An Introduction to HPC @ Linaro

Accelerating deployment of Arm-based solutions for Supercomputers

Elsie Wahlig
78% of companies run on open source

Source: Black Duck Software & North Bridge
Most of us know the benefits of using open source software to develop and deploy our products. So what value does Linaro add?

- Focus on Differentiation
- Faster Time to Market
- Better Security
- Reliability & Quality
- Freedom of Choice

? ? ? ?
Laying the foundations upon which to innovate

Collaborate on the essentials
Linaro provides a collaborative forum where industry and community work together on open source software to solve common problems.

Focus on differentiation
There is no need to differentiate on the basics. Solving common problems together once and for all allows you to focus on your value add.

See tangible results
Solving problems doesn’t just mean developing strategy. It means actual engineering solutions are delivered by Linaro and member engineers.

Work with Arm software experts
Linaro co-maintains the Arm ecosystem, providing the tools, security and Linux kernel quality needed for a solid base to differentiate on. Arm software is our expertise.

Linaro co-maintains the Arm ecosystem. We work with members to consolidate fragmented Arm code bases in the ecosystem as a whole as well as specific market segments.
Enable markets on Arm architecture since 2010

**2010**

Arm code bases are fragmented.

**Linaro is formed** to consolidate and improve the way open source software is used.

**2012-2018**

Responding to demand, Linaro creates groups tasked with addressing fragmentation in specific segments.

**Today**

New and exciting technologies continue to emerge which require collaboration. Collaborative engineering drives innovation.

- Data Center & Cloud
- High Performance Computing
- Consumer (Mobile & Android)
- Edge & Fog Computing
- IoT & Embedded
- Open Source Security
- Multimedia on Arm
- Open Source Tools for Arm
- Artificial Intelligence
- Autonomous Vehicles
- Linux Kernel Quality
LDCG
Datacenter & Cloud Segment Group

- Arm64 Server Architecture
- Cloud Orchestration
- Big Data & Data Science

CI Community
Continuously tested and available as part of the Developer Cloud

Developer Cloud
Member Servers hosted in London, UK. Publicly available

LDCG Special Interest Groups

HPC SIG

Key Projects & Workloads

- ACPICA
- Powered by Apache
- CCIX
- Ceph
- Docker
- DPDK
- ODPI
- OpenJDK
- OpenBMC
- OpenStack
- OPAQUE ARROW
- EMU
- Spark
- MongoDB
- Ambari
- Apache Drill
The Linaro HPC SIG drives open source software development for the Arm architecture. It aims to lower barriers to deployment and management through standardisation, interoperability, orchestration and use case development.

https://www.linaro.org/engineering/high-performance-computing/
HPC-SIG Achievements and New Initiatives

Built a lab infrastructure to reliably work on ecosystems, toolchains and libraries.

Upstreamed SVE in GCC.

Supporting SVE Enablement in LLVM.

Contributions to OpenBLAS to leverage the full power of the servers’ microarchitectures.

Testing and providing feedback for the full enablement of Lustre Server on ARM.

Release testing of OpenHPC as well as development of a framework to easily provide Cloud based as well as bare-metal ARM HPC solutions.

Convergence of Datacenter workloads in Supercomputers
HPC-SIG Focus areas

1. **Ecosystem stability**, including base Linux, HPC services (Lustre, MPI, OMP), hardware reliability and speed (cross-vendor, infiniband). OpenHPC is a means to that end, not the end itself.

2. **Toolchain usability and performance**, more specifically LLVM. It needs to be on par with GCC on Arm first, but ultimately, the aim is to compete with ICC on x86_64.

3. **Library suitability and performance**, to cover the huge gap of hand-optimisation for SSE/AVX that doesn’t yet exist in NEON/SVE, and all the unknown assumptions of the x86 architecture. This includes distributed filesystems.
Current HPC ecosystem

- Top500 list
  - All of them running Linux
  - 96.2% based commodity Intel (up from 89% in 2015)
  - Many vendors / integrators

Striking contrast in software vs. integration?

- The Linux ecosystem, however, is also diverse
  - 46.6% “Linux” (custom)
  - 31.6% OSS distros (CentOS, Scientific, Ubuntu, TOSS)
  - 21.8% Commercial (Cray, Bull, SUSE, RedHat)
Server Architecture Standards

- Standards Compliant (SBSA/SBBR/UEFI/ACPI/IPMI)
  - UEFI/ACPI/IPMI/SMBIOS already mature standards in x86
  - SBSA/SBBR define how to apply these to ARM to make all machines predictable
  - Use Arm Server Architecture Compliance Suite for out-of-the-box experience.

- Leverage existing knowledge and development (with x86)
  - Platforms look familiar and use same monitoring/debug tools
  - RAS Reporting is the same across all Arm vendors

- Standardised OS-to-Firmware interfaces
  - Allows old distributions to function on new hardware
  - Allows hardware to be generic to OS (Linux distros / Windows Server / etc)

- Linaro’s work
  - 2859 patches over last 2 years accepted into Linux and 878 in EDK2
Linux ecosystem

● Upstream out-of-the-box experience expected
  ○ Linux has to work on any new hardware
  ○ Standards on hardware and software needed

● Arm vendors provide unique solutions
  ○ All need the same base Arm support
  ○ The only way to collaborate is upstream

● Linaro has been working on that for 8+ years
  ○ We're on top Linux committer/reviewer list since 2013

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Toolchains

● System toolchains
  ○ The system toolchain, used to build kernel and packages, is generally the distro’s GCC
  ○ Modern GCC is a solid toolchain for most uses
  ○ HPC: Benefits greatly from special (versus generic) build options

● Application toolchains can be (and often are) special
  ○ Used to compile libraries (math, distributed, etc) and applications
  ○ Potentially extended by vendors (optimised libraries, for example)

● Clang/LLVM is a good alternative
  ○ Consistent efforts for server side and Arm performance
  ○ Multiple existing products on top of LLVM
  ○ But the base must be solid
  ○ Linaro has over 1000 patches on Arm support, core changes, stability
  ○ We also participate actively in HPC/performance changes’ design
HPC SIG History

The HPC SIG was officially launched at Linaro Connect Las Vegas in September 2016 to drive the adoption of ARM in HPC through the creation of a data center ecosystem.

It is a collaborative project comprised of members and an advisory board.

Current members include ARM, Fujitsu, FutureWei, Marvell, Red Hat, Sandia. CERN and Riken are on the advisory board.

HPC SIG Mission

Leverage server class infrastructure, multi-gigabit interconnect support and Scalable Vector Extensions on an Arm software ecosystem to build exascale HPC deployments based on Arm Server Standards.
Accelerate Deployment of ARM into Data Centers

The Linaro Developer Cloud provides open source developers and commercial ISVs access to the latest Arm-based, server-class hardware running mainstream environments, to enable the IoT, Edge and Cloud ecosystem to develop, port, test and enable CI/CD for the Arm architecture.
Let's Collaborate!
Thank you

Join Linaro to accelerate deployment of your Arm-based solutions through collaboration

contact@linaro.org