

GRUPPO TELECOM ITALIA

ECOC 2009

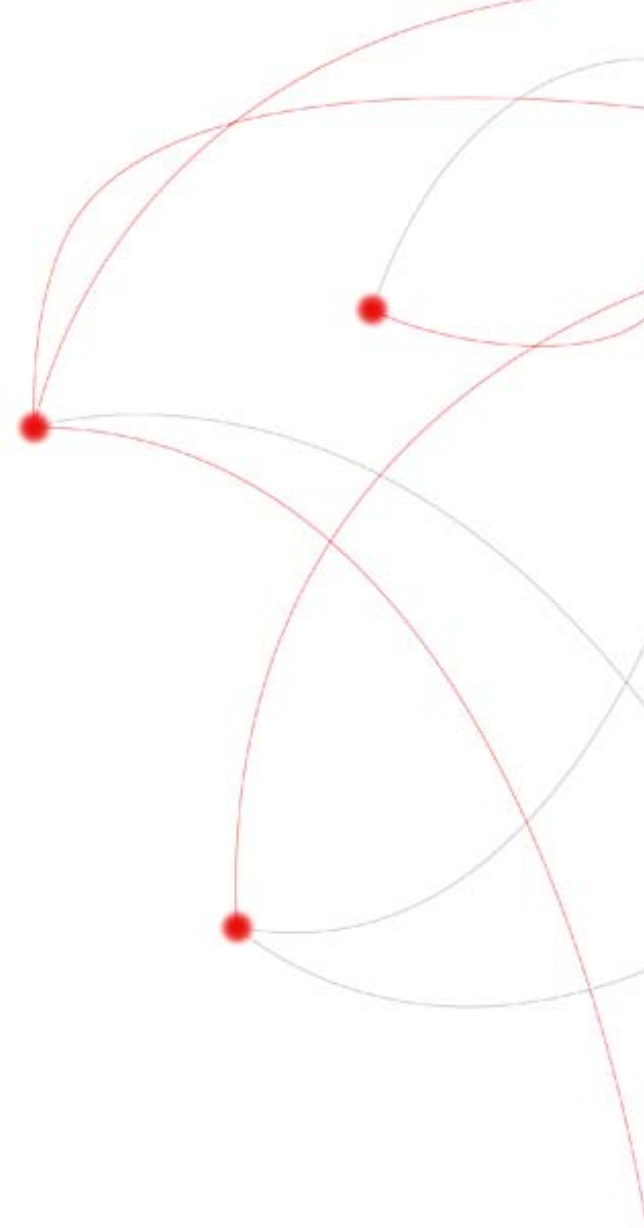
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Scalability issues of the new Photonic backbone of Telecom Italia

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Transport & OPB Engineering

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Summary

- ▶ **Network structure and dimensioning**
- ▶ **Network scalability**
- ▶ **Toward 100 G networking**

The Photonic Backbone structure



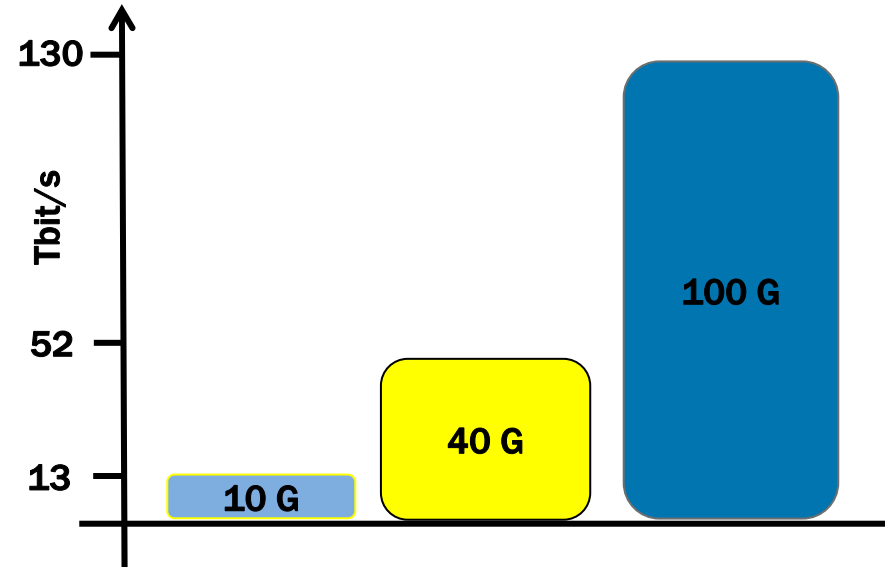
Tentative scheme of the new Backbone

- ▶ **Network diameter: 2400-3100 km (working-protection paths)**
- ▶ **Maximum number of hops: 11**
- ▶ **Nodal degree: 2÷5 (av. 3.1)**
- ▶ **Technology:**
 - ▶ **~40 λ switching nodes based on ROADMs**
 - ▶ **~60 ULH DWDM systems with 80 lambdas**
 - ▶ **G.655 and G.652 fibers**
 - ▶ **10 and 40 Gbit/s optical channels (OCh)**
 - ▶ **Ready for 100 G transmission**

Network scalability raw estimation

Total network capacity: 1300 OCh

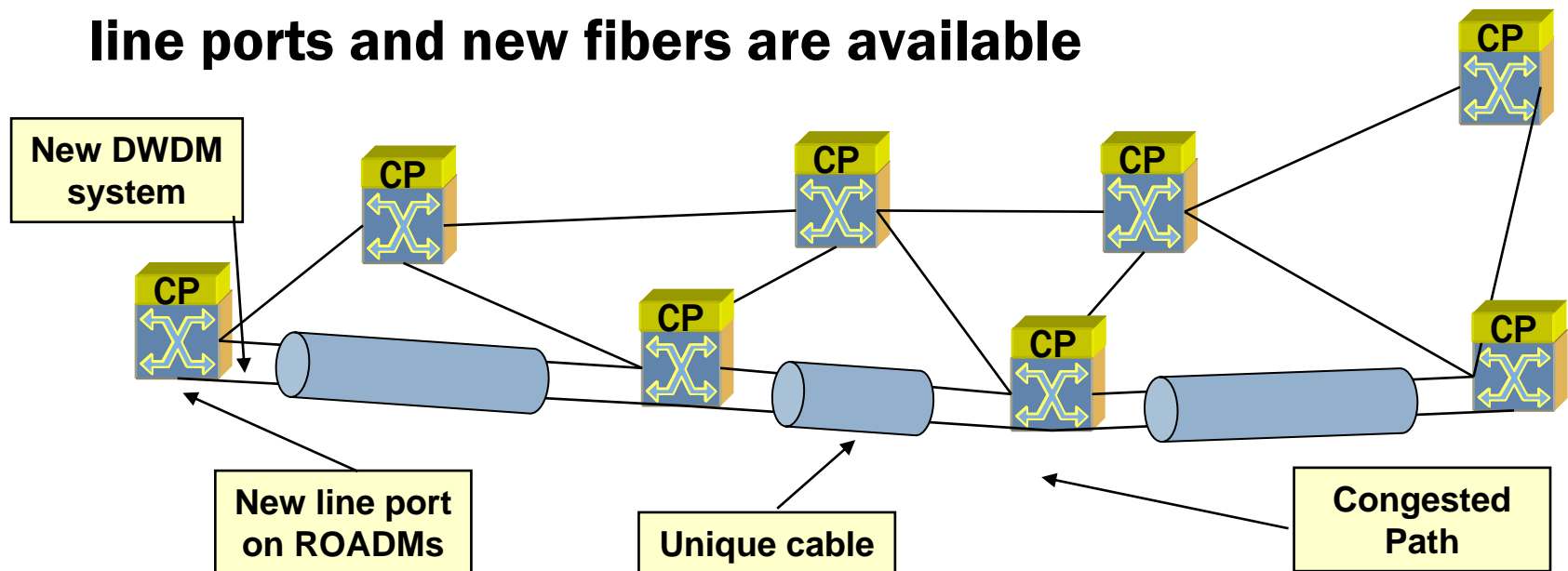
- ▶ **OCh network capacity: ~ 1300 OCh**
(estimation based on present traffic pattern)
- ▶ **Bandwidth capacity ranges from 13 to 130 Tbit/s** depending on OCh bit rates



- ▶ **2011 network utilization (542 OCh, 6 Tbit/s):**
 - ▶ ~ **30% OCh exploitation**
 - ▶ ~ **11% bandwidth exploitation** (referred to fully 40G network)

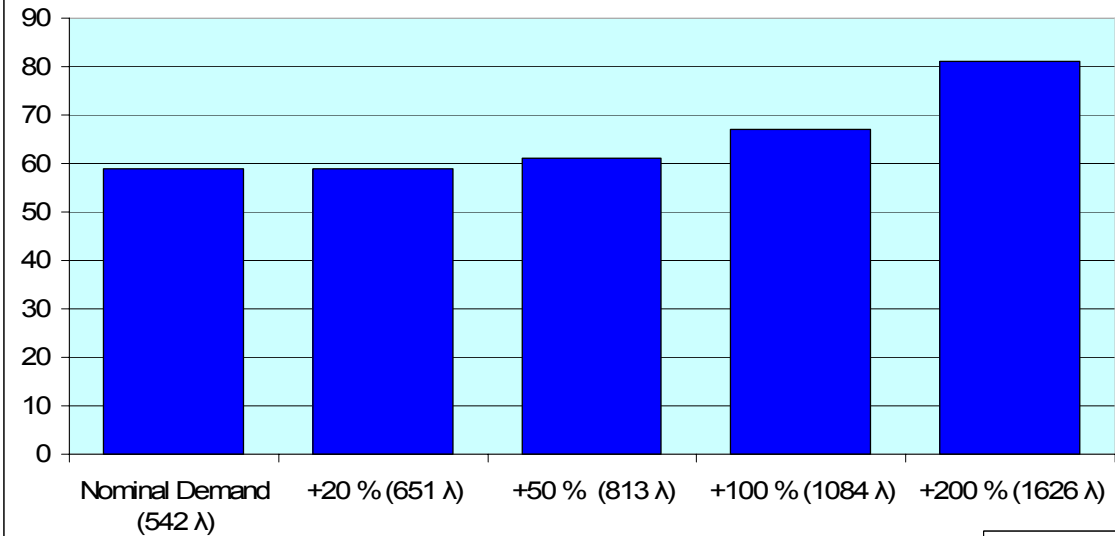
Network scalability analysis

- ▶ Increasing OCh number may be limited by fully loaded DWDM links
- ▶ Adding new DWDM systems “in parallel” is the easiest way to upgrade the network, provided that new ROADM line ports and new fibers are available

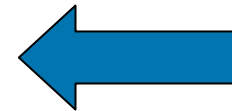


DWDM systems and node degree as a function of increasing traffic

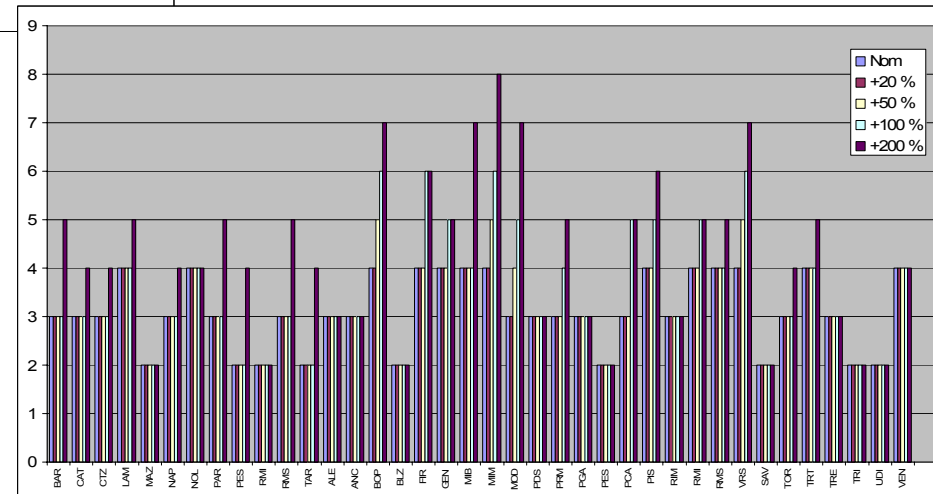
Number of Systems (80 Lambda @40G)



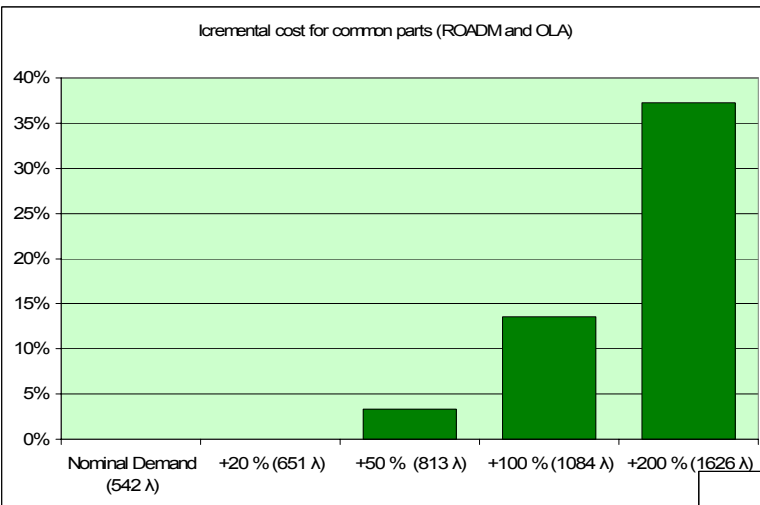
Number of DWDM systems



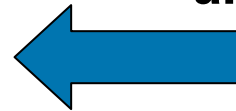
ROADM degree



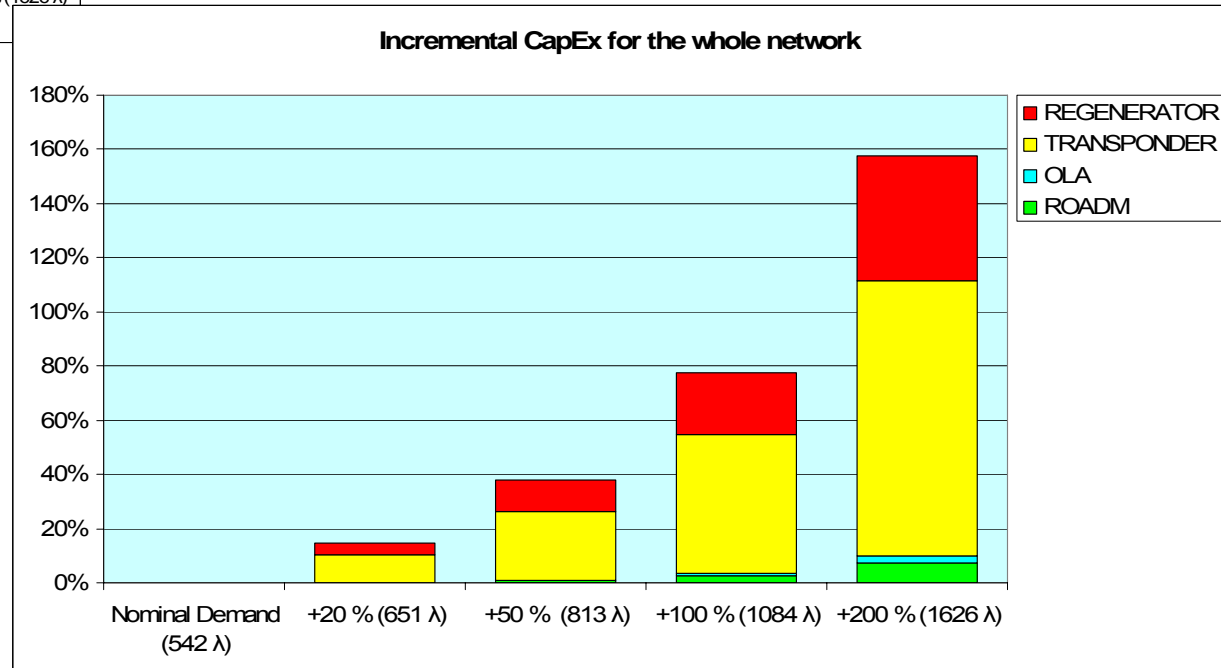
CAPEX evaluation for traffic increasing



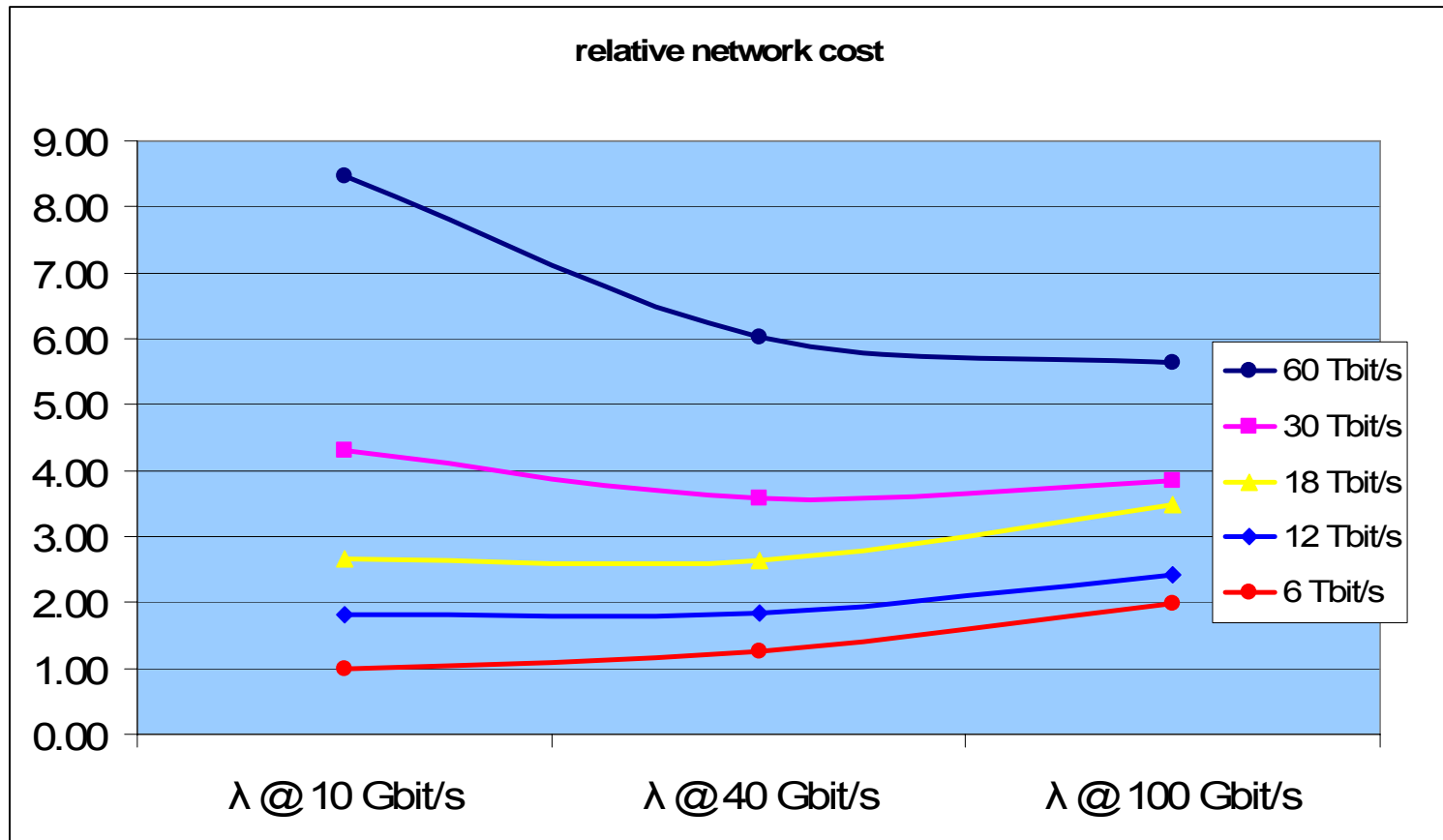
**CAPEX increment for ROADM
and amplifiers**



**Whole network
CAPEX growth**

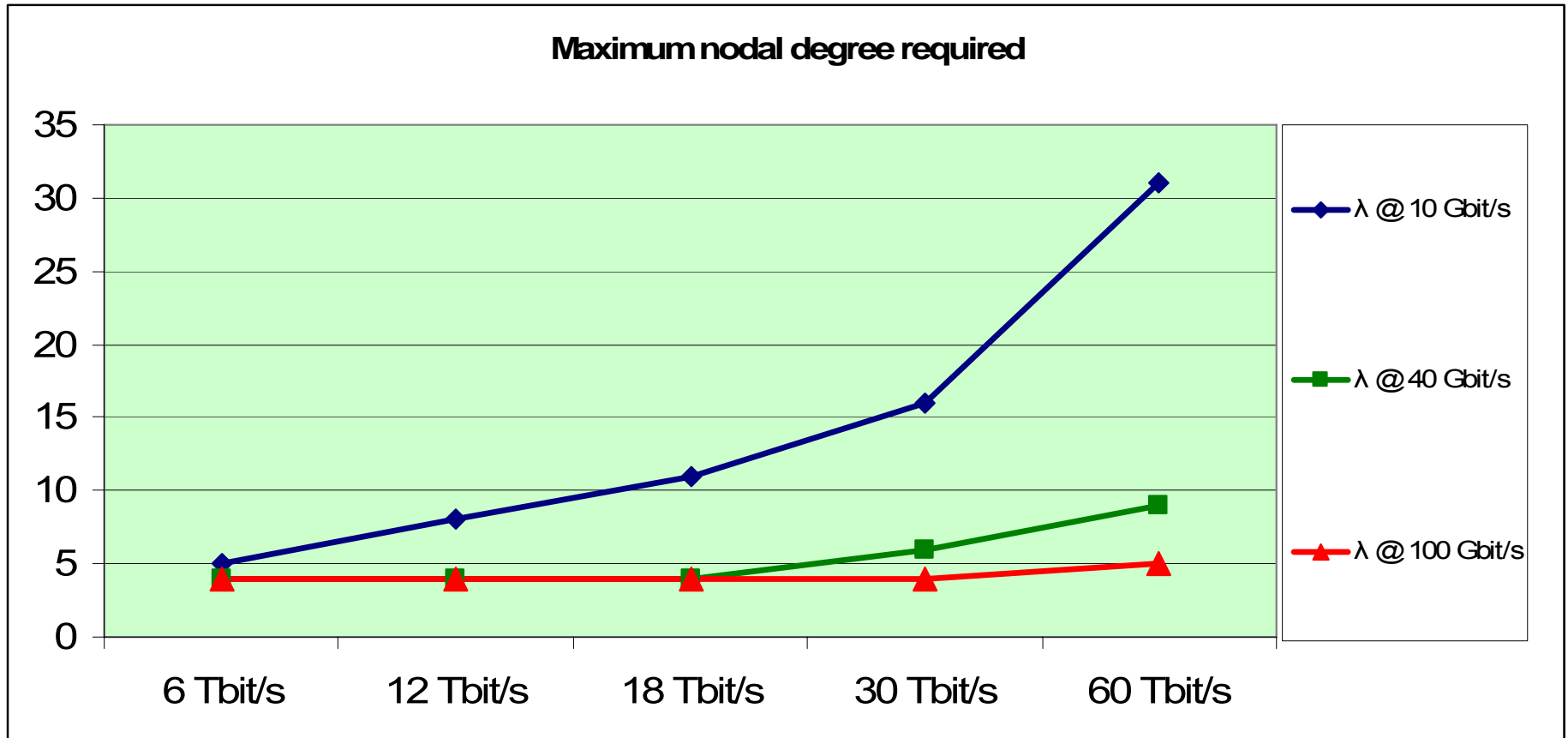


When 100 G will become economically viable?



Assumptions on transponders cost ratio: $40\text{G}/10\text{G}=2.5$, $100\text{G}/40\text{G}=2$

When 100 G will become mandatory?



Energy savings and other operational benefits

- ▶ **Compared to transport on point-to-point DWDM systems, energy savings range between 20 and 30%**
- ▶ **Energy saving is mainly due to the regenerator number reduction, while ROADMs power consumption is very low**
- ▶ **Other important benefits are:**
 - ▶ **Remarkable spare parts reduction (due to fewer regenerators);**
 - ▶ **~40% circuit creation cost reduction;**
 - ▶ **Opportunity of relocating the circuits of legacy networks on the new backbone simplifying the transport in the backbone**

Conclusions

- ▶ **The new photonic backbone provides flexibility and bandwidth that seem sufficient at least for the next 10 years**
- ▶ **Energy savings are remarkable if compared to point-to-point DWDM, but they are small compared to other network segments consumption**
- ▶ **λ switching functions in the optical layer will be very beneficial for network operation as well**
- ▶ **We gratefully acknowledge the fundamental contribution of several colleagues: Sergio Augusto, Maurizio Bartoli, Valentina Brizi, Carlo Cavazzoni, Andrea Di Giglio, Giuseppe Ferraris, Marco Quagliotti, Alberto Rossaro**