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Generalized MPLS (GMPLS) Data Channel Switching Capable (DCSC) and Channel Set Label Extensions

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Abstract

This document describes two technology-independent extensions to Generalized Multi-Protocol Label Switching. The first extension defines the new switching type Data Channel Switching Capable. Data Channel Switching Capable interfaces are able to support switching of the whole digital channel presented on single channel interfaces. The second extension defines a new type of generalized label and updates related objects. The new label is called the Generalized Channel_Set Label and allows more than one data plane label to be controlled as part of an LSP.

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1. Introduction

This document describes two technology independent extensions to Generalized Multi-Protocol Label Switching (GMPLS). Both of these extensions were initially defined to in the context of Ethernet services, see [GMPLS-ESVCS] and [GMPLS-MEF-UNI], but are generic in nature and may be useful to any switching technology controlled via GMPLS.

The first extension defines a new switching type, which is called Data Channel Switching Capable (DCSC). DCSC interfaces are able to support switching of the whole digital channel presented on single channel interfaces. The second extension defines a new type of generalized label and updates related objects. The new label is called the Generalized Channel_Set Label and allows more than one data plane label to be controlled as part of an LSP.

1.1. 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 [RFC2119].

2. Data Channel Switching

Current GMPLS switching types are defined in [RFC3945] and [RFC3471] and support switching at the packet (PSC), frame (L2SC), time-slot (TDM), frequency (LSC) and fiber (FSC) granularities. One type of switching that is not well represented in this current set is switching that occurs when all data received on an ingress port is switched through a network to an egress port. While there are similarities between this level of switching and the "opaque single wavelength" case described in Section 3.5 of [RFC4202], such port-to-port switching is not limited to the optical switching technology implied by the LSC type. FSC is also similar, but it is restricted to fiber ports and also supports multiple data channels with-in the fiber port.

This document defines the new switching type called Data Channel Switching Capable (DCSC). Port switching seems a more intuitive name, but this naming collides with PSC so it isn't used. DCSC interfaces are able to support switching of the whole digital channel presented on single channel interfaces. Interfaces that inherently support multiple channels, e.g., WDM and channelized TDM interfaces, are specifically excluded from this type. Any interface that can be represented as a single digital channel are included. Examples

include concatenated TDM and line encoded interfaces. Framed interfaces may also be included when they support switching on an interface granularity.

DCSC is represented in GMPLS, see [RFC3471] and [RFC4202], using the value TBA (by IANA).

Port labels, as defined in [RFC3471], SHOULD be used for LSPs signaled using the DCSC Switching Type. The DCSC Switching Type may be used with the Generalized Label Request object, [RFC3473], or the Generalized Channel_Set LABEL_REQUEST Object defined below.

2.1. Compatibility

Transit and egress nodes that do not support the DCSC Switching Type when receiving a Path message with a Label Request containing the DCSC Switching Type will behave in the same way nodes generally handle the case of an unsupported Switching Type. Specifically, per [RFC3473], such nodes are required to generate a PathErr message, with a "Routing problem/Unsupported Encoding" indication.

Ingress nodes initiating a Path message containing a Label Request containing the DCSC Switching Type, receiving such a PathErr messages, then notify the requesting application user as appropriate.

3. Generalized Channel_Set Label Related Formats

This section defines a new type of generalized label and updates related objects. This section updates the label related definitions of [RFC3473]. The ability to communicate more than one label as part of the same LSP was motivated by the support for the communication of one or more VLAN IDs. Simple concatenation of labels as is done in [RFC4606] was deemed impractical given the large number of VLAN IDs (up to 4096) that may need to be communicated. The formats defined in this section are not technology specific and may be useful for other switching technologies. The LABEL_SET object defined in [RFC3473] serves as the foundation for the defined formats.

3.1. Generalized Channel_Set LABEL_REQUEST Object

The Generalized Channel_Set LABEL_REQUEST object is used to indicate that the Generalized Channel_Set LABEL Object is to be used with the associated LSP. The format of the Generalized Channel_Set LABEL_REQUEST object is the same as the Generalized LABEL_REQUEST object and uses a C-Type of TBA.

3.2. Generalized Channel_Set LABEL Object

The Generalized Channel_Set LABEL Object communicates one or more labels, all of which can be used equivalently in the data path associated with a single LSP. The format of the Generalized Channel_Set LABEL Object is based on the LABEL_SET object defined in [RFC3473]. It differs from the the LABEL_SET object in that the full set may be represented in a single object rather than the multiple objects required by the [RFC3473] LABEL_SET object. The object MUST be used on LSPs that use the Generalized Channel_Set LABEL_REQUEST object. The object MUST be processed per [RFC3473]. Make-before-break procedures, see [RFC3209], SHOULD be used when modifying the Channel_Set LABEL object.

The format of the Generalized Channel_Set LABEL object is:

o Generalized Channel_Set LABEL object: Class = 16, C-Type = TBA (By IANA)

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Channel_Set Sub-Object 1                    |
|                              ...                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                               :                               :
:                               :                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Channel_Set Sub-Object N                    |
|                              ...                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The Channel_Set Sub-Object size is measured in bytes and MUST always be a multiple of 4, and at least 4, and has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Action     |  Num Subchannels  |        Label Type         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Subchannel 1                         |
|                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       ...                     |                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               :
:                               :                               :
:                               :                               :
:                               :                               :
:                               :                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Subchannel N                         |
|                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           ...                 |         Padding               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Action: 8 bits

See [RFC3471] for definition of actions. Range actions SHOULD be used when possible to minimize the size of the Channel_Set LABEL Object.

Number of Subchannels: 10 bits

Indicates the number of subchannels carried in the sub-object. When the number of subchannels required exceeds the limit of the field, i.e., 1024, multiple Channel_Set Sub-Objects MUST be used. Note that the size of the sub-object may result in a Path message being larger than a single unfragmented IP packet. See section 4.4 for an example of how this case may be handled.

A value of zero (0) has special meaning and MAY be used in either the LABEL or UPSTREAM_LABEL object. A value of zero (0) is used in a LABEL or UPSTREAM_LABEL object to indicate that the subchannel(s) used in the corresponding (downstream or upstream) direction MUST match the subchannel(s) carried in the reverse directions label object. When value of zero (0) is used, no Subchannels are included in the Channel_Set Sub-Object and only one Channel_Set Sub-Object may be present. The zero (0) value MUST NOT be used in both the LABEL and UPSTREAM_LABEL object of the same LSP.

Label Type: 14 bits

See [RFC3473] for a description of this field.

Subchannel: Variable

See [RFC3471] for a description of this field. Note that this field might not be 32 bit aligned.

Padding: Variable

Padding is used to ensure that the length of a Channel_Set Sub-Object meets the multiple of 4 byte size requirement stated above. The field is only required when the Subchannel field is not 32 bit aligned and the number of included Subchannel fields result in the Sub-Object not being 32 bit aligned.

The Padding field MUST be included when the number of bits represented in all the Subchannel fields included in a Generalized Channel_Set Sub-Object result in the Sub-Object not being 32 bit aligned. When present, the Padding field MUST have a length that results in the Sub-Object being 32 bit aligned. When present, the Padding field MUST be set to a zero (0) value on transmission and MUST be ignored on receipt. These bits SHOULD be passed through unmodified by transit nodes.

3.3. Other Label related Objects

The previous section introduced a new LABEL object. As such the formats of the other label related objects are also impacted. Processing of these objects is not modified and remains per their respective specifications. The other label related objects are defined in [RFC3473] and include:

- SUGGESTED_LABEL object
- LABEL_SET object
- ACCEPTABLE_LABEL_SET object
- UPSTREAM_LABEL object
- RECOVERY_LABEL object

3.4. Compatibility

Transit and egress nodes that do not support the Generalized Channel_Set Label related formats will first receive a Path message containing Generalized Channel_Set LABEL_REQUEST object. When such a node receives the Path message, per [RFC3209], it will send a PathErr with the error code "Unknown object C_Type".

Ingress nodes initiating a Path message containing a Generalized Channel_Set LABEL_REQUEST object on receiving such a PathErr messages, then notify the requesting application user as appropriate.

4. IANA Considerations

IANA is requested to administer assignment of new values for namespaces defined in this document and summarized in this section.

4.1. Data Channel Switching Type

Upon approval of this document, IANA will make the assignment in the "Switching Types" section of the "GMPLS Signaling Parameters" registry located at http://www.iana.org/assignments/gmpls-sig-parameters:

Value	Type	Reference
125*	Data Channel Switching Capable (DCSC)	[This document]

(*) Suggested value.

It should be noted that the assigned value should be reflected in IANAGmplsSwitchingTypeTC at http://www.iana.org/assignments/ianagmplstc-mib.

4.2. Generalized Channel_Set LABEL_REQUEST Object

Upon approval of this document, IANA will make the assignment in the "Class Names, Class Numbers, and Class Types" section of the "RSVP PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-parameters.

A new class type for the existing LABEL_REQUEST Object class number (19) with the following definition:

Class Types or C-Types:

5* Generalized Channel_Set [This document]

(*) Suggested value.

4.3. Generalized Channel_Set LABEL Object

Upon approval of this document, IANA will make the assignment in the "Class Names, Class Numbers, and Class Types" section of the "RSVP PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-parameters.

A new class type for the existing RSVP_LABEL Object class number (16) with the following definition:

Class Types or C-Types:

4* Generalized Channel_Set [This document]

(*) Suggested value.

5. Security Considerations

This document introduces new message object formats for use in GMPLS signaling [RFC3473]. It does not introduce any new signaling messages, nor change the relationship between LSRs that are adjacent in the control plane. As such, this document introduces no additional security considerations. See [RFC3473] for relevant security considerations. Additionally, the existing framework for MPLS and GMPLS security is documented in [MPLS-SEC].

6. References

6.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," RFC 2119.

[RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V. and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[RFC3471] Berger, L., Editor, "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.

[RFC3473] Berger, L., Editor, "Generalized Multi-Protocol Label Switching (GMPLS) Signaling - Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.

[RFC3945] Mannie, E., Editor, "Generalized Multi-Protocol Label Switching (GMPLS) Architecture", RFC 3945, October 2004.

[RFC4202] Kompella, K., Ed., and Y. Rekhter, Ed., "Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4202, October 2005.

6.2. Informative References

[GMPLS-ESVCS] Berger, L., Fedyk, D., "Generalized MPLS (GMPLS) Support For Metro Ethernet Forum and G.8011 Ethernet Service Switching", Work in Progress, draft-ietf-ccamp-gmpls-ether-svcs.

[GMPLS-MEF-UNI] Berger, L., Fedyk, D., "Generalized MPLS (GMPLS) Support For Metro Ethernet Forum and G.8011 User-Network Interface (UNI)", Work in Progress, draft-ietf-ccamp-gmpls-mef-uni.

[MPLS-SEC] Fang, L., et al, "Security Framework for MPLS and GMPLS Networks", Work in Progress, draft-ietf-mpls-mpls-and-gmpls-security-framework.

[RFC4606] Mannie, E., et al "Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control", RFC 4606, August 2006.

7. Acknowledgments

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