

OVERVIEW OF ITU-T STANDARDS FOR OPTICAL SYSTEMS FOR TERRESTRIAL TRANSPORT NETWORKS

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14° Convegno Nazionale delle Tecnologie Fotoniche, Firenze, 16 May 2012



Outline

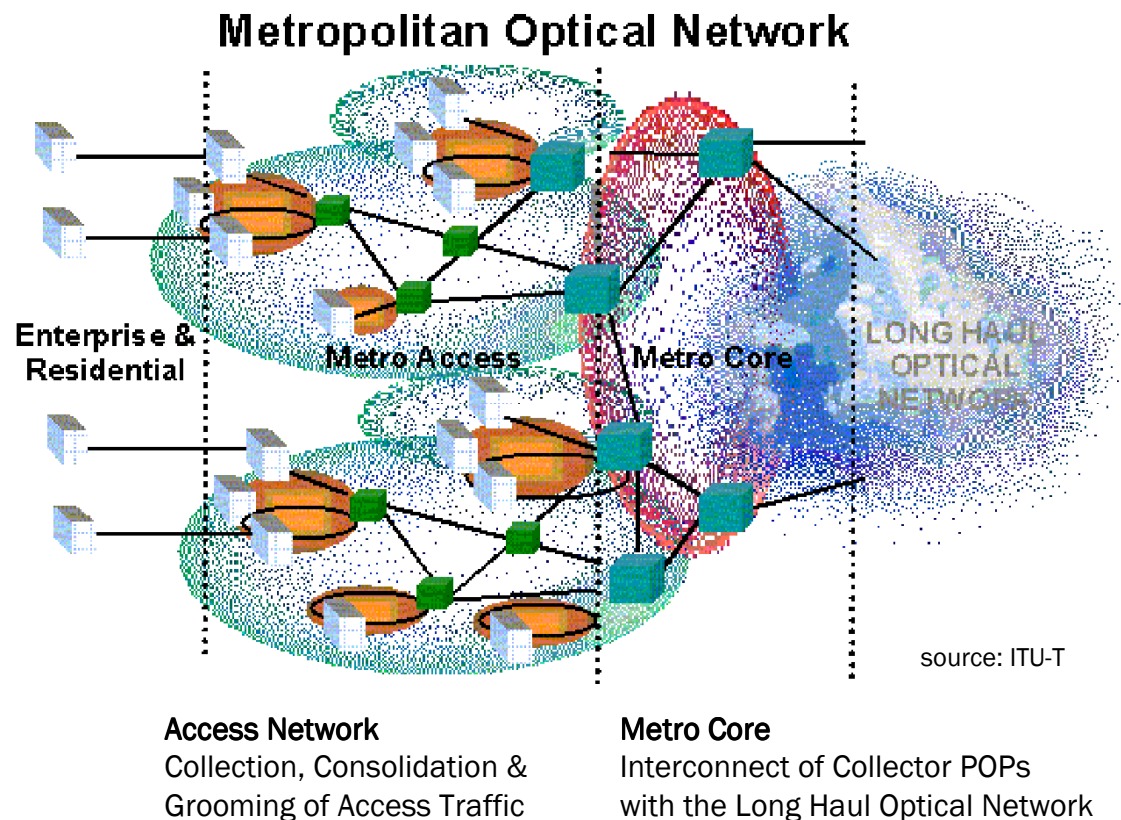
- **ITU-T standardization activities in Optical Transport**
- **Transversely Compatible Systems**
- **Enabling Optical Transparent Domains**
- **Future-proofing Spectral Usage via the Flexible Grid**
- **Conclusions**

ITU-T standardization activity in Optical Transport

Optical Technologies: cables, components, methods

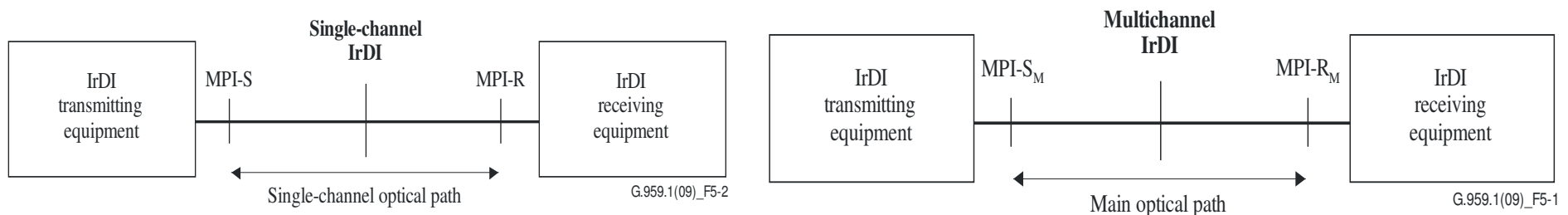
Major projects in SG15:

- ▶ **Access Network Transport**
 - ▶ Q1, 2, 4a, 4b, 4c
- ▶ **Optical Technologies**
 - ▶ Q5, 6, 7, 8, 16, 17, 18
- ▶ **Optical Transport Networks**
 - ▶ Q3, 9, 10, 11, 12, 13, 14, 15



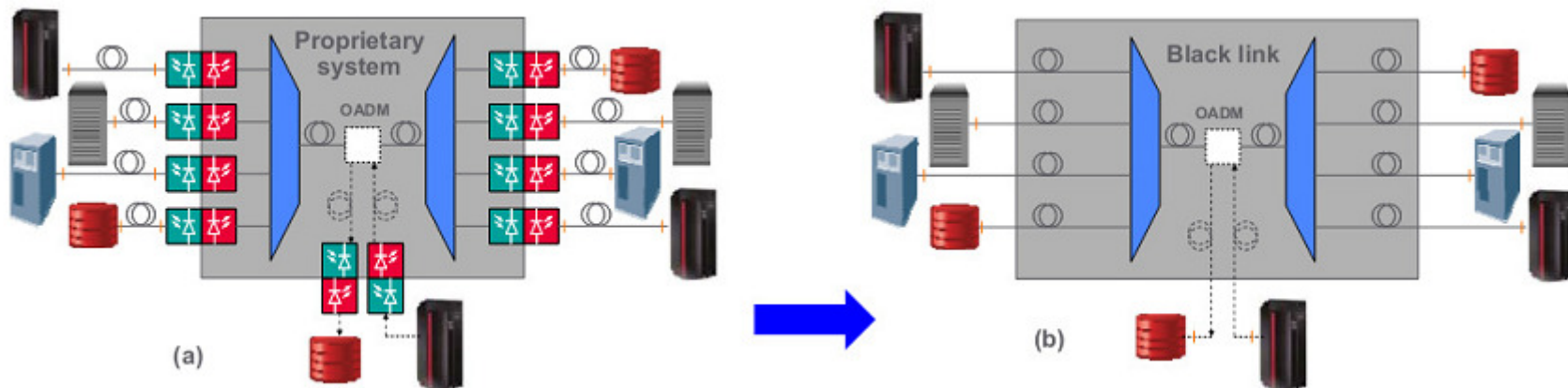
Transversely Compatible Systems – G.959.1/G.693

- ▶ “transversely-compatible interfaces”, “no line amplifiers”
- ▶ applications for 2.5/10/25/40G “optical tributary signal classes”
- ▶ example of implementations in XFP, XFP+, QSFP+, CFP form factors



Transversely Compatible Systems (G.698.x series)

- ▶ **Passive, “metro” amplified and “seeded WDM” applications**
- ▶ **May lead to the elimination of transponders**
- ▶ **The “black link” concept for G.698.1 and G.698.2:**

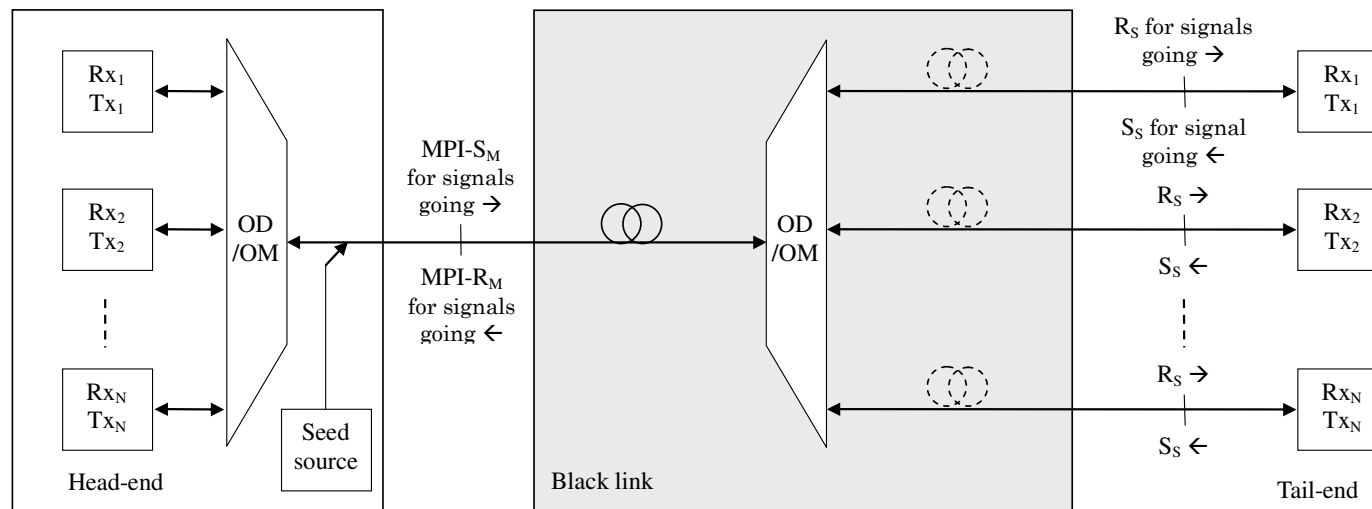


- ▶ **G.698.{1,2}: up to 10G and 50GHz applications**
- ▶ **40G specification is ongoing in G.698.2**

source: P. Anslow, OFC 2007

Transversely Compatible Systems – seeded WDM

▶ Reference diagram



source: ITU-T G.698.3

- ▶ **Application: 1.25G over about 40km of G.652 fibre**
- ▶ **100 GHz (tail- to head-end) / 97.15 GHz spacing (head- to tail-end)**

Enabling Optical Transparent Domains – G.680

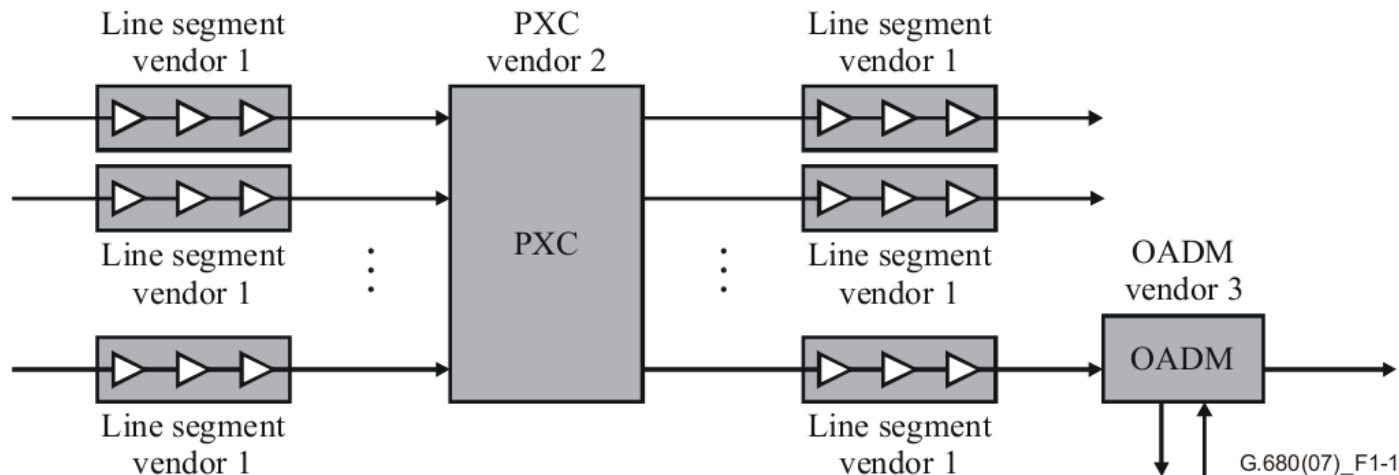
- ▶ **Domains of optical transparency large enough to ensure that all the potential routes of the backbone network could be realized all optically**



- ▶ ***adapted from R. Clemente, ECOC 2010***

Enabling Optical Transparent Domains – G.680

- ▶ G.680 defines a "degradation function" of optical network elements making up an optical network:

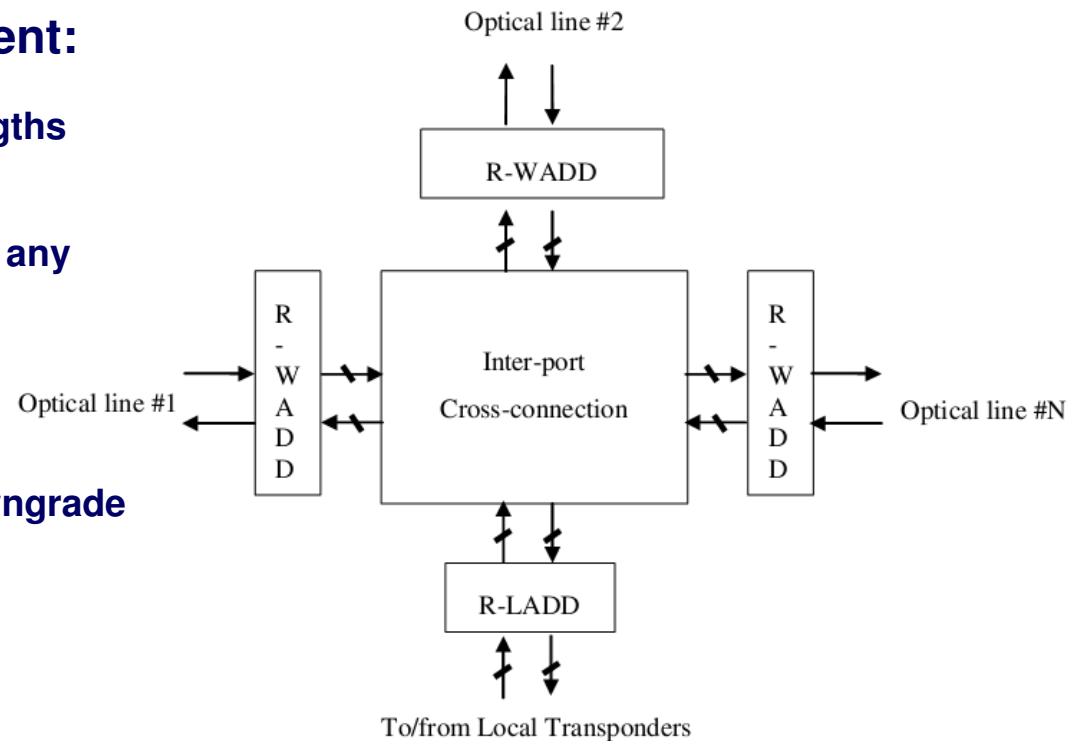


- ▶ the case where line segments are from different vendors is under study

Enabling Optical Transparent Domains – G.rmon

G.rmon (under development) defines MD-ROADM as a network element:

- ▶ to provide (remotely) routing wavelengths from any optical line to another one
- ▶ to provide (remotely) add and drop for any wavelength to/from any optical line
- ▶ to provide colourless, directionless, contentionless A/D
- ▶ to provide hitless degree upgrade/downgrade
- ▶ to provide hitless optical channels provisioning
- ▶ to support optical restoration



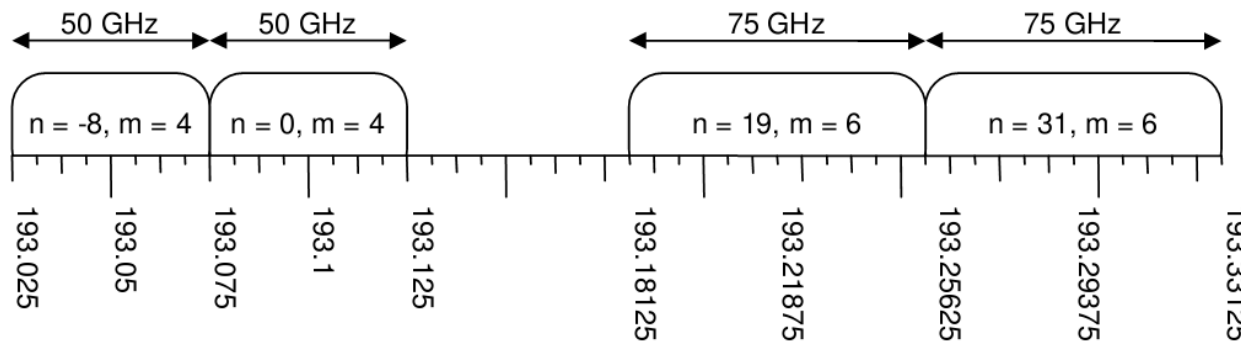
MD-ROADM described in G.rmon

Future-proofing Spectral Usage via the Flexible Grid

Frequency grids are defined in G.694.1 to support DWDM applications:

- ▶ 12.5, 25, 50 and 100 GHz spacings, 193.1 THz common to all grids

The flexible grid (example):



source: ITU-T G.694.1

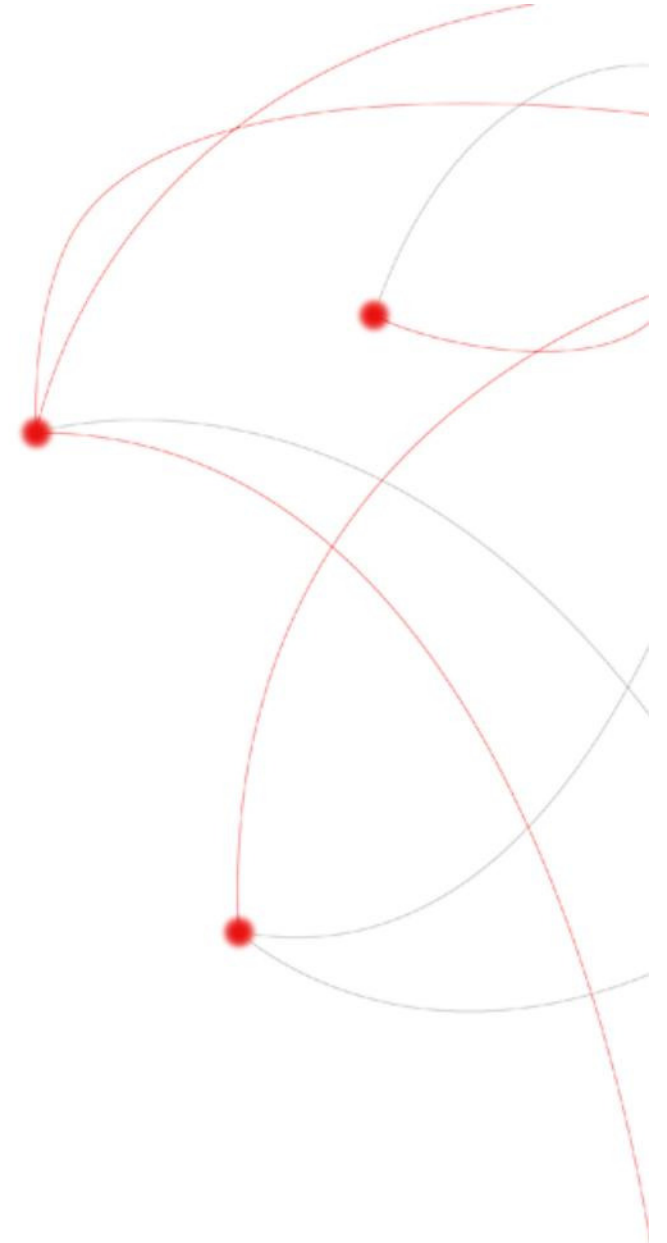
- ▶ allows a mixed bit-rates/modulation formats transmission system to allocate frequency slots with different widths
- ▶ allows better exploitation of the spectrum



Conclusions

- ▶ **In the last 5 years Q6 and Q7 have produced or updated 16 ITU-T recommendations related to the optical transport physical layer**
- ▶ **Quick process: 18 months from inception to approval for the new G.698.3 and less than one year for the revision of G.694.1**
- ▶ **10 recommendations and a Supplement are currently under active working in the field of transversal compatibility of interfaces, monitoring, network design engineering and other topics**

We thank Peter Stassar and Pete Anslow for the useful discussion



THANK YOU!