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LIAISON STATEMENT

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Title: Comments on MPLS-TP working group drafts

LIAISON STATEMENT

For action to: IETF MPLS, PWE WGs

For comment to:

For information to: IETF MEAD team

Approval: Agreed to at the SG15 meeting, (Geneva, 1-12 December 2008)

Deadline: January 2009

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We very much appreciate working with IETF experts on MPLS-TP. We are encouraged by the excellent progress that has been made in cooperation between the ITU-T and the IETF experts.

We have provided detailed comments on draft-ietf-mpls-tp-requirements-00 in the attachment to this liaison statement.

The ITU-T experts will continue to work by correspondence and conference calls in the MPLS-TP ad hoc and will provide comments directly to the mpls-tp@ietf.org email list.

We look forward to continuing to work with you on the development of this important transport technology.

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MPLS-TP Requirements
draft-ietf-mpls-tp-requirements-00

Abstract

This document specifies the requirements for a MPLS Transport Profile (MPLS-TP). This document is a product of a joint International Telecommunications Union (ITU)-IETF effort to include a MPLS Transport Profile within the IETF MPLS architecture to support the capabilities and functionalities of a packet transport network as defined by International Telecommunications Union - Telecommunications Standardization Sector (ITU-T).

Note: we consider MPLS-TP as being composed by both MPLS LSP and PW layer networks (i.e. is the relationship between PW and MPLS-TP the same as between PW and MPLS, is there a potential need for PW extensions and/or profiling to support transport requirements). Is our understanding correct?

ITU-T Q12/15 will provide some deployment scenario by the end of January in order to assist the resolution of this comment.

This work is based on two sources of requirements, MPLS architecture as defined by IETF and packet transport networks as defined by ITU-T.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

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1. Introduction

For many years, Synchronous Optical Networking (SONET)/Synchronous Digital hierarchy (SDH) has provided carriers with a high benchmark for reliability and operational simplicity. With the accelerating growth of packet-based services (such as Ethernet, Voice over IP (VoIP), Layer 2 (L2)/Layer 3 (L3) Virtual Private Networks (VPNs), IP Television (IPTV), Radio Access Network (RAN) backhauling, etc.), carriers are in need of capabilities to efficiently support packet-based services on their transport networks. The need to increase their revenue while remaining competitive forces operators to look for the lowest network Total Cost of Ownership (TCO). Investment in equipment and facilities (Capital Expenditure (CAPEX)) and Operational Expenditure (OPEX) should be minimized.

The increasing penetration of applications, with various bandwidth and QoS requirements, generates a driver for developing technologies capable of carrying over a common transport infrastructure the traffic generated by these applications.

Carriers are considering migrating or evolving to packet transport networks in order to reduce their costs and to improve their ability to support services with guaranteed Service Level Agreements (SLAs). For carriers it is important that migrating from SONET/SDH to packet transport networks should not involve dramatic changes in network operation, should not necessitate extensive retraining, and should not require major changes to existing work practices. The aim is to preserve the look-and-feel to which carriers have become accustomed in deploying their SONET/SDH networks, while providing common, multi-layer operations, resiliency, control and management for packet, circuit and lambda transport networks.

Transport carriers require control and deterministic usage of network resources. They need end-to-end control to engineer network paths and to efficiently utilize network resources. They require capabilities to support static (Operations Support System (OSS) based) or dynamic (control plane) provisioning of deterministic, protected and secured services and their associated resources.

Carriers will still need to cope with legacy networks (which are composed of many layers and technologies), thus the packet transport network should interwork with other packet and transport networks (both horizontally and vertically). Vertical interworking is also known as client/server or network interworking. Horizontal interworking is also known as peer-partition or service interworking. For more details on each type of interworking and some of the issues that may arise (especially with horizontal interworking) see [ITU.Y1401.2008].

MPLS is a maturing packet technology and it is already playing an important role in transport networks and services. However, not all of MPLS's capabilities and mechanisms are needed and/or consistent with transport network operations. There is therefore the need to

define an MPLS Transport Profile (MPLS-TP) in order to support the capabilities and functionalities needed for packet transport network services and operations through combining the packet experience of MPLS with the operational experience of SONET/SDH.

MPLS-TP will enable the migration of SONET/SDH networks to a packet-based network that will efficiently scale to support packet services in a simple and cost effective way. MPLS-TP needs to combine the necessary existing capabilities of MPLS with additional minimal mechanisms in order that it can be used in a transport role.

This document specifies the requirements for a MPLS Transport Profile (MPLS-TP). This document is a product of a joint ITU-IETF effort to include a MPLS Transport Profile within the IETF MPLS architecture to support the capabilities and functionalities of a packet transport network as defined by ITU-T.

This work is based on two sources of requirements, MPLS architecture as defined by IETF and packet transport networks as defined by ITU-T. The requirements of MPLS-TP are provided below. The relevant functions of MPLS are included in MPLS-TP, except where explicitly excluded.

Although both static and dynamic configuration of MPLS-TP transport paths (including Operations, Administration and Maintenance (OAM) and protection capabilities) is required by this document, it MUST be possible for operators to be able to completely operate (including OAM and protection capabilities) an MPLS-TP network in the absence of any control plane protocols for dynamic configuration.

1.1. Terminology

Domain: A domain represents a collection of entities (for example network elements) that are grouped for a particular purpose, examples of which are administrative and/or managerial responsibilities, trust relationships, addressing schemes, infrastructure capabilities, survivability techniques, distributions of control functionality, etc. Examples of such domains include IGP areas and Autonomous Systems.

Layer network: A layer network as defined in G.805 [ITU.G805.2000] provides for the transfer of client information and independent operations (OAM) of the client OAM. For an explanation of how a layer network as described by G.805 relates to the OSI concept of layering see Appendix I of Y.2611 [ITU.Y2611.2006].

Link: A link as defined in G.805 [ITU.G805.2000] is used to describe a fixed relationship between two ports within a layer network. A link is not necessarily a physical link but can also be supported by a transport path in the server layer (e.g. SONET/SDH, OTN or MPLS-TP).

Path: See Transport path.

Section: A section is a MPLS-TP network server layer which provides for encapsulation and OAM of a MPLS-TP transport path client layer. A section layer may provide for aggregation of multiple MPLS-TP clients.

Note: Definition of Section should be aligned with the description below:

If two MPLS-TP nodes are directly connected by a physical media or a non MPLS-TP server layer (e.g. Ethernet, SONET/SDH, OTH), then to support the OAM between those two nodes you need a Section Layer is used (which could be supported by either the server layer or by MPLS-TP).
In the case the server layer network does not support adequate OAM capabilities, an MPLS-TP Section layer network can provide those capabilities for MPLS-TP clients.

That Section is used to support a Link in the lowest MPLS-TP layer network.

If the definition of Section is not used in this document, it may be worth to have it only in the OAM requirements document.

Segment: A segment corresponds to part of a path. A segment may be a single link (hop) within a path, a series of adjacent links (hops) within a path, or the entire end-to-end-path.

Note: Align the definition of Segment above with the definition of LSP Segment in RFC 4397:

LSP (connection) segment <Data Plane> is a single resource or a set of cross-connected resources that constitutes a segment of an LSP (connection).

It is also our understanding that a PW segment is equivalent to a link connection within the PW layer network.

Service layer: A layer network in which transport paths are used to carry a customer's (individual or bundled) service (may be point-to-point, point-to-multipoint or multipoint-to-multipoint services).

Note: To avoid confusion with the client service layer network, this document should use the term “Transport service layer” instead of the unqualified “Service layer” term.

Note: Span proposed to be removed (Link can be used instead) to avoid confusion with ITU-T terminology.

Tandem Connection: A tandem connection corresponds to a segment of a path. This may be either a segment of an LSP (i.e. a sub-path), or one or more segment(s) of a PW.

Note: A tandem connection is a arbitrary part of a transport path that can be monitored (via OAM) independently from the end-to-end monitoring (OAM).

It may be a segment or any other ordered sequence of contiguous "link connections" and/or "subnetwork connections" of a transport path.

Transport path: A network connection as defined in G.805 [ITU.G805.2000]. The combination of a PW (Single Segment or Multi-Segment) and LSP corresponds to an MPLS-TP transport path.

Note: the text "The combination of a PW (Single Segment or Multi-Segment) and LSP corresponds to an MPLS-TP transport path" requires some clarification.

Transport path layer: A layer network which provides point-to-point or point-to-multipoint transport paths which are used to carry a higher (client) layer network or aggregates of higher (client) layer networks, for example the network service layer. It provides for independent OAM (of the client OAM) in the transport of the clients.

Transmission media layer: A layer network which provides sections (two-port point-to-point connections) to carry the aggregate of network transport path or network service layers on various physical media.

1.2. Transport network overview

The connection (or transport path) service is the basic service provided by a transport network. The purpose of a transport network is to carry its clients (i.e. the stream of client PDUs or client bits) between endpoints in the network (typically over several intermediate nodes). These endpoints may be service switching points or service terminating points. The connection services offered to customers are aggregated into large transport paths with long-holding times and independent OAM (of the client OAM), which contribute to enabling the efficient and reliable operation of the transport network. These transport paths are modified infrequently.

Note 1: We are not sure that the description above matches with our original description reported hereafter. If necessary we can supply some text together with some deployment scenarios on this extent.

The transport network uses encapsulation and aggregation to carry client signals: client signals are first encapsulated to allow monitoring. These encapsulated client signals are then aggregated for transport through the network in order to achieve optimized network management. At every hop the aggregated signals may be further aggregated to cross a physical link. At the edges of aggregation domains encapsulated client signals are extracted and either delivered to client or forwarded to another domain. In the core of the network only the aggregated signals are monitored, individual client signals are monitored at the network boundary.

Note 2: we understood that within the IETF context aggregation and merging are different concepts:

- merging when different LSPs are forwarded with the same outgoing label. When this label is popped, the client signal (e.g. IP) carried by the merged LSPs gets exposed
- aggregation when different LSPs are multiplexed together into another LSP. When the label is popped, each individual original LSP gets exposed and can be identified.

Is our understanding correct?

Note 3: we need to clarify that the services offered to the clients can be point-to-point, point-to-multipoint or multipoint-to-multipoint services but the actual transport paths can be point-to-point or point-to-multipoint.

Aggregation and hierarchy are beneficial for achieving scalability and security since:

1. They reduce the number of provisioning and forwarding states in the network core.

2. They reduce load and the cost of implementing service assurance and fault management.

3. Clients are encapsulated and layer associated OAM overhead is added. This allows complete isolation of customer traffic and its management from carrier operations.

An important attribute of a transport network is that it is able to function regardless of which clients are using its connection service or over which transmission media it is running. The client, transport network and server layers are from a functional and operations point of view independent layer networks. Another key characteristic of transport networks is the capability to maintain the integrity of the client across the transport network. A transport network must provide the means to commit quality of service objectives to clients. This is achieved by providing a mechanism for client network service demarcation for the network path together with an associated network resiliency mechanism. A transport network must also provide a method of service monitoring in order to verify the delivery of an agreed quality of service. This is enabled by means of carrier-grade OAM tools.

Clients are first encapsulated. These encapsulated client signals may then be aggregated into a connection for transport through the network in order to optimize network management. Server layer OAM is used to monitor the transport integrity of the client layer or client aggregate. At any hop, the aggregated signals may be further aggregated in lower layer transport network paths for transport across intermediate shared links. The encapsulated client signals are extracted at the edges of aggregation domains, and are either delivered to the client or forwarded to another domain. In the core of the network, only the server layer aggregated signals are monitored; individual client signals are monitored at the network boundary in the client layer network.

Quality-of-service mechanisms are required in the packet transport network to ensure the prioritization of critical services, to guarantee BW and to control jitter and delay.

2. MPLS-TP Requirements

2.1. General requirements

1 MPLS-TP MUST be compatible with the MPLS data plane as defined by IETF. When MPLS offers multiple options in this respect, MPLS-TP SHOULD select the minimum sub-set (necessary and sufficient subset) applicable to a transport network application.

2 Any new functionality that is defined to fulfil the requirements for MPLS-TP MUST be agreed within IETF and re-use (as far as practically possible) existing MPLS standards.

3 Mechanisms and capabilities MUST be able to interoperate with existing IETF MPLS [RFC3031] and IETF PWE3 [RFC3985] control and data planes where appropriate.

4 MPLS-TP MUST support only a connection-oriented packet switching paradigm with traffic engineering capabilities that allow deterministic control of the use of network resources.

5 MPLS-TP MUST support traffic engineered point to point (P2P) or point to multipoint (P2MP) transport paths.

6 MPLS-TP MUST support the logical separation of the control and management planes from the data plane.

7 MPLS-TP MUST allow the physical separation of the control and management planes from the data plane.

8 MPLS-TP MUST support static provisioning of transport paths via an OSS.

9 Static provisioning MUST NOT depend on routing or signaling protocols (e.g. Generalized Multiprotocol Label Switching (GMPLS), Open Shortest Path First (OSPF), Intermediate System to Intermediate Systems (ISIS), Resource Reservation Protocol (RSVP), Border gateway Protocol (BGP), Label Distribution Protocol (LDP) etc.).

10 MPLS-TP MUST support the capability for network operation (including OAM and recovery) via an OSS (without the use of any control plane protocols).

11 The MPLS-TP specification MUST include a solution to support a control plane for dynamic provisioning of MPLS-TP transport paths. This control plane is OPTIONAL to be implemented or enabled.

12 The MPLS-TP data plane MUST be capable of functioning independently of the control or management plane used to operate the MPLS-TP layer network. That is the MPLS-TP data plane operation MUST continue to operate normally if the management plane or control plane that configured the transport paths fails.

13 MPLS-TP MUST support transport paths through multiple homogeneous domains.

14 MPLS-TP MUST NOT dictate the deployment of any particular network topology either physical or logical.

15 MPLS-TP MUST be able to scale with growing and increasingly complex network topologies as well as increasing bandwidth demands, number of customers or number of services.

16 MPLS-TP SHOULD support mechanisms to safeguard against the provisioning of transport paths which contain forwarding loops.

2.2. Layering requirements

17 An MPLS-TP network MUST operate in a multiple layer network environment consisting of independent service, transport path and transmission media layers.

MPLS-TP may be used as the service layer (for P2P and P2MP services) and/or as the transport path layer within a packet transport network.

18 A solution MUST be provided to support the transport of MPLS-TP transport paths over MPLS-TP (MPLS-TP as a client of MPLS-TP)

19A A generic and extensible solution MUST be provided to support the transport of client layer transport paths (e.g. Ethernet, ATM, FR, etc.) over an MPLS-TP layer network.

19B A generic and extensible solution MUST be provided to support the transport of MPLS-TP transport paths over server layer network (such as Ethernet, SONET/SDH, OTN, etc.).

20 In an environment where an MPLS-TP layer network is supporting a client network, and the MPLS-TP layer network is supported by a server layer network then operation of the MPLS-TP layer network MUST be possible without any dependencies on the server or client network.

The above are not only technology requirements, but also operational. Different administrative groups may be responsible for the same layer network or different layer networks, and require the capability for

autonomous network operations.

21 It MUST be possible to hide MPLS-TP layer network addressing and other information (e.g. topology) from client layers.

2.3. Data plane requirements

22 The identification of each transport path within its aggregate MUST be supported.

23 A label in a particular Link MUST uniquely identify the transport path within that Link.

Question: why was the term "section" instead of "Link" used in requirement 23? In our understanding the requirement 23 is applicable to Link.

24 A transport path's source MUST be identifiable at its destination within its layer network.

Transport paths can be aggregated by pushing and de-aggregated by popping labels. MPLS-TP labels are swapped within a transport path in a layer network instance when the traffic is forwarded from one MPLS-TP link to another MPLS-TP link.

Note: it would be worth adding a note to the paragraph above stating that a label push/pop can be used also for other purposes other than aggregation/de-aggregation.

25 MPLS-TP MUST support MPLS labels that are assigned by the downstream (with respect to data flow) node per [RFC3031] and [RFC3473] and MAY support context-specific MPLS labels as defined in [RFC5331].

26 It MUST be possible to operate and configure the MPLS-TP data (transport) plane without any IP forwarding capability in the MPLS-TP data plane.

27 MPLS-TP MUST support both unidirectional and bi-directional point-to-point transport paths.

28 An MPLS-TP network MUST require the forward and backward directions of a bi-directional transport path to follow the same path at each layer.

29 The intermediate nodes at each layer MUST be aware about the pairing relationship of the forward and the backward directions belonging to the same bi-directional transport path.

30 MPLS-TP MUST support unidirectional point-to-multipoint transport paths.

Note: We propose to remove requirement 31 since it is redundant with requirement 24 as rephrased above.

32 MPLS-TP MUST be extensible in order to accommodate new types of client networks
and services.

33 MPLS-TP SHOULD support mechanisms to avoid or minimize traffic impact (e.g. packet delay, reordering and loss)
during network reconfiguration.

Note: Requirement 33 is a general requirement, in the scope of section 2.1

34 MPLS-TP MUST support mechanisms which ensure the integrity of the transported customer's service traffic.

35 MPLS-TP MUST support an unambiguous and reliable means of distinguishing users' (client) packets from MPLS-TP control packets (e.g. control plane, management plane, OAM and protection switching packets).

2.4. Control plane requirements

This section defines the requirements that apply to MPLS-TP when a control plane is deployed.

The requirements for ASON signalling and routing and the requirements for multi-region and multi-layer networks as specified in [RFC4139], [RFC4258] and [RFC5212] respectively apply to MPLS-TP.

Note: the MPLS-TP control plane should meet the requirements for ASON architecture (G.8080, ...) unless explicitly excluded as well as the additional MPLS-TP specific requirements explicitly added.

Additionally:

36 MPLS-TP control plane SHOULD support control plane topology and data plane topology independence.

37 The MPLS-TP control plane MUST be able to be operated independent of any particular client or server layer control plane.

38 The MPLS-TP control plane MUST support establishing all the connectivity patterns defined for the MPLS-TP data plane (e.g., uni-directional and bidirectional P2P, uni-directional P2MP, etc.) including configuration of protection functions and any associated maintenance functions.

39 The MPLS-TP control pane MUST support the configuration and modification of OAM maintenance points as well as the activation/ deactivation of OAM when the transport path is established or modified.

40 An MPLS-TP control plane MUST support pre-allocated path protection.

In some situations it is impractical to expect acceptable recovery performance to be achieved using dynamic recalculation of transport

path routes. For this reason, it is necessary to allow for pre-planning of protection routes for selected transport paths.

41 An MPLS-TP control plane MUST scale gracefully to support a large number of transport paths, nodes and links.

42 An MPLS-TP control plane SHOULD provide a common control mechanism for architecturally similar operations.

2.5. Network Management (NM) requirements

The requirements in this section apply to the Management Plane per ITU-T terminology.

For requirements related to NM functionality for MPLS-TP, see the MPLS-TP NM requirements document [I-D.gray-mpls-tp-nm-req].

2.6. Operation, Administration and Maintenance (OAM) requirements

For requirements related to OAM functionality for MPLS-TP, see the MPLS-TP OAM requirements document [I-D.vigoureux-mpls-tp-oam-requirements].

2.7. Network performance management (PM) requirements

For requirements related to PM functionality for MPLS-TP, see the MPLS-TP OAM requirements document [I-D.vigoureux-mpls-tp-oam-requirements].

2.8. Recovery requirements

Note: Title proposed to change in alignment with the terminology of RFC 4427.

Note to Q9/15: This section 2.8 needs to be reviewed also by Q9/15 (protection) experts.

Network survivability plays a critical factor in the delivery of reliable services. Network availability is a significant contributor to revenue and profit. Service guarantees in the form of SLAs require a resilient network that rapidly detects facility or node failures and restores network operation in accordance with the terms of the SLA.

The requirements in this section use the recovery terminology defined in RFC 4427 [RFC4427].

43 MPLS-TP MUST support transport network style recovery mechanisms to provide the appropriate recovery time required to maintain customer SLAs when potentially thousands of services are simultaneously affected by a single failure.

44 MPLS-TP recovery mechanisms MUST be applicable at various levels throughout the network including support for link, tandem connection and end-to-end recovery.

Note: Span proposed to change to Link to avoid confusion with ITU-T terminology.

Note: the requirement is to protect a sub-network connection (as defined in G.805). TCM can, for example, be used to provide the monitoring to trigger SNC/S (as defined in G.808.1) protection switching.

45 MPLS-TP MUST support network restoration mechanisms controlled by a distributed control plane, if the control plane is supported, and MUST support network restoration mechanisms controlled by a management plane.

A. The restoration resources MAY be pre-planned and selected a priori, or computed after failure occurrence.

B. MPLS-TP MAY support shared-mesh restoration.

C. MPLS-TP MUST support soft (make before break) LSP restoration.

D. MPLS-TP MAY support hard (break before make) LSP restoration.

E. The restoration mechanism MUST be applicable to any topology.

F. Restoration priority MUST be implemented to determine the order in which transport paths should be restored (to minimize service restoration time as well as to gain access to available spare capacity on the best paths). Preemption priority MUST be supported, so that in the event that not all transport paths can be restored transport paths with lower preemption priority can be released. When preemption is supported, its use MUST be operator configurable.

G. The restoration mechanism MUST operate in synergy with other transport network technologies (e.g. SONET/SDH, OTN, WDM).

Note: the synergy in requirement 45G can apply also wrt MPLS-TP client layers within the transport network.

46 MPLS-TP MUST support inband OAM driven protection mechanisms (without any dependency on a control plane) to enable fast recovery from failure.

47 If protection is supported then:

A. MPLS-TP REQUIRES common protection mechanisms being defined for LSPs and PWs.

B. MPLS-TP MUST support mechanisms that rapidly detect, locate, notify and remedy network defects.

C1. MPLS-TP MUST support 1:1 bidirectional protection switching for bidirectional point-to-point transport paths.

If bi-directional 1:1 protection switching is activated then the protection state of both ends of the protected entity MUST be synchronized.

C2. MPLS-TP SHOULD support 1:1 unidirectional protection switching for unidirectional point-to-point and point-to-multipoint transport paths.

D. MPLS-TP MAY support 1+1 unidirectional protection switching.

Unidirectional protection switching (e.g. 1+1 unidirectional protection switching as in requirement 47D) is not related with bidirectional transport path as defined in requirement 28.
With unidirectional protection switching, it is possible to setup and operate bi-directional transport paths in such a way that the forward and backward direction follows the same path (as per requirement 28). However, because of the unidirectional nature of the protection switching action, traffic can be delivered on different transport paths in the forward and backward directions.

E. MPLS-TP protection mechanisms MUST be applicable to point-to-point and point-to-multipoint transport paths.

Note: 47E should be a generic recovery requirement

F. Protection ratio MUST be of 100%, i.e. 100% of impaired working traffic MUST be protected for a failure on the working path. Additionally:

1. The QoS objectives defined by the operator MUST also be met along the protection path.

2. In the case of 1:1 protection mechanisms, the bandwidth reserved for the protecting path MAY be available for other traffic when the working path is operational.

Note: extra-traffic is not needed, QoS mechanisms (e.g. best-effort) allow achieving the same objective in a simpler way.

G. Operator requests for manual control of protection switching such as clear, lockout of protection, forced-switch and manual-switch commands MUST be supported. Prioritized protection between Signal Fail (SF), Signal Degradation (SD) and operator switch requests MUST be supported.

H. MPLS-TP protection mechanisms MUST support priority logic to negotiate and accommodate coexisting requests (i.e. multiple requests) for protection switching (e.g. "administrative" requests and requests due to link/node failures).

I1. MPLS-TP protection mechanisms MUST support revertive mode.

I2. MPLS-TP protection mechanisms SHOULD support non-revertive mode.

I3. If both revertive and non-revertive protection switching, the mode MUST be configurable by the operator.

J. MPLS-TP protection switching mechanisms MUST prevent frequent operation of the protection switch due to an intermittent defect.

K. MPLS-TP protection mechanisms MUST ensure co-ordination of timing of protection switches at multiple layers to avoid races and to allow the protection switching mechanism of the server layer to fix the problem before switching at the MPLS-TP layer.

L. MPLS-TP MAY support mechanisms that are optimized for specific network topologies (e.g. ring). These mechanisms MUST be interoperable with the mechanisms defined for arbitrary topology (mesh) networks.

M. If optimised mechanisms for ring topologies are supported then they MUST support switching times within 50 ms (depending on CV rate configuration) assuming a reference network of a 16 node ring with less than 1200 Km of fiber, as defined by ITU SG15, Question 9.

Note: individuals from ITU-T will send some comments on requirements 47L and 47M together with ring protection switching requirements.

Note: ITU-T Q9/15 and Q12/15 will provide by end of January a requirement for protection switching time in case of linear protection (e.g. within 50 ms) together with a reference network.

2.9. QoS requirements

Carriers require advanced traffic management capabilities to enforce and guarantee the QoS parameters of customers' SLAs.

48 Quality of service mechanisms are REQUIRED to ensure:

A Support for differentiated services and different traffic types with traffic class separation associated with different traffic.

B Prioritization of critical services.

C Enabling the provisioning and the guarantee of Service Level Specifications (SLS), with support for hard and relative end-to-end BW guaranteed.

D Support of services, which are sensitive to jitter and delay.

E Guarantee of fair access, within a particular class, to shared resources in an MPLS-TP network.

F Guaranteed resources for in-band control and management plane traffic regardless of the amount of data plane traffic.

49 MPLS-TP MUST support a flexible bandwidth allocation scheme. This will provide carriers with the capability to efficiently support service demands over the MPLS-TP network.

[Should we refer here to the requirements specified in RFC 2702?]

2.10. Security requirements

For a description of the security threats relevant in the context of MPLS and GMPLS and the defensive techniques to combat those threats see the Security Framework for MPLS & GMPLS Networks [I-D.draft-ietf-mpls-mpls-and-gmpls-security-framework].

3. IANA Considerations

This document makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an RFC.

4. Security Considerations

For a description of the security threats relevant in the context of MPLS and GMPLS and the defensive techniques to combat those threats see the Security Framework for MPLS & GMPLS Networks [I-D.draft-ietf-mpls-mpls-and-gmpls-security-framework].

5. Acknowledgements

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