OSPF extensions for supporting spectrum sub-band allocation

draft-wang-ccamp-flexigrid-wavelength-range-ospf-02

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Existing Problems

- Completely freedom and indiscriminate positioning of various channels with different bit rates is likely to lead to dramatically impaired system performance due to:
  - (1). XPM (Cross-phase modulation) effect.
    - XPM: variation of intensity of optical signal can change the refractive index of the fiber, and modulate the phase of the other optical signals co-propagating in the same fiber.
    - E.g., mix 10Gbit/s NRZ → Intensity modulated & 100Gbit/s xPSK → coherent system phase modulated.
    - Optical coherent system is a phase sensitive system (e.g., 100Gbits/s xPSK), and XPM would have a detrimental effect on the 100Gbit/s channels if this are caused by 10Gbit/s signal.

Existing Problems

– (2). Fragment of Spectrum

  • Frequently setup and release of flexible grid optical channels which occupy different slot widths would result in the small spectrum fragments that can't be used anymore, which would reduce spectrum utilization rate.

Overview of the Solution

- In current DWDM systems with different bit rates, the common practice is to group the channels with the same bit rates into the same wavelength sub-band.

- As long as there is no good way to solve the mixture of signals with different bit rate currently, this is a general advice for the short term as a smart thing to do when engineering DWDM network.
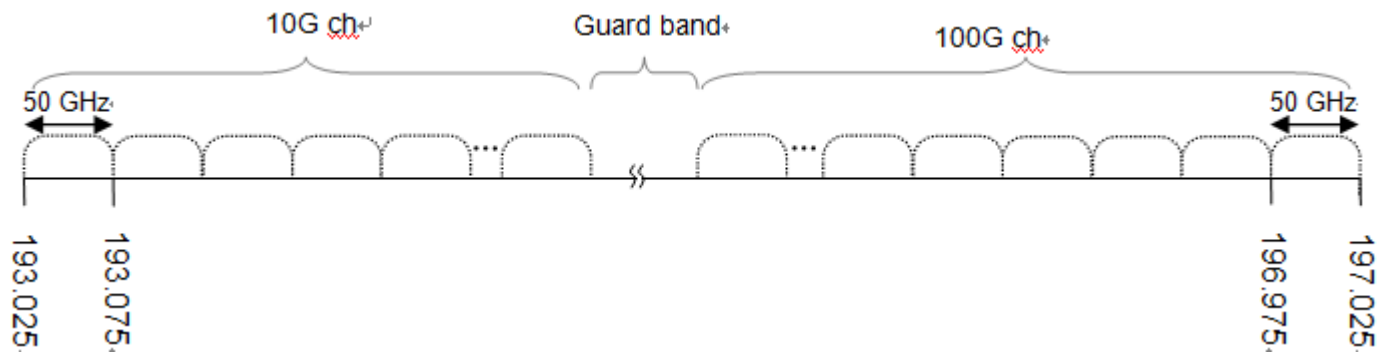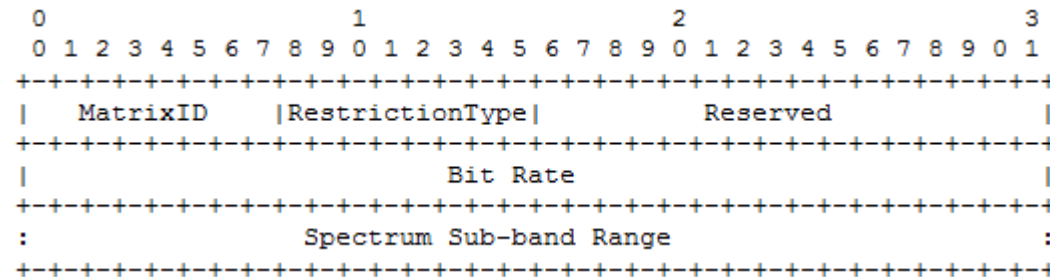
Advantage Brought by the Solution

- Grouping of channels with the same bit rate.
  - As XPM only occurs when pulses overlap, grouping of channels with the same bit rate with guard band sit between them could avoid XPM effect happening between intensity modulated channels and coherent modulated channels.
  - Grouping of channels with the same bit rate could reduce spectrum fragment and raise spectrum utilization rate, because channels in the same group sub-band have the same slot width.

Extensions

- Spectrum sub-band allocation information should be flooded in order to help path computation. This document mainly focus on the advertisement of this information.

- Port Label Restriction sub-TLV can be used here to carry this spectrum sub-band allocation information.

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 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   MatrixID    |RestrictionType|            Reserved           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            Bit Rate                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                      Spectrum Sub-band Range                  :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Next steps

- Refine the document according to the feedback of meeting and mailing list.