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*Centro Nacional de Supercomputación*



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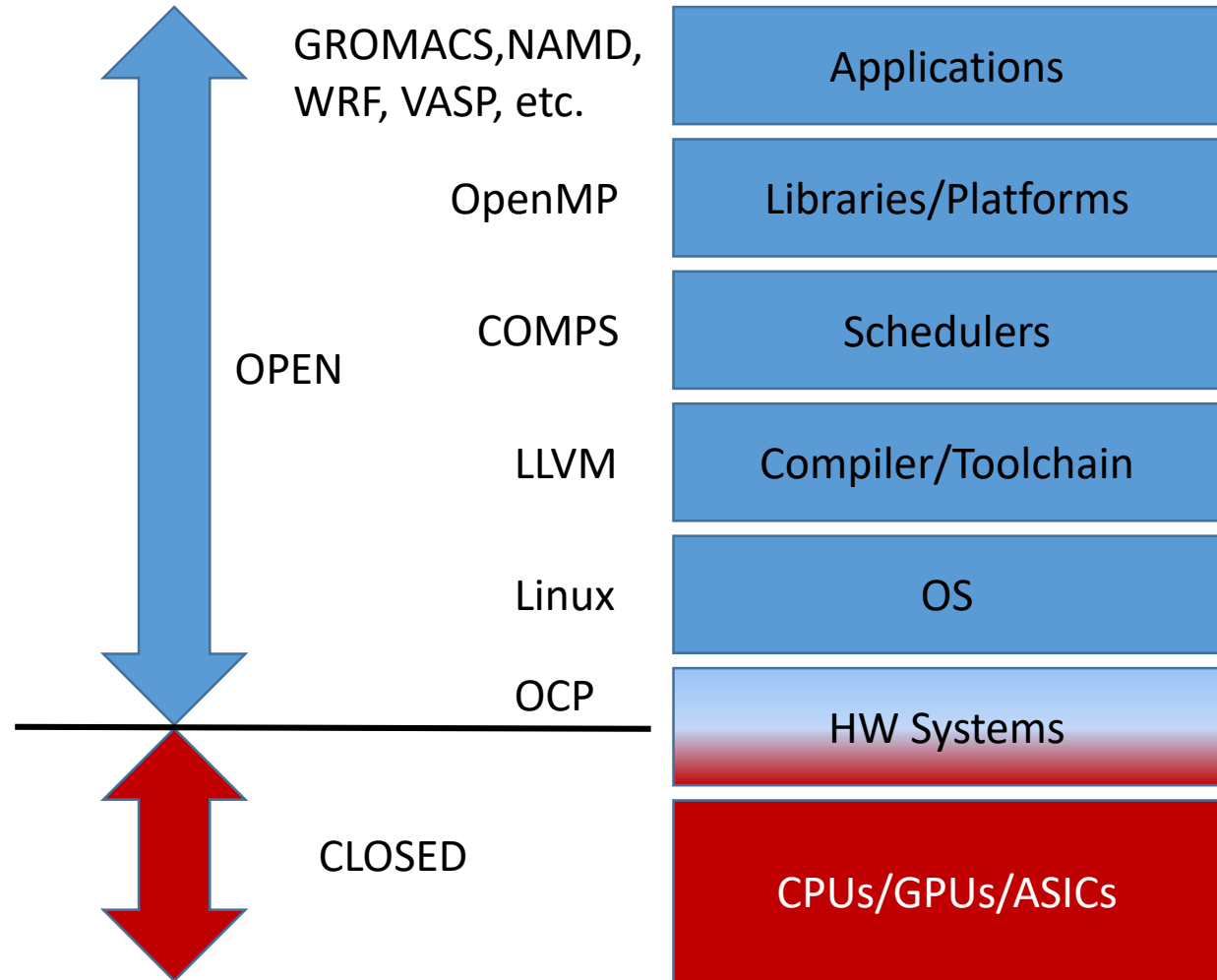
# Building an Open HPC Ecosystem

John D. Davis, Ph.D.

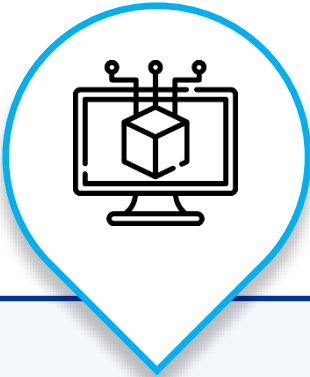
22/3/2022

# HPC Today

- Europe has led the way in defining a common open HPC software ecosystem
- Linux is the de facto standard OS despite proprietary alternatives
- Software landscape from Cloud to IoT already enjoys the benefit of open source
- Open source provides:
  - A common platform, specification and interface
  - Accelerates building new functionality by leveraging existing components
  - Lowers the entry barrier for others to contribute new components
  - Crowd-sources solutions for small and larger problems
- **What about Hardware and in particular, the CPU and accelerators?**



# Today's technology trends



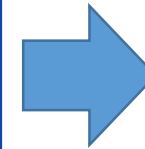
Massive penetration of Open Source Software

- IoT (Arduino),
- Mobile (Android),
- Enterprise (Linux),
- HPC (Linux, OpenMP, etc.)



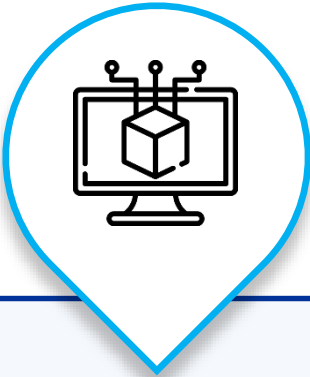
Moore's Law + Power =  
**Specialization**

- More cost effective
- More performant
- Less Power



**SOFTWARE/  
HARDWARE  
CO-DESIGN**

# Today's technology trends



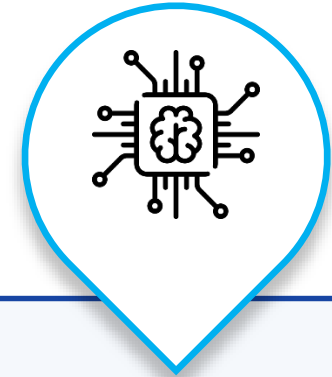
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New Open Source Hardware  
Momentum from IoT and the  
Edge to HPC

- RISC-V

# Why Open Source Hardware?

**Software:** Leverage a large ecosystem compatible across implementations

**Security:** A fully auditable collection of IPs: processors, accelerators, etc.

**Safety:** No black-boxes

**SWaP & Customization:** SW/HW co-design for exact feature match

**Performance:** State-of-the-art implementations

**No vendor lock-in:** Ecosystem to enable custom develop from SME to large enterprise

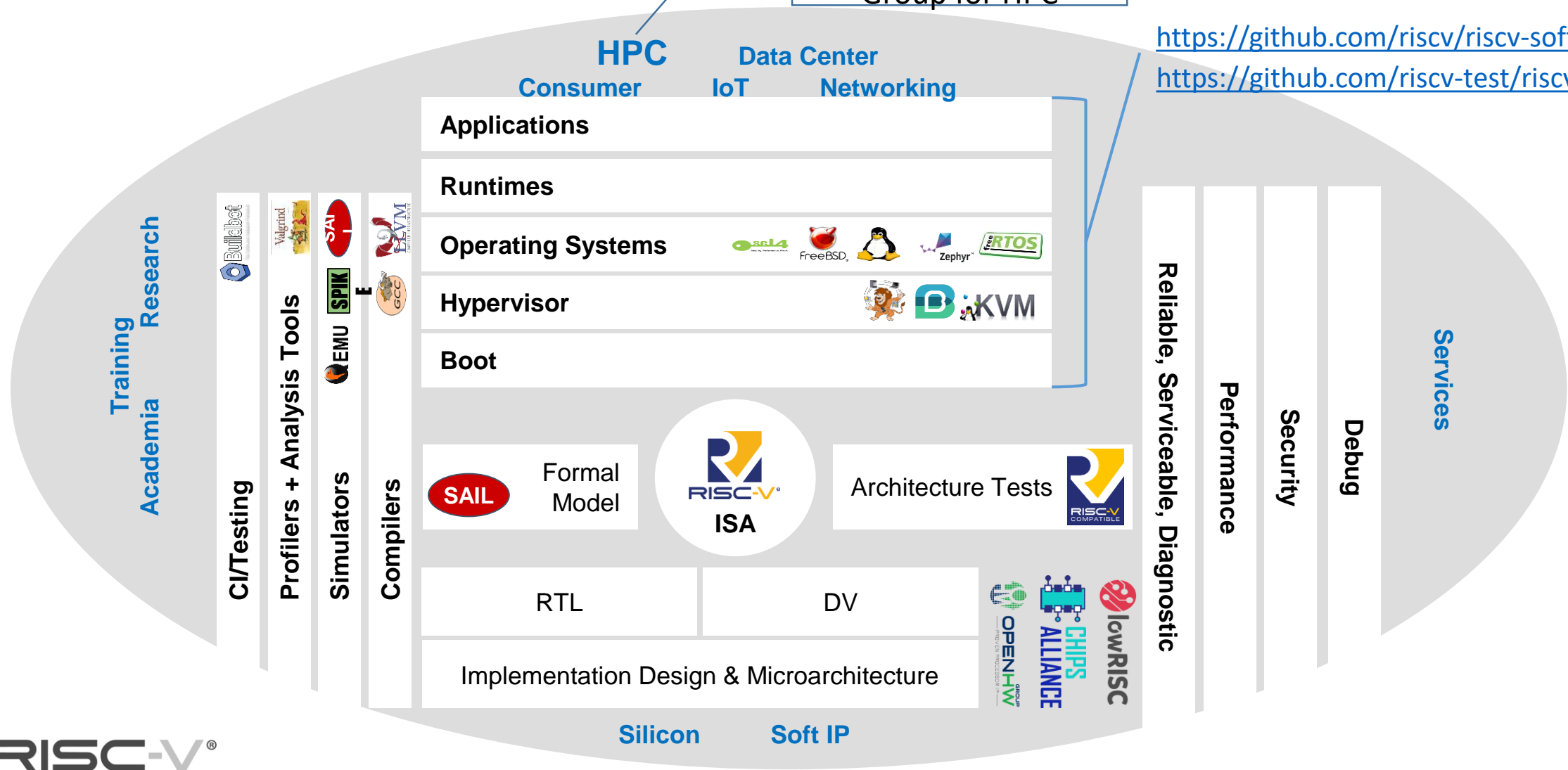
**Sovereignty:** Freedom of access and implementation from design to production

**Open Collaboration:** Faster time to market, community, leverage existing open source

# RISC-V Ecosystem

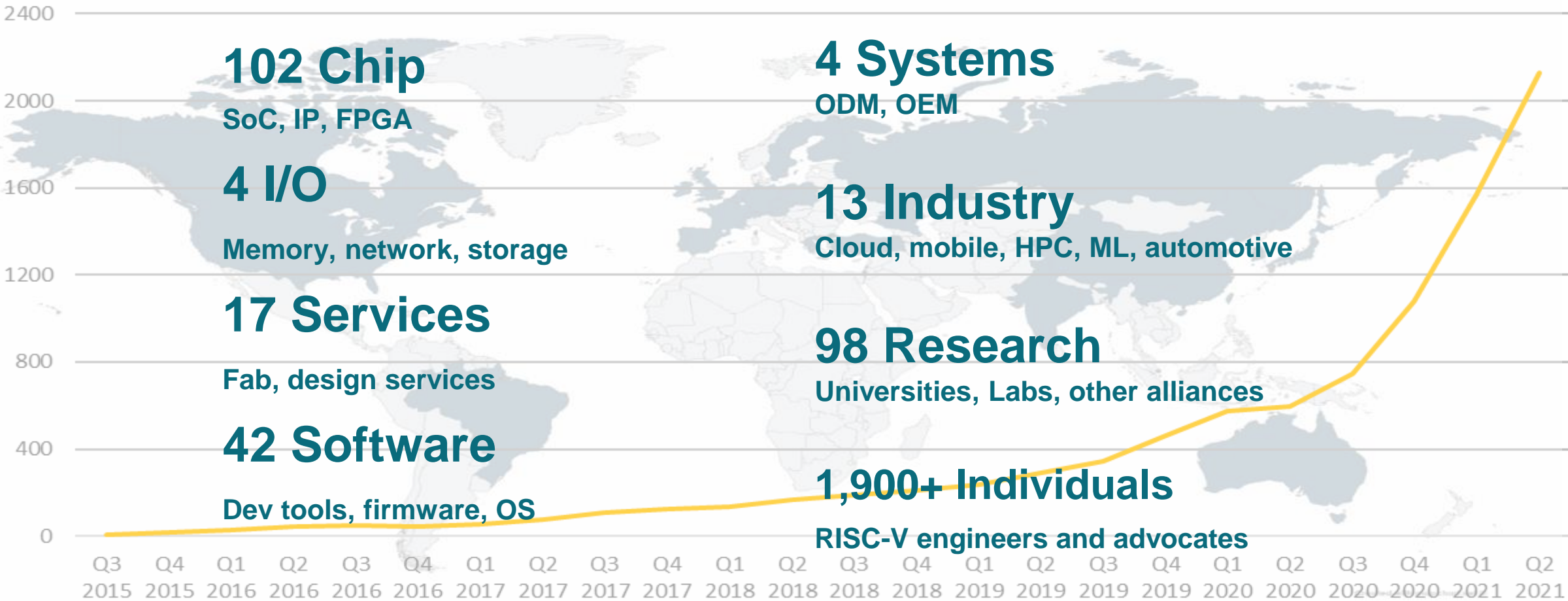
BSC created and leads the Special Interest Group for HPC

<https://github.com/riscv/riscv-software-list>  
<https://github.com/riscv-test/riscv-hpc>



# More than 2,200 RISC-V Members

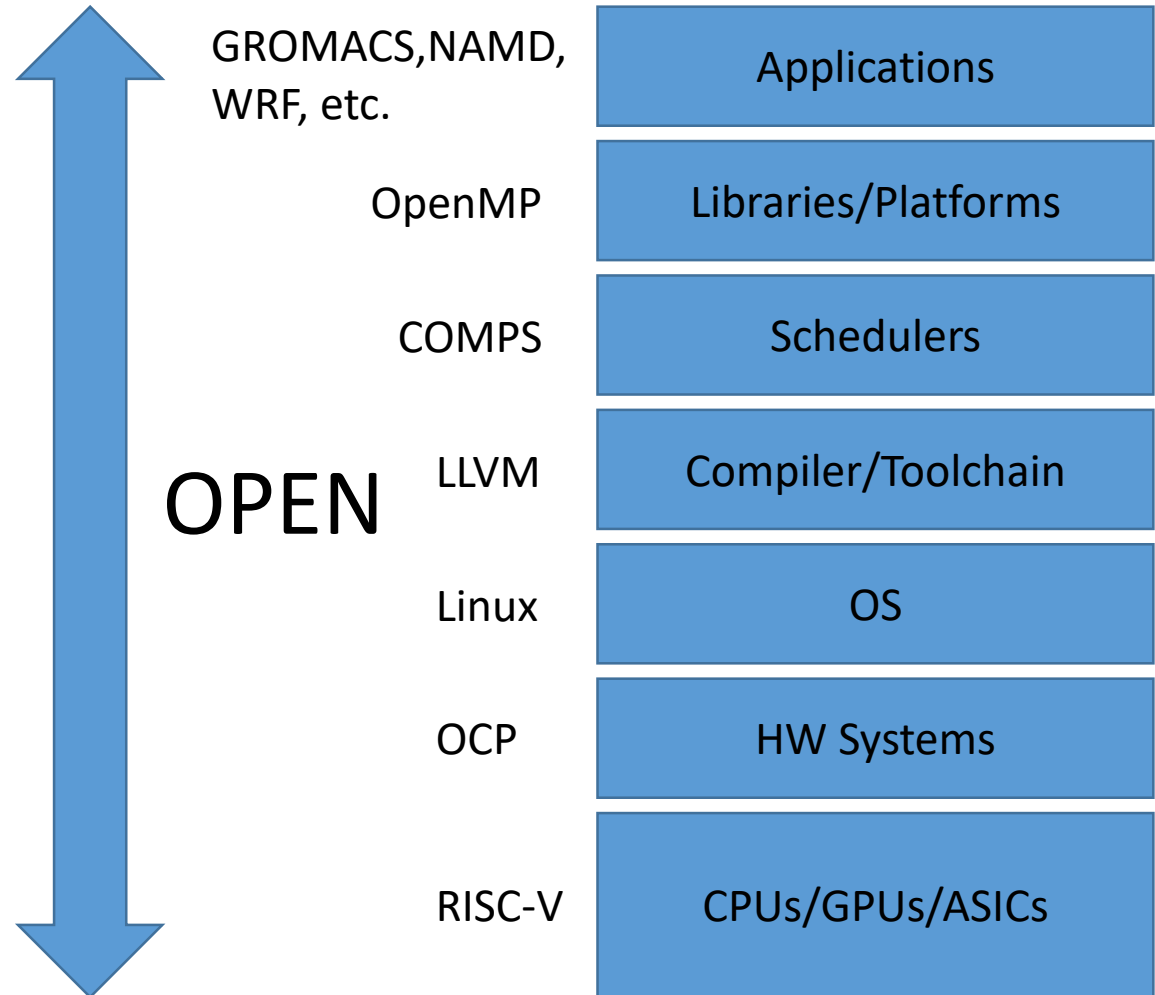
across 70 Countries



**RISC-V membership grew 133% in 2020.**  
**In 2021, RISC-V membership has already doubled.**

# HPC Tomorrow

- Europe can lead the way to a completely **open SW/HW stack for the world**
- RISC-V provides the open source hardware alternative to dominating proprietary non-EU solutions
- Europe can achieve complete technology independence with these foundational building blocks
- Currently at the same early stage in HW as we were with SW when Linux was adopted many years ago
- **RISC-V can unify, focus, and build a new microelectronics industry in Europe.**

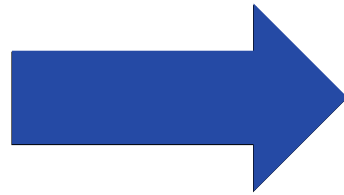




# The BSC Vision of the Future of European HPC



MontBlanc @ BSC



Fugaku #1 Top500 @ Riken for \$1B over 7 years (CAPEX)

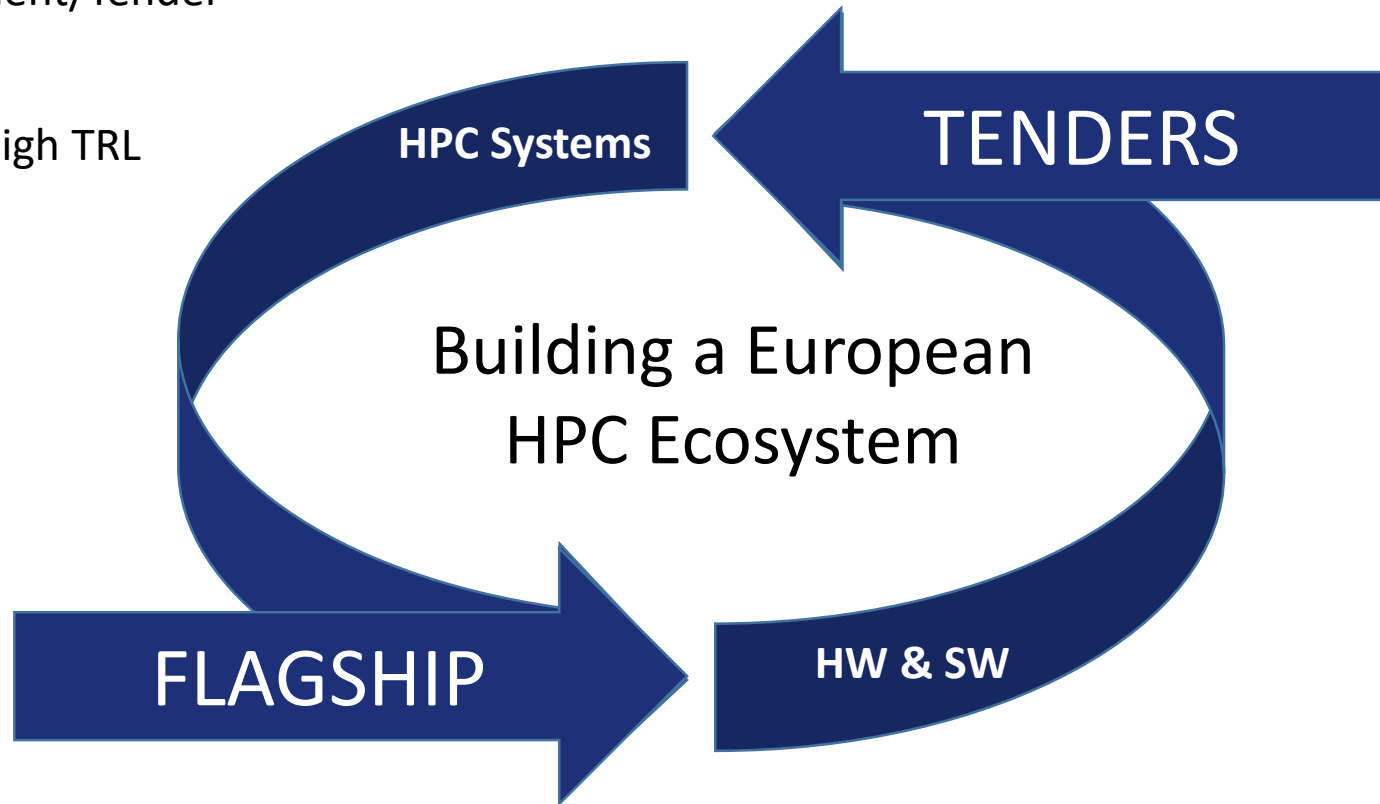
## MareNostrum6

European Supercomputers @ Top500

# Research to Product Lifecycle

- Successful model:
  - Research Funding & Procurement/Tender
    - Fugaku
    - ECP
  - Defining a path from Low to High TRL
- HW and SW in a holistic approach
- EU follow the US & Japan model
- Major investments required
  - Flagship: 1 B€
  - Tenders: 1-2 B€

**Supercomputer  
Flagship  
R&D Project**



Lumi@  
CSC

XXX

MN6 @  
BSC

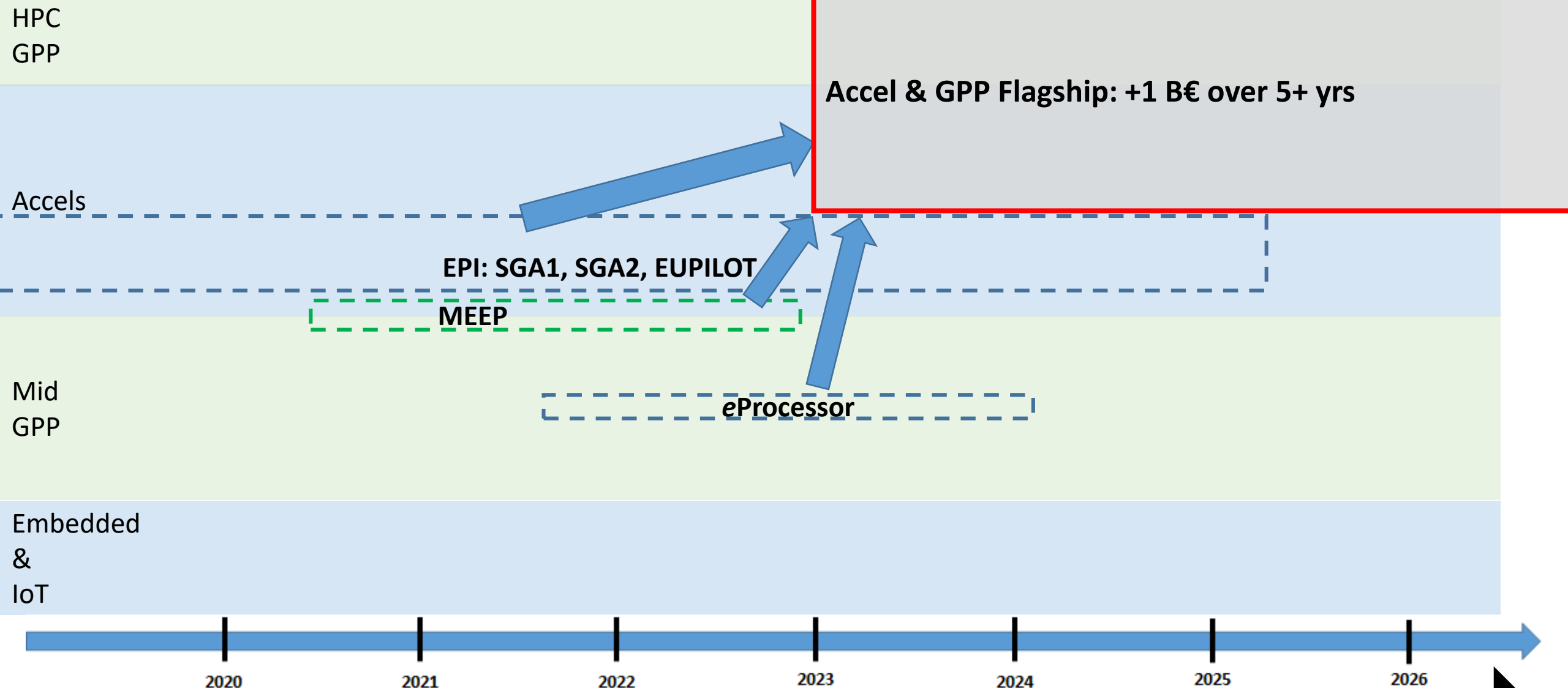
Leo@  
CINECA

YYY

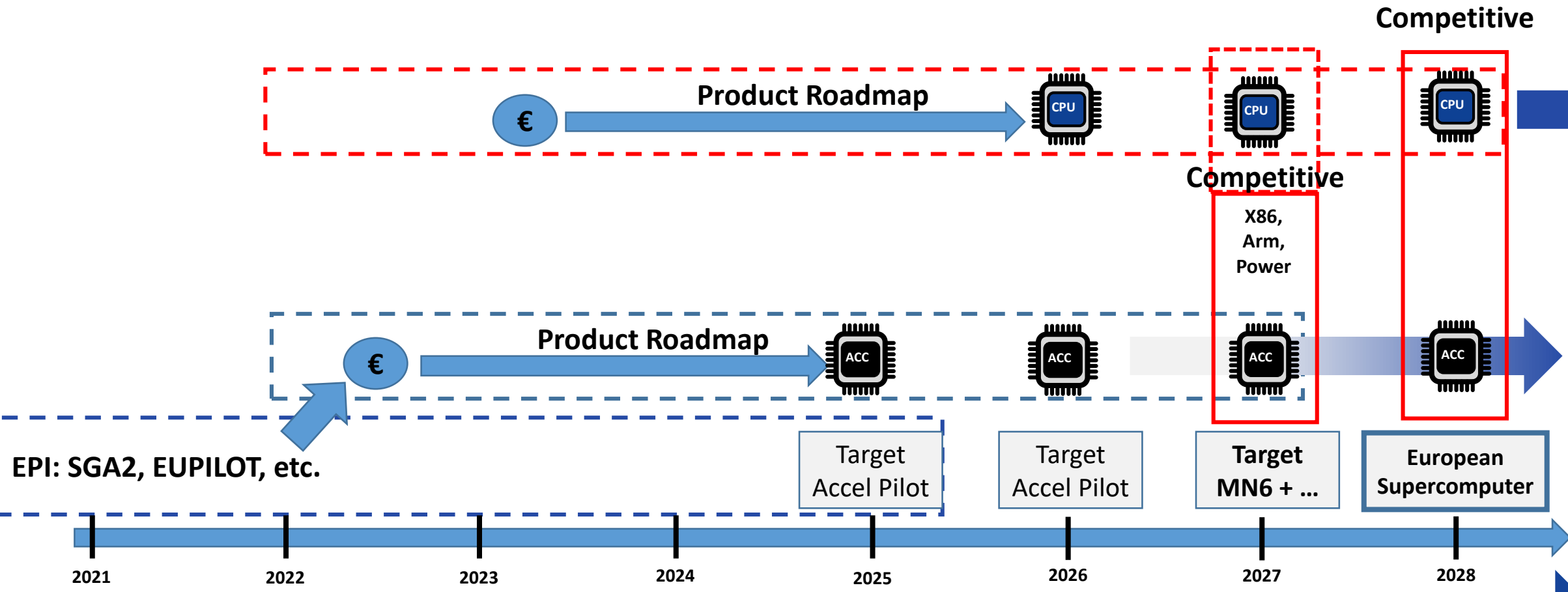
# What is the Flagship?

- R&D
  - Hardware:
    - +1 B€ & Small number of partners
  - Software
    - Leverage EU ecosystem and many partners
- System Integrator
- RISC-V HPC Accelerator, then GPP
- Precursor to the Machine tender
- Examples
  - Fugaku: +\$1 B R&D + \$1 B system (over 6 years)
  - ECP: \$2 B R&D + \$1.8 B for 3 systems

# The Flagship RIAG Chip Roadmap



# Ideal RISC-V Timeline for a European Supercomputer



# A Successful EC Roadmap for the Future

- Embrace Open Source Hardware
  - Build infrastructure to support open source
  - Create an environment that links research to the ICT industry
  - Supported by research and industrial funding instruments
- Teach, train, tools, and collaborate
- Leverage the Global Technology ecosystem
- Requires **SIGNIFICANT** funding for programs to build made in Europe IP
  - Many **focused** projects
  - Many **focused** teams
  - Total and integrated vision for the future: Build vs Buy...
  - Large Accelerator and CPU investment (> **1B€**)



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# Thank you

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