendation G.8032v2 adding interconnected and multiple rings, operator commands and non-revertive mode was approved in March 2010.

IEEE 802.1 WG is developing a standard on Shortest Path Bridging (IEEE 802.1aq) to optimize restoration capabilities. In addition, they completed in June 2009 a standard on Provider Backbone Bridge Traffic Engineering (IEEE 802.1Qay), which includes linear protection switching. IEEE 802.17 WG is developing standards on Resilient Packet Ring (RPR). The latest 802.17 project has been IEEE P802.17c: "Protected Inter-Ring Connection". This project extends the property of fast (50 ms) restoration time, associated with an individual RPR ring, to dual-interconnected rings. This project reached IEEE Sponsor Ballot approval stage in July 2009.

5.5.1.8 QoS/traffic control/traffic conditioning

QoS, traffic control and traffic conditioning issues are being studied by ITU-T (SG12 and SG13), IEEE 802.3 and Metro Ethernet Forum (MEF). IEEE 802.1 completed work in June 2009 on

Provider Backbone Bridge Traffic Engineering (IEEE 802.1Qay). MEF has developed MEF 10.1.1: "Amendment to Ethernet Services Attributes Phase 2", completed in September 2009.

5.5.1.9 Higher bit rates

IEEE 802.3 has been developing a standard on 10Gbit/s Ethernet Passive Optical Network. Work on the 10G EPON: IEEE 802.3av standard has been completed and was approved by the IEEE-SA Standards Board in September 2009.

Also within IEEE 802.3, the 802.3ba Task Force is developing standards both for 40 Gbit/s and 100 Gbit/s Ethernet. The current approved objectives as of July 2009 are:

- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum FrameSize of current 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface
- Provide appropriate support for OTN
- Support a MAC data rate of 40 Gb/s
- Provide Physical Layer specifications which support 40 Gb/s operation over:
  - at least 10km on SMF
  - at least 100m on OM3 MMF
  - at least 7m over a copper cable assembly
  - at least 1m over a backplane
- Support a MAC data rate of 100 Gb/s
- Provide Physical Layer specifications which support 100 Gb/s operation over:
  - at least 40km on SMF
  - at least 10km on SMF
  - at least 100m on OM3 MMF
  - at least 7m over a copper cable assembly

The target of this project is for completion by the middle of 2010.

Note: It should be considered that the materials in this section (40GBASE-LR4, 100GBASE-LR4, and 100GBASE-ER4 interface descriptions) may be moved to section 5.5.1.1, based on the approval of the IEEEP802.3ba which is planned in June, 2010.

5.5.2 Standardization activities on Ethernet

Standardization work on "carrier-class" Ethernet is conducted within ITU-T SG13, SG15, IEEE 802.1 WG, IEEE 802.3 WG, IETF and Metro Ethernet Forum. The table below summarizes current standardization responsibilities on "carrier-class" Ethernet. Table 7-5 lists the current status of individual Ethernet related ITU-T Recommendations

Table 5-1 Standardization on "carrier-class" Ethernet.

#	Standard body	Q/SG (WG)	Study items
1	ITU-T SG12	Q.17/12	Ethernet services performance
2	ITU-T SG15	Q.3/15	Coordination on OTN including optical Ethernet
		Q.9/15	Ethernet protection/restoration and equipment functional architecture
		Q.10/15	Ethernet OAM mechanisms
		Q.11/15	Ethernet Service description and frame mapping (GFP)
		Q.12/15	Ethernet architecture
		Q.13/15	Synchronous Ethernet
		Q14/15	Management aspects of Ethernet
		Q15/15	Synchronous Ethernet test equipment
3	IEEE 802	P802.1	Higher layers above the MAC (including Network level Ethernet OAM mechanisms, Provider bridges, Provider backbone bridges)
		P802.3	Ethernet (including Ethernet in the First Mile (completed in June 2004), 10G-EPON (completed in September 2009) and 40G/100G Ethernet)
4	IETF	CCAMP WG	common control plane and measurement plane solutions and GMPLS mechanisms/protocol extensions to support source-controlled and explicitly-routed Ethernet data paths for Ethernet data planes
		L2VPN WG	Layer 2 Virtual Private Networks
		PWE3 WG	encapsulation, transport, control, management, interworking and security of Ethernet services emulated over MPLS enabled IP packet switched networks
5	Metro Ethernet Forum	Technical Committee	Service attributes including traffic and performance parameters, service definitions, Aggregation and E-NNI interfaces, management interfaces, performance monitoring, and test specifications.

5.5.3 Further details

Further details about standardization of Ethernet can be obtained the website of ITU-T SG13, SG15, IEEE 802.1, IEEE 802.3, IETF and Metro Ethernet Forum as below:

ITU-T SG13: http://www.itu.int/ITU-T/studygroups/com13/index.asp

ITU-T SG15: http://www.itu.int/ITU-T/studygroups/com15/index.asp

IEEE 802.1 WG: http://www.ieee802.org/1/

IEEE 802.3 WG: http://www.ieee802.org/3/

IETF: http://www.ietf.org/

Metro Ethernet Forum: http://metroethernetforum.org/

5.6 Standardization on MPLS/MPLS-TP (T-MPLS)

In order to use MPLS technology in operators' network, standardization for enhancing MPLS is conducted by ITU-T SG13 and SG15. In addition to “normal” MPLS, Transport MPLS (T-MPLS)

has been studied actively. In 2007-2008 timeframe, several meetings were held to discuss the working method on T-MPLS between ITU-T (in particular, SG13 and SG15) and IETF. In a SG15 plenary meeting in February 2008, it was decided to set up a Joint Work Team (JWT) to discuss this matter intensively. At the December 2008 plenary meeting SG 15 agreed to use the term MPLS-TP to refer to the extensions to MPLS technology being developed by the IETF to meet the requirements of the transport network. The meeting also agreed the plan to migrate the existing T-MPLS Recommendations to MPLS-TP provided in Migration of T-MPLS Recommendations to MPLS-TP. In October 2009, MPLS-TP steering committee has been established to provide MPLS-TP project management coordination between IETF and ITU-T. Figure 5-4 shows the structure of the relationship between IETF and ITU-T.

IETF and ITU-T relationship on MPLS-TP

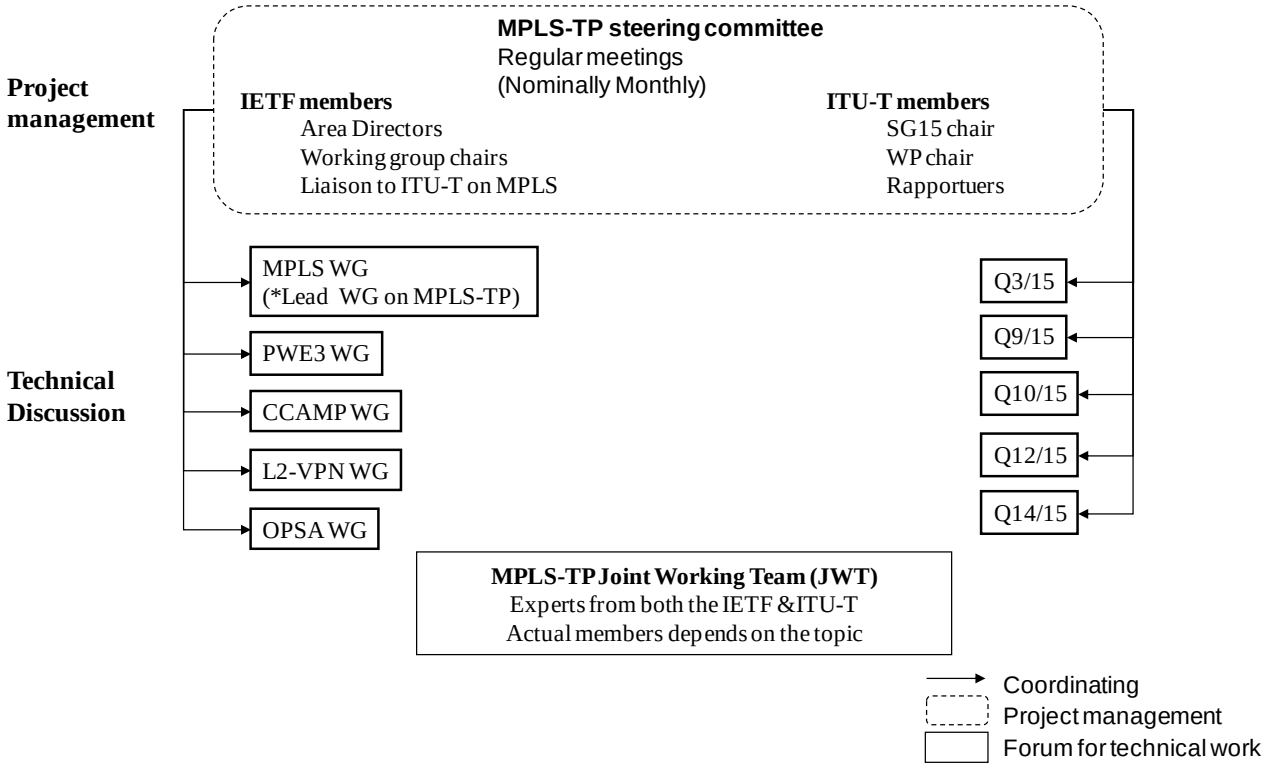

Figure 5-4 Structure of the Joint Working Team (JWT) and related Sub-Groups

The JWT recommended that:

- Jointly agree to work together and bring transport requirements into the IETF and extend IETF MPLS forwarding, OAM, survivability, network management and control plane protocols to meet those requirements through the IETF Standards Process
- The Joint Working Team believes this would fulfill the mutual goal of improving the functionality of the transport networks and the internet and guaranteeing complete interoperability and architectural soundness
- Refer to the technology as the Transport Profile for MPLS (MPLS-TP)
- Therefore, we recommend that future work should focus on:
  - In the IETF: Definition of the MPLS "Transport Profile" (MPLS-TP)
  - In the ITU-T:

- Integration of MPLS-TP into the transport network
- Alignment of the current T-MPLS Recommendations with MPLS-TP and,
- Terminate the work on current T-MPLS

Further details can be found at:

http://ties.itu.int/ftp/public/itu-t/ahtmpls/readandwrite/doc_exchange/overview/MPLS-TP_overview-22.ppt

The table below summarizes current standardization responsibilities on MPLS-TP.

Table 5-2 Standardization on MPLS-TP.

#	Standard body	Q/SG (WG)	Study items
1	ITU-T SG15	Q.3/15	Terms and definitions for MPLS-TP
		Q.9/15	MPLS-TP protection/survivability and equipment functional architecture
		Q.10/15	MPLS-TP interfaces, OAM architecture and mechanisms
		Q.12/15	MPLS-TP network architecture
		Q.14/15	MPLS-TP network management and control
2	IETF	BFD WG	Bidirectional Forwarding Detection (bfd) extntions for MPLS-TP
		CCAMP WG	Common control plane and measurement plane solutions and GMPLS mechanisms/protocol extensions for MPLS transport profile (MPLS-TP), Automatically Switched Optical Networks (ASON) and Wavelength Switched Optical Networks (WSON)
		L2VPN WG	Extensions to L2VPN protocols and RFC's necessary to create an MPLS Transport Profile (MPLS-TP)
		MPLS WG	Requirements, mechanisms, protocols and framework for MPLS-TP
		OPSAWG	Definition of the OAM acronym
		PCE WG	Specification of Path Computation Element (PCE) based architecture for the computation of paths for MPLS and GMPLS LSPs
		PWE3 WG	Extensions to the PWE3 protocols and RFCs necessary to create an MPLS Transport Profile (MPLS-TP)

5.6.1 MPLS/MPLS-TP OAM

MPLS OAM was originally standardized by ITU-T SG13 (Q.5/13). Recommendations on OAM requirements (Y.1710), mechanisms (Y.1711), OAM under ATM-MPLS interworking (Y.1712) and misbranch detection (Y.1713) have been published. IETF is also standardizing MPLS OAM. The usage of the "OAM Alert label" is described in RFC3429. RFC4377 describes OAM MPLS OAM requirements. RFC4378 describes MPLS OAM framework. RFC4379 specifies methods for

defect detection (LSP ping and traceroute).

It was decided to move Q.5/13 (OAM) to SG15 at the WTSA-08 in October, 2008. Q.10/15 is allocated to do this work. As such, work on MPLS/MPLS-TP OAM has been conducted by Q.10/15 in 2009-2012 Study Period. Regarding MPLS-TP OAM, new Recommendation (G.tpoam) is planned to be consent in February 2011.

5.6.2 MPLS/MPLS-TP protection switching

MPLS protection switching has been standardized by ITU-T SG15 (Q.9/15). Revised Recommendation on MPLS protection switching (Y.1720) was approved in December 2006. T-MPLS linear protection switching (G.8131) was approved in December 2006. IETF is also standardizing MPLS survivability techniques. RFC3469 describes MPLS recovery framework. RFC4090 specifies Fast ReRoute (FRR).

Regarding MPLS-TP, MPLS-TP linear protection switching (revised G.8131) and MPLS-TP ring protection switching (new G.8132) has been developed with cooperation with IETF based on the agreement of JWT. Both Recommendations are planned to be consent in December 2011.

5.6.3 MPLS interworking

Interworking with MPLS networks has been studied by ITU-T SG13 (Q.7/13). Recommendations on ATM-MPLS interworking (cell mode: Y.1411, frame mode: Y.1412), TDM-MPLS interworking (Y.1413), Voice services – MPLS interworking (Y.1414) and Ethernet-MPLS network interworking (Y.1415) have been published.

5.6.4 MPLS-TP network architecture

MPLS layer network architecture (G.8110) was approved by ITU-T SG15 in January 2005. Transport MPLS (T-MPLS) network architecture (G.8110.1) was approved by ITU-T SG15 (Q.12/15) in November 2006. Regarding MPLS-TP, Architecture of MPLS-TP Layer Network is planned to be consent June 2010 and has been being developed.

5.6.5 MPLS-TP equipment functional architecture

T-MPLS equipment functional architecture (G.8121) was approved within ITU-T SG15 (Q.9/15) in March 2006 and amended October 2007. MPLS-TP equipment functional architecture (revised G.8121) is planned to be consent in February 2011.

5.6.6 MPLS-TP equipment network management

T-MPLS equipment network management (G.8151) was approved within ITU-T SG15 (Q.14/15) in October 2007. MPLS-TP network management (revised G.8151) is planned to be consent in February 2011.

5.6.7 MPLS-TP interface

G.8112, “Interfaces for the Transport MPLS (T-MPLS) hierarchy” was approved by ITU-T SG15 (Q.11/15) in October 2006. In December 2008, the packet transport work of Question 11/15 will be moved to new Question 10/15 in order to balance the load among questions of Working Party 3/15. As a result, MPLS-TP interface(revised G.8112) has been being developed in Q10/15. The Recommendation is planned to be consent in February 2011.

5.6.7 Further details

Table 7-6 lists the current status of individual MPLS related ITU-T Recommendations. Table 7-7 lists the current status of individual MPLS-TP (T-MPLS) related IETF RFCs, internet drafts and ITU-T Recommendations.

Further details about standardization of MPLS/MPLS-TP can be obtained from the websites of ITU-T SG15 as below:

http://www.itu.int/ITU-T/studygroups/com15/index.asp

Further details about standardization of MPLS-TP can be obtained from the following website of ITU-T SG15.

http://www.itu.int/ITU-T/studygroups/com15/ahmpls-tp/

The dependancy between the draft revised MPLS-TP Recommendations and the MPLS-TP drafts and RFCs can be found at

http://www.itu.int/oth/T0906000002/en

5.7 Standardization on NGN related issues

5.7.1 Relationships between OTN standardization and NGN standardization

Standardization work on the Next Generation Network (NGN) is conducted by several groups within ITU-T, in particular, by SG13, SG11 and GSI (Global Standardization Initiative). The overview and the definition of the NGN is given by ITU-T Recommendation Y.2000[1]. Further details of the NGN are described by a set of related Recommendations. NGN-FG worked on several NGN related documents until November 2005. These documents were transferred to appropriate SGs based on the subjects. Also, GSI (Global Standardization Initiative) was established to facilitate collaboration among SGs. Table 7-8 lists the current status of NGN related ITU-T Recommendations.

One of the characteristics of the NGN is that it consists of a service stratum and a transport stratum (see Figure 5-3). Transport technologies such as OTN, ATM and SDH (developed by SG15) can be a means to realize a transport stratum. In addition to these, Ethernet and MPLS/MPLS-TP can also construct the transport stratum based on the recent standardization work for enhancing these technologies toward "carrier-class" Ethernet and MPLS/MPLS-TP.

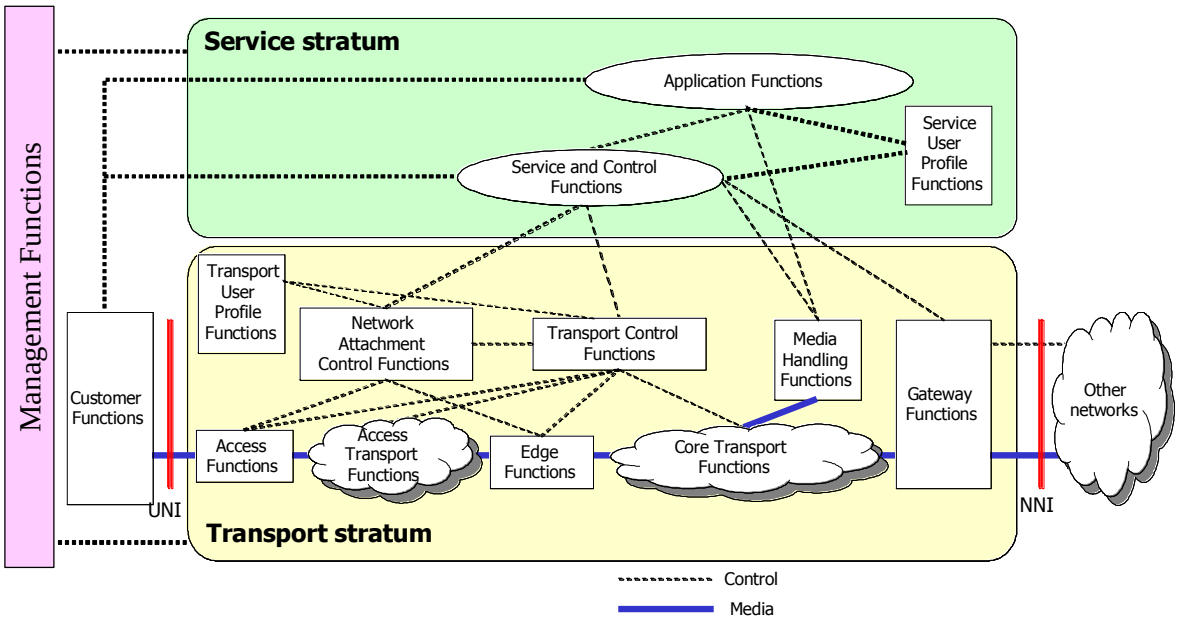

Figure 5-3 NGN architecture overview

This architecture enables service and transport technologies evolve independently keeping the interfaces between them consistent. However, close cooperation between these efforts is nevertheless important.

5.7.2 Standardization status for transport stratum

Various technologies such as PDH, SDH, ATM, OTN, Ethernet and MPLS/MPLS-TP can provide capabilities for transport stratum. The following table summarizes the standardization status for each technology in terms of various aspects.

Table 5-3 – Standardization status on the various aspects of PDH, SDH, ATM, OTN, Ethernet, MPLS and MPLS-TP (T-MPLS)(note 3)

Topic	Generic	PDH	SDH	ATM	OTN	Ethernet	MPLS	MPLS-TP (T-MPLS)
Architectural aspects	G.800, G.805, G.809		G.803, G.805	G.805 , I.326	G.872,	G.809, G.8010, [IEEE] 802.3, 802.1D, 802.1Q, 802.1ad, 802.1ah	G.8110, [IETF] RFC 3031	G.8110.1
Structures and mapping		G.704, G.73x, G.74x, G.75x (note 1), G.804, G.7043, G.8040	G.707, G.832, G.7041, G.7042	I.361, I.362, I.363	G.709, G.7041, G.7042	G.7041, G.7042, [IEEE] 802.3, 802.3ax	[IETF] RFC3032	G.8112
Equipment functional characteristics	G.806	G.706, G.73x, G.74x, G.75x (note 1)	G.783, G.784, G.806, G.813,	I.731, I.732	G.798, G.806	G.8021		G.8121
OAM and protection switching	G.808.1		G.707, G.783, G.841, G.842	I.610, I.630	G.873.1	Y.1730, Y.1731, G.8031, G.8032 [IEEE] 802.1ag, 802.3, 802.3av,, 802.1aq, 802.1Qay	Y.1710, Y.1711, Y.1712, Y.1713, Y.1720, [IETF] RFC3429, RFC4377, RFC4378, RFC4379, RFC3469, RFC4090	G.8131 [SG13] Y.Sup4
Management aspects	G.7710 G.7712 M.3010 M.3013		G.774-x, G.784, G.831, G.7710, M.3100 am3	I.751	G.874, G.874.1 , G.875, G.7710, M.3100 am3	G.8051, G.8052 [IEEE] 802.1ap, P802.3.1	Y.1714	G.8151
Physical layer characteristics		G.703	G.664, G.691, G.692, G.693, G.703, G.957	G.703 , G.957 , I.432	G.664, G.680, G.693, G.698.1 G.698.2 G.959.1	[IEEE] 802.3, 802.3av		

Topic	Generic	PDH	SDH	ATM	OTN	Ethernet	MPLS	MPLS-TP (T-MPLS)
Performance		G.821, G.822, G.826, G.823, G.824	G.826, G.827, G.828, G.829, G.783, G.825	I.356, I.357	G.8201, G.8251	Y.1563 Y.1730, Y.1731	Y.1561	
Terminology	G.870		G.780		G.870, G.8081	G.8001		G.8101

Note 1: G.73x, G.74x, G.75x denote series of Recommendations of which numbers start with G.73, G.74 or G.75.

Note 2: Y-series Recommendation numbers are assigned to NGN related Recommendations in addition to their original Recommendation numbers.

Note 3: The next update of the T-MPLS related Recommendations shown in the right-most column of above table will only describe MPLS-TP and will include normative references to the IETF MPLS-TP RFCs under development to meet ITU-T transport requirements.

Note 4: ASON related Recommendations are shown in Table 7-4-2: Estimated mapping of protocol-specific documents in ITU-T ASON Recommendations.

5.7.3 Further details

Further details about NGN standardization can be obtained from SG13, SG11 and FG-NGN websites as below.

ITU-T SG13: http://www.itu.int/ITU-T/studygroups/com13/index.asp

ITU-T SG11: http://www.itu.int/ITU-T/studygroups/com11/index.asp

6. OTNT Correspondence and Liaison Tracking

6.1 OTNT Related Contacts

The International Telecommunication Union - Telecommunications Sector (ITU-T) maintains a strong focus on global OTNT standardization. It is supported by other organizations that contribute to specific areas of the work at both the regional and global levels. Below is a list of the most notable organizations recognised by the ITU-T and their URL for further information.

ATIS - Alliance for Telecommunications Industry Solutions: http://www.atis.org

TIA - Telecommunications Industry Association: http://www.tiaonline.org

IEC - International Electrotechnical Commission: http://www.iec.ch/

IETF - Internet Engineering Task Force: http://www.ietf.org

IEEE 802 LAN/MAN Standards Committee: http://grouper.ieee.org/groups/802/index.shtml

Optical Internetworking Forum (OIF) Technical Committee: http://www.oiforum.com/public/techcommittee.html

Broadband (ex. IP/MPLS) Forum: http://www.broadband-forum.org/

Metro Ethernet Forum (MEF) Technical Committee: http://metroethernetforum.org/

TMF- TeleManagement Forum: http://www.tmforum.org/browse.aspx

7. Overview of existing standards and activity

With the rapid progress on standards and implementation agreements on OTNT, it is often difficult to find a complete list of the relevant new and revised documents. It is also sometimes difficult to find a concise representation of related documents across the different organizations that produce them. This section attempts to satisfy both of those objectives by providing concise tables of the relevant documents.

7.1 New or Revised OTNT Standards or Implementation Agreements

Many documents, at different stages of completion, address the different aspect of the OTNT space. The table below lists the known drafts and completed documents under revision that fit into this area. The table does not list all established documents which might be under review for slight changes or addition of features.

Three major families of documents (and more) are represented by fields in the following table, SDH/SONET, OTN Transport Plane, and ASON Control Plane. All of the recommendations and standards of these three different families are included in tables in later sections of this document.

TABLE 7-1-1/OTNT: OTNT Related Standards and Industry Agreements (ITU-T Recommendations)

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (SG2)	M.2401	Error Performance Limits and Procedures for Bringing-Into-Service and Maintenance of multi-operator international paths and sections within Optical Transport Networks	12/2003
ITU-T (Q.17/12)	G.1563	Ethernet frame transfer and availability performance	01/2009
ITU-T (Q.2/15)	G.983.1	Broadband optical access systems based on Passive Optical Networks (PON)	01/2005
ITU-T (Q.2/15)	G.983.1 (Amend.1)	PICS for OLT and ONU – published in English only	05/2005
ITU-T (Q.2/15)	G.983.2	ONT management and control interface specification for ATM PON	07/2005
ITU-T (Q.2/15)	G.983.2 (Amend. 1)	Omnibus improvements for OMCI	03/2006
ITU-T (Q.2/15)	G.983.2 (Amend. 2)	Various Enhancements to OMCI	01/2007
ITU-T (Q.2/15)	G.Imp983.2	Implementer's Guide to G.983.2	02/2006
ITU-T (Q.2/15)	G.983.3	A broadband optical access system with increased service capability by wavelength allocation	03/2001
ITU-T (Q.2/15)	G.983.3 (Amend. 1)	A broadband optical access system with increased service capability by wavelength allocation	02/2002
ITU-T (Q.2/15)	G.983.3 (Amend. 2)	A broadband optical access system with increased service capability by wavelength allocation	07/2005
ITU-T (Q.2/15)	G.983.4	A Broadband Optical Access System with increased service capability using Dynamic Bandwidth Assignment	11/2001
ITU-T (Q.2/15)	G.983.4 (Amend. 1)	New Annex A – Performance monitoring parameters	12/2003
ITU-T (Q.2/15)	G.983.4 (Corrig. 1)	New Annex A – Performance monitoring parameters	01/2005

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.2/15)	G.983.5	A Broadband Optical Access System with enhanced survivability	01/2002
ITU-T (Q.2/15)	G.984.1	Gigabit-capable Passive Optical Networks (GPON): General characteristics	03/2008
ITU-T (Q.2/15)	G.984.2	Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification	03/2003
ITU-T (Q.2/15)	G.984.2 (Amend. 1)	New Appendix III – Industry best practice for 2.488 Gbit/s downstream, 1.244 Gbit/s upstream	02/2006
ITU-T (Q.2/15)	G.984.2 (Amend. 2)	Enhancement to support optical layer supervision and a new optical line termination (OLT)	03/2008
ITU-T (Q.2/15)	G.984.3	Gigabit-capable Passive Optical Networks (GPON): Transmission Convergence layer specification	03/2008
ITU-T (Q.2/15)	G.984.3 (Amend. 1)	Specification of the ONU registration method and various clarifications	02/2009
ITU-T (Q.2/15)	G.984.3 (Amend.2)	Specification of the ONU registration method and various clarifications	11/2009
ITU-T (Q.2/15)	G.984.4	Gigabit-capable Passive Optical Networks (GPON): ONT Management and Control Interface specification	02/2008
ITU-T (Q.2/15)	G.Imp984.4	Implementer's Guide to G.984.4	12/2008
ITU-T (Q.2/15)	G.984.4 (Amend. 1)	Gigabit-capable Passive Optical Networks (GPON): ONT Management and Control Interface specification	06/2009
ITU-T (Q.2/15)	G.984.4 (Corrig. 1)	Gigabit-capable Passive Optical Networks (GPON): ONT Management and Control Interface specification	03/2010
ITU-T (Q.2/15)	G.984.5	Gigabit-capable Passive Optical Networks (G-PON): Enhancement band	09/2007
ITU-T (Q.2/15)	G.984.6	Gigabit-capable passive optical networks (GPON): Reach extension	03/2008
ITU-T (Q.2/15)	G.984.6 (Amend. 1)	Gigabit-capable passive optical networks (GPON): Reach extension	11/2009
ITU-T (Q.2/15)	G.985	100 Mbit/s point-to-point Ethernet based optical access system	03/2003
ITU-T (Q.2/15)	G.985 (Corrig. 1)	100 Mbit/s point-to-point Ethernet based optical access system	01/2005
ITU-T (Q.2/15)	G.985 (Amend. 1)	Silent start function of optical network terminals	01/2009
ITU-T (Q.3/15)	G.780/Y.1351	Terms and definitions for synchronous digital hierarchy (SDH) networks	03/2008
ITU-T (Q.3/15)	G.870/Y.1352	Terms and definitions for Optical Transport Networks (OTN)	03/2008
ITU-T (Q.3/15)	G.870/Y.1352 (Amend. 1)	Terms and definitions for Optical Transport Networks (OTN)	11/2009
ITU-T (Q.3/15)	G.8081/Y.1353	Terms and definitions for Automatically Switched Optical Networks (ASON)	03/2008

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.3/15)	G.8001/Y.1354	Terms and definitions for Ethernet Frames Over Transport Networks	03/2008
ITU-T (Q.3/15)	G.8101/Y.1355 *	Terms and definitions for transport MPLS	12/2006
ITU-T (Q.5/15)	G.650.1	Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable	06/2004
ITU-T (Q.5/15)	G.650.2	Definitions and test methods for statistical and non-linear attributes of single-mode fibre and cable	07/2007
ITU-T (Q.5/15)	G.650.3	Test methods for installed single-mode optical fibre cable links	03/2008
ITU-T (Q.5/15)	G.651.1	Characteristics of a 50/125 µm multimode graded index optical fibre cable for the optical access network	07/2007
ITU-T (Q.5/15)	G.652	Characteristics of a single-mode optical fibre cable	11/2009
ITU-T (Q.5/15)	G.653	Characteristics of a dispersion-shifted single-mode optical fibre and cable	12/2006
ITU-T (Q.5/15)	G.654	Characteristics of a cut-off shifted single-mode optical fibre and cable	12/2006
ITU-T (Q.5/15)	G.655	Characteristics of a non-zero dispersion shifted single-mode optical fibre and cable	11/2009
ITU-T (Q.5/15)	G.656	Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport	12/2006
ITU-T (Q.5/15)	G.657	Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network	11/2009
ITU-T (Q.5/15)	G.Sup40	Optical fibre and cable recommendations and standards guideline	11/2006
ITU-T (Q.6/15)	G.664	Optical safety procedures and requirements for optical transport systems	03/2006
ITU-T (Q.6/15)	G.680	Physical transfer functions of optical network elements	07/2007
ITU-T (Q.6/15)	G.691	Optical interfaces for single channel STM-64 and other SDH systems with optical amplifiers	03/2006
ITU-T (Q.6/15)	G.692	Optical interfaces for multichannel systems with optical amplifiers	10/1998
ITU-T (Q.6/15)	G.692 (Corrig. 1)	Optical interfaces for multichannel systems with optical amplifiers	01/2000
ITU-T (Q.6/15)	G.692 (Corrig. 2)	Optical interfaces for multichannel systems with optical amplifiers	06/2002
ITU-T (Q.6/15)	G.692 (Amend. 1)	Optical interfaces for multichannel systems with optical amplifiers	01/2005
ITU-T (Q.6/15)	G.693	Optical interfaces for intra-office systems	11/2009
ITU-T (Q.6/15)	G.694.1	Spectral grids for WDM applications: DWDM frequency grid	06/2002
ITU-T (Q.6/15)	G.694.2	Spectral grids for WDM applications: CWDM wavelength grid	12/2003

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.6/15)	G.695	Optical interfaces for Coarse Wavelength Division Multiplexing applications	12/2006
ITU-T (Q.6/15)	G.696.1	Intra-Domain DWDM applications	07/2005
ITU-T (Q.6/15)	G.697	Optical monitoring for DWDM system	06/2004
ITU-T (Q.6/15)	G.698.1	Multichannel DWDM applications with single-channel optical interfaces	11/2009
ITU-T (Q.6/15)	G.698.2	Amplified multichannel DWDM applications with single channel optical interfaces	11/2009
ITU-T (Q.6/15)	G.911	Parameters and calculation methodologies for reliability and availability of fibre optic systems	04/1997
ITU-T (Q.6/15)	G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy	03/2006
ITU-T (Q.6/15)	G.959.1	Optical transport network physical layer interfaces	11/2009
ITU-T (Q.6/15)	G.Sup39	Optical system design and engineering considerations	12/2008
ITU-T (Q.7/15)	G.671	Transmission characteristics of optical components and subsystems	01/2009
ITU-T (Q.9/15)	G.781	Synchronization layer functions	09/2008
ITU-T (Q.9/15)	G.781(Corrig. 1)	Synchronization layer functions	11/2009
ITU-T (Q.9/15)	G.783	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks	03/2006
ITU-T (Q.9/15)	G.783 (Errata 1)	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks	11/2006
ITU-T (Q.9/15)	G.783 (Amend. 1)	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks	05/2008
ITU-T (Q.9/15)	G.783 (Amend. 2)	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks	03/2010
ITU-T (Q.9/15)	G.798	Characteristics of Optical Transport Network Hierarchy Equipment Functional Blocks	12/2006
ITU-T (Q.9/15)	G.798 (Amend. 1)	Characteristics of Optical Transport Network Hierarchy Equipment Functional Blocks	12/2008
ITU-T (Q.9/15)	G.798 (Corrig. 1)	Characteristics of optical transport network hierarchy equipment functional blocks	01/2009
ITU-T (Q.9/15)	G.Imp798	Implementer's Guide to G.798	05/2005
ITU-T (Q.9/15)	G.806	Characteristics of transport equipment – Description methodology and generic functionality	01/2009
ITU-T (Q.9/15)	G.808.1	Generic protection switching – Linear trail and subnetwork protection	02/2010
ITU-T (Q.9/15)	G.Imp808.1	Implementer's Guide to G.808.1	05/2005
ITU-T (Q.9/15)	G.841	Types and characteristics of SDH network protection architectures	10/1998
ITU-T (Q.9/15)	G.841 (Corrig. 1)	Types and characteristics of SDH network protection architectures	08/2002

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.9/15)	G.842	Interworking of SDH network protection architectures	04/1997
ITU-T (Q.9/15)	G.873.1	Optical Transport network (OTN) - Linear Protection	03/2006
ITU-T (Q.9/15)	G.Imp873.1	Implementer's Guide to G.873.1	05/2005
ITU-T (Q.9/15)	G.8021/Y.1341	Characteristics of Ethernet transport network equipment functional blocks	12/2007
ITU-T (Q.9/15)	G.8021/Y.1341 (Amend. 1)	Characteristics of Ethernet transport network equipment functional blocks	01/2009
ITU-T (Q.9/15)	G.8021/Y.1341 (Amend. 2)	Characteristics of Ethernet transport network equipment functional blocks	02/2010
ITU-T (Q.9/15)	G.8031/Y.1342	Ethernet linear protection switching	11/2009
ITU-T (Q.9/15)	G.8032//Y.1344	Ethernet ring protection switching	03/2010
ITU-T (Q.9/15)	G.8121/Y.1381 *	Characteristics of Transport MPLS equipment functional blocks	03/2006
ITU-T (Q.9/15)	G.8121/Y.1381 * (Corrig. 1)	Characteristics of Transport MPLS equipment functional blocks	12/2006
ITU-T (Q.9/15)	G.8121/Y.1381 * (Amend. 1)	Characteristics of Transport MPLS equipment functional blocks	10/2007
ITU-T (Q.9/15)	G.8131/Y.1382 *	Linear protection switching for transport MPLS (T-MPLS) networks	02/2007
ITU-T (Q.9/15)	G.8131/Y.1382 * (Amend. 1)	Linear protection switching for transport MPLS (T-MPLS) networks	09/2007
ITU-T (Q.9/15)	G.8201	Error performance parameters and objectives for multi-operator international paths within the Optical Transport Network (OTN)	09/2003
ITU-T (Q.9/15)	Y.1720	Protection switching for MPLS networks	12/2006
ITU-T (Q.9/15)	Y.1720 (Amend. 1)	Protection switching for MPLS networks	02/2008
ITU-T (Q.10/15)	G.8011/Y.1307	Ethernet service characteristics	01/2009
ITU-T (Q.10/15)	G.8011.1/Y.1307.1	Ethernet Private Line Service	01/2009
ITU-T (Q.10/15)	G.8011.2/Y.1307.2	Ethernet Virtual Private Line Service	01/2009
SG15(Q.10/15)	G.8011.3/Y.1307.3	Ethernet Virtual Private LAN Service	02/2010
SG15(Q.10/15)	G.8011.4/Y.1307.4	Ethernet Virtual Private Routed Multipoint Service	02/2010
SG15(Q.10/15)	G.8011.5/Y.1307.5	Ethernet Private LAN service	02/2010
ITU-T (Q.10/15)	G.8012/Y.1308	Ethernet UNI and Ethernet NNI	08/2004
ITU-T (Q.10/15)	G.8012/Y.1308 (Amend. 1)	Ethernet UNI and Ethernet NNI	05/2006
ITU-T (Q.10/15)	G.8112/Y.1371 *	Interfaces for the Transport MPLS (T-MPLS) hierarchy	10/2006
ITU-T (Q.10/15)	G.8112/Y.1371) * (Corrig. 1)	Interfaces for the Transport MPLS (T-MPLS) hierarchy	01/2007
ITU-T (Q.10/15)	Y.1710	Requirements for OAM functionality for MPLS networks	11/2002

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.10/15)	Y.1711	Operation & Maintenance mechanism for MPLS networks	02/2004
ITU-T (Q.10/15)	Y.1711 (Corr. 1)	Operation & Maintenance mechanism for MPLS networks	02/2005
ITU-T (Q.10/15)	Y.1711 (Amend. 1)	Operation & Maintenance mechanism for MPLS networks	10/2005
ITU-T (Q.10/15)	Y.1712	OAM functionality for ATM-MPLS interworking	01/2004
ITU-T (Q.10/15)	Y.1713	Misbranching detection for MPLS networks	03/2004
ITU-T (Q.10/15)	Y.1714	MPLS management and OAM framework	01/2009
ITU-T (Q.10/15)	Y.1730	Requirements for OAM functions in Ethernet-based networks and Ethernet services	01/2004
ITU-T (Q.10/15)	Y.1731	OAM functions and mechanisms for Ethernet based networks	02/2008
ITU-T (Q.11/15)	G.707/Y.1322	Network node interface for the synchronous digital hierarchy (SDH)	01/2007
ITU-T (Q.11/15)	G.707/Y.1322 (Amend. 1)	Network node interface for the synchronous digital hierarchy (SDH)	07/2007
ITU-T (Q.11/15)	G.707/Y.1322 (Amend. 2)	Network node interface for the synchronous digital hierarchy (SDH)	11/2009
ITU-T (Q.11/15)	G.709/Y.1331	Interfaces for the optical transport network (OTN)	12/2009
ITU-T (Q.11/15)	G.Imp709/Y.1331	Implementer's Guide to G.709	05/2005
ITU-T (Q.11/15)	G.7041/Y.1303	Generic framing procedure (GFP)	10/2008
ITU-T (Q.11/15)	G.7041/Y.1303 (Amend. 1)	Generic framing procedure (GFP)	01/2009
ITU-T (Q.11/15)	G.7042/Y.1305	Link capacity adjustment scheme (LCAS) for virtual concatenated signals	03/2006
ITU-T (Q.11/15)	G.7043/Y.1343	Virtual Concatenation of PDH Signals	07/2004
ITU-T (Q.11/15)	G.7043/Y.1343 (Amend. 1)	Virtual Concatenation of PDH Signals	01/2005
ITU-T (Q.11/15)	G.7043/Y.1343 (Corrig.. 1)	Virtual Concatenation of PDH Signals	12/2006
ITU-T (Q.11/15)	G.Sup43	Transport of IEEE 10GBASE-R in optical transport networks (OTN)	01/2009
ITU-T (Q.12/15)	G.800	Unified functional architecture of transport networks	09/2007
ITU-T (Q.12/15)	G.800 (Amend. 1)	Techniques to enhance the availability of transport networks	03/2009
ITU-T (Q.12/15)	G.805	Generic functional architecture of transport networks	03/2000
ITU-T (Q.12/15)	G.872	Architecture of optical transport networks	11/2001
ITU-T (Q.12/15)	G.872 (Amend. 1)	Architecture of optical transport networks	12/2003
ITU-T (Q.12/15)	G.872 (Corrig. 1)	Architecture of optical transport networks	01/2005
ITU-T (Q.12/15)	G.Imp872	Implementer's Guide to G.872	05/2005

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.12/15)	G.8080/Y.1304	Architecture for the Automatically Switched Optical Network (ASON)	06/2006
ITU-T (Q.12/15)	G.8080/Y.1304 (Err. 1)	Architecture for the Automatically Switched Optical Network (ASON)	04/2007
ITU-T (Q.12/15)	G.8080/Y.1304 (Corrig. 1)	Architecture for the Automatically Switched Optical Network (ASON)	09/2007
ITU-T (Q.12/15)	G.8080/Y.1304 (Amend. 1)	Architecture for the Automatically Switched Optical Network (ASON)	03/2008
ITU-T (Q.12/15)	G.Imp8080/ Y.1304	Implementer's Guide to G.8080/Y.1304	06/2007
ITU-T (Q.12/15)	G.8010/Y.1306	Ethernet Layer Network Architecture	02/2004
ITU-T (Q.12/15)	G.8010/Y.1306 (Amend 1)	Ethernet Layer Network Architecture	05/2006
ITU-T (Q.12/15)	G.8010/Y.1306 (Err. 1)	Ethernet Layer Network Architecture	09/2007
ITU-T (Q.12/15)	G.8010/Y.1306 (Err. 2	Ethernet Layer Network Architecture	10/2007
ITU-T (Q.12/15)	G.8110/Y.1370	MPLS Layer Network Architecture	01/2005
ITU-T (Q.12/15)	G.8110.1/Y.1370.1 *	Architecture of Transport MPLS (T-MPLS) layer network	11/2006
ITU-T (Q.12/15)	G.8110.1/Y.1370.1 * (Amend. 1)	Architecture of Transport MPLS (T-MPLS) layer network	07/2007
ITU-T (Q.13/15)	G.813	Timing Characteristics of SDH Equipment Slave Clocks (SEC)	03/2003
ITU-T (Q.13/15)	G.813 (Corrig. 1)	Timing Characteristics of SDH Equipment Slave Clocks (SEC)	06/2005
ITU-T (Q.13/15)	G.8251	The Control of Jitter and Wander within the Optical Transport Network (OTN)	11/2001
ITU-T (Q.13/15)	G.8251 (Amend. 1)	The Control of Jitter and Wander within the Optical Transport Network (OTN)	06/2002
ITU-T (Q.13/15)	G.8251 (Corrig. 1)	The Control of Jitter and Wander within the Optical Transport Network (OTN)	06/2002
ITU-T (Q.13/15)	G.8251 (Corrig. 2)	The Control of Jitter and Wander within the Optical Transport Network (OTN)	05/2008
ITU-T (Q.13/15)	G.8251 (Amend. 2)	The Control of Jitter and Wander within the Optical Transport Network (OTN)	01/2010
ITU-T (Q.13/15)	G.8261/Y.1361	Timing and synchronization aspects in packet networks	04/2008
ITU-T (Q.13/15)	G.8262/Y.1362	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	08/2007
ITU-T (Q.13/15)	G.8262/Y.1362 (Amend. 1)	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	04/2008
ITU-T (Q.13/15)	G.8262/Y.1362 (Amend. 2)	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	01/2010

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.13/15)	G.8264/Y.1364	Distribution of timing information through packet networks	10/2008
ITU-T (Q.13/15)	G.8264/Y.1364 (Corrig. 1)	Distribution of timing information through packet networks	11/2009
ITU-T (Q.14/15)	G.784	Management aspects of synchronous digital hierarchy (SDH) transport network elements	03/2008
ITU-T (Q.14/15)	G.874	Management aspects of optical transport network elements	03/2008
ITU-T (Q.14/15)	G.Imp874	Implementer's Guide to G.874	05/2005
ITU-T (Q.14/15)	G.874.1	Optical Transport Network (OTN) Protocol-Neutral Management Information Model For The Network Element View	01/2002
ITU-T (Q.14/15)	G.Imp874.1	Implementer's Guide to G.874.1	05/2005
ITU-T (Q.14/15)	G.7710/Y.1701	Common equipment management function requirements	07/2007
ITU-T (Q.14/15)	G.7710/Y.1701 (Corrig. 1)	Common equipment management function requirements	11/2009
ITU-T (Q.14/15)	G.7712/Y.1703	Architecture and specification of data communication network	06/2008
ITU-T (Q.14/15)	G.7713/Y.1704	Distributed call and connection management (DCM)	11/2009
ITU-T (Q.14/15)	G.Imp7713/ Y.1704	Implementer's Guide to G.7713/Y.1704	05/2005
ITU-T (Q.14/15)	G.7713.1/ Y.1704.1	Distributed Call and Connection Management (DCM) based on PNNI	03/2003
ITU-T (Q.14/15)	G.Imp7713.1/ Y.1704.1	Implementer's Guide to G.7713.1/Y.1704.1	05/2005
ITU-T (Q.14/15)	G.7713.2/ Y.1704.2	Distributed Call and Connection Management: Signalling mechanism using GMPLS RSVP-TE	03/2003
ITU-T (Q.14/15)	G.Imp7713.2/ Y.1704.2	Implementer's Guide to G.7713.2/Y.1704.2	05/2005
ITU-T (Q.14/15)	G.7713.3/ Y.1704.3	Distributed Call and Connection Management: Signalling mechanism using GMPLS CR-LDP	03/2003
ITU-T (Q.14/15)	G.Imp7713.3/ Y.1704.3	Implementer's Guide to G.7713.3/Y.1704.3	05/2005
ITU-T (Q.14/15)	G.7714/Y.1705	Generalized automatic discovery for transport entities	08/2005
ITU-T (Q.14/15)	G.7714.1/ Y.1705.1	Protocol for automatic discovery in SDH and OTN networks	04/2003
ITU-T (Q.14/15)	G.7714.1/ Y.1705.1 (Amend. 1)	Protocol for automatic discovery in SDH and OTN networks	02/2006
ITU-T (Q.14/15)	G.Imp7714.1/ Y.1705.1	Implementer's Guide to G.7714.1/Y.1705.1	05/2005
ITU-T (Q.14/15)	G.7715/Y.1706	Architecture and requirements for routing in automatically switched optical networks	06/2002

Organisation (Subgroup responsible)	Number	Title	Publication Date
ITU-T (Q.14/15)	G.7715/Y.1706 (Amend. 1)	Architecture and requirements for routing in automatically switched optical networks	02/2007
ITU-T (Q.14/15)	G.7715.1/Y.1706.1	ASON routing architecture and requirements for link state protocols	02/2004
ITU-T (Q.14/15)	G.7715.2/Y.1706.2	ASON routing architecture and requirements for remote route query	02/2007
ITU-T (Q.14/15)	G.7716/Y.1707	Architecture of Control Plane Operations	01/2010
ITU-T (Q.14/15)	G.7718/Y.1709	Framework for ASON management	02/2005
ITU-T (Q.14/15)	G.7718.1/Y.1709.1	Protocol-neutral management information model for the control plane view	12/2006
ITU-T (Q.14/15)	G.8051/Y.1345	Management aspects of the Ethernet-over-Transport (EoT) capable network element	11/2009
ITU-T (Q.14/15)	G.8151/Y.1374 *	Management aspects of the T-MPLS network element	10/2007
ITU-T (Q.15/15)	O.172	Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)	04/2005
ITU-T (Q.15/15)	O.172 (Erratum 1)	Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)	10/2005
ITU-T (Q.15/15)	O.172 (Amend. 1)	Jitter and wander measuring equipment for digital systems which are based on the synchronous digital hierarchy (SDH)	06/2008
ITU-T (Q.15/15)	O.173	Jitter measuring equipment for digital systems which are based on the Optical Transport Network (OTN)	03/2007
ITU-T (Q.15/15)	O.174	Jitter and wander measuring equipment for a synchronous packet network	11/2009
ITU-T (Q.15/15)	O.182	Equipment to assess error performance on Optical Transport Network interfaces	07/2007
ITU-T (Q.15/15)	O.182 (Amend. 1)	Equipment to assess error performance on Optical Transport Network interfaces	01/2009
ITU-T (Q.15/15)	O.201	Q-factor test equipment to estimate the transmission performance of optical channels	07/2003

* The next update of these Recommendations will only describe MPLS-TP and will include normative references to IETF MPLS-TP RFCs under development to meet ITU-T transport requirements.

Table 7-1-2 below lists IETF RFCs and Internet Drafts. It should be noted that all Internet-Drafts should be identified as "work in progress". This request is made, as standard, by the IETF in the following text at the head of every Internet-Draft:

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

TABLE 7-1-2/OTNT: OTNT Related Standards and Industry Agreements (IETF RFCs and Internet Drafts)

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (mpls)	RFC5317	JWT Report on MPLS Architectural Considerations for a Transport Profile	02/2009
IETF (mpls)	RFC5586	MPLS Generic Associated Channel	06/2009
IETF (mpls)	RFC5654	MPLS-TP Requirements	08/2009
IETF (mpls)	RFC5718	An Inband Data Communication Network For the MPLS Transport Profile	08/2009
IETF (mpls)	RFC5860	Requirements for OAM in MPLS Transport Networks	03/2010
IETF (mpls)	draft-ietf-mpls-tp-framework-12.txt	A Framework for MPLS in Transport Networks	05/2010
IETF (mpls)	draft-ietf-mpls-tp-nm-req-06.txt	MPLS TP Network Management Requirements	10/2009
IETF (mpls)	draft-ietf-mpls-tp-survive-fwk-05.txt	Multiprotocol Label Switching Transport Profile Survivability Framework	04/2009
IETF (mpls)	draft-ietf-mpls-tp-oam-framework-06.txt	MPLS-TP OAM Framework	04/2010
IETF (mpls)	draft-ietf-mpls-tp-nm-framework-05.txt	MPLS-TP Network Management Framework	02/2010
IETF (mpls)	draft-ietf-mpls-tp-process-05.txt	IETF Multi-Protocol Label Switching (MPLS) Transport Profile (MPLS-TP) Document Process	01/2010
IETF (mpls)	draft-ietf-mpls-tp-rosetta-stone-02.txt	A Thesaurus for the Terminology used in Multiprotocol Label Switching Transport Profile (MPLS-TP) drafts/RFCs and ITU-T's Transport Network Recommendations.	05/2010
IETF (mpls)	draft-ietf-opsawg-mpls-tp-oam-def-00.txt	The OAM Acronym Soup	09/2009
IETF (mpls)	draft-ietf-mpls-tp-data-plane-03	MPLS Transport Profile Data Plane Architecture	05/2010
IETF (mpls)	draft-ietf-mpls-tp-identifiers-01	MPLS-TP Identifiers	03/2010
IETF(mpls)	draft-ietf-mpls-tp-ach-tlv-02	Definition of ACH TLV Structure	03/2010
IETF(mpls)	draft-ietf-mpls-tp-oam-analysis-01.txt	MPLS-TP OAM Analysis	03/2010
IETF(mpls)	draft-ietf-ccamp-mpls-tp-cp-framework-01.txt	MPLS-TP Control Plane Framework	03/2010
IETF (ccamp)	RFC 3468	The Multiprotocol Label Switching (MPLS) Working Group decision on MPLS signaling protocols	02/2003
IETF (ccamp)	RFC 3609	Tracing Requirements for Generic Tunnels	09/2003

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (ccamp)	RFC 3945	Generalized Multi-Protocol Label Switching Architecture	10/2004
IETF (ccamp)	RFC 4003	GMPLS Signaling Procedure For Egress Control – updates RFC 3473	02/2005
IETF (ccamp)	RFC 4139	Requirements for Generalized MPLS (GMPLS) Signaling Usage and Extensions for Automatically Switched Optical Network (ASON)	07/2005
IETF (ccamp)	RFC 4201	Link Bundling in MPLS Traffic Engineering (TE)	10/2005
IETF (ccamp)	RFC 4202	Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)	10/2005
IETF (ccamp)	RFC 4203	OSPF Extensions in Support of Generalized Multi-Protocol Label Switching – updates RFC 3630	10/2005
IETF (ccamp)	RFC 4204	Link Management Protocol (LMP)	10/2005
IETF (ccamp)	RFC 4207	Synchronous Optical Network (SONET)/Synchronous Digital Hierarchy (SDH) Encoding for Link Management Protocol (LMP) Test Messages	10/2005
IETF (ccamp)	RFC4208	Generalize Multiprotocol Label Switching(GMPLS) User-Network Interface (UNI): Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Support for the Overlay Model	10/2005
IETF (ccamp)	RFC4209	Link Management Protocol (LMP) for Dense Wavelength Division Multiplexing (DWDM) Optical Line Systems	10/2005
IETF (ccamp)	RFC4258	Requirements for Generalized Multi-Protocol Label Switching (GMPLS) Routing for the Automatically Switched Optical Network (ASON)	11/2005
IETF (ccamp)	RFC4257	Framework for Generalized Multi-Protocol Label Switching (GMPLS)-based Control of Synchronous Digital Hierarchy/Synchronous Optical Networking (SDH/SONET) Networks	12/2005
IETF (ccamp)	RFC4328	Generalized Multi-Protocol Label Switching (GMPLS) Signaling Extensions for G.709 Optical Transport Networks Control – updates RFC 3471	01/2006
IETF (ccamp)	RFC4394	A Transport Network View of the Link Management Protocol	02/2006
IETF (ccamp)	RFC4397	A Lexicography for the Interpretation of Generalized Multiprotocol Label Switching (GMPLS) Terminology within The Context of the ITU-T's Automatically Switched Optical Network (ASON) Architecture	02/2006
IETF (ccamp)	RFC4426	Generalized Multi-Protocol Label Switching (GMPLS) Recovery Functional Specification	03/2006
IETF (ccamp)	RFC4427	Recovery (Protection and Restoration) Terminology for Generalized Multi-Protocol Label Switching (GMPLS)	03/2006

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (ccamp)	RFC4428	Analysis of Generalized Multi-Protocol Label Switching (GMPLS)-based Recovery Mechanisms (including Protection and Restoration)	03/2006
IETF (ccamp)	RFC4558	Node ID based RSVP Hello: A Clarification Statement	06/2006
IETF (ccamp)	RFC4606	Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control	08/2006
IETF (ccamp)	RFC4631	Link Management Protocol (LMP) Management Information Base (MIB) – updates RFC4327	09/2006
IETF (ccamp)	RFC4652	Evaluation of existing Routing Protocols against ASON routing requirements	10/2006
IETF (ccamp)	RFC4726	A Framework for Inter-Domain MPLS Traffic Engineering	11/2006
IETF (ccamp)	RFC4736	Reoptimization of Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) loosely routed Label Switch Path (LSP)	11/2006
IETF (ccamp)	RFC4783	GMPLS – Communication of Alarm Information	12/2006
IETF (ccamp)	RFC4801	Definitions of Textual Conventions for Generalized Multiprotocol Label Switching (GMPLS) Management	02/2007
IETF (ccamp)	RFC4802	Generalized Multiprotocol Label Switching (GMPLS) Traffic Engineering Management Information Base	02/2007
IETF (ccamp)	RFC4803	Generalized Multiprotocol Label Switching (GMPLS) Label Switching Router (LSR) Management Information Base	02/2007
IETF (ccamp)	RFC4872	RSVP-TE Extensions in support of End-to-End Generalized Multi-Protocol Label Switching (GMPLS)-based Recovery	05/2007
IETF (ccamp)	RFC4873	GMPLS Based Segment Recovery	05/2007
IETF (ccamp)	RFC4874	Exclude Routes – Extension to RSVP-TE	04/2007
IETF (ccamp)	RFC4920	Crankback Signaling Extensions for MPLS and GMPLS RSVP-TE	07/2007
IETF (ccamp)	RFC4972	Routing extensions for discovery of Multiprotocol (MPLS) Label Switch Router (LSR) Traffic Engineering (TE) mesh membership	07/2007
IETF (ccamp)	RFC4974	Generalized MPLS (GMPLS) RSVP-TE Signaling Extensions in support of Calls	08/2007
IETF (ccamp)	RFC4990	Use of Addresses in Generalized Multi-Protocol Label Switching (GMPLS) Networks	09/2007
IETF (ccamp)	RFC5063	Extensions to GMPLS RSVP Graceful Restart	10/2007
IETF (ccamp)	RFC5073	IGP Routing Protocol Extensions for Discovery of Traffic Engineering Node Capabilities	12/2007

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (ccamp)	RFC5145	Framework for MPLS-TE to GMPLS Migration	03/2008
IETF (ccamp)	RFC5146	Interworking Requirements to Support Operation of MPLS-TE over GMPLS Networks	03/2008
IETF (ccamp)	RFC5150	Label Switched Path Stitching with Generalized Multiprotocol Label Switching Traffic Engineering (GMPLS TE)	02/2008
IETF (ccamp)	RFC5151	Inter-Domain MPLS and GMPLS Traffic Engineering -- Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions	02/2008
IETF (ccamp)	RFC5152	A Per-Domain Path Computation Method for Establishing Inter-Domain Traffic Engineering (TE) Label Switched Paths (LSPs)	02/2008
IETF (ccamp)	RFC5212	Requirements for GMPLS-Based Multi-Region and Multi-Layer Networks (MRN/MLN)	07/2008
IETF (ccamp)	RFC5298	Analysis of Inter-Domain Label Switched Path (LSP) Recovery	08/2008
IETF (ccamp)	RFC5316	ISIS Extensions in Support of Inter-Autonomous System (AS) MPLS and GMPLS Traffic Engineering	12/2008
IETF (ccamp)	RFC5339	Evaluation of Existing GMPLS Protocols against Multi-Layer and Multi-Region Networks (MLN/MRN)	09/2008
IETF (ccamp)	RFC5392	OSPF Extensions in Support of Inter-Autonomous System (AS) MPLS and GMPLS Traffic Engineering	01/2009
IETF (ccamp)	RFC5420 (replaces RFC4420)	Encoding of Attributes for MPLS LSP Establishment Using Resource Reservation Protocol Traffic Engineering (RSVP-TE)	02/2009
IETF (ccamp)	RFC5467	GMPLS Asymmetric Bandwidth Bidirectional Label Switched Paths (LSPs)	03/2009
IETF (ccamp)	RFC5493	Requirements for the Conversion between Permanent Connections and Switched Connections in a Generalized Multiprotocol Label Switching (GMPLS) Network	04/2009
IETF (ccamp)	RFC5495	Description of the Resource Reservation Protocol - Traffic-Engineered (RSVP-TE) Graceful Restart Procedures	03/2009
IETF (ccamp)	RFC5553	Resource Reservation Protocol (RSVP) Extensions for Path Key Support	05/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-g-694-lambda-labels-04.txt	Generalized Labels for G.694 Lambda-Switching Capable Label Switching Routers	03/2009
IETF (ccamp)	draft-ietf-ccamp-ethernet-traffic-parameters-08.txt	Ethernet Traffic Parameters	04/2009
IETF (ccamp)	draft-ietf-ccamp-wson-impairments-00.txt	A Framework for the Control of Wavelength Switched Optical Networks (WSON) with Impairments	06/2009

Organisation (Subgroup responsible)	**Number**	**Title**	**Publication Date**
IETF (ccamp)	draft-ietf-ccamp-ethernet-gmpls-provider-reqs-02.txt	Service Provider Requirements for Ethernet control with GMPLS	06/2009
IETF (ccamp)	draft-ietf-ccamp-rwa-wson-encode-02.txt	Routing and Wavelength Assignment Information Encoding for Wavelength Switched Optical Networks	07/2009
IETF (ccamp)	draft-ietf-ccamp-pc-spc-rsvpte-ext-03.txt	RSVP-TE Signaling Extension For Management Plane To Control Plane LSP Handover In A GMPLS Enabled Transport Network	07/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-mln-extensions-07.txt	Generalized Multi-Protocol Label Switching (GMPLS) Protocol Extensions for Multi-Layer and Multi-Region Networks (MLN/MRN)	08/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-ason-routing-ospf-09.txt	OSPFv2 Routing Protocols Extensions for ASON Routing	08/2009 (awaiting RFC #)
IETF (ccamp)	draft-ietf-ccamp-confirm-data-channel-status-07.txt	Data Channel Status Confirmation Extensions for the Link Management Protocol	09/2009
IETF (ccamp)	draft-ietf-ccamp-rwa-wson-framework-03.txt	Framework for GMPLS and PCE Control of Wavelength Switched Optical Networks (WSON)	09/2009
IETF (ccamp)	draft-ietf-ccamp-lsp-dppm-08.txt	Label Switched Path (LSP) Dynamic Provisioning Performance Metrics in Generalized MPLS Networks	09/2009
IETF (ccamp)	draft-ietf-ccamp-rwa-info-04.txt	Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks	09/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-ethernet-arch-05.txt	Generalized Multi-Protocol Label Switching (GMPLS) Ethernet Label Switching Architecture and Framework	09/2009
IETF (ccamp)	draft-ietf-ccamp-mpls-graceful-shutdown-10.txt	Graceful Shutdown in MPLS and Generalized MPLS Traffic Engineering Networks	09/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-vcat-lcas-08.txt	Operating Virtual Concatenation (VCAT) and the Link Capacity Adjustment Scheme (LCAS) with Generalized Multi-Protocol Label Switching (GMPLS)	07/2009
IETF (ccamp)	draft-ietf-ccamp-gmpls-ted-mib-05.txt	Traffic Engineering Database Management Information Base in support of GMPLS	01/2009
IETF (ccamp)	draft-ietf-ccamp-rwa-info-04.txt	Routing and Wavelength Assignment Information Model for Wavelength Switched Optical Networks	09/2009
IETF (ccamp)	draft-ietf-ccamp-oam-configuration-fwk-03	OAM Configuration Framework and Requirements for GMPLS RSVP-TE	01/2010
IETF (pce)	RFC 4655	A Path Computation Element (PCE) Based Architecture	08/2006
IETF (pce)	RFC 4657	Path Computation Element (PCE) Communication Protocol Generic Requirements	09/2006

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (pce)	RFC 4674	Requirements for Path Computation Element (PCE) Discovery	10/2006
IETF (pce)	RFC4927	PCE Communication Protocol (PCECP) Specific Requirements for Inter-Area Multi Protocol Label Switching (MPLS) and Generalized MPLS (GMPLS) Traffic Engineering	07/2007
IETF (pce)	RFC 5088	OSPF Protocol Extensions for Path Computation Element (PCE) Discovery	01/2008
IETF (pce)	RFC 5089	IS-IS Protocol Extensions for Path Computation Element (PCE) Discovery	01/2008
IETF (pce)	RFC 5376	Inter-AS Requirements for the Path Computation Element Communication Protocol (PCECP)	11/2008
IETF (pce)	RFC 5394	Policy-Enabled Path Computation Framework	12/2008
IETF (pce)	RFC 5440	Path Computation Element (PCE) Communication Protocol (PCEP)	03/2009
IETF (pce)	RFC 5441	A Backward-Recursive PCE-Based Computation (BRPC) Procedure to Compute Shortest Constrained Inter-Domain Traffic Engineering Label Switched Paths	04/2009
IETF (pce)	RFC 5455	Diffserv-Aware Class-Type Object for the Path Computation Element Communication Protocol	03/2009
IETF (pce)	draft-ietf-pce-vpn-req-00.txt	PCC-PCE Communication Requirements for VPNs	03/2009
IETF (pce)	RFC 5520	Preserving Topology Confidentiality in Inter-Domain Path Computation Using a Path-Key-Based Mechanism	04/2009
IETF (pce)	RFG 5521	Extensions to the Path Computation Element Communication Protocol (PCEP) for Route Exclusions	04/2009
IETF (pce)	RFC 5541	Encoding of Objective Functions in the Path Computation Element Communication Protocol (PCEP)	06/2009
IETF (pce)	draft-ietf-pce-monitoring-05.txt	A set of monitoring tools for Path Computation Element based Architecture	06/2009
IETF (pce)	RFC 5557	Path Computation Element Communication Protocol (PCEP) Requirements and Protocol Extensions in Support of Global Concurrent Optimization	07/2009
IETF (pce)	draft-ietf-pce-gmpls-aps-req-01.txt	Requirements for GMPLS applications of PCE	07/2009
IETF (pce)	draft-ietf-pce-manageability-requirements-07.txt	Inclusion of Manageability Sections in PCE Working Group Drafts	07/2009
IETF (pce)	draft-ietf-pce-vendor-constraints-00.txt	Conveying Vendor-Specific Constraints in the Path Computation Element Protocol	07/2009

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (pce)	draft-ietf-pce-pcep-svec-list-02.txt	The use of SVEC (Synchronization VECtor) list for Synchronized dependent path computations	08/2009
IETF (pce)	draft-ietf-pce-inter-layer-req-10.txt	PCC-PCE Communication Requirements for Inter-Layer Traffic Engineering	08/2009
IETF (pce)	draft-ietf-pce-inter-layer-frwk-10.txt	Framework for PCE-Based Inter-Layer MPLS and GMPLS Traffic Engineering	03/2009 (awaiting RFC #)
IETF(opsawg)	draft-ietf-opsawg-mpls-tp-oam-def-05.txt	"The OAM Acronym Soup"	05/2010

TABLE 7-1-3/OTNT: OTNT Related Standards and Industry Agreements (IEEE 802 standards)

Organisation (Subgroup responsible)	Number	Title	Publication Date
IEEE 802.1	IEEE Std. 802.1D-2004	Media access control (MAC) Bridges (Incorporates IEEE 802.1t-2001 and IEEE 802.1w)	06/2004
IEEE 802.1	IEEE Std. 802.1Q-2005	Virtual Bridged Local Area Networks—Revision	05/2006
IEEE 802.1	IEEE Std. 802.1ad-2005	Amendment to IEEE 802.1Q-2005. Virtual Bridged Local Area Networks—Revision—Amendment 4: Provider Bridges	05/2006
IEEE 802.1	IEEE Std. 802.1ag-2007	Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management	12/2007
IEEE 802.1	IEEE Std. 802.1ah-2008	Virtual Bridged Local Area Networks Amendment 7: Provider Backbone Bridges	08/2008
IEEE 802.1	IEEE Std 802.1 AX-2008	Link Aggregation	11/2008
IEEE 802.1	IEEE Std. 802.1Qay-2009	Virtual Bridged Local Area Networks - Amendment 10: Provider Backbone Bridge Traffic Engineering	06/2009
IEEE 802.3	IEEE Std. 802.3-2008	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications	12/2008
IEEE 802.3	IEEE Std 802.3at-2009	Amendment to 802.3： Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements	10/2009
IEEE 802.3	IEEE Std. 802.3av-2009	Amendment to 802.3: Physical Layer Specifications and Management Parameters for 10 Gb/s Passive Optical Networks	10/2009
IEEE 802.3	IEEE Std 802.3bc-2009	Amendement to 802.3: Ethernet Organizationally Specific Type, Lengh, Value(TLVs)	09/2009
IEEE 802.3	IEEE Std 802.3-2008/Cor1-2009	Corrigendum to 802.3: Timing Considerations for PAUSE Operation	02/2010

Organisation (Subgroup responsible)	Number	Title	Publication Date
IEEE 802.17	IEEE Std. 802.17-2004	Resilient packet ring (RPR) access method and physical layer specifications	09/2004
IEEE 802.17	IEEE Std. 802.17a-2004	Media Access Control (MAC) Bridges - Amendment 1: Bridging of IEEE Std 802.17	09/2004
IEEE 802.17	IEEE Std. 802.17b-2007	Resilient packet ring (RPR) access method and physical layer specifications - Amendment 2: Spatially aware sublayer	07/2007
IEEE 802.17	IEEE Std. 802.17c-2009	Resilient Packet Ring (RPR) Access Method and Physical Layer Specifications - Amendment 3 - Protected Inter-Ring Connection	09/2009 (Sponsor Ballot)

TABLE 7-1-4/OTNT: OTNT Related Standards and Industry Agreements (OIF documents)

Organisation (Subgroup responsible)	Number	Title	Publication Date
OIF	OIF-TL-01.1	Implementation Agreement for Common Software Protocol, Control Syntax, and Physical (Electrical and Mechanical) Interfaces for Tunable Laser Modules.	11/2002
OIF	OIF-TLMSA-01.0	Multi-Source Agreement for CW Tunable Lasers.	05/2003
OIF	OIF-ITLA-MSA-01.0	Integratable Tunable Laser Assembly Multi-Source Agreement.	06/2004
OIF	OIF-ITLA-MSA-01.1	Integrable Tunable Laser Assembly Multi Source Agreement	11/2005
OIF	OIF-ITLA-MSA-01.2	Integrable Tunable Laser Assembly Multi Source Agreement	06/2008
OIF	OIF-ITTA-MSA-01.0	Integrable Tunable Transmitter Assembly Multi Source Agreement	11/2008
OIF	OIF-UNI-01.0	User Network Interface (UNI) 1.0 Signaling Specification	10/2001
OIF	OIF-UNI-01.0-R2-Common	User Network Interface (UNI) 1.0 Signaling Specification, Release 2: Common Part	02/2004
OIF	OIF-UNI-01.0-R2-RSVP	RSVP Extensions for User Network Interface (UNI) 1.0 Signaling, Release 2	02/2004
OIF	OIF-UNI-02.0-Common	User Network Interface (UNI) 2.0 Signaling Specification: Common Part	02/2008
OIF	OIF-UNI-02.0-RSVP	User Network Interface (UNI) 2.0 Signaling Specification: RSVP Extensions for User Network Interface (UNI) 2.0	02/2008
OIF	OIF-CDR-01.0	Call Detail Records for OIF UNI 1.0 Billing	04/2002
OIF	OIF-SEP-01.0	Security Extension for UNI and NNI	05/2003
OIF	OIF-SEP-02.1	Addendum to the Security Extension for UNI and NNI	03/2006

Organisation (Subgroup responsible)	Number	Title	Publication Date
OIF	OIF-SLG-01.0	OIF Control Plane Logging and Auditing with Syslog	11/2007
OIF	OIF-E-NNI-Sig-01.0	Intra-Carrier E-NNI Signaling Specification	02/2004
OIF	OIF-E-NNI-Sig-02.0	E-NNI Signaling Specification	04/2009
OIF	OIF-ENNI-OSPF-01.0	External Network-Network Interface (E-NNI) OSPF-based Routing - 1.0 (Intra-Carrier) Implementation Agreement	01/2007
OIF	OIF-G-Sig-IW-01.0	OIF Guideline Document: Signaling Protocol Interworking of ASON/GMPLS Network Domains	06/2008
OIF	OIF-SMI-01.0	Security Management Interfaces to Network Elements	09/2003
OIF	OIF-SMI-02.1	Addendum to the Security for Management Interfaces to Network Elements	03/2006
OIF	OIF-VSR4-01.0	Very Short Reach (VSR) OC-192 Interface for Parallel Optics	12/2000
OIF	OIF-VSR4-03.0	Very Short Reach (VSR) OC-192 Four Fiber Interface Based on Parallel Optics	07/2003
OIF	OIF-VSR4-04.0	Serial Shortwave Very Short Reach (VSR) OC-192 Interface for Multimode Fiber	01/2001
OIF	OIF-VSR4-05.0	Very Short Reach (VSR) OC-192 Interface Using 1310 Wavelength and 4 and 11 dB Link Budgets	10/2002
OIF	OIF-VSR5-01.0	Very Short Reach Interface Level 5 (VSR-5): SONET/SDH OC-768 Interface for Very Short Reach (VSR) Applications	09/2002
OIF	OIF-LRI-02.0	Interoperability for Long Reach and Extended Reach 10 Gb/s Transponders and Transceivers	07/2006
OIF	OIF-FD-100G-DWDM-01.0	100G Ultra Long Haul DWDM Framework Document	06/2009

7.2 SDH & SONET Related Recommendations and Standards

The following table lists all the known documents specifically related to SDH and SONET.

TABLE 7-2/OTNT: SDH & SONET Recommendations & Industry Standards

	ITU-T Published Recommendation	Published or Draft (Revised) ETS or EN	Published or Draft (Revised) ATIS/ANSI
Internet Document Source	http://www.itu.int/publications/itut.htm	http://www.etsi.org/WebSite/Standards/Standard.aspx	http://www.atis.org/docstore/default.aspx
Physical Interfaces	G.703 (11/01), Cor. 1 (03/08) G.957 (3/06), G.692 (10/98), Cor.1(01/00),Cor.2(06/02), Amd1(01/05)	ETS 300 166 ETS 300 232, ETS 300 232(A1) ETS 300 166 (09/99)	ATIS-0900102.1993(R2005) ATIS-0900105.06.2002 (R2007) ATIS-0600416.1999(R2005) ATIS-0600416.01.1999

	ITU-T Published Recommendation	**Published or Draft (Revised) ETS or EN**	**Published or Draft (Revised) ATIS/ANSI**
	G.691 (03/06)		(R2005) ATIS-0600416.02.1999 (R2005) ATIS-0600416.03.1999 (R2005)
Network Architecture	G.805 (03/00) G.803 (03/00), Amd1 (06/05)	ETR 114	ATIS-0900105.04.1995 (R2005)
Structures & Mappings	G.704 (10/98) G.707 (01/07) , Amd1(07/07), Amd2(11/09) G.7041 (10/08), Amd1 (01/09) G.7042 (03/06) G.708 (07/99) G.832 (10/98), Amd1 (06/04)	ETS 300 167 (08/93), (09/99) ETS 300 147 Ed.3 ETS 300 337 Ed.2	ATIS-0900105.2008 (01/08) ATIS-0900105.02.2007 (09/07)
Equipment Functional Characteristics	G.781 (09/08), Corr1(11/09) G.783 (03/06), Err1(11/06), Amd1(05/08), Amd2(03/10) G.806 (01/09)	EN 300 417-x-y (x=1-7,9 y=1-2) ETS 300 635 ETS 300 785 RE/TM-1042-x-1 (x=1-5) MI/TM-4048 (9712)	-
Laser Safety	G.664 (03/06)	-	-
Transmission Protection	G.841 (10/98), Corr1 (08/02) G.842 (04/97) G.808.1 (02/10) M.2102 (02/00)	ETS 300 746 ETS 300 417-1-1 ETS 300 417-3-1 ETS 300 417-4-1 TS 101 009 TS 101 010 RE/TM-1042 TR/TM-03070	ATIS-0900105.01.2000 (R2005)
Equipment Protection	M.3100 (04/05)	-	-
Restoration	-	DTR/TM-3076	-
Equipment Management	G.784 (03/08)	EN 301 167 EN 300 417-7-1 DE/TM-2210-3	-
Management Communications Interfaces			ATIS-0900105.04.1995 (R2005)
Information Model	G.773 (03/93) G.774 (02/01) G.774.1 (02/01) G.774.2 (02/01) G.774.3 (02/01) G.774.4 (02/01) G.774.5 (02/01) G.774.6 (02/01) G.774.7 (02/01) G.774.8 (02/01) G.774.9 (02/01) G.774.10 (02/01)	ETS 300 304 Ed.2 ETS 300 484 ETS 300 413 ETS 300 411 ETS 300 493 prEN 301 155	ATIS-0900119.2006 (07/06) ATIS-0900119.01.2006 (06/06) ATIS-0900119.02.2006 (06/06) ATIS-0300245.1997 (R2008)

	ITU-T Published Recommendation	Published or Draft (Revised) ETS or EN	Published or Draft (Revised) ATIS/ANSI
Network Management	G.831 (03/00) G.85x.y (11/96)	ETS 300 810	ATIS-0300204.2008 (06/08)
Error Performance [network level view]	G.826 (12/02) G.827 (09/03) G.828 (03/00), Corr1 (07/01) G.829 (12/02), Corr1 (07/07) M.2101 (06/03) M.2102 (02/00) M.2110 (07/02) M.2120 (07/02) M.2130 (02/00) M.2140 (02/00)	EN 301 167	ATIS-0900105.05.2002 (R2008) ATIS-0100514.2009 (03/09)
Error Performance [equipment level view]	G.783 (03/06), Err1 (11/06), Amd1(05/08), Amd2(03/10) G.784 (03/08)	EN 300 417-x-1 RE/TM-1042	-
Jitter & Wander Performance	G.813 (03/03), Corr1 (06/05) G.822 (11/88) G.823 (03/00) G.824 (03/00) G.825 (03/00), Err1 (08/01), Amd1 (05/08) G.783 (03/06), Err1 (11/06), Amd1(05/08) , Amd2(03/10) O.171 (04/97) O.172 (04/05), Err1 (10/05), Amd1 (06/08)	EN 300 462-5-1 EN 302 084 (01/99) DEN/TM-1079 (05/98)	ATIS-0900105.03.2003 (R2008)
Leased Lines	M.1301 (01/01)	EN 301 164 EN 301 165	-
Synchronisation [Clocks & Network Architecture]	G.803 (03/00), Amd1 (06/05) G.810 (08/96), Corr1 (11/01) G.811 (09/97) G.812 (06/04), Err1 (03/05) G.813 (03/03), Corr1 (06/05)	EN 300 462-1 EN 300 462-2 EN 300 462-3 EN 300 462-4 EN 300 462-5 EN 300 462-6 EN 300 417-6-1 DEG/TM-01080 (03/99)	ATIS-0900101.2006 (11/06) ATIS-0900105.09.1996 (R2008)
Test signals	O.150 (05/96), Corr1 (05/02) O.181 (05/02)	-	-

7.3 ITU-T Recommendations on the OTN Transport Plane

The following table lists all of the known ITU-T Recommendations specifically related to the OTN Transport Plane. Many also apply to other types of optical networks.

TABLE 7-3/OTNT: ITU-T Recommendations on the OTN Transport Plane

	ITU-T Published Recommendations	Publ.
Definitions	**G.870** Definitions and Terminology for Optical Transport Networks (OTN)	03/08

	ITU-T Published Recommendations	Publ.
Framework for Recommendations	**G.871/Y.1301** Framework for Optical Transport Network Recommendations	10/00
Architectural Aspects	**G.872** Architecture of Optical Transport Networks	11/01
	G.872 Amendment 1 Architecture of Optical Transport Networks	12/03
Control Plane	ASTN/ASON recommendations are moved to specific ASTN/ASON standards page.	
Structures & Mapping	**G.709/Y.1331** Network node interface for the optical transport network (OTN)	12/09
	G.709/Y.1331 Erratum 1	05/10
	G.975 Forward Error Correction	10/00
	G.798 Characteristics of optical transport network (OTN) equipment functional blocks	12/06
	G.798 Amendment 1	12/08
	G.798 Corrigendum 1	01/09
	G.806 Characteristics of transport equipment - Description Methodology and Generic Functionality	01/09
	G.7041 Generic Framing Procedure	10/08
	G.7041 Amendment 1	01/09
	G.7042 Link capacity adjustment scheme (LCAS) for virtual concatenated signals	03/06
	G.Sup43 Transport of IEEE 10GBASE-R in optical transport networks (OTN)	01/09
Protection Switching	**G.808.1** Generic protection switching - Linear trail and subnetwork protection	03/06
	G.808.1 Amendment 1	01/09
	G.873.1 Optical Transport network (OTN) - Linear Protection	03/06
	G.Imp873.1 Implementer's Guide	05/05
Management Aspects	**G.874** Management aspects of the optical transport network element	03/08
	G.Imp874 Implementer's Guide	05/05
	G.874.1 Optical Transport Network (OTN) Protocol-Neutral Management Information Model For The Network Element View	01/02
	G.Imp874.1 Implementer's Guide	05/05
	G.7710/Y.1701 Common Equipment Management Requirements	07/07
	G.7714/Y.1705 Generalized automatic discovery for transport entities	08/05
	G.7714.1/Y.1705.1 Protocol for automatic discovery in SDH and OTN networks	04/03
	G.7714.1/Y.1705.1 Amendment 1	02/06
Data Communication Network (DCN)	**G.7712/Y.1703** Architecture and specification of data communication network	06/08
Error Performance	**G.8201** Error performance parameters and objectives for multi-operator international paths within the Optical Transport Network (OTN)	09/03
	M.2401 Error Performance Limits and Procedures for Bringing-Into-Service and Maintenance of multi-operator international paths and sections within Optical Transport Networks	12/03
Jitter & Wander Performance	**G.8251** The control of jitter and wander within the optical transport network (OTN)	11/01
	G.8251 Corrigendum 1	06/02

	ITU-T Published Recommendations	Publ.
	G.8251 Amendment 1 The control of jitter and wander within the optical transport network (OTN)	06/02
	G.8251 Corrigendum 2 The control of jitter and wander within the optical transport network (OTN)	05/08
Physical-Layer Aspects	**G.664** General Automatic Power Shut-Down Procedures for Optical Transport Systems	03/06
	G.691 Optical Interfaces for single-channel STM-64 and other SDH systems with Optical Amplifiers,	03/06
	G.692 Optical Interfaces for Multichannel Systems with Optical Amplifiers	10/98
	G.692 Corrigendum 1	01/00
	G.692 Corrigendum 2	06/02
	G.692 Amendment 1	01/05
	G.693 Optical interfaces for intra-office systems	05/06
	G.694.1 Spectral grids for WDM applications: DWDM frequency grid	06/02
	G.694.2 Spectral grids for WDM applications: CWDM wavelength grid	12/03
	G.695 Optical interfaces for Coarse Wavelength Division Multiplexing applications	12/06
	G.696.1 Intra-Domain DWDM applications	07/05
	G.696. 1 Erratum 1	03/06
	G.697 Optical monitoring for DWDM system	04/06
	G.698.1 Multichannel DWDM applications with single-channel optical interfaces	12/06
	G.698.2 Amplified multichannel DWDM applications with single channel optical interfaces	07/07
	G.959.1 Optical Transport Networking Physical Layer Interfaces	03/08
	G.Sup.39 Optical System Design and Engineering Considerations	12/08
Fibres	**G.651.1** Characteristics of a 50/125 µm multimode graded index optical fibre cable for the optical access network	07/07
	G.652 Characteristics of a single-mode optical fibre and cable	06/05
	G.653 Characteristics of a dispersion-shifted single mode optical fibre and cable	12/06
	G.654 Characteristics of a cut-off shifted single-mode fibre and cable	12/06
	G.655 Characteristics of a non-zero dispersion shifted single-mode optical fibre and cable	03/06
	G.656 Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport	12/06
	G.657 Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network	12/06
	G.Sup40 Optical fibre and cable Recommendations and standards guideline	11/06
Components & Sub-systems	**G.661** Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems	07/07
	G.662 Generic characteristics of optical amplifier devices and subsystems	07/05
	G.663 Application related aspects of optical amplifier devices and subsystems	04/00
	G.663 Amendment 1	01/03

	ITU-T Published Recommendations	Publ.
	G.665 Generic characteristics of Raman amplifiers and Raman amplified subsystems	01/05
	G.671 Transmission characteristics of optical components and subsystems	01/09

7.4 Standards on the ASTN/ASON Control Plane

The following table lists ITU-T Recommendations specifically related to the ASTN/ASON Control Plane.

TABLE 7-4-1/OTNT: Standards on the ASTN/ASON Control Plane

Topic	Title	Publ.
Definitions	**G.8081/Y.1353** Definitions and Terminology for Automatically Switched Optical Networks (ASON)	03/08
Architecture	**G.8080/Y.1304** Architecture for the Automatic Switched Optical Network (ASON)	06/06
	G.8080/Y.1304 Erratum 1	04/07
	G.8080/Y.1304 Corrigendum 1	09/07
	G.8080/Y.1304 (2001) Amendment 1	03/08
	G.Imp8080 Implementer's Guide	05/05
Protocol Neutral Specifications for key signalling elements	**G.7713/Y.1704** Distributed Call and Connection Management (DCM)	05/06
	G.Imp7713/Y.1704 Implementer's Guide	05/05
	G.7713.1/Y.1704 Distributed Call and Connection Management based on PNNI	03/03
	G.Imp7713.1/Y.1704 Implementer's Guide	05/05
	G.7713.2/Y.1704 Distributed Call and Connection Management: Signalling mechanism using GMPLS RSVP-TE	03/03
	G.Imp7713.2/Y.1704 Implementer's Guide	05/05
	G.7713.3/Y.1704 Distributed Call and Connection Management : Signalling mechanism using GMPLS CR-LDP	03/03
	G.Imp7713.3/Y.1704 Implementer's Guide	05/05
	G.7714/Y.1705 Generalised automatic discovery for transport entities	08/05
	G.7714.1/Y.1705.1 Protocol for automatic discovery in SDH and OTN networks	04/03
	G.7714.1/Y.1705.1 Amendment 1	02/06
	G.Imp7714.1 Implementer's Guide	05/05
	G.7715/Y.1706 Architecture and requirements for routing in automatically switched optical networks	06/02
	G.7715/Y.1706 Amendment 1	02/07
	G.Imp7715 Implementer's Guide	05/05

Topic	Title	Publ.
	G.7715.1/Y.1706.1 ASON routing architecture and requirements for link state protocols	02/04
	G.Imp7715.1 Implementer's Guide	05/05
	G.7715.2/Y.1706.2 ASON routing architecture and requirements for remote route query	02/07
	G.7718/Y.1709 Framework for ASON Management	02/05
	G.7718.1/Y.1709.1 Protocol-neutral management information model for the control plane view	12/06
Data Communication Network (DCN)	**G. 7712/Y.1703** Architecture and specification of data communication network	06/08

Table 7-4-2 shows the mapping of existing protocol-specific documents between ITU-T Recommendations and ones that were received from other organizations.

	Requirements Protocol neutral		Requirement Protocol dependent	Protocol specific related documents in OIF & IETF					
				UNI		I-NNI		E-NNI	
G.8080 (ASON)	G.7713 (Signalling)		G.7713.1 (PNNI)	PNNI					
			G.7713.2 (RSVP-TE)	OIF	UNI 1.0	IETF	RFC3471	OIF	E-NNI 1.0
					UNI 2.0		RFC3473		E-NNI 2.0
				IETF	RFC4208		RFC4974		G-Sig-Iw
					RFC4974		RFC4328	IETF	RFC5151
					RFC4606		RFC4139		RFC4974
									RFC5150
			G.7713.3 (CR-LDP)			IETF	RFC3471		
							RFC3472		
							RFC3468		
	G.7714 (Discovery)		G.7714.1 (SDH&OTN)	IETF	RFC4204				
					RFC5073				
					RFC5088				
					RFC5089				
	G.7715 (Routing)		G.7715.1 (Link State)			IETF	RFC4258	OIF	E-NNI 1.0
							RFC4202	IETF	gmpls-ason-routing-ospf
							RFC4652		
							RFC4393		
			G.7715.2 (RRQ)	IETF	RFC5440				
	G.7716 (C-plane operation)								
	G.7718 (Management)	G.7718.1 (Information Model)		OIF	SEP.01	IETF	RFC4801	OIF	SEP.01
					SEP.02		RFC4631		SEP.02
							RFC4802		
							RFC4783		
							RFC4803		

Table 7-4-2: Estimated mapping of protocol-specific documents in ITU-T ASON Recommendations

7.5 Standards on the Ethernet Frames, MPLS, Transport MPLS and MPLS-TP

The following tables 7-5, 7-6 and 7-7 list ITU-T Recommendations specifically related to Ethernet, MPLS and T-MPLS.

Table 7-5 Ethernet related Recommendations

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG12 (Q.17/12)	G.1563	Ethernet frame transfer and availability performance	01/2009
SG13(Q.7/13)	Y.1415	Ethernet-MPLS network interworking - User plane interworking	02/2005
SG15(Q.10/15)	Y.1730	Requirements for OAM functions in Ethernet-based networks and Ethernet services	01/2004
SG15(Q.10/15)	Y.1731	OAM functions and mechanisms for Ethernet based networks	02/2008
SG15(Q.3/15)	G.8001	Terms and definitions for Ethernet frames over transport	03/2008
SG15(Q.12/15)	G.8010/Y.1306	Architecture of Ethernet Layer Networks	02/2004
SG15(Q.12/15)	G.8010/Y.1306	Amendment 1 to Recommendation G.8010/Y.1306	05/2006
SG15(Q.12/15)	G.8010/Y.1306	Erratum 1 to Recommendation G.8010/Y.1306	09/2007
SG15(Q.12/15)	G.8010/Y.1306	Erratum 2 to Recommendation G.8010/Y.1306	10/2007
SG15(Q.10/15)	G.8011/Y.1307	Ethernet service characteristics	01/2009
SG15(Q.10/15)	G.8011.1/Y.1307.1	Ethernet private line service	01/2009
SG15(Q.10/15)	G.8011.2/Y.1307.2	Ethernet Virtual Private Line Service	01/2009
SG15(Q.10/15)	G.8011.3/Y.1307.3	Ethernet Virtual Private LAN Service	02/2010
SG15(Q.10/15)	G.8011.4/Y.1307.4	Ethernet Virtual Private Routed Multipoint Service	02/2010
SG15(Q.10/15)	G.8011.5/Y.1307.5	Ethernet Private LAN service	02/2010
SG15(Q.10/15)	G.8012/Y.1308	Ethernet UNI and Ethernet NNI	08/2004
SG15(Q.10/15)	G.8012/Y.1308	Amendment 1 to Recommendation G.8012/Y.1308	05/2006
SG15(Q.9/15)	G.8021/Y.1341	Characteristics of Ethernet transport network equipment functional blocks	12/2007
SG15(Q.9/15)	G.8021/Y.1341 (Amend. 1)	Amendment 1 to Recommendation G.8021/Y.1341	01/2009
SG15(Q.9/15)	G.8021/Y.1341 (Amend. 2)	Amendment 2 to Recommendation G.8021/Y.1341	02/2010
SG15(Q.9/15)	G.8031/Y.1342	Ethernet linear protection switching	11/2009
SG15(Q.9/15)	G.8032/Y.1344	Ethernet ring protection switching	03/2010

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG15(Q.14/15)	G.8051/Y.1345	Management aspects of the Ethernet-over-Transport (EoT) capable network element	11/2009
SG15(Q.13/15)	G.8262/Y.1362	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	08/2007
SG15(Q.13/15)	G.8262/Y.1362 (Amend 1)	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	04/2008
ITU-T (Q.13/15)	G.8262/Y.1362 (Amend. 2)	Timing characteristics of synchronous Ethernet equipment slave clock (EEC)	01/2010

Table 7-6 MPLS related Recommendations

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG13(Q.3/13)	Y.1311.1	Network-based IP VPN over MPLS architecture	07/2001
SG12 (Q.17/12)	Y.1561	Performance and availability parameters for MPLS networks	05/2004
SG13(Q.4/13)	Y.2174	Distributed RACF architecture for MPLS networks	06/2008
SG13(Q.4/13)	Y.2175	Centralized RACF architecture for MPLS core networks	11/2008
SG13(Q.12/13)	Y.1411	ATM-MPLS network interworking - Cell mode user plane interworking	02/2003
SG13(Q.12/13)	Y.1412	ATM-MPLS network interworking - Frame mode user plane interworking	11/2003
SG13(Q.12/13)	Y.1413	TDM-MPLS network interworking - User plane interworking	03/2004
SG13(Q.12/13)	Y.1413 (Corr. 1)	TDM-MPLS network interworking - User plane interworking	10/2005
SG13(Q.12/13)	Y.1414	Voice services - MPLS network interworking	07/2004
SG13(Q.12/13)	Y.1415	Ethernet-MPLS network interworking - User plane interworking	02/2005
SG13(Q.12/13)	Y.1415 (Amend. 1)	Ethernet-MPLS network interworking – User plane interworking	04/2007
SG13(Q.12/13)	Y.1416	Use of virtual trunks for ATM/MPLS client/server control plane interworking	06/2007
SG13(Q.12/13)	Y.1417	ATM and frame relay/MPLS control plane interworking: Client-server	06/2007
SG15(Q.10/15)	Y.1710	Requirements for OAM functionality for MPLS networks	11/2002
SG15(Q.10/15)	Y.1711	Operation & Maintenance mechanism for MPLS networks	02/2004
SG15(Q.10/15)	Y.1711 (Corr. 1)	Operation & Maintenance mechanism for MPLS networks	02/2005

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG15(Q.10/15)	Y.1711 (Amend. 1)	Operation & Maintenance mechanism for MPLS networks	10/2005
SG15(Q.10/15)	Y.1712	OAM functionality for ATM-MPLS interworking	01/2004
SG15(Q.10/15)	Y.1713	Misbranching detection for MPLS networks	03/2004
SG15(Q.10/15)	Y.1714	MPLS management and OAM framework	01/2009
SG15(Q.9/15)	Y.1720	Protection switching for MPLS networks	12/2006
SG15(Q.9/15)	Y.1720 (Amend. 1)	Protection switching for MPLS networks	02/2008
SG15(Q.12/15)	G.8110/Y.1370	MPLS Layer Network Architecture	01/2005

Table 7-7 T-MPLS related Recommendations

The next updates of the ITU-T Study Group Recommendations in Table 7-7 will only describe MPLS-TP and will include normative references to IETF MPLS-TP RFCs under development to meet ITU-T transport requirements.

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG15(Q.3/15)	G.8101/Y.1355	Terms and Definitions for Transport MPLS	12/2006
SG15(Q.12/15)	G.8110.1/Y.1370.1	Architecture of Transport MPLS (T-MPLS) layer network	11/2006
SG15(Q.12/15)	G.8110.1/Y.1370.1 (Amend. 1)	Architecture of Transport MPLS (T-MPLS) layer network	07/2007
SG15(Q.10/15)	G.8112/Y.1371	Interfaces for the Transport MPLS (T-MPLS) hierarchy	10/2006
SG15(Q.10/15)	G.8112/Y.1371 (Corrig. 1)	Interfaces for the Transport MPLS (T-MPLS) hierarchy	01/2007
SG13(Q.5/13)	Y.Sup4	Supplement on transport requirements for T-MPLS OAM and considerations for the application of IETF MPLS technology	01/2008
SG15(Q.9/15)	G.8121/Y.1381	Characteristics of Transport MPLS (T-MPLS) equipment functional blocks	03/2006
SG15(Q.9/15)	G.8121/Y.1381 (Corrig. 1)	Characteristics of Transport MPLS (T-MPLS) equipment functional blocks	12/2006
SG15(Q.9/15)	G.8121/Y.1381 (Amend. 1)	Characteristics of Transport MPLS (T-MPLS) equipment functional blocks	10/2007
SG15(Q.9/15)	G.8131/Y.1382	Linear protection switching for transport MPLS (T-MPLS) networks	02/2007
SG15(Q.9/15)	G.8131/Y.1382 (Amend. 1)	Linear protection switching for transport MPLS (T-MPLS) networks	09/2007
SG15(Q.14/15)	G.8151/Y.1374	Management aspects of the T-MPLS network element	10/2007

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG15(Q.14/15)	G.8152/Y.1375	Protocol-neutral management information model for the T-MPLS network element	Planned 2010

The following Table 7-8 lists the IETF MPLS-TP RFCs and Internet Drafts specifically related to the ITU-T MPLS-TP Recommendations.

Table 7-8 MPLS-TP-related IETF RFCs and Internet Drafts

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF (mpls)	RFC5317	JWT Report on MPLS Architectural Considerations for a Transport Profile	02/2009
IETF (mpls)	RFC5586	MPLS Generic Associated Channel	06/2009
IETF (mpls)	RFC5654	MPLS-TP Requirements	08/2009
IETF (mpls)	RFC5718	An Inband Data Communication Network For the MPLS Transport Profile	08/2009
IETF (mpls)	RFC5860	Requirements for OAM in MPLS Transport Networks	03/2010
IETF (mpls)	draft-ietf-mpls-tp-framework-12.txt	A Framework for MPLS in Transport Networks	05/2010
IETF (mpls)	draft-ietf-mpls-tp-nm-req-06.txt	MPLS TP Network Management Requirements	10/2009
IETF (mpls)	draft-ietf-mpls-tp-survive-fwk-05.txt	Multiprotocol Label Switching Transport Profile Survivability Framework	04/2009
IETF (mpls)	draft-ietf-mpls-tp-oam-framework-06.txt	MPLS-TP OAM Framework	04/2010
IETF (mpls)	draft-ietf-mpls-tp-nm-framework-05.txt	MPLS-TP Network Management Framework	02/2010
IETF (mpls)	draft-ietf-mpls-tp-process-05.txt	IETF Multi-Protocol Label Switching (MPLS) Transport Profile (MPLS-TP) Document Process	01/2010
IETF (mpls)	draft-ietf-mpls-tp-rosetta-stone-02.txt	A Thesaurus for the Terminology used in Multiprotocol Label Switching Transport Profile (MPLS-TP) drafts/RFCs and ITU-T's Transport Network Recommendations.	05/2010
IETF (mpls)	draft-ietf-opsawg-mpls-tp-oam-def-00.txt	The OAM Acronym Soup	09/2009
IETF (ccamp)	draft-ietf-ccamp-oam-configuration-fwk-03	OAM Configuration Framework and Requirements for GMPLS RSVP-TE	01/2010

Organisation (Subgroup responsible)	Number	Title	Publication Date
IETF(opsawg)	draft-ietf-opsawg-mpls-tp-oam-def-05.txt	"The OAM Acronym Soup"	05/2010

7.6 Standards on the NGN

The following table lists ITU-T Recommendations specifically related to the NGN. ITU-T Study Group 13 also maintains an NGN project management tool at URL http://www.itu.int/ngnproject/ that contains the status of all items related to the NGN.

Table 7-9 NGN related Recommendations

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG3	D.271	Charging and accounting principles for NGN	04/2008
SG13	Y.2001	General overview of NGN	12/2004
SG13	Y.2006	Description of capability set 1 of NGN release 1	02/2008
SG13	Y.2011	General principles and general reference model for next generation networks	10/2004
SG13	Y.2012	Functional requirements and architecture of the NGN release 1	09/2006
SG13	Y.2013	Converged services framework functional requirements and architecture	12/2006
SG13	Y.2014	Network attachment control functions in next generation networks	05/2008
SG13	Y.2015	General requirements for ID/locator separation in NGN	01/2009
SG13	Y.2016	Functional requirements and architecture of the NGN for applications and services using tag-based identification	08/2009
SG13	Y.2021	IMS for Next Generation Networks	09/2006
SG13	Y.2031	PSTN/ISDN emulation architecture	09/2006
SG13	Y.2091	Terms and definitions for Next Generation Networks	02/2008
SG13	Y.2111	Resource and admission control functions in Next Generation Networks	11/2008
SG13	Y.2112	A QoS control architecture for Ethernet-based IP access network	06/2007
SG13	Y.2113	Ethernet QoS control for next generation networks	01/2009
SG13	Y.2121	Requirements for the support of flow-state-aware transport technology in NGN	01/2008
SG13	Y.2122	Flow aggregate information exchange functions in NGN	06/2009
SG13	Y.2171	Admission control priority levels in Next Generation Networks	09/2006
SG13	Y.2172	Service restoration priority levels in Next Generation Networks	06/2007
SG13	Y.2173	Management of performance measurement for NGN	09/2008

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG13	Y.2201	NGN release 1 requirements	04/2007
SG13	Y.2205	Next Generation Networks – Emergency telecommunications – Technical considerations	
SG13	Y.2211	IMS-based real-time conversational multimedia services over NGN	10/2007
SG13	Y.2212	Requirements of managed delivery services	02/2008
SG13	Y.2213	NGN service requirements and capabilities for network aspects of applications and services using tag-based identification	09/2008
SG13	Y.2215	Requirements and framework for the support of VPN services in NGN, including the mobile environment	06/2009
SG13	Y.2232	NGN convergence service model and scenario using web services	01/2008
SG13	Y.2233	Requirements and framework allowing accounting and charging capabilities in NGN	01/2008
SG13	Y.2234	Open service environment capabilities for NGN	09/2008
SG13	Y.2235	Converged web-browsing service scenarios in NGN	11/2008
SG13	Y.2261	PSTN/ISDN evolution to NGN	09/2006
SG13	Y.2271	Call server based PSTN/ISDN emulation	09/2006
SG2	M.3060/ Y.2401	Principles for the Management of the Next Generation Networks	03/2006
SG13	Y.2601	Fundamental characteristics and requirements of future packet based networks	12/2006
SG13	Y.2611	High level architecture of future packet based networks	12/2006
SG13	Y.2612	Generic requirements and framework of addressing, routing and forwarding in future, packet-based networks	01/2009
SG13	Y.2701	Security requirements for NGN release 1	04/2007
SG13	Y.2702	Authentication and authorization requirements for NGN release 1	09/2008
SG13	Y.2703	The application of AAA service in NGN	01/2009
SG13	Y.2720	NGN identity management framework	01/2009
SG13	Y.2801	Mobility management requirements for NGN	11/2006
SG13	Q.1762/ Y.2802	Fixed-mobile convergence general requirements	09/2007
SG13	Q.1763/ Y.2803	FMC service using legacy PSTN or ISDN as the fixed access network for mobile network users	10/2007
SG13	Q.1707/ Y.2804	Generic framework of mobility management for next generation networks	02/2008
SG13	Q.1708/ Y.2805	Framework of location management for NGN	10/2008
SG13	Q.1709/ Y.2806	Framework of handover control for NGN	10/2008
SG13	Y.2807	MPLS-based mobility capabilities in NGN	01/2009

Organisation (Subgroup responsible)	Number	Title	Publication Date
SG13	Y.2901	The carrier grade open environment reference model	12/2006
SG13	Y.2902	Carrier grade open environment components	11/2008
SG13	Y. Sup1	NGN release 1 scope	07/2006
SG13	Y.Sup6	Use of DSL-based systems in next generation networks	09/2008
SG13	Y.Sup7	NGN release 2 scope	09/2008
SG11	Q.3900	Methods of testing and model network architecture for NGN technical means testing as applied to public telecommunication networks	09/2006

8. Overview of existing holes/overlaps/conflicts

Considering the number and diversity of different organizations working on standardising aspects of OTNT, it is inevitable that some areas will be missed. For the same reasons, some aspects will be addressed in multiple groups, resulting in possible conflicts based on different applications, priorities, or technical expertise. These items need to be identified and addressed as appropriate. The following table lists those that have been identified, the recommended action, and the status of that action.

TABLE 8-1/OTNT: Known OTNT Standardization Holes/Overlaps/Conflicts

No		Issue	Action	Status
1.		WSON(wavelength switched optical network) is now under discussion between IETF ccamp and ITU-T SG15. While ITU-T SG15 is specifying architecture and transport plane aspects, IETF ccamp is specifying control plane standard	Liaisons to and from the IETF ccamp, continuing work by Q.6 & 12/15	Ongoing
2.		Parallel work by ITU-T on permanent virtual circuit based on NNI with work at IETF work on both soft switch service based on optical UNI and soft permanent virtual connections based on optical NNI		Inactive
3.		OTN Routing and how to deal with physical impairments on logical routing decisions	Possible proposals should be considered in Q.6/15, Q12 & Q.14/15	Ongoing
4.		Optical Supervisory Channel (OSC) has slightly different definitions and views of standardization among the different questions. What is necessary?	Possible proposals should be considered by Q.12/15 and Q.6/15	Inactive
5.		Optical control plane protocols to support ASON are currently being discussed, revised, or defined in several organizations, including ITU-T SG15, the IETF, the OIF, and the ATM Forum.	Formal communications, Cross-pollination by company representatives and liaisons	Ongoing collaboration by representatives and liaisons, IETF Design Team working to align routing requirements
6		**Interconnection of core & access transport of time & SSM issues** Timing distribution method over access technologies such as GPON for directly passing time and phase information from the ONU to the base stations are requested and investigated. Technical details and approaches are under discussion.	Possible proposals should be considered in Q.2/15, Q4/15 and Q13/15	On-going

No		Issue	Action	Status
7		**Ethernet over OTN (E-OTN) issues** The use of Ethernet technology in PTN requires an extension of the tagging option defined in 802.1Q to support VC, VP, VS stacking in single and multi-domain scenarios. The necessity of the new transport tag option, PTN Layer Hierarchy (the 3 packet layer) and the role of each layer are still under discussion.	Liaisons to and from the IEEE 802.1, continuing work by Q.9/15 and Q12/15	On-going
8		**Updating Recommendations of terms and definitions** Some of the terms and definitions Recommendations haven't been kept up to date aligning with source Recommendations. Therefore, there is a possibility that duplication of definitions could exist. Some implementer's guides haven't been reflected to source Recommendations and some source recommendations haven't referred to the terms and definitions Recommendation.	Follow the procedure of the guidance made by Q3(TDxxx/WP3) and keep good communication with other editors	On-going
9		**Jitter requirements for OTU3&4 multilane interface** The maximum permissible levels of jitter at OTL3.4 and OTL4.4 interfaces are under discussion. The jitter specification of G.8251 should be aligned as far as possible with that of IEEE 802.3ba for cost-effectiveness.	Correspondence work in Q6 and Q13	On-going
10		**Transport of CPRI interface over OTN)** Transport of CPRI over OTN is proposed. A definition of the applicable OTN hypothetical reference model (HRM) is required. Further clarifications of the requirements are undergoing discussion.	Correspondence work in Q11 and Q13	On-going

Annex A - Terminology Mapping

The terminology used by different organizations working on similar or overlapping technical areas of standardization has complicated attempts to co-ordinate work between different groups. The same terms are often used, with different meanings by multiple organizations. Question 3 of ITU-T Study Group 15 is responsible for maintaining "Terms and definitions" Recommendations on a number of established major categories of optical networks and technologies, as listed in Table 7-1-1. Readers are warned to verify the definitions before assuming a common understanding of the terms. Specific appendices have been included in ITU-T Recommendations G.7713.x to assist the reader in mapping signalling protocol terminology used in those document to the similar terms used in other well know references.

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