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Configuration of pro-active MPLS-TP Operations, Administration, and Maintenance (OAM) Functions Using LSP Ping
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Abstract

This specification describes the configuration of pro-active MPLS-TP Operations, Administration, and Maintenance (OAM) Functions for a given LSP using a common set of TLVs that is carried on LSP Ping.

Status of this Memo

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1.   Introduction   TOC

This document describes the configuration of pro-active MPLS-TP
Operations, Administration, and Maintenance (OAM) Functions for a given
LSP using a common set of TLVs that can be carried on either RSVP-TE
[RFC3209] or LSP Ping [BFD-Ping]. In particular it specifies the
mechanisms necessary to establish MPLS-TP OAM entities monitoring an
LSP and defines information elements and procedures to configure pro-
active MPLS OAM functions. Initialization and control of on-demand MPLS
OAM functions are expected to be carried out by directly accessing
network nodes via a management interface; hence configuration and
control of on-demand OAM functions are out-of-scope for this document.
Because the Transport Profile of MPLS, by definition [RFC5654], must be
capable of operating without a control plane, there are two options for
in-band OAM: by using an NMS or by using LSP-Ping if a control plane is
not instantiated.
Pro-active MPLS OAM is based on the Bidirectional Forwarding Detection
(BFD) protocol [BFD]. Bidirectional Forwarding Detection (BFD), as
described in [BFD], defines a protocol that provides low- overhead,
short-duration detection of failures in the path between two forwarding

engines, including the interfaces, data link(s), and to the extent
possible the forwarding engines themselves. BFD can be used to track
the liveliness and detect data plane failures of MPLS-TP point-to-point
and might also be extended to p2mp connections.
MPLS Transport Profile (MPLS-TP) describes a profile of MPLS that
enables operational models typical in transport networks, while
providing additional OAM, survivability and other maintenance functions
not currently supported by MPLS. [MPLS-TP-OAM-REQ] defines the
requirements for the OAM functionality of MPLS-TP.
BFD has been chosen to be the basis of pro-active MPLS-TP OAM
functions. MPLS-TP OAM extensions for transport applications, for which
this document specifies the configuration, are specified in [BFD-CCCV],
[MPLS-PM], and [MPLS-FMS].

1.1. Contributing Authors

The editors gratefully acknowledge the contribution of John Drake.

1.2. 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 RFC 2119 (Bradner, S.,
"Key words for use in RFCs to Indicate Requirement Levels,"
March 1997.) [RFC2119].

1.3. Overview of BFD OAM operation

BFD is a simple hello protocol that in many respects is similar to the
detection components of well-known routing protocols. A pair of systems
transmits BFD packets periodically over each path between the two
systems, and if a system stops receiving BFD packets for long enough,
some component in that particular bidirectional path to the neighboring
system is assumed to have failed. Systems may also negotiate to not
send periodic BFD packets in order to reduce overhead.
A path is only declared to be operational when two-way communication
has been established between systems, though this does not preclude the
use of unidirectional links to support bidirectional paths (co-routed
or bidirectional or associated bidirectional).
Each system estimates how quickly it can send and receive BFD packets
in order to come to an agreement with its neighbor about how rapidly

detection of failure will take place. These estimates can be modified
in real time in order to adapt to unusual situations. This design also
allows for fast systems on a shared medium with a slow system to be
able to more rapidly detect failures between the fast systems while
allowing the slow system to participate to the best of its ability.
The ability of each system to control the BFD packet transmission rate
in both directions provides a mechanism for congestion control,
particularly when BFD is used across multiple network hops.
As recommended in [BFD-CCCV], the BFD tool needs to be extended for the
proactive CV functionality by the addition of an unique identifier in
order to meet the requirements. The document in [BFD-CCCV] specifies
the BFD extension and behavior to meet the requirements for MPLS-TP
proactive Continuity Check and Connectivity Verification functionality
and the RDI functionality as defined in [MPLS-TP-OAM-REQ].

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2. Overview of MPLS OAM for Transport Applications

[MPLS-TP-OAM-FWK] describes how MPLS OAM mechanisms are operated to
meet transport requirements outlined in [MPLS-TP-OAM-REQ].
[BFD-CCCV] specifies two BFD operation modes: 1) "CC mode", which uses
periodic BFD message exchanges with symmetric timer settings,
supporting Continuity Check, 2) "CV/CC mode" which sends unique
maintenance entity identifiers in the periodic BFD messages supporting
Connectivity Verification as well as Continuity Check.
[MPLS-PM] specifies mechanisms for performance monitoring of LSPs, in
particular it specifies loss and delay measurement OAM functions.
[MPLS-FMS] specifies fault management signals with which a server LSP
can notify client LSPs about various fault conditions to suppress
alarms or to be used as triggers for actions in the client LSPs. The
following signals are defined: Alarm Indication Signal (AIS), Link Down
Indication (LDI) and Locked Report (LKR). To indicate client faults
associated with the attachment circuits Client Signal Failure
Indication (CSF) can be used. CSF is described in [MPLS-TP-OAM-FWK] and
in the context of this document is for further study.
[MPLS-TP-OAM-FWK] describes the mapping of fault conditions to
consequent actions. Some of these mappings may be configured by the
operator, depending on the application of the LSP. The following
defects are identified: Loss Of Continuity (LOC), Misconnectivity, MEP
Misconfiguration and Period Misconfiguration. Out of these defect
conditions, the following consequent actions may be configurable: 1)
whether or not the LOC defect should result in blocking the outgoing
data traffic; 2) whether or not the "Period Misconfiguration defect"
should result a signal fail condition.

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3. Theory of Operations

3.1. MPLS OAM Configuration Operation Overview

Refer to section 3.1 of [RSVP-TE CONF] for the applicability scenarios description and their related configurations and mechanisms. In fact, each of them can be completely reused in case of LSP Ping configuration as well as already done for RSVP-TE.
The only exception is that LSP Ping needs an extra TLV to carry the information required for the "CV/CC mode" OAM [BFD-CCCV] and defined in [MPLS-TP-IDENTIF]. Such information is supplied by an additional sub-TLV as defined in section 3.3.

3.2. TLVs structure

LSP Ping follows the same TLV structure defined for RSVP-TE in [RSVP-TE CONF] from section 3.2 to section 3.6.
In addition, an extra TLV is defined "MPLS OAM SOURCE MEP-ID TLV" in order to supply the information needed for the Connectivity Verification functionality. In fact, RSVP-TE does not need such TLV because it already encodes this information in other mandatory objects already included in its messages.
The MPLS OAM SOURCE MEP-ID TLV is intended to be inserted in the scope of the "OAM configuration TLV" together with the othe sub-TLV as defined in [RSVP-TE CONF] section 3.2.

3.3. MPLS OAM SOURCE MEP-ID TLV for LSP Ping

The "MPLS OAM SOURCE MEP-ID TLV for LSP Ping" depicted below is carried as a sub-TLV of the "OAM Configuration TLV" in case LSP Ping is used.

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           Type (6)  (IANA)    |          Length = 12          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                           SRC NODE ID                         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |          TUNNEL ID            |            LSP ID             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type: indicates a new type, the "MPLS OAM SOURCE MEP-ID" (IANA to define).
Length: indicates the TLV total length in octets.
SRC NODE ID: 32-bit node identifier as defined in [MPLS-TP-IDENTIF].
TUNNEL ID: a 16-bit unsigned integer unique to the node as defined in [MPLS-TP-IDENTIF].
LSP ID: a 16-bit unsigned integer unique within the Tunnel_ID as defined in [MPLS-TP-IDENTIF].

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4. BFD OAM configuration errors

In addition to error values specified in [OAM-CONF-FWK] and [ETH-OAM] this document defines the following values for the "OAM Problem" Error Code:

- "MPLS OAM Unsupported Functionality";

- "OAM Problem/Unsupported TX rate interval".

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5. Security Considerations

The signaling of OAM related parameters and the automatic establishment of OAM entities introduces additional security considerations to those discussed in [RFC3473]. In particular, a network element could be overloaded, if an attacker would request liveliness monitoring, with frequent periodic messages, for a high number of LSPs, targeting a single network element.
Security aspects will be covered in more detailed in subsequent versions of this document.

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[LSP Ping]	Kompella, K. and G. Swallow, "Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures," 2006.
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Appendix A. Additional Stuff

This becomes an Appendix.

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