ARM at Cray

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CRAY™

arm

ARM at Cray

Collaborations	• DOE Cray Fast Forward 2 and PathForward programs • Contributed to SVE and other aspects of ARM ISA
Systems	• Cray XC50 “Scout”
Software	• Full Cray programing environment support • Same management system and operating environment (Linux) as for x86

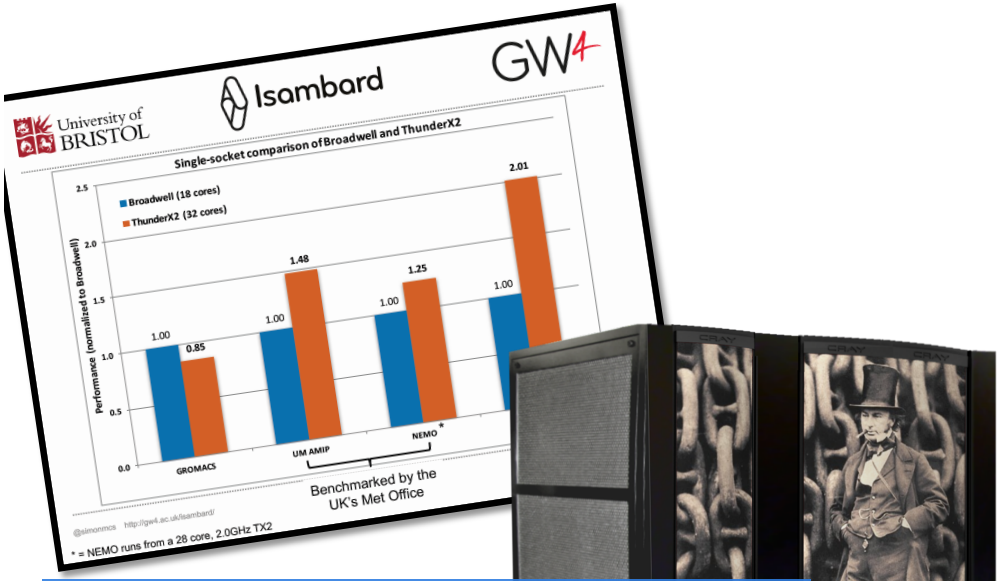
Cray Collaboration Evident in ARM SVE

Feature	Benefit
Scalable vector length (VL)	Increased parallelism while allowing implementation choice of VL
VL agnostic (VLA) programming	Supports a programming paradigm of write-once, run-anywhere scalable vector code
Gather-load & Scatter-store	Enables vectorization of complex data structures with non-linear access patterns
Per-lane predication	Enables vectorization of complex, nested control code containing side effects and avoidance of loop heads and tails (particularly for VLA)
Predicate-driven loop control and management	Reduces vectorization overhead relative to scalar code
Vector partitioning and SW managed speculation	Permits vectorization of uncounted loops with data-dependent exits
Extended integer and floating-point horizontal reductions	Allows vectorization of more types of reducible loop-carried dependencies
Scalarized intra-vector sub-loops	Supports vectorization of loops containing complex loop-carried dependencies

Nigel Stephens – https://community.arm.com/processors/b/blog/posts/technology-update-the-scalable-vector-extension-sve-for-the-armv8-a-architecture

ARM is in the Cray XC50

CRAY XC50 – LEADING SUPPORT FOR ARM IN HPC



"Having access to Cray's optimised HPC software stack of compilers and libraries in addition to all of the open source tools has been a real advantage."

-- Prof. Simon McIntosh-Smith
University of Bristol and GW4

ARM IS THE NNSA'S NEW SECRET WEAPON

November 7, 2018 Nicole Hemsoth

THENEXTPLATFORM

"Every time we get more memory bandwidth, we go faster. But when you give us FLOPS, we don't. We just wait for memory more often and we are looking for a better way to do this for our codes."

-- Gary Grider
Los Alamos National Lab

THE GW4 ARM HACKATHON WAS BORING*

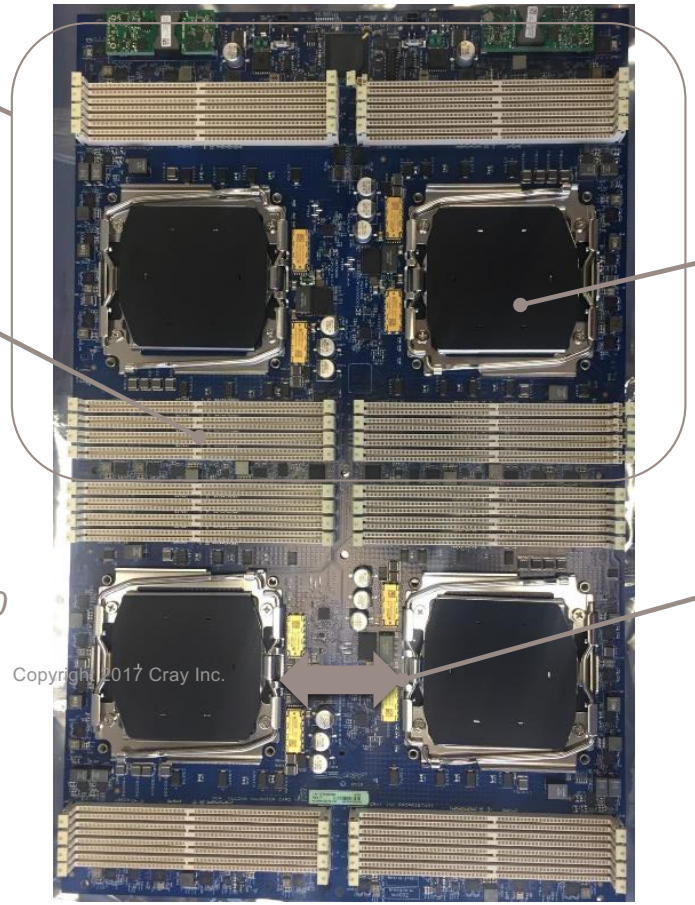
Applications	Unified Model, OpenFOAM, GROMACS FAST. FLEXIBLE. FREE., CP2K, VASP (Vienna Ab-initio Simulation Package)
Armv8 Compilers	CRAY CCE, LLVM, GCC
Profilers	CRAY CrayPat, arm FORGE

* It was boring because all of these codes “just worked”

Thunder X2 Processor Daughter Card

2-Socket Nodes

8 DIMMs per Socket



ThunderX2 Processor
32 Cores
2.1 GHz base frequency + boost
537 Gflops
32 MB L3 Cache

Inter-chip Interconnect
75 GB/s/dir
24 lanes @
25 Gbps

High memory and inter-chip link bandwidth permit a flat (uniform) 300 GB/s local memory system!

Shasta Compute Infrastructures

MOUNTAIN
Optimized Cabinet

RIVER
Standard 19” Rack

Same Interconnect – Same Software Environment

Shasta Development Environment

Programming Languages

Languages

- Fortran
- C
- C++
- Chapel
- Python
- R

Programming Models

Distributed Memory

- Cray MPI SHMEM

Shared Memory / GPU

- OpenMP

PGAS & Global View

- UPC
- Fortran coarrays
- Coarray C++
- Chapel

Programming Environments

ProgEnv-

- Cray Compiling Environment PrgEnv-cray
- GNU PrgEnv-gnu
- 3rd Party compilers (ARM, Allinea, etc) PrgEnv-???

Optimized Libraries

Scientific Libraries

- LAPACK
- ScaLAPACK
- BLAS
- Iterative Refinement Toolkit
- FFTW

I/O Libraries

- NetCDF
- HDF5

Tools

Environment setup

- Modules / Lmod
- Tool Enablement (supports Spack, CMake, etc.)

Performance Analysis

- CrayPAT
- Cray Apprentice[2]

Porting

- Reveal
- CCDB

Tools (continued)

Debuggers

- gdb4hpc
- TotalView
- DDT

Debugging Support

- Abnormal Termination Processing (ATP)
- STAT
- Valgrind4hpc

Analytics / AI **

AI Toolboxes

- Cray Urika AI - Analytics
- Chapel AI

DL Frameworks

- Cray PE DL Scalability Plugin

Cray Developed
Cray added value to 3rd party
3rd party packaging
Licensed ISV SW

** Not PE dependent

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These statements are only predictions and actual results may materially vary from those projected. Please refer to Cray's documents filed with the SEC from time to time concerning factors that could affect the Company and these forward-looking statements.

THANK YOU

QUESTIONS?

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