Developing Rhea, the SiPearl European High-Performance Processor

Linaro Connect, Sept 2020
The European Server Processor Solution

• HQ: Maisons-Laffitte (Paris), France
• Design centers: Maisons-Laffitte, FR & Duisburg (Düsseldorf), GE
• CEO and Founder, Philippe Notton
• Seed Money: 7.4 M euros via Horizon 2020
• Headcount: 22 employees from ST, Intel, Atos, Marvell, Mstar-Mediatek
• Architecture based on Arm Neoverse (Zeus cores)
• Cornerstone of EU Pilot machines, and soon Exascale machines

Founded in 2019 as the production hand of the European Processor Initiative (EPI), SiPearl holds a central position in the EPI for Exascale Processor Development and EuroHPC Pilots.
High Performance
Arm Server Processor
Arm Neoverse Zeus cores, NOC, acceleration...

Flexible Common Platform
Processing + Acceleration

Security/Safety/Data Protection

EU Sovereignty
Founded through EU commission, 27 partners in EPI

P3S: Performance, Security, Safety, Sovereignty
SiPearl will cover the full range of advanced computing from high-end HPC to edge devices and will secure the global network with Secure Room in Secure Chip (SRSC) technology for End-2-End security.
Multiple Processor companies, HPC OEM, 2 large CSPs, Sandia “Astra”, Stony Brook University

CPU manufacturer, HPC OEM, HPC systems at CEA, UK, MontBlanc, EPI

Most widely used ISA on the planet with over 200B processors sold.

Fully fleshed ecosystem is growing organically across HPC, Cloud; Edge, IOT, Automotive...

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European Processor Initiative

- High Performance General Purpose Processor for HPC
- High-performance RISC-V based accelerator
- Computing platform for edge and autonomous cars
- Will also target the AI, Big Data and other markets in order to be economically sustainable

EPI Objective

Develop a complete EU designed high-end microprocessor, addressing Supercomputing and edge-HPC segments
SIPEARL RHEA HYPERSCALE CONFIGURATION

- Zeus CPU core as compute unit building blocks
  - Performance computing and intelligent memory subsystem
  - General-purpose processor with rich software ecosystem(s)

- Memory-coherent on-chip network
  - Topology-aware design for scalability and flexibility
  - Distributed last-level cache to memories with reconfigurable NUMA domains
  - Isolation between computing units
  - Coherent SMP between chip domains

- HBM and DDR for both bandwidth and capacity

- Latest PCIe/CCIX links to interconnect and accelerators

- Low-power - low latency links for die-to-die or chip-to-chip connections

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SIPEARL COMMON PLATFORM

- Integrate best-in-class processor cores
- Integrate innovations
- Leverage industry IP supports
- Leverage foundry and manufacturing platforms

Scalable platform design to decouple architecture requirements and implementations
SIPEARL AND THE EPI COMMON PLATFORM

- Allow integration of customized functions in chip, in package, on board, or over PCIe or network link
- EPI Accelerators to work in I/O coherent mode and share the same memory view;
- Targeting high Byte/FLOP ratio
- HBM, DDR and PCIe
- Coherent NoC with system level cache to keep data local
- D2D interface open to EPI (and beyond)
RHEA DESIGN GOAL: BALANCED GENERAL PURPOSE PROCESSOR
## ECOSYSTEM

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### HPC SW STACK

**Job schedulers and Resource Management:**
- SLURM, IBM LSF, Altair PBS Pro, etc.

**Communication Stacks and run-times:**
- Mellanox IB/OFED/HPC-X, OpenMPI, MPICH, MVAPICH2, OpenSHMEM, OpenUCX, HPE MPI, GASPI, MPC

**Parallelism standards:**
- OpenMP (omp / gomp), MPI, SHMEM

**HPC Prog Languages:**
- Fortran, C, C++ via GNU, LLVM, Arm & OEMs

**Debug and perf analysis tools:**
- Arm Forge, Rogue Wave, TAU, etc.

**Filesystems:**
- BeeGFS, LUSTRE, ZFS, HDFS, GPFS

**Applications:**
- Open-source, Private, and Commercial ISV codes

App/ISA specific optimizations, optimized libs and intrinsics:
- Arm PL, BLAS, FFTW, etc.

**User-space utilities, scripting, containers, and other packages:**
- Singularity, Openstack, OpenHPC, Python, NumPy, SciPy, etc.

**Cluster Management Tools:**
- Bright, HPE CMU, xCat, Warewulf

**Linux OS Distro of choice:**
- RHEL, SUSE, CENTOS,...

**Arm Server Ready Platform:**
- Standard OS compatible FW and RAS features

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We accelerate accelerators

SIPEARL SAS
RCS Versailles Siren 851 434 365
contact@sipearl.com
www.sipearl.com
Lan: +33 1 80 83 54 90
R&D in Paris / Sophia Antipolis / Duisburg (DE)