                        Link Management Protocol (LMP) for
        Dense Wavelength Division Multiplexing (DWDM) Optical Line Systems

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Abstract

   The Link Management Protocol (LMP) is defined to manage traffic
   engineering (TE) links. In its present form, LMP focuses on peer
   nodes, i.e., nodes that peer in signaling and/or routing. This
   document proposes extensions to LMP to allow it to be used between a
   peer node and an adjacent optical line system (OLS). These
   extensions are intended to satisfy the "Optical Link Interface
   Requirements" described in a companion document.

1. Introduction

   Networks are being developed with routers, switches, optical cross-
   connects (OXCs), dense wavelength division multiplexing (DWDM)
   optical line systems (OLSes), and add-drop multiplexors (ADMs) that
   use a common control plane (e.g., Generalized MPLS (GMPLS)) to
   dynamically provision resources and to provide network survivability
   using protection and restoration techniques.

   The Link Management Protocol (LMP) is being developed as part of the
   GMPLS protocol suite to manage traffic engineering (TE) links
   [RFC4204]. In its present form, LMP focuses on peer nodes, i.e.,
   nodes that peer in signaling and/or routing (e.g., OXC-to-OXC, as
   illustrated in Figure 1). In this document, extensions to LMP are
   proposed to allow it to be used between a peer node and an adjacent
   optical line system (OLS). These extensions are intended to satisfy

the "Optical Link Interface Requirements" described in [OLI]. It is
assumed that the reader is familiar with LMP, as defined in
[RFC4204].

```
    +------+         +------+         +------+         +------+
    |      | -----   |      |         |      | -----   |      |
    | OXC1 | -----   | OLS1 | =====   | OLS2 | -----   | OXC2 |
    |      | -----   |      |         |      | -----   |      |
    +------+         +------+         +------+         +------+
       ^                                                  ^
       |                                                  |
       +--------------------LMP--------------------+
```
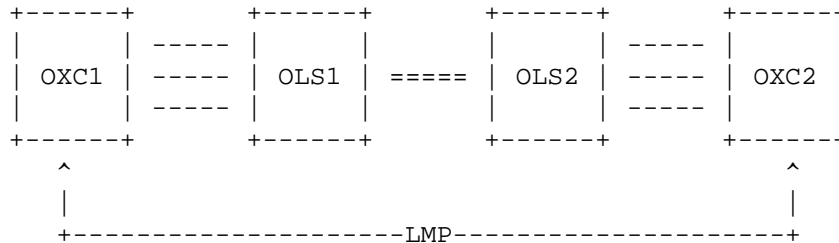
Figure 1: LMP Model

Consider two peer nodes (e.g., two OXCs) interconnected by a
wavelength-multiplexed link, i.e., a DWDM optical link (see Figure 1
above). Information about the configuration of this link and its
current state is known by the two OLSes (OLS1 and OLS2). Allowing
them to communicate this information to the corresponding peer nodes
(OXC1 and OXC2) via LMP can improve network usability by reducing
required manual configuration and by enhancing fault detection and
recovery.

Information about the state of LSPs using the DWDM optical link is
known by the peer nodes (OXC1 and OXC2), and allowing them to
communicate this information to the corresponding OLSes (OLS1 and
OLS2) is useful for alarm management and link monitoring. Alarm
management is important because the administrative state of an LSP,
known to the peer nodes (e.g., via the Admin Status object of GMPLS
signaling [RFC3471]), can be used to suppress spurious alarm
reporting from the OLSes.

The model for extending LMP to OLSes is shown in Figure 2.

```
    +------+         +------+         +------+         +------+
    |      | -----   |      |         |      | -----   |      |
    | OXC1 | -----   | OLS1 | =====   | OLS2 | -----   | OXC2 |
    |      | -----   |      |         |      | -----   |      |
    +------+         +------+         +------+         +------+
     ^  ^              ^                ^              ^  ^
     |  |              |                |              |  |
     |  +-----LMP-----+                 +-----LMP-----+  |
     |                                                   |
     +--------------------LMP--------------------+
```
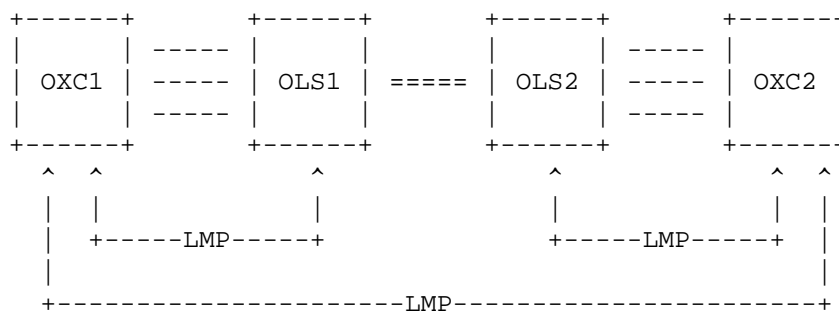
Figure 2: Extended LMP Model

In this model, a peer node may have LMP sessions with adjacent OLSes, as well as adjacent peer nodes. In Figure 2, for example, the OXC1-OXC2 LMP session can be used to build traffic-engineering (TE) links for GMPLS signaling and routing, as described in [RFC4204]. The OXC1-OLS1 and the OXC2-OLS2 LMP sessions are used to exchange information about the configuration of the DWDM optical link and its current state and information about the state of LSPs using that link.

The latter type of LMP sessions is discussed in this document. It is important to note that a peer node may have LMP sessions with one or more OLSes and an OLS may have LMP sessions with one or more peer nodes.

Although there are many similarities between an LMP session between two peer nodes and an LMP session between a peer node and an OLS, there are some differences as well. The former type of LMP session is used to provide the basis for GMPLS signaling and routing. The latter type of LMP session is used to augment knowledge about the links between peer nodes.

A peer node maintains its peer node-to-OLS LMP sessions and its peer node-to-peer node LMP sessions independently. This means that it MUST be possible for LMP sessions to come up in any order. In particular, it MUST be possible for a peer node-to-peer node LMP session to come up in the absence of any peer node-to-OLS LMP sessions, and vice versa.

1.1. Terminology

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 [RFC2119].

The reader is assumed to be familiar with the terminology in [RFC4204].

DWDM: Dense wavelength division multiplexing

OLS: Optical line system

Opaque:

   A device is called X-opaque if it examines or modifies the X aspect of the signal while forwarding an incoming signal from input to output.

OXC: Optical cross-connect

   Transparent:

      As defined in [RFC4204], a device is called X-transparent if it
      forwards incoming signals from input to output without examining
      or modifying the X aspect of the signal. For example, a Frame
      Relay switch is network-layer transparent; an all-optical switch
      is electrically transparent.

1.2. Scope of LMP-WDM Protocol

   This document focuses on extensions required for use with opaque
   OLSes. In particular, this document is intended for use with OLSes
   having SONET, SDH, and Ethernet user ports.

   At the time of this writing, work is ongoing in the area of fully
   transparent wavelength routing; however, it is premature to identify
   the necessary information to be exchanged between a peer node and an
   OLS in this context. Nevertheless, the protocol described in this
   document provides the necessary framework in which to exchange
   additional information that is deemed appropriate.

2. LMP Extensions for Optical Line Systems

   LMP currently consists of four main procedures, of which the first
   two are mandatory and the last two are optional:

      1. Control channel management
      2. Link property correlation
      3. Link verification
      4. Fault management

   All four functions are supported in LMP-WDM.

2.1. Control Channel Management

   As in [RFC4204], we do not specify the exact implementation of the
   control channel; it could be, for example, a separate wavelength,
   fiber, Ethernet link, an IP tunnel routed over a separate management
   network, a multi-hop IP network, or the overhead bytes of a data
   link.

   The control channel management for a peer node-to-OLS link is the
   same as for a peer node-to-peer node link, as described in [RFC4204].

   To distinguish between a peer node-to-OLS LMP session and a peer
   node-to-peer node LMP session, a new LMP-WDM CONFIG object is defined
   (C-Type = 2). The format of the CONFIG object is as follows:

   Class = 6

   o   C-Type = 2, LMP-WDM_CONFIG

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|W|O|                      (Reserved)                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Reserved field should be sent as zero and ignored on receipt.

   WDM: 1 bit

         This bit indicates support for the LMP-WDM extensions defined
         in this document.

   OLS: 1 bit

         If set, this bit indicates that the sender is an optical line
         system (OLS). If clear, this bit indicates that the sender is
         a peer node.

   The LMP-WDM extensions are designed for peer node-to-OLS LMP
   sessions. The OLS bit allows a node to identify itself as an OLS or
   a peer node. This is used to detect misconfiguration of a peer
   node-to-OLS LMP session between two peer nodes or a peer node-to-peer
   node LMP session between a peer node and an OLS.

   If the node does not support the LMP-WDM extensions, it MUST reply to
   the Config message with a ConfigNack message.

   If a peer node that is configured to run LMP-WDM receives a Config
   message with the OLS bit clear in LMP-WDM_CONFIG object, it MUST
   reply to the Config message with a ConfigNack message.

2.2. Link Verification

   The Test procedure used with OLSes is the same as described in
   [RFC4204]. The VerifyTransportMechanism (included in the BeginVerify
   and BeginVerifyAck messages) is used to allow nodes to negotiate a
   link verification method and is essential for line systems that have
   access to overhead bytes rather than the payload. The VerifyId
   (provided by the remote node in the BeginVerifyAck message and used
   in all subsequent Test messages) is used to differentiate Test
   messages from different LMP Link Verification procedures. In

addition to the Test procedure described in [RFC4204], the trace
monitoring function of [RFC4207] may be used for link verification
when the OLS user ports are SONET or SDH.

In a combined LMP and LMP-WDM context, there is an interplay between
the data links being managed by peer node-to-peer node LMP sessions
and peer node-to-OLS LMP sessions. For example, in Figure 2, the
OXC1-OLS1 LMP session manages the data links between OXC1 and OLS1,
and the OXC2-OLS2 LMP session manages the data links between OXC2 and
OLS2. However, the OXC1-OXC2 LMP session manages the data links
between OXC1 and OXC2, which are actually a concatenation of the data
links between OXC1 and OLS1, the DWDM span between OLS1 and OLS2, and
the data links between OXC2 and OLS2. It is these concatenated links
that comprise the TE links that are advertised in the GMPLS TE link
state database.

The implication of this is that when the data links between OXC1 and
OXC2 are being verified, using the LMP link verification procedure,
OLS1 and OLS2 need to make themselves transparent with respect to
these concatenated data links. The coordination of verification of
OXC1-OLS1 and OXC2-OLS2 data links to ensure this transparency is the
responsibility of the peer nodes, OXC1 and OXC2.

It is also necessary for these peer nodes to understand the mappings
between the data links of the peer node - OLS LMP session and the
concatenated data links of the peer node - peer node LMP session.

2.3. Link Summarization

As in [RFC4204], the LinkSummary message is used to synchronize the
Interface_Ids and correlate the properties of the TE link. (Note
that the term "TE link" originated from routing/signaling
applications of LMP, and this concept does not necessarily apply to
an OLS. However, the term is used in this document to remain
consistent with LMP terminology.) The LinkSummary message includes
one or more DATA_LINK objects. The contents of the DATA_LINK object
consist of a series of variable-length data items called Data Link
sub-objects describing the capabilities of the data links.

In this document, several additional Data Link sub-objects are
defined to describe additional link characteristics. The link
characteristics are, in general, those needed by the CSPF to select
the path for a particular LSP. These link characteristics describe
the specified peer node-to-OLS data link, as well as the associated
DWDM span between the two OLSes.

The format of the Data Link sub-objects follows the format described
in [RFC4204] and is shown below for readability:

```
 0                   1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+--------------//--------------+
|     Type      |    Length     |     (Sub-object contents)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+--------------//--------------+
```

Type: 8 bits

        The Type indicates the type of contents of the sub-object.

Length: 8 bits

        The Length field contains the total length of the sub-object in
        bytes, including the Type and Length fields. The Length MUST
        be at least 4, and MUST be a multiple of 4.

The following link characteristics are exchanged on a per data link
basis.

2.3.1. Link Group ID

The main purpose of the Link Group ID is to reduce control traffic
during failures that affect many data links. A local ID may be
assigned to a group of data links. This ID can be used to reduce the
control traffic in the event of a failure by enabling a single
ChannelStatus message with the LINK GROUP CHANNEL_STATUS object (see
Section 2.4.1) to be used for a group of data links instead of
individual ChannelStatus messages for each data link. A data link
may be a member of multiple groups. This is achieved by including
multiple Link Group ID sub-objects in the LinkSummary message.

The Link Group ID feature allows Link Groups to be assigned based on
the types of fault correlation and aggregation supported by a given
OLS. From a practical perspective, the Link Group ID is used to map
(or group) data links into "failable entities" known primarily to the
OLS. If one of those failable entities fails, all associated data
links are failed and the peer node is notified with a single message.

For example, an OLS could create a Link Group for each laser in the
OLS. The data links associated with each laser would then each be
assigned the Link Group ID for that laser. If a laser fails, the OLS
would then report a single failure affecting all of the data links
with a Link Group ID of the failed laser. The peer node that
receives the single failure notification then knows which data links
are affected. Similarly, an OLS could create a Link Group ID for a

fiber, to report a failure affecting all of the data links associated
with that fiber if a loss-of-signal (LOS) is detected for that fiber.

The format of the Link Group ID sub-object (Type = 3, Length = 8) is
as follows:

```
 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      |    Length     |            (Reserved)         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Link Group ID                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Reserved field should be sent as zero and ignored on receipt.

Link Group ID: 32 bits

     Link Group ID 0xFFFFFFFF is reserved and indicates all data
     links in a TE link. All data links are members of Link Group
     0xFFFFFFFF by default.

2.3.2. Shared Risk Link Group (SRLG) Identifier

This identifies the SRLGs of which the data link is a member. This
information may be configured on an OLS by the user and used for
diverse path computation (see [RFC4202]).

The format of the SRLG sub-object (Type = 4, Length = (N+1)*4 where N
is the number of SRLG values) is as follows:

```
 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      |    Length     |            (Reserved)         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       SRLG value #1                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       SRLG value #2                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                          ...                                //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       SRLG value #(N-1)                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       SRLG value #N                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Reserved field should be sent as zero and ignored on receipt.

      Shared Risk Link Group Value: 32 bits

          See [RFC4202]. List as many SRLGs as apply.

2.3.3. Bit Error Rate (BER) Estimate

   This object provides an estimate of the BER for the data link.

   The Bit Error Rate (BER) is the proportion of bits that have errors
   relative to the total number of bits received in a transmission,
   usually expressed as ten to a negative power. For example, a
   transmission might have a BER of "10 to the minus 13", meaning that,
   out of every 10,000,000,000,000 bits transmitted, one bit may be in
   error. The BER is an indication of overall signal quality.

   The format of the BER Estimate sub-object (Type = 5; Length = 4) is
   as follows:

```
 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      |    Length     |     BER       |  (Reserved)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Reserved field should be sent as zero and ignored on receipt.

   BER: 8 bits

          The exponent from the BER representation described above. That
          is, if the BER is 10 to the minus X, the BER field is set to X.

2.3.4. Optical Protection

   This indicates whether the link is protected by the OLS. This
   information can be used as a measure of link capability. It may be
   advertised by routing and used by signaling as a selection criterion,
   as described in [RFC3471].

   The format of the Optical Protection sub-object (Type = 6; Length =
   4) is as follows:

```
 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      |    Length     |      (Reserved)   | Link Flags|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Reserved field should be sent as zero and ignored on receipt.

   Link Flags: 6 bits

        Encoding for Link Flags is defined in Section 7 of [RFC3471].

2.3.5. Total Span Length

   This indicates the total distance of fiber in the OLS. This may be
   used as a routing metric or to estimate delay.

   The format of the Total Span Length sub-object (Type = 7, Length = 8)
   is as follows:

```
 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      |    Length     |           (Reserved)          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Span Length                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Reserved field should be sent as zero and ignored on receipt.

   Span Length: 32 bits

        This value represents the total length of the WDM span in
        meters, expressed as an unsigned (long) integer.

2.3.6. Administrative Group (Color)

   The administrative group (or Color) to which the data link belongs.

   The format of the Administrative Group sub-object (Type = 8, Length =
   8) is as follows:

```
 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      |    Length     |           (Reserved)          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Administrative Group                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The Reserved field should be sent as zero and ignored on receipt.

   Administrative Group: 32 bits

        A 32-bit value, as defined in [RFC3630].

2.4. Fault Management

   The Fault Management procedure used between a peer and an OLS follows
   the procedures described in [RFC4204]; some further extensions are
   defined in this section. The information learned from the OLS-peer
   fault management procedures may be used to trigger peer-peer LMP
   fault management, or may be used to trigger GMPLS signaling/routing
   procedures directly.

   Fault management consists of three major functions:

      1. Fault Detection
      2. Fault Localization
      3. Fault Notification

   The fault detection mechanisms are the responsibility of the
   individual nodes and are not specified as part of this protocol.

   Fault detection mechanisms may include a Bit Error Rate (BER)
   exceeding a threshold, and loss-of-signal (LOS) and SONET/SDH-level
   errors. It is the responsibility of the OLS to translate these
   failures into (Signal) OK, Signal Failure (SF), or Signal Degrade
   (SD), as described in [RFC4204].

   That is, an OLS uses the messages defined in the LMP fault
   localization procedures (ChannelStatus, ChannelStatusAck,
   ChannelStatusRequest, and ChannelStatusResponse messages) to inform
   the adjacent peer node of failures it has detected, in order to
   initiate the LMP fault localization procedures between peer nodes,
   but it does not participate in those procedures.

   The OLS may also execute its own fault localization process to allow
   it to determine the location of the fault along the DWDM span. For
   example, the OLS may be able to pinpoint the fault to a particular
   amplifier in a span of thousands of kilometers in length.

   To report data link failures and recovery conditions, LMP-WDM uses
   the ChannelStatus, ChannelStatusAck, ChannelStatusRequest, and
   ChannelStatusResponse messages defined in [RFC4204].

   Each data link is identified by an Interface_ID. In addition, a Link
   Group ID may be assigned to a group of data links (see Section
   2.3.1). The Link Group ID may be used to reduce the control traffic
   by providing channel status information for a group of data links. A
   new LINK GROUP CHANNEL_STATUS object is defined below for this
   purpose. This object may be used in place of the CHANNEL_STATUS
   objects described in [RFC4204] in the ChannelStatus message.

2.4.1. LINK_GROUP CHANNEL_STATUS Object

   The LINK_GROUP CHANNEL_STATUS object is used to indicate the status
   of the data links belonging to a particular Link Group. The
   correlation of data links to Group ID is made with the Link Group ID
   sub-object of the DATA_LINK object.

   The format of the LINK_GROUP CHANNEL_STATUS object is as follows
   (Class = 13, C-Type = 4):

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Link Group ID                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|A|D|                     Channel Status                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                               :                               |
//                              :                              //
|                               :                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Link Group ID                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|A|D|                     Channel Status                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Link Group ID: 32 bits

        The Link Group ID 0xFFFFFFFF is reserved and indicates all data
        links in a TE link. All data links are members of the Link
        Group 0xFFFFFFFF by default.

   Channel Status: 32 bits

        The values for the Channel Status field are defined in
        [RFC4204].

   This object is non-negotiable.

3. Security Considerations

   LMP message security uses IPsec, as described in [RFC4204]. This
   document only defines new LMP objects that are carried in existing
   LMP messages. As such, this document introduces no other new
   security considerations not covered in [RFC4204].

4. IANA Considerations

   LMP [RFC4204] defines the following name spaces and the ways in which
   IANA can make assignments to these namespaces:

   - LMP Message Type
   - LMP Object Class
   - LMP Object Class type (C-Type) unique within the Object Class
   - LMP Sub-object Class type (Type) unique within the Object Class

   This memo introduces the following new assignments:

   LMP Object Class Types:

       o under CONFIG class name (as defined in [RFC4204])
          - LMP-WDM_CONFIG   (C-Type = 2)

       o under CHANNEL_STATUS class name (as defined in [RFC4204])
          - LINK_GROUP   (C-Type = 4)

   LMP Sub-Object Class names:

       o under DATA_LINK Class name (as defined in [RFC4204])
          - Link_GroupId   (sub-object Type = 3)
          - SRLG   (sub-object Type = 4)
          - BER_Estimate   (sub-object Type = 5)
          - Optical_Protection   (sub-object Type = 6)
          - Total_Span_Length   (sub-object Type = 7)
          - Administrative_Group (sub-object Type = 8)

5. Contributors

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   Snyder, George Swallow, Gopala Tumuluri, Yong Xue, Lucy Yong, and
   John Yu.

6. References

6.1. Normative References

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6.2. Informative References

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