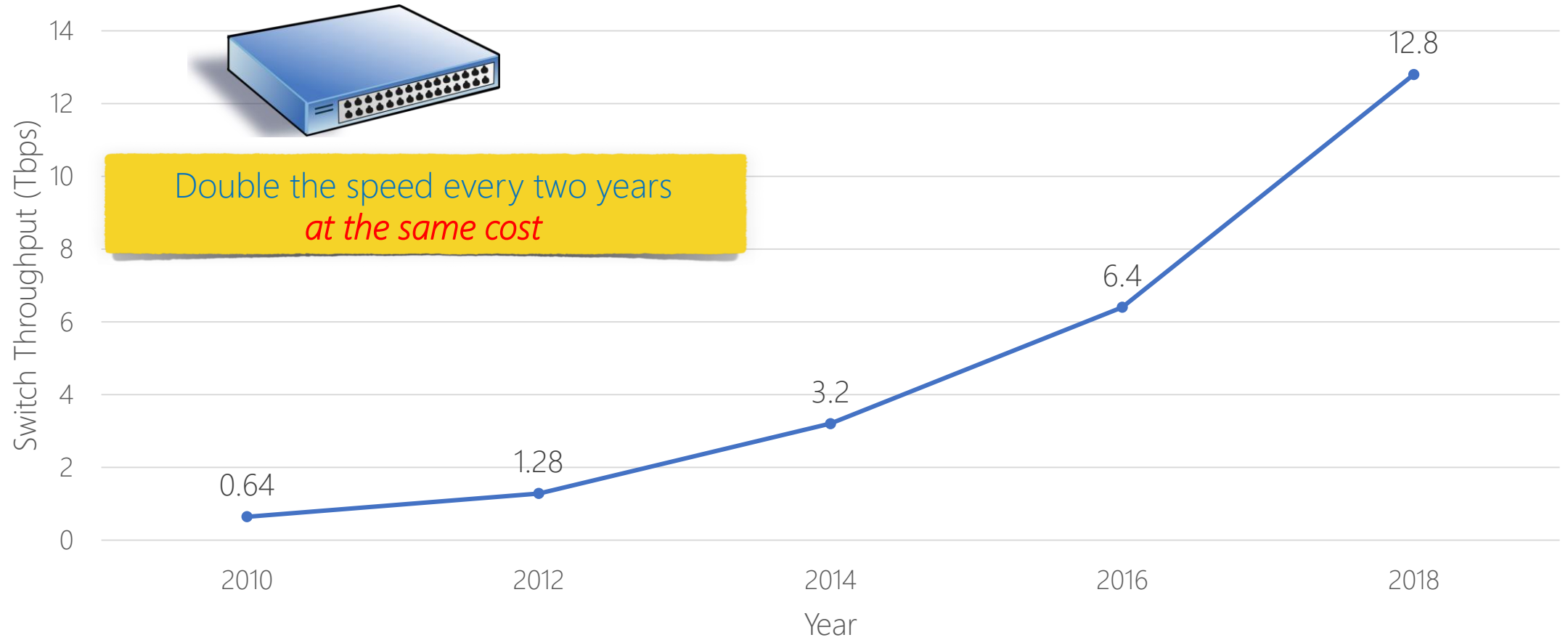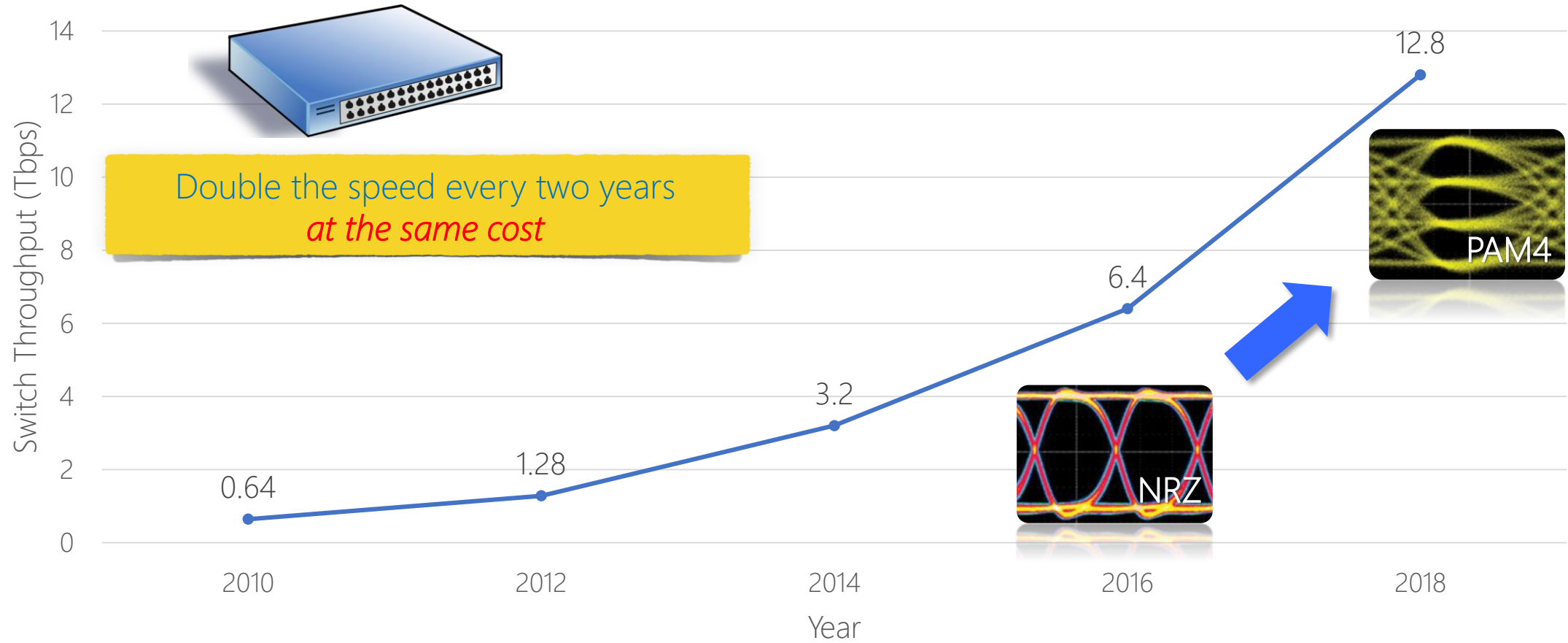# Opportunities and Challenges for Optical Switching in the Data Center

Paolo Costa (Microsoft), Ben Yoo (UC Davis), Yvan Pointurier (Nokia Bell Labs)
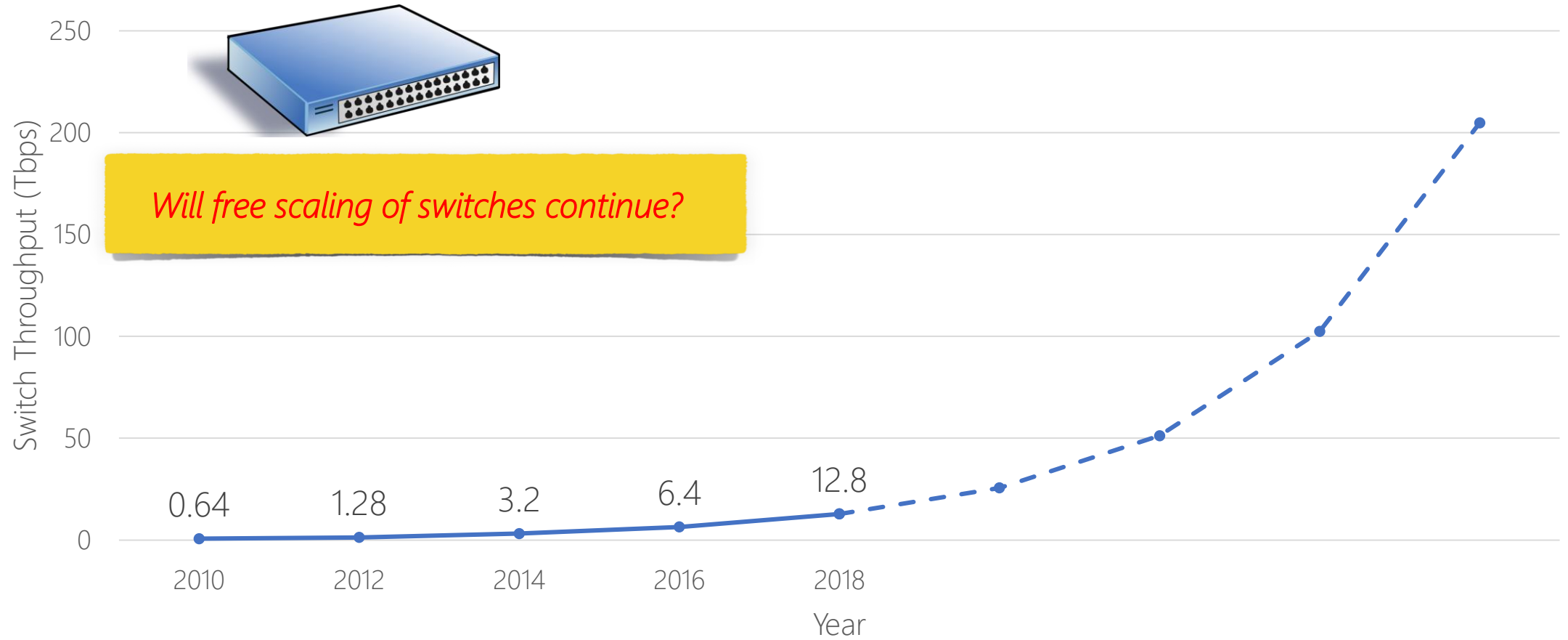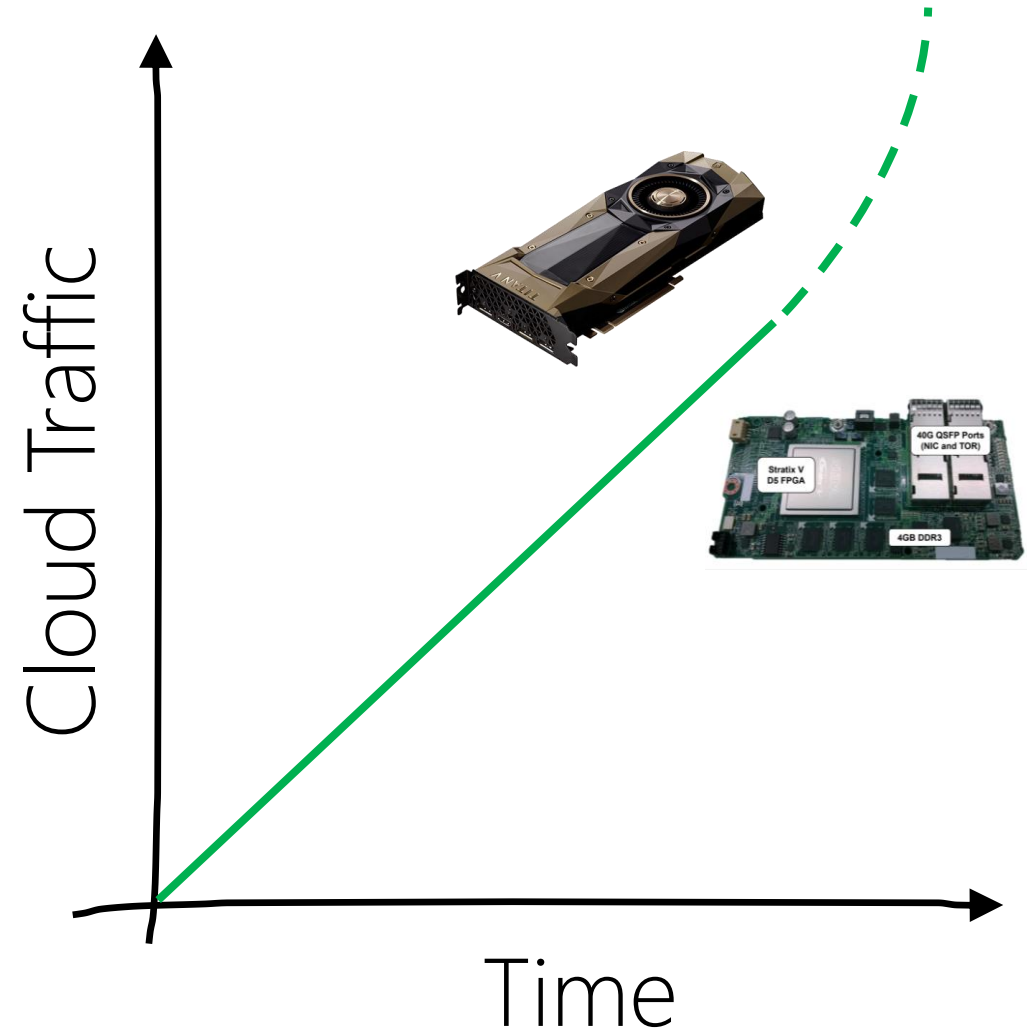
Moore's Law for Networking

Switch Throughput (Tbps) vs **Year**

Double the speed every two years
at the same cost

- 2010: 0.64
- 2012: 1.28
- 2014: 3.2
- 2016: 6.4
- 2018: 12.8

Moore's Law for Networking

Double the speed every two years *at the same cost*

Switch Throughput (Tbps)

- 0.64 (2010)
- 1.28 (2012)
- 3.2 (2014)
- 6.4 (2016)
- 12.8 (2018)

NRZ

PAM4

Year

Moore's Law for Networking

Will free scaling of switches continue?

Switch Throughput (Tbps) vs. Year

- 2010: 0.64
- 2012: 1.28
- 2014: 3.2
- 2016: 6.4
- 2018: 12.8

The (not so) perfect storm!

This might lead to cost increase

Cloud network cost

Time

Cloud Traffic

Time

The (not so) perfect storm!

Cloud network cost

This might lead to cost increase

Optical switches?

Time

1. Non-CMOS dependent
2. Optics already used for transmission
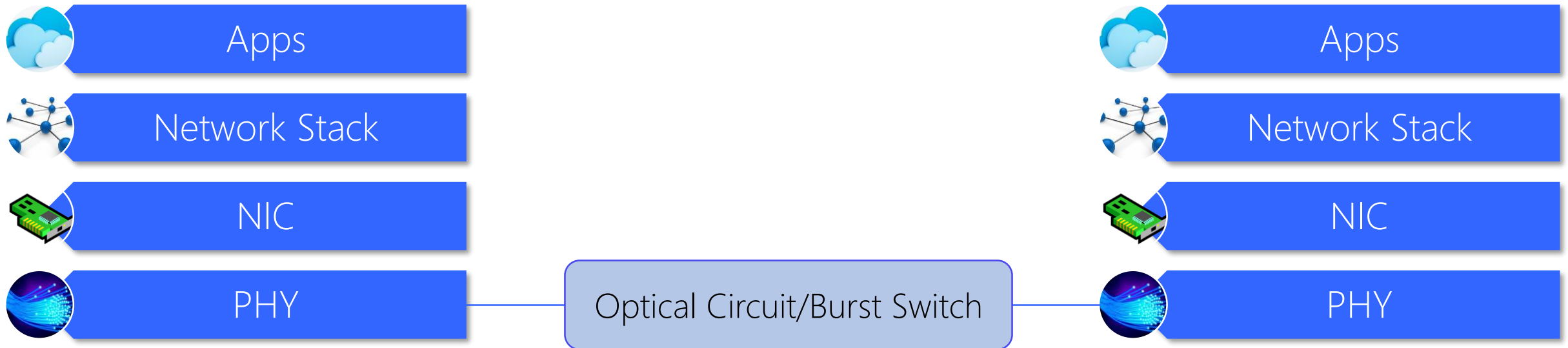3. Ultra-low latency

Opportunities...and Challenges!

PHY

PHY

Opportunities...and Challenges!

PHY

Optical Circuit/Burst Switch

PHY

A fundamentally different abstraction
From *asynchronous* packet switches to *synchronous* circuit switches

Opportunities...and Challenges!

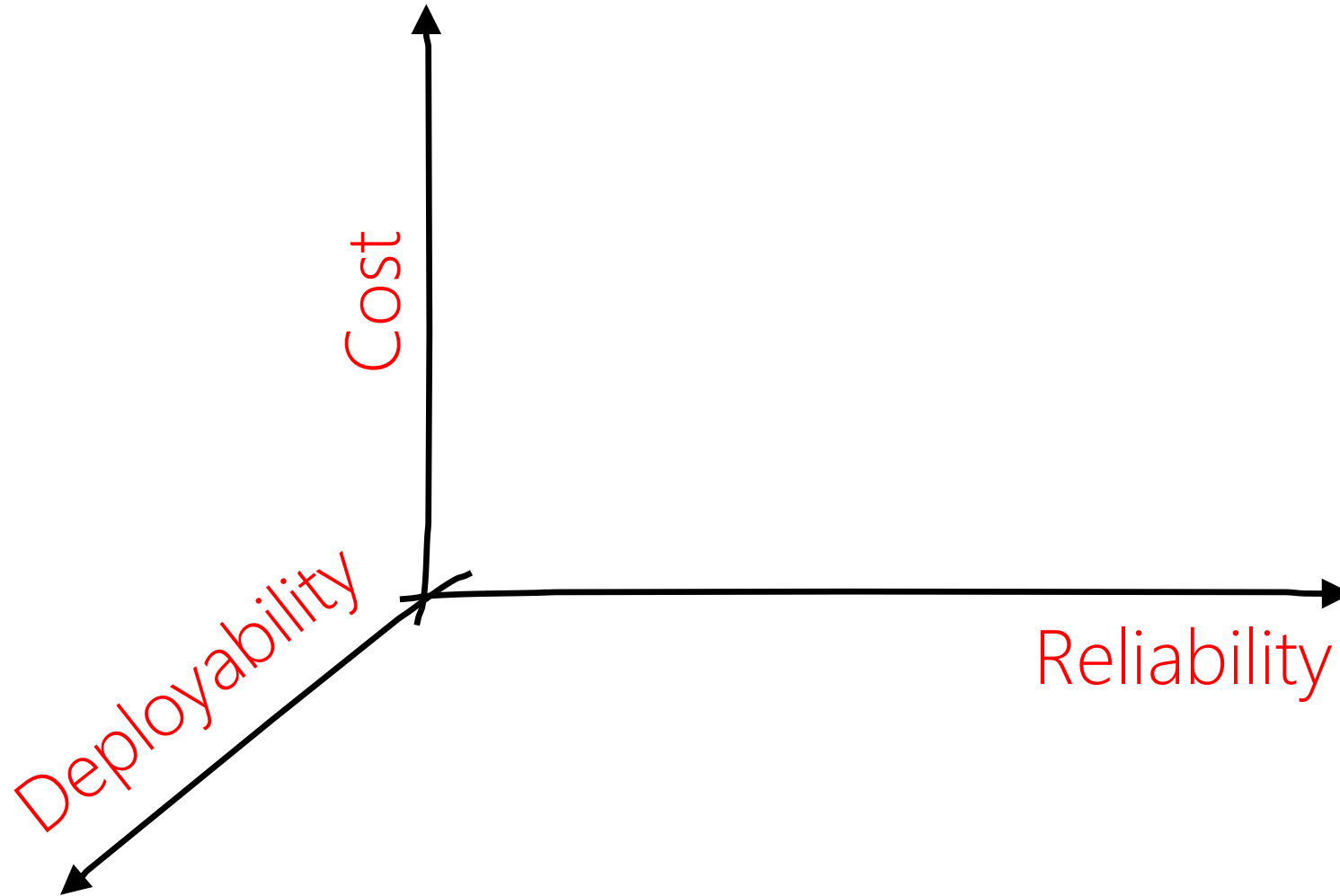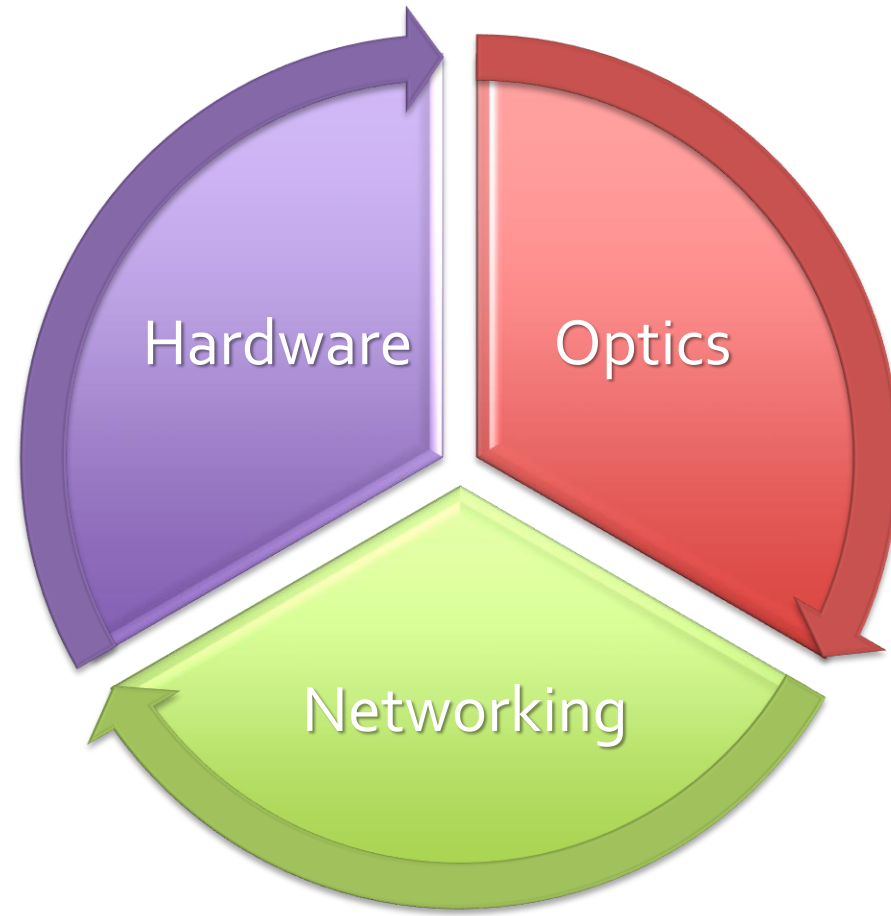|		
Apps		Apps
Network Stack		Network Stack
NIC		NIC
PHY	Optical Circuit/Burst Switch	PHY

We need to consider the implications for the whole system
(burst CDR, scheduling, synchronization, congestion control, ...)

It's not just about performance…

Cost

Deployability

Reliability

Let's do it together!

Plan for today

- ## Hitesh Ballani (Microsoft Research)
  - *Optics for the Cloud: Trends, Challenges and Opportunities*

- ## Eitan Zahavi (Mellanox)
  - *Optical Data Centers: Fundamental and Other System Considerations*

- ## Mike Frankel (Ciena)
  - *Optical Switching for Link Bandwidth Adaptation in Future Data-center Networks*

- ## Benjamin Lee (IBM Research)
  - *Platforms for Integrated Photonic Switching Modules*

- ## George Papen (UC San Diego)
  - *Control Planes for Optical Switches*

- ## Roberto Proietti (UC Davis)
  - *Control Plane Solutions for Scalable and Modular Optically Interconnected Datacenters*