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CONTRIBUTION TO T1 STANDARDS PROJECT

TITLE **Detecting and correlating external path-related faults by cohesive PXC and DWDM protocols**

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PROJECT **Optical Hierarchical Interfaces**

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, 3] and to streamline the requirements for such a protocol.

Key words: PXC, DWDM, LMP, NTIP, Fault monitoring

Notice

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1 Introduction

The DWDM equipment, located between a pair of PXCs, already monitors for degradation and faults along the fiber path that span to its neighbor DWDM equipment. Expensive electronic circuitry monitors such degradations at a wavelength level at each repeater and amplifier along the fiber path. Repeaters and Amplifiers detect fiber cuts and pass along the information to other equipment along the path. The failure information is then provided by the DWDM to its client equipment. Since this failure information is carried within SONET streams, expensive electronic circuitry is necessary at the client equipment. A PXC client of a DWDM avoids the use of SONET circuitry to provide a more cost effective solution. In this perspective a messaging based protocol between the DWDM and the PXC can provide the same fault information to a non-SONET client.

In the current proposal we streamline different requirements [2, 3] 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.
- 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).

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 may continue to run a proprietary messaging protocol between the DWDMs. This channel can carry the error notifications among the DWDM, the repeater and the amplifier equipment along the path.
- Only the fault information carried within the proprietary OSC protocol is required to be translated into messages being proposed by the DWDM equipment to be sent to the OXC devices.

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.

2 Understanding the requirements

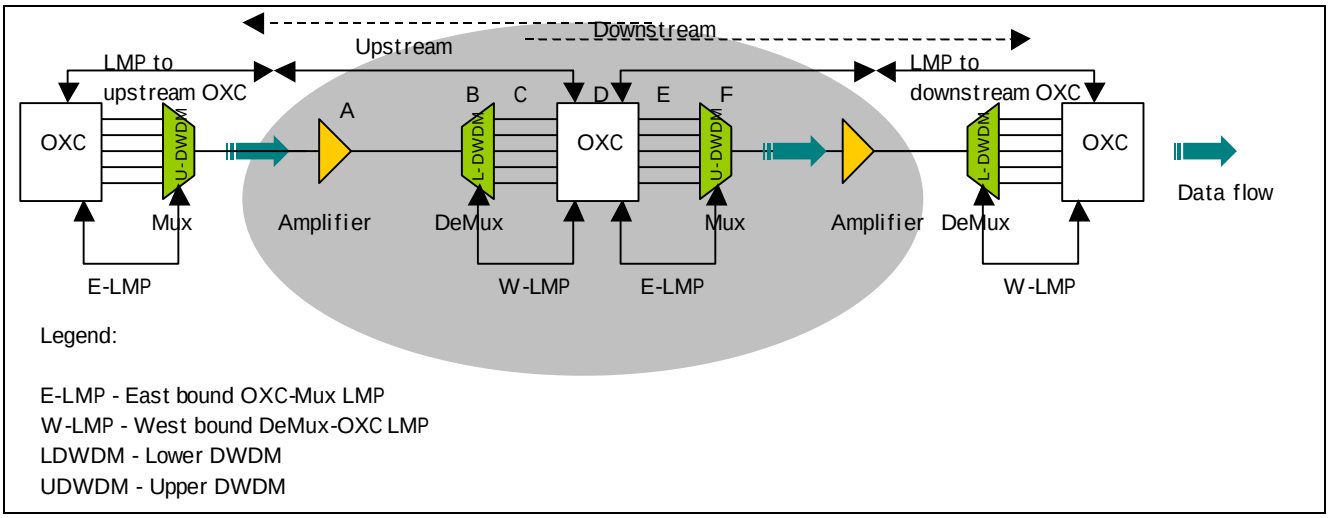

Figure 1 A number of faults that can be detected and correlated by this proposal

In Figure 1, we present a typical optical domain segment with external fault locations that cannot be distinguished by the LMP [1] (Hence a new DWM-OXC protocols [2, 3] are 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)

From now onwards we consider [2], where as the same can be extended to [3] as well. Here we distinguish between the W-LMP and E-LMP to better understand the requirements. **Error! Reference source not found.**, presents different actions performed (with the solution provided in this document) by different equipment (LDWDM, OXC, UDWDM) in response to the above-identified 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 G – Generate Fault information in OSC/SONET header D – Extract Fault information from OSC R – Report using LMP C – Correlate Fault/Degradation		
		L-DWDM	OXC	U-DWDM
A	Fault	D, R (Down)		
B	Fault	M, G, R		
C	Fault		M, R	M, G, R
D	Fault		M, R	M, G, R
E	Fault			R
F	Fault			R

The protocol being proposed between the DWDM and the PXC may be specified to consist of different phases to support the following proposed features, namely:

- Fault Localization and performance reporting
  - Event driven (reporting)
    - Monitors thresholds for the degradation and fault monitoring
  - Polled for information
    - Keep the history of the monitored parameters.
- Customized error reporting (future)
  - Specifying and negotiating the parameter set to be monitored
  - Specifying and negotiating the threshold values

Additional phases may be added in future proposals to add the following features

- Control channel management: 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

- Link property correlation
- Connectivity verification
- Negotiate a LOL behavior
- Group reporting to reduce the overhead

3 Suggestions

- With the understanding of the requirements as mentioned in the previous section, here we present suggestions to be considered [2] or [3].

- 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.

  - What should be done by the OXC and what should be done by DWDM?
    - OXC
      - Monitor for fiber cut between DWDM and PXC
      - Report failure to upstream and downstream DWDM
      - Monitor local fabric failure
      - Report failure to upstream and downstream DWDM.
    - DWDM:
      - West bound (DWDM-OXC) (De-multiplexing):
        - Monitor path related failures and degradations (SONET level).
        - Correlate the upstream-related faults and degradations (OSC based).
        - 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

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] or [3]. Then we extended the requirements for [2] or [3] 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] or [3]. These suggestions can directly be mapped to realize the protocol extensions.

5 References

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