

Overview of Optical Layer Technology

Presented to FCC Engineering
Department

March 12, 1999

Presenters

- Mr. David Charlton
 - Manger, Commercial Development
- Dr. Richard Wagner
 - Director

Outline

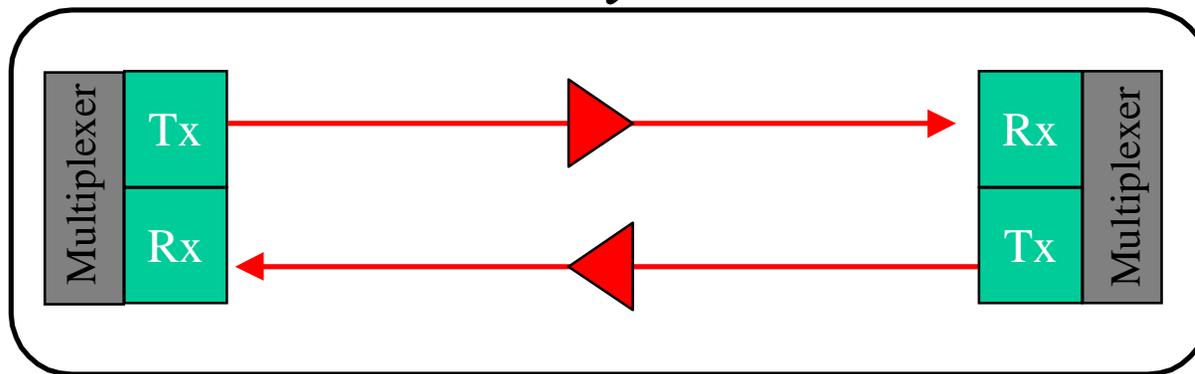
- What is the optical layer?
- Fundamental technologies of the optical layer
- Use of technologies in networks
- Road map for adoption

Optical Layer

- What is it?
- Be able to...
 - Define a “transport system”
 - Define an “optical layer system”

What is a “system?”

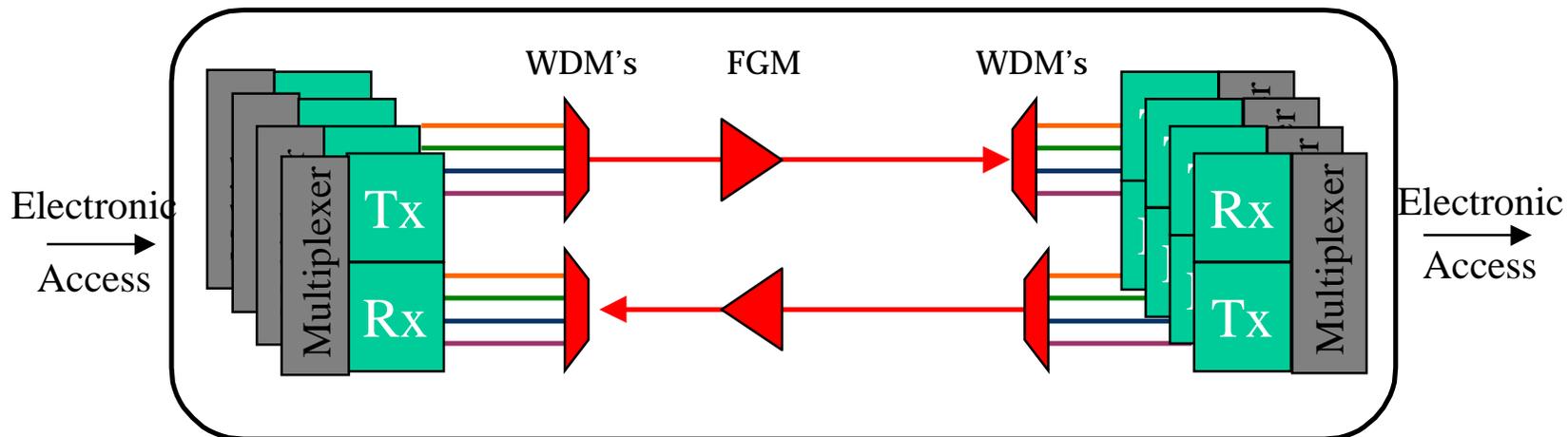
- Traditional transport system design includes terminals, amplifiers and other network elements all designed to work together
- *but as a “closed” system to other vendors*



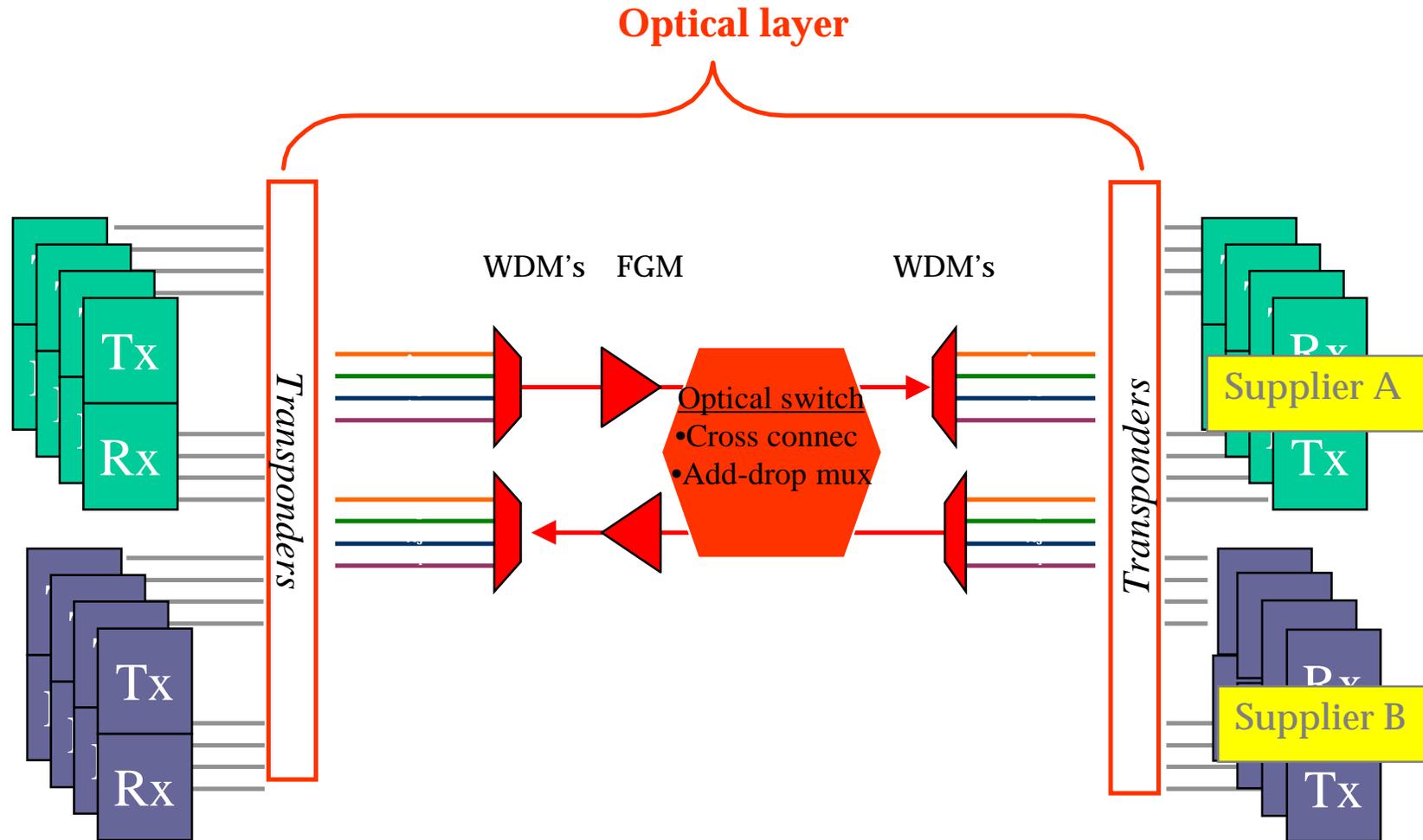
How do traditional systems OEMs use DWDM?

Dense Wavelength Division Multiplexing

- Note that the system is still “closed”

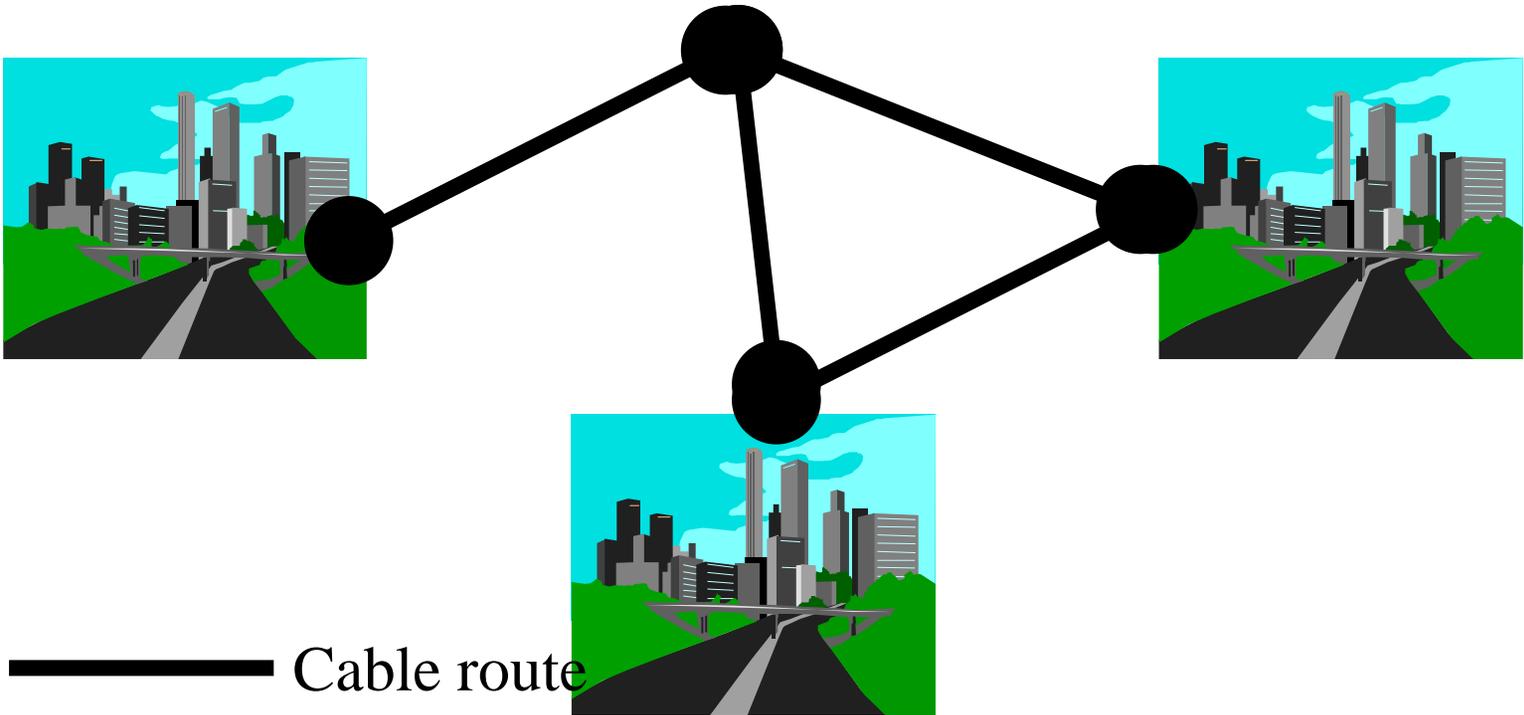
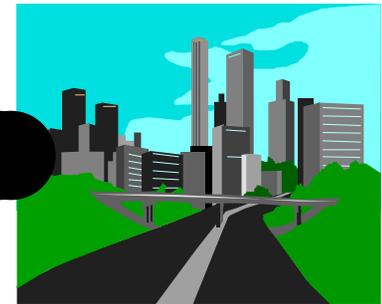


The “optical layer” of 2000



Using the Optical Layer...

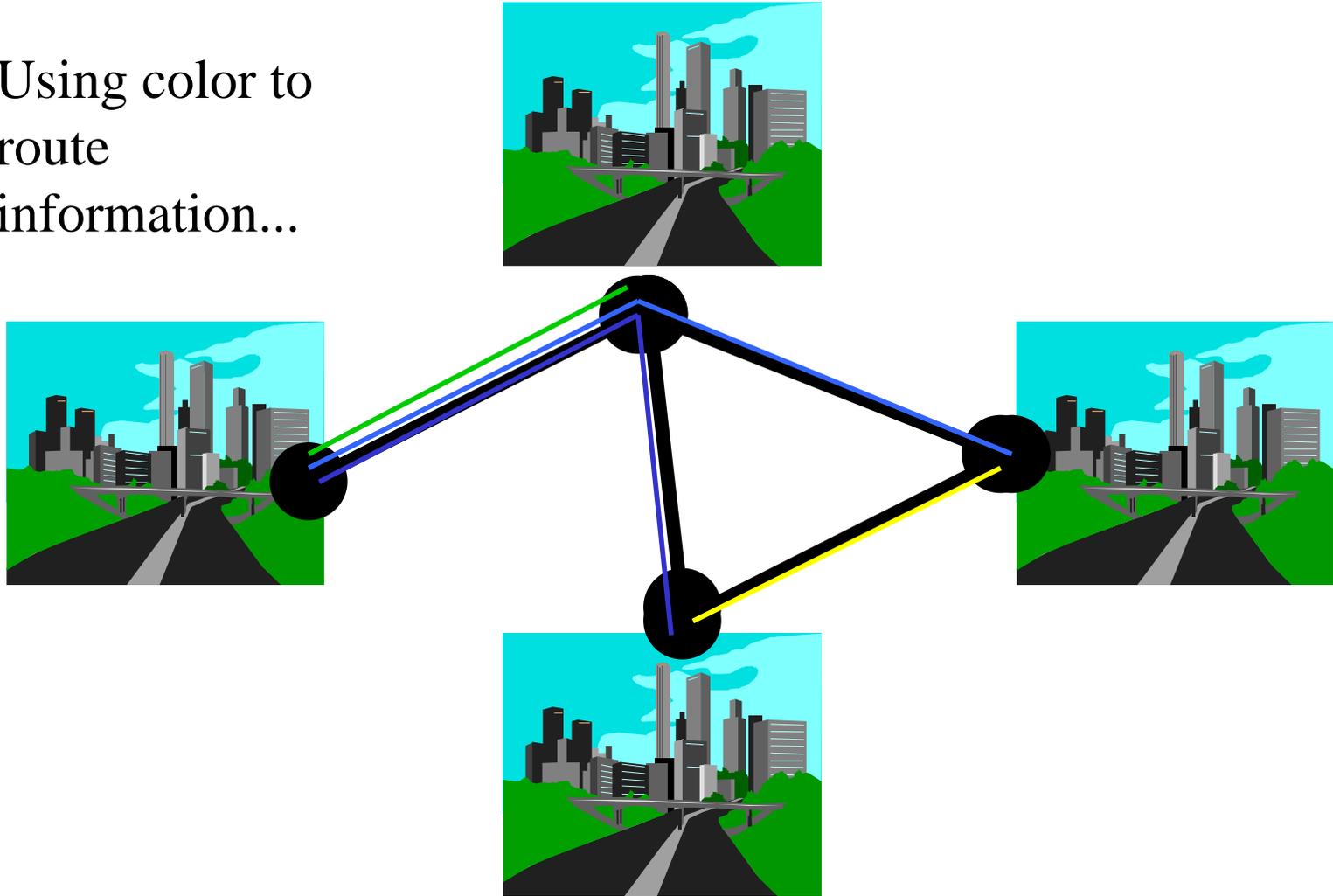
Cable connects
locations...



— Cable route

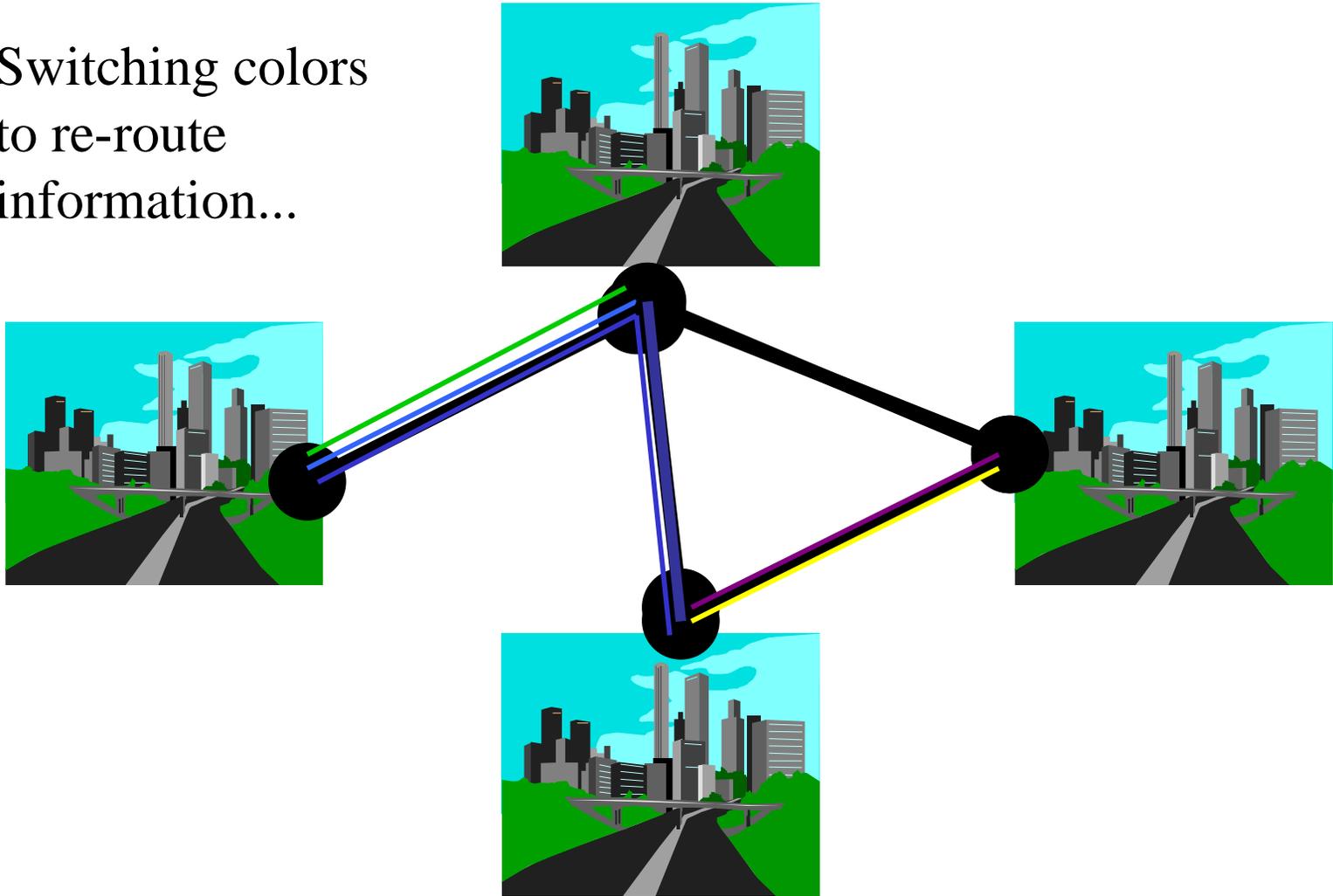
Providing channels

Using color to
route
information...

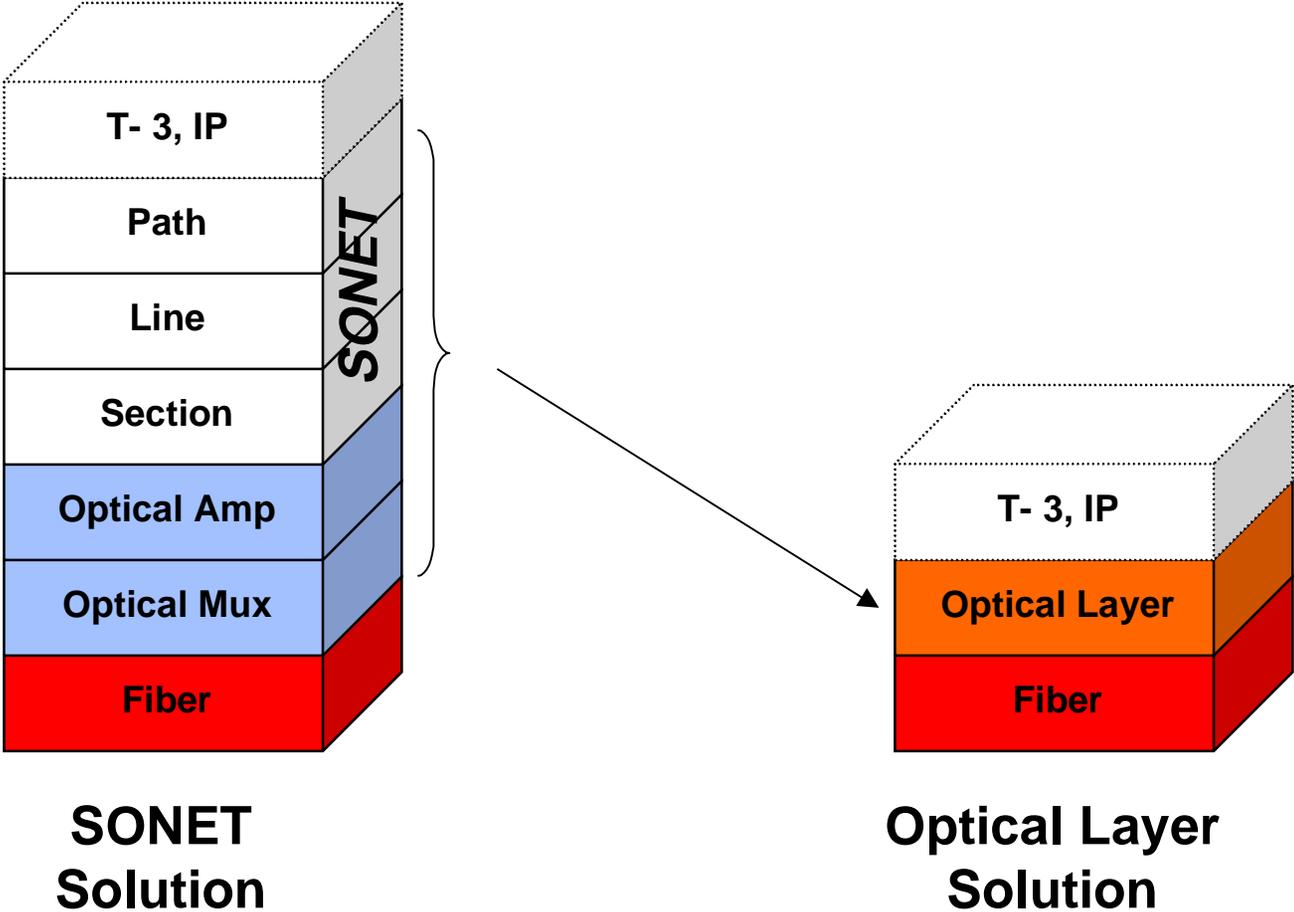


Responding-changing conditions

Switching colors
to re-route
information...



What are network layers?

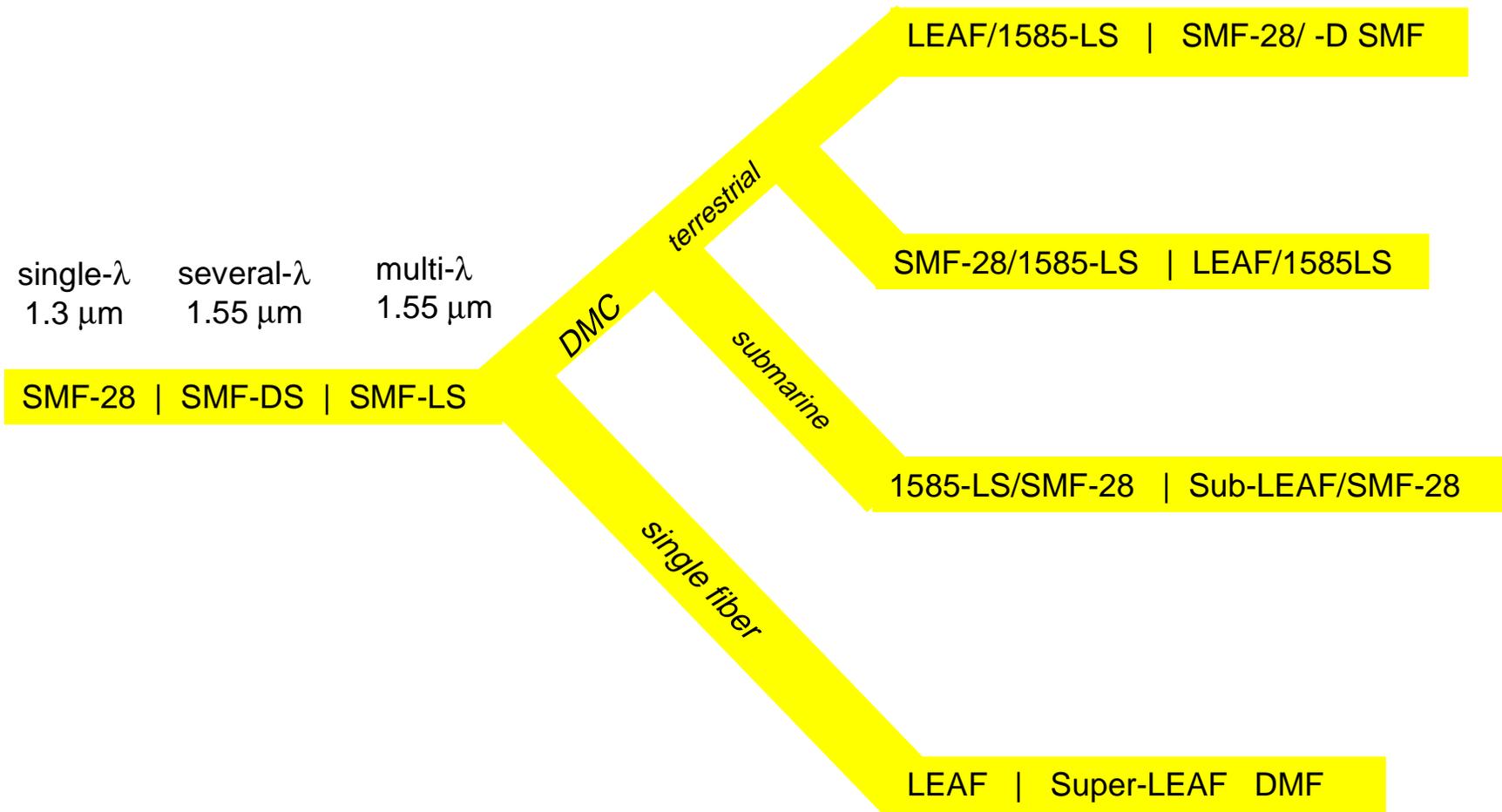


Fundamental Technologies of the Optical Layer

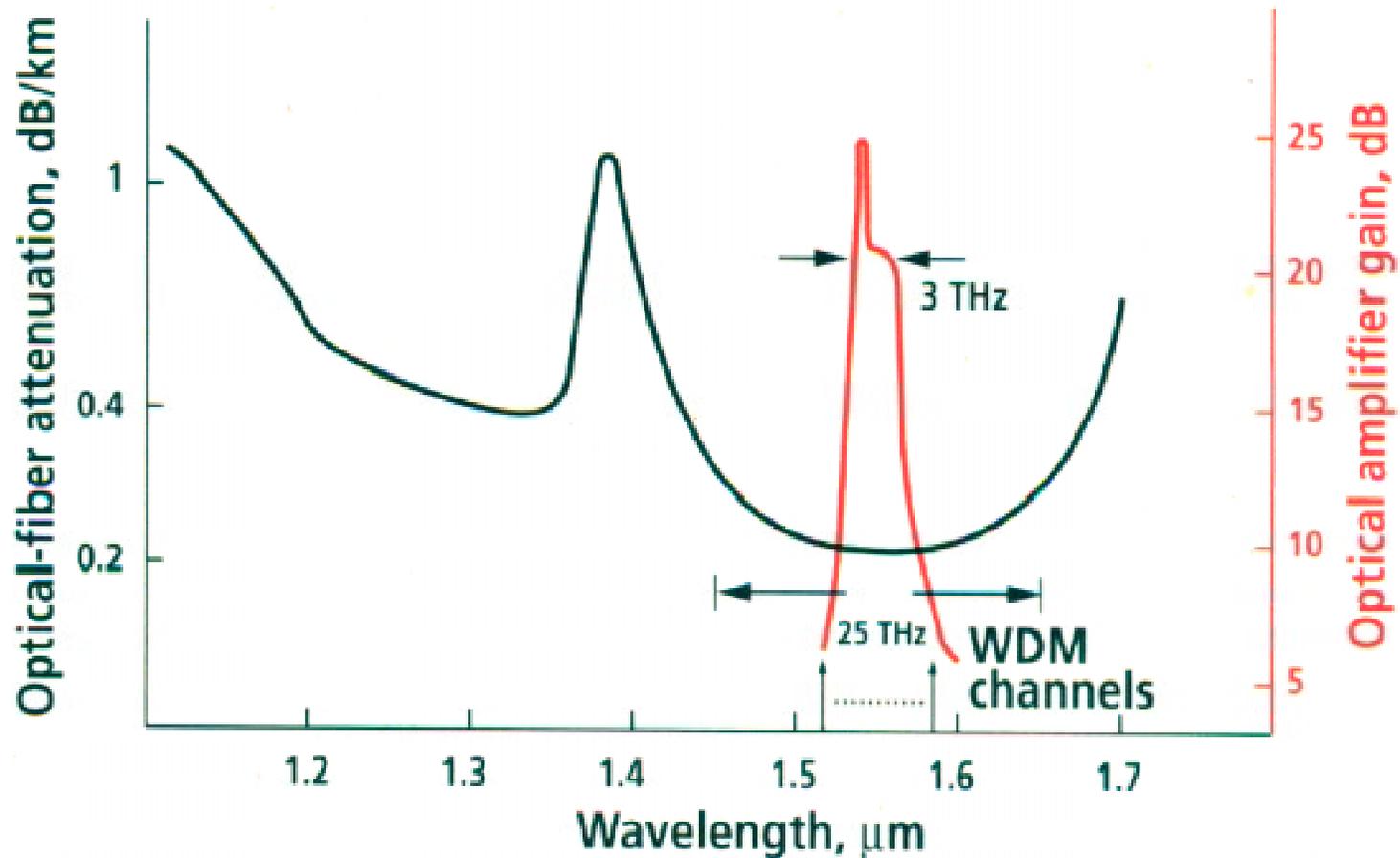
What is the Future of Photonics?

- Fibers
- Amplification
- Switching

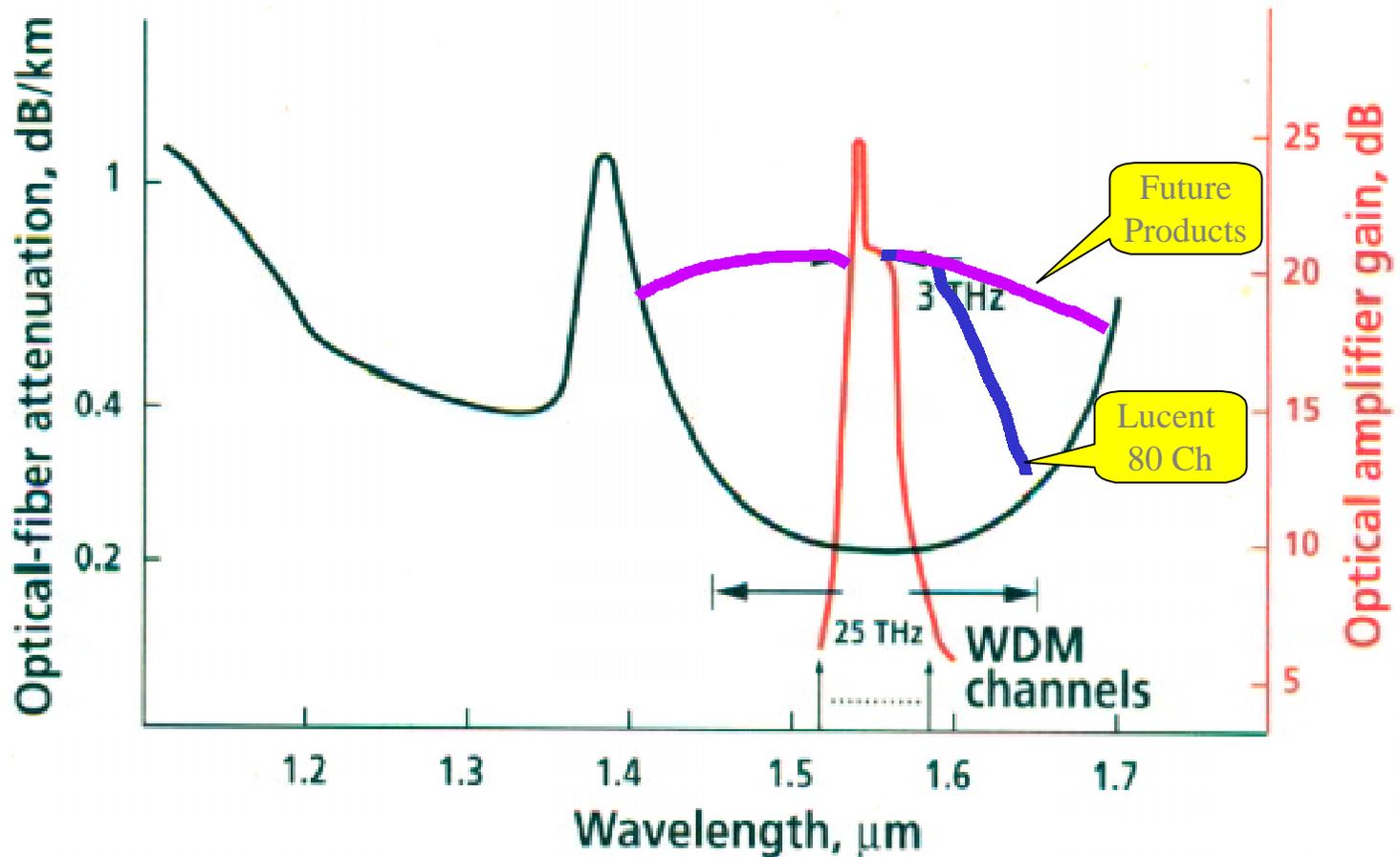
High Data Rate Fiber Evolution



Amplifiers Today



Future Amplifiers



Switching occurs all over the network

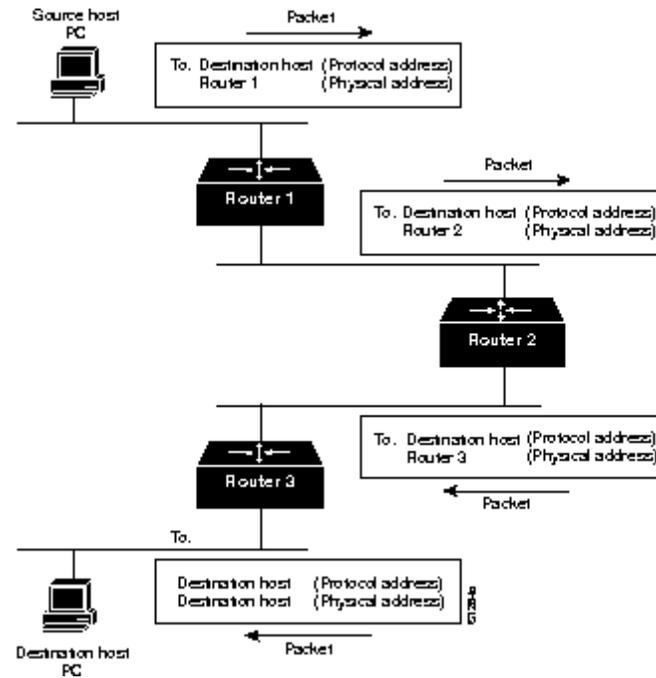
- Packet
- Circuit
- Cross connect
 - Electrical
 - Optical
- Service efficiency
- Service provision
- Capacity management

Circuit Switching



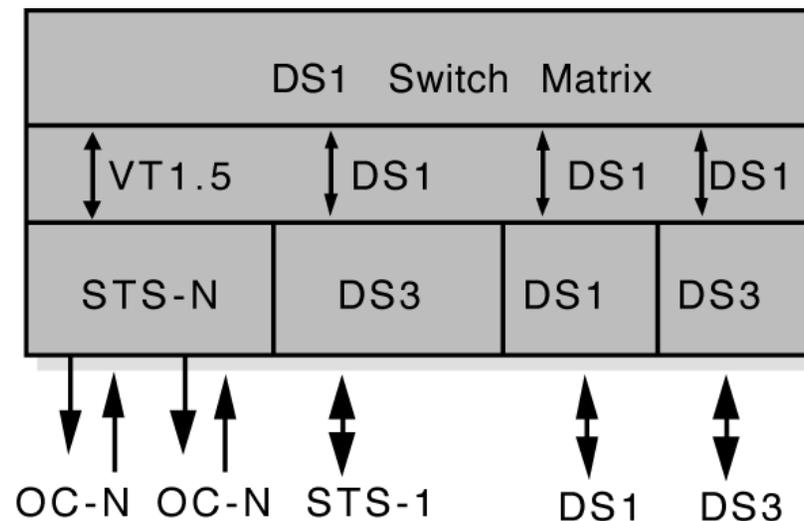
Packet Switching

To reach network.	Send to.
27	Node A
57	Node B
17	Node C
24	Node A
52	Node A
16	Node B
26	Node A

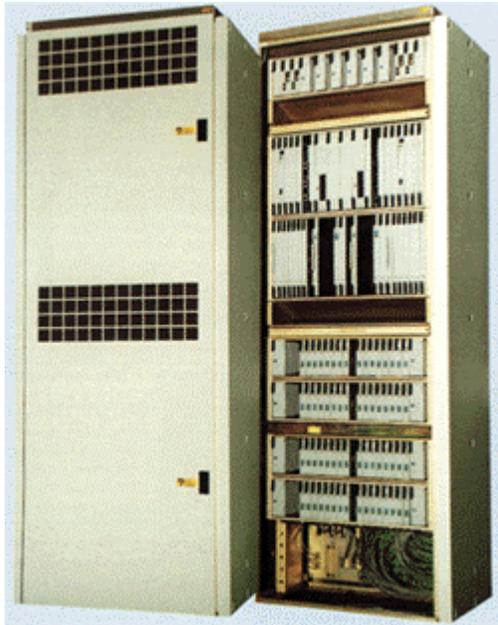


What do Crossconnects do?

- Consolidation and integration of services
- Protocol conversion
- Network management
- Interconnection of different suppliers equipment



Cross connects



Alcatel 1644

256 STM-1



Tellabs 532e

512 DS-1

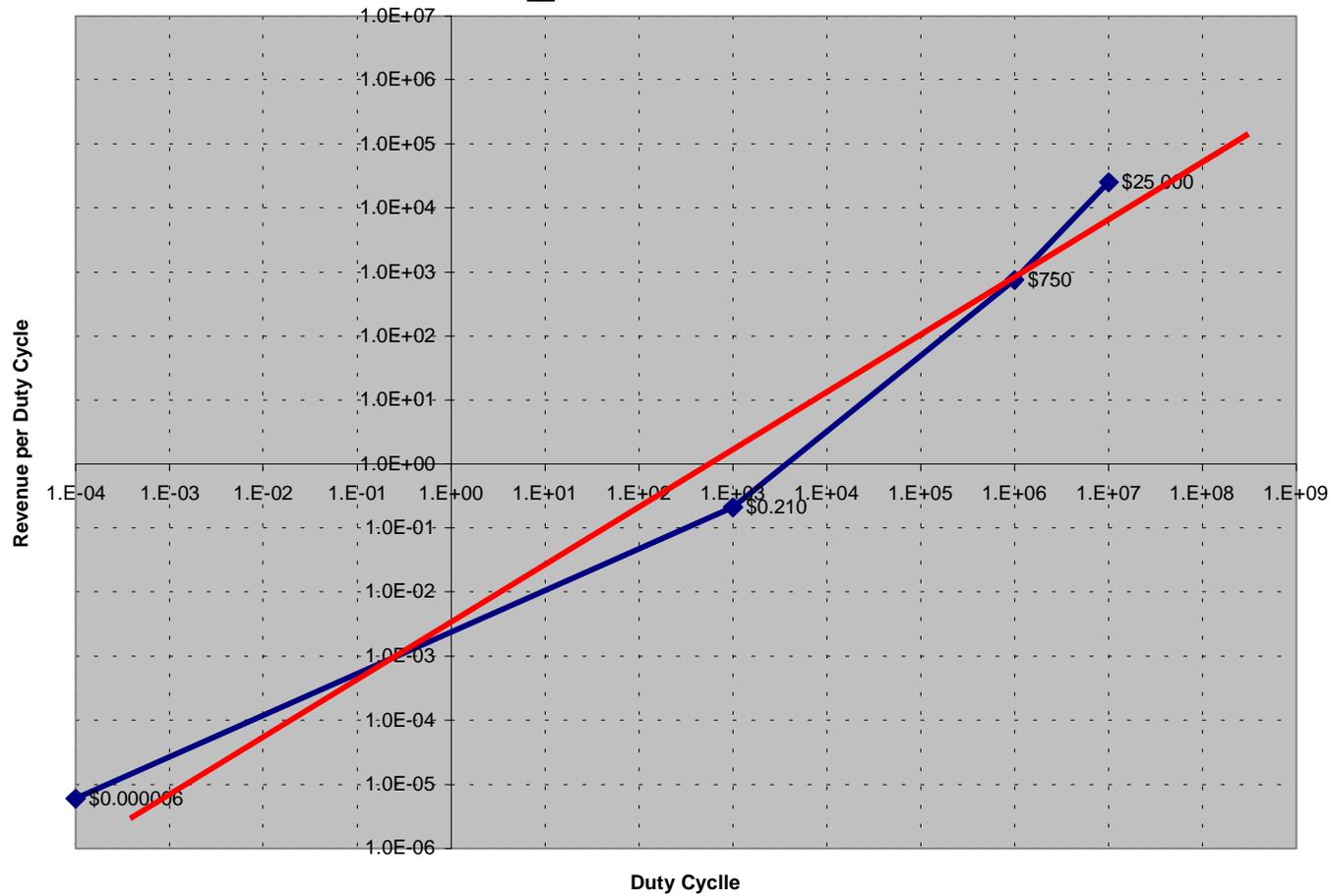
Switching attributes

- Bandwidth processed
(how much is switched)
- Duty cycle
(how often switching occurs)
- Revenue per duty cycle
(how much revenue generated)
- Investment per cross point
(how much does the equipment cost)

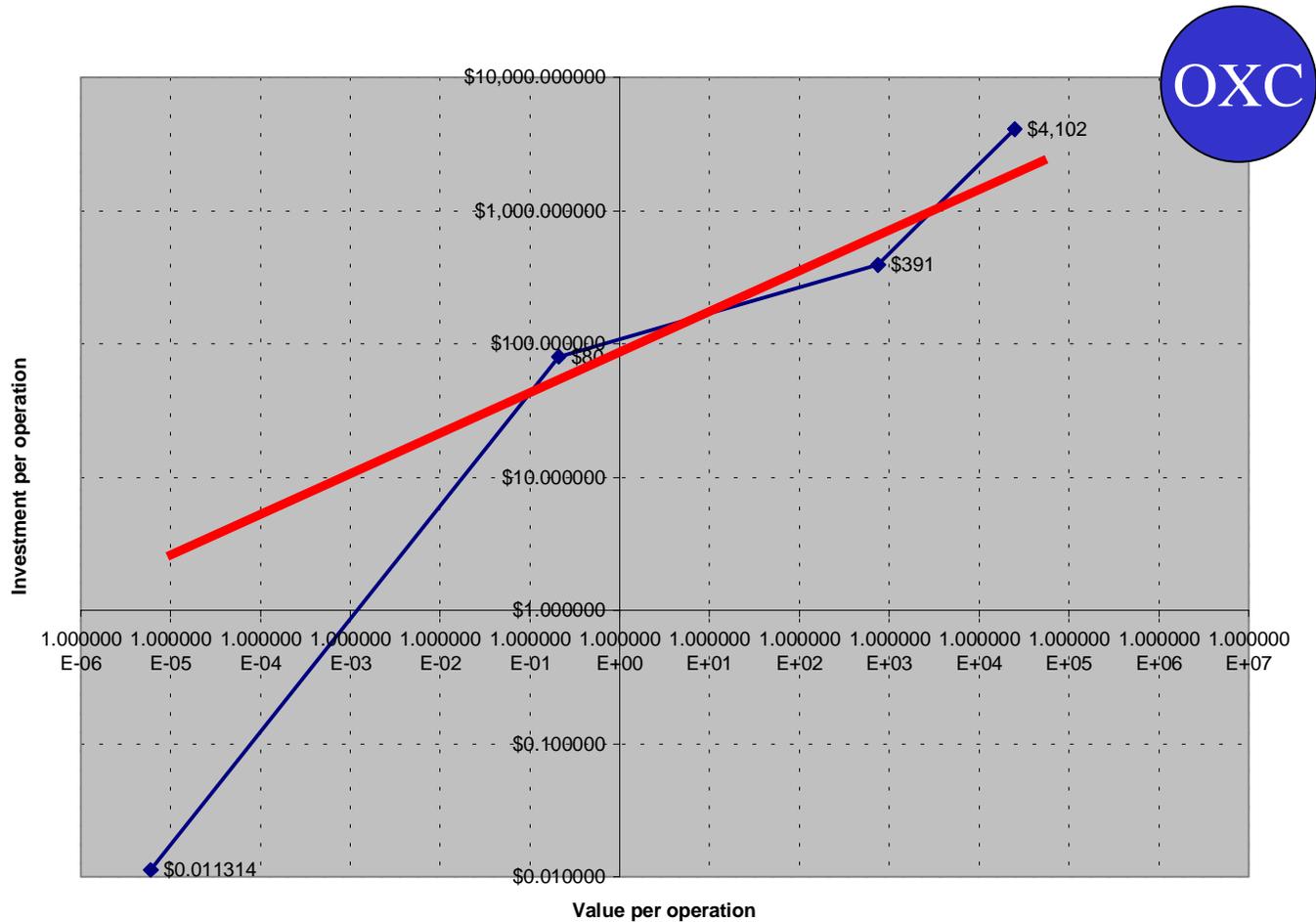
What are the attributes?

	<u>Router</u>	<u>Switch</u>	<u>Crossconnect</u>
Bandwidth switched	kbytes	kilobits	Megabits
Duty cycle	μ sec	minutes	weeks
Revenue	μ \$	\$0.30	\$000's
Investment per function	\$0.0001	\$100's	\$000's

Duty Cycle Vs. Revenue per operation



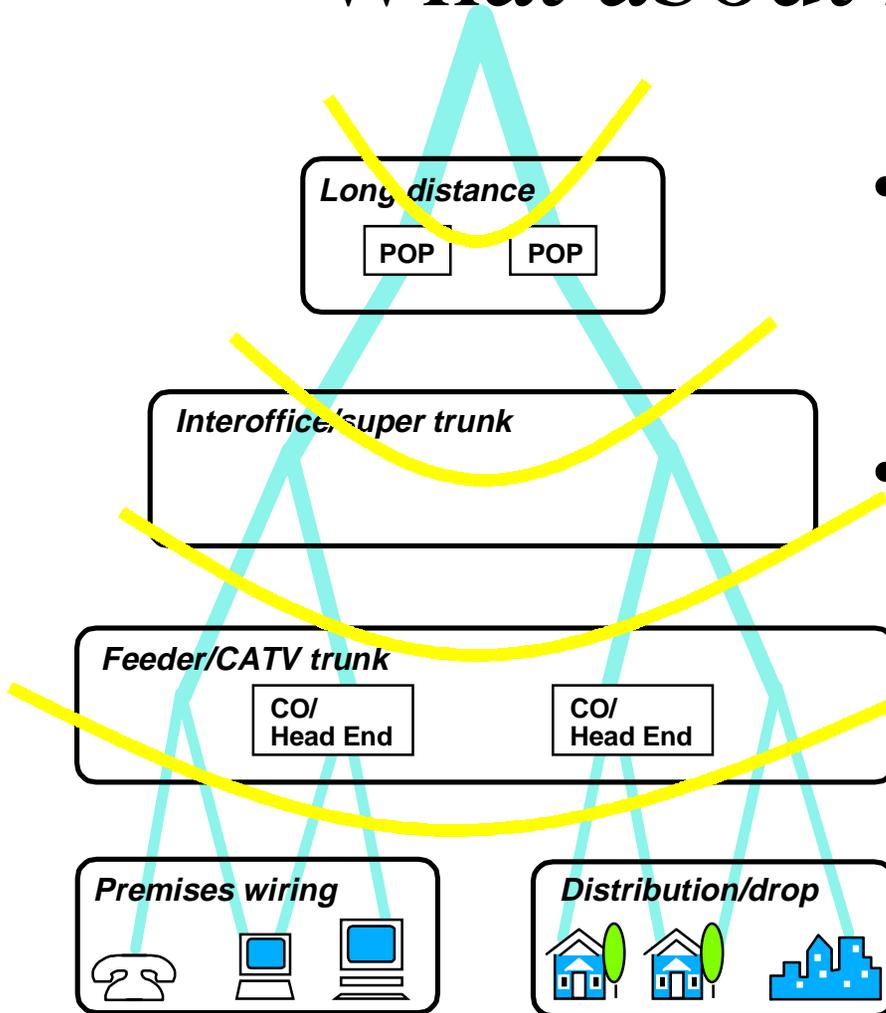
Value of operation Vs. Investment for operation



Message so far...

- Application space for optical switching exists
- Same space could be met with electrical capability
- Cost advantage would tip the balance toward optics

What about networks?



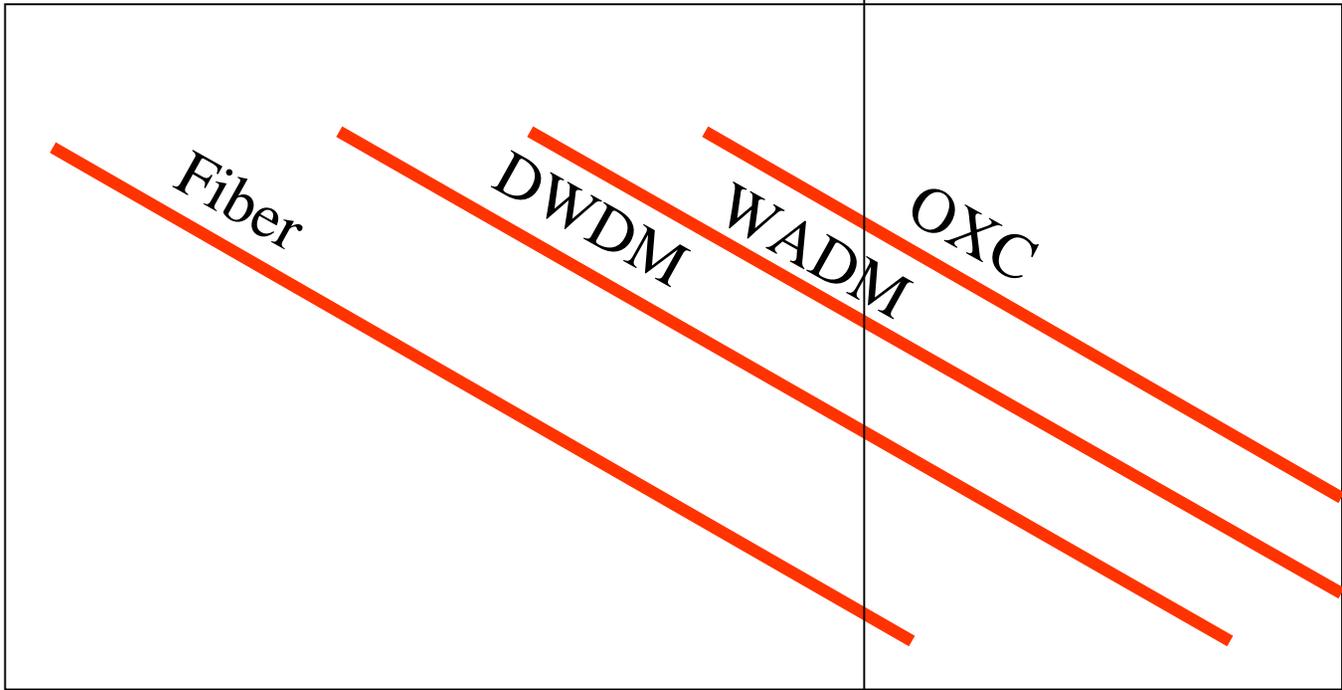
- Photonic technology diffuses from the top to the bottom
- Small changes in demand at the bottom make big requirements at the top

Photonics Diffusion over Time

Homes per node

Many

Few



1980

Today

2000

Conclusion

- Optical Layer
 - will be adopted by carriers
 - Lowers cost
 - Provide more capability
 - penetration of the network will depend on economics