THE NEXT PHASE OF ARM HPC DEPLOYMENTS

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Seattle, WA – November 13, 2017 – Global supercomputer leader Cray Inc. (Nasdaq: CRAY) today announced the Company is creating the world’s first production-ready, Arm®-based supercomputer with the addition of Cavium (Nasdaq: CAVM) ThunderX2™ processors, based…
Arm is Boring

“My goal with Arm was always to make it exactly as boring as x86. […] You get adoption if it feels exactly the same and familiar. Boring sells.”

– Jon Masters
RedHat, NuVia

“Porting to Arm was boring.”

– Prof. Simon McIntosh-Smith
University of Bristol / GW4

“Worst hackathon ever!”

– Heidi Poxon
Cray Programming Tools
Figure 3. CloverLeaf scaling results up to 64 nodes for Broadwell, Skylake and ThunderX2 systems.
“THE FUTURE IS SELDOM THE SAME AS THE PAST.”

SEYMOUR CRAY
Enabling the Future of HPC Systems

“Me Too” isn’t good enough!

In coming “Cambrian Explosion” of Exascale Era architectures, HPC will need purpose-built solutions!

Cray has been working to develop the ecosystem of HPC-relevant technologies
Partnership on Future Architectures

- Cray contributed to the development of the Arm Scalable Vector Extension (SVE)
  - Leverages ISA elements pioneered by Cray
  - Provided guidance on compiler-friendliness of ISA

- SVE instruction set has many features familiar to Cray’s compiler such as wider vector widths, predication, gather/scatter, etc.

- Partnered with DOE to understand impact on end-user applications
  - Application-driven architecture requires understanding!
DOE FF2: Prototyping SVE Compiler Support

• First pass: Transliteration of Cray X2
  • Low overhead for experimentation
  • Cases where mappings are inexact are painful

• Capabilities:
  • SVE Vectors
  • Predicated execution, with various predication schemes
  • Widths from 128 bits to 2048 bits
  • OpenMP 4.0 capabilities, including SIMD directives
  • Explicit memory hierarchy support

• Followed by prototype of native SVE CCE
Data Movement Optimized Computing

• Explored HPC-relevance of a broad range of memory technologies
• Worked to make sure HBM standard was appropriate for HPC
• Characterized apps in terms of memory behavior
• Explored system-level design space
Introducing the Cray CS500 - Fujitsu A64FX Arm Server

• Next generation Arm® solution

• Cray Fujitsu Technology Agreement

• Supported in Cray CS500 infrastructure

• Cray Programming Environment

• Leadership performance for many memory intensive HPC applications

• GA in mid-2020
Technical Overview

• 2U chassis supporting 4 blades
  • Each blades has 2 single socket nodes
  • 8 single socket nodes in 2U

• A64FX Processor
  • First implementation of Armv8-A SVE architecture
  • 1024 GB/s memory bandwidth per socket
  • 48 Cores with SVE 512-bit wide SIMD
  • >2.7 Tflops per socket
Cray Developer Environment for A64FX

**Programming Languages**
- Fortran
- C
- C++
- Chapel

**Programming Models**
- Distributed Memory
  - MVAPICH (or MPICH)
- Shared Memory
  - OpenMP

**Programming Environments**
- PrgEnv-
  - Cray Compiling Environment PrgEnv-cray
  - GNU PrgEnv-gnu

**3rd Party compilers**
- PrgEnv-Allinea*

**Optimized Libraries**
- Scientific Libraries
  - BLAS
  - LAPACK
  - ScaLAPACK
  - Iterative Refinement Toolkit
  - FFTW
  - I/O Libraries
    - NetCDF
    - HDF5

**Cray Developed**
- Cray Compiling Environment
- PrgEnv-
- MVAPICH (or MPICH)

**Cray added value to 3rd party**
- 3rd Party compilers
- PrgEnv-Allinea*

**3rd party package**
- MVAPICH
- UPC Fortran coarrays
- Coarray C++
- Chapel

**Licensed ISV SW**
- TotalView**
- DDT*

**Tools**
- Environment setup
  - Modules
  - Tool Enablement (Spack, CMake, EasyBuild, etc.)
- Performance Analysis
  - CrayPAT
  - Cray Apprentice^2
  - Porting
  - Reveal
  - CCDB

**Tools Interface**
- CTI

**Debuggers**
- gdb4hpc*

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* Depending on gdb and compiler availability from Allinea / arm
** Depending on availability from RogueWave
Come See Us!

See the Cray CS500 Fujitsu A64FX on the SC’19 show floor:

HPE booth #1325
Cray booth #625
Looking Forward

• The next phase of HPC Arm deployments will be *purpose-built*

• Cray has been working to enable the ecosystem to take on HPC challenges

• A64FX is the first step into purpose-built Arm HPC solutions
  • Will prove out value of both SVE and HBM