Contribution Number: **OIF2001.055**

Working Group: **Architecture, Signaling, OAM&P**

TITLE:

Detecting and correlating external path-related faults and degradations by extending LMP between OXC and DWDM

SOURCE: **Sudheer Dharanikota (sudheer@nayna.com)**
Raj Jain (raj@nayna.com)
Jay Shah (jay@nayna.com)
Nayna Networks

Yong Xue (yxue@uu.net)
UUNET/Worldcom

DATE: **January 22, 2001**

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 propose some such extensions that can be made to the LMP to run between the DWDM and OXC. This proposal is to extend [2] and to streamline the needs for such a protocol.

Table of Contents

1 INTRODUCTION

Link Management Protocol (LMP) [1] was proposed between the OXCs (Optical Cross Connects) to perform the tasks of channel monitoring, link correlation, link verification and fault detection. But this mechanism cannot identify and correlate all the faults between the OXCs. The DWDM equipment, which is another active device between the OXCs, can also detect and correlate many of path related faults and degradations[1]. In this perspective, a protocol devised between the OXC and the DWDM ([2]) can provide tighter control on fault detection and hence restoration times.

In the current proposal we streamline different requirements [2] with the following ***goals*** in mind:

- Monitor and communicate the status of different λ(s), link(s) and equipment(s), which are not visible to the OXC and communicate the status to the relevant parties.
  - This helps in creating a hierarchy of link(s) and equipment(s) for the sake of fault analysis.
- Reduce the error detection and reporting time.
  - Fault reporting should be both event-driven and polling-driven.
  - Monitored information should be periodic and event-driven (in case of degrading links or on demand).
- Avoid all downstream nodes detecting the same error and sending myriad of messages to the upstream nodes, which is a normal case in [1].
- Backward notification of the forward path status to ease the layer 3 signaling intervention (*for future extension*).

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

- OXC and DWDM can communicate on the configuration relationships.
- OXC and DWDM can negotiate on the feature support capabilities.
- The OSC channel between the DWDMs can carry the error notifications of the forward data channels for the sake quicker response to the faults (in stead of relying on the timer-oriented protocols).
  - *Note this is the DWDM-DWDM LMP. Need further work in the current proposal.*

In section 2, we present a scenario to understand the requirements of such a solution. Section 3 discusses the suggestions or modifications required for such an LMP between the DWDM and OXCs. In section 4 we highlight the value-added by this document as conclusions, followed by references in section 5.

---

[1] This is mainly due to the multiplexing and demultiplexing capability and due to the OEO nature of the equipment.

2 UNDERSTANDING THE REQUIREMENTS

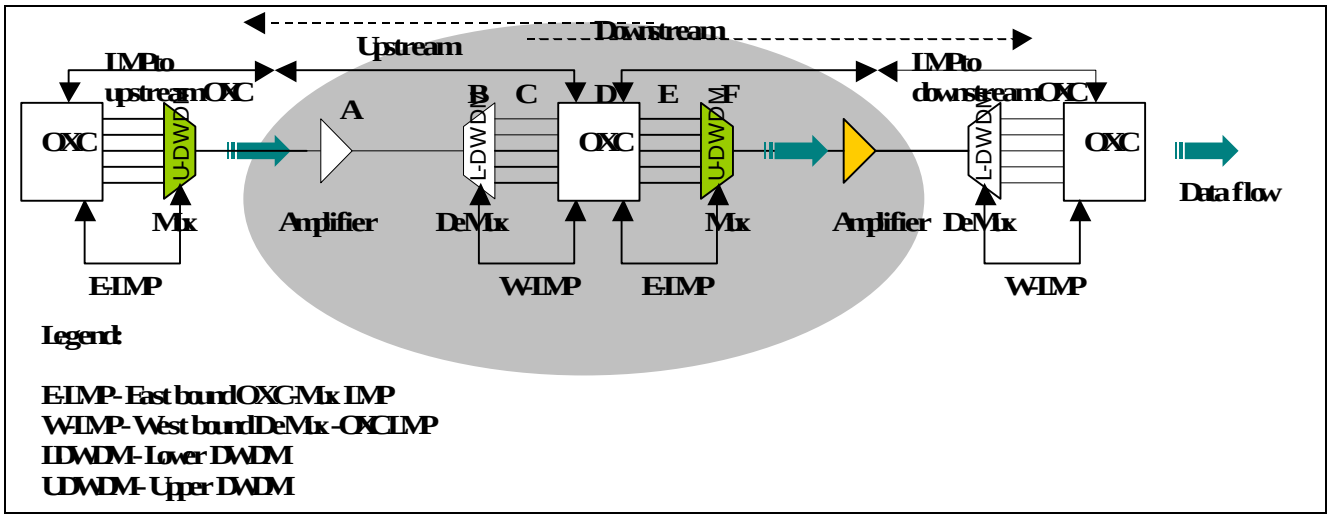

Figure 1 A number of faults that can be detected and correlated by this proposal

In Figure 1, we present a typical optical domain segment with external fault (or degradation) locations that cannot be distinguished by the LMP [1] (Hence a new DWM-OXC LMP [2] is proposed). These faults and degradations are:

- A - Fault or degradation due to path (Optical Amplifier, fiber etc.)
- B - Fault or degradation due to LDWDM (DeMux)
- C - Fault or degradation due to the links between LDWDM (DeMux) and OXC
- D - Fault or degradation due to OXC
- E - Fault or degradation due to links between OXC and UDWDM (Mux)
- F - Fault or degradation due to UDWDM (Mux)

Here we distinguish between the W-LMP and E-LMP to better understand the requirements. Table 1, presents different actions performed (with the solution provided in this document) by different equipment (LDWDM, OXC, UDWDM) in response to the above-identified degradation or fault locations. This table can be used to understand the protocol operations the protocol fields that need to be carried.

Table 1 Fault/degradation versus the mechanisms of reaction by OXC and DWDMS

Location	Degradation Or Fault	Actions M – Monitor Fault/Degradation D – Detect Fault/Degradation R – Report Fault/degradation C – Correlate Fault/Degradation P – Protect from Fault/Degradation G – Generate LOL negotiated action		
		L-DWDM	OXC	U-DWDM
A	Degradation	M, C, R (G downstream)	C, P, (R upstream)	M, R to OXC, G
	Fault	M, C, R (G downstream)	C, P, (R upstream)	M, R to OXC, G
B	Degradation	M, C, R (G downstream)	C, P	M, R to OXC, G
	Fault		M[2], C, P (R upstream)	M, R to OXC, G
C	Degradation		C, P (R upstream)	M, R to OXC, G
	Fault		M, C, P (R upstream)	M, R to OXC, G
D	Degradation		C, P (R upstream)	M, R to OXC, G
	Fault		M, C, P (R upstream)	M, R to OXC, G
E	Degradation		C, P (R upstream)	M, C, R to OXC, G
	Fault		C, P (R upstream)	M, C, R to OXC, G
F	Degradation		C, P (R upstream)	M, C, R to OXC, G
	Fault		C, P (R upstream)	M, C R to OXC, G

Table 2, presents a better picture of the modification required to different phases of the native LMP ([1]) against the proposed features, namely:

- Group status monitoring and reporting
- Customized error reporting
- Reduce the upstream proliferation of the error reporting as in [1]

[2] Monitoring the sanity of the OSC channel performs this action.

Table 2 Additional requirements required to [2] against the proposed features

Feature		Additions needed for different phases of DWDM-OXC LMP communication			
		Control channel management	Link property correlation	Connectivity verification	Fault localization
Group Status monitoring and reporting - Link(s) or equipment(s)	Fiber	Exchange Fiber ownership information Fiber <-> λ mapping	Exchange Fiber <-> Link bundle information	Note: Elaborate on the DWDM links and Link bundle correlation from connectivity point-of-view.	Group notification per SRLG
	DWDM	OSC channel termination point and monitoring	OSC <-> DWDM correlation	OSC channel being terminated on the OXC	OXC detecting the upstream DWDM failure and notifying the downstream equipment.
Reduce the upstream proliferation of the error reporting		Error proliferation suppression mechanism negotiation.			Implementation of error suppression mechanism. Example for this being reporting the error + generating AIS-like optical signal.
Customized error reporting behavior		Negotiating the type of reporting, groups of parameters to be monitored etc.			Reporting/responding to the requests from the OXC/DWDM. Correlating the faults/degradations.

3 SUGGESTIONS

With the understanding of the requirements as mentioned in the previous section, here we present suggestions to be considered in [1] and [2].

- General suggestions to [1] and [2] (please note that these points are not elaborated in this document before this juncture):
  - Transport mechanisms should be specified clearly.

        - If LMP/IP then what DSCP/ToS fields, TTL etc need to be specified.
        - If LMP/L2 then which fields should be set for the sake of priority etc.
        - If LMP/Overhead bytes, need to define this in the document.
        - Crispness of the message formats and the requirements for monitoring and fault management are missing.
    - Comment on the security issues for the OOB (Out Of Band) signaling via external clouds.

- During control channel management in [2]:
    - Feature capability negotiation should be incorporated in this phase.
        - Configuration features
            - Fiber – Port (1:N) information exchange
            - Resource ownership information
        - Monitoring features
            - DWDM monitoring
            - Fiber monitoring
            - λ monitoring
        - Support features
            - OSC termination on the OXC
            - LOF behavior
            - LOL behavior

- Monitoring requirements in the DWDM equipment:
    - Types of monitoring:
        - Event driven (reporting)
            - Monitors thresholds for the degradation and fault monitoring
        - Polled for information
            - Keep the history of the monitored parameters and/or running average of these parameters.
            - What is the available time between measurements?
    - Per λ monitoring
        - Need to get a crisp definition of the parameters monitored.
        - Should be able to group the monitored parameters for “the parameters to be monitored” negotiation.
            - Monitoring threshold for the degradation report
                - Use counters used for measuring such as BER, cross talk, OSNR
    - Group monitoring (E.g., Fiber, Cable, Node etc.,)
    - What should be done by the OXC and what should be done by DWDM?
        - OXC
            - Monitor OSC for the equipment failures
            - Correlate the error information received on E and W LMP
            - Communicate this information upstream (or down stream) for faster fault reporting (instead of relying on the signaling or routing protocols).

        - Perform relevant protection.
    - DWDM:
        - West bound (DWDM-OXC) (De-multiplexing):
            - Monitor path related failures and degradations.
            - Correlate the upstream-related faults and degradations.
            - Report the faults/degradations to downstream OXC.
            - Act according to the negotiated LOL behavior for downstream detection.
        - East bound (OXC-DWDM) (Multiplexing):
            - Monitor and correlate the Faults and degradations (caused by OXC and others).
            - Report this information to the upstream OXC.
            - Act according to the negotiated LOL behavior for downstream detection.

- Fault localization and reporting:
    - Group fault Correlation
        - Correlation of fiber failures
        - Correlation of DWDM failures
    - Group reporting to reduce the overhead
    - Individual errors

4 CONCLUSIONS

Analyzed the faults and degradations that cannot be detected by [1] and observed some of these can be solved by a mechanism like [2]. Then we extended the requirements for [2] for better bounds on the fault (and degradation) identification and reaction times between the OXCs. Many suggestions are made to realize the extended services expected by [2]. These suggestions can directly be mapped to realize the protocol extensions.

5 REFERENCES

1. J. P. Lang, et al., “Link Management Protocol (LMP),” IETF working group document, draft-ietf-mpls-lmp-01.txt, an IETF working group draft.
2. A. Fredette, et al., “Link Management Protocol (LMP) for WDM Transmission Systems,” draft-fredette-lmp-wdm-00.txt, an IETF work in progress.