



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



LOCA

Enabling HW/SW Co-Design for IoT to HPC

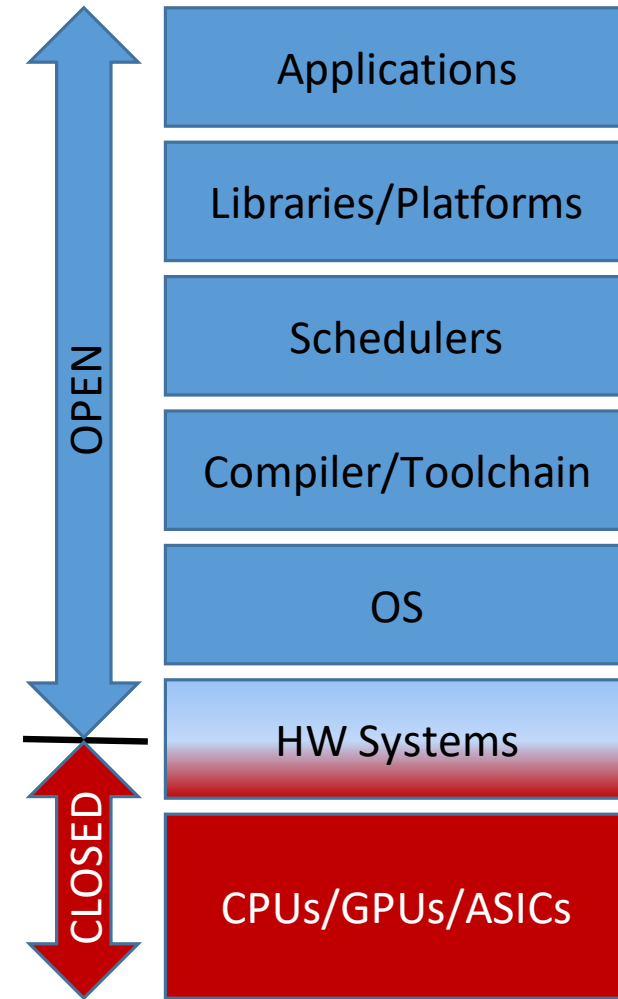
John D. Davis



European Laboratory for Open
Computer Architecture

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?**
- Inhibits opportunities in holistic co-design
 - Facing barrier to innovation
 - Being able to have a conversation or not



Mont-Blanc HPC Stack for ARM



Industrial applications



Termo Fluids



Applications



H L R I S



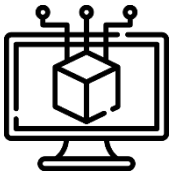
System software



Hardware



Today's technology trends



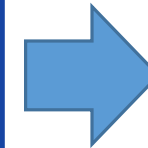
Massive penetration of Open Source Software

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



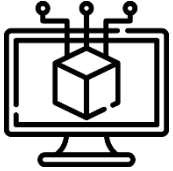
Moore's Law + Power =
Specialization

- More cost effective
- More performant
- Less Power



**SOFTWARE/
HARDWARE
CO-DESIGN**

Today's technology trends



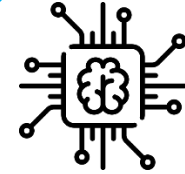
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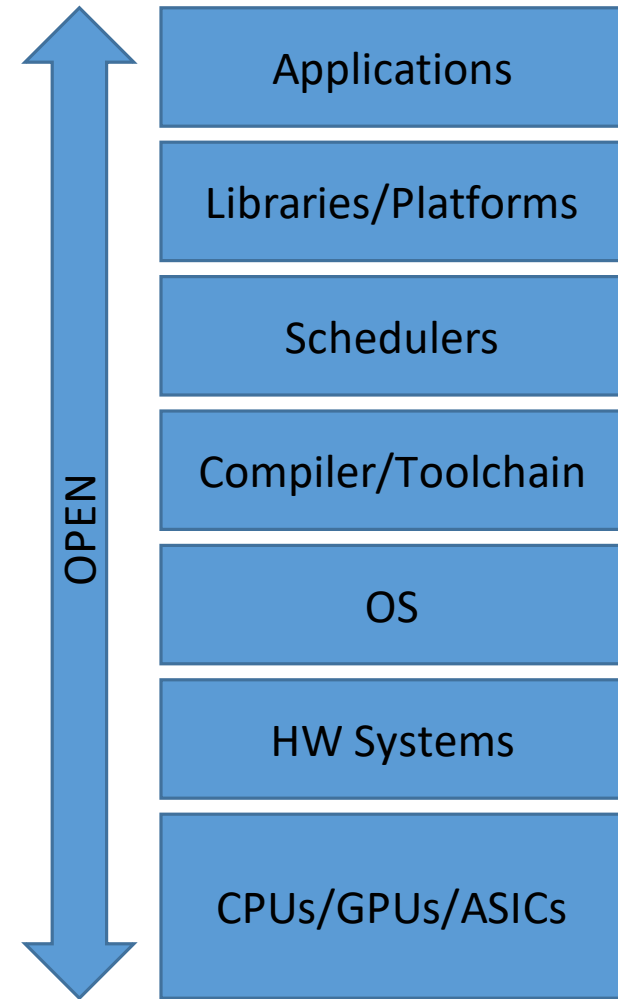


New Open Source Hardware
Momentum from IoT and the
Edge to HPC

- RISC-V
- OpenPOWER
- MIPS

HPC tomorrow

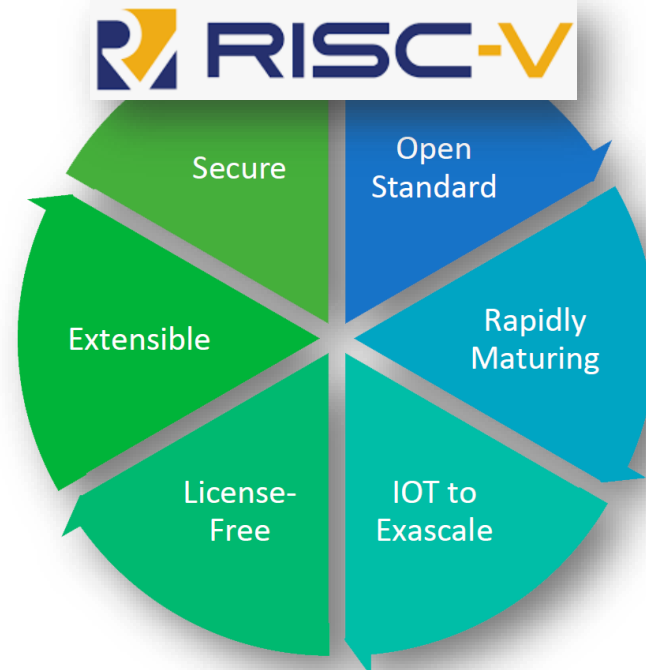
- Europe can lead the way to a completely open SW/HW stack for the world
- RISC-V provides the open source hardware alternative to dominating proprietary non-EU solutions
- Europe can achieve complete technology independence with these foundational building blocks
- Currently at the same early stage 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.



Just an example: RISC-V in EPI



- ➡ More and more global IT actors are adopting RISC-V architectures to be vendor independent
- ➡ And of course the entire IoT ecosystem for lower performance, lower energy applications.



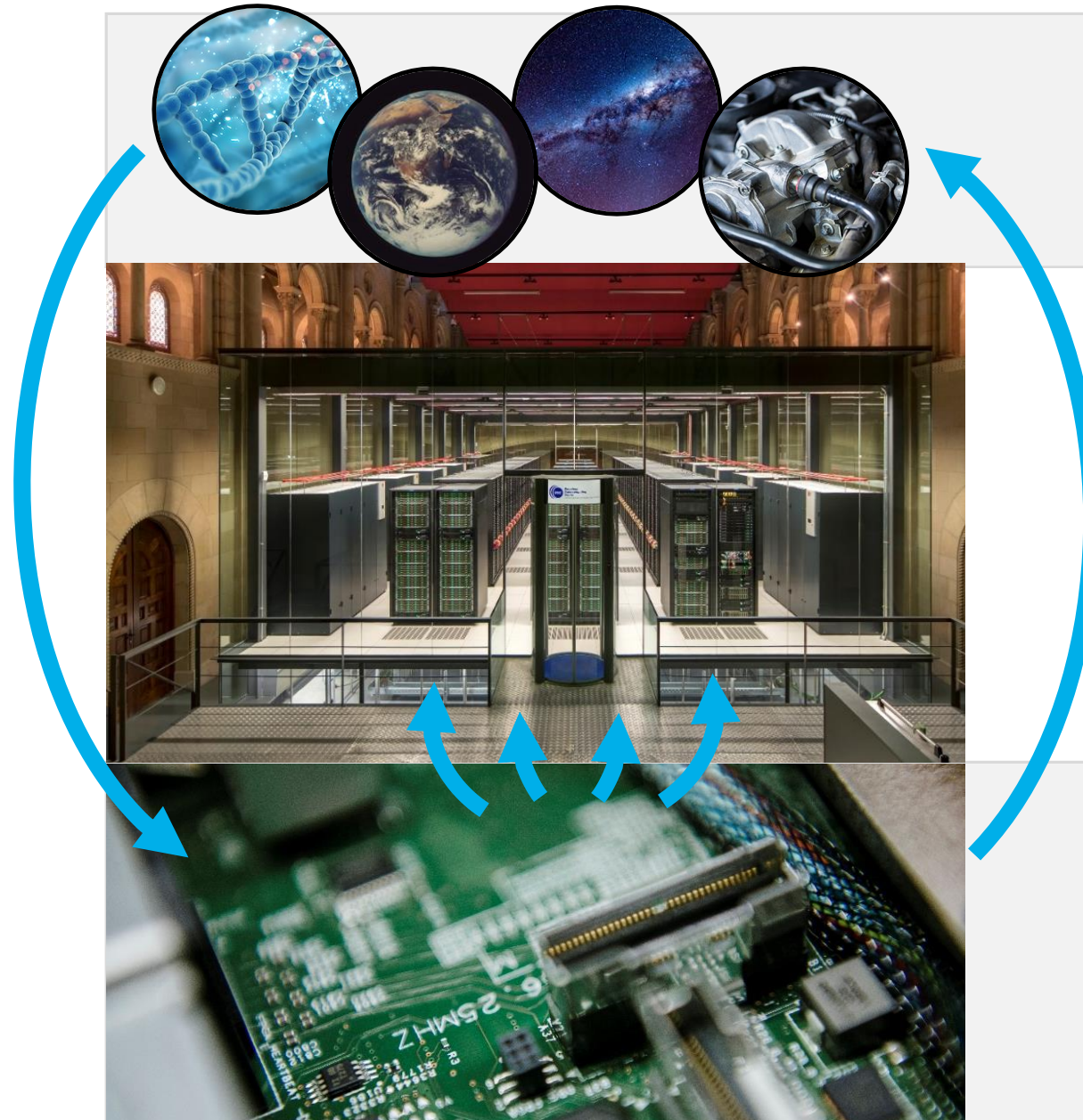
LOCA @ BSC?



LOCA

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Computer Architecture

BSC full stack



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LOCA Goals

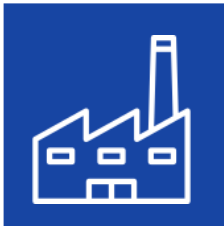
- Mechanism to extend open source ecosystem to include H/W
 - Add H/W expertise to BSC and European partners, leverage existing S/W expertise
 - Open European IP repository → rapid implementation
 - Provide proven/usable Open Source H/W
 - Intersection of academia and industry
 - Catalyst to reinvigorate European ICT industry Global collaboration and training center
 - Incubator for European IP



Open



- Participation from Academia across Europe
 - Student training
 - Affiliate Labs at other institutions
 - Research collaboration
 - Repository for research work



- Participation from European and global industry
 - Engagement with European Research and Development
 - Access to European talent
 - European visibility and branding
 - Innovation incubator

European Collaboration & Education



Casteller

(human tower)



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Traditional chip design is done in a Master/Apprentice environment

LOCA recreates this environment by bringing in Masters from industry to collaborate with a variety of people, pushing beyond RTL

Professors, students, and industry veterans all together

Ideal sandbox for creative and innovative **full stack** R&D

Research and Design to chip fabrication



Focus, Freedom, and Forward

- BSC is embracing a Open Source Hardware to complement OSS
 - RISC-V has the momentum to succeed as the Open Source ISA, much like Linux
- BSC is building the infrastructure to support the future of computing
 - Combining applications, system software, hardware design and hardware
- BSC is organizing and coordinating full stack efforts
 - More resources = faster time to success
 - More partners (Academia/Industry)
 - Research/Resource multiplier
- Europe and the world can unite around the open source vision to move forward faster, together



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BSC is Made in Europe



LOCA is broader



Casteller
(human tower)



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European
Open
Hardware,
Architecture
Initiative ?

We are hiring. Come to Barcelona to help build the future!



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**EXCELENCIA
SEVERO
OCHOA**

Thank you

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