

Optovia

Expect more from an amplifier.

Advances in optical amplifier technologies

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Outline

- Past
 - Present
 - Future
- ... of optical amplifiers for long distance networks

A build example



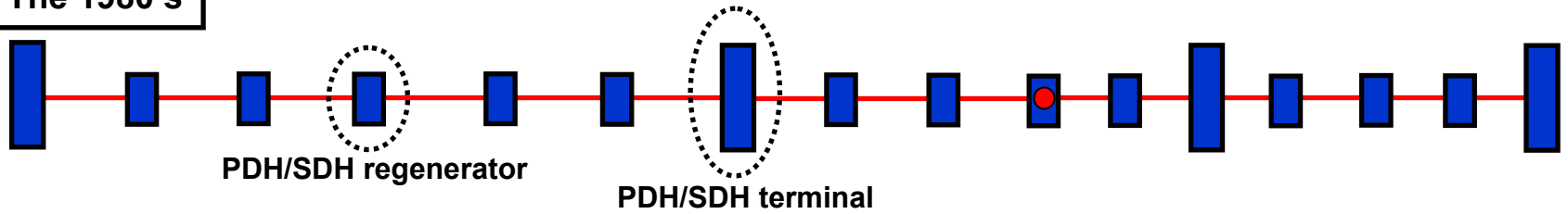
A build example



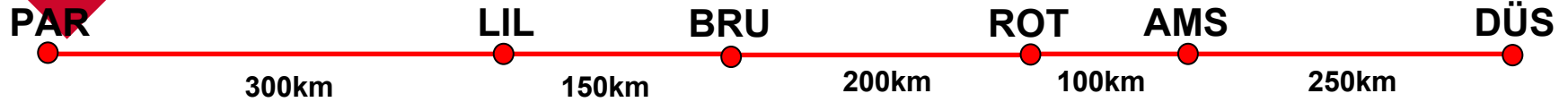
A build example



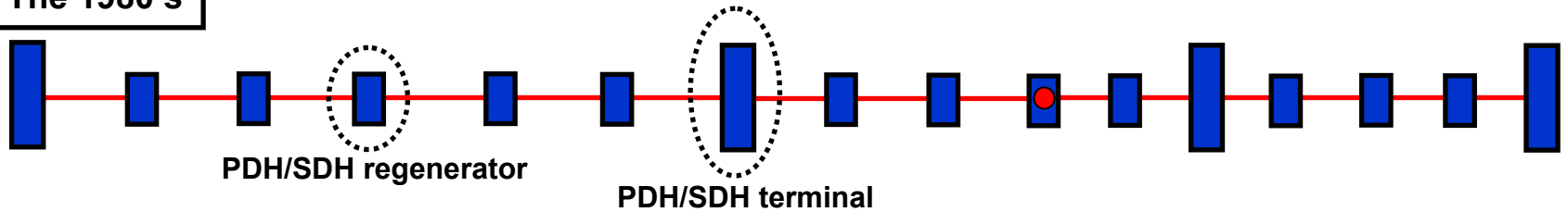
The 1980's



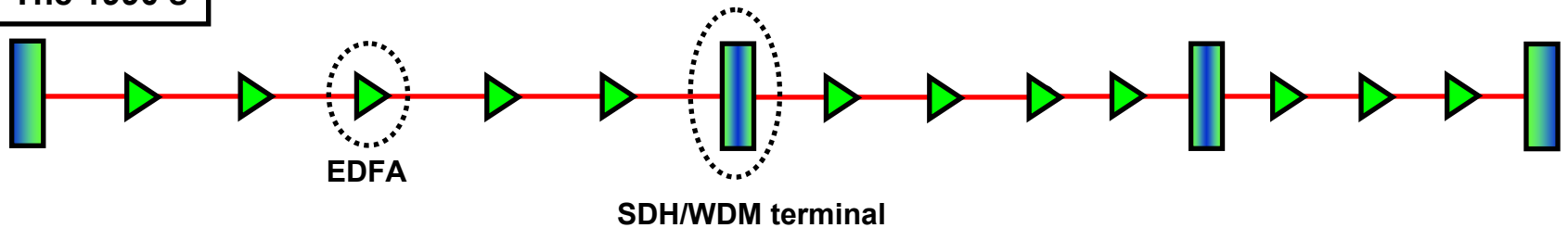
A build example



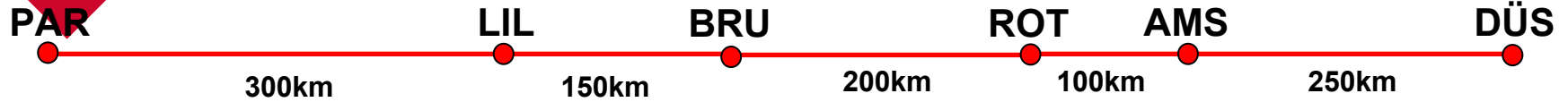
The 1980's



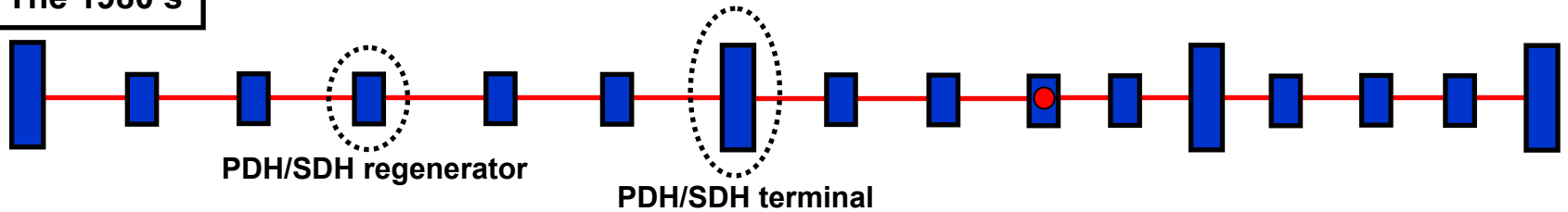
The 1990's



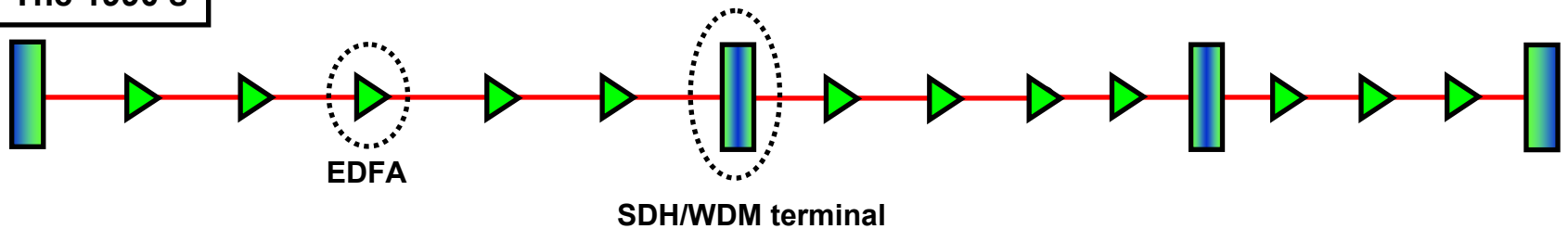
A build example



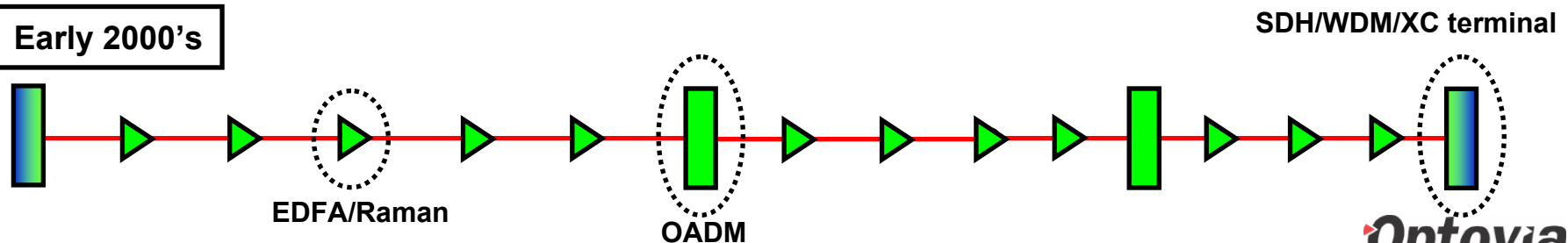
The 1980's



The 1990's



Early 2000's



Optical amplifier trends over the last decade

■ Performance

- Reach: Several 100 km's to several 1000 km's
- Capacity: 4x2.5G λ 's to 160x10G λ 's
- (R)OADM support

■ Cost

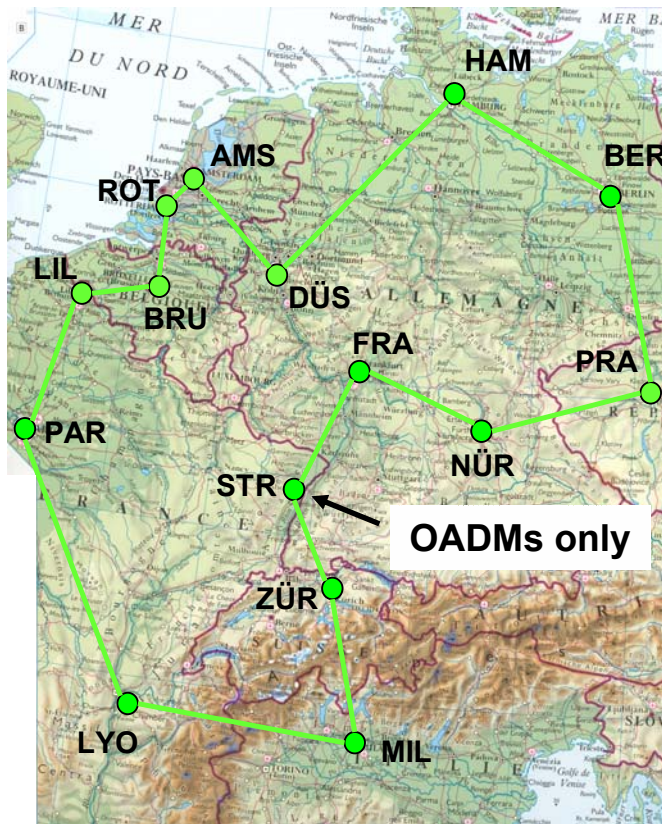
- EDFA: > €5000/ λ to < €1000/ λ (1996-present)
- Raman: > €5000/ λ to < €1000/ λ (1999-present)

■ Interworking

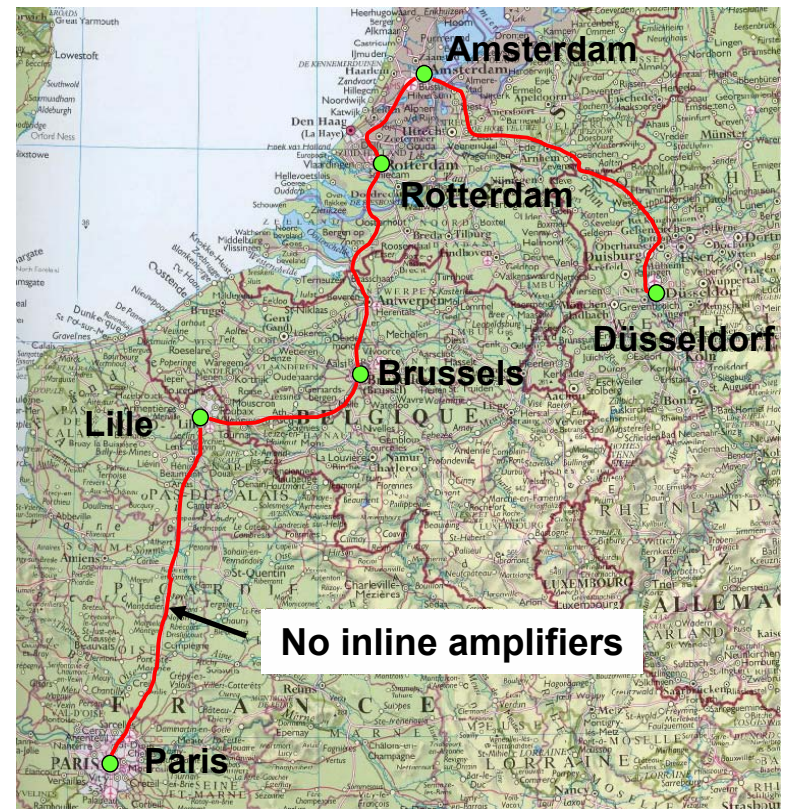
- Coloured LR optics on SDH ADM's and XC's

Next steps in performance

- All Optical Networks



- Hut Skipped Networks



Next steps in performance

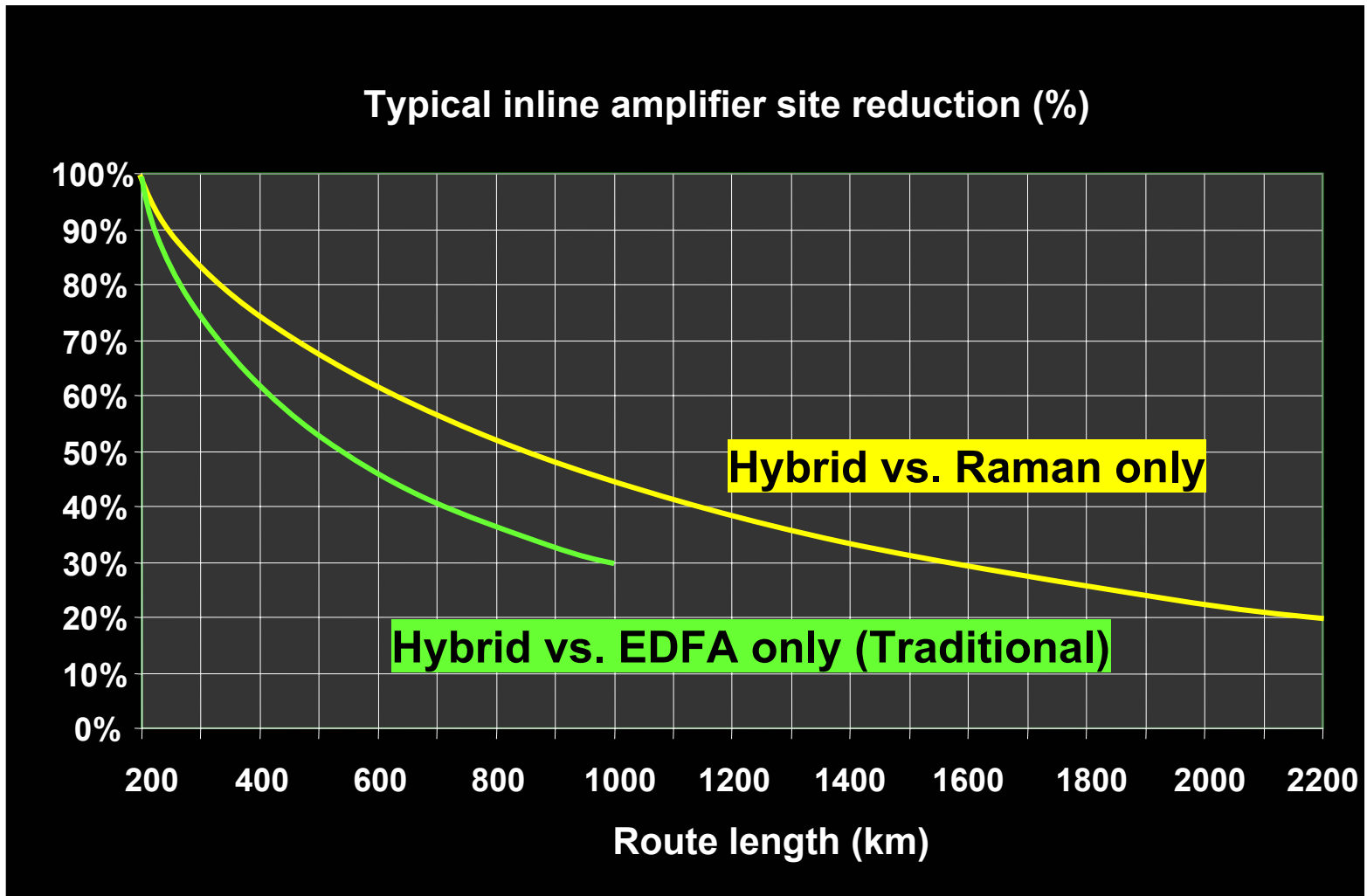
■ All Optical Networks

- Amplifier requirements
 - Very low noise (~ 0 dB)
 - Moderate gain (~ 15 dB)
 - Moderate dynamic range (~ 5 dB)
 - Raman only
- Network requirements
 - Very high capacity (> 100 Gb/s per route)
 - Long circuits (> 2000 km)

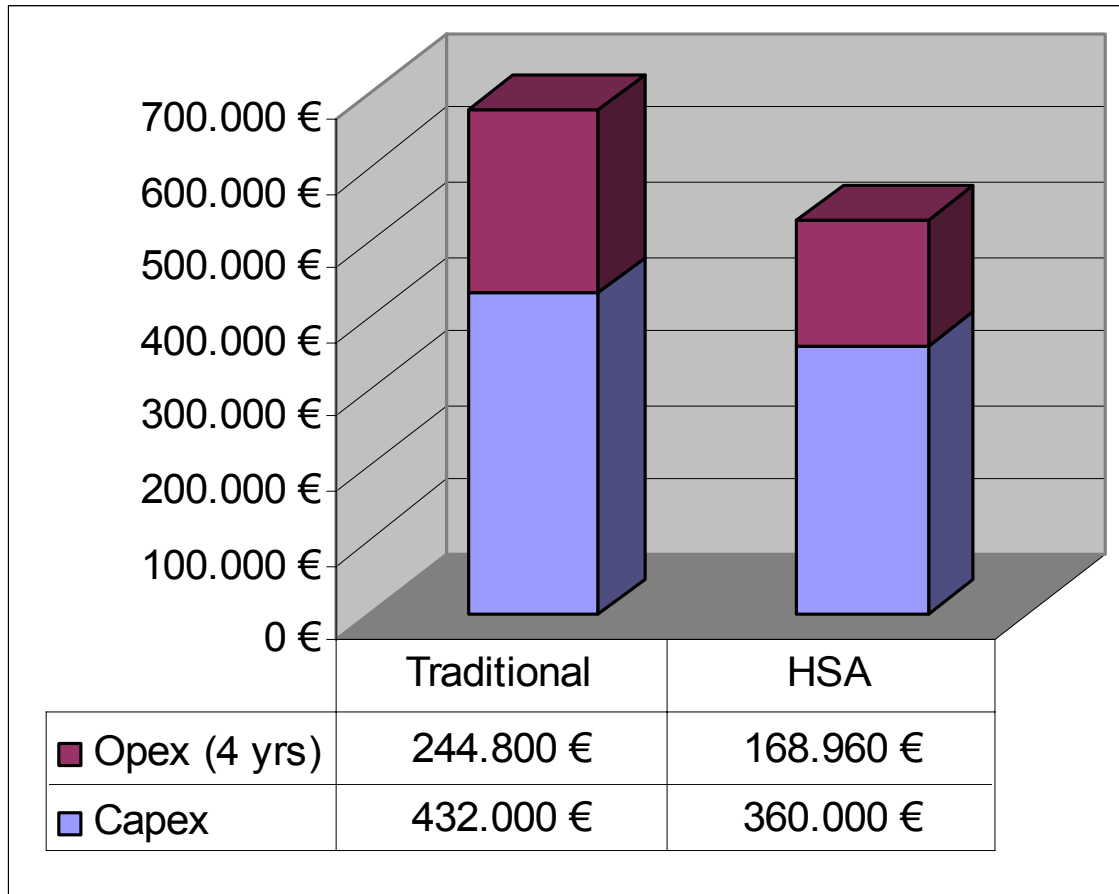
■ Hut Skipped Networks

- Amplifier requirements
 - Low noise (< 3 dB)
 - High gain (> 30 dB)
 - Large dynamic range (> 10 dB)
 - Hybrid EDFA/Raman
- Network requirements
 - Moderate capacity (< 100 Gb/s per route)
 - Shorter circuits (< 1000 km)

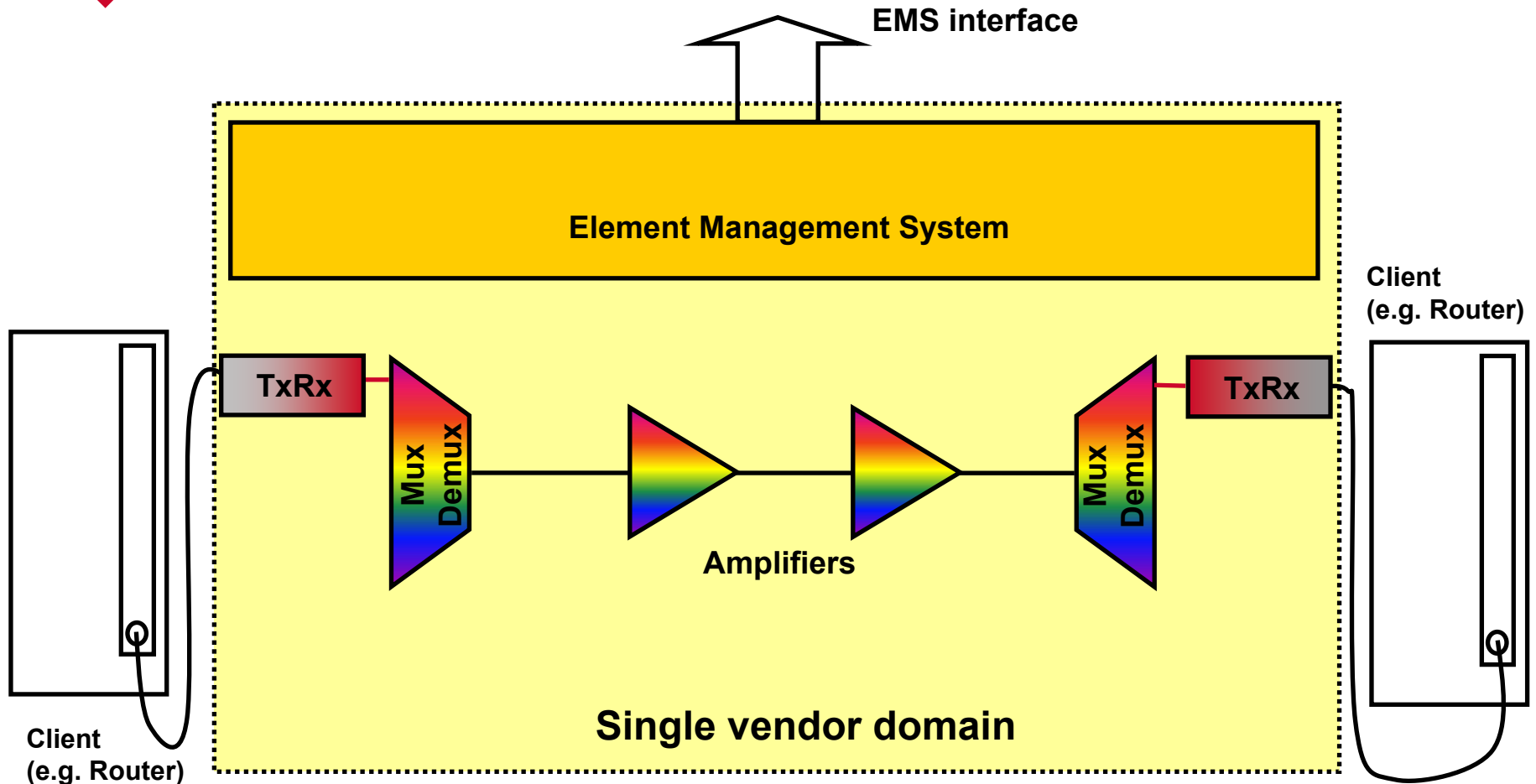
Hut Skipping « Rule of thumb »



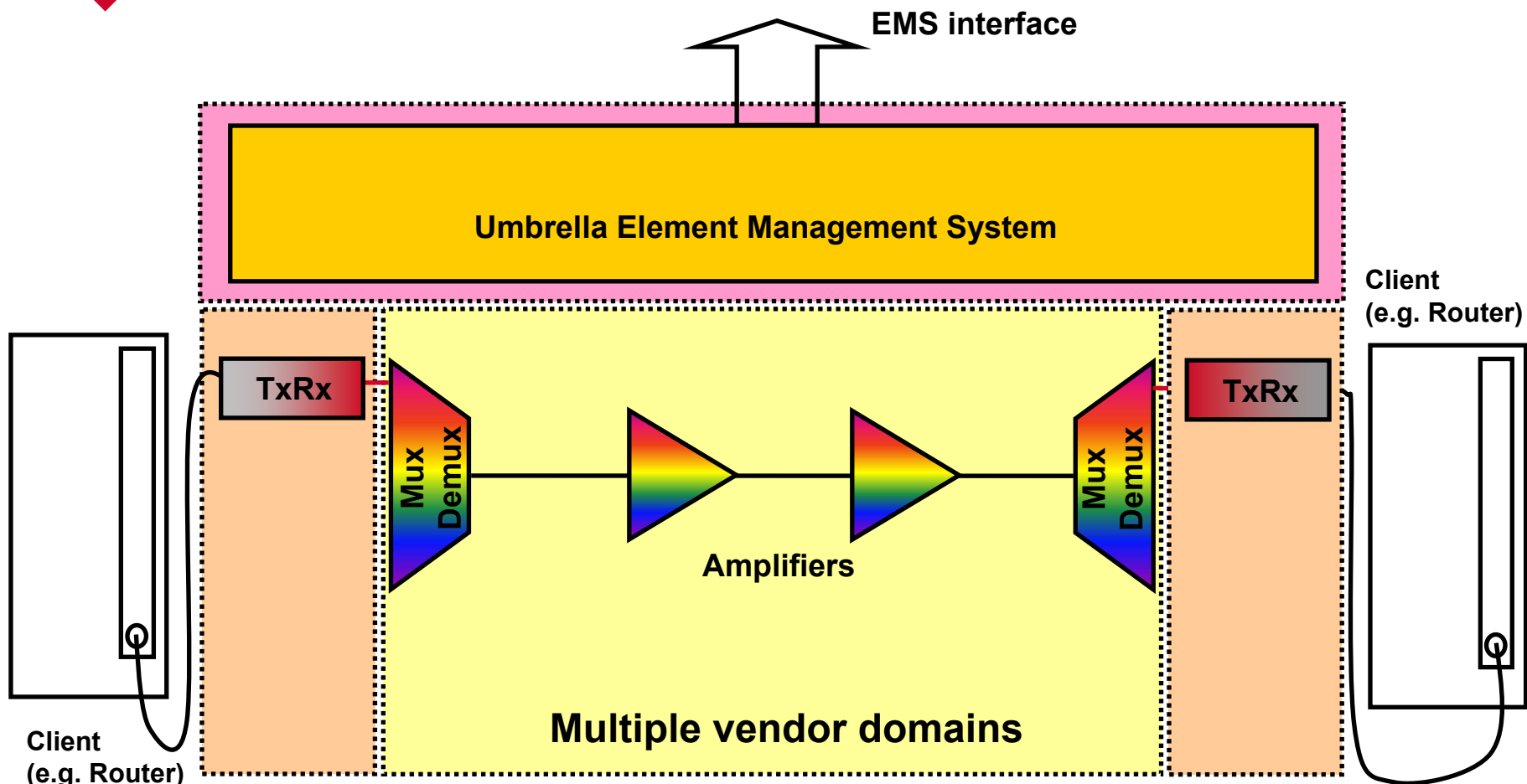
Economics of Hut Skipping (~650km link)



Traditional WDM system engineering

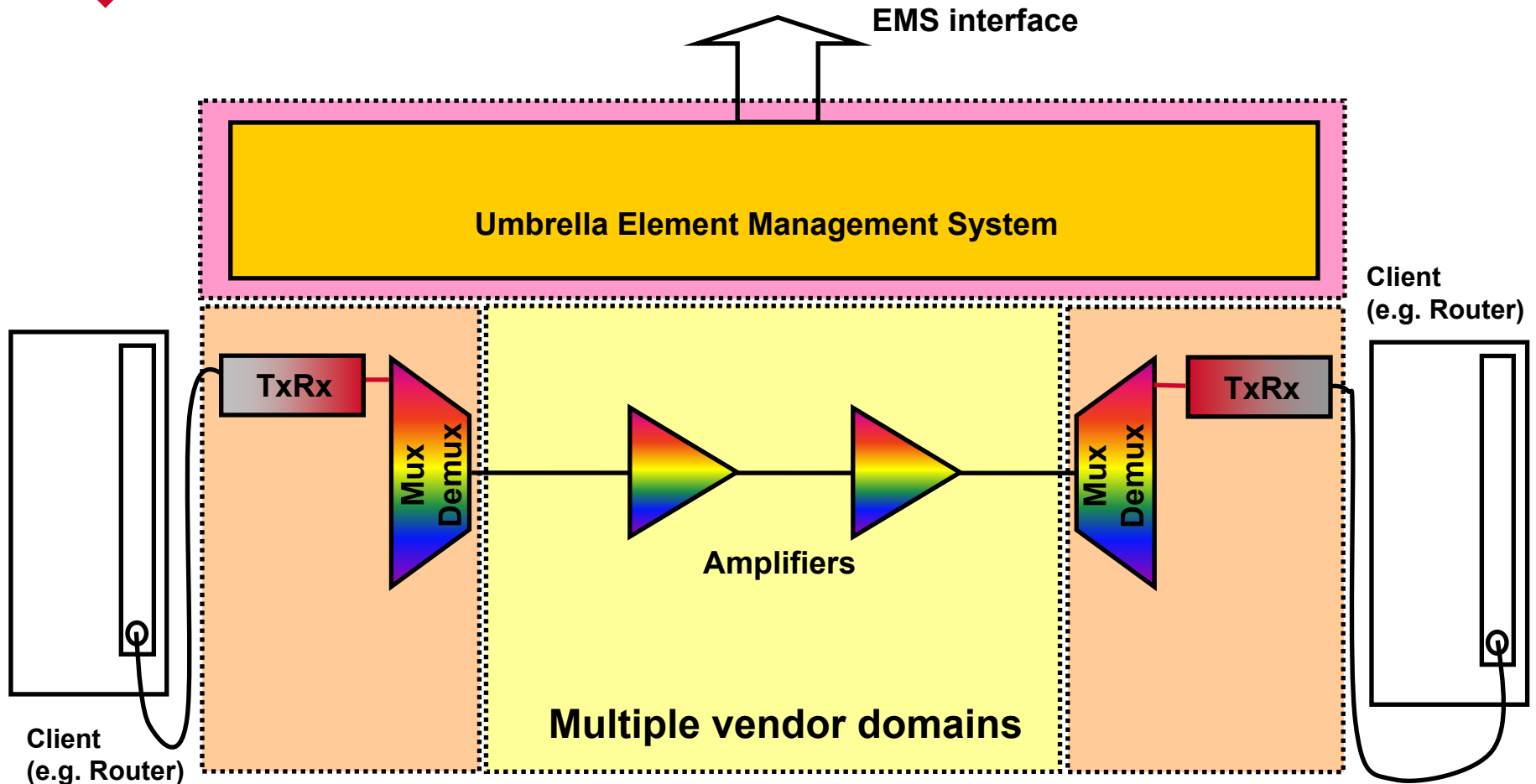


Open WDM system engineering



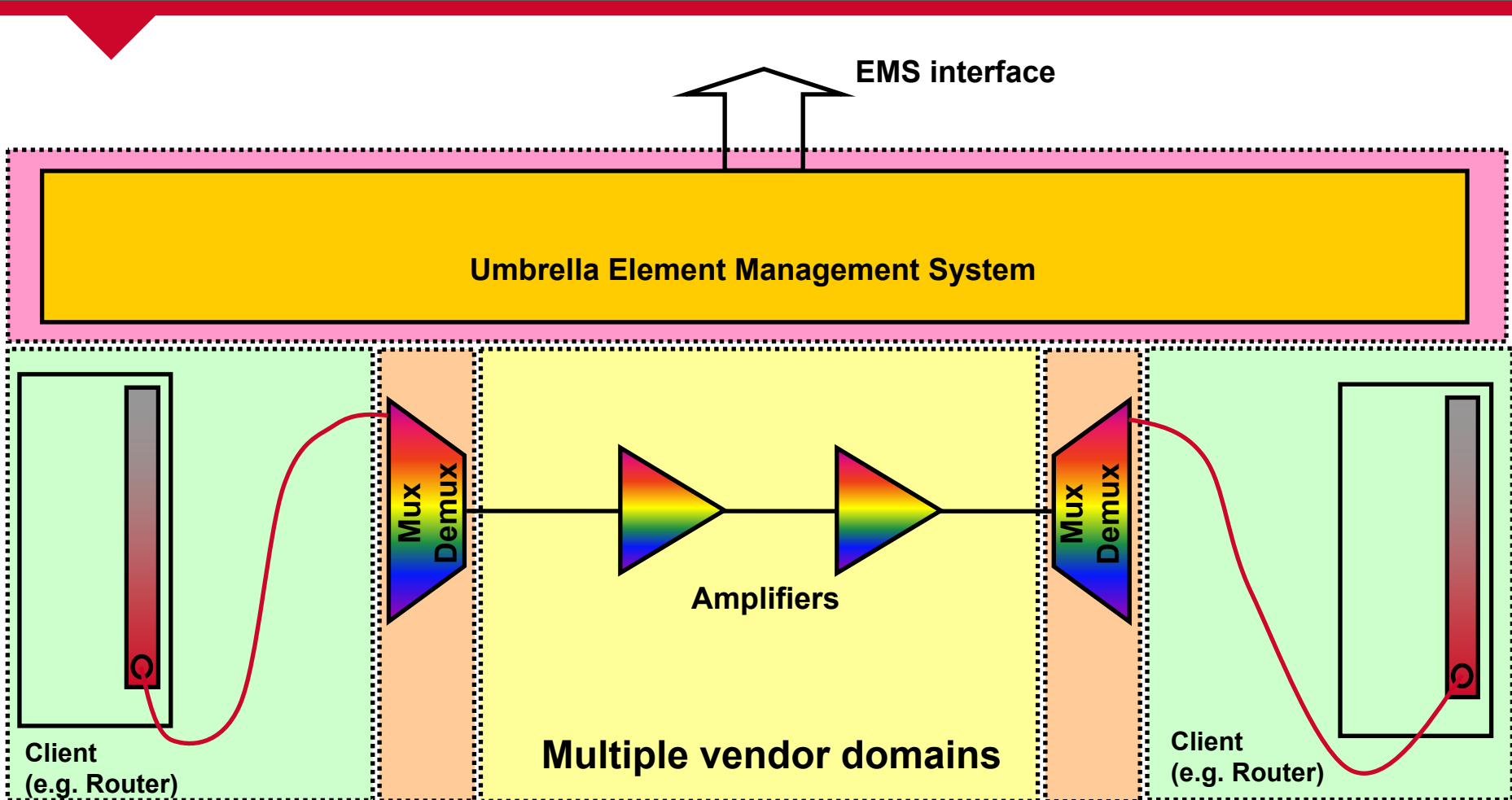
Example: Strategy pursued by 40G transponder vendors for upgrading existing links

Open WDM system engineering



Example: Strategy pursued by Optovia

Open WDM system engineering



Early examples in the SDH world
Next logical step in the IP/WDM world!?

How can an amplifier support Open WDM systems?

- Flexible link engineering
 - Compatibility with broad range of TxRx settings
 - Transparency to modulation formats (NRZ, RZ, xPSK, ...)
 - Compatibility with any kind of DCM
 - Easy to use link engineering tool
- Optical Supervisory Channel interworking
 - Compatibility with OSC of client system
- EMS integration
 - Integrability into 3rd party NMS
 - Integrability into EMS of client system (WDM, XC, ...)
 - Autonomous EMS

The road ahead

- The basic amplifier technology is available.
- Innovation will come from...
 - Integration of components (the « secret sauce »)
 - Standardization of ancillary functions
 - Open WDM systems
- ... and advances in enabling technologies
 - New fibre types
 - New modulation formats
 - « Super-Turbo » FEC chipsets



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Questions?