Master Informatics Eng.

2020/21

A.J.Proença

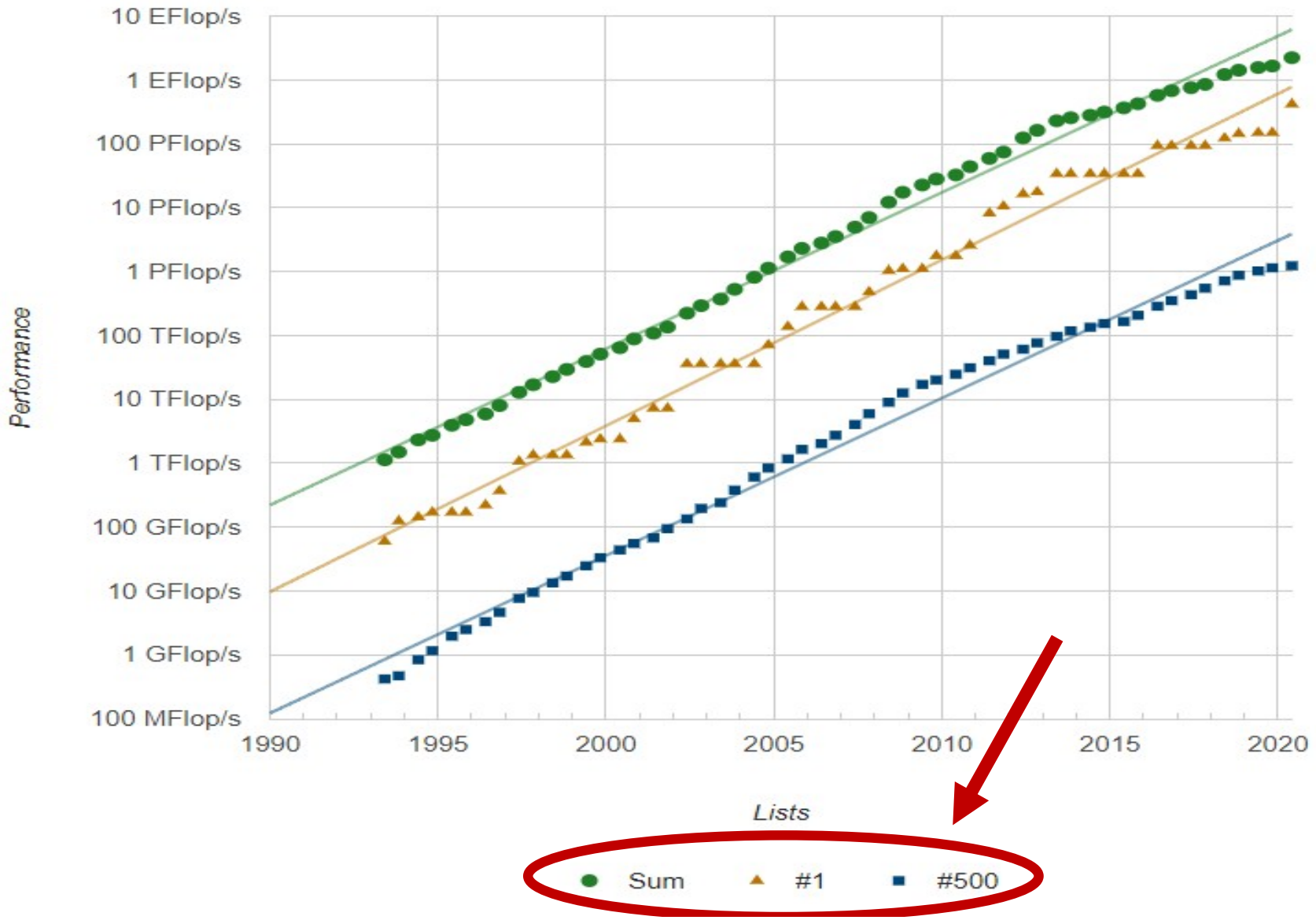
TOP500 & MACC *(online)*

(most images and some slides are borrowed)

Suggestion of homework for discussion in this session

1. Go to the TOP500 website and analyse & comment:
   i. The country distribution over the past 25 years, in #systems and aggregate performance in the TOP500 list
   ii. The evolution of the key PU chip technologies and the accelerator families in the past 25 years
   iii. The overall impact of each processor technology and accelerator family in the past 3 years
2. EuroHPC is funding 8 supercomputing centres selected in June 2019: 3 pre-exascale & 5 petascale
   i. Find & identify these 8 supercomputing centres
   ii. Characterize the architecture of Deucalion in MACC

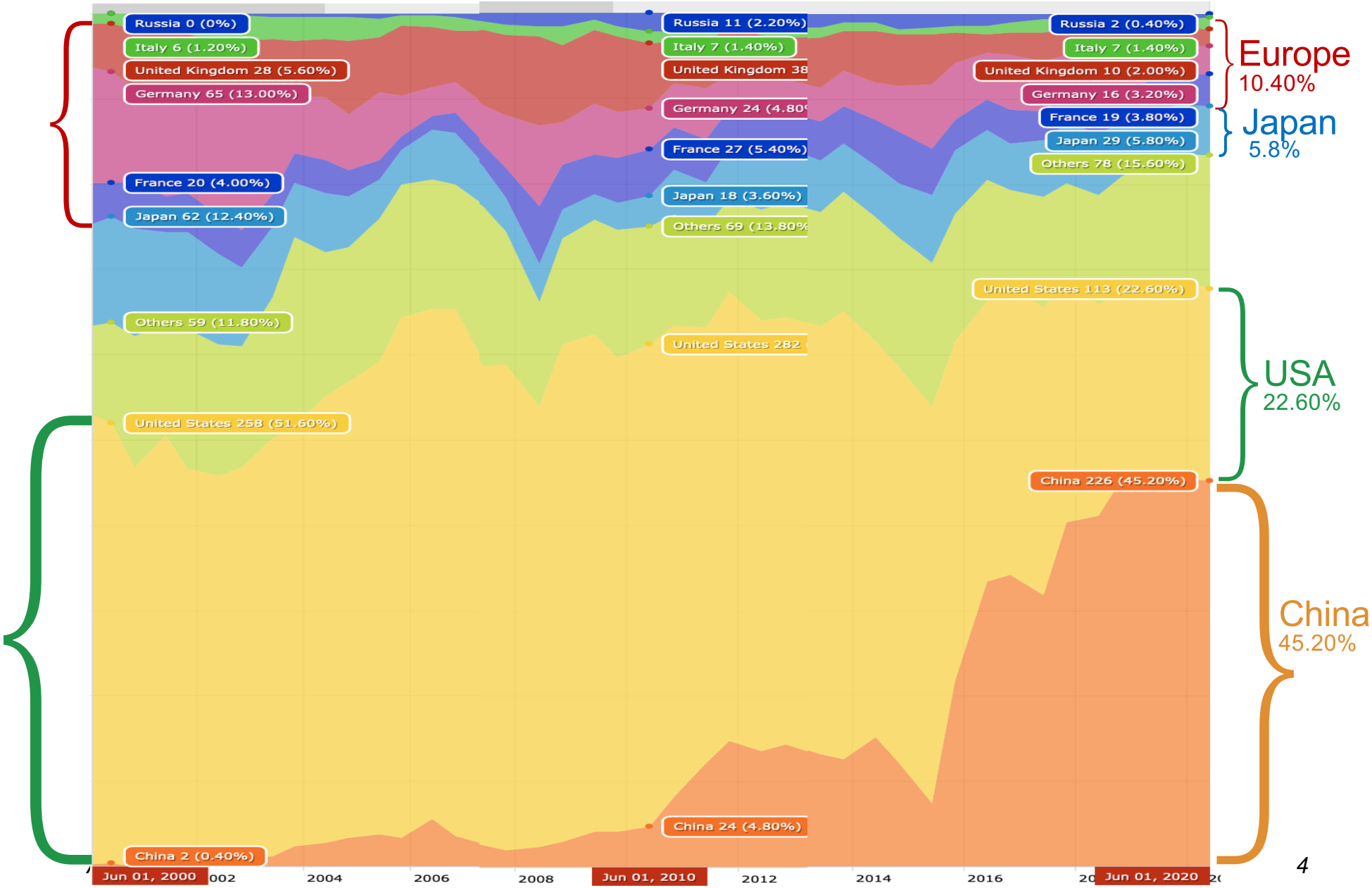
Peak performance from 1993 to 2020



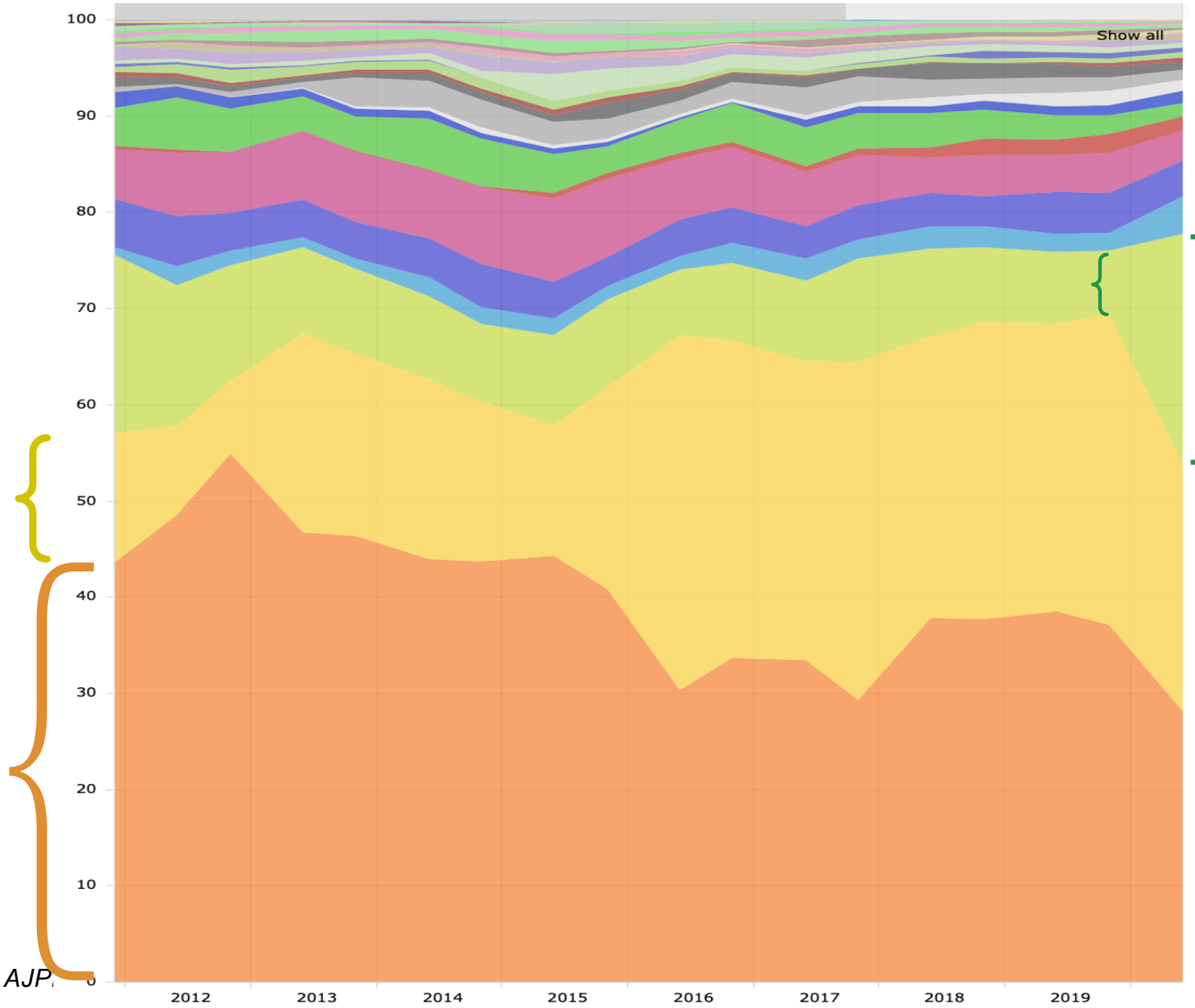
https://www.nextplatform.com/2020/06/22/arm-and-japan-get-their-day-in-the-hpc-sun/

Country distribution over the past 20 years:

systems



Country distribution over the past 8 years:
aggregate performance



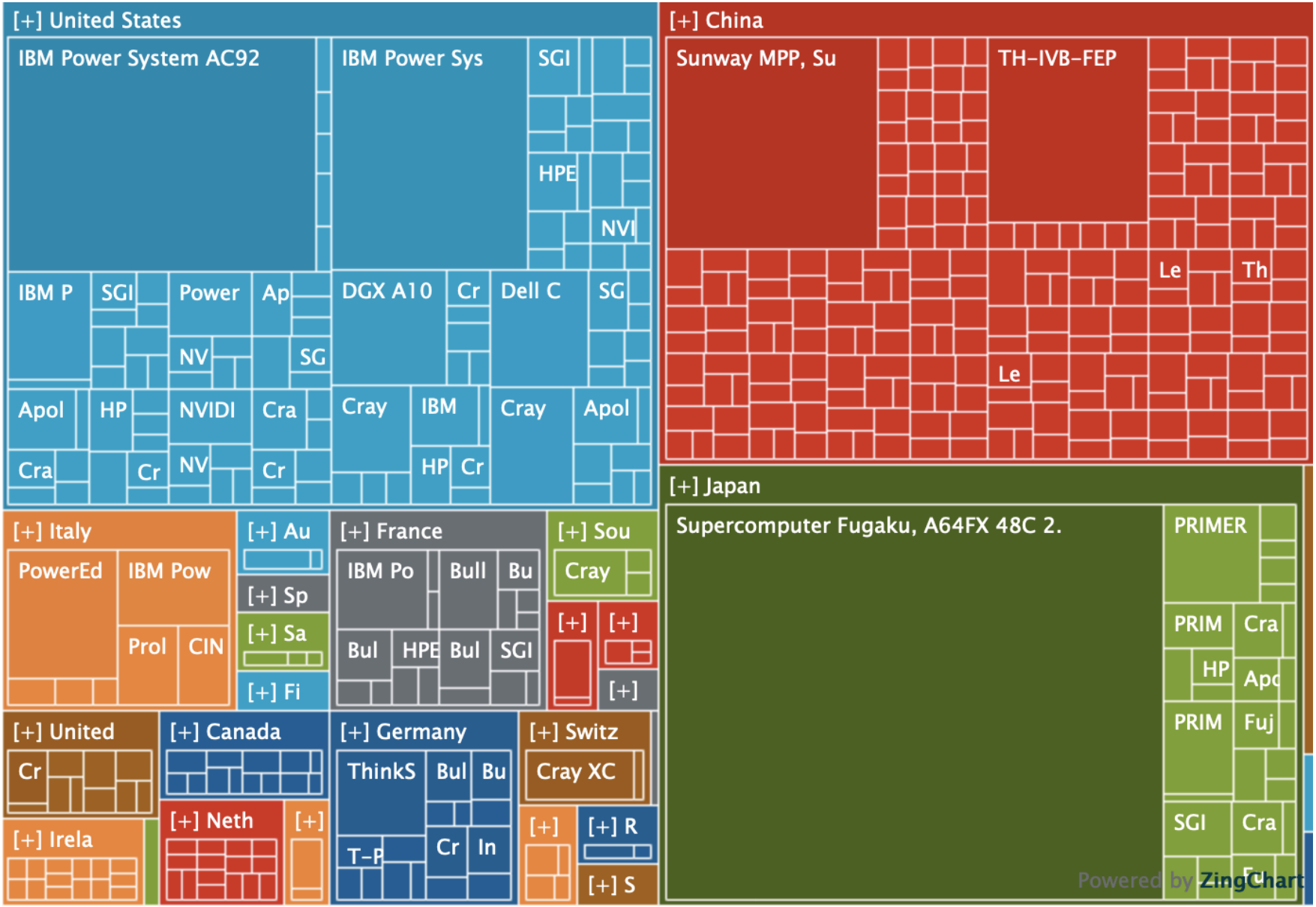
Europe
13.46%

Japan
23.92%

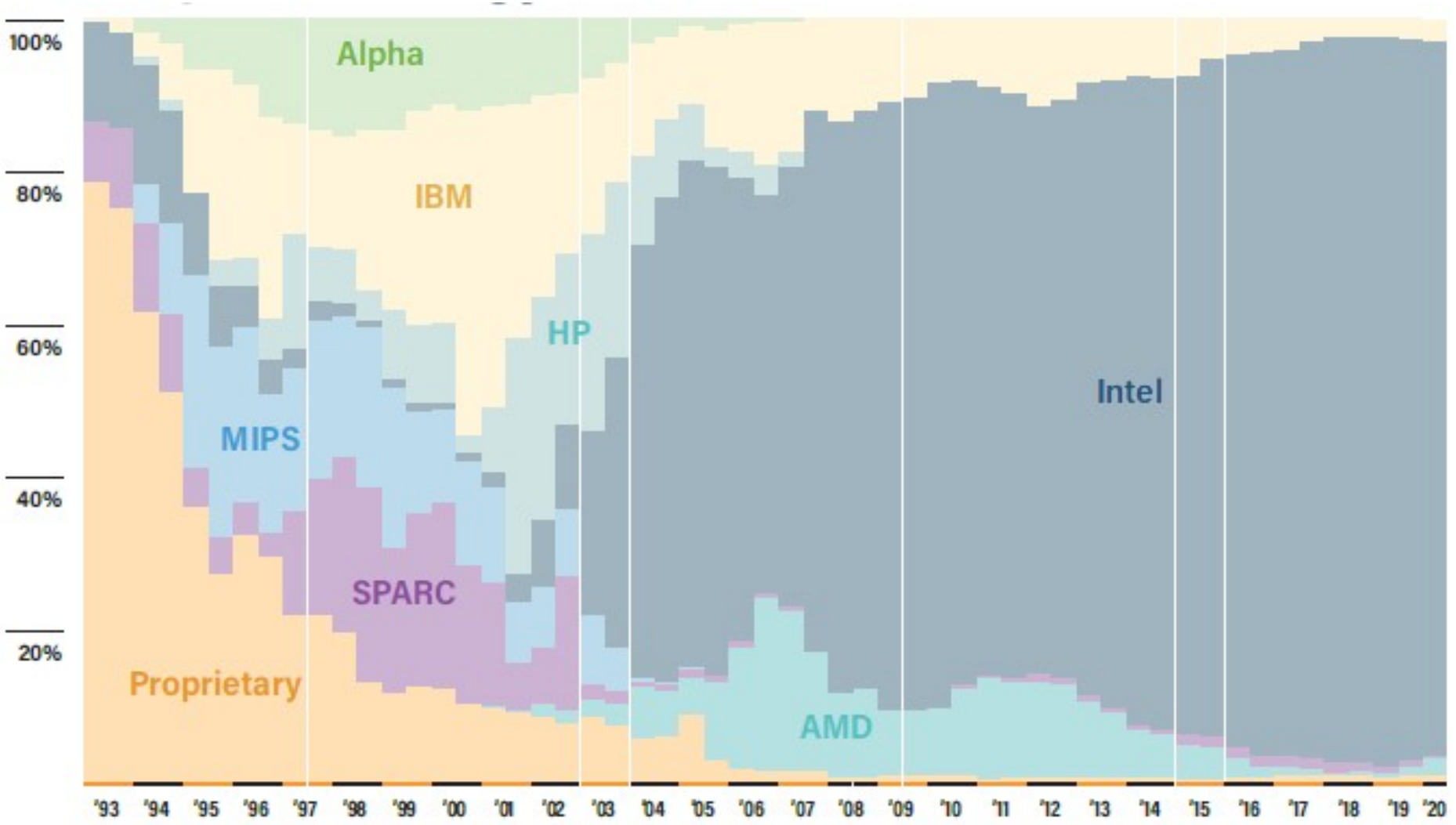
China
25.64%

USA
28.18%

Country distribution in Jun'20:
#systems & performance

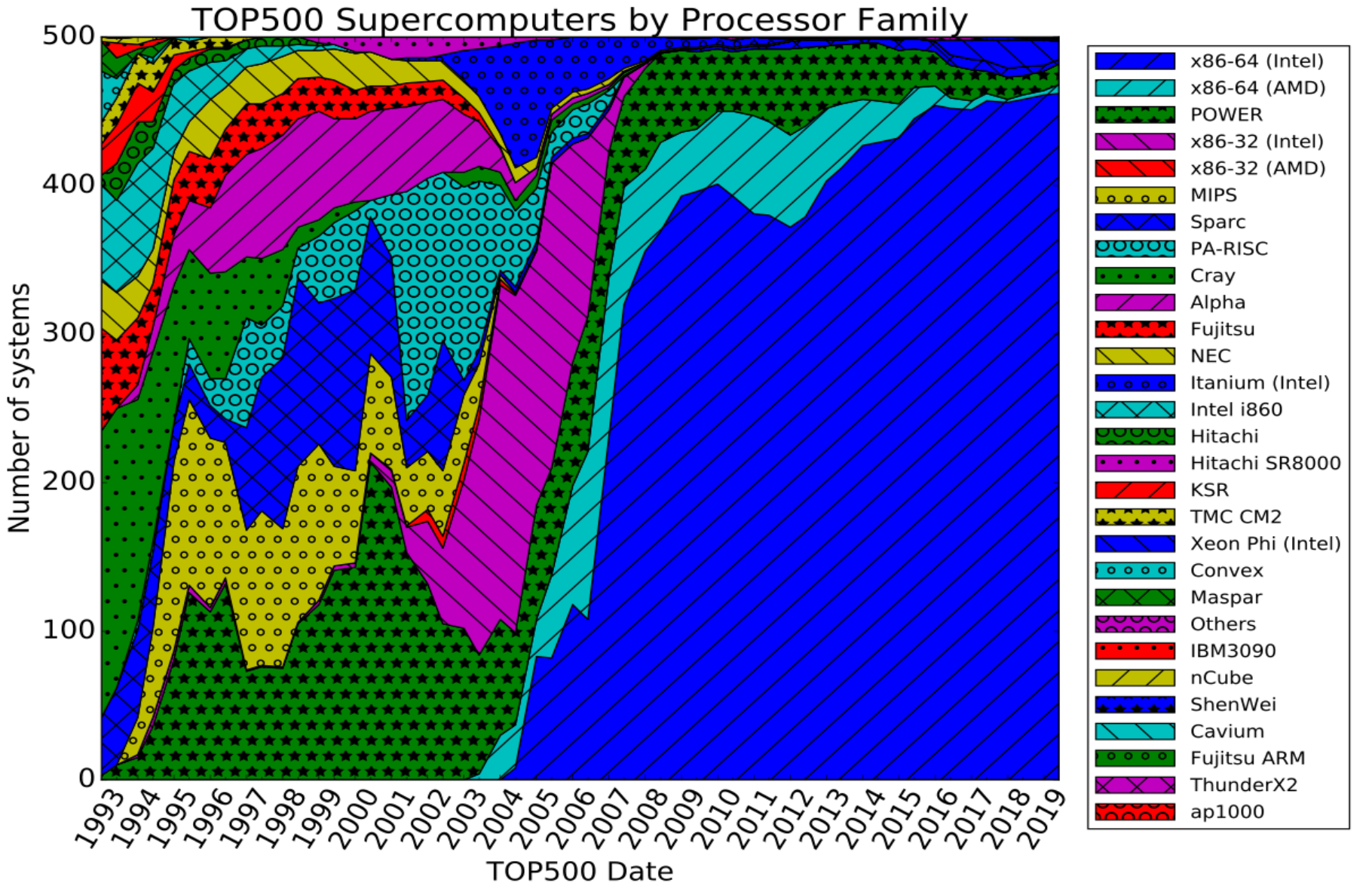


PU chip technology from 1993 to 2020



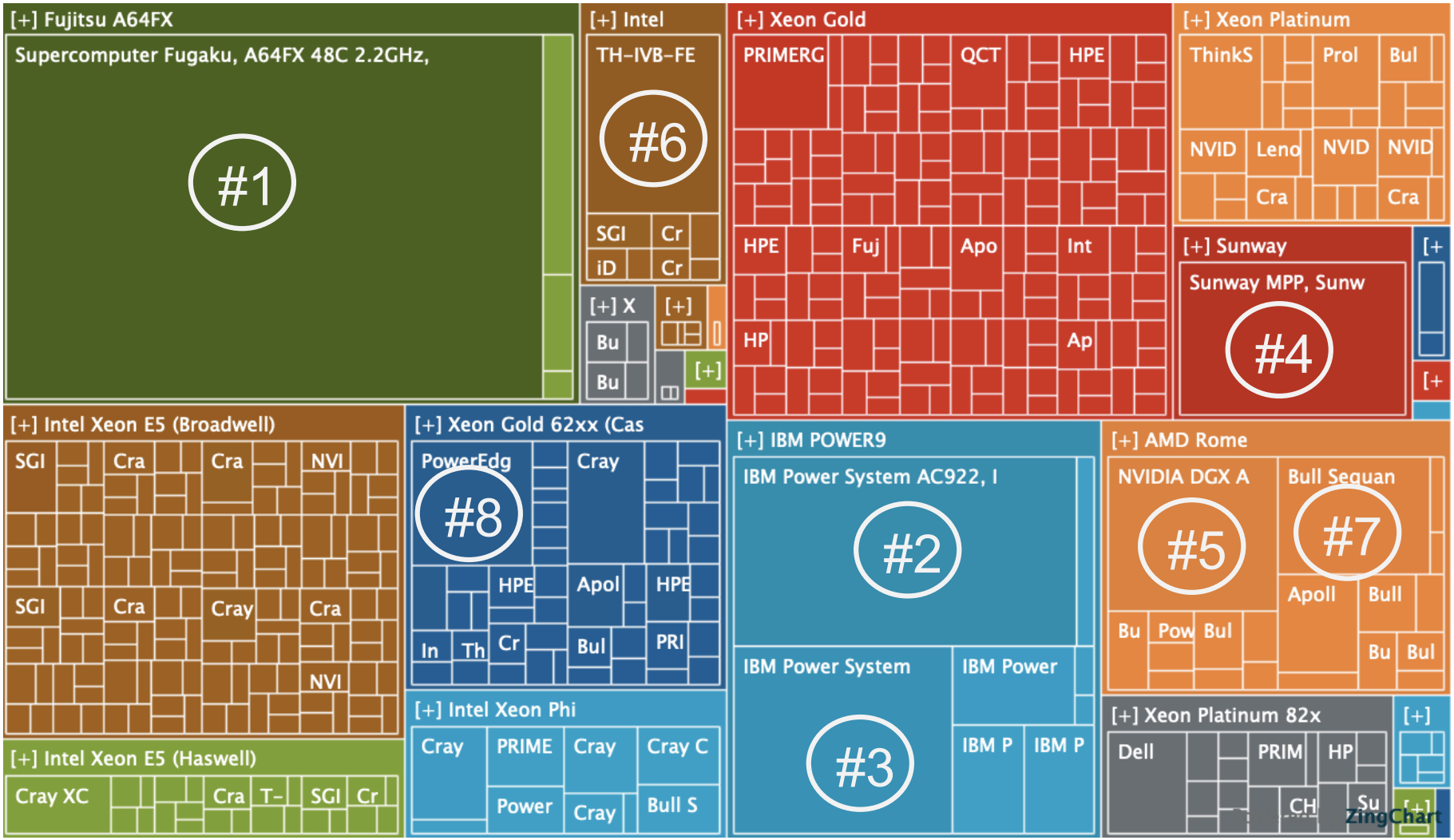
https://www.nextplatform.com/2020/06/22/arm-and-japan-get-their-day-in-the-hpc-sun/

Top processor families from 1993 to 2019



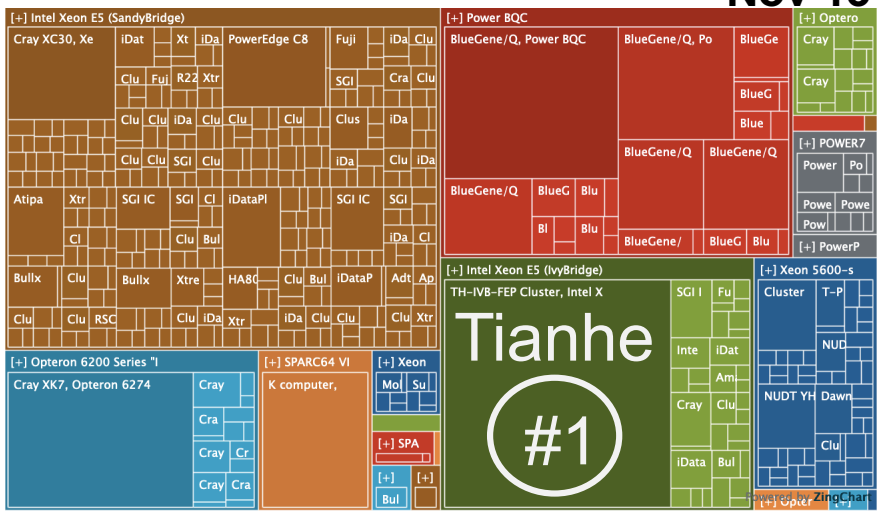
https://en.wikipedia.org/wiki/TOP500

Processor distribution
Nov'20

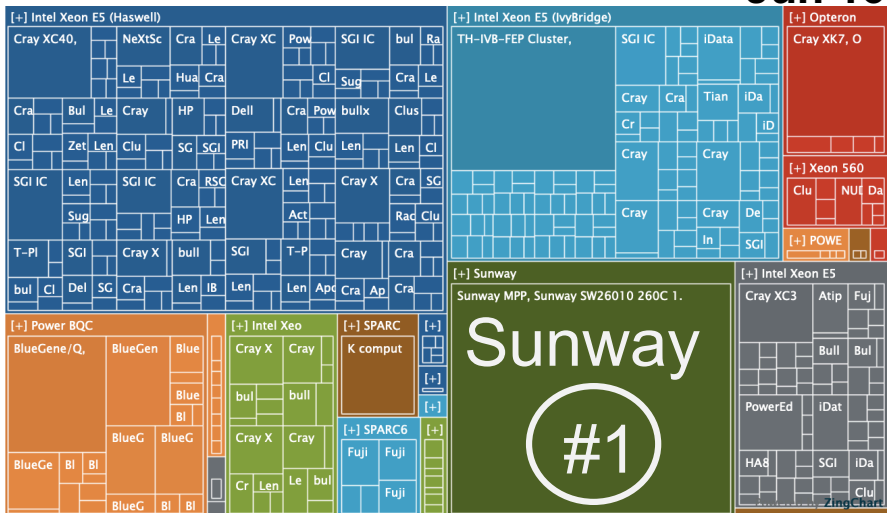


Architecture family of key #1's: from Nov'13 to Nov'20

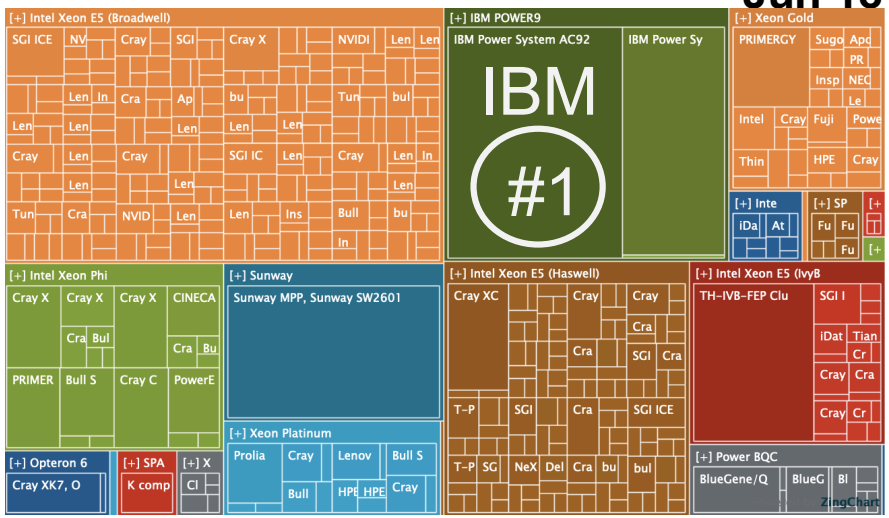
Nov'13



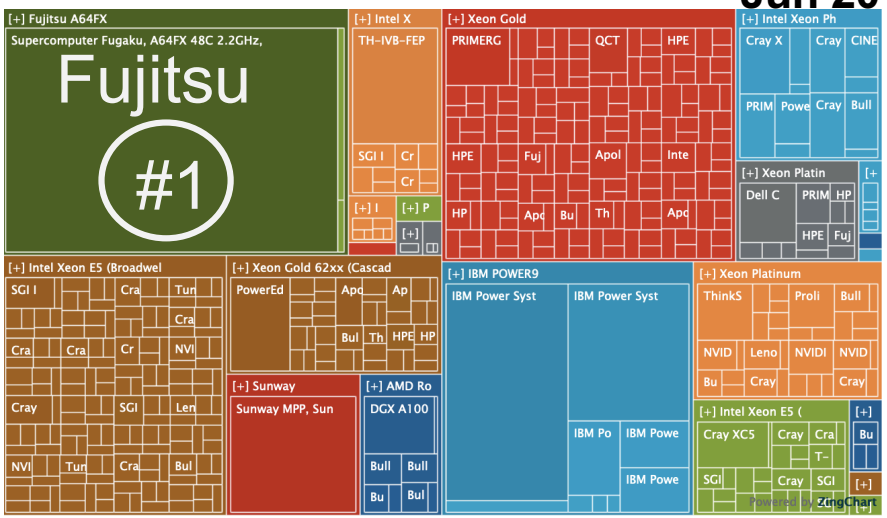
Jun'16



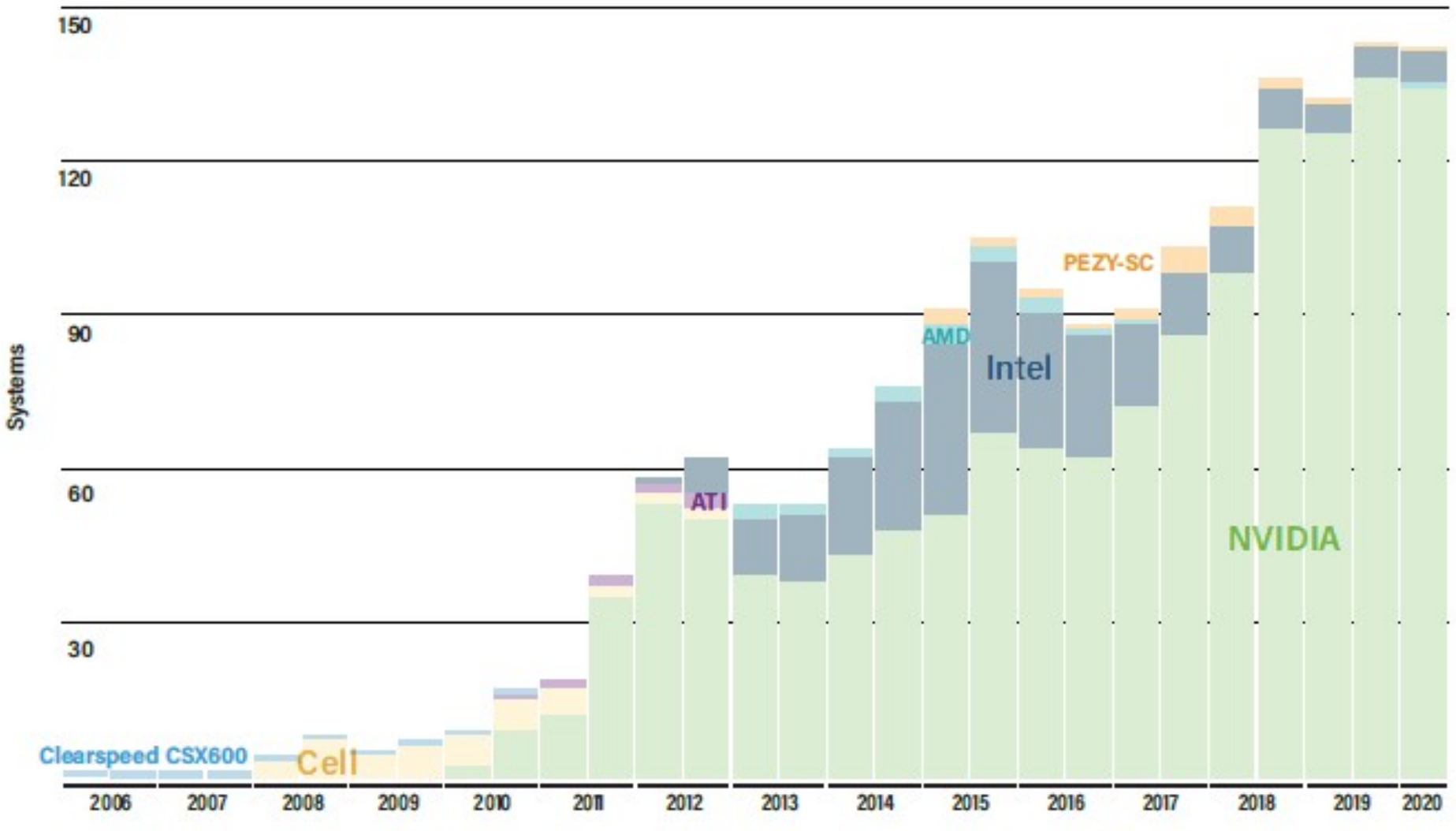
Jun'18



Jun'20



Accelerator families from 2006 to 2020



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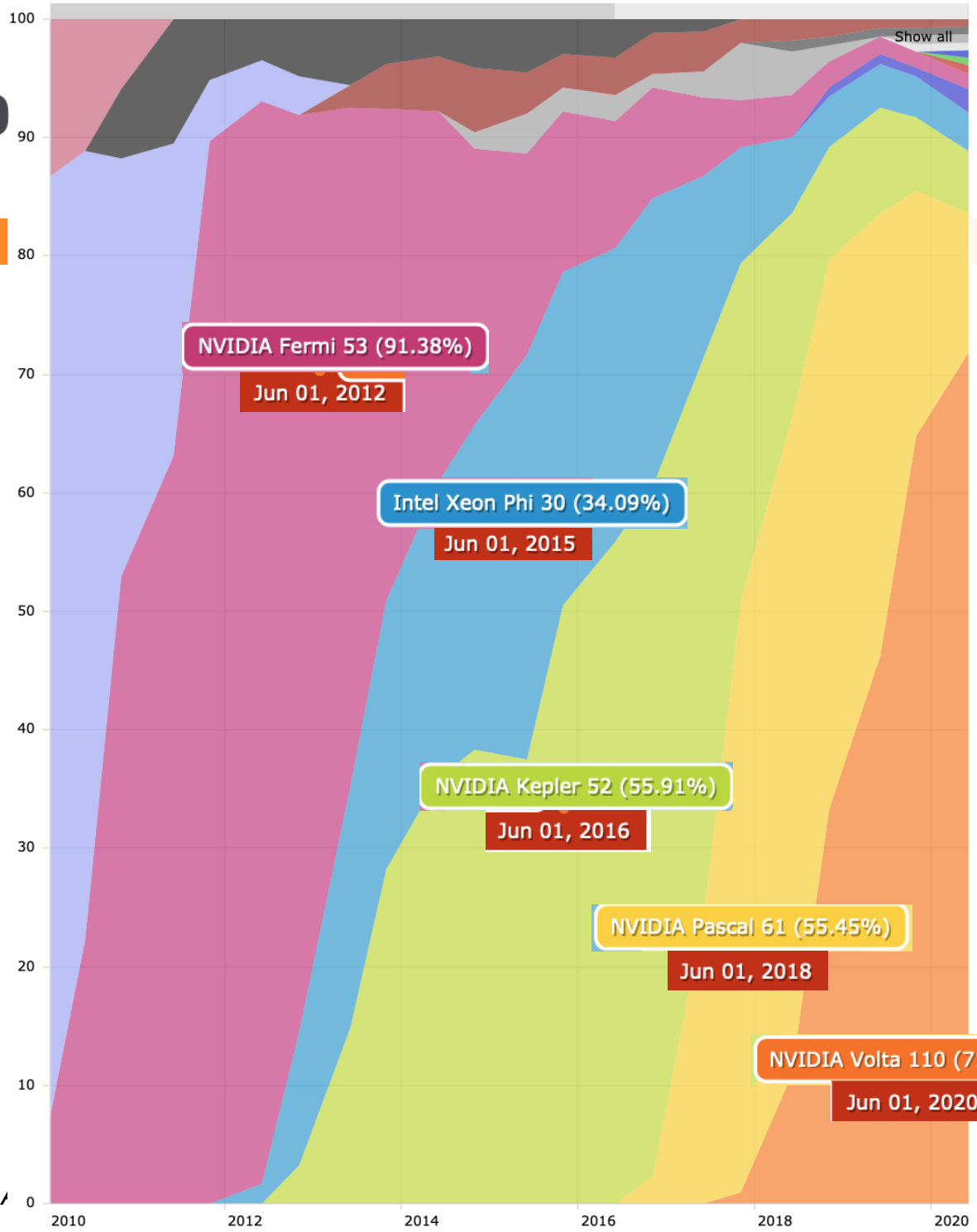
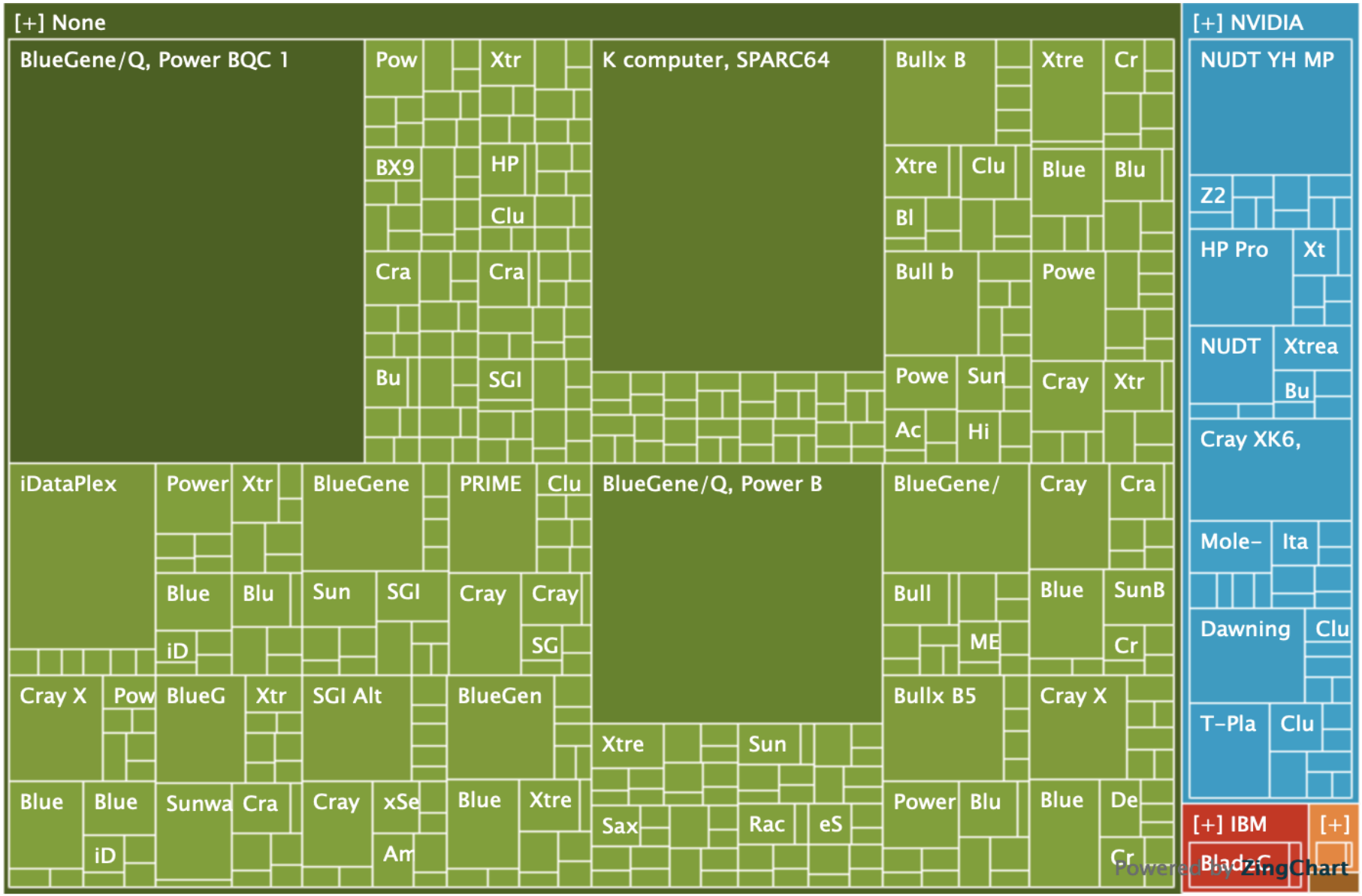
Accelerators: #systems Jun'10-Jun'20



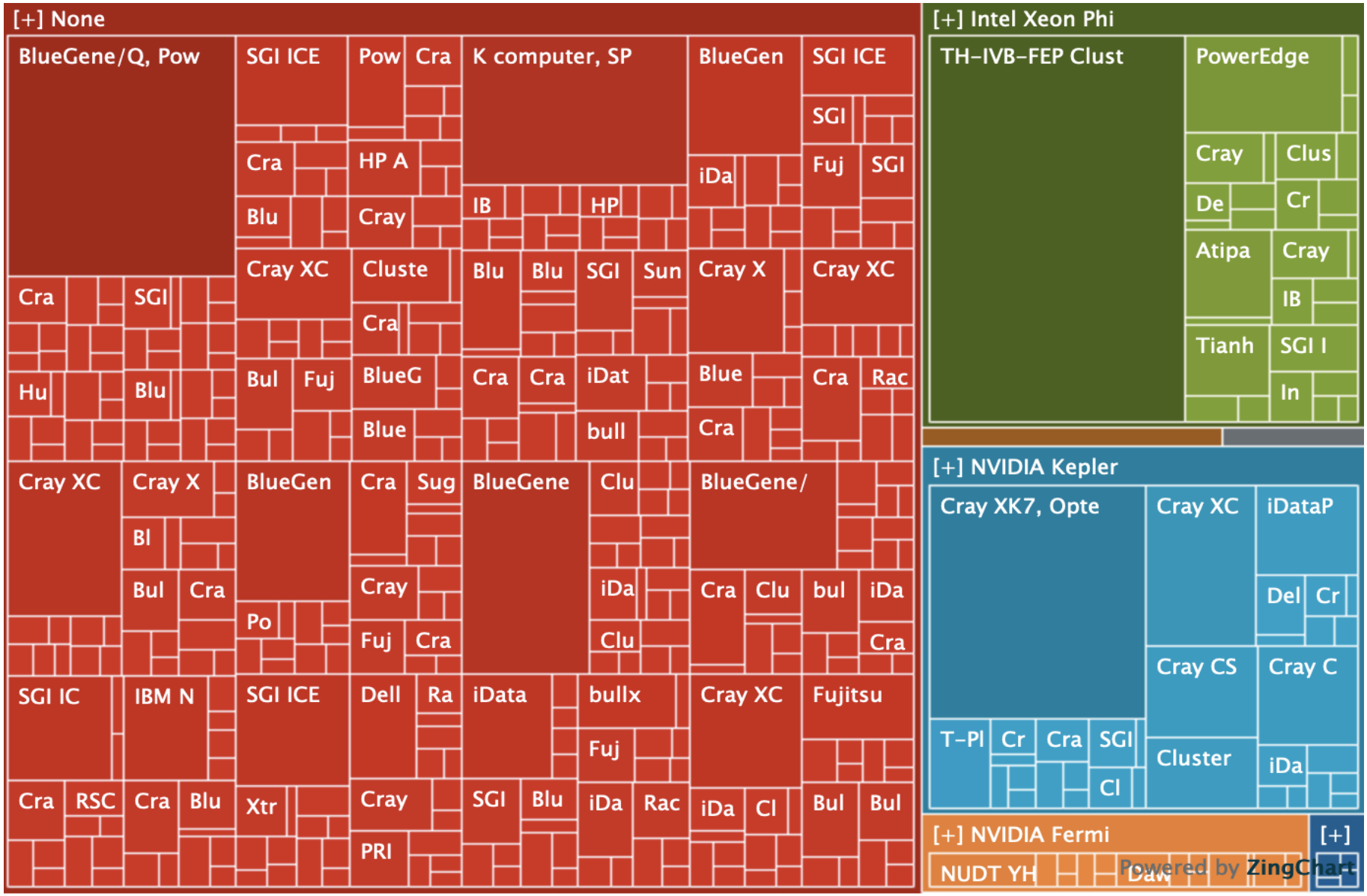
Jun 01, 2020

NVIDIA Volta	107
NVIDIA Pascal	17
NVIDIA Kepler	8
Intel Xeon Phi	5
NVIDIA Fermi	2
NVIDIA Ampere	1
PEZY-SC	1
Matrix-2000	1
MN-Core	1

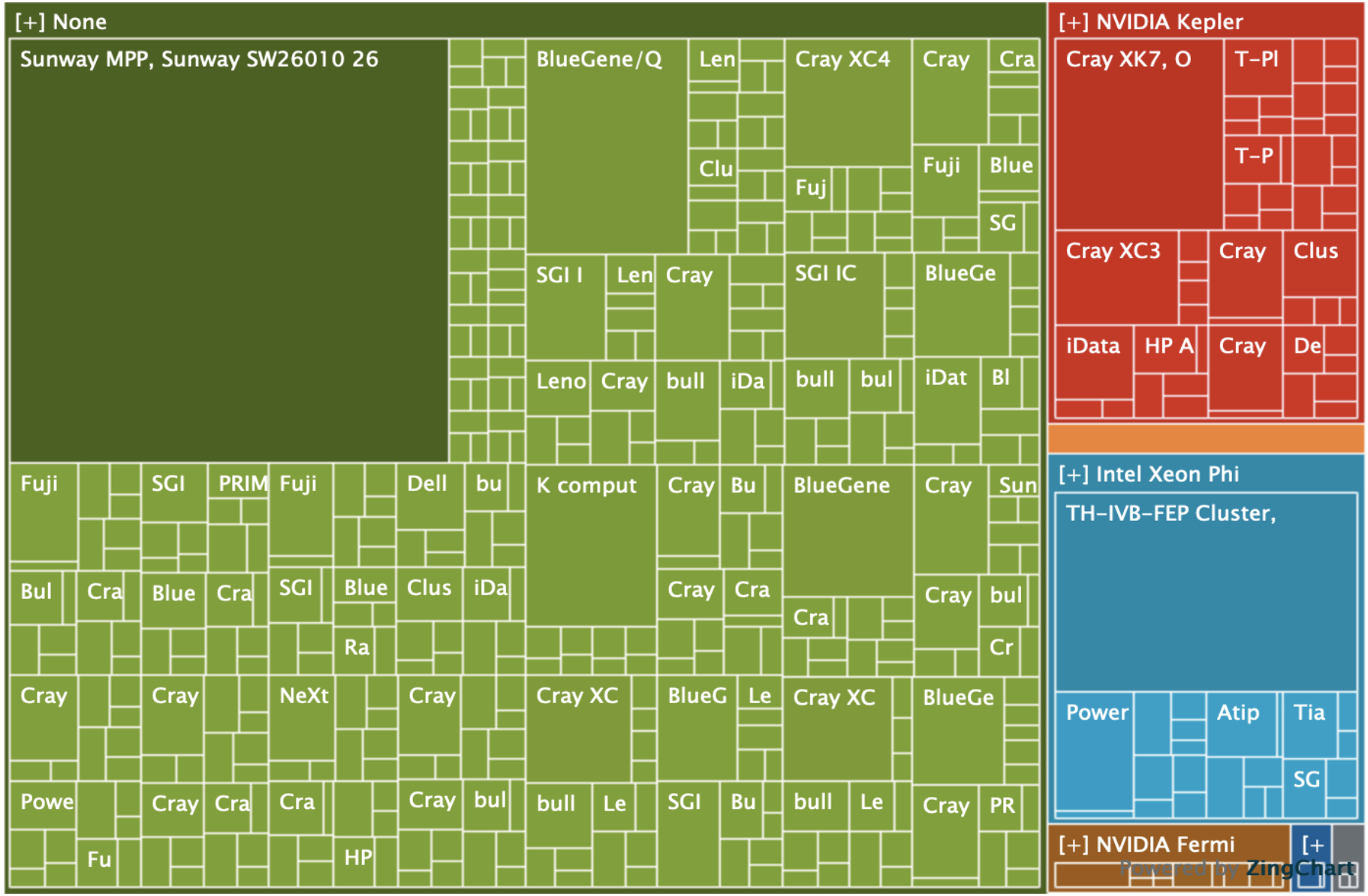
Accelerator family distribution
Jun'12



Accelerator family distribution
Jun'15



Accelerator family distribution
Jun'16



Accelerator family distribution
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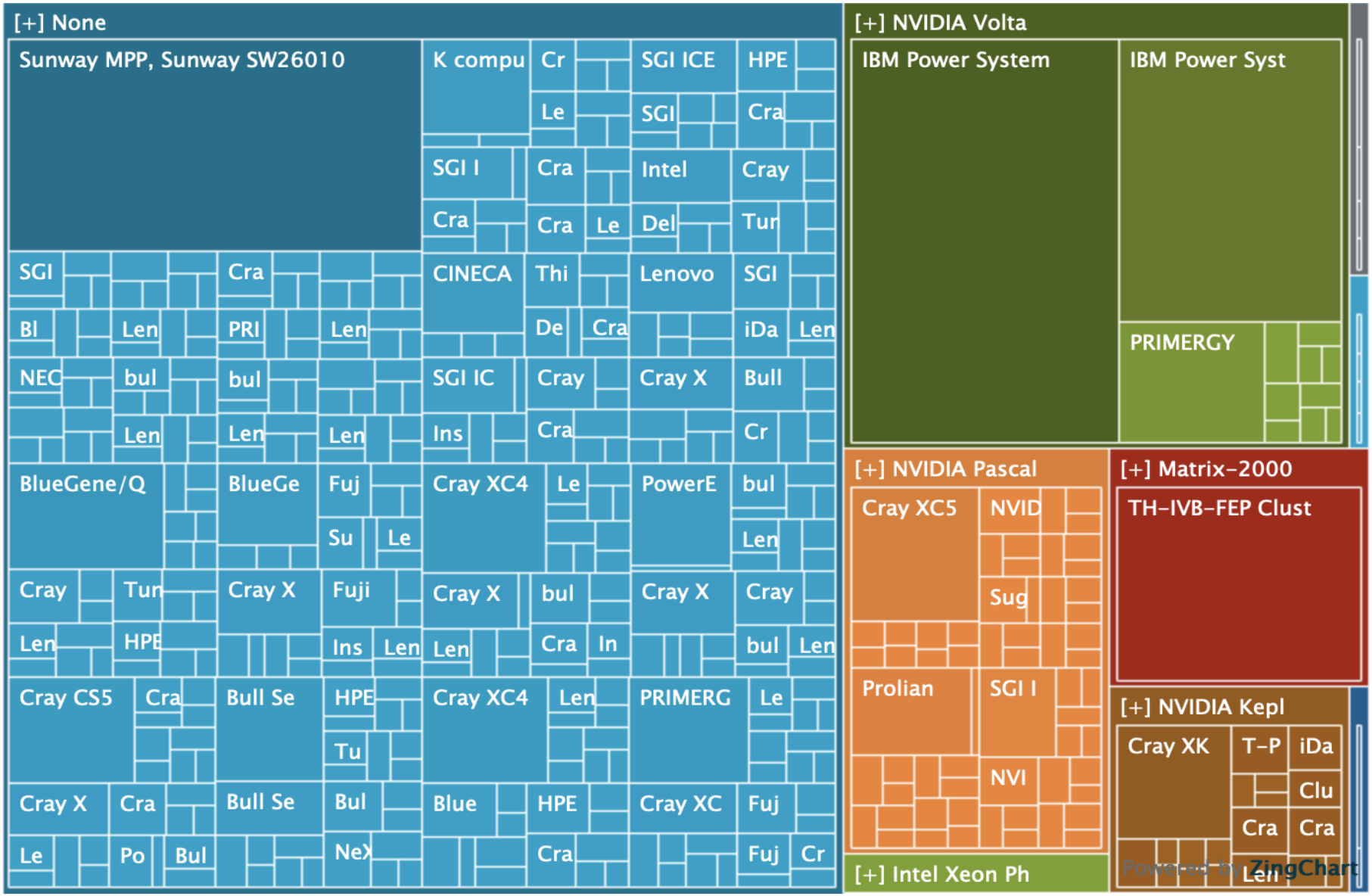
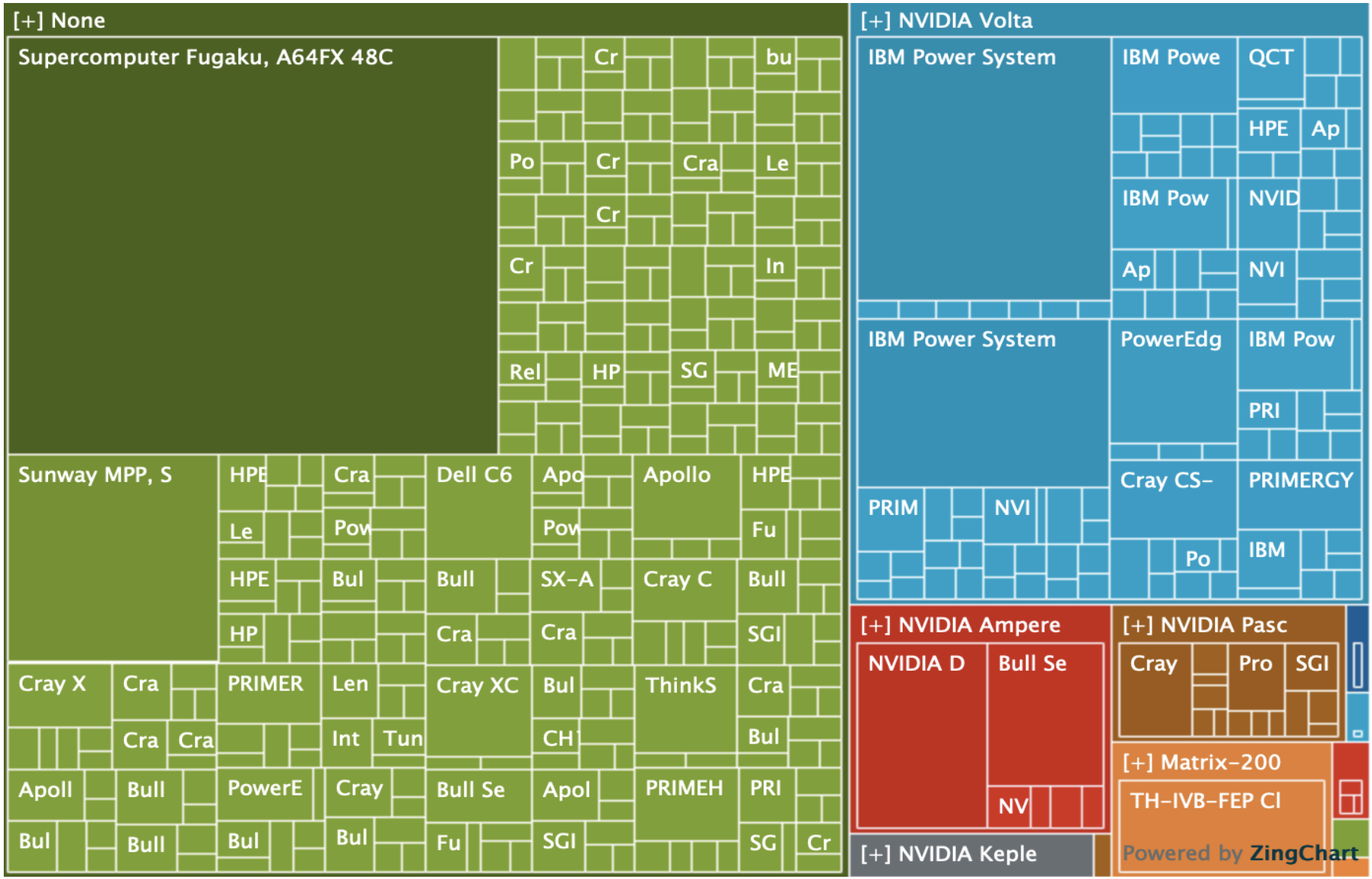
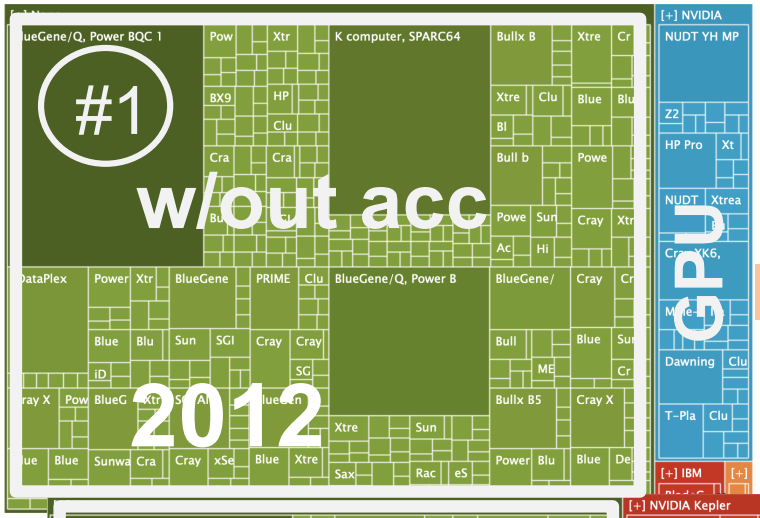
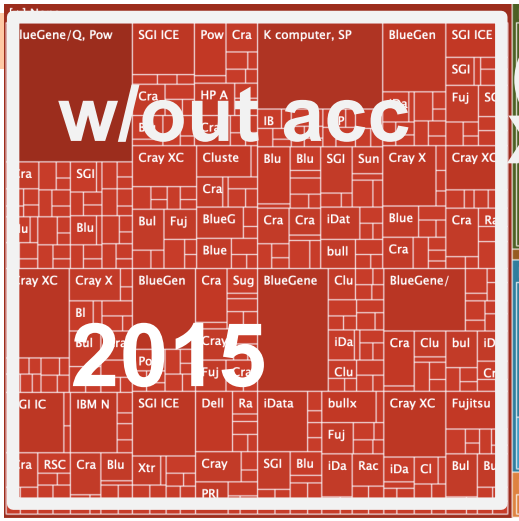


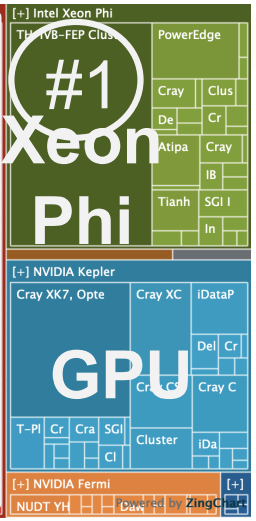
Accelerator family distribution
Nov'20

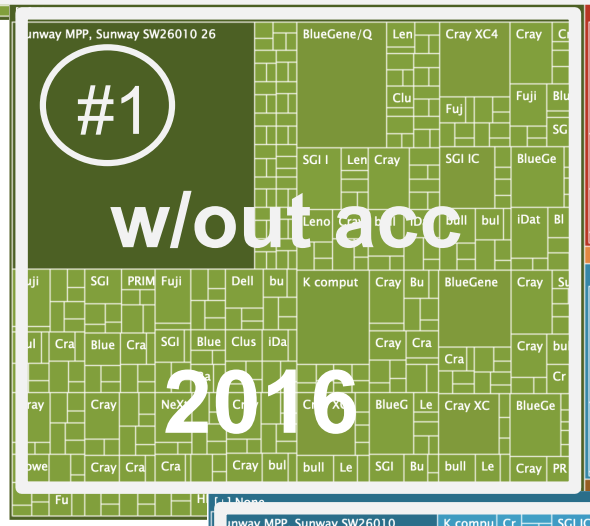


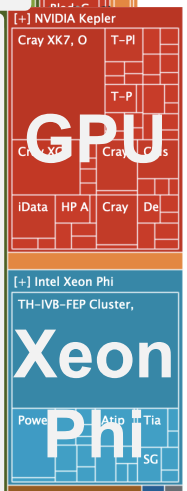
Accelerator families
evolution 2012 - 2020

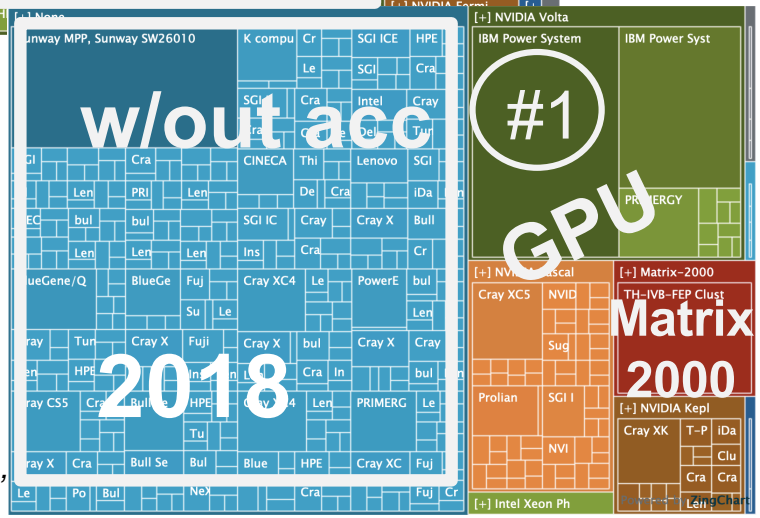


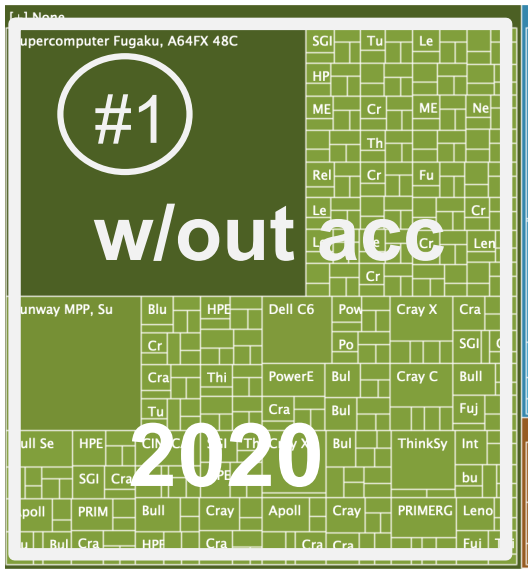


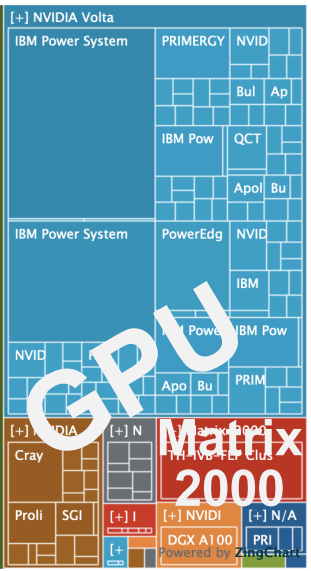












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PRACE: Best Practice Guide

Best Practice Guide - Modern Processors

Processor manufacturers are continuously pushing the performance limits for delivering more computational capabilities to the end users. These efforts, however, typically imply new architectural modifications requiring corresponding guidance for the efficient utilization of the underlying platform by application developers.
Recently, PRACE (Partnership for Advanced Computing Europe) released its "Best Practice Guide – Modern Processors" that extends the previously developed series of BPGs (https://prace-ri.eu/training-support/best-practice-guides/) by providing an update on a selection of recent processors, namely: ARM64 (Huawei/HiSilicon and Marvell) and x86-64 (AMD and Intel). More specifically the guide provides information on the available programming models and development environment as well as outlines guidelines on application performance analysis and improvement, accompanied with examples tailored for scientists not deeply involved into the art of HPC programming.

This guide also provides an overview on recently deployed European flagship supercomputing systems that rely on the discussed processor architectures, namely:

- **Fulhame** at Edinburgh Parallel Computing Centre (EPCC), UK
- **MareNostrum** at Barcelona Supercomputing Center (BSC), Spain
- **SuperMUC-NG** at Leibniz Supercomputing Centre (LRZ), Germany
- **Hawk** at High-Performance Computing Center Stuttgart (HLRS), Germany
- **Betzy** at SIGMA2, Norway

The complete PRACE "**Best Practice Guide - Modern Processors**" can be accessed via the following link:

- https://prace-ri.eu/training-support/best-practice-guides/modern-processors/

EuroHPC supercomputers

EuroHPC selected 8 supercomputer centres for funding

- **3 exascale** supercomputers:
  - **MareNostrum 5** (BSC, Spain): **200** peak PFLOPS
  - **Leonardo** (CINECA, Italy): **200** peak PFLOPS
  - **LUMI** (CSC, Finland): **200** peak PFLOPS

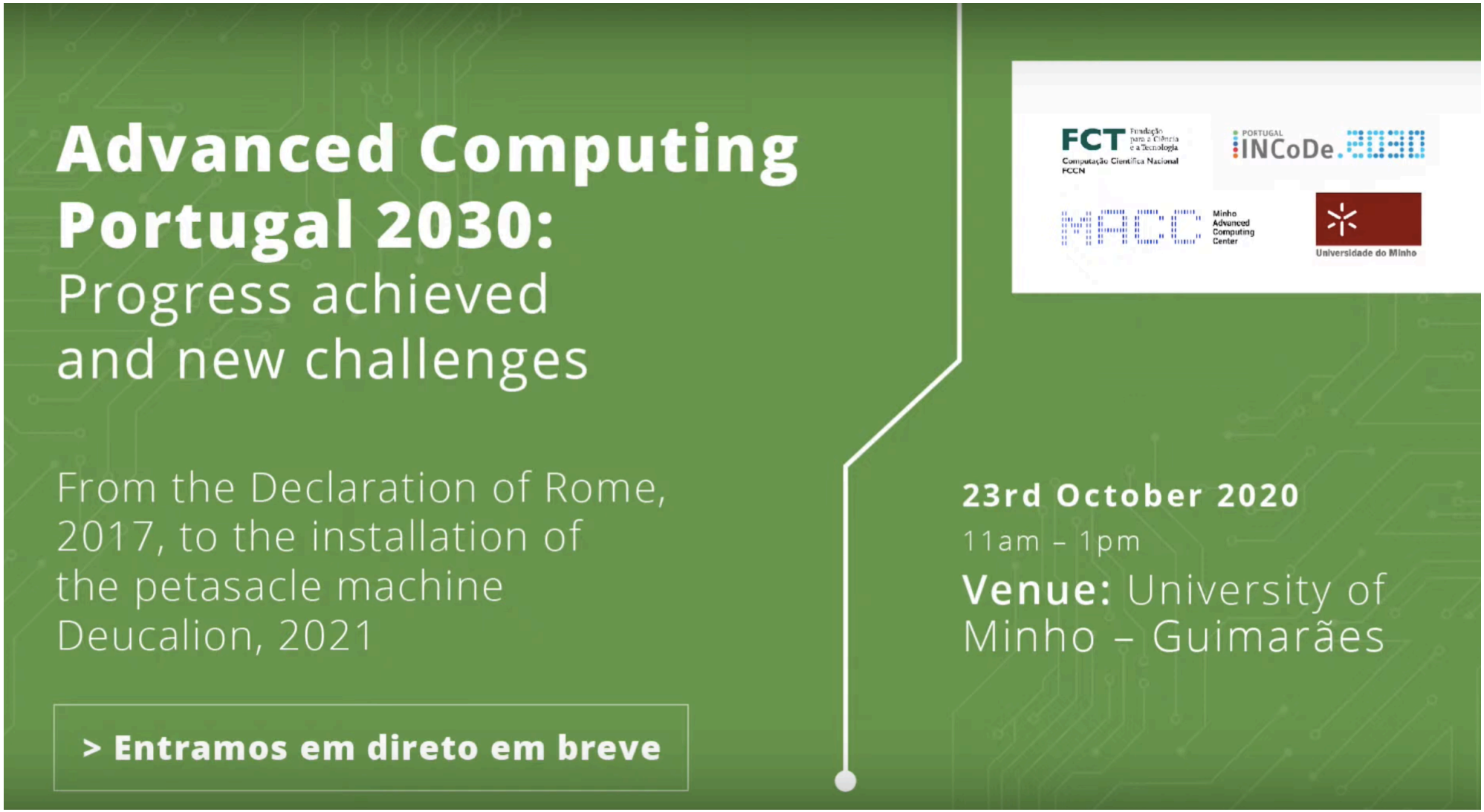
current #2 in TOP500

- **5 petascale** supercomputers:
  - **Meluxina** (LuxConnect, Luxembourg): **18** peak PFLOPS
  - **EURO IT4I** (IT4 Innov. Nat. Superc. Center, Czech Rep.: **15.2** peak PFLOPS

current #29 in TOP500

  - **Deucalion** (MACC, Portugal): **10** peak PFLOPS
  - **Vega** (IZUM, Slovenia): **6.8** peak PFLOPS
  - **PetaSC** (Sofiatech, Bulgaria): **4** peak PFLOPS

Advanced Computing Portugal 2030 (1)



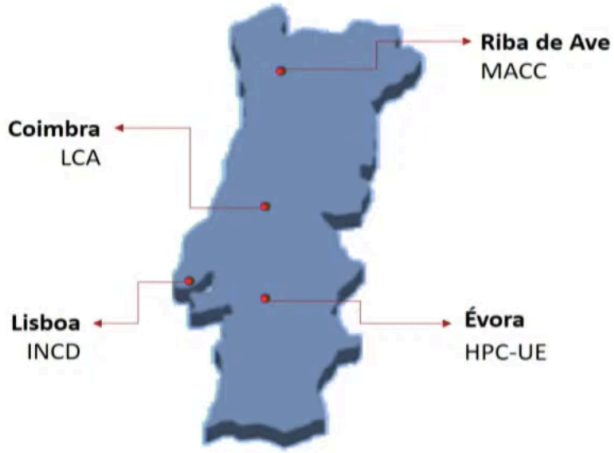
Advanced Computing Portugal 2030 (2)

Advanced Computing Portugal 2030

FCT Fundação para a Ciência e a Tecnologia — Computação Científica Nacional FCCN | INCoDe.2030 | MACC Minho Advanced Computing Center | Universidade do Minho

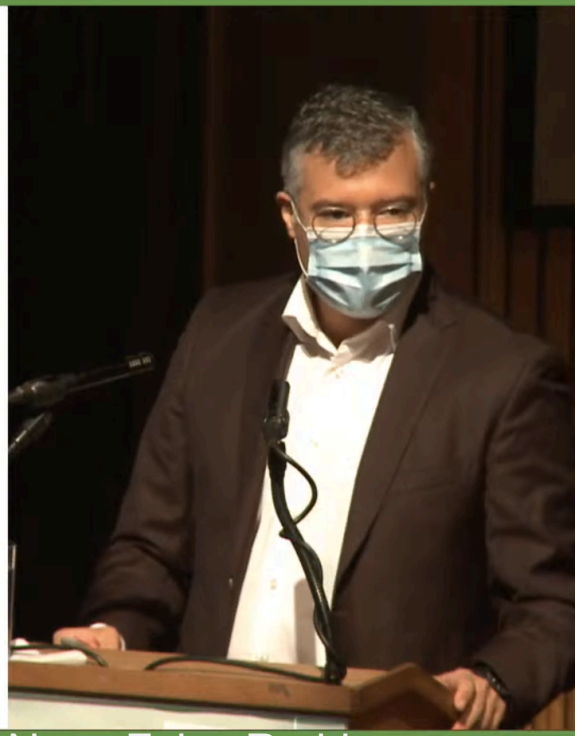
INFRASTRUCTURE | OC

Advanced Computing Operation Centres (OC)



- **MACC** → Bob
- **LCA** → Navigator(+)
- **UPC-UE** → Oblivion
- **INCD** → Stratus, Cirrus

INCoDe.2030 4



Nuno Feixa Rodrigues
Vice-Presidente FCT

Advanced Computing Portugal 2030 (3)

Advanced Computing Portugal 2030

FCT Fundação para a Ciência e a Tecnologia — Computação Científica Nacional FCCN | PORTUGAL INCoDe.2030 | MACC Minho Advanced Computing Center | Universidade do Minho

MACC | Bob -> Deucalion

- 1PFLOP; 800 Compute Nodes; 12.800 cores; 1.5PB
- After some initial setbacks (storage), usage has been steadily increasing

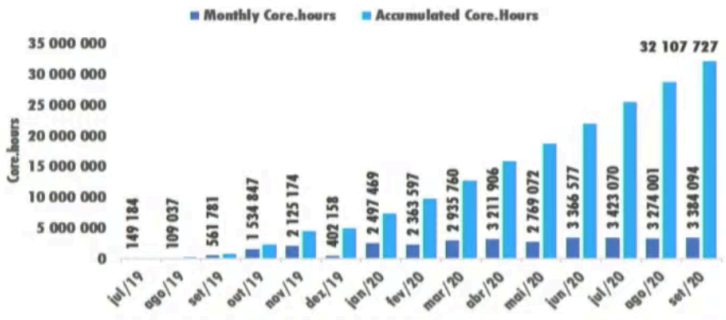
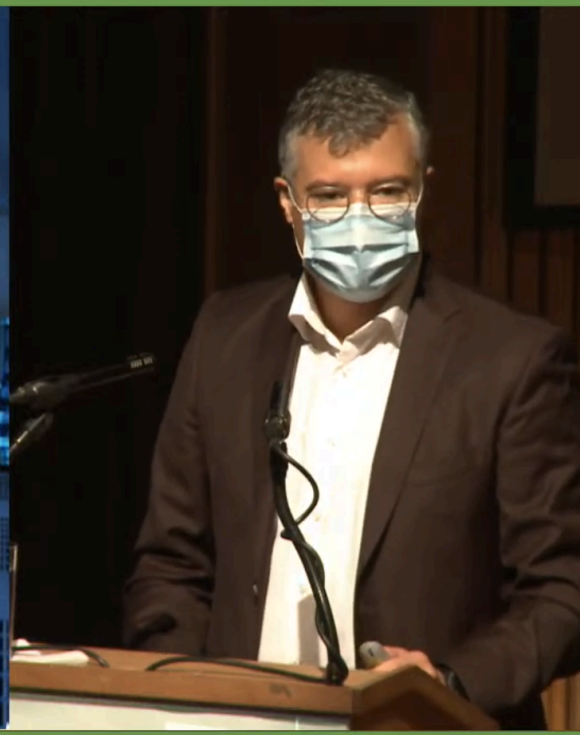


Figure 3 - Monthly and accumulated usage from July 2019 until September 2020.



Advanced Computing Portugal 2030 (4)

Advanced Computing Portugal 2030

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BOOTSTRAPPING MACC WITH BOB

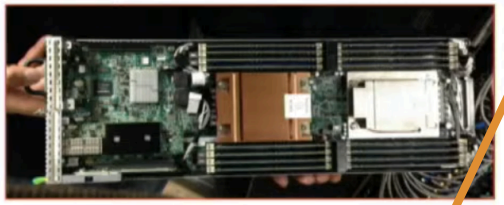
UTAustin Portugal

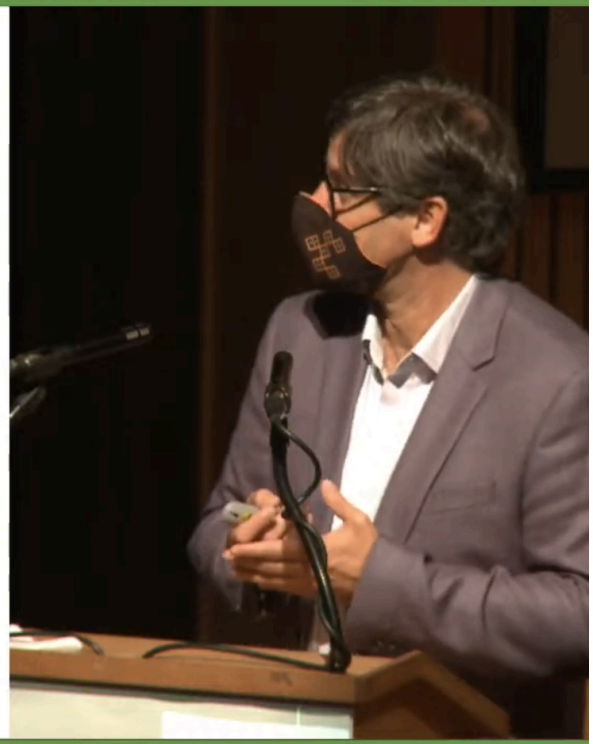
PART OF TACC'S STAMPEDE SUPERCOMPUTER

800 DUAL INTEL XEON + XEON PHI NODES

1.5 PB HIGH PERFORMANCE STORAGE

1PF PEAK PERFORMANCE





Rui Carlos Oliveira
Diretor do MACC

6	**Stampede** - PowerEdge C8220, Xeon E5-2680 8C 2.700GHz, Infiniband FDR, Intel Xeon Phi SE10P, Dell EMC	Texas Advanced Computing Center/Univ. of Texas	United States	462,462	June 2013

TOP 500 The List.

Advanced Computing Portugal 2030 (5)

Advanced Computing Portugal 2030

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FROM BOB TO DEUCALION


DEUCALION

EuroHPC

Annex 1
to the call for expression of interest for the selection of Hosting Entities for Petascale Supercomputers
REF: EUROHPC-2019-CEI-PT-01

APPLICATION FORM

Application Ref: DEUCALION

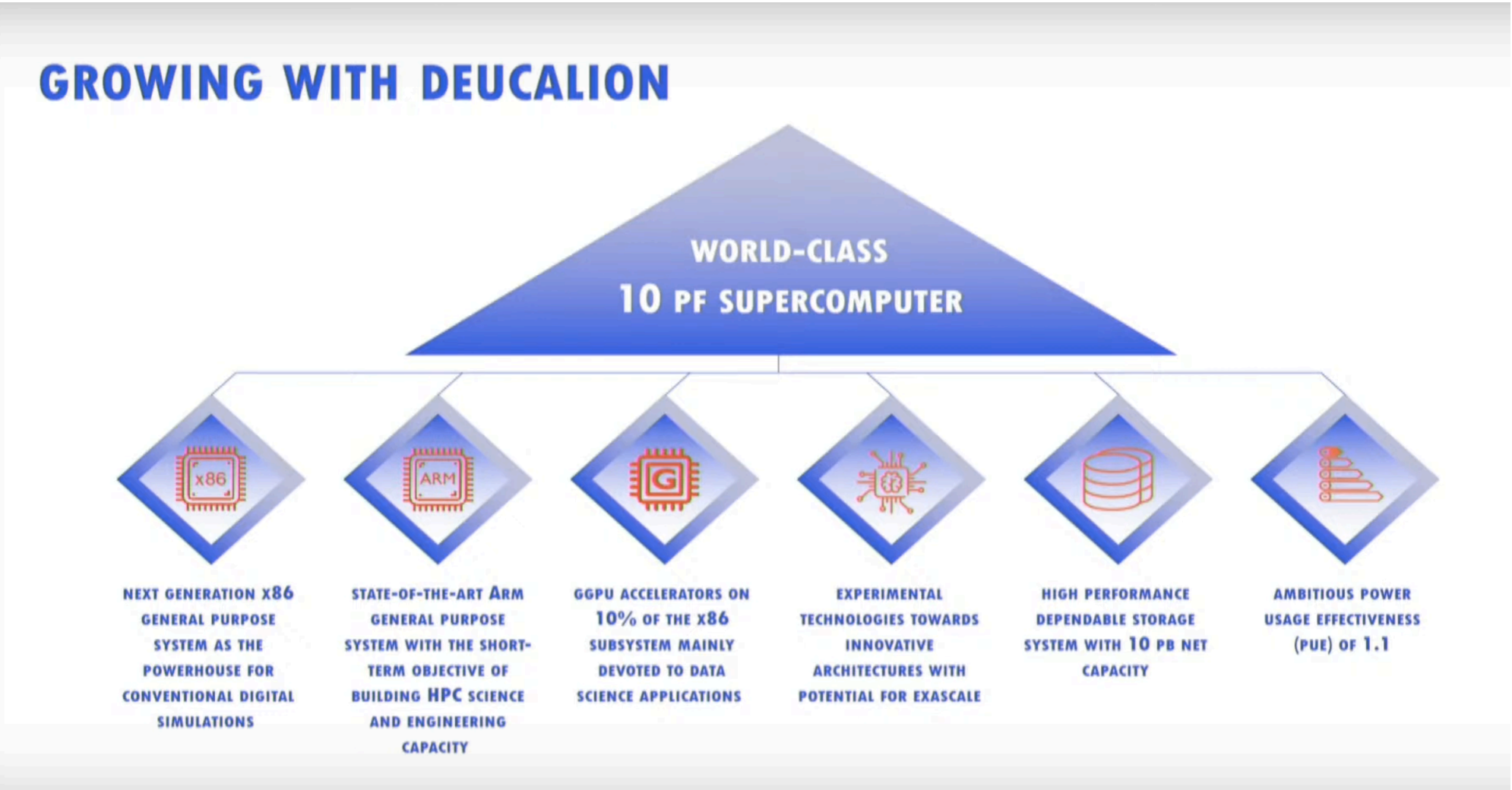
15 April 2019

26 November 2019

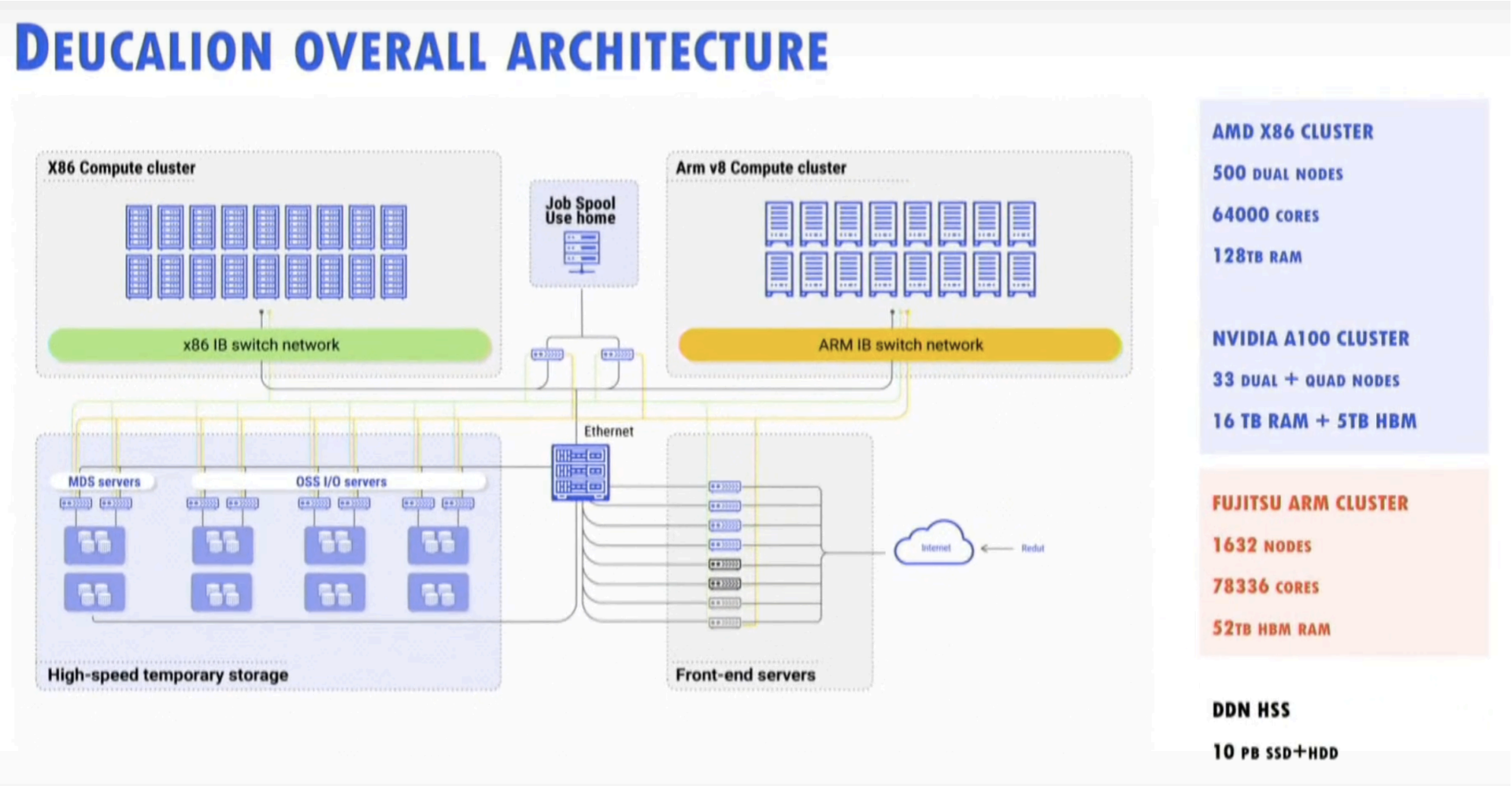
DEUCALION

(16 October 2020)

Advanced Computing Portugal 2030 (6)



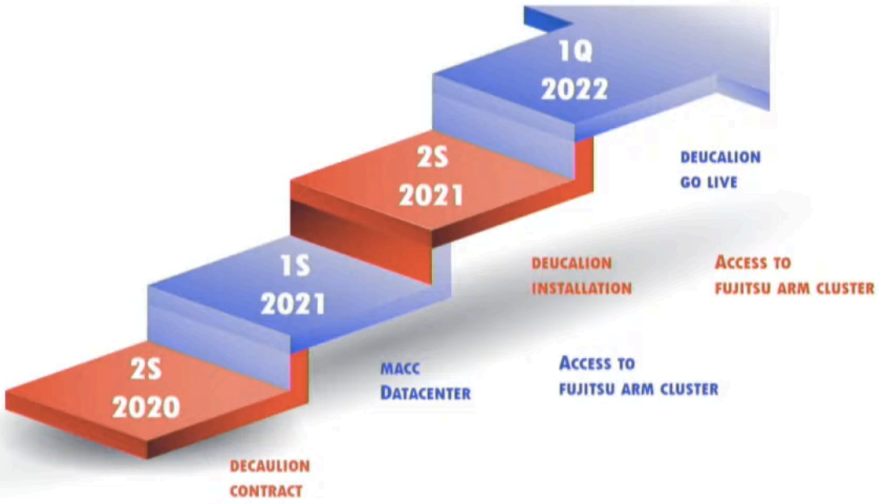
Advanced Computing Portugal 2030 (7)



Advanced Computing Portugal 2030 (8)

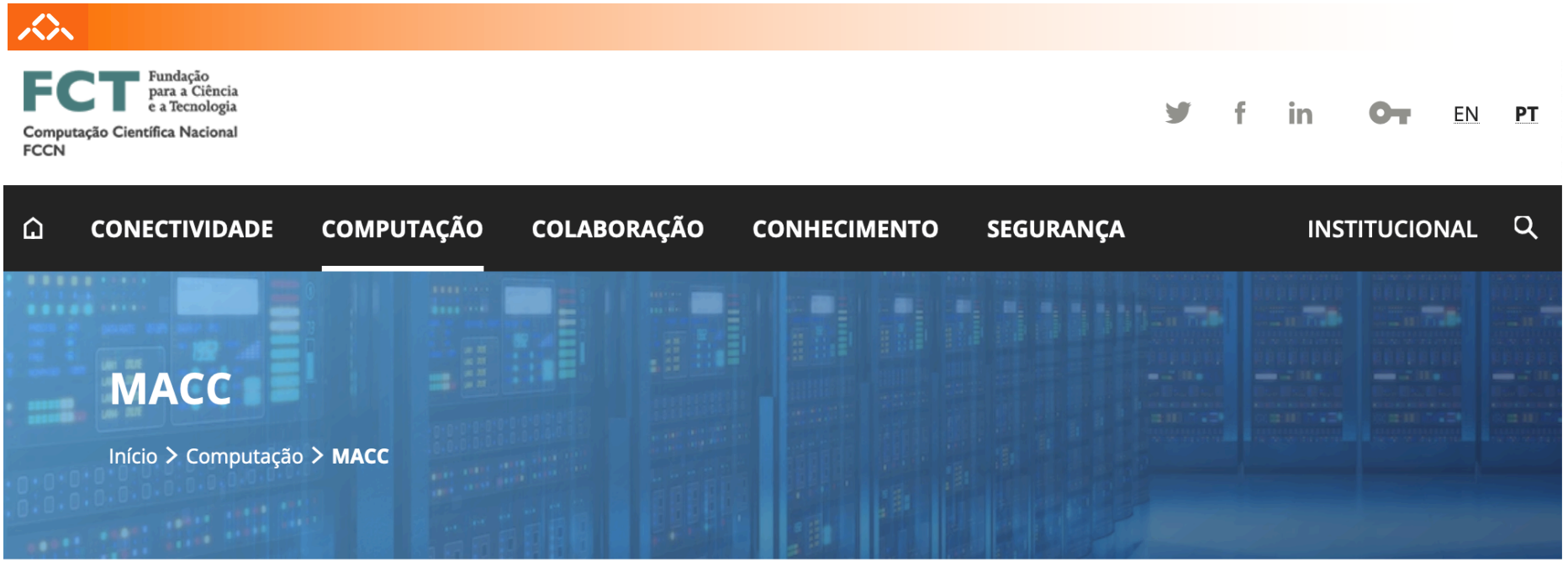
Advanced Computing Portugal 2030

MACC TIMELINE



MACC:

https://www.fccn.pt/computacao/macc/



Minho Advanced Computing Center

O MACC é uma infraestrutura colaborativa nacional para promover e apoiar iniciativas de Ciência Aberta em supercomputação, ciência de dados e visualização.