Minimal Optical Network Planning and Maximum Wavelength Flexibility in metro & regional networks

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Metro/Regional Optical Networks - challenge 1

Challenge 1:
Traffic Growth is non-uniform and unpredictable
Bandwidth Provisioning Concept

**Dedicated bandwidth: one-step provisioning**

(One-Hop)

**Shared bandwidth: multi-step provisioning**

(Multiple-Hops)
Challenge 2:
70~80% of the traffic is express
Fork-lifting upgrade should be avoided
Metro/Regional Optical Networks - Ideal Plan

All-Optical ROADM
Physical Ring
Logical Mesh
However, all-optical ROADM(s) face old and new challenges.

Dedicated bandwidth: multi-step provisioning (One-Hop)

- Multi-step provisioning within 50ms when fiber breaks
- Heavy-duty ROADM (>32ch) could be an overkill
- Are fiber dispersion and polarization-mode-dispersion suitable for any-to-any 10G/40G/100G transmission?
Upgrading 2.5G infrastructure to 10G or 20G w/o Fiber Plant Change

- 100 GHz
- 1x2.5G Wavelength
- 10G Upgrade
- 4x2.5G Wavelengths
- 20G Upgrade
- 8x2.5G Wavelengths

2.5G system <1000 km

OSNR of all wavelengths represents the entire network performance, fiber dispersion or PMD-induced system penalties can be ignored.
Upgrading 10G infrastructure to 40G/50G/100G w/o Fiber Plant Change

100 GHz

1x10G Wavelength

40G Upgrade

4x10 G Wavelengths

Highly spectral efficient 10G wavelengths

DCM

10G infrastructure
Future-Proof ROADM

• Deployed ROADM(s) should remain useable even when:
  – Higher data rates need to be added
    2.5G $\rightarrow$ 10G $\rightarrow$ 40G $\rightarrow$ 100G
  – More channels need to be added
    Channel spacing: 100GHz $\rightarrow$ 50GHz $\rightarrow$ 25GHz
  – New nodes need to be inserted, or networks need to be optically interconnected
Future-Proof Solution I

- Software Programmable ROADM with a small granular passband
400-GHz bandwidth programmed for various rates and channel numbers

Granular passband: 12.5GHz

• Push ROADMs off the main ring path, so that the main ring path is always transparent.
OpVista S-ROADM Features

- **Grows from single $\lambda$**
- **No active ROADM in the main ring path**
  - Enabling highest network reliability
  - No bandwidth reduction and no severe node number limitation due to cascaded ROADMs
  - No need to keep changing ROADM when #wavelengths grow beyond 40, or when data rate is increased to 40G
  - Zero hit time on other wavelengths when ROADM is reconfiguring wavelengths
  - One step end-to-end provisioning
- **10G traffic not affected by the change in accumulated chromatic dispersion when ROADM reconfigures add/drop nodes**
- **Most space-efficient**
- **Optical broadcast/multicast capability**
OpVista2000 Ultra-dense WDM provides means to upgrade network capacity without outside plant changes.

Transparent optical ring architecture with agile transceivers:
- Enables minimal network planning and maximum wavelength flexibility.
- Future-proof and forward-compatible with emerging software programmable ROADM (Helps service providers buy some time to get the best and future-proof ROADM).