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Discovering Beyond Imagination

Update on ITU-T Q16/15

G.695, CWDM system interfaces: the black link

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Q16/15 Background

- SG15: Transport
- Q16: Optical interfaces for SDH (and other) systems
  - G.957 (initial)
  - G.691 (up to 10 Gbit/s, single channel with amplifier)
  - G.692 (DWDM)
  - G.959.1 (inter-domain interface)
  - G.693 (very short distance)
  - G.694.1 (DWDM frequency grid)
  - G.694.2 (CWDM frequency grid)
  - G.695 (CWDM applications)

CWDM background

- Added low water fiber G.652.C (Q15/15)
  - Support 16-18 channels
- CWDM generically defined in G.671
- Decided to split the grid from the applications
- Wavelength grid: G.694.2
  - 1311 nm ± i * 20 nm (indefinitely) [uncooled DFB lasers]
- Applications: G.695
    - Channel plans
      - 4,8,16, unidirectional or bidirectional
    - Mux/deMux BW: 13 or 14 nm (tbd)
    - Tx Power levels
    - Rx Sensitivity/overload

Basic approach to link characteristics (single-channel)

- Loss: The Tx/Rx must work with up to the maximum overall attenuation and also with the minimum.
  - Defined between reference points
  - Target length only
  - If actual link doesn't meet limits, owner must
    - Add dB pads
    - Go shorter distance
    - Remake splices
    - Take a risk
- Same approach for maximum Chromatic dispersion
- Same approach for maximum DGD

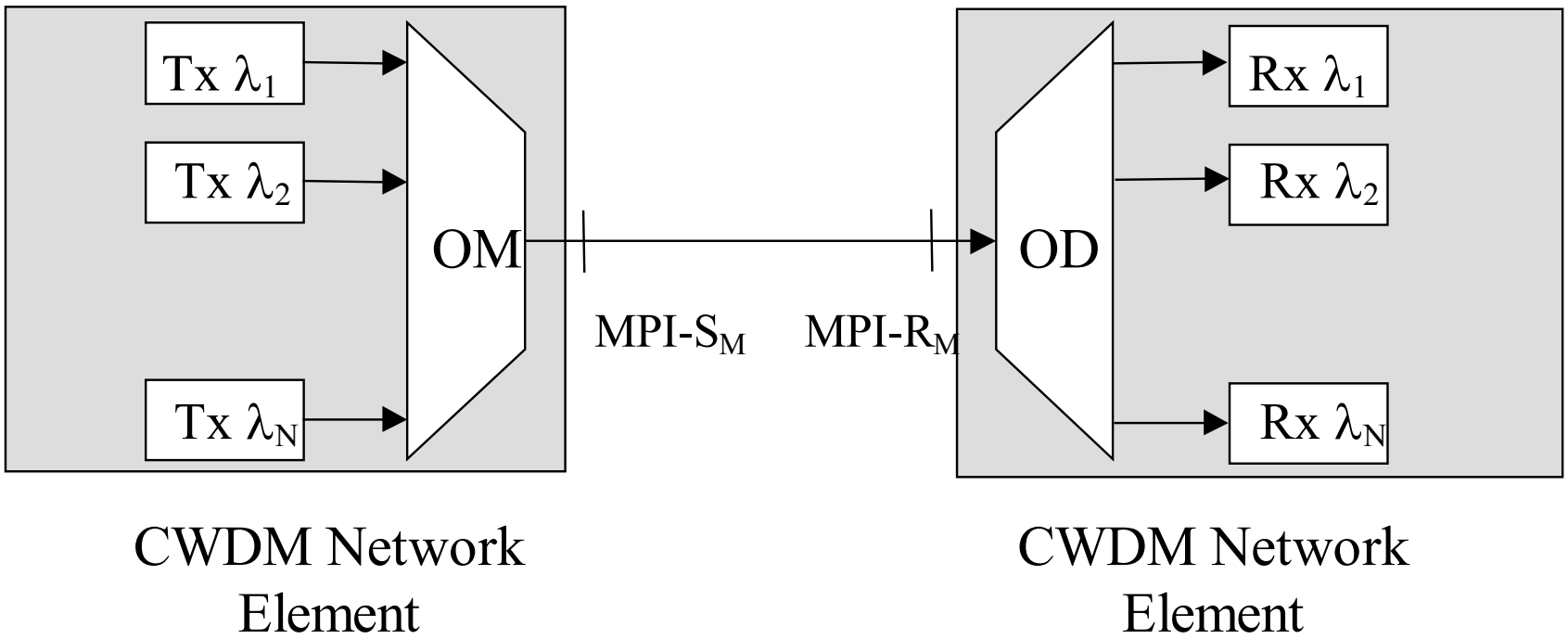
Approaches for multiple channels

- Full transverse compatibility problems:
  - Precise channel plans
  - Mux/DeMux bandwidth
  - Mux/DeMux Insertion loss (across channels)
  - Isolation/Crosstalk
- Black box (used in G.692 & G.959.1)
  - Longitudinal compatibility only
- Black link (new as of Jan. 2003)
  - Transverse compatibility at the Tx/Rx level

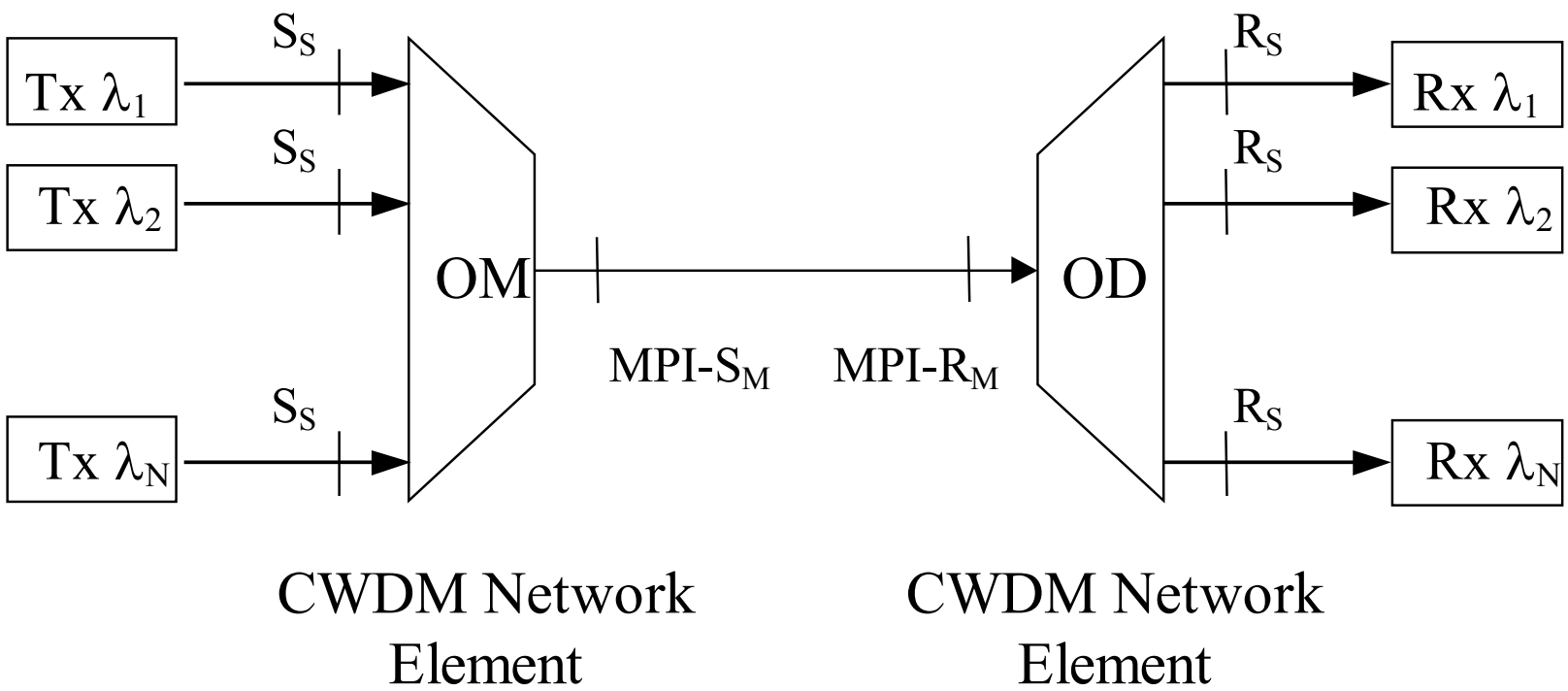
Compatibility levels

- Longitudinal:
  - Must have the same equipment vender for both Tx and Rx on a fiber pair
  - Can have different venders on different pairs
- Transverse
  - Can have different venders for Tx and Rx

Black box approach



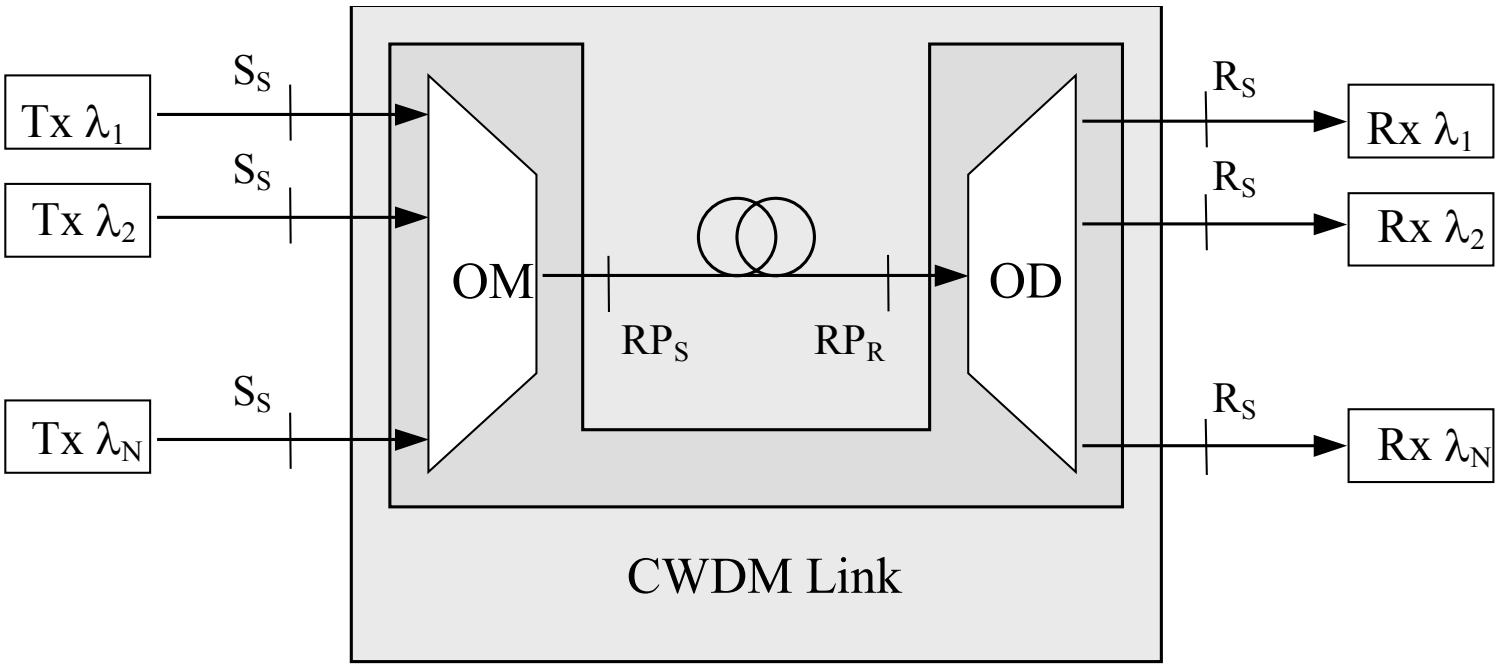
Full transverse compatibility



Problems

- Too many parameters to get agreement
- Even if agreement possible, higher cost
- Limits on technology
- Mux/Demux units are practically installed as pairs
  - Attenuation/Insertion loss: linear
  - Allows balancing/optimization

Black link



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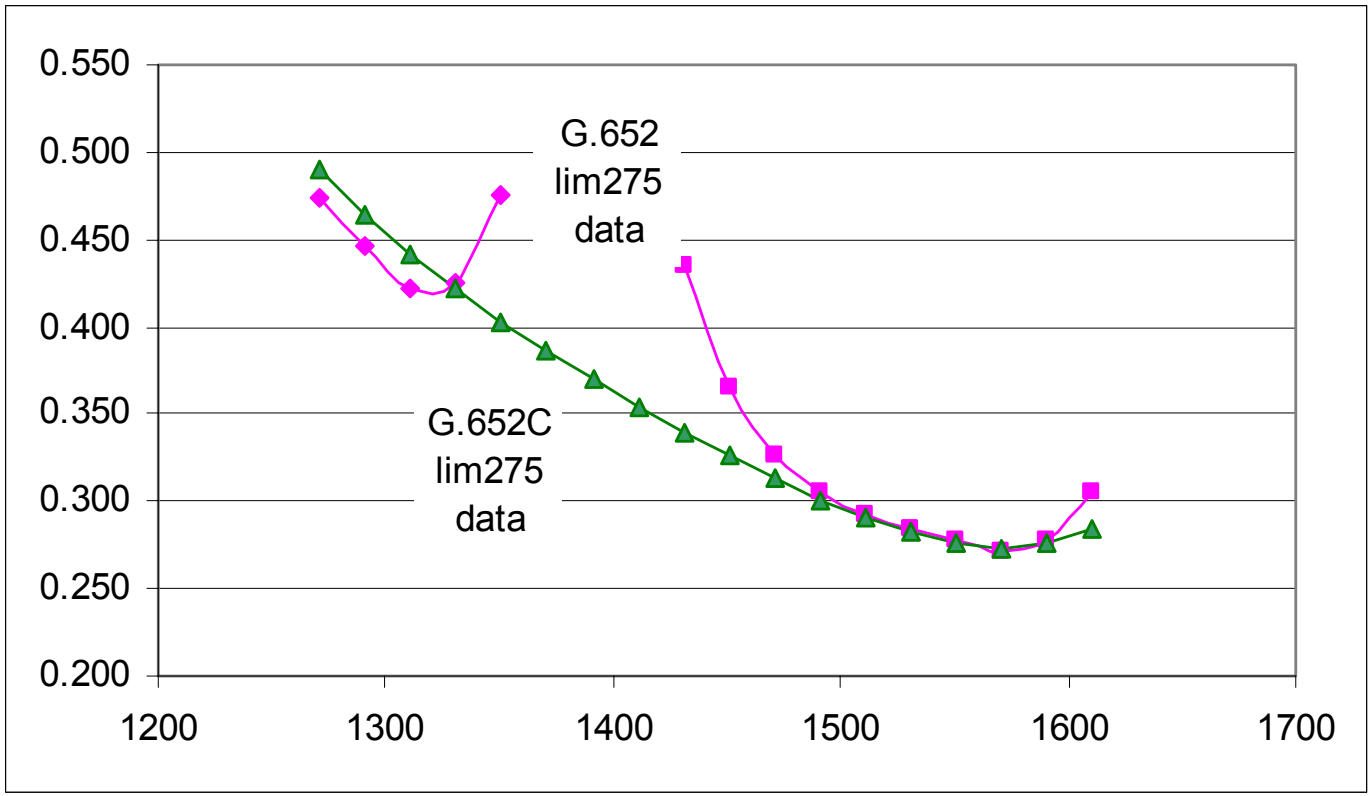
Black link advantages

- Once link characteristics are defined between R and S, transverse compatibility possible at the TX/Rx level
- Interface points RP_S and RP_R are informative
  - Practical target length may be different for different regions
  - Different splice frequencies
- Need to add a maximum cross-talk value
  - Similar treatment as DGD
- Allows balanced or variable channel insertion loss
  - Trade Mux/DeMux vs. target length

Problem: Variable fibre attenuation



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Approach to solution: Iterative

- Want: Common receiver characteristics
- May need:
  - Different power levels for different sub-bands
  - Different Mux/DeMux insertion loss for different sub-bands
- Start with fibre + notion of Mux/DeMux capability
- Assess power/sensitivity alternatives
- Refine Mux/DeMux capability
- Repeat
- Result: target length from defined set of assumptions
  - October 2003?

Commercial implications of black link

- Allows third party ownership of infrastructure
  - A conforming black link can carry multiple services
- City/State government could own the black link
  - Lease channels to different service providers
  - Who can obtain Tx/Rx from different venders
- City/State can finance over longer time
  - New business model for telecom?

- Similar model as airports

Opportunities

- Focused Mux/DeMux Recommendation from Q17/15
- Rest of infrastructure from SG6?
  - Requirements for termination points
  - Deployment strategies
- Consolidated testing regime from IEC 86C/WG1?
  - Attenuation
  - Isolation?
- New DWDM black link Recommendation from Q16/15?


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