ON2020: Industry visions for sustainably scaling optical networks
An IEEE Industry Connections Activity

https://standards.ieee.org/industry-connections/optical-networks-2020.html

Peter J. Winzer (Chair), Brandon Collings (Vice-Chair), Xiang Liu (Secretary)

First ITU Workshop on ***Network 2030***
New York, United States, 2 October 2018

What is Optical Networks 2020 (ON2020)

- Industry-wide initiative, started informally as workshops at major conferences in 2016 (when 2020 still seemed rather far away … but think of 20/20 vision ☺)
- Formalized within the IEEE Industry Connections Program in December 2017
- *Goals:*
  - Understand requirements and develop industry visions with a *10-year horizon* (*beyond* current product deployments and product roadmaps)
  - Freed from near-term thinking, competition, and standardization constraints
  - Establish commonly agreed-upon industry directions
  - Foster an open and sustainable ecosystem for end users, service providers, equipment and component vendors for optical networking in the cloud era.

Important activities

- **Pre-IEEE:** Workshops at major optical networking conferences and an industry survey
  - http://www.on2020.org/Information-Sharing_Meeting_at_ECOC_2017.html
  - Significant involvement from over 10 major global telecom and webscale operators
- **Currently ongoing** within the IEEE Industry Connections activity:
  - Discussion on the most relevant topic areas for further study:
    1. Traffic evolution in optical networks over the coming 10 years
    2. Optics integration onto switch engines
    3. Optics integration onto coherent engines
    4. The transport network in 10 years (physical layer)
    5. The transport network in 10 years (autonomy/control)
- **Near future:**
  - One or more white papers to be written by year-end (or thereabouts)
  - Showfloor Program event at the Optical Fiber Communications Conference (OFC) 2019

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Please participate through ON2020@IEEE

Some existing studies (example individual views)

JOURNAL OF LIGHTWAVE TECHNOLOGY, VOL. 35, NO. 5, MARCH 1, 2017 1099

From Scaling Disparities to Integrated Parallelism: A Decathlon for a Decade

Peter J. Winzer, *Fellow, IEEE*, and David T. Neilson, *Fellow, IEEE*

(Invited Tutorial)

Fiber-Optic Transmission and Networking: The Previous 20 and the Next 20 Years

PETER J. WINZER*, DAVID T. NEILSON, AND ANDREW R. CHRAPLYVY

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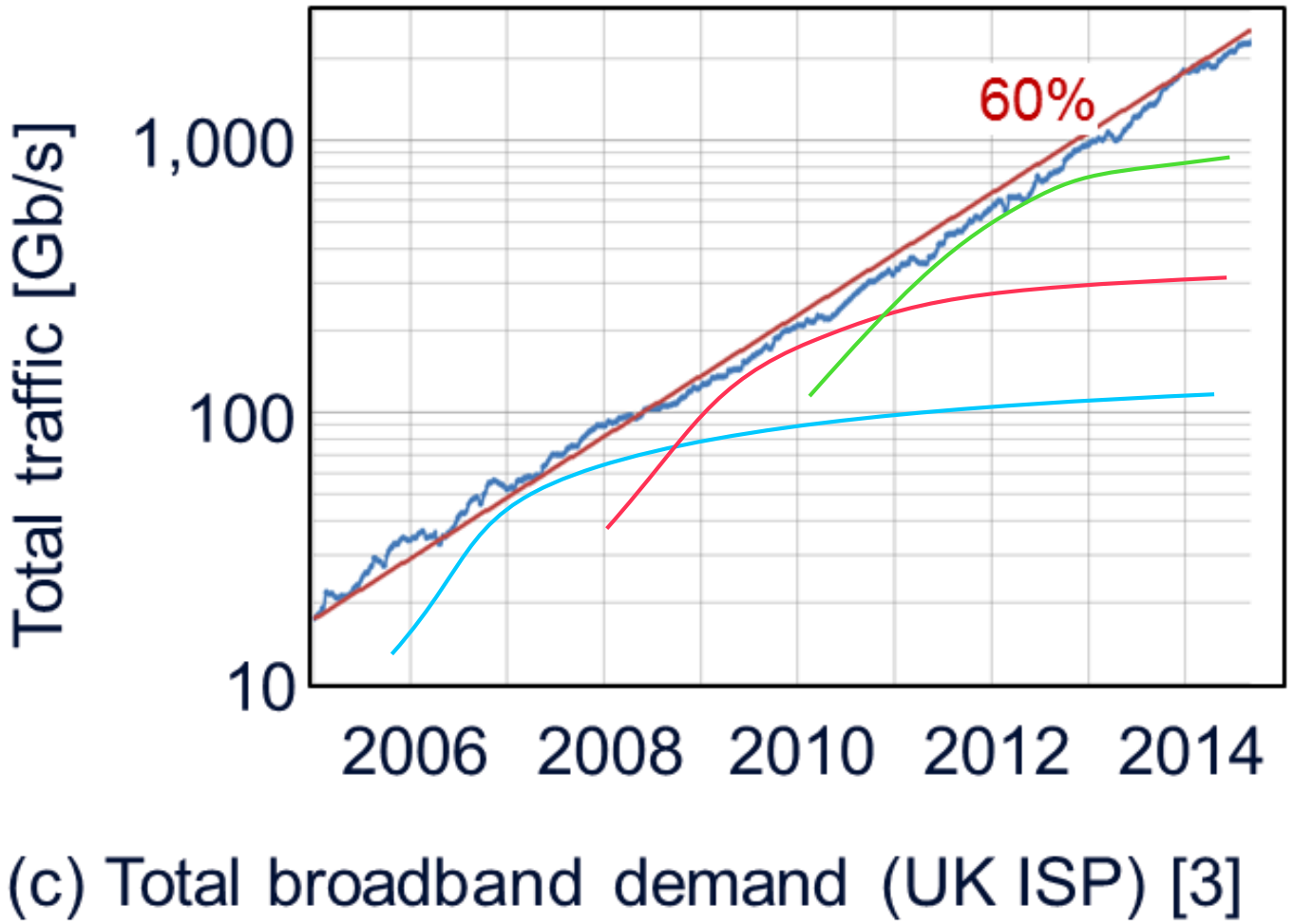
Traffic evolution – Long-term exponentials



(c) Total broadband demand (UK ISP) [3]

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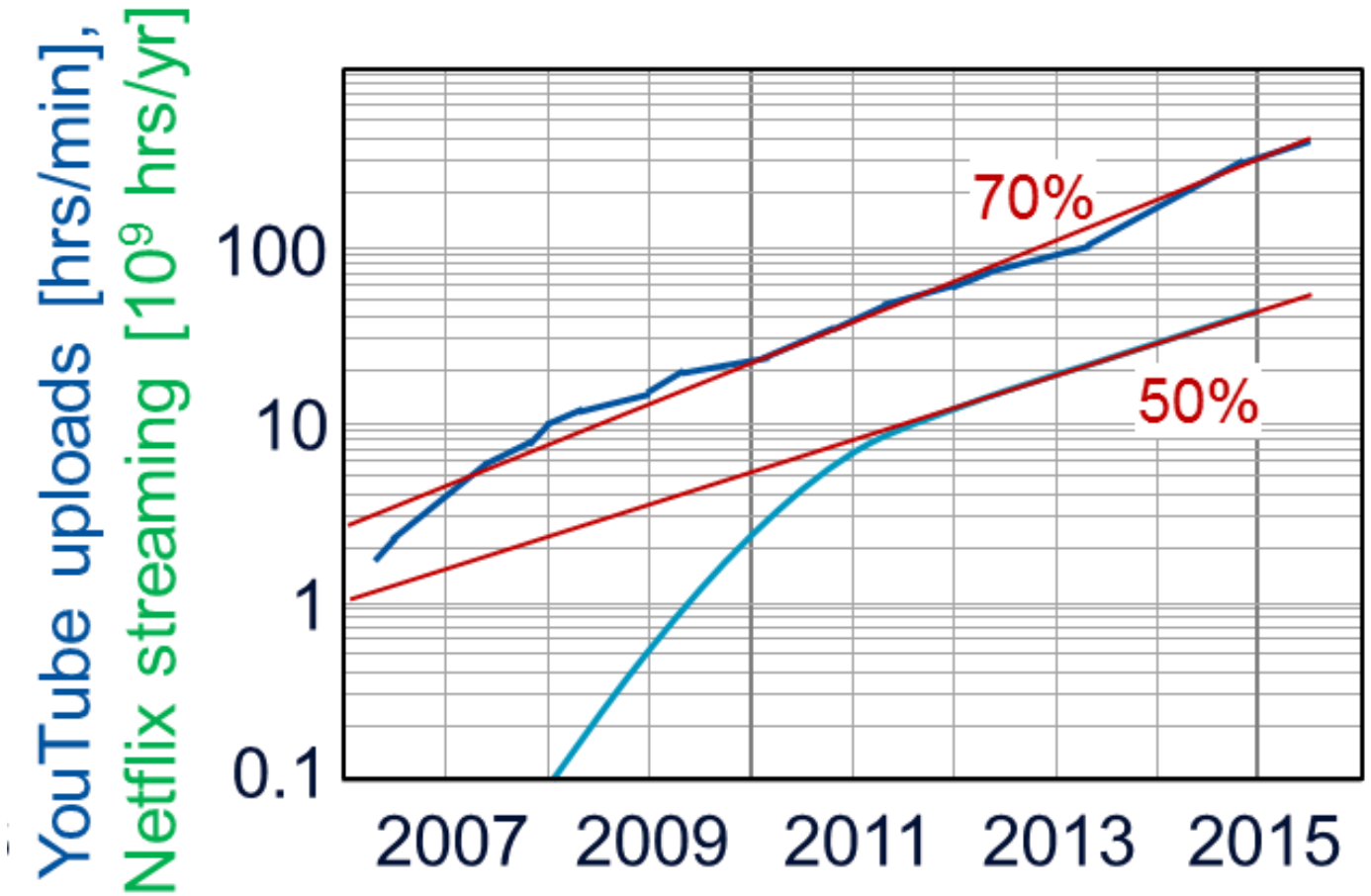
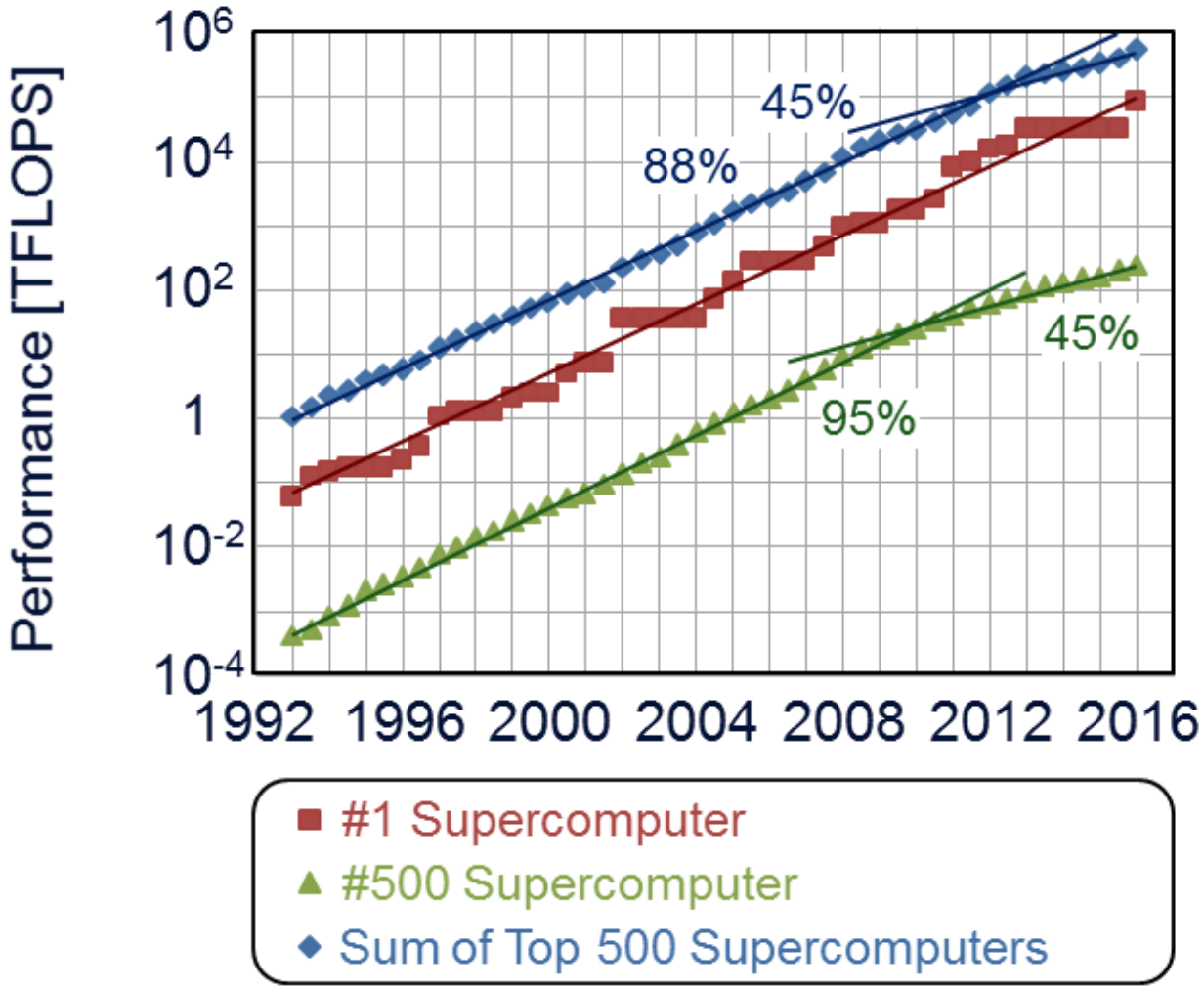


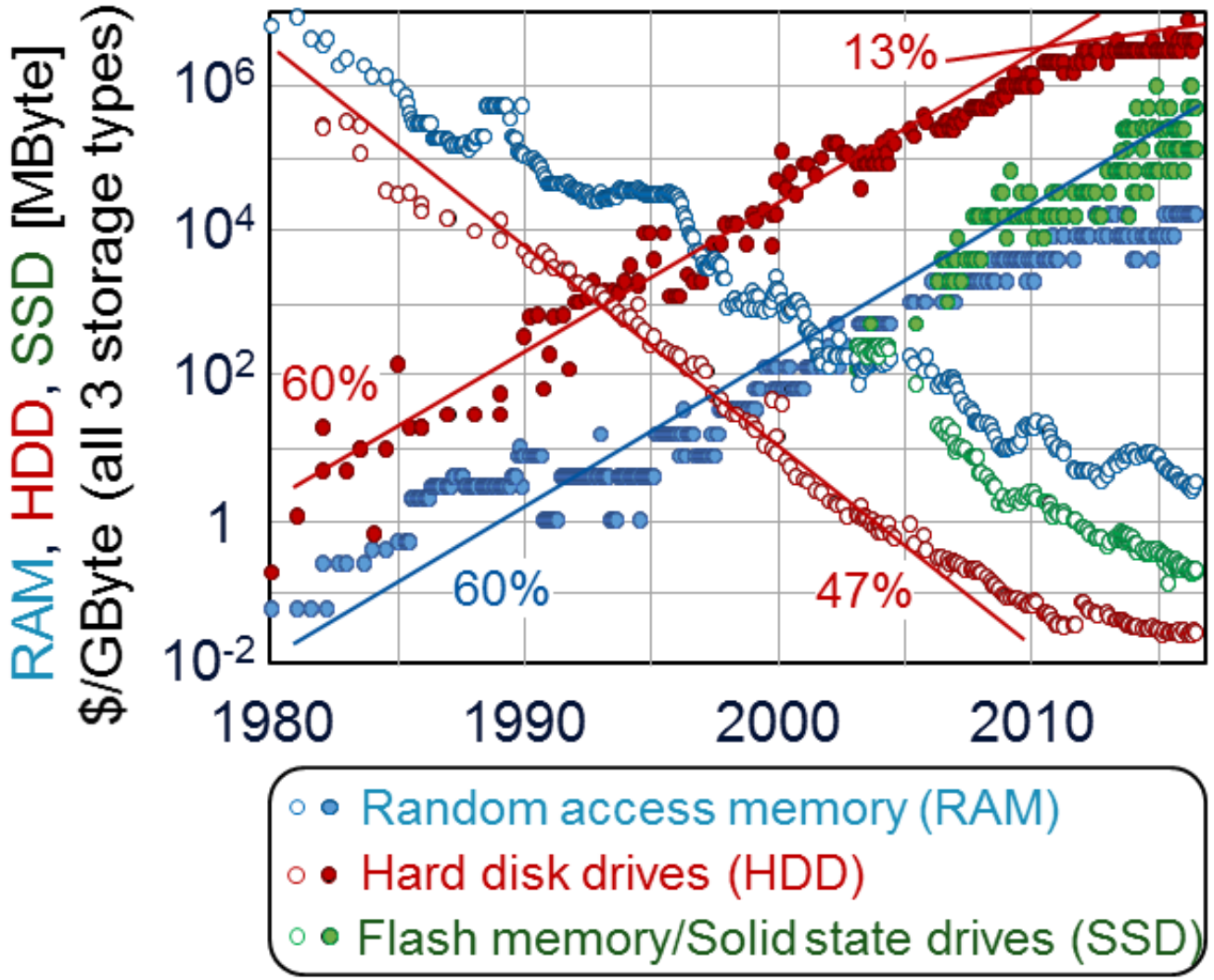
(f) Video traffic (YouTube, Netflix) [24, 25]

Technology Scaling – Long-term exponentials



(a) Supercomputer performance, Top500 [30]

Technology Scaling – Long-term exponentials



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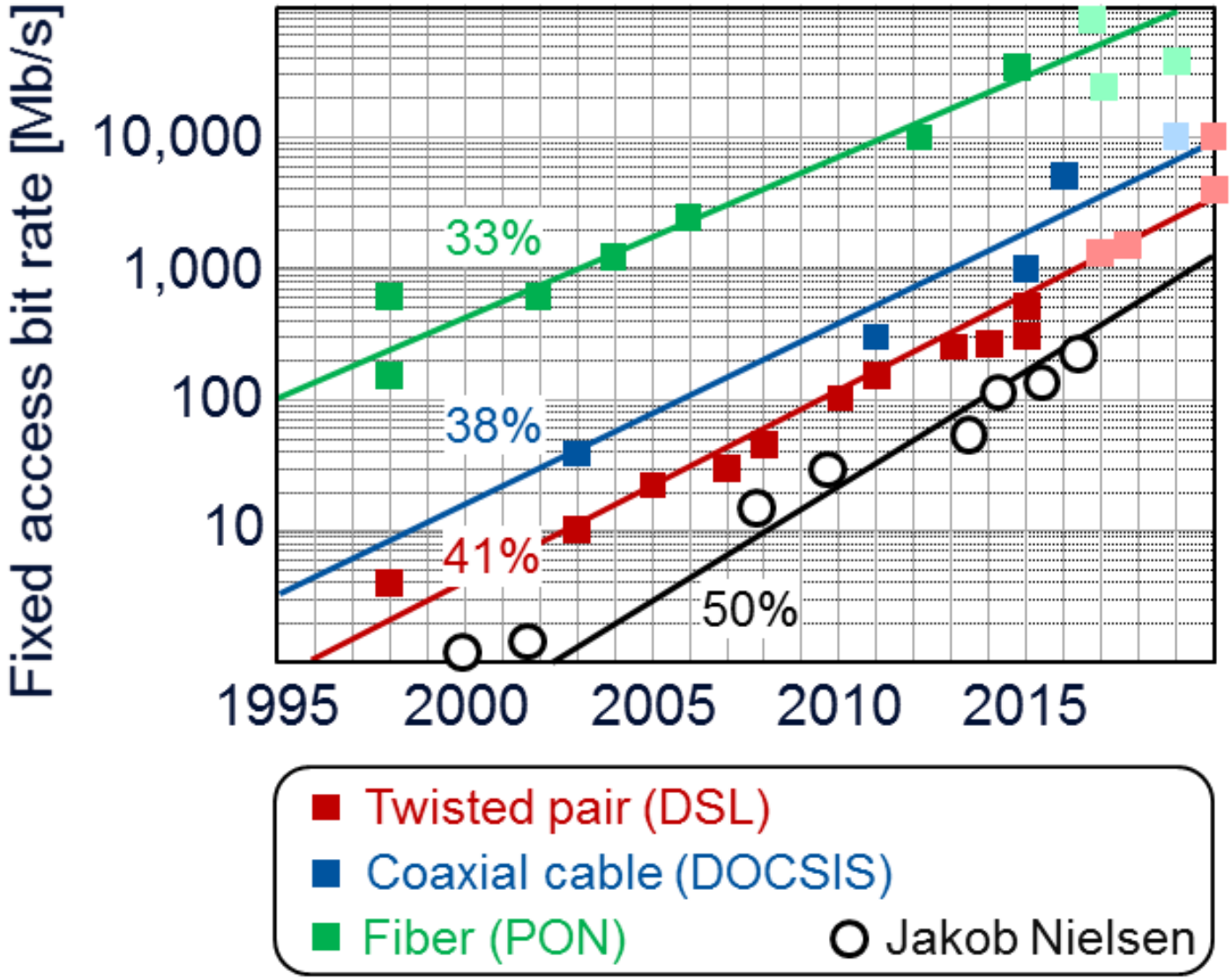
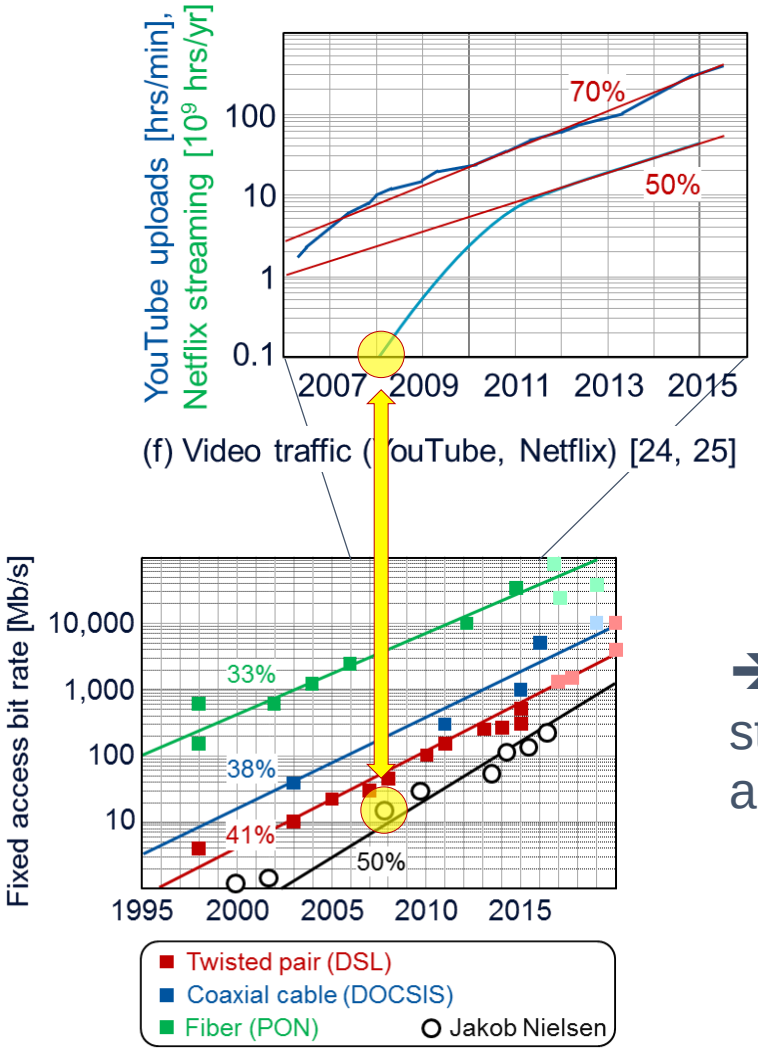


Correlations: Anticipating scalability problems

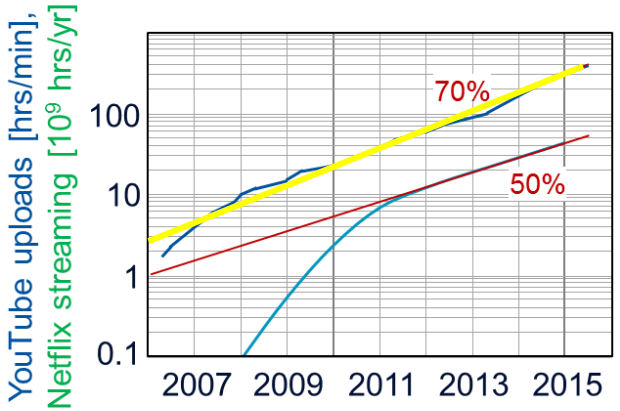


(f) Video traffic (YouTube, Netflix) [24, 25]

(f) Fixed access bit rates [61, 62]

➔ The availability of sufficient access bandwidth triggered streaming video services, with all their implications on the metro and core networks.

Correlations: Anticipating scalability problems



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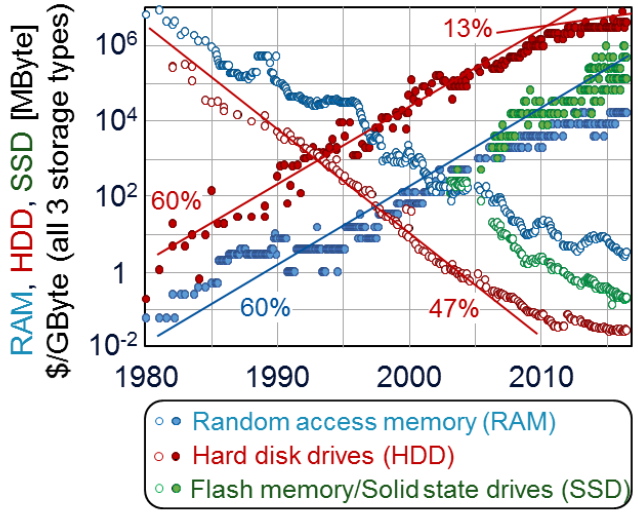


(c) Storage capacity (◦) and cost (•) [47, 48]

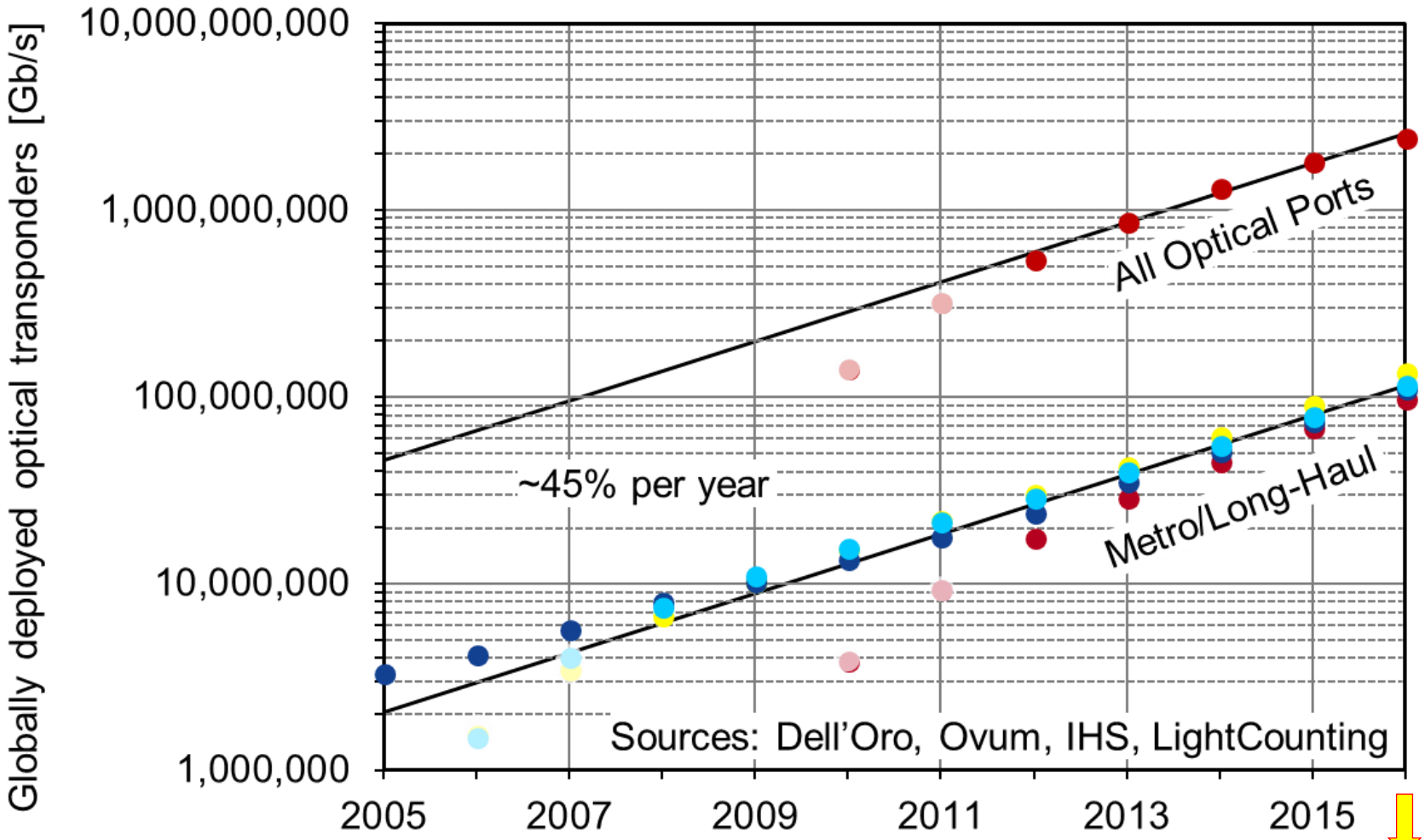
Amount of storage capacity: $C(t) = C_0 e^{\rho t}$

Is most of that content "old content" ?

No! - Average age of content: $1/\rho$

➔ The average age of YouTube videos remains constant at around 22 months and the number of videos younger than this constant average age (around 63% of the database) grows at the CAGR of the uploads. (70% YouTube content growth vs. 60% memory scaling!)

A global optical port capacity sales point of view



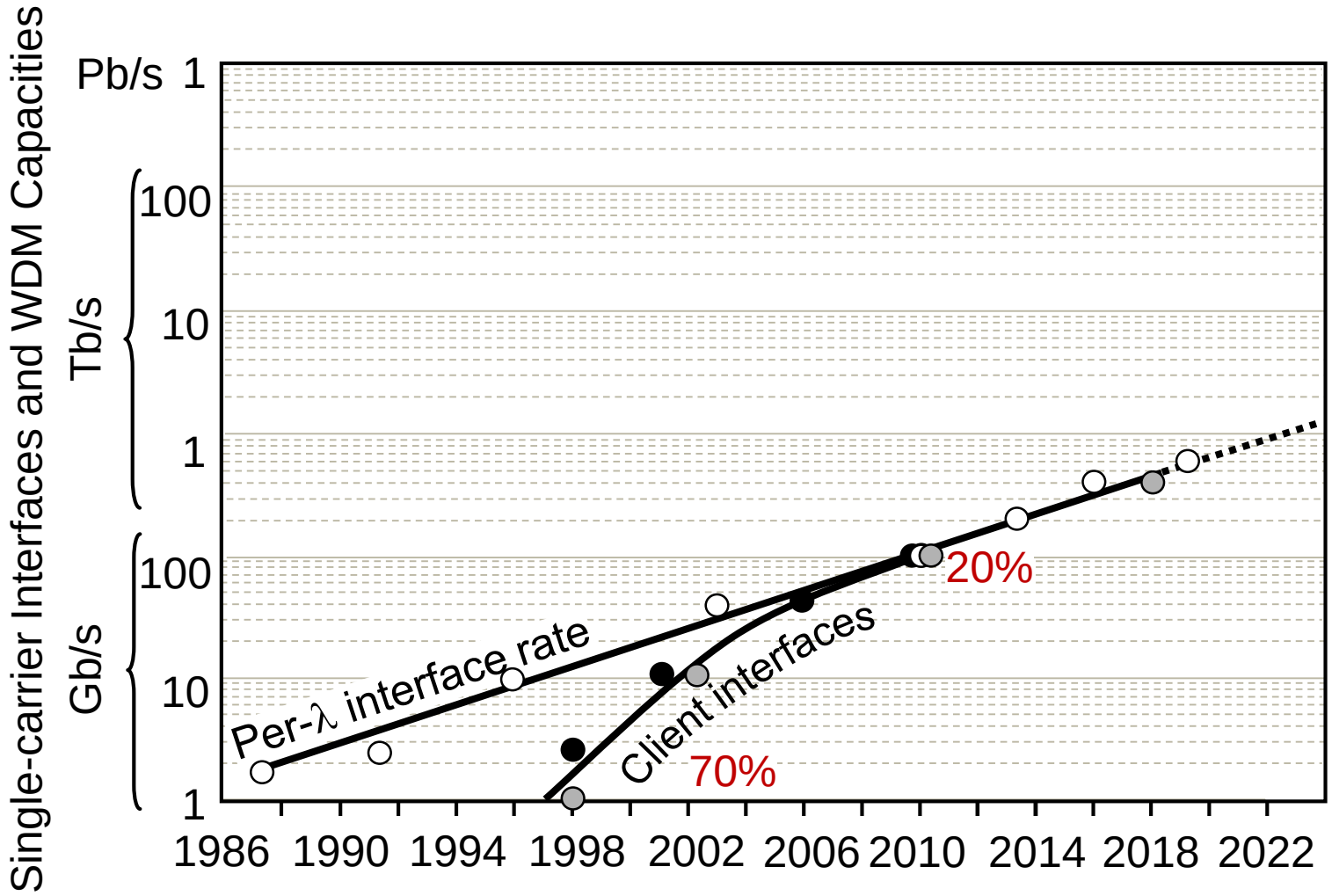
← >2 Exabit/s

← ~100 Petabit/s

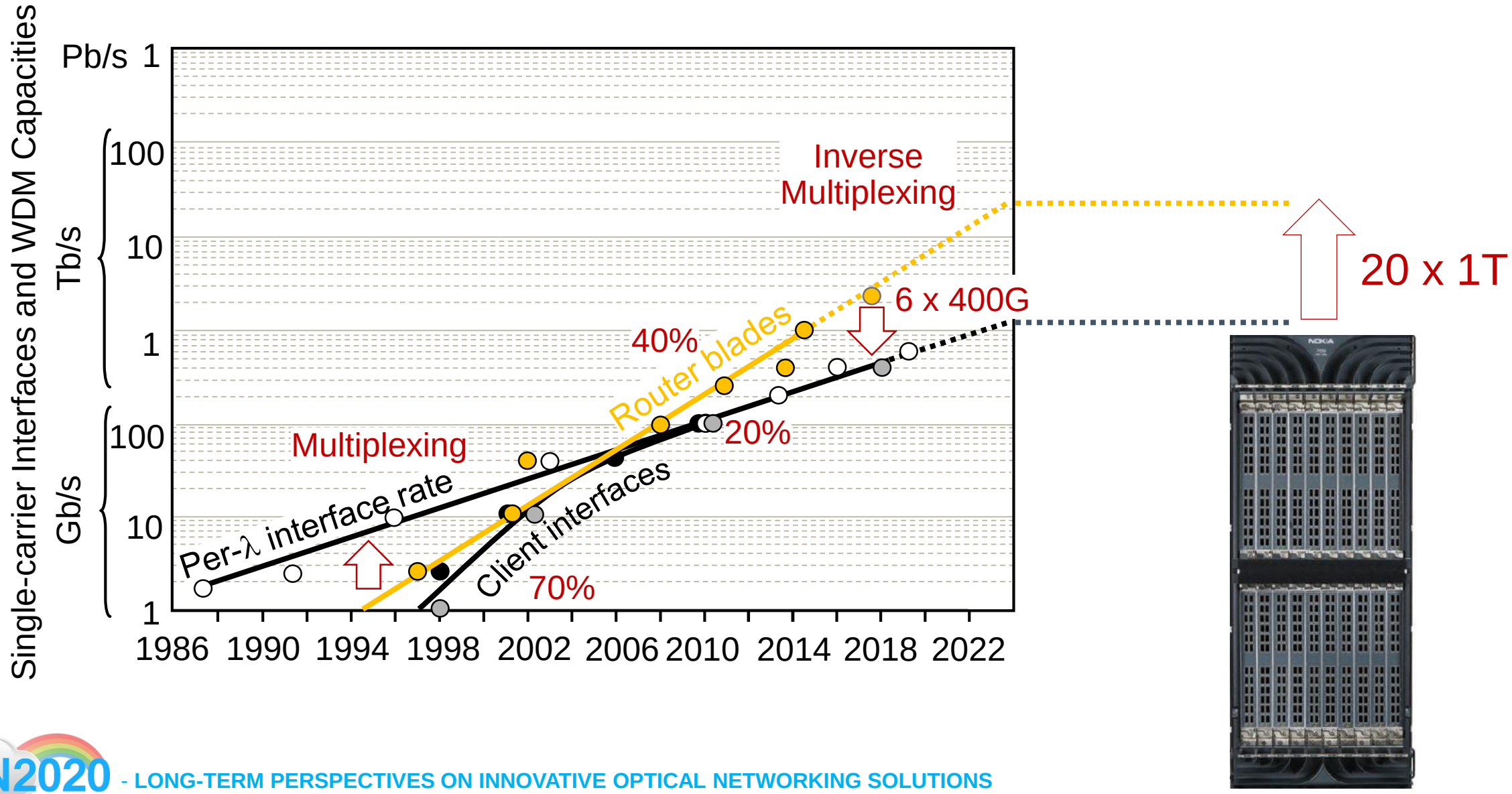
End-user IP traffic
End-to-end bytes
Peak-average

Compare with Cisco VNI:
~100 EB/month
~300 Terabit/s (average)
~24% growth per year

Optical networking interface rates



Optical networking interfacing vs. routing



Switch and coherent chip scaling – The same story

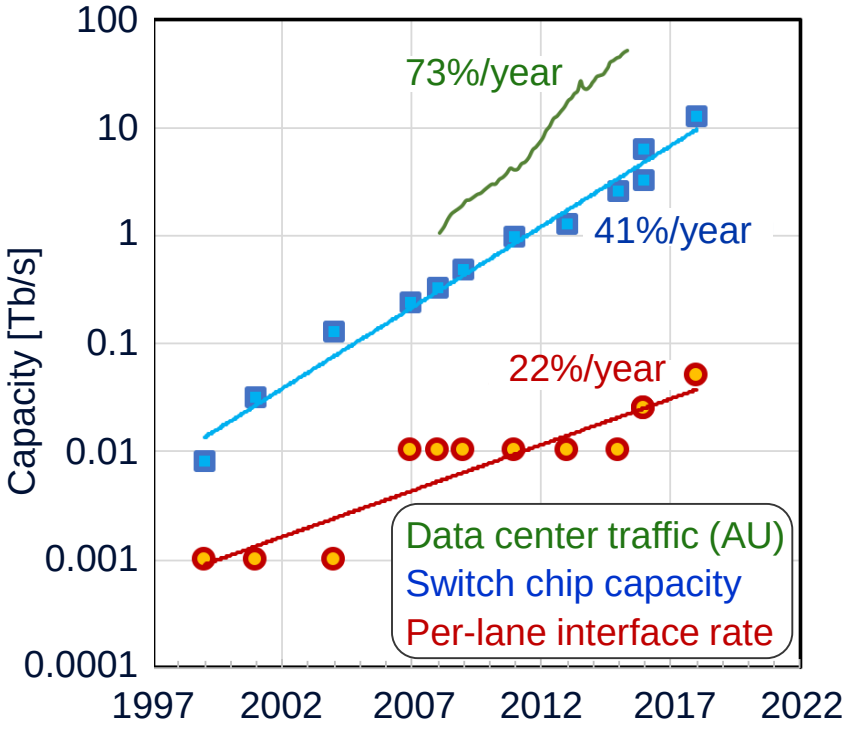
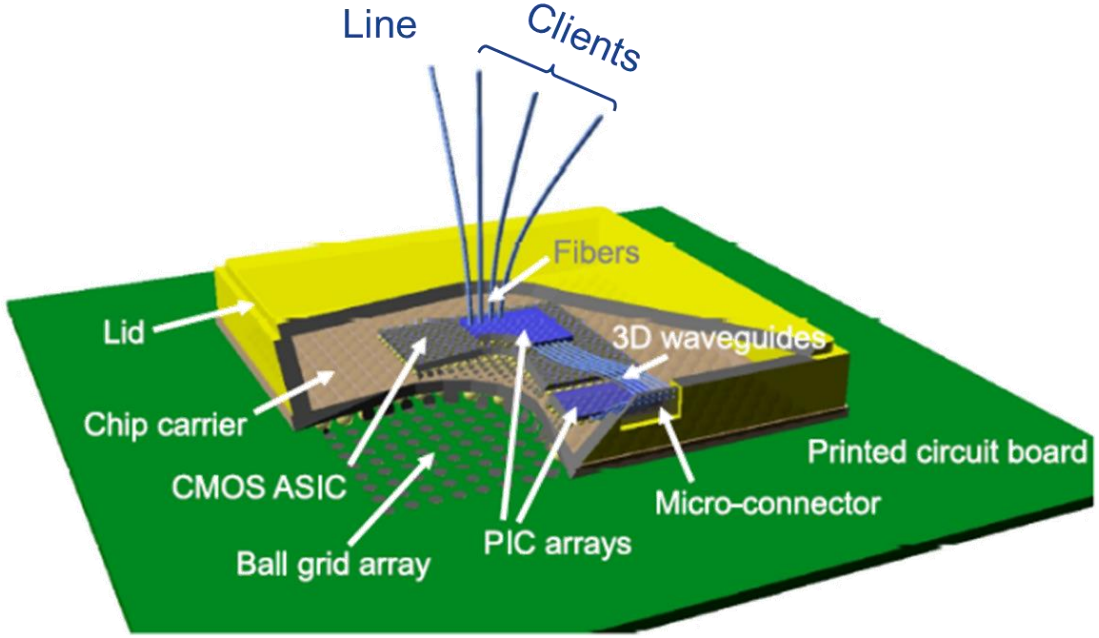


Figure after:
[R. J. Stone, OFC'17, Th3G.5]
[A. Singh et al., Sigcomm'15, 183]



Towards full optics-electronics integration
Fiber-in-fiber-out (FIFO) communications engines

https://www.osapublishing.org/oe/abstract.cfm?URI=oe-26-18-24190

Significant technology disparities

	Technology scaling	Exponential trend period	CAGR
Information Generation, Consumption, Processing	Supercomputer performance	1995 – 2017	90%
	Microprocessor performance	1980 – 2017	40% - 70%
	Storage capacity	1980 – 2017	60%
	Core router capacity	1985 – 2017	45%
	Switch chip capacity	1998 – 2018	40%
	Wireless interfaces	1995 – 2017	60%
	Fixed access interfaces	1983 – 2017	40 - 55%
Information Transport	Router interface speed	1980 – 2005	70%
		2005 – 2017	**20%**
	Transport interface speed	**1985 – 2017**	**20%**
	Per-lane chip interface speed	**1998 - 2018**	**20%**
	WDM capacity per fiber	1995 – 2000	100%
		2000 – 2017	**20%**

40%-90% (~60%)

!

~20%

5 years: 4x disparity

10 years: 17x disparity

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IEEE-SA - Optical Networks 2020

Helping to drive innovative optical network solutions toward the year 2020 and beyond

< Industry Connections

Optical Networks 2020

ABOUT

Optical Networks 2020 (ON2020) is a global association that drives innovative optical network solutions to better meet the optical networking demands in the cloud era towards year 2020 and beyond.

Please participate

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