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TITLE: Proposed Link Management Requirements

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ABSTRACT:
This working document provides and initial set of link management requirements that WorldCom would like to be considered by Q14/15.

The need for faster detection and restoration of faults and degradations is essential in the optical networks due to the amount of traffic being carried by them. This calls for tighter control on the detection and reporting mechanisms. In this document we analyze the requirements event communications between the active and passive devices, which in turn can be used by the optical control plane.

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Link Management Requirements

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Abstract

The need for faster detection and restoration of faults and degradations is essential in the optical networks due to the amount of traffic being carried by them. This calls for tighter control on the detection and reporting mechanisms. In this document we analyze the requirements event communications between the active and passive devices, which in turn can be used by the optical control plane. This function is to be defined in such that it works without an upper GMPLS layer.

1   Introduction

The configuration and management of today's transport networks are largely driven by significant human intervention, which increases the time to turn up revenue generating services and is prone to errors and inefficiencies. Even where management systems provide automation for some provisioning and management tasks, the management systems are still proprietary and cumbersome. The Generalized Multi-protocol Label (Lambda) Switching (GMPLS) protocol is being specified in the IETF to provide a standard automated and distributed control plane for optical networks. The use of GMPLS will enable the dynamic provisioning of resources and provide network survivability using protection and restoration techniques. The main intent of GMPLS is to make optical networks more manageable, scalable and efficient, while maintaining or improving on their current high availability characteristics.

Optical networks being deployed today consist of the following three basic types of devices as shown in Figure 1. These types are as follows:
- Service delivery platforms (e.g., routers, ATM switches, and SONET/SDH devices),
- Optical switching platforms (e.g. optical switches which contain Optical-Electrical-Optical (OEO) capabilities, Optical-Optical-Optical (OOO) switches),
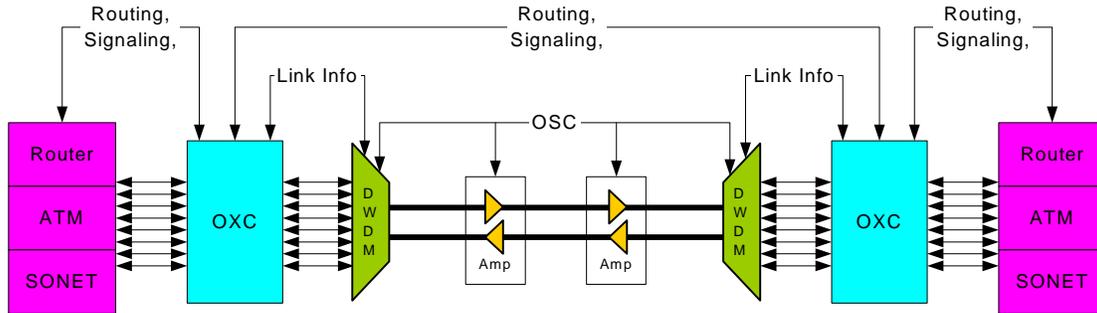- Optical line transmission systems (e.g. DWDM, Optical Amplifiers, etc.)

Routing,
Signaling,

Routing,
Signaling,

Routing,
Signaling,

Link Info

Link Info

OSC

Router
ATM
SONET

OXC

D W D M

Amp

Amp

D W D M

OXC

Router
ATM
SONET

Figure 1: Optical Networks with GMPLS

GMPLS protocols define standard control interfaces between service delivery platforms and optical switching systems to exchange routing [GMPLS-OSPF, GMPLS-ISIS] and signaling [GMPLS-SIG, GMPLS-RSVP, GMPLS-LDP] information, and perform link management functions.

The use of DWDM (Dense Wavelength Division Multiplexing) technology implies that there can be a very large number (hundreds or even thousands) of parallel links between two directly adjacent nodes. The Link Management Protocol (LMP) was specified to address the issue of the manual configuration and control of the links. In addition, managing the state of the links from a serviceability point is essential. The management of the links must be automated.

However, in the optical switching and optical line transmission systems there are two types of systems. The types are as follows:

−   OEO – For the purpose of this document the OEO systems will be considered as active systems with access to both the analogue and the digital signal characteristics which contain the link fault, trace, and performance information.
−   OOO – For the purpose of this document OOO systems will be considered to be passive systems with access only to a set of analogue optical characteristics which contain only basic analogue fault information.

The purpose of this document is to define the needs of active systems to communicate with passive systems. This document separates the various requirements with the following *goals* in mind:

−   For active systems to monitor and communicate the status and configuration of different λ(s), link(s) and equipment(s), which are not visible to the passive systems and communicate the status to the relevant parties.
−   Reduce the error detection and immediate reporting time to passive systems.
    −   State reporting only is required.
−   Monitored information reported via link management should only include degraded conditions that exceed SLAs.

The following *assumptions* make the requirements for such mechanisms clearer:

−   Active and passive systems are IP addressable entities
−   Active and passive systems can communicate configurable relationships.
−   Active and passive systems can negotiate the supported feature capabilities.

- The OSC channel may use a proprietary messaging protocol between the connected systems. This channel may carry configuration, management and state information for both the active and passive systems along its connectivity.
- Only the state and configuration information carried within the proprietary OSC protocol is required to be translated into messages understandable by the active and passive control systems.
- The use of standardized signaling transport and standardized protocol through the OSC is not precluded.

2 The Need for a Control Interface with Transmission Systems

There is currently no standard control interface defined between active and passive systems. Standard SONET/SDH equipment provides extensive fault detection, reporting and handling capabilities. Opaque devices using SONET/SDH overhead messaging can employ these SONET/SDH standards; however, as networks transition to the use of more transparent optical networking devices, access to the SONET/SDH overhead may not exist in every node. Currently, SONET/SDH only provides automation through the use of NMS systems and proprietary management capabilities. In addition SONET/SDH devices are also active devices, thus having access to both the analogue and digital information. However, in the new optical networking domain many passive devices exist. These passive devices do not have immediate access to the digit information and may only have a limited access to analogue information. Therefore, another alternative is necessary. We call this alternative Optical Link Management (OLM). With the use of the OLM, both active and passive systems may provide the same level of configuration and state information handling and reporting as found in SONET/SDH networks.

For example, a great deal of information about a link between two passive systems is known by the intermediate active systems. Exposing this information to the control plane can improve network usability by further reducing required manual configuration and also greatly enhancing state detection and recovery. State detection is particularly an issue when the network is using passive systems. Once a connection is established, passive systems have only limited visibility into the health of the connection. Even though the passive system is all-optical, active systems typically terminate channels electrically and regenerate them optically, which presents an opportunity to monitor the health of a channel between passive systems. The elements of a transmission system also typically communicate over an optical service channel (OSC). This can provide a system wide view of OXC-to-OXC link health.

Another characteristic of active systems is that they can span very long distances. Typically these systems span distances of 100's to 1000's of kilometers and contain multiple nodes including terminals at the endpoints and optical amplifiers in between. Reaction time to state changes, as well as fault isolation, can be improved if the transmission system notifies attached devices as quickly as possible rather than relying on other means for the attached devices to detect, and report the state change.

The typical active system located between a pair of passive systems monitors for degradation and faults along the fiber path that span to its peer active system. Electronic circuitry monitors such degradations at the SONET/SDH and wavelength level at various points along the fiber path. Active and passive systems detect fiber cuts and pass along the information to other systems along the path. To use the SONET/SDH-level fault reporting methods, all devices require the digital level monitoring capabilities. A passive client of an active system avoids the use of SONET/SDH monitoring capabilities utilizing this solution. An OLM capability between the active and passive systems can provide the same configuration and state information of SONET/SDH systems while not duplicating the capability.

3 Requirements for Optical Link Management

OLM is required for better configuration and state reporting thus allowing more accurate connections and faster restoration – notice without this information GMPLS can not be used as a restoration capability for lambda switching systems since the information coming from intermediate systems will be hidden from the GMPLS-based control plane.

The link management processes are required for faster state reporting, and communication of minimal link configuration information. The communication of these two information sets will allow the control plane to setup connections with more accuracy and in less time.
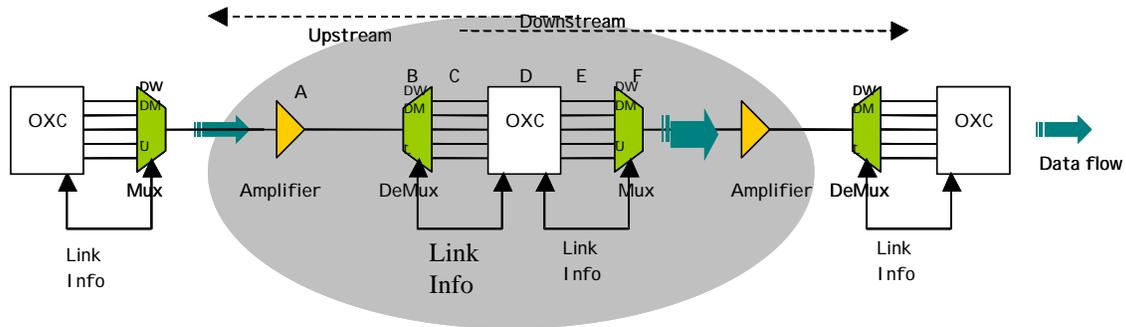The high-level link management requirements are outlined in the following subsections.

Figure 2: Faults and their detection using the protocol

3.1   *General Link Characteristics*

As used within a control plane the general link characteristics include two major items. These items are Link State and Link Configuration.

−   The Link State characteristic contains sufficient information to allow the routing protocols to select the best available link for new connections. It all would then have the ability to allow routing protocols the ability to make restoration choices based on current state information. The required states to support this capability are as follows:

−   Signal Failed – this state is used to report that a configured trail (connection) has failed while in service. For the purpose of this document I would like to suggest that we define Signal Fail in the same manner as it is defined in ITU-T G.806. This will insure that a consistent initiation criterion is maintained.

−   Signal Degrade – this state is used to report that a configured trail (connection) has degraded to a level that is not acceptable to the service being supported. For the purpose of this document I would like to suggest that we define Signal Degrade in the same manner as it is defined in ITU-T G.806. This will insure that a consistent initiation criterion is maintained.

−   Operational – this state is used to confirm the link is operating in a satisfactory manner. This state could also be used to report that a link has returned to a satisfactory operating state after a Signal Fail or Signal Degrade state has cleared. I recommend that we also use the clearing conditions for Signal Fail and Signal Degrade as defined in G.806.

- Unequipped Available – this state would indicate that a link has been built but is not configured to carry bearer traffic.

- Unequipped Unavailable – this state would indicate that a link has been built but is not suitable for carrying bearer traffic.

- Automatic Report Control (ARC) – this state indicates that a link has been built and configured for bearer traffic but no bearer traffic has been passed.

- Link Configuration characteristic contains sufficient information to allow the discovery protocols to obtain the required neighbour characteristics. The following is an example list of those characteristics.

- Link Node Identification – this characteristic will provide the system with identification for the link neighbour devices.

- Link Identification – this characteristic will both provide the system with identification of a link and provide a means for the control plane to name the link.

- Grade of Service (Quality of Service) – this characteristic will allow the control plane to configure the active systems with the configuration information required to set the Signal Fail and Signal Degrade parameters to meet the SLA needs.

3.2   *General Considerations*

The protocol being proposed may be specified such that it is able to support different capabilities based on the requirements of the specific connection.

- Link State characteristics must be available from all link connections.
- Link Configuration must be supportable across all links. However, the details supported for this requirement are dependant on the capabilities of the connected devices
- Path (optical trail) tracing mechanism

With the understanding of the requirements the following should be the protocol properties.

- Transport mechanisms should be specified clearly.
- The goal should be achieving faster reporting time between the connected devices (e.g. The defect notification must be fast enough to support switch times in the range of a few 10's of milliseconds.).
- Security issues should be given proper attention especially when the control signaling is traversing via external clouds.
- The protocol must be reliable.

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