[[Docs](../html/)] [[txt](http://tools.ietf.org/id/draft-ietf-mpls-tp-p2mp-framework-04.txt%22%20%5Co%20%22Plaintext%20version%20of%20this%20document)|[pdf](/pdf/draft-ietf-mpls-tp-p2mp-framework-04.txt)|[xml](/id/draft-ietf-mpls-tp-p2mp-framework-04.xml)|[html](/id/draft-ietf-mpls-tp-p2mp-framework-04.html)] [[Tracker](https://datatracker.ietf.org/doc/draft-ietf-mpls-tp-p2mp-framework)] [[WG](../wg/mpls)] [Email] [[Diff1](/rfcdiff?difftype=--hwdiff&url2=draft-ietf-mpls-tp-p2mp-framework-04.txt)] [[Diff2](/rfcdiff?url2=draft-ietf-mpls-tp-p2mp-framework-04.txt)] [[Nits](/idnits?url=http://tools.ietf.org/id/draft-ietf-mpls-tp-p2mp-framework-04.txt)]

Versions: ([draft-fbb-mpls-tp-p2mp-framework](./draft-fbb-mpls-tp-p2mp-framework))

 [00](./draft-ietf-mpls-tp-p2mp-framework-00) [01](./draft-ietf-mpls-tp-p2mp-framework-01) [02](./draft-ietf-mpls-tp-p2mp-framework-02) [03](./draft-ietf-mpls-tp-p2mp-framework-03) [04](./draft-ietf-mpls-tp-p2mp-framework-04)

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 A Framework for Point-to-Multipoint MPLS in Transport Networks

 draft-ietf-mpls-tp-p2mp-framework-04

Abstract

 The Multiprotocol Label Switching Transport Profile is the common set

 of MPLS protocol functions defined to enable the construction and

 operation of packet transport networks. The MPLS-TP supports both

 point-to-point and point-to-multipoint transport paths. This

 document defines the elements and functions of the MPLS-TP

 architecture applicable specifically to supporting point-to-

 multipoint transport paths.

Status of This Memo

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**[1](%22%20%5Cl%20%22section-1)**. Introduction

 The Multiprotocol Label Switching Transport Profile is the common set

 of MPLS protocol functions defined to meet the requirements specified

 in [[RFC5654](./rfc5654)]. The MPLS-TP Framework [[RFC5921](./rfc5921)] provides an overall

 introduction to the MPLS-TP and defines the general architecture of

 the Transport Profile, as well as those aspects specific to point-to-

 point transport paths. The purpose of this document is to define the

 elements and functions of the MPLS-TP architecture applicable

 specifically to supporting point-to-multipoint transport paths.

**[1.1](%22%20%5Cl%20%22section-1.1)**. Scope

 This document defines the elements and functions of the MPLS-TP

 architecture related to supporting point-to-multipoint transport

 paths. The reader is referred to [[RFC5921](./rfc5921)] for those aspects of the

 MPLS-TP architecture that are generic, or concerned specifically with

 point-to-point transport paths.

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**[1.2](%22%20%5Cl%20%22section-1.2)**. Terminology

 Term Definition

 ------- ---------------------------------------------------

 CE Customer Edge

 GMPLS Generalized MPLS

 LDP Label Distribution Protocol

 LSP Label Switched Path

 LSR Label Switching Router

 MEP Maintenance End Point

 MPLS Multiprotocol Label Switching

 MPLS-TE MPLS Traffic Engineering

 MPLS-TP MPLS Transport Profile

 OAM Operations, Administration and Maintenance

 OTN Optical Transport Network

 P2MP Point-to-multipoint

 PW Pseudowire

 RSVP-TE Resource Reservation Protocol - Traffic Engineering

 SDH Synchronous Digital Hierarchy

 T-LDP Targeted LDP

**[1.2.1](%22%20%5Cl%20%22section-1.2.1)**. Additional Definitions and Terminology

 Detailed definitions and additional terminology may be found in

 [[RFC5921](./rfc5921)] and [[RFC5654](./rfc5654)].

**[1.3](%22%20%5Cl%20%22section-1.3)**. Applicability

 The point-to-multipoint connectivity provided by an MPLS-TP network

 is based on the point-to-multipoint connectivity provided by MPLS

 networks. P2MP MPLS TE-LSP support is discussed in [[RFC4875](./rfc4875)] and

 [[RFC5332](./rfc5332)], and P2MP PW support is being developed based on

 [[I-D.ietf-pwe3-p2mp-pw-requirements](#ref-I-D.ietf-pwe3-p2mp-pw-requirements)] and

 [[I-D.ietf-l2vpn-vpms-frmwk-requirements](#ref-I-D.ietf-l2vpn-vpms-frmwk-requireme)]. MPLS-TP point-to-

 multipoint connectivity is analogous to that provided by traditional

 transport technologies such as Optical Transport Network point-to-

 multipoint [[G.798](#ref-G.798)] and drop-and-continue [[G.780](#ref-G.780)], and thus supports

 the same class of traditional applications, e.g., video distribution.

 There is no definition for MPLS TE-LSP support of multipoint-to-

 multipoint connectivity and none is anticipated.

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**[2](%22%20%5Cl%20%22section-2)**. MPLS Transport Profile Point-to-Multipoint Requirements

 The requirements for MPLS-TP are specified in [[RFC5654](./rfc5654)]. This section provides a brief summary of point-to-

 multipoint transport requirements as set out in those documents; the

 reader is referred to the documents themselves for the definitive and

 complete list of requirements. This summary does not include the

 [[RFC2119](./rfc2119)] conformance language used in original documents as this

 document is not authoritative.

 o MPLS-TP must support unidirectional point-to-multipoint transport

 paths.

 o MPLS-TP must support traffic-engineered point-to-multipoint

 transport paths.

 o MPLS-TP must be capable of using P2MP server (sub)layer

 capabilities as well as P2P server (sub)layer capabilities when

 supporting P2MP MPLS-TP transport paths.

 o The MPLS-TP control plane must support establishing all the

 connectivity patterns defined for the MPLS-TP data plane (i.e.,

 unidirectional P2P, associated bidirectional P2P, co-routed

 bidirectional P2P, unidirectional P2MP) including configuration of

 protection functions and any associated maintenance functions.

 o Recovery techniques used for P2P and P2MP should be identical to

 simplify implementation and operation.

 o Unidirectional 1+1 and 1:n protection for P2MP connectivity must

 be supported.

 o MPLS-TP recovery in a ring must protect unidirectional P2MP

 transport paths.

**[3](%22%20%5Cl%20%22section-3)**. Architecture

 The overall architecture of the MPLS Transport Profile is defined in

 [[RFC5921](./rfc5921)]. The architecture for point-to-multipoint MPLS-TP

 comprises the following additional elements and functions:

 o Unidirectional point-to-multipoint LSPs

 o Unidirectional point-to-multipoint PWs

 o Optional point-to-multipoint LSP and PW control planes

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 o Survivability, network management, and Operations, Administration

 and Maintenance functions for point-to-multipoint PWs and LSPs

 The following subsections summarise the encapsulation and forwarding

 of point-to-multipoint traffic within an MPLS-TP network, and the

 encapsulation options for delivery of traffic to and from MPLS-TP CE

 devices when the network is providing a packet transport service.

**[3.1](%22%20%5Cl%20%22section-3.1)**. MPLS-TP Encapsulation and Forwarding

 Packet encapsulation and forwarding for MPLS-TP point-to-multipoint

 LSPs is identical to that for MPLS-TE point-to-multipoint LSPs.

 MPLS-TE point-to-multipoint LSPs were introduced in [[RFC4875](./rfc4875)] and the

 related data-plane behaviour was further clarified in [[RFC5332](./rfc5332)].

 MPLS-TP allows for both upstream-assigned and downstream-assigned

 labels for use with point-to-multipoint LSPs.

 Packet encapsulation and forwarding for point-to-multipoint PWs has

 been discussed within the PWE3 Working Group

 [[I-D.raggarwa-pwe3-p2mp-pw-encaps](#ref-I-D.raggarwa-pwe3-p2mp-pw-encaps)], but such definition is for

 further study.

**[4](%22%20%5Cl%20%22section-4)**. Operations, Administration and Maintenance

 The requirements for MPLS-TP OAM are specified in [RFC5860].

The overall OAM architecture for MPLS-TP is defined in [[RFC6371](./rfc6371)], and

 P2MP OAM design considerations are described in [Section 3.7](%22%20%5Cl%20%22section-3.7) of that

 RFC.

 All the traffic sent over a P2MP transport path, including OAM

 packets generated by a MEP, is sent (multicast) from the root to all

 the leaves, thus OAM Packets is sent to all leaves and processed by all the MEs in a P2MP MEG. If an OAM packet is to be

 processed by only a specific leaf, it requires information to

 indicate to all other leaves that the packet must be discarded. To

 address a packet to an intermediate node in the tree, TTL based

 addressing is used to set the radius and additional information in

 the OAM payload is used to identify the specific destination. It is worth noting that a MIP and MEP may be instantiated on a node when it is both a branch and leaf node.

 P2MP paths are unidirectional; therefore, any return path to an

 originating MEP for on-demand transactions will be out-of-band. Out

 of band return paths are discussed in [Section 3.8 of [RFC5921]](./rfc5921#section-3.8).

 Packet Loss and Delay Measurement for MPLS Networks [[RFC6374](./rfc6374)] already

 considers the P2MP case and no change is needed to the MPLS-TP

 profile of [[RFC6375](./rfc6375)].

 A more detailed discussion of P2MP OAM considerations can be found in

 [[I-D.hmk-mpls-tp-p2mp-oam-framework](#ref-I-D.hmk-mpls-tp-p2mp-oam-framework)].

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**[5](%22%20%5Cl%20%22section-5)**. Control Plane

 The framework for the MPLS-TP control plane is provided in [[RFC6373](./rfc6373)].

 This document reviews MPLS-TP control plane requirements as well as

 provides details on how the MPLS-TP control plane satisfies these

 requirements. Most of the requirements identified in [[RFC6373](./rfc6373)] apply

 equally to P2P and P2MP transport paths. The key P2MP specific

 control plane requirements are:

 o requirement 6 (P2MP transport paths),

 o requirement 34 (use P2P sub-layers),

 o requirement 49 (common recovery solutions for P2P and P2MP),

 o requirement 59 (1+1 protection),

 o requirement 62 (1:n protection),

 o and requirement 65 (1:n shared mesh recovery).

 [RFC6373] defines the control plane approach used to support MPLS-TP

 transport paths. It identifies GMPLS as the control plane for MPLS-

 TP LSPs T-LDP as the control plane for PWs. MPLS-TP allows that

 either, or both, LSPs and PWs to be provisioned statically or via a

 control plane. As noted in [[RFC6373](./rfc6373)]:

 The PW and LSP control planes, collectively, must satisfy the MPLS-TP

 control-plane requirements. As with P2P services, when P2MP client

 services are provided directly via LSPs, all requirements must be

 satisfied by the LSP control plane. When client services are

 provided via PWs, the PW and LSP control planes can operate in

 combination, and some functions may be satisfied via the PW control

 plane while others are provided to PWs by the LSP control plane.

 This is particularly noteworthy for P2MP recovery.

**[5.1](%22%20%5Cl%20%22section-5.1)**. Point-to-Multipoint LSP Control Plane

 The MPLS-TP control plane for point-to-multipoint LSPs uses GMPLS and

 is based on RSVP-TE for point-to-multipoint LSPs as defined in

 [[RFC4875](./rfc4875)]. A detailed listing of how GMPLS satisfies MPLS-TP control

 plane requirements is provided in [[RFC6373](./rfc6373)].

 Per [[RFC6373](./rfc6373)], the definitions of P2MP, [[RFC4875](./rfc4875)], and GMPLS

 recovery, [[RFC4872](./rfc4872)] and [[RFC4873](./rfc4873)], do not explicitly cover their

 interactions. MPLS-TP requires a formal definition of recovery

 techniques for P2MP LSPs. Such a formal definition will be based on

 existing RFCs and may not require any new protocol mechanisms but,

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 nonetheless, should be documented. Protection of P2MP LSPs is also

 discussed in [[RFC6372] Section 4.7.3](./rfc6372#section-4.7.3).

**[5.2](%22%20%5Cl%20%22section-5.2)**. Point-to-Multipoint PW Control Plane

 The MPLS-TP control plane for point-to-multipoint PWs should be based

 on the LDP control protocol used for point-to-point PWs [[RFC4447](./rfc4447)],

 with updates as required for P2MP applications. A detailed

 specification of the control plane for P2MP PWs is for further study.

**[6](%22%20%5Cl%20%22section-6)**. Survivability

 The overall survivability architecture for MPLS-TP is defined in

 [[RFC6372](./rfc6372)], and [section 4.7.3](#section-4.7.3) in particular describes the application

 of linear protection to unidirectional P2MP entities using 1+1 and

 1:1 protection architecture. For 1+1, the approach is for the root

 of the P2MP tree to bridge the user traffic to both the working and

 protection entities. Each sink/leaf MPLS-TP node selects the traffic

 from one entity according to some predetermined criteria. For 1:1,

 the source/root MPLS-TP node needs to identify the existence of a

 fault condition on any of the leaves of the network. Fault

 notification happens from the node identifying the fault to the root

 node or from the leaves to the root via an out of band path. In

 either case the root then selects the protection transport path for

 traffic transfer. More sophisticated survivability approaches such

 as partial tree protection and 1:n protection are for further study.

 The IETF has no experience with P2MP PW survivability as yet, and

 therefore it is proposed that the P2MP PW survivability will

 initially rely on the LSP survivability. Further work is needed on

 this subject, particularly if a requirement emerges to provide

 survivability for P2MP PWs in an MPLS-TP context.

**[7](%22%20%5Cl%20%22section-7)**. Network Management

 An overview of network management considerations for MPLS-TP can be

 found in [Section 3.14](#section-3.14) of "Framework for MPLS in Transport Networks"

 [[RFC5921](./rfc5921)]. The provided description applies equally to P2MP

 transport paths.

 The network management architecture and requirements for MPLS-TP are

 specified in [[RFC5951](./rfc5951)]. They derive from the generic specifications

 described in ITU-T G.7710/Y.1701 [[G.7710](#ref-G.7710)] for transport technologies.

 They also incorporate the OAM requirements for MPLS Networks

 [[RFC4377](./rfc4377)] and MPLS-TP Networks [[RFC5860](./rfc5860)] and expand on those

 requirements to cover the modifications necessary for fault,

 configuration, performance, and security in a transport network.

 [[RFC5951](./rfc5951)] covers all MPLS-TP connection types, including P2MP.

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 [RFC6639] provides the MIB-based architecture for MPLS-TP. It

 reviews the interrelationships between different non MPLS-TP specific

 MIB modules that can be leveraged for MPLS-TP network management, and

 identifies areas where additional MIB modules are required. While

 the document does not consider P2MP transport paths, it does provide

 a foundation for an analysis of areas where MIB module modification

 and addition may be needed to fully support P2MP transport paths.

 There has also been work in the MPLS working group on a P2MP specific

 MIB, [[I-D.ietf-mpls-p2mp-te-mib](#ref-I-D.ietf-mpls-p2mp-te-mib)].

**[8](%22%20%5Cl%20%22section-8)**. Security Considerations

 General security considerations for MPLS-TP are covered in [[RFC5921](./rfc5921)].

 Additional security considerations for point-to-multipoint LSPs are

 provided in [[RFC4875](./rfc4875)]. This document introduces no new security

 considerations beyond those covered in those documents.

**[9](%22%20%5Cl%20%22section-9)**. IANA Considerations

 There are no requests for IANA actions in this document.

**[10](%22%20%5Cl%20%22section-10)**. References

**[10.1](%22%20%5Cl%20%22section-10.1)**. Normative References

 [RFC4872] Lang, J., Rekhter, Y., and D. Papadimitriou, "RSVP-TE

 Extensions in Support of End-to-End Generalized Multi-

 Protocol Label Switching (GMPLS) Recovery", [RFC 4872](./rfc4872), May

 2007.

 [RFC4873] Berger, L., Bryskin, I., Papadimitriou, D., and A. Farrel,

 "GMPLS Segment Recovery", [RFC 4873](./rfc4873), May 2007.

 [RFC4875] Aggarwal, R., Papadimitriou, D., and S. Yasukawa,

 "Extensions to Resource Reservation Protocol - Traffic

 Engineering (RSVP-TE) for Point-to-Multipoint TE Label

 Switched Paths (LSPs)", [RFC 4875](./rfc4875), May 2007.

 [RFC5332] Eckert, T., Rosen, E., Aggarwal, R., and Y. Rekhter, "MPLS

 Multicast Encapsulations", [RFC 5332](./rfc5332), August 2008.

 [RFC5654] Niven-Jenkins, B., Brungard, D., Betts, M., Sprecher, N.,

 and S. Ueno, "Requirements of an MPLS Transport Profile",

 [RFC 5654](./rfc5654), September 2009.

 [RFC5921] Bocci, M., Bryant, S., Frost, D., Levrau, L., and L.

 Berger, "A Framework for MPLS in Transport Networks", [RFC](./rfc5921)

 [5921](./rfc5921), July 2010.

Frost, et al. Expires April 14, 2014 [Page 8]

Internet-Draft MPLS Transport Profile P2MP Framework October 2013

 [RFC6374] Frost, D. and S. Bryant, "Packet Loss and Delay

 Measurement for MPLS Networks", [RFC 6374](./rfc6374), September 2011.

 [RFC6375] Frost, D. and S. Bryant, "A Packet Loss and Delay

 Measurement Profile for MPLS-Based Transport Networks",

 [RFC 6375](./rfc6375), September 2011.

**[10.2](%22%20%5Cl%20%22section-10.2)**. Informative References

 [G.7710] ITU-T Recommendation G.7710/Y.1701 (07/2007), "Common

 equipment management function requirements", 2007.

 [G.780] ITU-T Recommendation G.780//Y.1351 (07/2010), "Terms and

 definitions for synchronous digital hierarchy (SDH)

 networks", 2010.

 [G.798] ITU-T Recommendation G.798 (10/2010), "Characteristics of

 optical transport network hierarchy equipment functional

 blocks", 2010.

 [I-D.hmk-mpls-tp-p2mp-oam-framework]

 Koike, Y., Hamano, T., and M. Namiki, "Framework for

 Point-to-Multipoint MPLS-TP OAM", [draft-hmk-mpls-tp-p2mp-](./draft-hmk-mpls-tp-p2mp-oam-framework-02)

 [oam-framework-02](./draft-hmk-mpls-tp-p2mp-oam-framework-02) (work in progress), February 2013.

 [I-D.ietf-l2vpn-vpms-frmwk-requirements]

 Kamite, Y., JOUNAY, F., Niven-Jenkins, B., Brungard, D.,

 and L. Jin, "Framework and Requirements for Virtual

 Private Multicast Service (VPMS)", [draft-ietf-l2vpn-vpms-](./draft-ietf-l2vpn-vpms-frmwk-requirements-05)

 [frmwk-requirements-05](./draft-ietf-l2vpn-vpms-frmwk-requirements-05) (work in progress), October 2012.

 [I-D.ietf-mpls-p2mp-te-mib]

 Farrel, A., Yasukawa, S., and T. Nadeau, "Point-to-

 Multipoint Multiprotocol Label Switching (MPLS) Traffic

 Engineering (TE) Management Information Base (MIB)

 module", [draft-ietf-mpls-p2mp-te-mib-09](./draft-ietf-mpls-p2mp-te-mib-09) (work in

 progress), April 2009.

 [I-D.ietf-pwe3-p2mp-pw-requirements]

 Bocci, M., Heron, G., and Y. Kamite, "Requirements and

 Framework for Point-to-Multipoint Pseudowires over MPLS

 PSNs", [draft-ietf-pwe3-p2mp-pw-requirements-05](./draft-ietf-pwe3-p2mp-pw-requirements-05) (work in

 progress), September 2011.

 [I-D.raggarwa-pwe3-p2mp-pw-encaps]

 Aggarwal, R. and F. JOUNAY, "Point-to-Multipoint Pseudo-

 Wire Encapsulation", [draft-raggarwa-pwe3-p2mp-pw-encaps-01](./draft-raggarwa-pwe3-p2mp-pw-encaps-01)

 (work in progress), March 2010.

Frost, et al. Expires April 14, 2014 [Page 9]

Internet-Draft MPLS Transport Profile P2MP Framework October 2013

 [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate

 Requirement Levels", [BCP 14](./bcp14), [RFC 2119](./rfc2119), March 1997.

 [RFC4377] Nadeau, T., Morrow, M., Swallow, G., Allan, D., and S.

 Matsushima, "Operations and Management (OAM) Requirements

 for Multi-Protocol Label Switched (MPLS) Networks", [RFC](./rfc4377)

 [4377](./rfc4377), February 2006.

 [RFC4447] Martini, L., Rosen, E., El-Aawar, N., Smith, T., and G.

 Heron, "Pseudowire Setup and Maintenance Using the Label

 Distribution Protocol (LDP)", [RFC 4447](./rfc4447), April 2006.

 [RFC5860] Vigoureux, M., Ward, D., and M. Betts, "Requirements for

 Operations, Administration, and Maintenance (OAM) in MPLS

 Transport Networks", [RFC 5860](./rfc5860), May 2010.

 [RFC5951] Lam, K., Mansfield, S., and E. Gray, "Network Management

 Requirements for MPLS-based Transport Networks", [RFC 5951](./rfc5951),

 September 2010.

 [RFC6371] Busi, I. and D. Allan, "Operations, Administration, and

 Maintenance Framework for MPLS-Based Transport Networks",

 [RFC 6371](./rfc6371), September 2011.

 [RFC6372] Sprecher, N. and A. Farrel, "MPLS Transport Profile (MPLS-

 TP) Survivability Framework", [RFC 6372](./rfc6372), September 2011.

 [RFC6373] Andersson, L., Berger, L., Fang, L., Bitar, N., and E.

 Gray, "MPLS Transport Profile (MPLS-TP) Control Plane

 Framework", [RFC 6373](./rfc6373), September 2011.

 [RFC6639] King, D. and M. Venkatesan, "Multiprotocol Label Switching

 Transport Profile (MPLS-TP) MIB-Based Management

 Overview", [RFC 6639](./rfc6639), June 2012.

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