OSPF-TE Extensions for Flex-grid

draft-dhillon-ccamp-super-channel-ospfte-ext-01.txt
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Outline

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- Proposal
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Motivation

Address Flex-Grid needs in GMPLS:

- Allow use of any combination of ‘Frequency Slots’
  - Allocation of ‘Frequency Slots’ of different widths based on service needs (Modulation, Bit-rate)
  - Slot overlap not allowed
- Slot Width Granularity
  - 12.5 GHz × m where ‘m’ is a positive integer
- Central Frequency Granularity
  - 6.35GHz

Goals

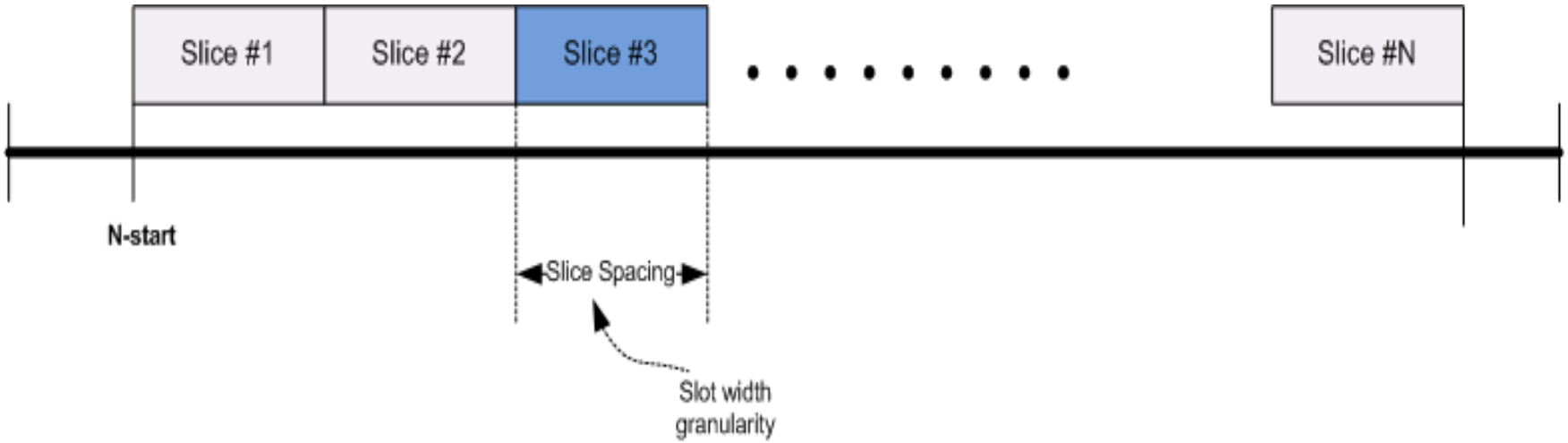
A generic BW model that:

- covers all Super-Channel services
  - Contiguous optical spectrum use
  - Non-contiguous optical spectrum use (split-spectrum)
- covers potential evolution Flex-Grid standards
  - Changes to slot-width, central frequencies
- ready for VCAT services

Proposal

- Simple extensions to ISCD [RFC 4202]
  - Use a new Switching Capability
  - Introduce Flex-Grid extensions in SCSI
- Flex-Grid extensions summary
  - Divide C-band spectrum in to 'Slices' of certain width
  - Advertise 'Slice' availability
  - Cover all 8-priorities
  - Cover Min/Max 'Frequency Slot' use per LSP

Slicing the C-band Spectrum



- The usable spectrum is divided in to n-slices
- Slice availability is advertised in BW-sub-TLV(s)
- Slice Numbering is anchored @ N-Start
- N-Start identifies start of usable spectrum supported by the advertising node
- Slice Spacing is Single Slice granularity (e.g. 12.5GHz)

Proposal: ISCD/SCSI formats

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Switch Cap=SCSC| Encoding=LSC |            Reserved           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Max LSP or Unreserved Bandwidth at priority 0         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Max LSP or Unreserved Bandwidth at priority 1         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          ...........                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Max LSP or Unreserved Bandwidth at priority 7         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Switching Capability Specific Info                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     BW-Sub-TLV for P0                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     BW-Sub-TLV for P1                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     BW-Sub-TLV for P2                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          ...........                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Switching Capability = Super Channel Switching Capable
- SCSI to contain one or more BW-sub-TLVs (Type=1 or Type=2)

Proposal: BW-sub-TLV(s)

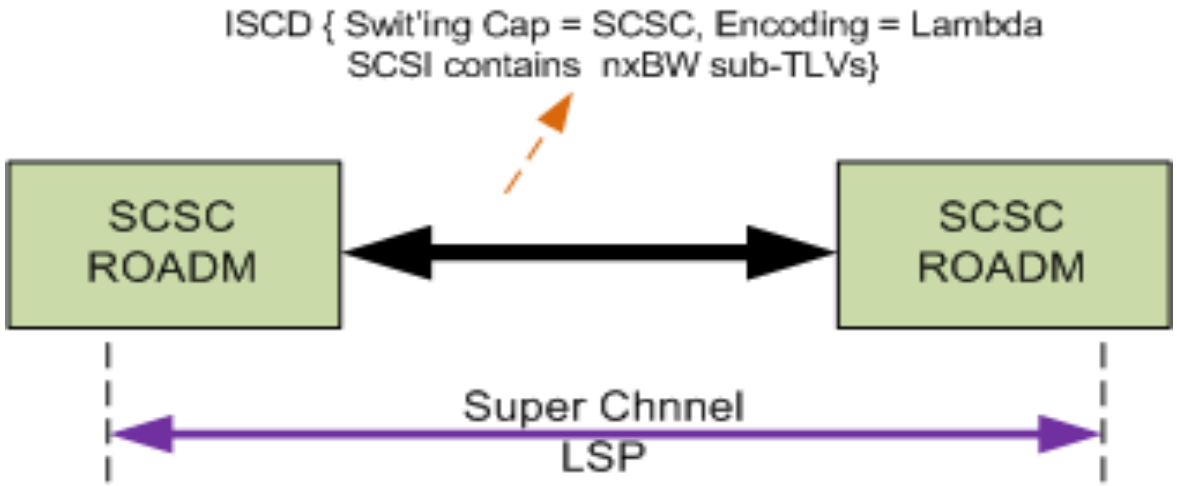
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Type=1            |              Length           |
+---------------------------------------------------------------+
|Slice Spacing | Pri |                    Reserved             |
+---------------------------------------------------------------+
|               N-Start         |          Num of Slices        |
+---------------------------------------------------------------+
|         Min Slot Width        |       Max Slot Width          |
+---------------------------------------------------------------+
|                                                               |
|                Bit-Map showing Available Slices               |
|                  (upto 48 bytes per priority)                 |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Sub-TLV for Bit-map option

```
 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=2            |              Length           |
+---------------------------------------------------------------+
|Slice Spacing | Pri |  Res    |         Num of Entries        |
+---------------------------------------------------------------+
|         Min Slot Width        |       Max Slot Width          |
+---------------------------------------------------------------+
|             N-Start-1         |          N-end-1              |
+---------------------------------------------------------------+
|             N-Start-2         |          N-end-2              |
+---------------------------------------------------------------+
|                              .........                        |
+---------------------------------------------------------------+
|             N-Start-n         |          N-end-n              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

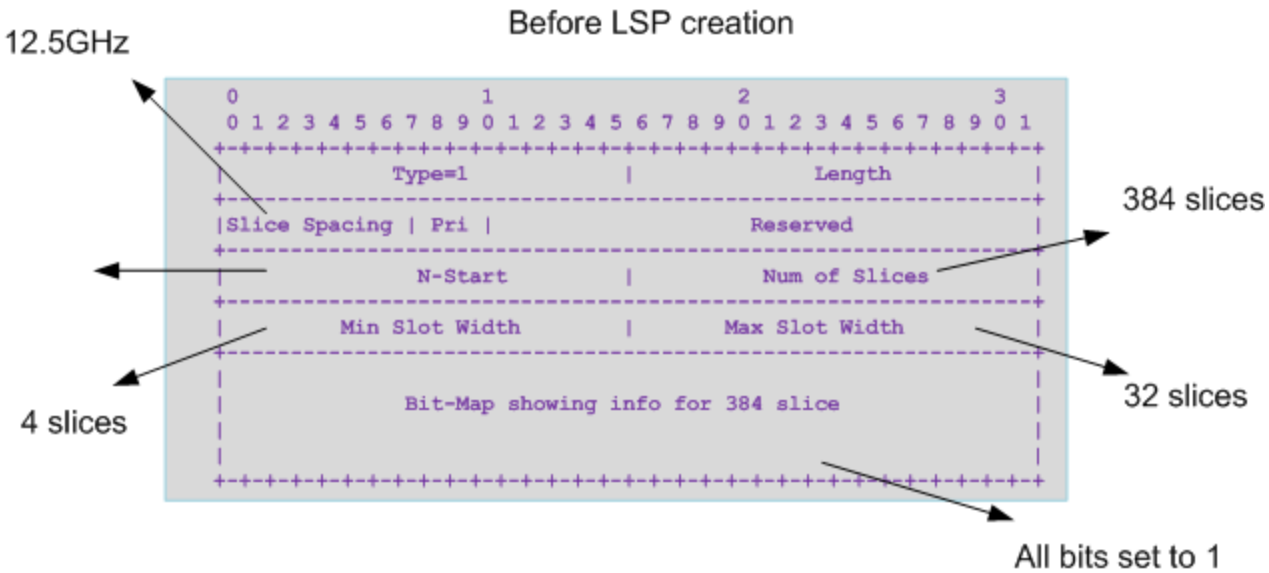
Sub-TLV for List or Range option

Example: BW adv & Super-Channel LSPs



- To create a Super Channel LSP over a single Flex-Grid link with
  - Contiguous BW requirement = 200GHz (assume Transponder fully tunable)
- The path computing node performs the following:
  - Determine the number of slices required for the LSP (200/Slice-Spacing = 16)
  - Look for contiguous spectrum availability on each link from BW adv (both dir)
    - If available select the link for LSP creation.
- Signal for LSP creation
- Once created, update BW available using Bandwidth sub-TLV.

Example: BW adv & Super-Channel LSPs cont'd



- Consider a Te-Link that supports 4.8THz extended C-band
- N-start = -142 (encode in 2's complement)
- Slice spacing = 12.5GHz (ref to Enumerated values in the draft)
- Total number of slices available on the link = 384
- Min SW field shows min consumption of 4 Slices per LSP (=50GHz)
- Max SW field shows up to 400GHz BW allowed per LSP (32x12.5GHz)

CCAMP Mailing List Comments/Response

- [Ramon Casellas] What will be the Max LSP BW for super channel
  - [Abinder Nov04/2011] Max LSP BW is not really needed for super channel connection. All we need is max number of spectral slices which I am proposing in ISCD specific information. If we do want to show LSP BW in bps then we can convert spectral bandwidth of super channel into bps based on modulation.

Summary & Next Steps

- Re-using of existing ISCD definitions (RFC 4202)
- Technology specific extensions consistent with GMPLS arch
- Coverage for evolving Flex-Grid technology
  - Different slice spacing, N-Start, Min/Max LSP BW
- Coverage for all 8-priorities

Next Steps:

- Discuss the requirements
- Evaluate options

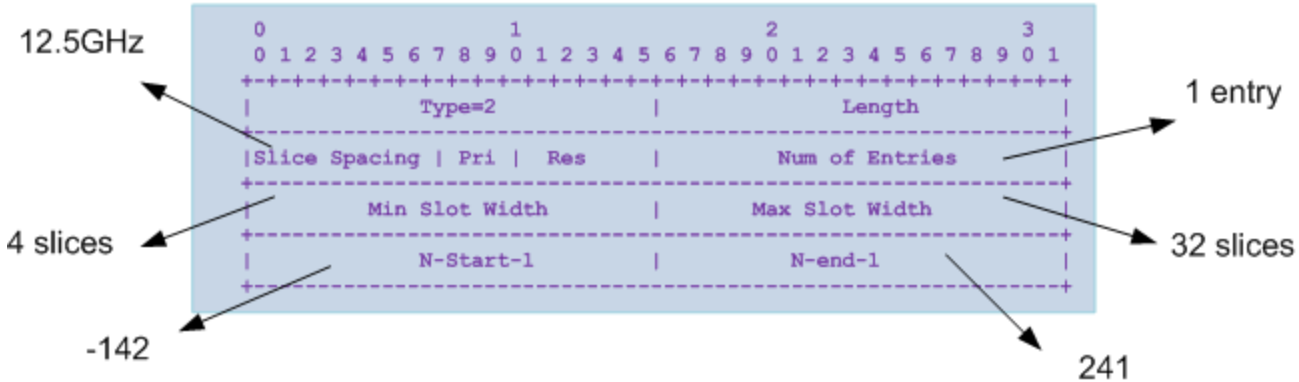
Backup

What is Super-Channel Connection

- Multi-rate end to end connection on flex-grid
- Realized with set of 12.5 GHz spectral slices
- Spectral Slices can be contiguous or non-contiguous (split-spectrum super-channel)
- Examples:
  - Super Channel connection with spectral bandwidth of 200GHz (16 slices)
  - Split-spectrum super-channel with spectral bandwidth of 250Ghz – 5 sets of slots of 50 GHz

Example-3: If Type=2 TLV is used (ref to e.g. in slide-9)

Before LSP creation



- Manipulate N-Start & N-End fields If Type=2 BW sub-TLV is used for adv of slices