Internet Engineering Task Force
Internet-Draft
Intended status: Informational
Expires: April 26, 2010

S. Mansfield, Ed.
E. Gray, Ed.
Ericsson
H. Lam, Ed.
Alcatel-Lucent

October 23, 2009

MPLS-TP Network Management Framework
draft-ietf-mpls-tp-nm-framework-01

Status of this Memo

This Internet-Draft is submitted to IETF in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

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."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt.

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html.

This Internet-Draft will expire on April 26, 2010.

Copyright Notice

Copyright (c) 2009 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents in effect on the date of publication of this document (http://trustee.ietf.org/license-info). Please review these documents carefully, as they describe your rights and restrictions with respect to this document.

Abstract

This document provides the network management framework for the

Transport Profile for Multi-Protocol Label Switching (MPLS-TP).

This framework relies on the management terminology from the ITU-T to describe the management architecture that could be used for an MPLS-TP management network.

The management of the MPLS-TP network could be based on multi-tiered distributed management systems. This document provides a description of the network and element management architectures that could be applied and also describes heuristics associated with fault, configuration, and performance aspects of the management system.

Table of Contents

1. Introduction 3
1.1. Terminology 3
2. Management Architecture 4
2.1. Network Management Architecture 4
2.2. Element Management Architecture 6
2.3. Standard Management Interfaces 9
2.4. Management and Control specific terminology 10
2.5. Management Channel 10
3. Fault Management 11
3.1. Supervision 12
3.2. Validation 12
3.3. Alarm Handling 12
4. Configuration Management 12
4.1. LSP ownership handover 12
5. Performance Management 13
6. Acknowledgements 14
7. Contributors 14
8. IANA Considerations 14
9. Security Considerations 14
10. References 15
10.1. Normative References 15
10.2. Informative References 15
Authors' Addresses 16

1. Introduction

This document provides a framework for using the MPLS-TP NM requirements [1] for managing the elements and networks that support a Transport Profile for MPLS.

This framework relies on the management terminology from the ITU-T to describe the management architecture that could be used for an MPLS-TP management network.

1.1. Terminology

Communication Channel (CCh): A logical channel between network elements (NEs) that can be used in - e.g. - management plane applications or control plane applications. The physical channel supporting the CCh is technology specific. ~~An example of~~ For MPLS-TP, the physical channels supporting the CCh is the MPLS-TP Management Communication Channel (MCC)~~a DCC channel within SDH~~.

Data Communication Network (DCN): A~~a~~ network that supports Layer 1 (physical), Layer 2 (data-link), and Layer 3 (network) functionality for distributed management communications related to the management plane, for distributed signaling communications related to the control plane, and other operations communications (e.g., order-wire/ voice communications, software downloads, etc.).

Equipment Management Function (EMF): T~~t~~he management functions within an NE. See ITU-T G.7710 [2].

...Label Switched Path (LSP): ...TBA

Local Craft Terminal (LCT): An out-of-band device that connects to an NE for management purposes.

Management Application Function (MAF): An application process that participates in system management. See ITU-T G.7710 [2].

Management Communication Channel (MCC): A CCh dedicated for management plane communications.

Message Communication Function (MCF): The communications process that performs functions such as information interchange and relay. See ITU-T M.3013 [6].

Management Communication Network (MCN): A DCN supporting management plane communication is referred to as a Management Communication Network (MCN).

MPLS-TP NE: A~~a~~ network element (NE) that supports MPLS-TP functions. Another term that is used for a network element is node. In terms of this document, the term node is equivalent to NE.

MPLS-TP network: A network in which MPLS-TP NEs are deployed.

Network Element Function (NEF): The set of functions necessary to manage a network element.

Operations System (OS): A system that performs the functions that support processing of information related to operations, administration, maintenance, and provisioning (OAM&P) for the networks, including surveillance and testing functions to support customer access maintenance.

Signaling Communication Network (SCN): A DCN supporting control plane communication is referred to as a Signaling Communication Network (SCN).

Signaling Communication Channel (SCC): A CCh dedicated for control plane communications. The SCC may be used for GMPLS/ASON signaling and/or other control plane messages (e.g., routing messages).

2. Management Architecture

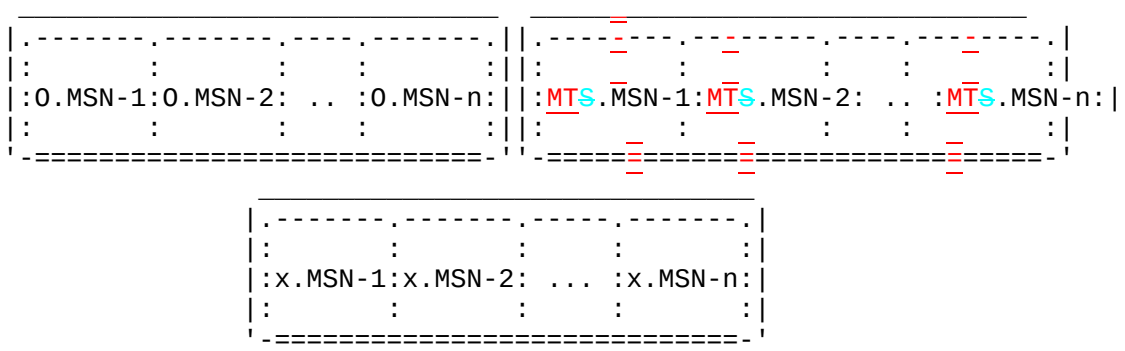
The management of the MPLS-TP network could be based on a multi-tiered distributed management systems, for example as described in ITU-T M.3010 [7] and ITU-T M.3060/Y.2401 [8]. Each tier provides a predefined level of network management capabilities. The lowest tier of this organization model includes the MPLS-TP Network Element that provides the transport service and the Operations System (OS) at the Element Management Level. The Management Application Function (MAF) within the NEs and OSs provides the management support. The MAF management application function at each entity can include agents only, managers only, or both agents and managers. The MAF management application function that include managers are capable of managing an agent included in other MAFs management application functions.

The management communication to peer NEs and/or Operations Systems (OSs) is provided via the Message Communication Function (MCF) within each entity (e.g. NE and OS). The user can access the management of the MPLS-TP transport network via a Local Craft Terminal (LCT) attached to the NE or via a Work Station (WS) attached to the OS.

2.1. Network Management Architecture

A transport Management Network (MN) may consist of several transport technology specific Management Networks. Management network partitioning (Figure 1) below based on from ITU-T G.7710 [2] shows the an example of management network partitioning. Notation used in G.7710 for a transport technology specific MN is x.MN, where x is the transport

specific technology. ~~In the example "O.MSN" is equivalent to an optical management subnetwork, and "S.MSN" is equivalent to an SDH management subnetwork.~~ An MPLS-TP specific MN is~~might be~~ abbreviated as MPLS-TP.MN. In the figure "O.MSN" is equivalent to an optical management Subnetwork. Where there is no ambiguity, we will use "MN" for an MPLS-TP specific MN~~, and "MPLS-TP.MN"~~ (or "MPLS- TP MN")~~ and "MN" where both are used in a given context~~.



Management Network Partitioning

Figure 1

The management of the MPLS-TP network is ~~be~~ separable from the management of the other technology-specific networks, and operate independently of any particular client or server layer management plane.

An MPLS-TP Management Network (MT.MN) could be partitioned into MPLS-TP Management SubNetworks ("MPLS-TP.MSN" or "MPLS-TP MSN", or just "MSN" where usage is unambiguous) for consideration of scalability (e.g. geographic or load balancing) or administrative (e.g. administrative or ownership).

The MPLS-TP MSN could be connected to other parts of the MN through one or more LCTs and/or OSs. The Mmessage Ccommunication Ffunction (MCF) of an MPLS-TP NE initiates/terminates, routes, or otherwise processes management messages over CChs or via an external interface.

Multiple addressable MPLS-TP NEs could be present at a single physical location (i.e. site or office). The inter-site communications link between the MPLS-TP NEs will normally be provided by the CChs. Within a particular site, the NEs could communicate via an intra-site CCh or via a LAN.

2.2. Element Management Architecture

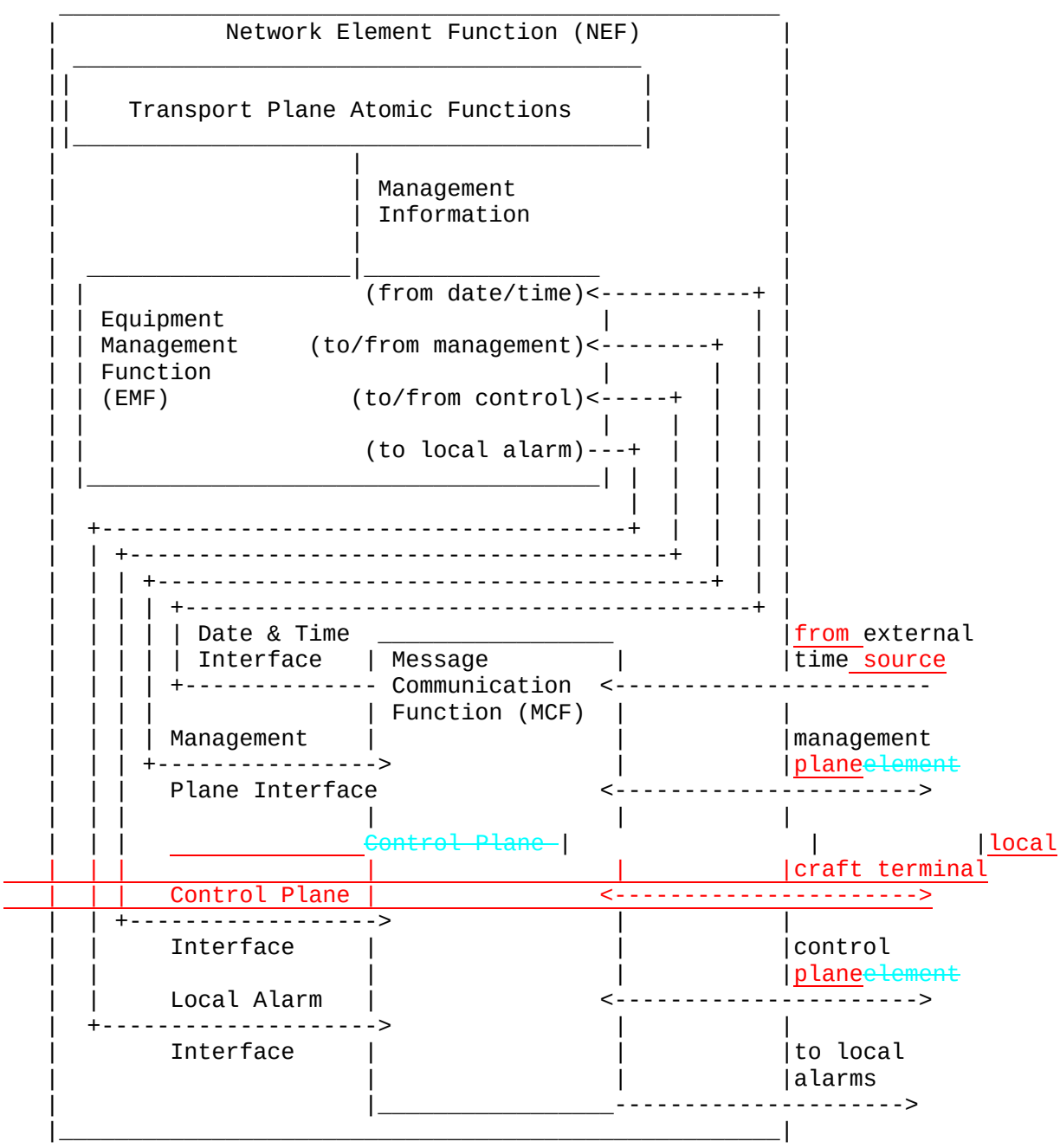
The Equipment Management Function (EMF) of a MPLS-TP NE provides the means through which a management system manages the NE.

The EMF interacts with the NE's transport functions by exchanging Management Information (MI) across the Management Point (MP) Reference Points. The EMF may contain a number of functions that provide a data reduction mechanism on the information received across the MP Reference Points.

The EMF includes functions such as Date & Time, FCAPS (Fault, Configuration, Accounting, Performance and Security) management, and Control Plane functions. The EMF provides event message processing, data storage and logging. The management Agent, a component of the EMF, converts internal management information (MI signals) into Management Application messages and vice versa. The Agent responds to Management Application messages from the Mmessage Ccommunication Ffunction (MCF) by performing the appropriate operations on (for example) the Managed Objects in a Management Information Base (MIB), as necessary. The MCFmessage communication function contains communications functions related to the outside world of the NE (i.e. Date & Time source, Management Plane, Control Plane, Local Craft Terminal and Local Alarms).

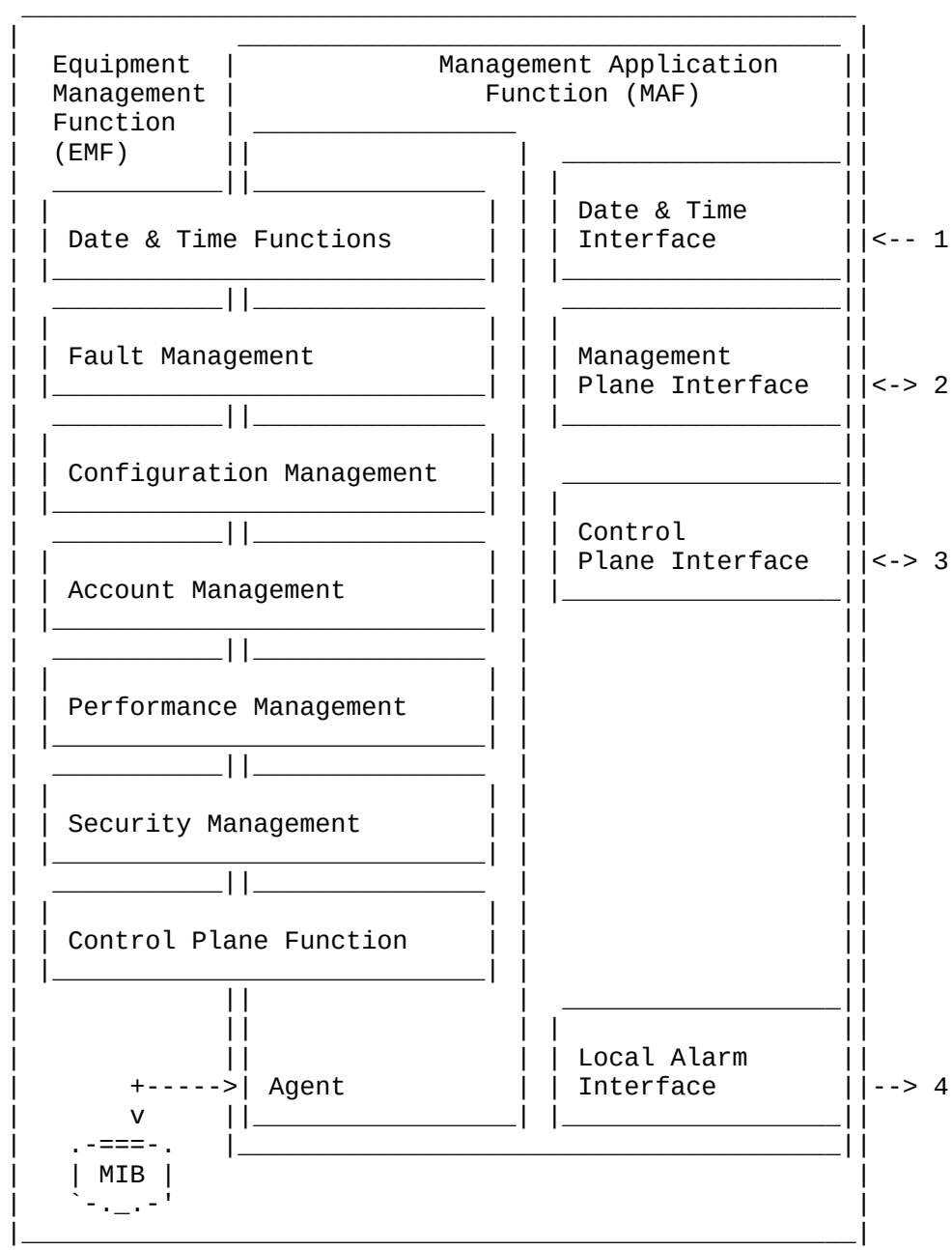
The Date & Time functions keep track of the NE's date/time which is used by the FCAPS management functions to e.g. time stamp event reports.

Below are diagrams that illustrate the components of the Eelement Mmanagement Ffunction (EMF) of a Nnetwork Eelement (NE). The high-level decomposition of the Network Element Function (NEF) picture (Figure 2) provides the breakdown of the Network Element Function, then the EMFequipment management function picture (Figure 3) provides the details of Equipment Management Function, and finally the Mmessage Ccommunication Ffunction (MCF) picture (Figure 4) details the Message Communication Function.



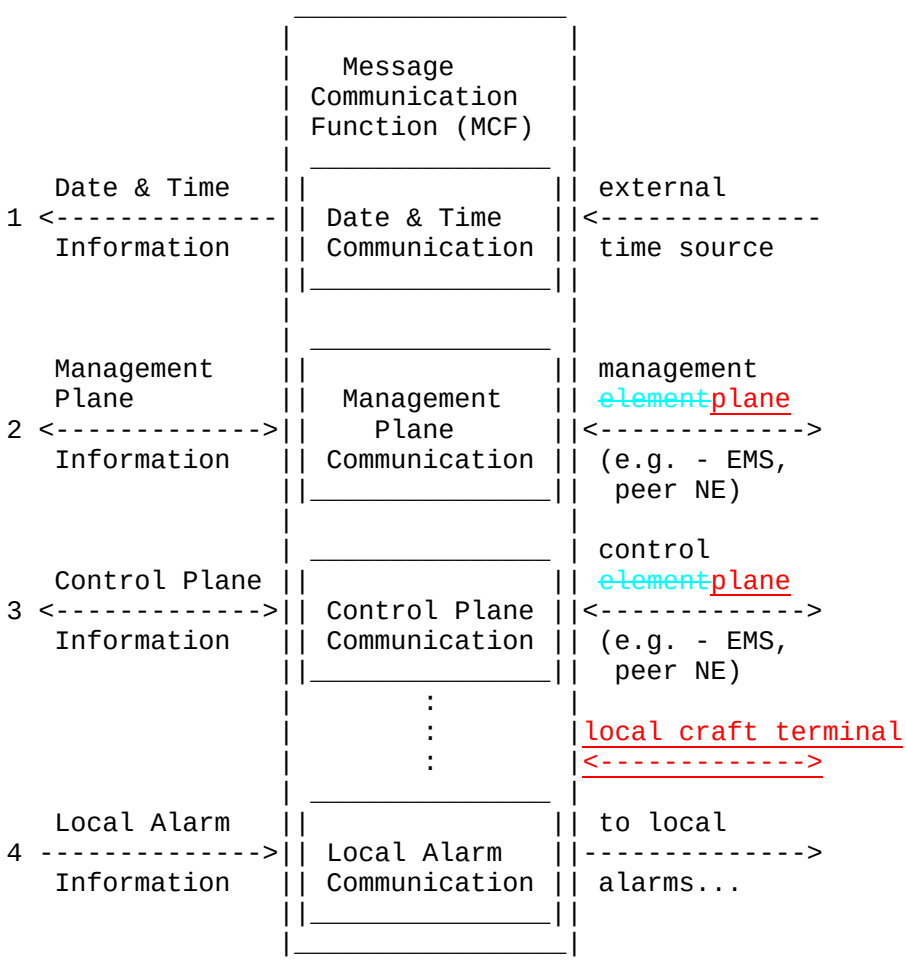
High-level decomposition of NEF

Figure 2



Equipment Management Function

Figure 3



Message Communication Function

Figure 4

2.3. Standard Management Interfaces

The MPLS-TP NM requirements [1] document places no restriction on which management interface is to be used for managing an MPLS-TP network. It is possible to provision and manage an end-to-end connection across a network where some segments are created/managed/deleted, for example by netconf or snmp and other segments by CORBA interfaces. Use of any network management interface for one management related purpose does not preclude use of another network management interface for other management related purposes, or the same purpose at another time. The protocol(s) to be supported are at

the discretion of the operator.

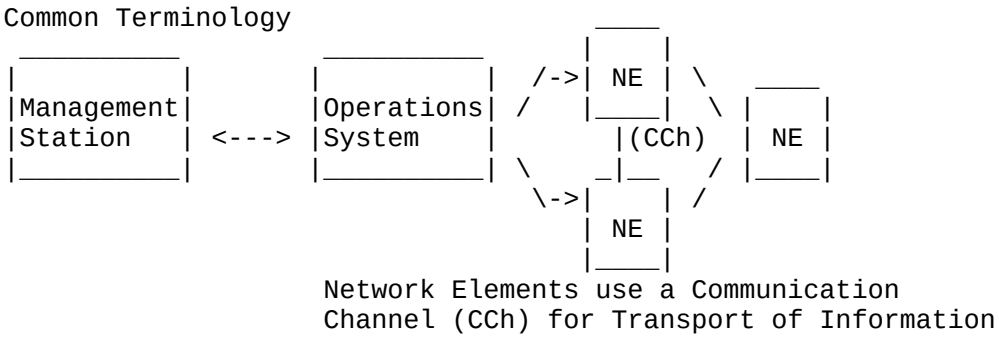
2.4. Management and Control specific terminology

Data Communication Network (DCN) is the common term for the network used to transport Management and Signaling information between: management systems and network elements, management systems to other management systems, and networks elements to other network elements. The Management Communications Network (MCN) is the part of the DCN which supports the transport of Management information for the Management Plane. The Signaling Communications Network (SCN) is the part of the DCN which supports transport for signaling information for the Control Plane. As shown in the communication channel terminology picture (Figure 5) each technology has its own terminology that is used for the channels that support management and control plane information transfer. For MPLS-TP, the management plane uses the Management Communication Channel (MCC) and the control plane uses the Signaling Communication Channel (SCC).

2.5. Management Channel

The Communication Channel (CCh) provides a logical channel between NEs for transferring Management and/or Signaling information. Note that some technologies provide separate communication channels for Management (MCC) and Signaling (SCC).

MPLS-TP NEs communicate via the DCN. The DCN connects NEs with management systems, NEs with NEs, and management systems with management systems.



Communication Channel Terminology

Figure 5

3. Fault Management

A fault is the inability of a function to perform a required action. This does not include an inability due to preventive maintenance,

lack of external resources, or planned actions. Fault management provides the mechanisms to detect, verify, isolate, notify, and recover from the fault.

3.1. Supervision

ITU-T G.7710 [2] lists five basic categories of supervision that provide the functionality necessary to detect, verify, and notify a fault. The categories are: Transmission Supervision, Quality of Service Supervision, Processing Supervision, Hardware Supervision, and Environment Supervision. Each of the categories provides a set of recommendations to ensure the fault management process is fulfilled.

3.2. Validation

ITU-T G.7710 [2] describes a fault cause as a limited interruption of the required function. It is not reasonable for every fault cause to be reported to maintenance personnel. The validation process is used to turn fault causes (events) into failures (alarms).

3.3. Alarm Handling

Within an element management system, it is important to consider mechanisms to support severity assignment, alarm reporting control, and logging.

4. Configuration Management

Configuration management provides the mechanisms to provision the MPLS-TP services, setup security for the MPLS-TP services and MPLS-TP network elements, and provides the destination for fault notifications and performance parameters. Inventory reporting is also considered part of configuration management.

Associated with configuration management are hardware and software provisioning and inventory reporting.

4.1. LSP ownership handover

MPLS-TP networks can be managed not only by Network Management Systems (i.e. Mmanagement Pplane (MP)), but also by Ccontrol Pplane (CP) protocols.
The utilization of the Ccontrol Pplane is not a mandatory requirement (see MPLS-TP Requirements [3]) but it is often used by network operators in order to make network configuration and Label Switched Path (LSP) recovery
both faster and simpler.

In networks where both CP and MP are provided, an LSP could be created by either (CP or MP). The entity creating an LSP owns the data plane resources comprising that LSP. Only the owner of an LSP is typically able to modify/delete it. This results in a need for interaction between the MP and CP to allow either to manage all the resources of a network.

Network operators might prefer to have full control of the network resources during the set-up phase and then allow the network to be automatically maintained by the Ccontrol Pplane. This can be achieved by creating LSPs via the Mmanagement Pplane and subsequently transferring LSP ownership to the Ccontrol Pplane. This is referred to as "ownership handover" RFC 5493 [9]. MP to CP ownership handover is then considered a requirement where a Ccontrol Pplane is in use that supports it. The converse (CP to MP ownership handover) is a feature that is recommended - but not required - for (G)MPLS networks because it has only minor applications (for example moving LSPs from one path to another as a maintenance operation).

The LSP handover procedure has already been standardized for GMPLS networks, where the signaling protocol used is RSVP-TE RFC 3209 [4]. The utilization of RSVP-TE enhancements are defined in [5].

MP and CP interworking includes also the exchange of information that is either requested by the MP, or a notification by the CP as a consequence of a request from the MP or an automatic action (for example a failure occurs or an operation is performed). The CP is asked to notify the MP in a reliable manner about the status of the operations it performs and to provide a mechanism to monitor the status of Ccontrol Pplane objects (e.g. TE Link status, available resources), and to log Ccontrol Pplane LSP related operations. Logging is one of the most critical aspects because the MP always needs to have an accurate history and status of each LSP and all Ddata Pplane resources involved in it.

5. Performance Management

Performance statistics could overwhelm a Mmanagement Nnetwork, so it is important to provide flexible instrumentation that provides control over the amount of performance data to be collected.

A distinction is made between performance data that is collected on-demand and data that is collected proactively.

On-demand measurement provides the operator with the ability to do performance measurement for maintenance purpose such as diagnosis or to provide detailed verification of proactive measurement. It is

used typically on specific LSP service instances for a limited time, thus limiting its impact on network performance under normal operations. Therefore on demand measurement does not result in scaling issues.

Proactive measurement is used continuously over time after being configured with periodicity and storage information. Data collected from proactive measurement are usually used for verifying the performance of the service. Proactive performance monitoring has the potential to overwhelm both the process of collecting performance data at a Nnetwork Eelement (for some arbitrary number of service instances traversing the NE), and the process of reporting this information to the OS. As a consequence of these considerations, operators would typically limit the services to which proactive performance measurement would be applied to a very selective subset of the services being provided and would limit the reporting of this information to statistical summaries (as opposed to raw or detailed performance statistics).

6. Acknowledgements

The authors/editors gratefully acknowledge the thoughtful review, comments and explanations provided by Diego Caviglia and Bernd Zeuner.

7. Contributors

8. IANA Considerations

This memo includes no request to IANA.

9. Security Considerations

Provisions to any of the network mechanisms designed to satisfy the requirements described herein need to prevent their unauthorized use and provide a means for an operator to prevent denial of service attacks if those network mechanisms are used in such an attack.

Solutions need to provide mechanisms to prevent private information from being accessed by unauthorized eavesdropping, or being directly obtained by an unauthenticated network element, system or user.

Performance of diagnostic functions and path characterization involves extracting a significant amount of information about network

construction that the network operator considers private.

10. References

10.1. Normative References

[1] Mansfield, S. and K. Lam, "MPLS TP Network Management Requirements", draft-ietf-mpls-tp-nm-req-06 (work in progress), October 2009.

[2] International Telecommunications Union, "Common equipment management function requirements", ITU-T Recommendation G.7710/ Y.1701, July 2007.

[3] Niven-Jenkins, B., Brungard, D., Betts, M., Sprecher, N., and S. Ueno, "MPLS-TP Requirements", draft-ietf-mpls-tp-requirements-10 (work in progress), August 2009.

[4] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V., and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[5] Caviglia, D., Ceccarelli, D., Bramanti, D., Li, D., and S. Bardalai, "RSVP-TE Signaling Extension For Management Plane To Control Plane LSP Handover In A GMPLS Enabled Transport Network.", draft-ietf-ccamp-pc-spc-rsvpte-ext-04 (work in progress), September 2009.

10.2. Informative References

[6] International Telecommunications Union, "Considerations for a telecommunications management network", ITU-T Recommendation M.3013, February 2000.

[7] International Telecommunications Union, "Principles for a telecommunication managemetn network", ITU-T Recommendation M.3010, April 2005.

[8] International Telecommunications Union, "Principles for the Management of Next Generation Networks", ITU-T Recommendation M.3060/Y.2401, March 2006.

[9] Caviglia, D., Bramanti, D., Li, D., and D. McDysan, "Requirements for the Conversion between Permanent Connections and Switched Connections in a Generalized Multiprotocol Label Switching (GMPLS) Network", RFC 5493, April 2009.

Authors' Addresses

Scott Mansfield (editor)
Ericsson
250 Holger Way
San Jose, CA 95134
US

Phone: +1 724 931 9316
Email: scott.mansfield@ericsson.com

Eric Gray (editor)
Ericsson
900 Chelmsford Street
Lowell, MA 01851
US

Phone: +1 978 275 7470
Email: eric.gray@ericsson.com

Hing-Kam Lam (editor)
Alcatel-Lucent
600-700 Mountain Ave
Murray Hill, NJ 07974
US

Phone: +1 908 582 0672
Email: ~~hklam~~Kam.Lam@alcatel-lucent.com