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Requirements For Adding Optical Support To GSMPv3

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Abstract

This memo provides requirements for adding of optical switching
support to the General Switch Management protocol (GSMP). It also
contains clarifications and suggested changes to the GSMP v3
specification.

Conventions used in this document

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 RFC-2119 [1].

1. Overview

This document details the changes to GSMP necessary for the support
of optical (non-transparent and all optical), SONET/SDH, and spatial
switching of IP packets, Layer 2 (L2) frames and TDM data. When
implemented, GSMP controllers will then be able to control: photonic
cross-connects (optical-optical), transparent optical cross connects
(optical-electrical-optical, frame independent), opaque cross
connects (optical-electrical-optical, SONET/SDH frames), and
traditional TDM switches (all electrical). The resulting systems
could form IP based optical routers, optical label switches,
wavelength routers, and dynamic optical cross connects.

Several different generic models exist defining how to provide
control plane functionality in an optical network [2][3][4].
This document takes no position on which model is most appropriate
(e.g., single or multiple routing plane instances). The only
assumption is that the ability to separate the control mechanisms
from the data switching is as useful for the signaling of optical
paths (e.g., GMPLS) as it is for the signaling of L2 paths (e.g.,
MPLS). Therefore, the requirements contained within are focused only
on the separation of control functions from data functions in order
to provide a more flexible network architecture.

GSMPv3[5] is well suited for providing the control interface
necessary for allowing an IP based controller to direct the
activities of an optical switch. In order for GSMP to operate
between controllers and optical switches and cross connects, support
for optical labels and service and resource abstractions must be
added to GSMP.

This document also includes changes recommended by implementers that
will facilitate easier development of a GSMP implementation. These
changes consist of rearranging PDU formats, clarification of flags,
transaction identifiers, and response codes.

2. Requirements for Optical Support

2.1. Label

2.1.1. Label Types

New labels are needed to identify the entities that are to be
switched in the optical fabric. These are longer than the labels
defined in GSMPv3 as they have physical and structural context. As

GMPLS[2][3] has had very similar requirements for label formats,
alignment with GMPLS is proposed. This includes support for:

    - Digital Carrier Hierarchy (e.g., DS-1, E1)
    - SONET and SDH Hierarchy (e.g., OC-3, STM-1, VT1.5, VC-12)
    - Plesiochronous Data Hierarchy (PDH) labels [6]
    - OTN G.709 labels
    - Lambdas
    - Fibers

GSMP MUST include support for all label types list above, as well as
for label hierarchies and label lists as defined by GMPLS. Therefore
the ability to perform operations on groups of the above labels MUST
also be supported (e.g., 5 OC-3s, contiguous wavebands)

2.1.2. Label Management Issues

An updated label range message MUST be provided. There MUST also be
support of multiplexing (e.g. no multiplexing, SONET, Gigabit
Ethernet multiplexing etc).

2.2. Statistics messages

Optical switches have a number of different statistics which are not
in common with ATM, or Frame Relay switches. Consequently, the
statistics messages SHOULD be updated to report Performance
Monitoring statistics defined for all new optical transport
technologies added to GSMP.

2.3. Configuration Issues

2.3.1. Switch Configuration

2.3.1.1. Layer Switching Identification

Since an Optical Switch may be able to provide connection services
at multiple transport layers (i.e. STS-3c, STS-1, VT-1.5, DS3, DS1),
and not all switches are expected to support the same transport
layers, the switch will need to notify the controller of the
specific layers it can support.

Therefore, the Switch Configuration message MUST be extended to
provide a list of the transport layers for which an optical switch

can perform switching.

2.3.2. Port Configuration

   The port configuration message supplies the controller with the
   configuration information related to a single port. Consequently,
   extensive additions will need to be made to this command.

2.3.2.1. Port Type extensions

   Port types MUST be added to support the mix of optical signals that
   can operate over a single fiber.

   The port information that MAY need to be conveyed includes [7]:

         - wavelengths available per interface
         - bit rate per wavelength
         - type of fiber

2.3.2.2. Supported Signal Type extensions

   Since a port on an optical switch may support signals at multiple
   transport layers, it is necessary to understand the signals
   supported, as well as the possible ways that one signal can be
   transported within another.

   For OTN, SONET/SDH and PDH optical switches, the Port configuration
   message MUST be extended to detail the different transport layer
   signals that are supported by a port. Furthermore, this extension
   MUST detail which signals may be transported by another signal.

   This mechanism MUST also provide information about optional
   capabilities (such as virtual concatenation and arbitrary
   concatenation for SONET/SDH) available on a port.

2.3.2.3. Trace Mechanism support Identification

   A number of transport layer signals include overhead channels that
   can be used to identify the source of a signal. Since they are
   embedded in the signal, only the network element has access to the
   signals. However, not all network elements have the capability to
   set or read the messages in these channels on every port.

Consequently, this port attribute needs to be reported to the
controller.

The Port Configuration message MUST be extended to report which
trace mechanisms are supported by a port.

2.3.2.4. Port Location Identification

Since contemporary Optical switches have the ability to support tens
of thousands of ports in hundreds of shelves located in as
potentially as many bays, the current "Slot/Port" location
identifier is inadequate.

The Slot/Port Location Identifier MUST be extended to encode
Bay/Shelf/Slot/Port.

2.3.2.5. Port-related Partitioning Extensions

Partitioning can be done for any resource that exists in the network
element. The GSMP partitioning draft currently defines ports and
switching resources as partitionable resources. Since optical
switches may support multiple transport network layers, an
additional resource type is introduced: the transport layer signal.

The point where a transport layer signal is inserted into a lower
layer signal (called an "access point" by the ITU [8]), is very
similar to a port. Therefore, when partitioning is done on a
transport layer signal basis, the partition that is the user of the
access point MUST have a port that associated with the access point.
Labels will then be used in the to describe the subordinate signals.

2.3.3. Service Configuration

While new capability sets MUST be added to support quality
parameters in optical switches, no changes are foreseen to the
service configuration message as its role to carry the service
information as defined in the applicable service model.

2.4. Service Model Issues

While one assumption of using optical media is that bandwidth is
plentiful, it should be expected that traffic engineering will be
necessary in any case[5]. GSMP provides the means for each

connection to be created with specific attributes. Therefore,
service parameters will need to be defined for each of the Different
Optical technologies.

2.4.1 Transparent Optical

Capability to control re-timing and re-shaping on a per port level
MUST be added.

2.4.2 SONET/SDH and OTN

The capability to control the adaptation parameters used when a
transport signal is inserted into another transport signal MUST be
added. These parameters SHOULD be modifiable at times other than
adding a branch so that functions such as Tandem Connection
Monitoring can be configured. Currently, the default set of service
models in GSMP are all based on the services models defined
elsewhere, e.g. the Intserv model[9][10], the Diffserv[11] model,
ATM QoS models and the Frame relay forum QoS models. A determination
needs to be made of the applicable service models for optical
channel trails. These models MUST then be mapped to the GSMP
capability set mechanism.

2.5. Encapsulation issues

The working group needs to decide whether a new encapsulation is
required. In other words, will all optical switches used in either
the MPLS over Optics and the IP over optics applications require
that IP be implemented on the control channel connecting the GSMP
controller and Optical switch (the GSMP target).

A new encapsulation SHOULD be defined allowing the use of a non-IP
raw wavelength control connection.

Likewise, a new encapsulation SHOULD be defined allowing GSMP to be
used in legacy DCN environments that use OSI CLNP.

2.6. MIB Issues

If a new encapsulation is defined, then the encapsulation group
SHOULD be updated. No other changes should be required.

2.7. OXC Transaction Model

2.7.1 Serial Transactions

   Many existing OXCs use a command interface which assumes a serial
   transaction model. That is, a new command cannot be issued or
   processed until the existing command is completed. Under
   provisioning control via a network management application, and with
   non-dynamic path setup, this model has been adequate.

   Moving to a dynamic path setup capability with a distributed control
   plane, a parallel transaction model is likely required for
   performance. This is particularly helpful when the performance of
   setting up a TDM style connection is much slower than setting up an
   L2 connection table. If the OXC is not able to support a parallel
   transaction model, a GSMP controller MUST be informed of this and
   adopt serial transaction behavior.

2.7.2. Bulk Transactions

   Again due to the time it may take some OXCs to setup TDM connections
   relative to L2 fabrics (e.g., VC-4/STS-1 SPE fabric in an HOVC/STS
   switch), support for sending multiple transactions in the same
   message is a useful optimization. When an OXC receives a bulk
   message, the individual transactions are acted upon and a single
   reply is sent. If parallel transactions are not supported, bulk
   messages can improve performance by reducing transaction overhead.
   Bulk transactions SHOULD be supported.

2.8. OXC Restoration Capabilities

   To achieve fast link protection performance (e.g., 50 ms after
   failure detection), SONET/SDH and some OXC systems use hardware
   based protection schemes (e.g., ring protection). Achieving this
   level of performance solely using a data control plane such as GMPLS
   is a serious challenge. An alternate approach is to utilize fast
   restoration capabilities of an OXC with a dynamic control plane. An
   implication of this hybrid approach is that extensions are needed to
   GSMP to provision the behavior of an OXC in anticipation of a link
   failure.

   This differs from the strict master-slave relationship in GSMP for
   Layer 2 switches in that here the OXC is capable of taking an action
   independent of the GSMP controller and then informing the controller
   afterwards. Consequently, the GSMP port configuration command MUST
   be extended to allow autonomous protection behaviors to be
   provisioned into the Network Element.

Furthermore, the controller MUST be able to provide the parameters
for when reversion from a backup link to the original link is
allowed. This may take the form of hold-off timers, BER parameters,
or the requirement for controller directed reversion.

2.8.1. Non-Reserved Protection Links

An example of protection OXC behavior is that when a link fails, a
backup link may be used to protect traffic on. This backup link
could be selected from a set of links, none of which are pre-
reserved. A backup link could be shared with one or more "working"
links which is a form of 1:n shared protection. Specifying the set
of possible backup links SHOULD be done as an option to the Add-
Branch message.

When a backup link is used or the OXC reverts back to the original
link, the control plane (i.e., signaling) may need to know about the
new path state in order to notify the operator, or take some other

OAM action (e.g., billing, SLA monitoring). An additional GSMP
message to inform the controller SHOULD be added to do this.

2.8.2. Dedicated Protection Links

A more specialized form of restoration called "1+1" defines a
(usually node disjoint) protection path in a transport/optical
network for a given working path. At the ingress node to the path,
the traffic signal is sent simultaneously along both working and
protection paths. Under non-failure conditions at the egress node,
only the last link of the working path is connected to the client.
When any link in the working path fails, traffic on the working path
ceases to be received at end of the path. The egress OXC detects
this condition and then switches to use the last link of the
protection path without the controller having to issue a Move-Input-
Branch message. At no time is the ingress node aware which link the
egress node is using. Selection of the protection path and all of
its links is outside the scope of GSMP.

Specification of the two output branches at the ingress node can be
done with the usual Add-Branch semantics. The ingress node
protection link is not shared with any other working link.

Specification of the two input branches at the egress node should be
done when the Add-Branch message is sent. This SHOULD be an option
to that message. The egress node protection link is not shared with
any other working link.

When a protection link is used or the OXC reverts back to the
working link, the control plane (i.e., signaling) may need to know
about the new path state in order to notify the operator, or take
some other OAM action (e.g., billing, SLA monitoring). An
additional GSMP message to inform the controller SHOULD be added to
do this.

If an alternate input port is not specified with an original Add-
Branch message, it MAY be specified in a subsequent Add-Branch
message. In this case, it is useful to include information about
existing users of the output port in that Add-Branch message. This
helps the OXC immediately learn of the association between the new
input port and an existing one. The association is used to enable
OXC protection procedures. This capability MUST be added to the add-
branch message.

Similar contextual information is needed for a Delete-Branch message
so that the OXC can determine if a path becomes unprotected. This
capability MUST be added to the Delete-branch message.

2.8.3. Protection Triggers

Aside from link or equipment failures, there are a variety of
maintenance conditions that could cause the backup/protection
link(s) to be used. These may include:

- Scheduled maintenance of the working link. Here the network
  operator deliberately takes a link out of service to perform
  maintenance.
- Reconfiguration of fiber/node/network which causes temporary need
  to use backup links.

It may be useful to specify these triggers when the
backup/protection links are defined with the Add-Branch message.
This depends on how the OXC is implemented to be aware of such
triggers. This is for further study.

2.8.4. Protection Link Capabilities

When an OXC has the capability to perform protection switching
independently from the Optical Call Controller (OCC), it may be
useful for the OCC to be informed of these capabilities at switch
and/or port configuration. Applications in the GSMP controller
could use this information. For example, signaling clients could

define a path protection scheme over multiple GSMP enabled OXCs.
This is for further study.

2.9. Controller directed restoration

Bi-directional Connection Replacement

Connections in the transport network are inherently point-to-point
bi-directional. Unfortunately, GSMPv3 currently does not allow for
the B and R flags to be set on an add branch message. This means
that it is not possible to do an atomic replacement of a bi-
directional connection -- an action that is desirable for controller
directed restoration. Consequently, the protocol MUST be changed to
allow these flags to be used at the same time.

2.10 Support for optical burst switching

GSMP for Optical Switching should also support optical burst
switching. As described in [12], [13], and [14], part of burst
switching connection setup includes reserving time on the transport
medium for the client.

This time is characterized by two parameters: a start time and the
duration. These values MAY define a one-time reservation or a
repeating reservation. Upon a request for setup of a burst
connection, the GSMP controller MUST perform appropriate Connection

Admission Control for the time and duration specified and, if the
connection is allowed, MUST signal these parameters to the burst
switching device to reserve the exact bandwidth required [12], [14].
The burst switch MUST perform the switching operation autonomously,
using the synchronization methods prescribed for the burst network
it is operating in.

3. Requirements from Implementers

This section describes requirements to GSMP v3 based on some
implementation experience. They address areas of ambiguity, missing
semantics, and configuration recommendations.

3.1. GSMP Packet Format

The Basic GSMP Message Format in chapter 3.1.1 in [5] describes the
common fields present in all GSMP messages except for the Adjacency
protocol.

3.1.1 Message segmentation

If a message exceeds the MTU of the link layer it has to be segmented. This was originally done with the "More" value in the Result field. The addition of the I flag and the SubMessage Number to the header has made the "More" value obsolete.

The I flag and SubMessage numbers should be used in all messages that can be segmented.

3.1.1.1 SubMessage Number and I flag

It should be specified if the SubMessage Number start on 0 or 1 in a segmented message and what value the I flag should have in an message that is not segmented.

3.1.1.2 Message Length

Clarification of what value should be used in the Length field for segmented messages. Specifically, does the Length field contain the total length of the message or the length of the current segment.

3.1.1.3. Message Segmentation example

To avoid all ambiguity an example of message segmentation should be provided.

3.1.2. Transaction Identifier

The Transaction Identifier in [5] does not distinguish between replies from a request with "AckAll" and "NoSuccessAck". It also does not provide any information about how to handle replies where the Transaction ID doesn't match a Transaction ID from a previously sent request.

If multiple controllers are connected to a single switch and the switch sends an event message with "ReturnReceipt" set to all of them, there is no way for the switch to identify which controller the receipt is coming from.

The "ReturnReceipt" value should not be permitted for Events.

3.2. Window Size

The Switch Configuration Message defined in chapter 8.1 in [5]
defines a Window size to be used by the controller when sending
messages to the switch. It is not stated if this window should
apply to all messages or only to messages that will always generate
a reply.

If messages that may not generate a reply should be counted against
the window a time-out period when they are to be removed from the
window should be defined.

It is not defined if the window should be cleared when the adjacency
is lost and later recovered.

3.3. Retransmission

A retransmission policy should be used if no reply is received for a
message with "AckAll" set.

3.4. Delete Branches Message

The "Delete Branch Element" has a 4 bit Error field that should be
redefined to match the size of the "Failure Response Codes".

3.5. Adjacency

The chapter about how to handle a new adjacency and re-established
adjacencies should be clarified.

3.5.1. Loss of Synchronization

The switch must not reset the connection states if another adjacency
has already been established since this would destroy an already
valid state.

4. Security Considerations

The security of GSMP's TCP/IP control channel has been addressed in
[15]. Any potential remaining security considerations are not
addressed in this requirements document.

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6. Informative References

1   Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

2   Ashwood-Smith, D., et. al., "Generalized MPLS - Signaling Functional Description," RFC 3471, August 2002.

3   Mannie, E., et. al., "Generalized Multi-Protocol Label Switching (GMPLS) Architecture," draft-ietf-ccamp-gmpls-architecture-03.txt (work in progress), August 2002.

4   International Telecommunications Union, "Architecture for the Automatic Switched Optical Network," G.8080, October 2001.

5   Doria, A, Sundell, K, Hellstrand, F, Worster, T, "General Switch Management Protocol V3," RFC 3292, June 2002.

6   Sadler, J., Mack-Crane, B., "TDM Labels for GSMP," draft-sadler-gsmp-tdm-labels-00.txt (work in progress), February 2001.

7   Rajagopalan, B., et. al., _IP over Optical Networks: A Framework, draft-ietf-ipo-framework-02.txt (work in progress), June 2002.

8   International Telecommunications Union, "Generic functional architecture of transport networks", G.805, March 2000.

9   Braden, R., "Integrated Services in the Internet Architecture: An Overview," RFC1633, June 1994.

10 J. Wroclawski, "Specification of the Controlled-Load Network Element Service," RFC2211, Sep 1997.

11 Blake, S., et. al., _"An Architecture for Differentiated Services," RFC2475, December 1998.

12 C. Qiao, M. Yoo, "Choice, and Feature and Issues in Optical Burst

    Switching", Optical Net. Mag., vol.1, No.2, Apr.2000, pp.36-44.

13 Ilia Baldine, George N. Rouskas, Harry G. Perros, Dan Stevension,
   "JumpStart: A Just-in-time Signaling Architecture for WDM Burst-
   Switching Networks", IEEE Comm. Mag., Fab. 2002.

14 Sanjeev Verma, et al. "Optical burst switching: a viable solution
   for terabit IP backbone", IEEE network, pp. 48-53, Nov/Dec 2000.

15 Worster, T, et. al., "GSMP Packet Encapsulations for ATM,
   Ethernet and TCP," RFC 3293, June 2002.

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