
# High end routing platform using optical interconnects

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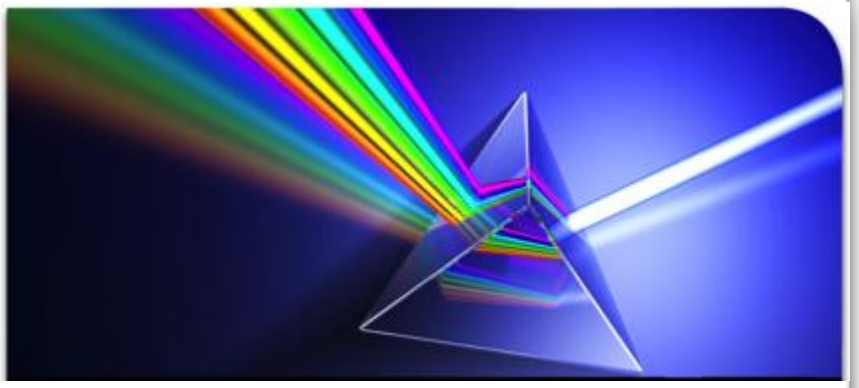
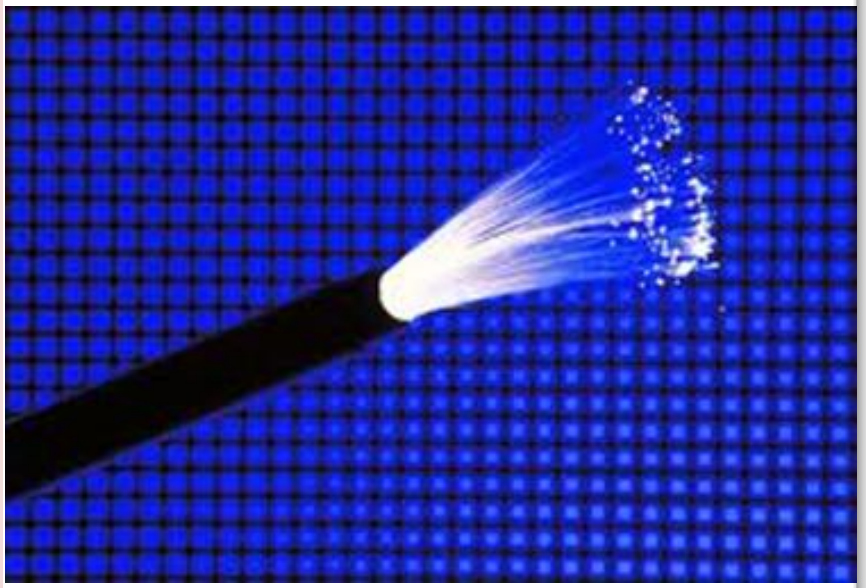
July 2013

# Outline

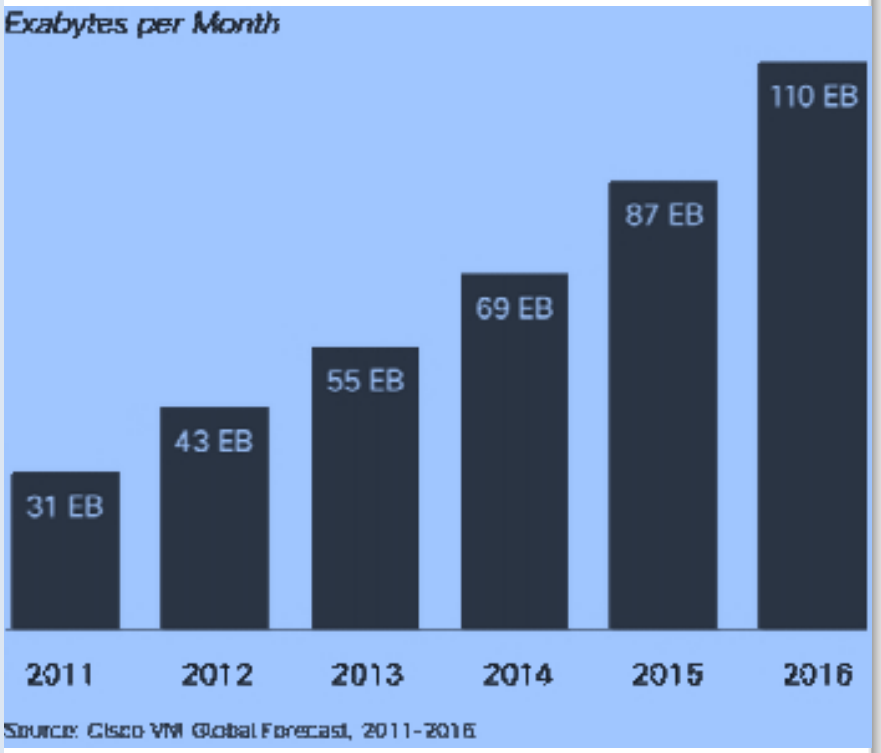
- Introduction
- The router bottleneck problem
- The solution - photonics
- The compass solution using optical interconnects





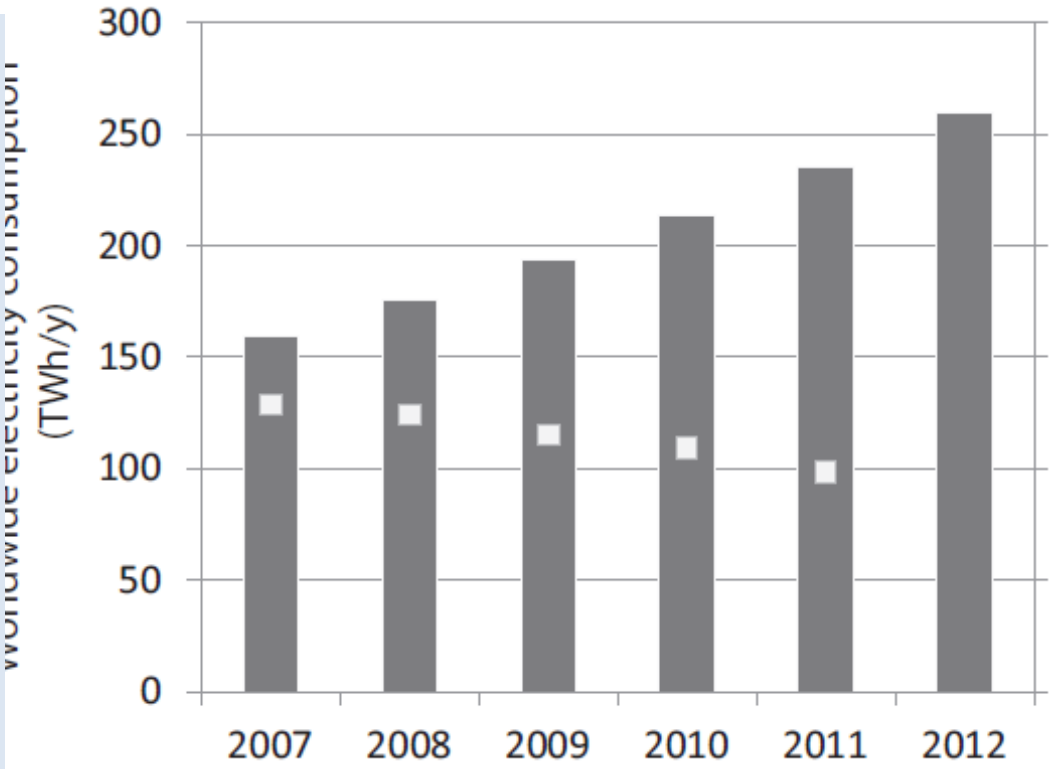
# The exploding demand for BW

- With the penetration of FTTx, Mobility and Video, the **demand** for BW continues to **accelerate**.
- Yet today's network infra-structure has already **maxed out** in terms of **size, BW, power, high cost and weight**.
- Current vendors offer no solution that will allow to scale forward.
- An order of magnitude improvement is required



# The price to pay 1: Power

- The total electricity consumption of routers will exceed 350TW/h/y in 2013
- This amounts to about 2% of the total electrical power in the world!
- However, the growth rate of ICT is ~40% annually!
- Core routers are responsible for most of the power consumption in ICT




**Worldwide electricity consumption in telecom operator networks** *(S. Lambert et. al., Optic Express Vol. 20 2012)*

# The price to pay 2: Size & Weight

- **Weight:** 740 kg 275 kg
- **H×W×D:** 2.1×0.6×1 m 0.44×0.95×0.78 m

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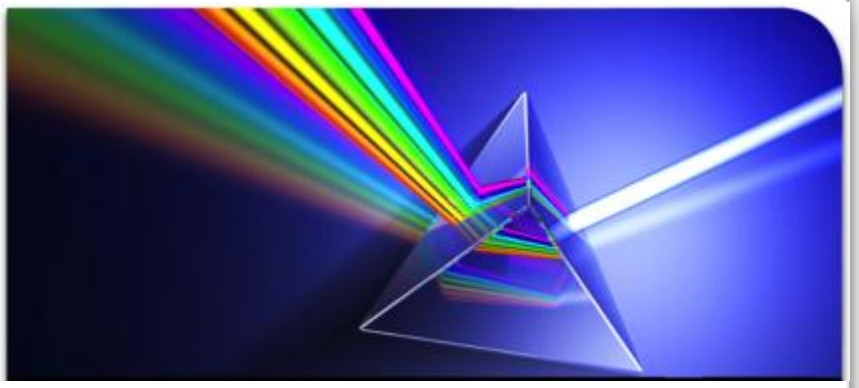
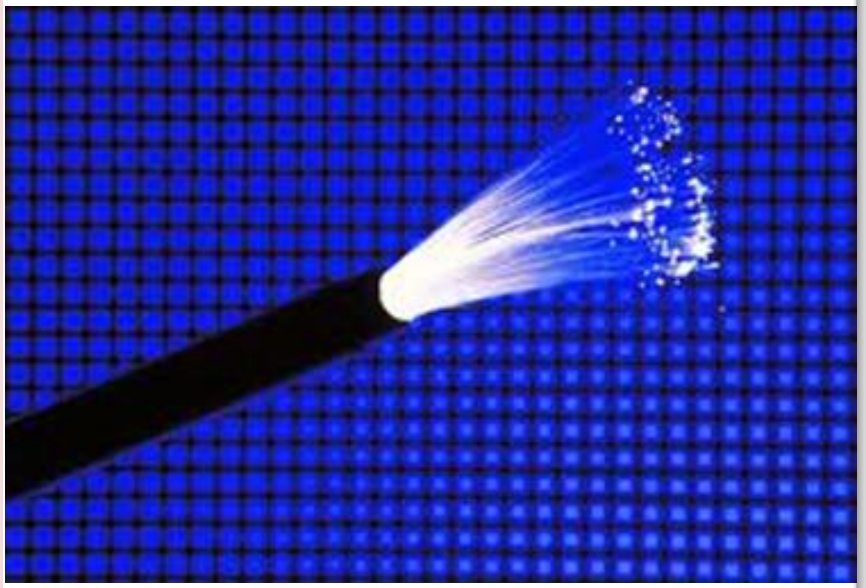
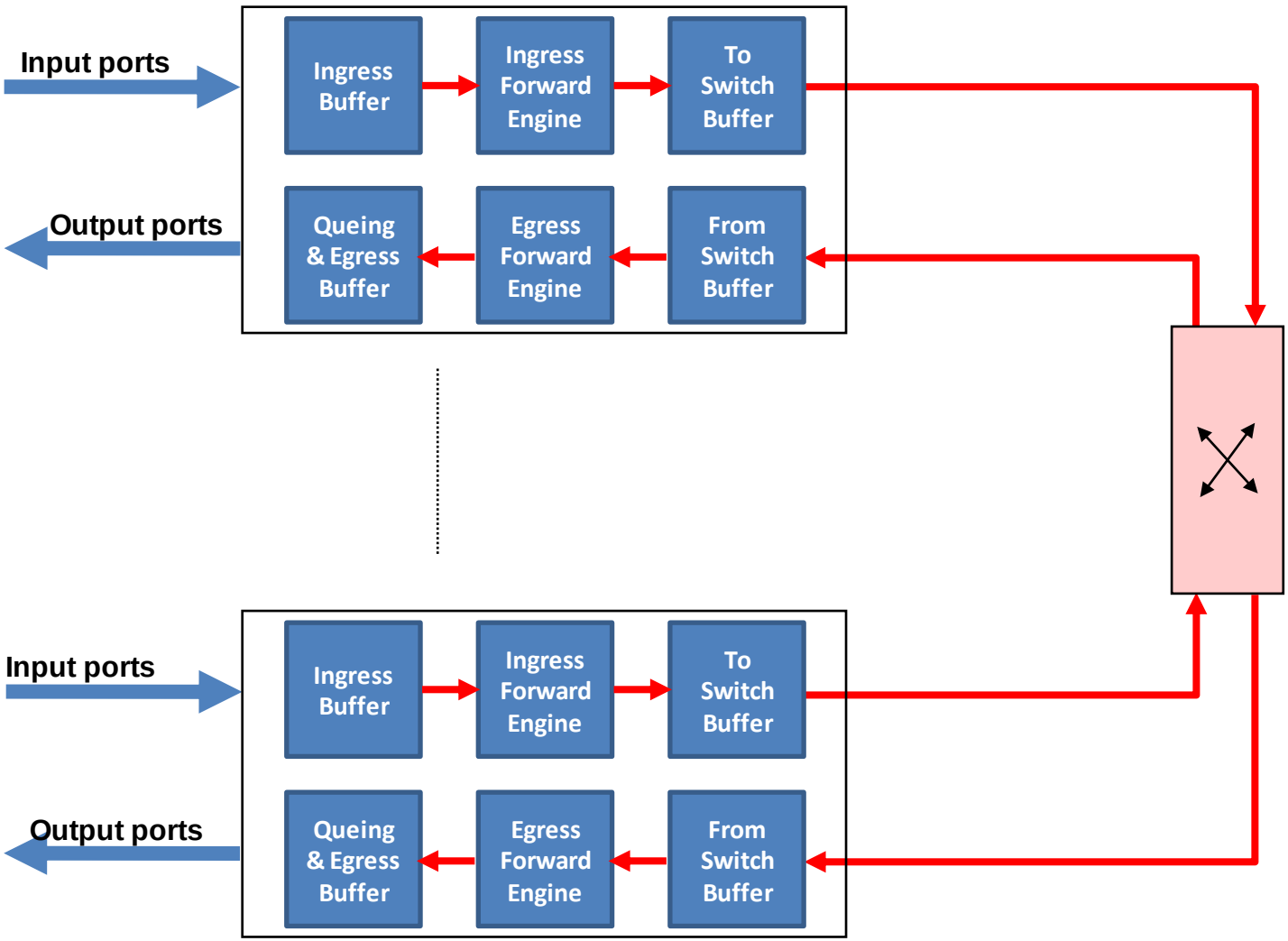
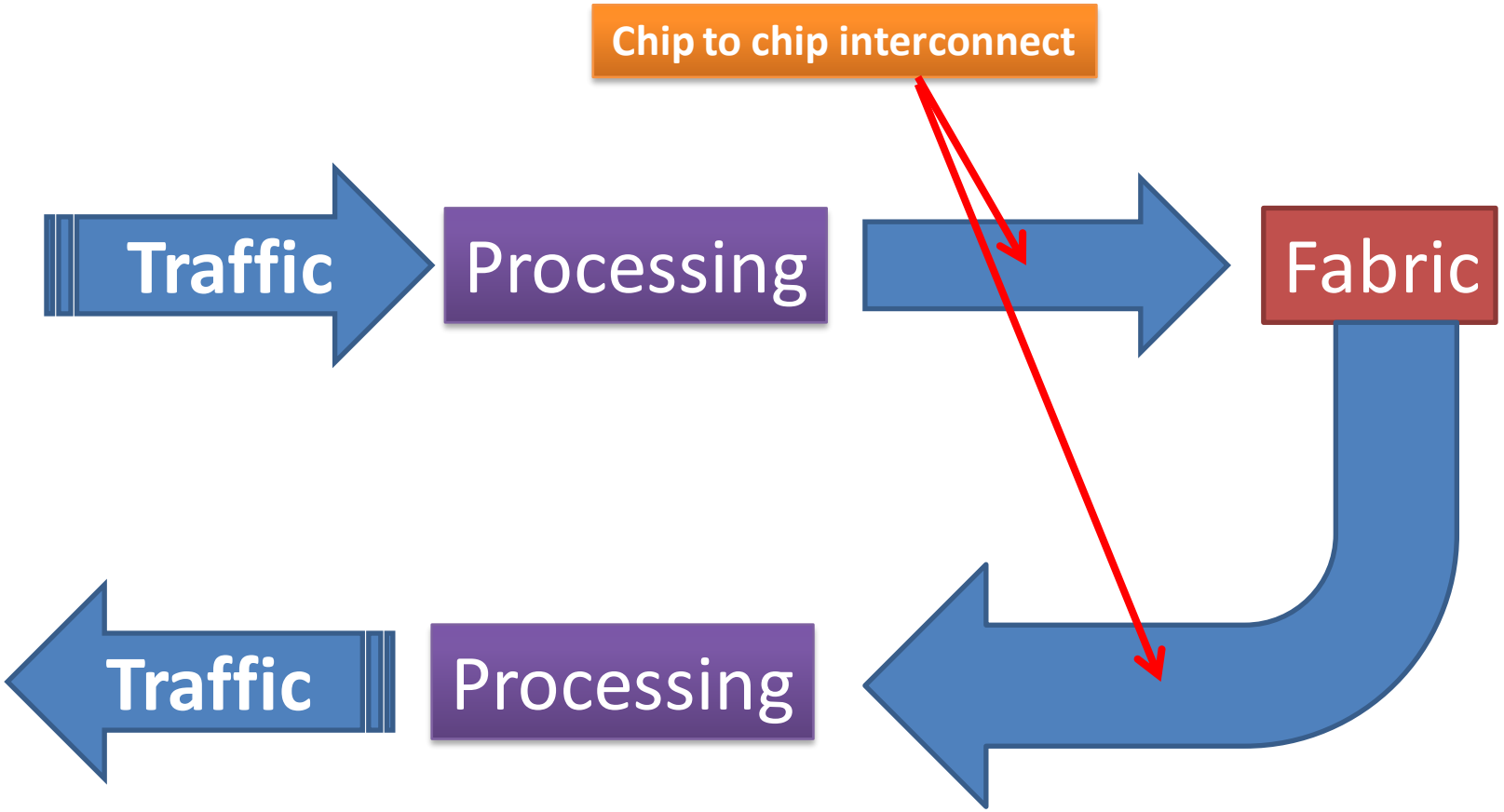


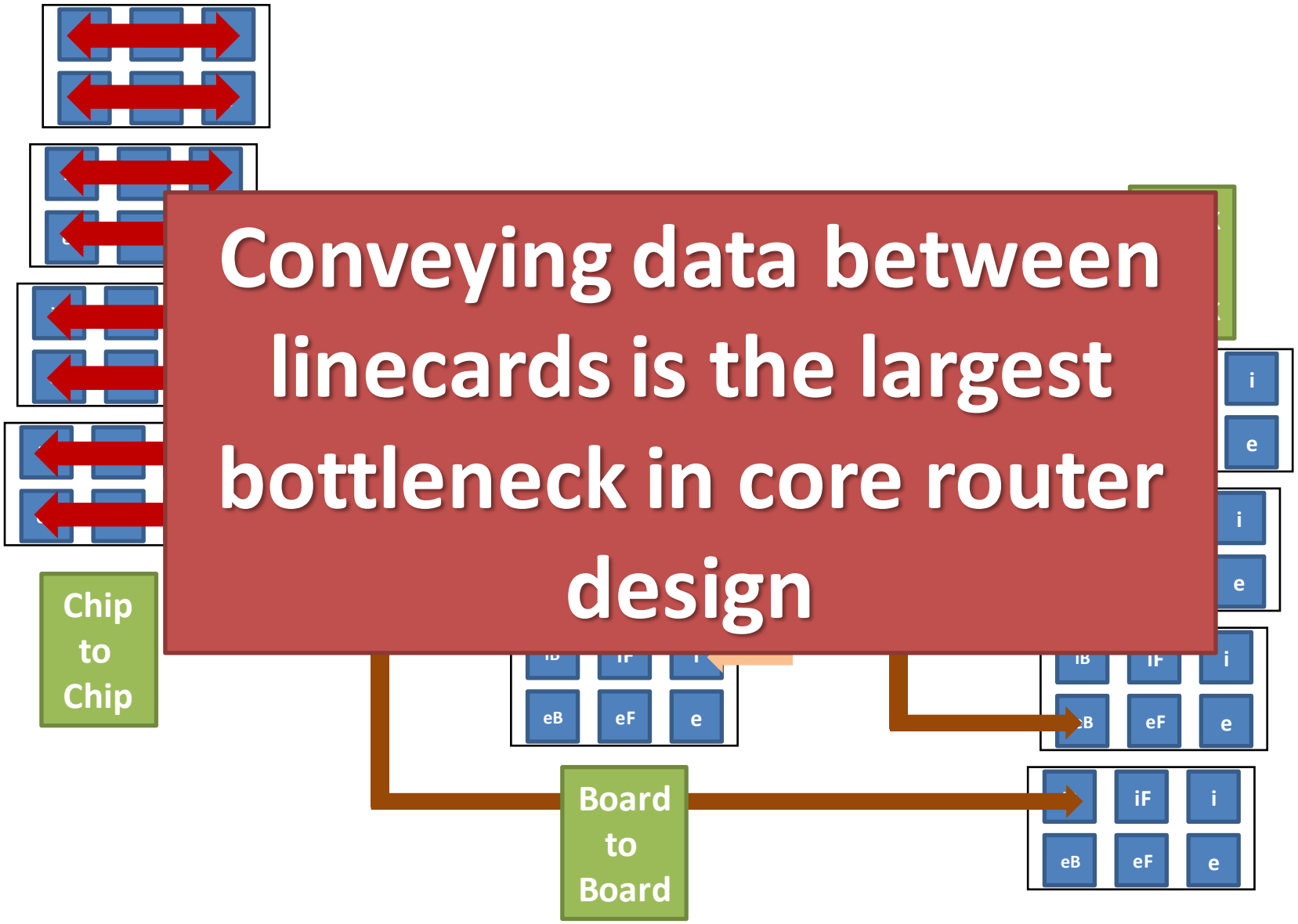


# Router Architecture (1)

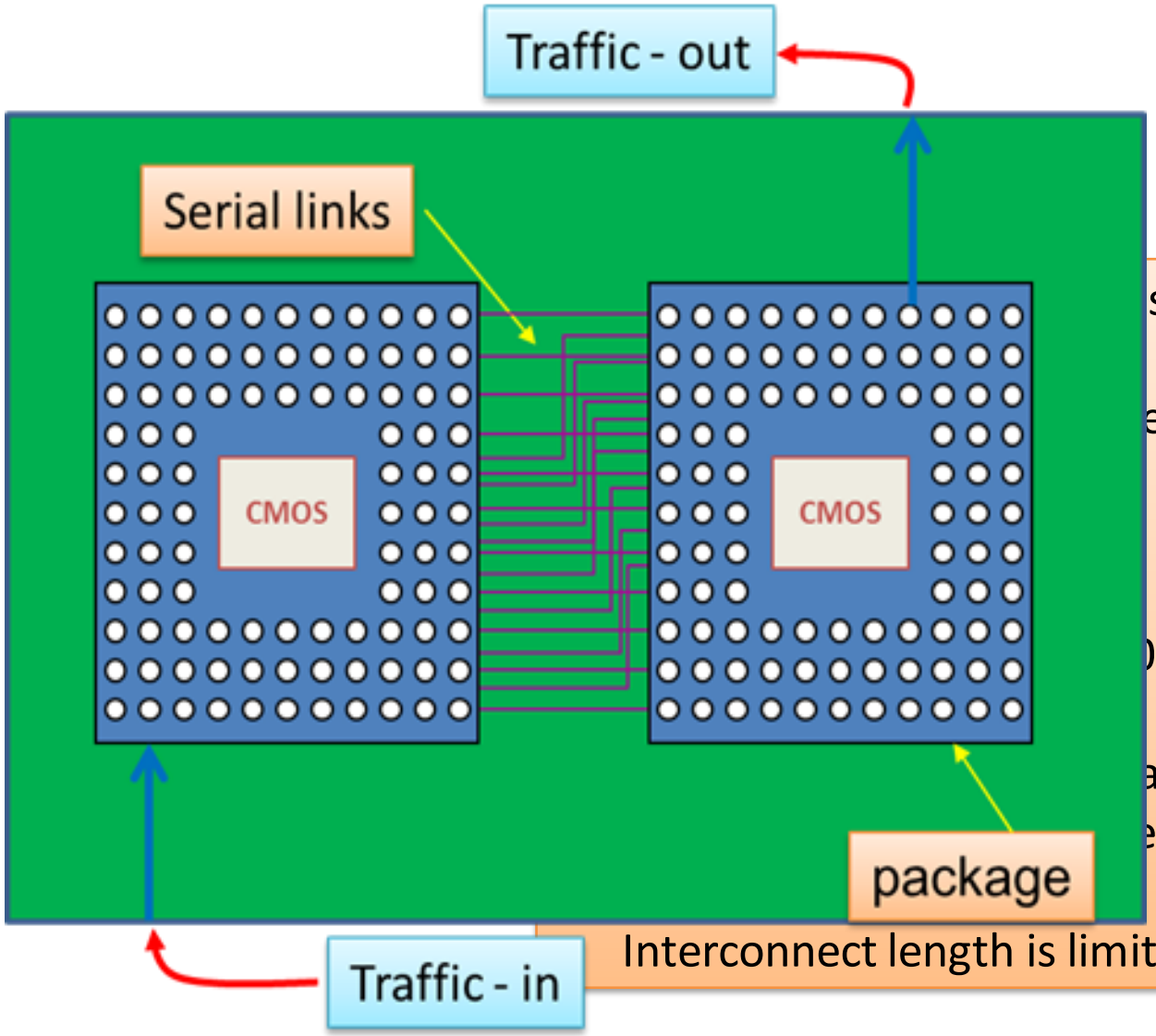




# Router Architecture (2)



# Problem #1: connectivity

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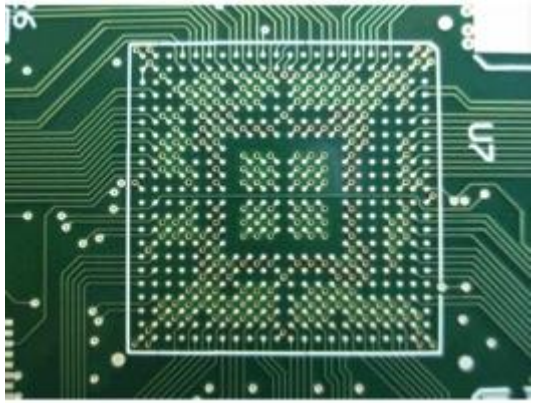
Interconnect length is limited

# Problem #2: density

- **Q**: How do you get all of the needed BW into a single CMOS chip?
- **A**: Not with BGA technology, its limited in scale and has run out of capacity.
  - Option 1: split the data into several CMOS chips
  - Option 2: push the limit of electrical SerDes to very high data rates using 20nm CMOS or lower (?)
  - Even if you push the limit, you cannot drive high frequency signals efficiently on the PCB!



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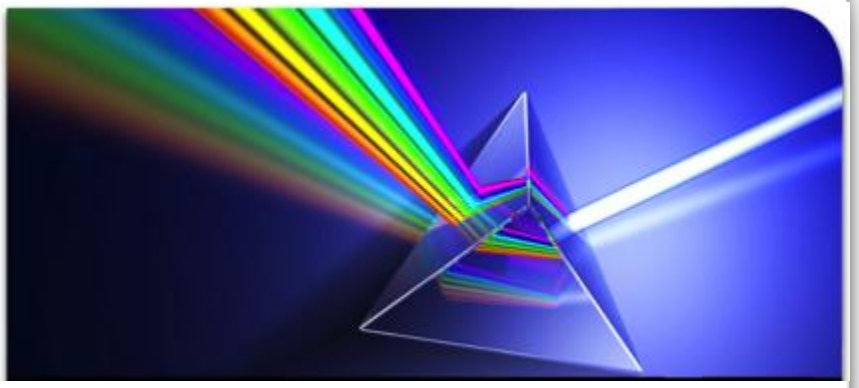
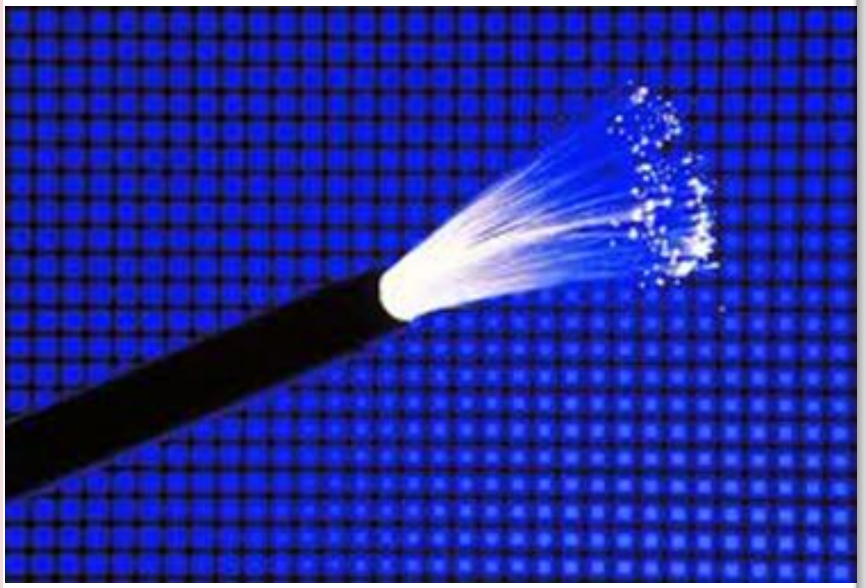
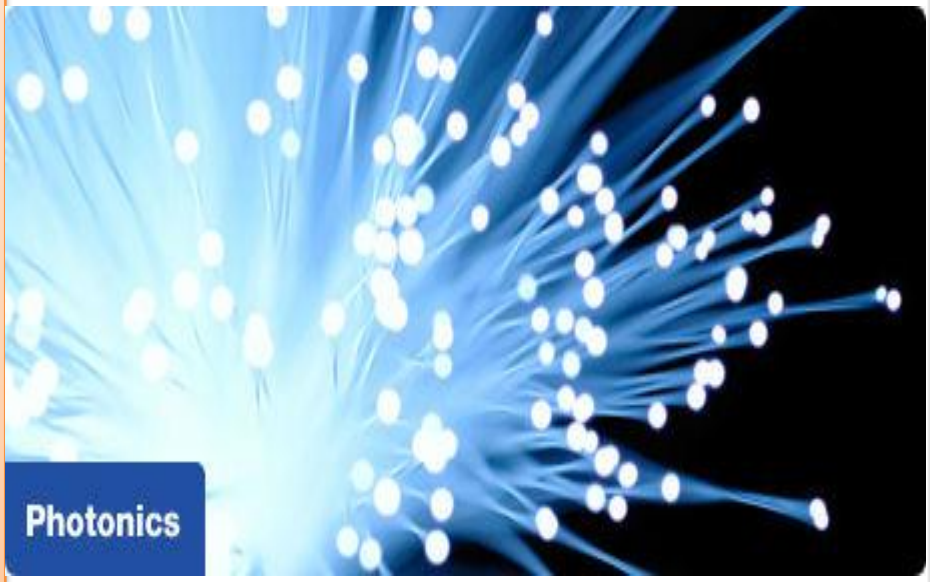


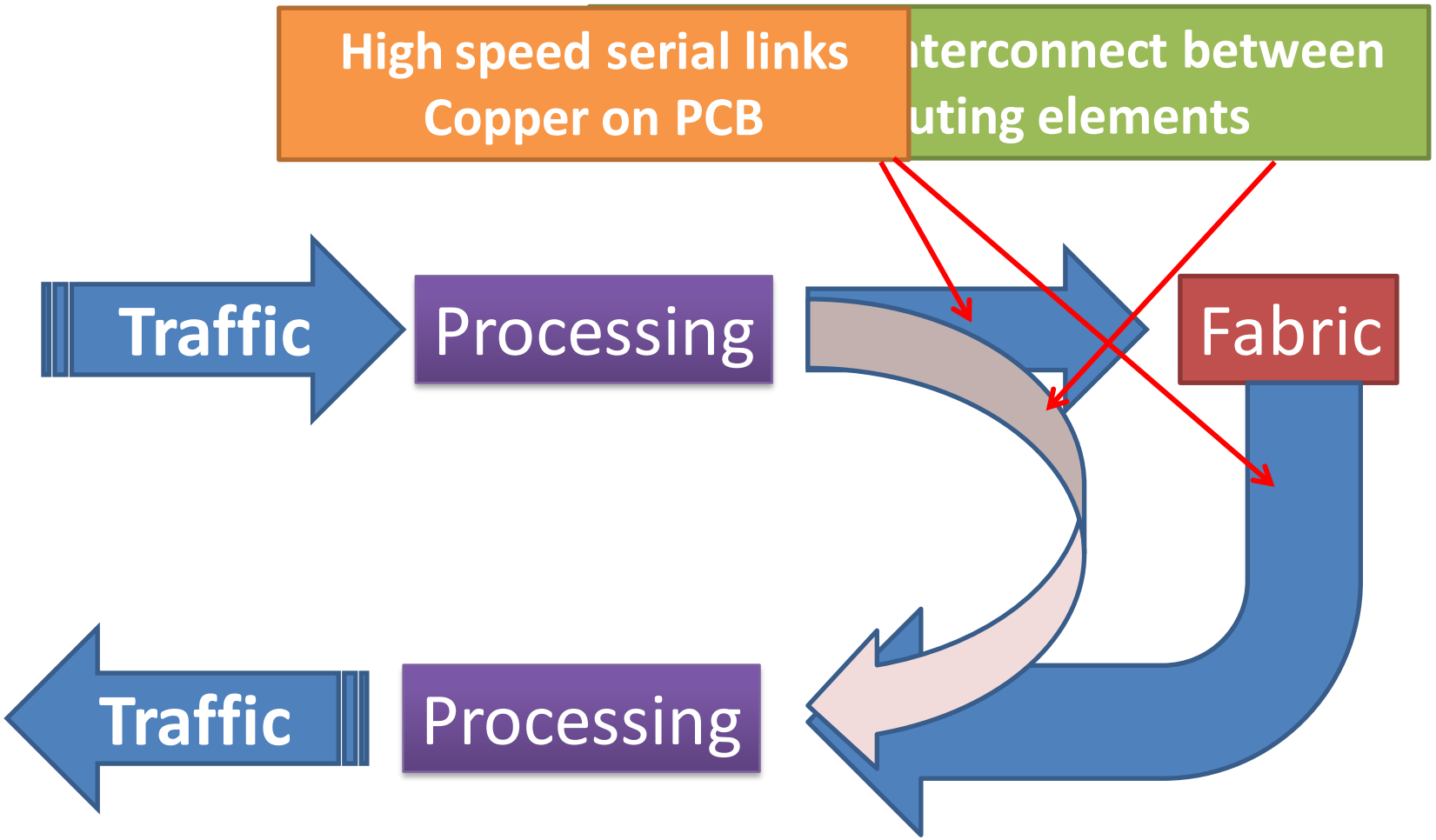


# Photonics Advantages

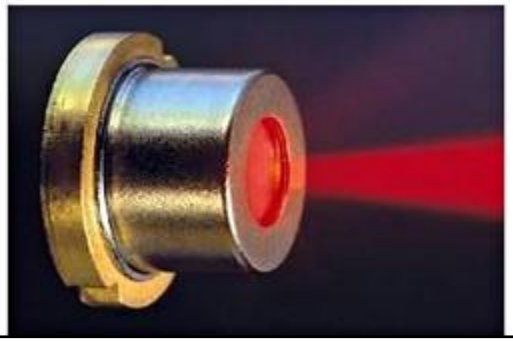
- Insensitive to data rate
- Small power consumption
- Negligible crosstalk
- 300m serial link, <1dB/km loss (multimode optics)
- Efficiency is high if using parallel links
- Minimal footprint on the CMOS chip

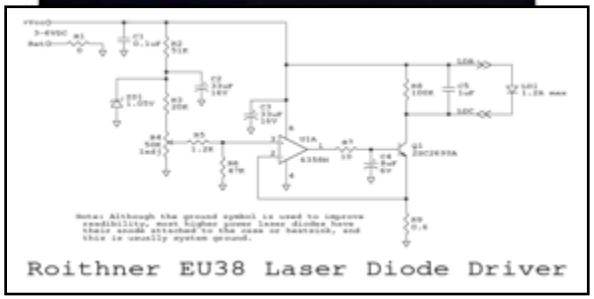


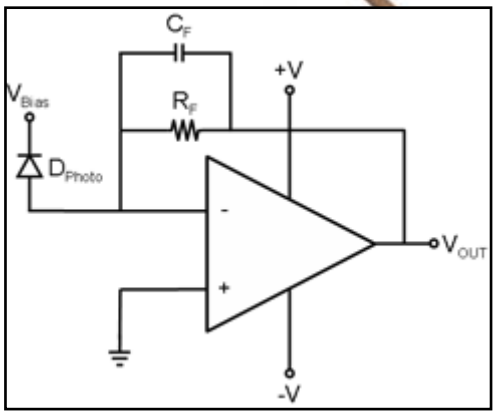
# From Copper to Photons



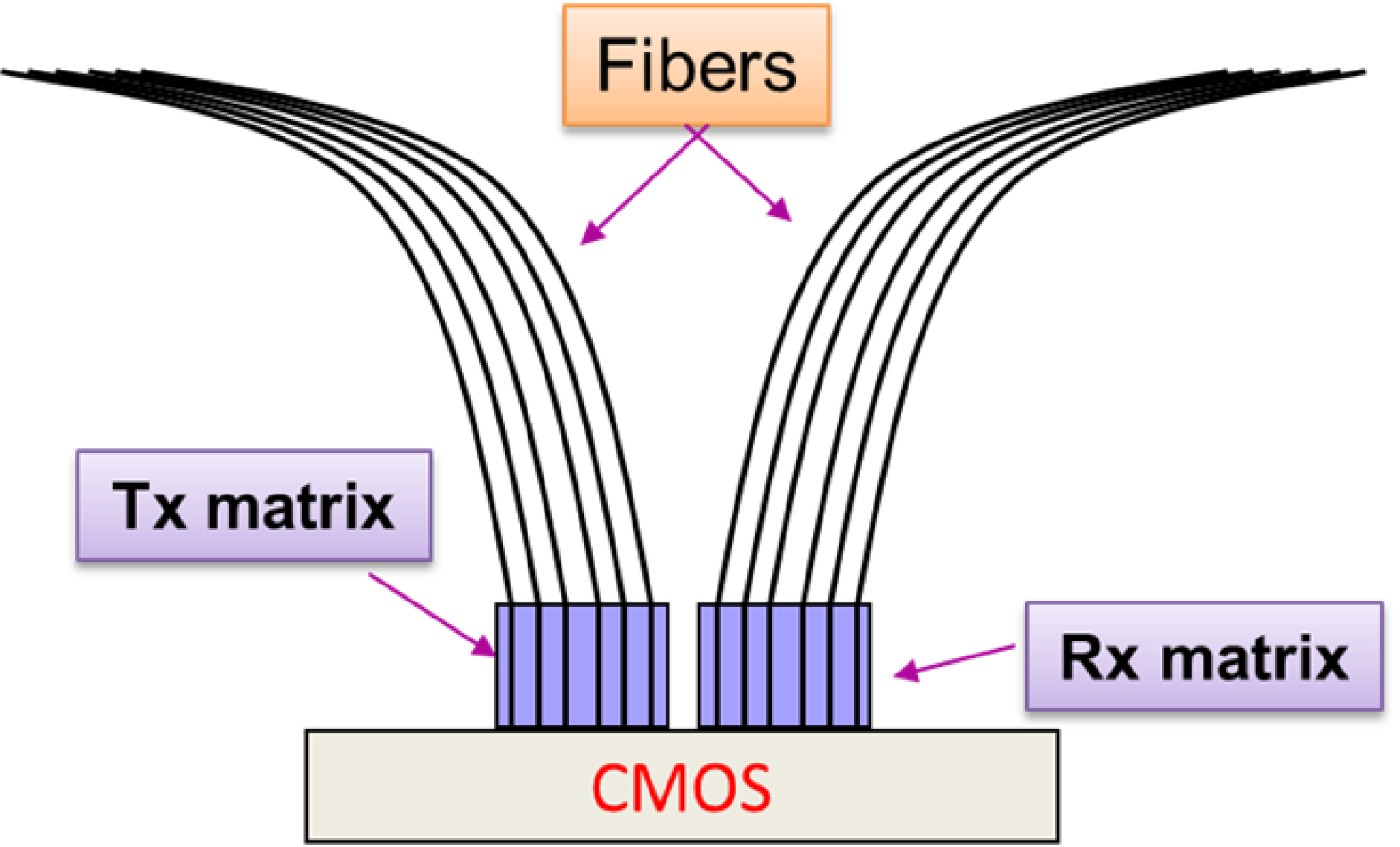
# The optical interconnect





# An optical interconnect-based router



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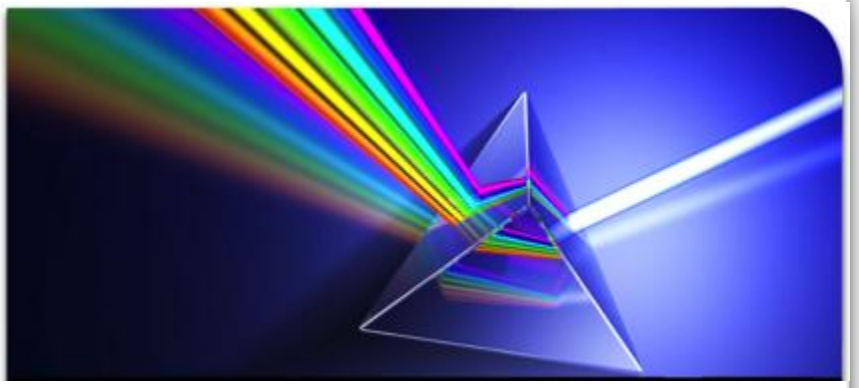
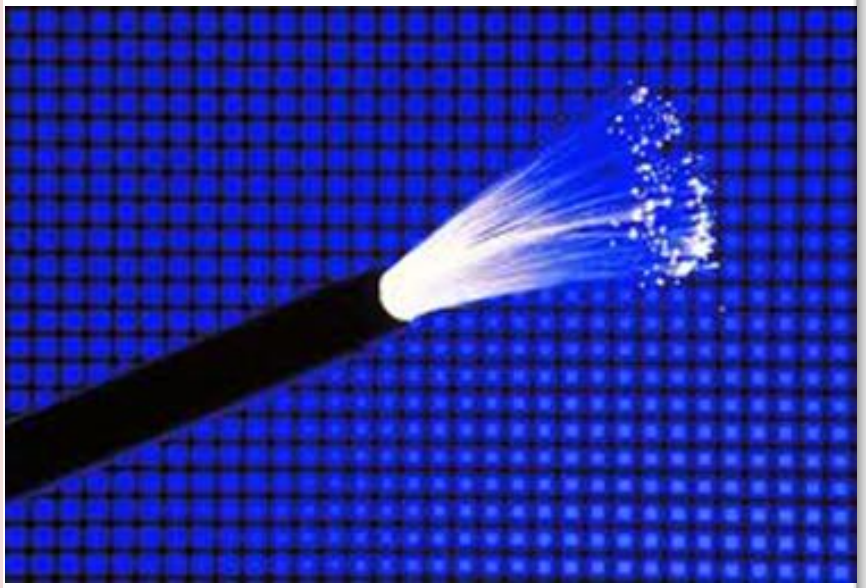
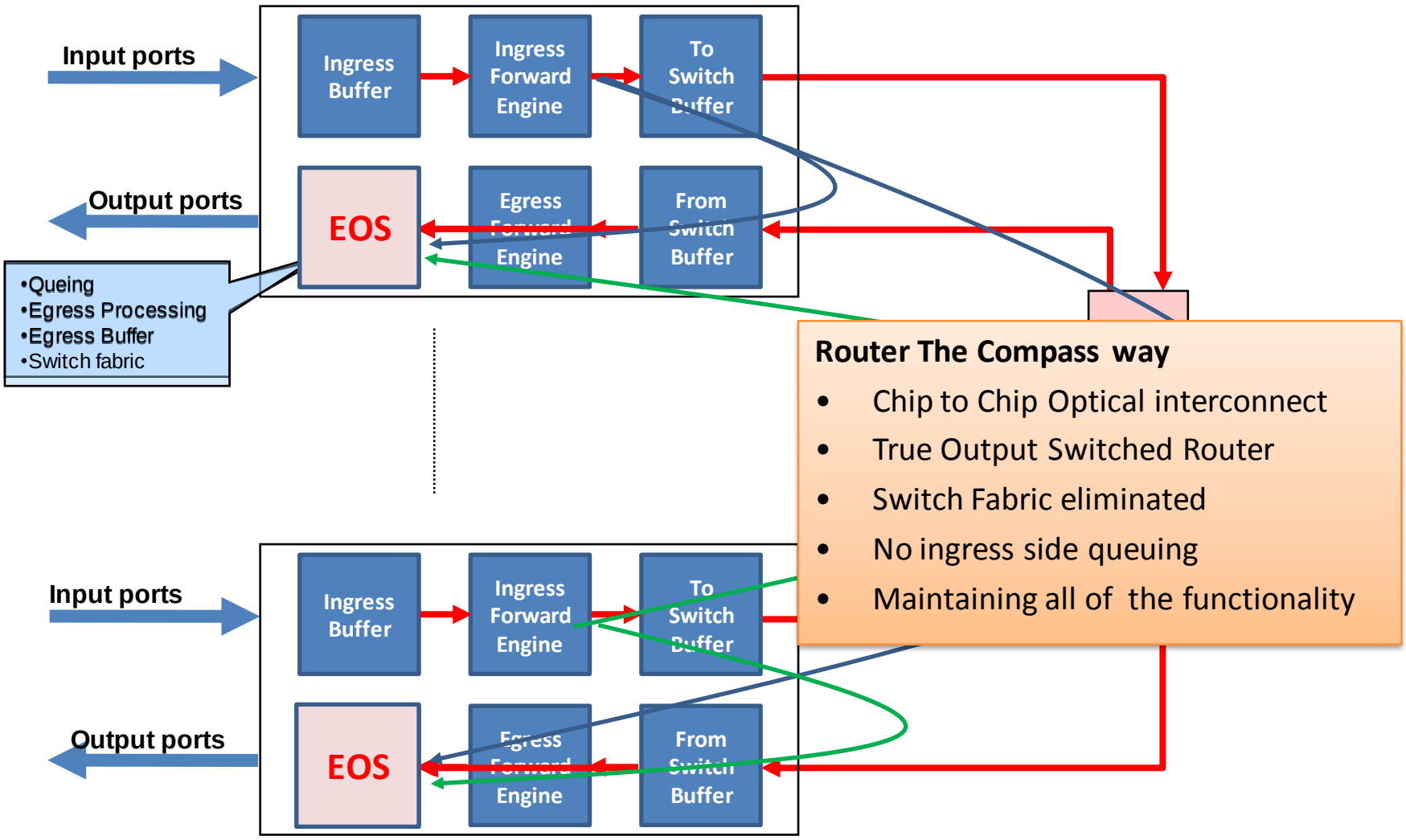




# A New Router Architecture

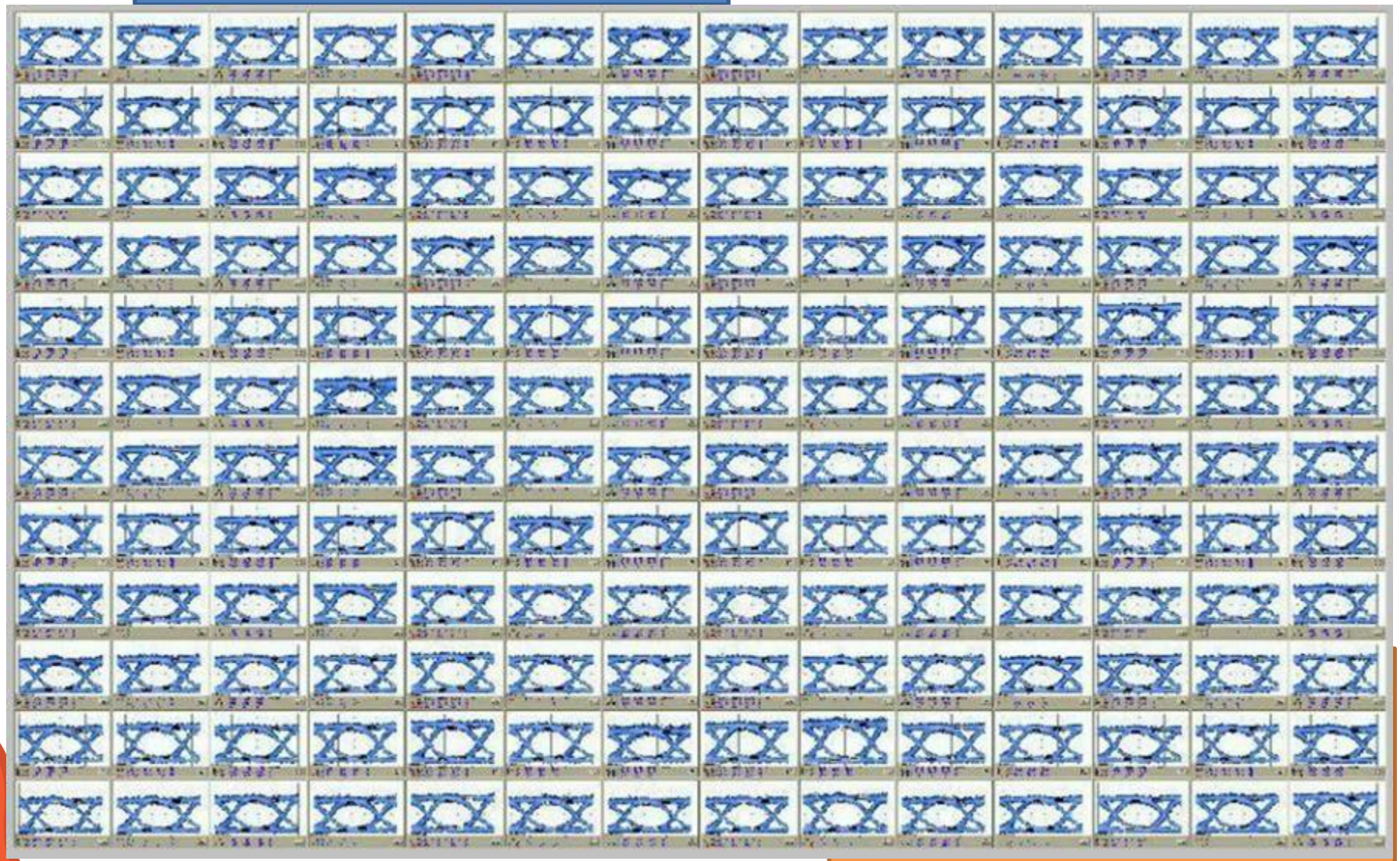



**Router The Compass way**

- Chip to Chip Optical interconnect
- True Output Switched Router
- Switch Fabric eliminated
- No ingress side queuing
- Maintaining all of the functionality

# Building an optical interconnect

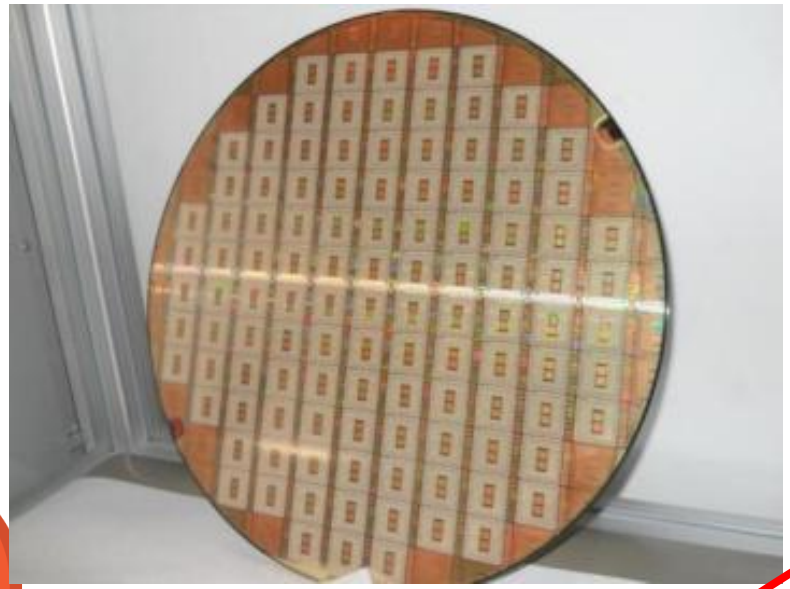
## Step 1: optoelectronic chips

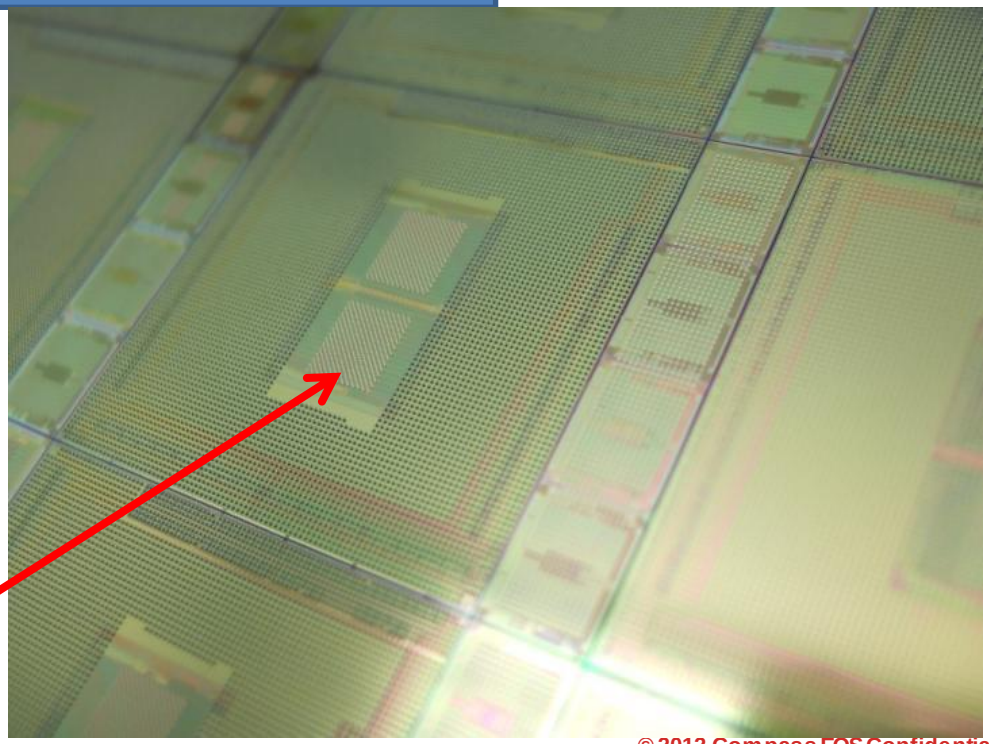


# Building an optical interconnect

Step 2: Design a new CMOS

- Queing
- Egress processing
- Egress buffer
- Switch fabric
- Optical transceiver

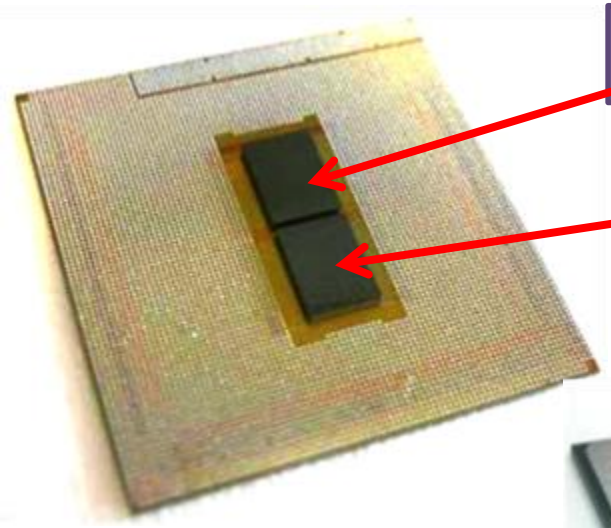


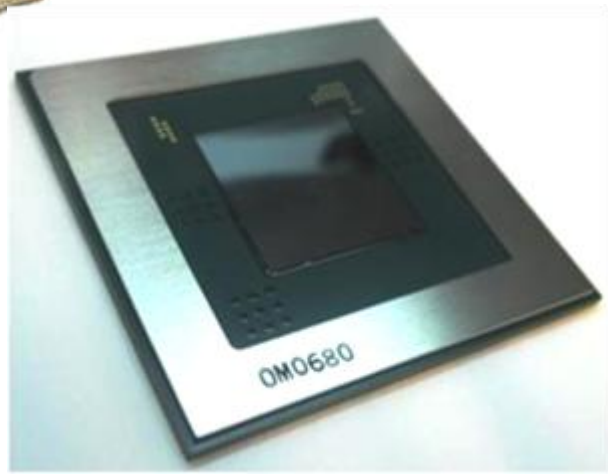


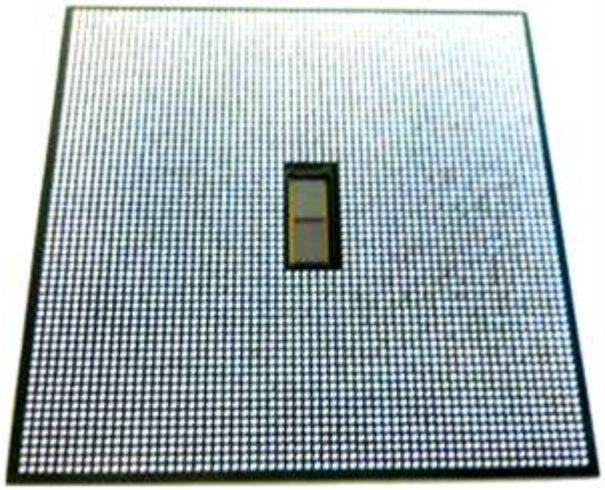
Analog circuits

# Building an optical interconnect

Step 3: assemble optics on chip

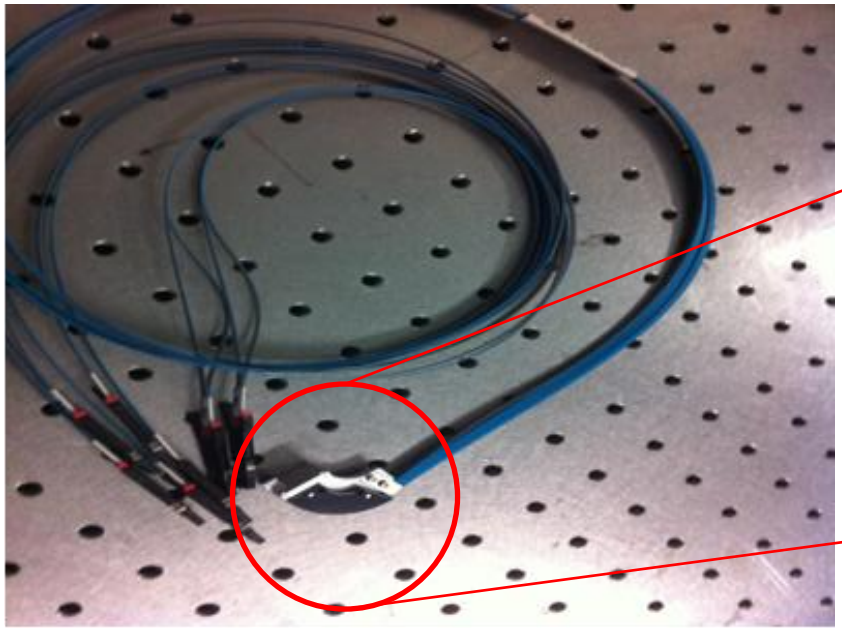


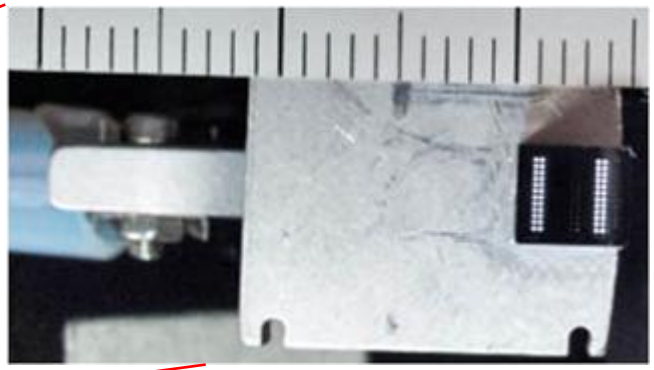



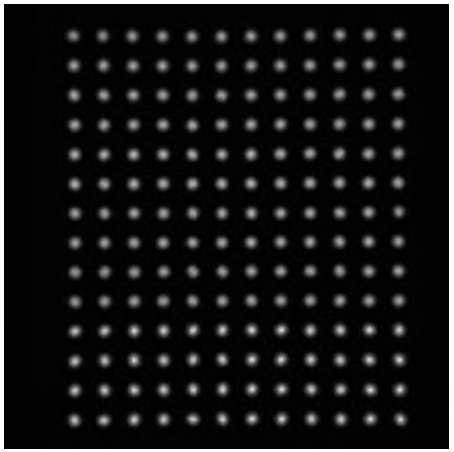



# Building an optical interconnect

## Step 4: build a 12×14 fiber matrix







# Building an optical interconnect

Step 5: assemble optics on PCB

# Building an optical interconnect

Step 6: Integrate with linecard and build a high end core router

# Building an optical interconnect

- The optical interconnect enables a new class of core and edge routers:
  - Lower power consumption
  - Smaller size
  - Lower weight
  - High BW utilization
  - **Lower cost**

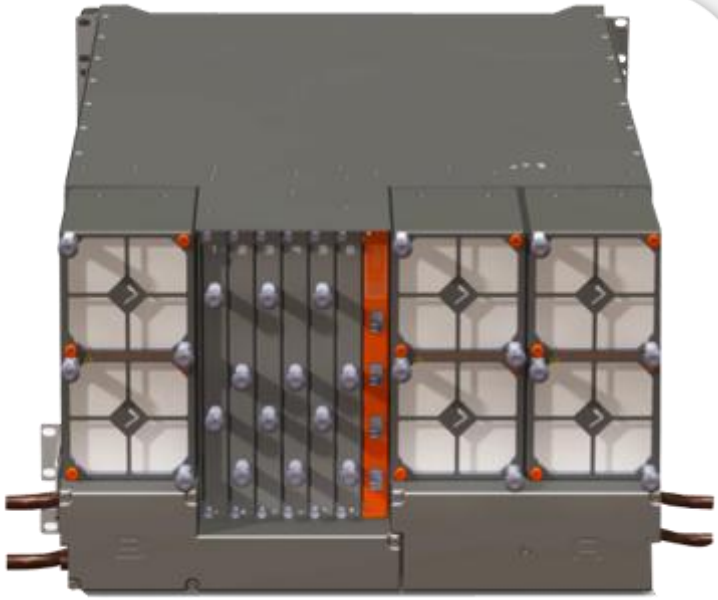
- Highest aggregate bandwidth reported for an optical interconnect: 1.34Tb/s full duplex
- Data density: 64Gb/s/mm$^2$
- 168 bi-directional 8Gb/s data links
- Power efficiency: 10.2 pJ/bit (including SERDES)

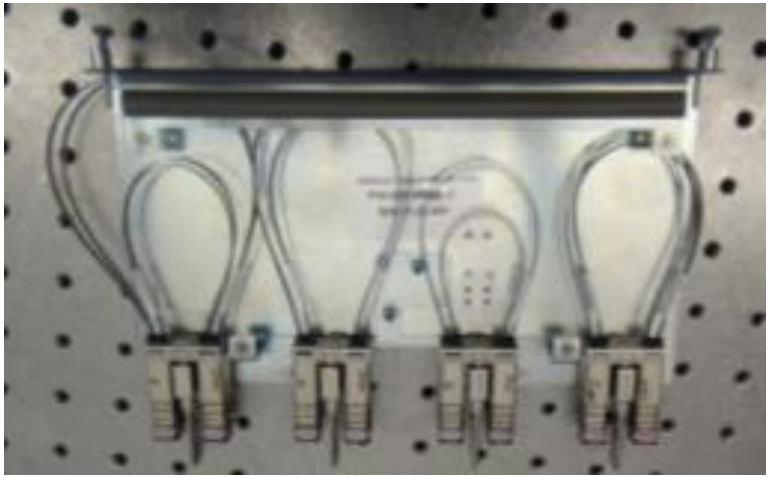
# The Compass EOS core router

- 800 Gbps system
- 6 RU , 19” shelf
- 4 x Line Cards
- 3 kW
- Optical BP
- Front to Back air flow
- Distributed DC Power Supply
- Carrier Grade
- Full L3 functionality
- Multi-chassis support
- 80x10GE, 8x100GE
- Configurable 10GE/OC192/OTN

# The Compass EOS core router

- Redundant power feeds
- Redundant cooling system
- Multi-chassis ready
- Passive optical backplane






# COMPASS EOS

## THANK YOU

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