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Super-Channel Optical Parameters GMPLS Routing Extensions
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Abstract

This document builds on [6][7] and defines GMPLS routing extensions to allow added CSPF constraints for efficient super-channel spectrum assignment on flexible grid networks.

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1. Introduction

Future transport systems are expected to support service upgrades to data rates of 1 Tbps and beyond. To scale networks beyond 100Gbps, multi-carrier super-channels coupled with advanced multi-level modulation formats and flexible channel spectrum bandwidth

allocation schemes have become pivotal for future spectral efficient transport network architectures [1,2].

The coexistence of super-channels using different modulation formats on the same optical fiber network infrastructure may have a detrimental effect on the Optical Signal to Noise Ratio (OSNR) of adjacent super-channels due to interference such as cross-phase modulation. Therefore, it may be highly desirable to be able to evaluate the mutual impact of the existing and new super-channels on each other's quality of transmission (e.g., bit error rate) before establishing new super-channels.

The document [9] defines GMPLS signaling extensions to convey super-channel optical parameters. This document defines GMPLS routing extensions to advertise the above mentioned super-channel parameters via OSPF-TE link LSA using new Super-Channel sub-TLV. This sub-TLV is carried under the Switching Capability-specific information (SCSI) field of the Interface Switching Capability Descriptor (ISCD) with the Super-Channel-Switch-Capable (SCSC) value defined in [6]. This information allows each source node across the network to apply added CSPF constraints and assign new super-channels spectrum efficiently by considering not only the availability of the required number of slices but also the optical signal compatibility of the existing and the new super-channels along the desired path.

2. 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 RFC 2119 [RFC2119].

3. GMPLS Routing Extensions for Super-Channel Optical Parameters

This document defines OSPF-TE extensions for advertising following information using the Super-Channel sub-TLV depicted in Figure 1. For each super-channel this sub-TLV advertises following information:

- o Super-Channel In-Use Slices sub-TLV

- o Super-Channel Carriers sub-TLV

```
 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
```

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           TLV Type            |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~           Super-Channel 1 In-Use Slices sub-TLV               ~
~                                                               ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~           Super-Channel 1 Carriers TLVsub-TLV                 ~
~                                                               ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~           More entries                                        ~
~                                                               ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~           Super-Channel nIn-Use Slices TLV sub-TLV            ~
~                                                               ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~           Super-Channel n Carriers TLV  sub-TLV               ~
~                                                               ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Super-Channel TLV Format.

The Super-Channel sub-TLV is advertised in the OSPF-TE link LSA under the under the SCSI field of the ISCD using Super-Channel-Switch-Capable (SCSC) value defined in [6]

3.1. Super-Channel In-Use Slices sub-TLV

This sub-TLV contains the in-use slices information of a super-channel. For further information about various fields in this sub-TLV refer to [6][7].

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
|           TLV Type            |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Super-Channel Id              |Grid | S.S.  | PRI | Reserved  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| n_start_1 (spectral slot 1)   | n_end_1  (spectral slot 1)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|n_start_2 (spectral slot 2)    | n_end_2 (spectral slot 2)     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~               More entries                                    ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|n_start_n (spectral slot n)   | n_end_n (spectral slot n)      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: Super-Channel In-Use Slices sub-TLV Format.

[Editor's Note: encoding of in-use slices in bitmap format is left for a possible future revision]

3.2. Super-Channel Carriers sub-TLV

The format of the Super-Channel Carriers sub-TLV is defined in [9]. In summary, this sub-TLV contains following information.

- o Number of Carriers in the Super-Channel
- o Carrier sub-TLV
  - o Carrier Center Frequency sub-sub-TLV
  - o Carrier Modulation sub-sub-TLV
  - o Carrier FEC sub-sub-TLV

4. Procedure for OSPF-TE Advertisement

This section describes procedure for advertising the aforementioned information in the OSPF-TE link LSAs.

- o The optical parameters of the super-channel are signaled when new super-channels are established (see [9]).

- o Over time change in the status of in-use slices occurs when new super-channels are setup (or when established super-channels are released).

- o Each node along the path traversed by the super-channels advertises the current status of the in-use slices for each super-channel in the OSPF-TE link LSA using sub-TLVs described earlier.

- o Through OSPF-TE LSAs flooding other nodes in the routing domain learn about the current status of in-use slices on each TE link.

5. Possible Applications

- o The presence of this information across the network topology enables source nodes in the network to apply added CSPF constraints for example to:

  - o Group super-channels with different modulation formats in different bands (slice ranges)

  - o Group super-channels with same bit-rate in a band while separating with guard band from super-channels with different bit-rate.

- o Allows efficient network utilization (e.g., reduces new requests blocking probability) by avoiding excessive worst-case OSNR penalty while preserving desired quality of transmission of the existing super-channels

6. TLV Encoding Examples

To be added later.

7. Security Considerations

<Add any security considerations>

8. IANA Considerations

IANA needs to assign a new Grid field value to represent ITU-T Flex-Grid.

9. References

9.1. Normative References

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10. Acknowledgments

<Add any acknowledgements>

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