Lecture 20
Top 500

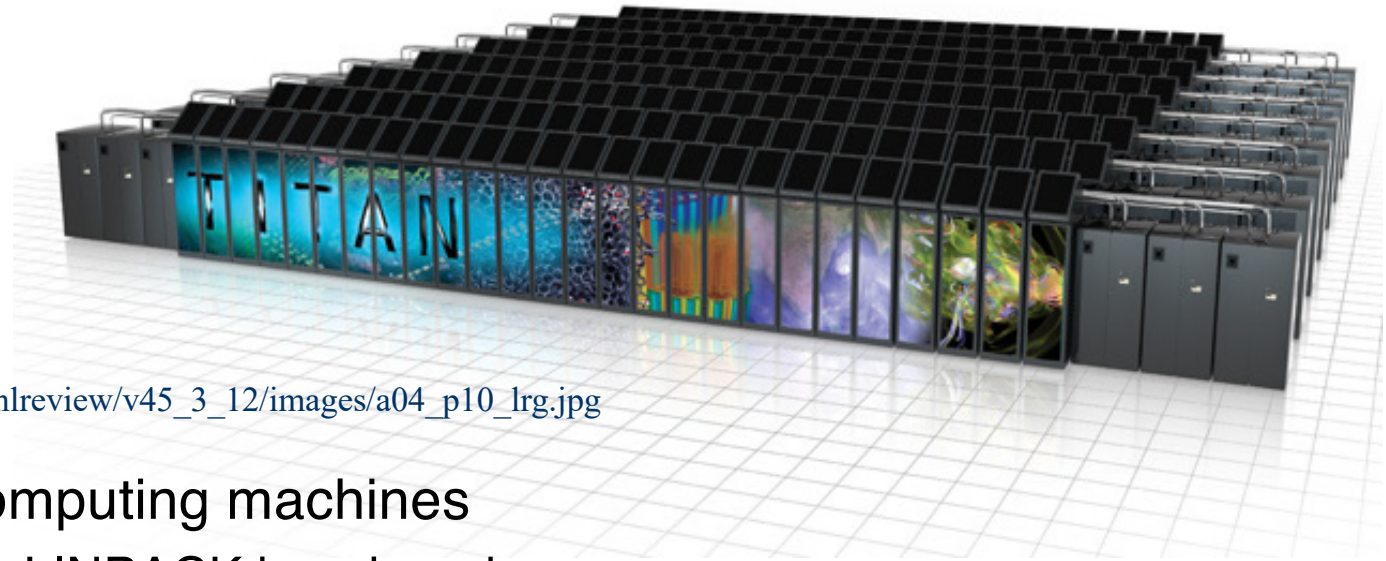EN 600.320/420/620

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12 March 2019

Department of Computer Science, *Johns Hopkins University*

Images in lecture from
https://www.top500.org/static/media/uploads/top500_ppt_201806.pdf
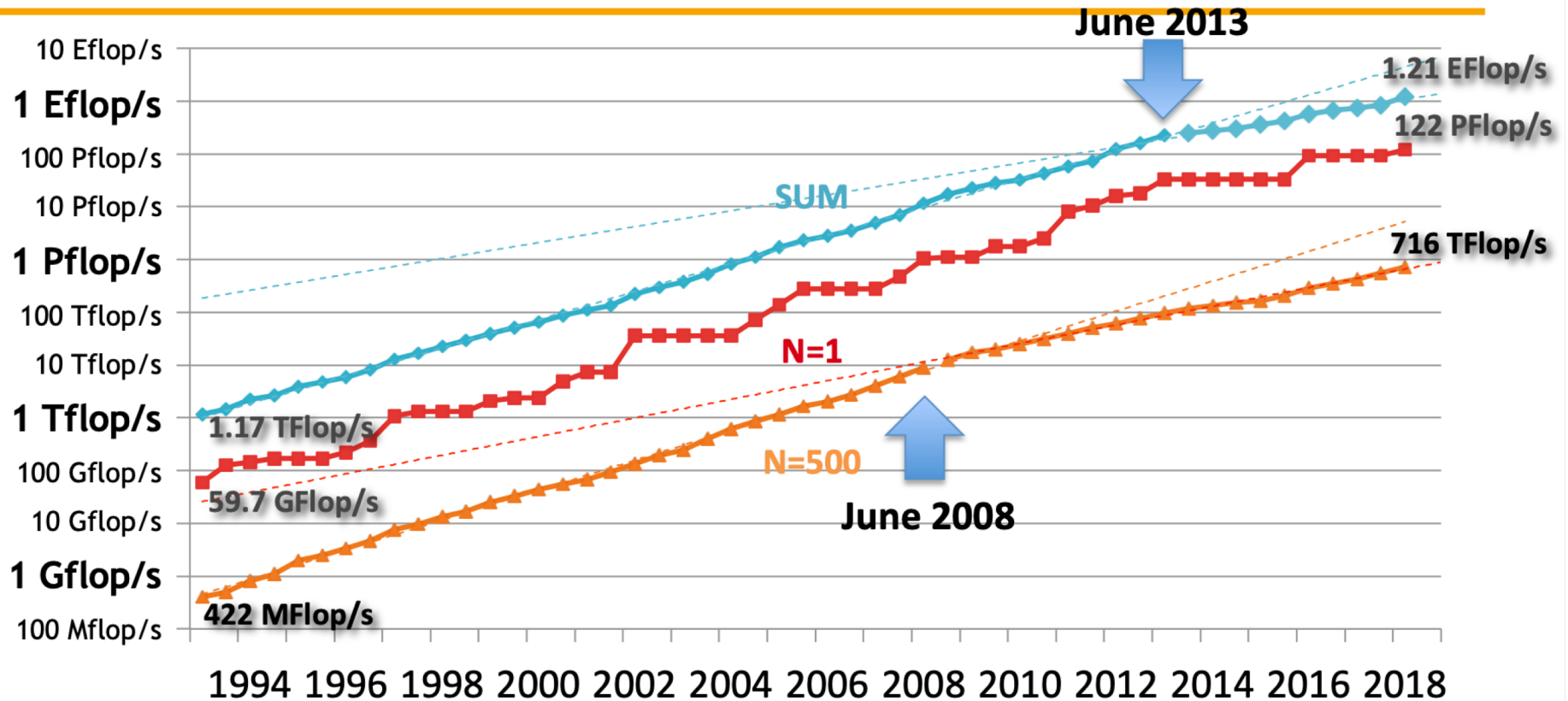
TOP500

- Fastest 500 computing machines
  - According to LINPACK benchmark
- Controversial
  - Other metrics represent other problems
  - Green500: best computing power per watt
- Currently "Summit" ORNL, US
  - 122 TFLOP/s, 2.2M cores, 8.8 kW
  - IBM Power 8 + NVidia V100 GPUs
- #2 "Sunway TaihuLight" Xiwu Chine
  - 93 TFlops, 10,649,000 cores, 15,371 kW
  - All Chinese hardware

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Top500 Growth (Exascale coming)

https://www.top500.org/static/media/uploads/top500_ppt_201806.pdf

Top500: Flops

| Rank	Site	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	DOE/SC/Oak Ridge National Laboratory United States	**Summit** - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband IBM	2,282,544	122,300.0	187,659.3	8,806
2	National Supercomputing Center in Wuxi China	**Sunway TaihuLight** - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway NRCPC	10,649,600	93,014.6	125,435.9	15,371
3	DOE/NNSA/LLNL United States	**Sierra** - IBM Power System S922LC, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband IBM / NVIDIA / Mellanox	1,572,480	71,610.0	119,193.6	
4	National Super Computer Center in Guangzhou China	**Tianhe-2A** - TH-IVB-FEP Cluster, Intel Xeon E5-2692v2 12C 2.2GHz, TH Express-2, Matrix-2000 NUDT	4,981,760	61,444.5	100,678.7	18,482

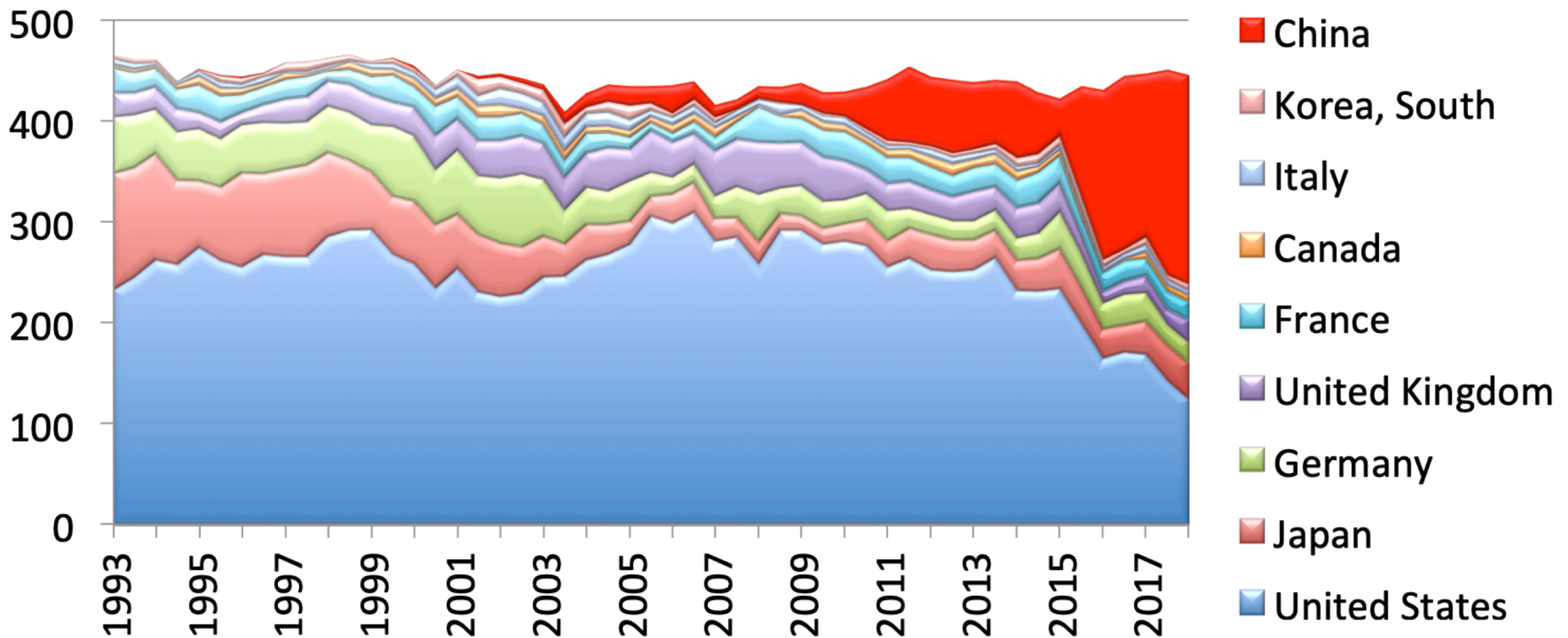# Top500 and Moore's Law

ANNUAL PERFORMANCE INCREASE OF THE TOP500

Top 500 Evolution

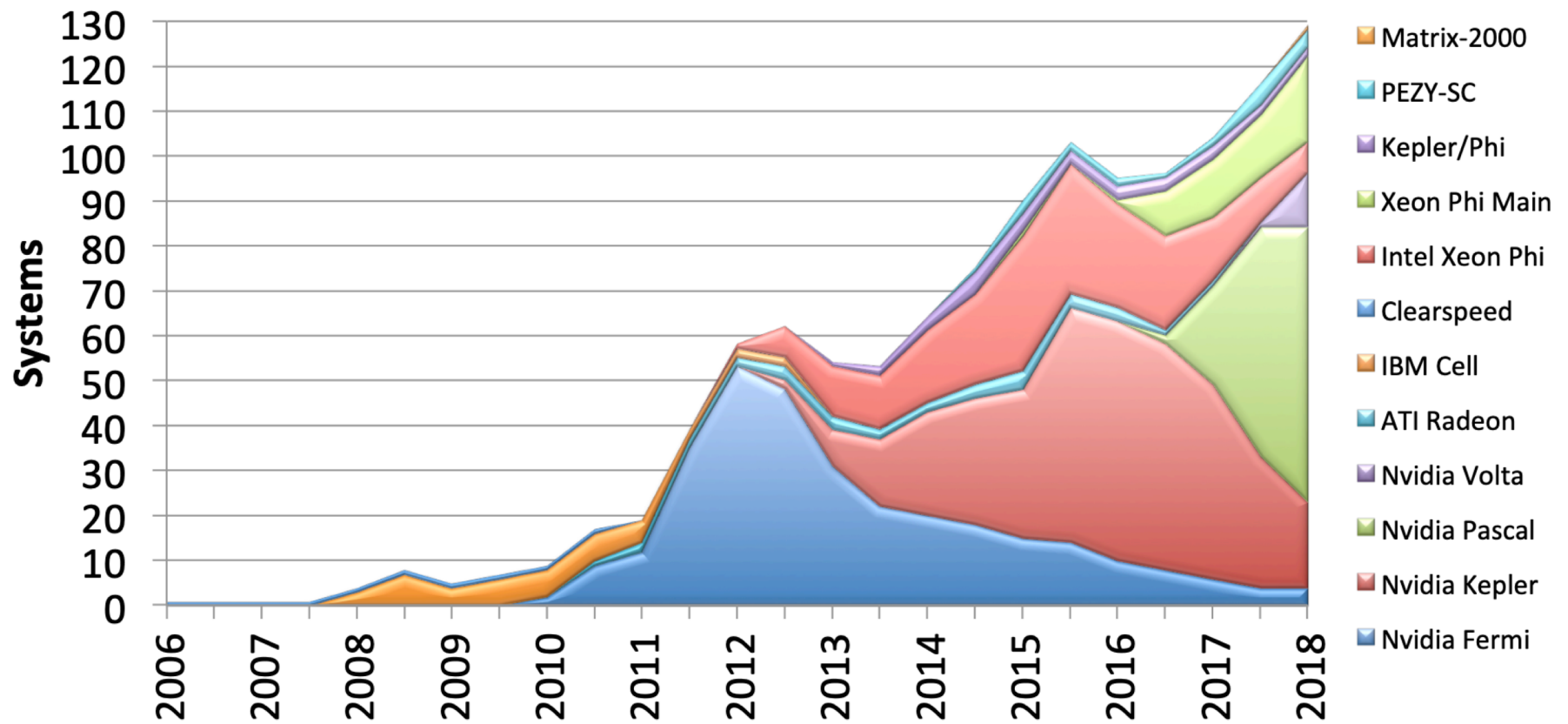Architecture Share Over Time
1993-2011

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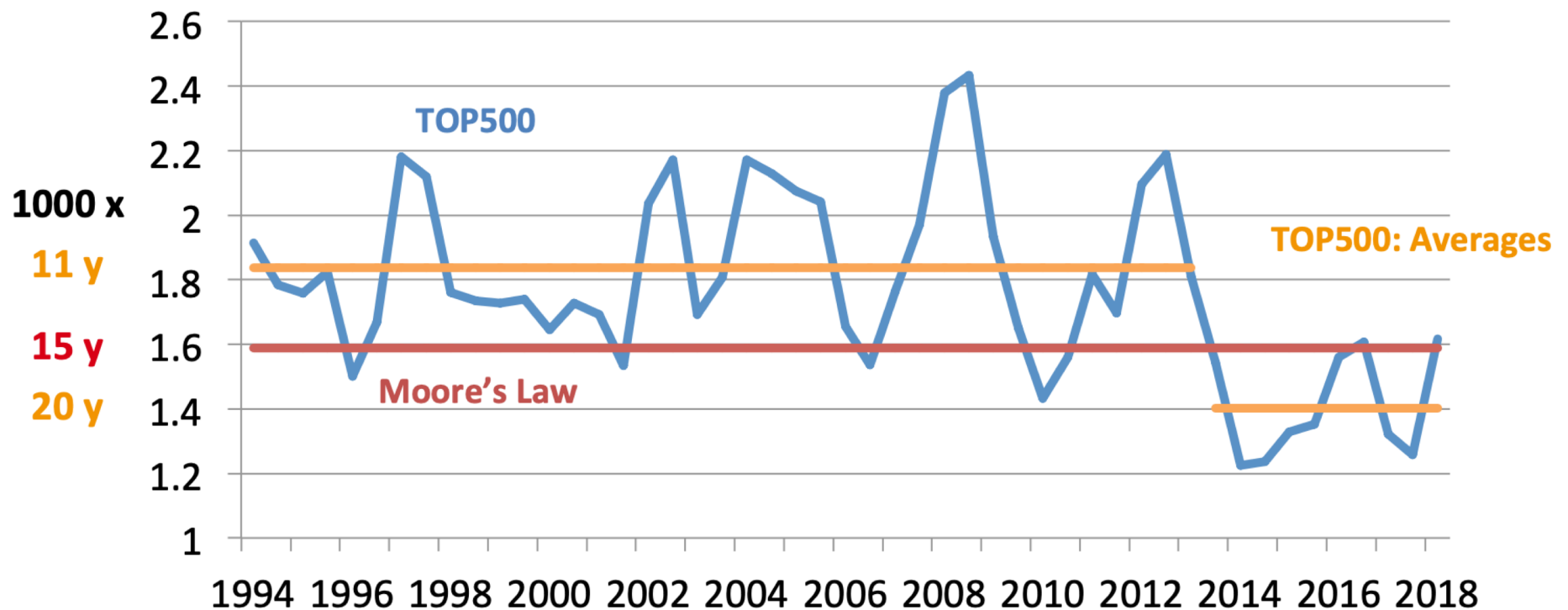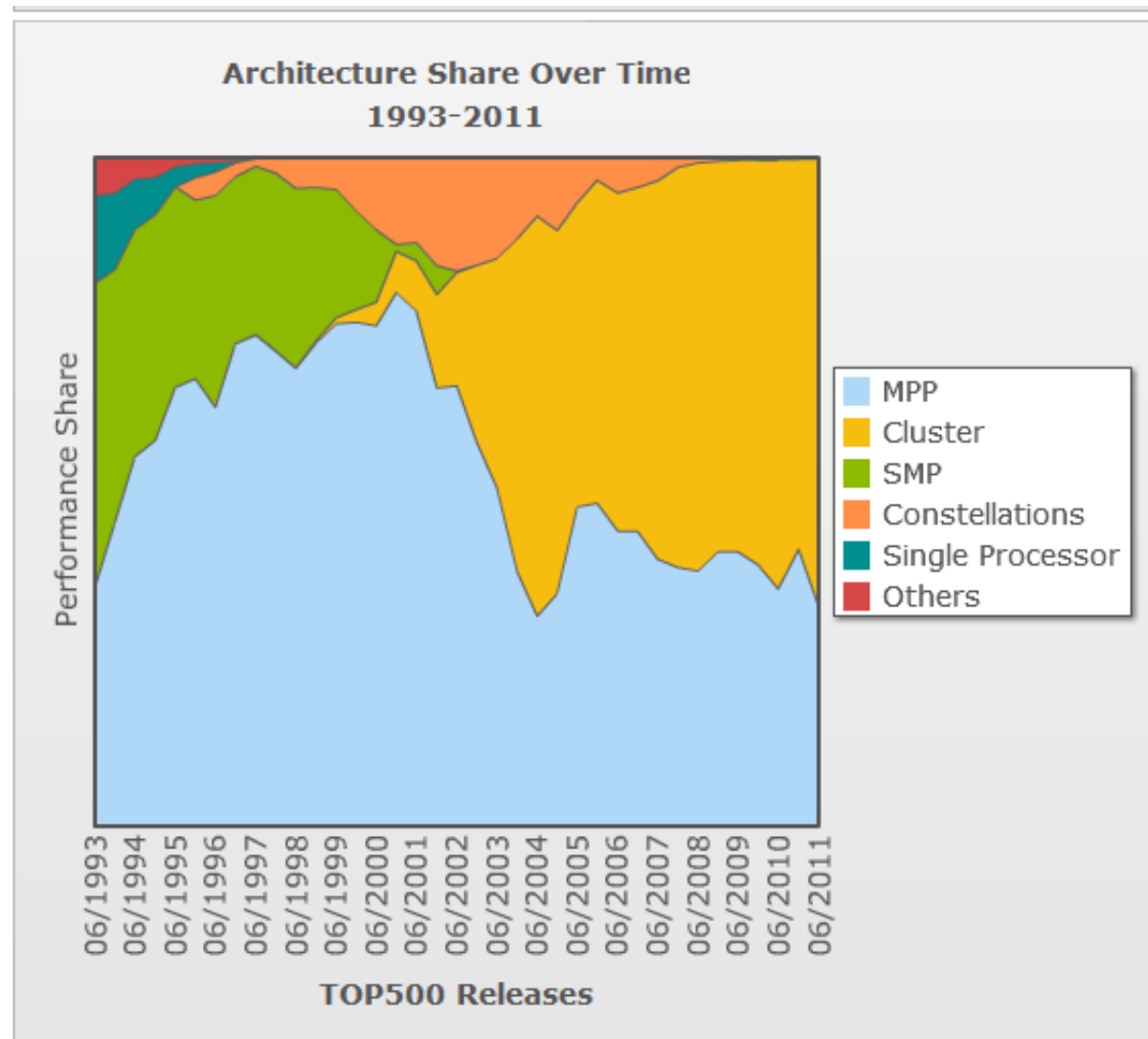
Who has supercomputers?

The Rise of Accelerators

Top 500 Conclusions

- Exaflop in reach

- Accelerators are ubiquitous

- Despite US reemergence, China dominates
  - 40% of systems
  - Chinese made hardware

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Green 500

- GFlops/watt

  – Power efficiency will be the limited factor in reaching exascale computing

  – Also co-branded as environmentally friendly

The GREEN 500

MOST ENERGY EFFICIENT ARCHITECTURES

TOP 500

Computer				Rmax/ Power
Shoubou system B, ZettaScaler-2.2	Xeon 16C 1.3GHz	Infiniband EDR	PEZY-SC2	**18.4**
Suiren2, ZettaScaler-2.2	Xeon 16C 1.3GHz	Infiniband EDR	PEZY-SC2	**16.8**
Sakura, ZettaScaler-2.2	Xeon 8C 2.3GHz	Infiniband EDR	PEZY-SC2	**16.7**
DGX Saturn V, NVIDIA DGX-1 Volta36	Xeon 20C 2.2GHz	Infiniband EDR	Tesla V100	**15.1***
Summit, IBM Power System	Power9 22C 3.07GHz	Infiniband EDR	Volta GV100	**13.9**

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What's a Zettascaler??

- PEZY-SCx accelerator
  - 3 level hierarchy of computer 128 cities x 4 villages x 4 cores
    - L2 shared @ "city"
    - L1 shared @ "village"

- ExaScaler flouro-carbon based liquid cooling
- TCI stack die RAMs
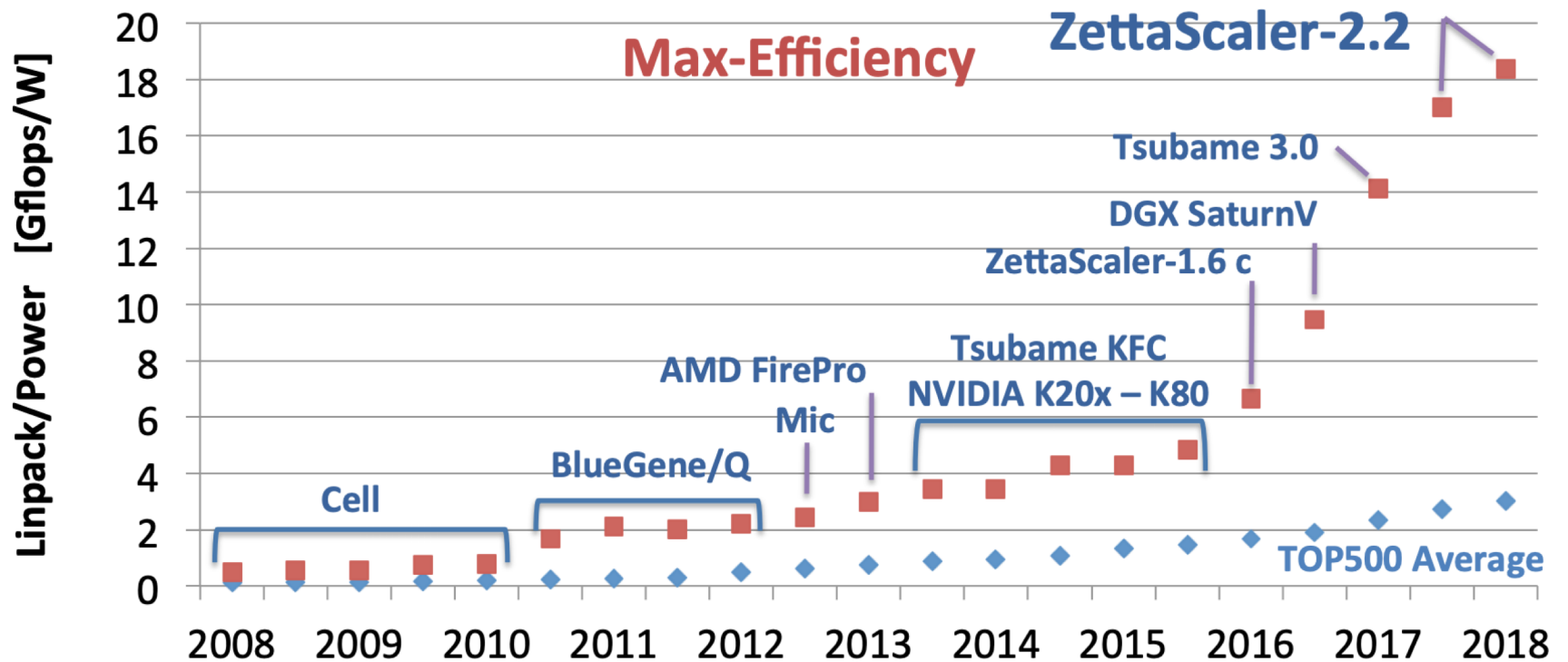
All of this creates remarkable density
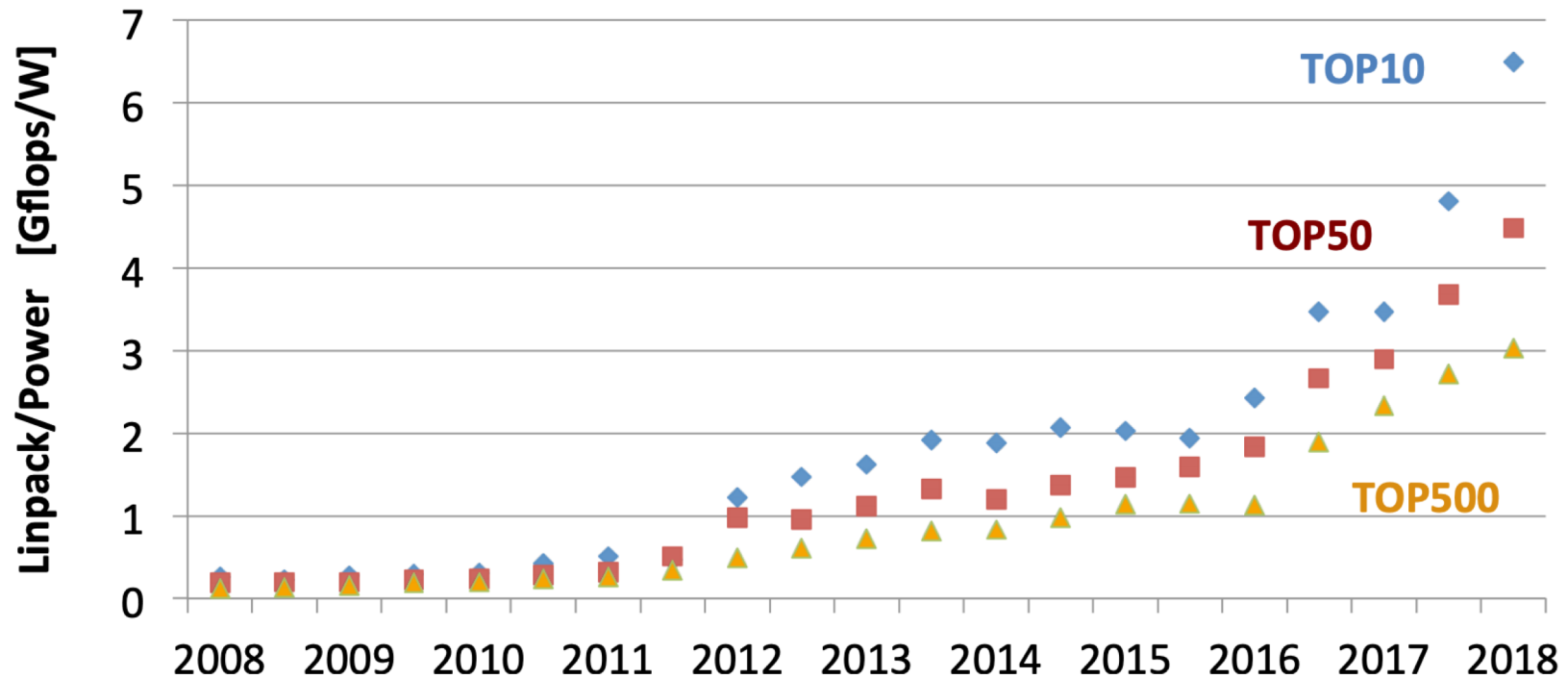
Green Trends Architectures

What else is going on?

- Convergence between TOP500 and Green 500
  - Power and cooling density limits overall performance
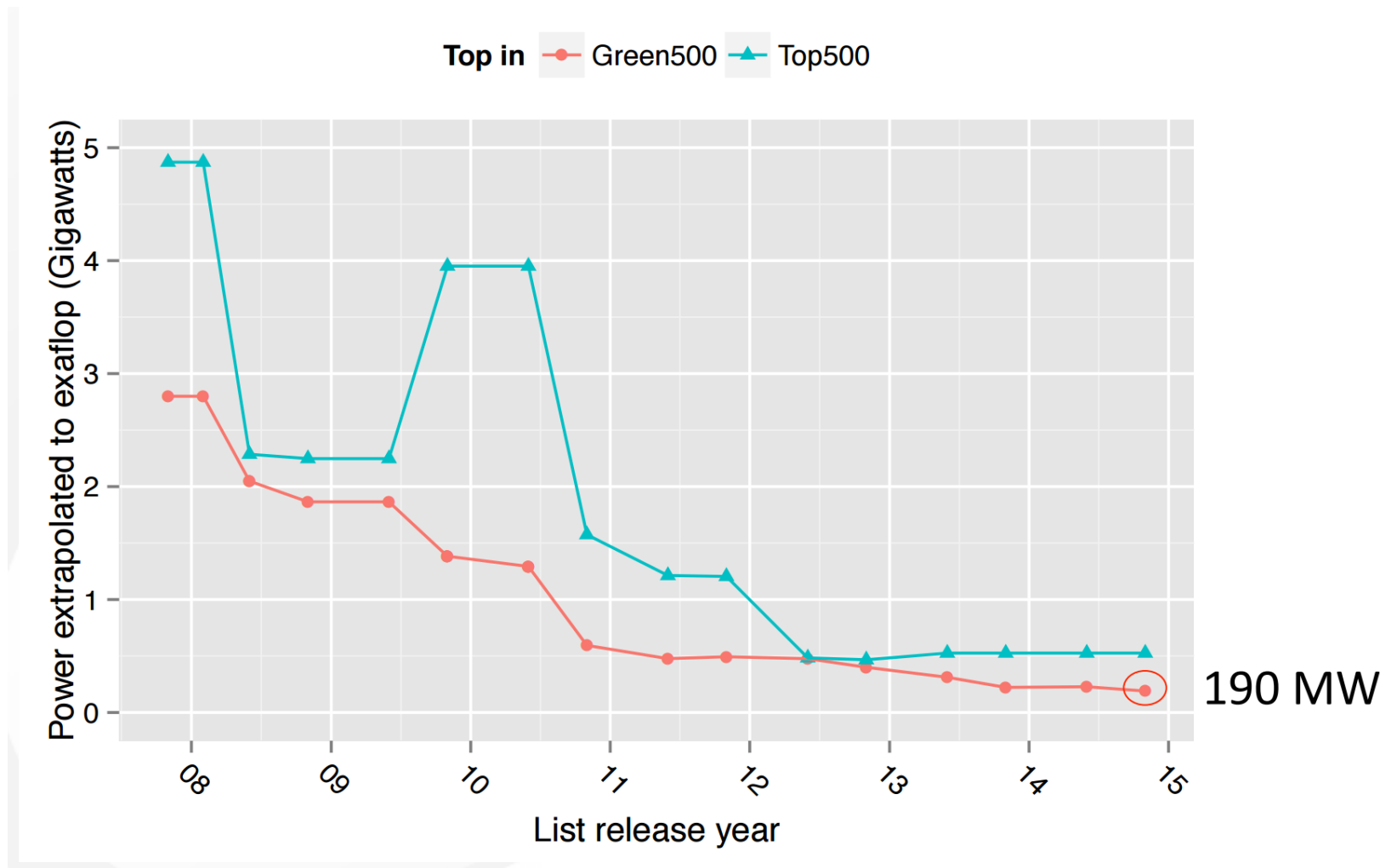 - Can't make a fast machine that's not efficient

- T#1 = G#5

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Green Trends
Efficiency

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Exascale at 25 MW?

The Green500 BoF, SC|14, Nov. 2014
POC: info@green500.org

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Final Comments

- Multiple Chinese manufacturers
- Lenovo doing substantial business outside China
  - 21 in US, 23 in rest of world

- Slow down in performance growth
  - More focus at top machines
  - Longer lifetime on TOP500 (2x)
  - I'm not totally convinced that this is not (death of) Moore's law related?

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