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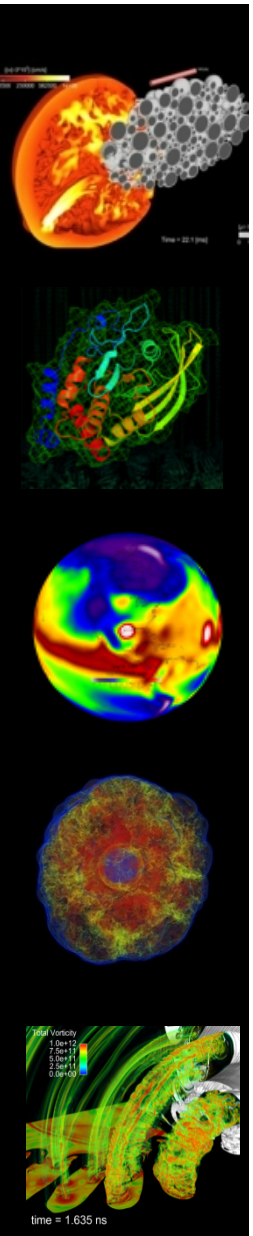

Crossroads: A Status on Design, Deployment, Acceptance, and Operation

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Design

- Follow-on to Trinity, LANL's current Advanced Technology System
- CPU – no accelerators
- Intel Sapphire Rapids processors
- Final configuration is High Bandwidth Memory
- DDR for early deliveries
- HPE Cray "Shasta" Mountain and River

Programming Environment

- Cray Programming Environment
- Intel OneAPI

Operations

- CSM
- CPE
- Slurm

Deployment

- Timeline
  - Early test systems
  - Application Readiness Systems
  - DDR Phase
  - HBM Phase

Acceptance

- General criteria
  - Delivery, installation, configuration, DOA
  - Boot times
  - Resiliency

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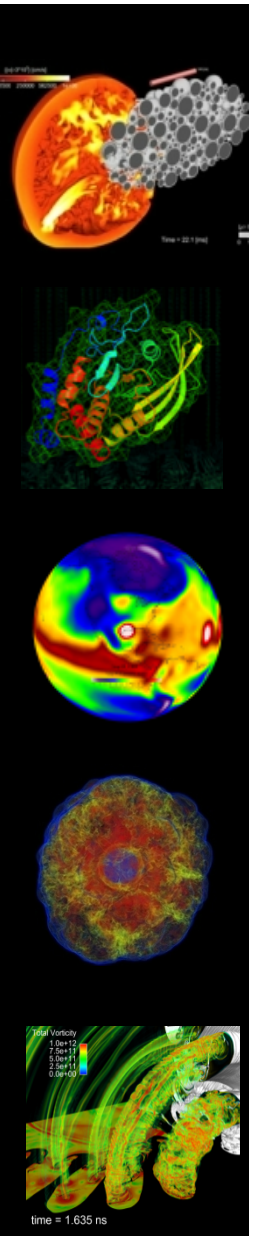

Performance Acceptance Subgroup

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Presenter: Kevin Stroup

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Performance Acceptance Subgroup Roster

- The **current** roster (alphabetical by lab) for the subgroup is:

Los Alamos National Laboratory (LANL)

- Christopher DeJager
- Charles Ferenbaugh
- Paul Ferrell
- Timothy Goetsch
- Adam Good
- Jennifer Green
- Hugh Greenberg
- Francine Lapid
- Alex Long
- Daniel Magee
- William Nystrom
- Jordan Ogas
- Howard Pritchard
- Charles Shereda
- Kevin Sheridan
- David Shrader
- Nicholas Sly
- Alfred Torrez

Sandia National Laboratories (SNL)

- Omar Aaziz
- Anthony Agelastos
- Sam Browne
- Simon Hamamond
- Erik Illescas
- Douglas Pase
- Joel Stevenson
- Vanessa Surjadidjaja
- Courtenay Vaughan

This is a team effort!

Performance Benchmarking Applications

Micro-Benchmarks

1. **DGEMM**: Measures the floating-point capabilities of a single node.
2. **IOR**: Measures parallel file system performance.
3. **mdtest**: Measures the metadata performance of a file system.
4. **STREAM**: Measures memory bandwidth.
5. **MPI Benchmarks**: Measures MPI and high-speed network (HSN) performance.

Production Applications

1. **PARTISN (LANL)**: Provides neutron transport solutions on orthogonal meshes in 1, 2, and 3 dimensions using a multi-group energy treatment w/ the Sn angular approximation.
2. **Mercury (LLNL)**: Tests performance of Monte Carlo Particle Transport methods.
3. **SPARC (SNL)**: SPARC (Sandia Parallel Aerodynamics and Reentry Code) simulates the aerodynamic environment for atmospheric flight vehicles from subsonic to hypersonic speeds.

SSI Apps (Mini and Production)

1. **SNAP**: A proxy for modern discrete ordinates neutral particle transport.
2. **HPCG**: A conjugate gradient benchmark.
3. **PENNANT**: A proxy for 2D, unstructured, finite element mesh (FEM) w/ arbitrary polygons.
4. **MiniPIC**: A particle-in-cell (PIC) proxy that solves the discrete Boltzman equation in an electrostatic field within an arbitrary domain w/ reflective walls.
5. **UMT**: A proxy that performs 3D, nonlinear, radiation transport calculations using deterministic (Sn) methods.
6. **VPIC**: A 3D, relativistic, electromagnetic PIC plasma simulation code.
7. **Branson**: A proxy for the Implicit Monte Carlo method to model the exchange of radiation w/ material at high temperatures.

lanl.gov/projects/crossroads/benchmarks-performance-analysis.php

Performance Benchmarking Assessment

- SOW for Crossroads Phase 1 and Phase 2 is still being finalized; the **actual requirements will not be discussed until this occurs**.
- Improvements are relative to ATS-1/Trinity Phase 1 (Intel Haswell).
- **Micro-Benchmarks**: The improvements are are application-specific.
- **SSI Apps**: The improvement(s) with these mini- and production-applications are handled as the Scalable System Improvement (SSI) benchmarking metric (see next).
- **Production Apps**: The improvement(s) with these have historically been handled in aggregate, e.g., with an arithmetic mean of improvement over the baseline.

Scalable System Improvement (SSI) Metric

$$SSI = \left(\prod_{i=1}^{M} (c_i U_i S_i)^{w_i} \right)^{\frac{1}{\sum_{i=1}^{M} w_i}}$$

- M: total # of applications
- c: capability scaling factor
- U: utilization factor $= \frac{n_{\text{ref}}}{n} \times \frac{N}{N_{\text{ref}}}$
  - n: total number of nodes used for the application
  - N: total number of nodes in the respective platform
  - ref: refers to the reference (i.e., baseline) system
- S: application speedup $= \frac{t_{\text{ref}}}{t}$ or $\frac{FOM}{FOM_{\text{ref}}}$
- w: weighting factor

Programming Environment (PE) Focus

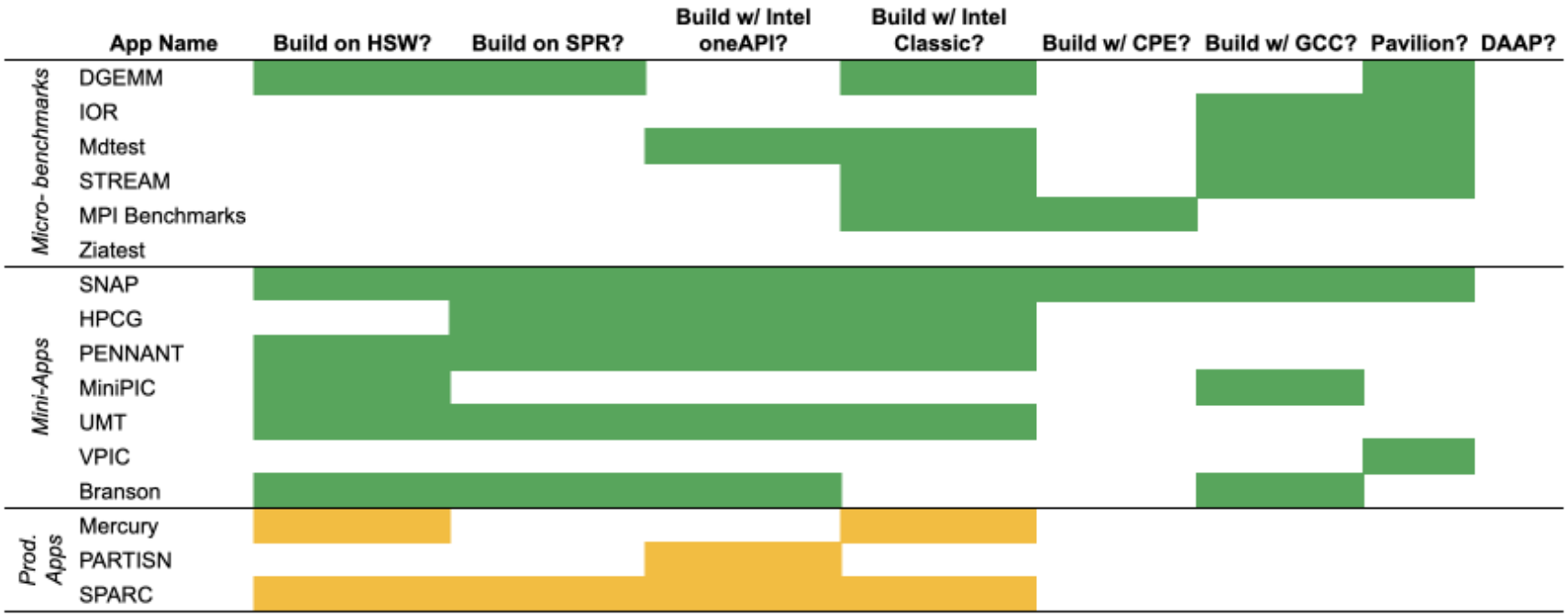
- For each of these, the goals are to:
  - Port application to latest version of PE
    - **Challenge**: Application snapshots are quite old
    - **Challenge**: Intel oneAPI is quite new and some of its components (e.g., Fortran) are not quite ready to replace Intel Classic in all cases
  - Communicate issues/successes to upstream vendors
- The order of preference above stems from generalized NNSA Tri-labs application teams' focus for Crossroads system
  - All PEs will, ultimately, be used by various teams on Crossroads
  - If performance goals are met and time remains, work will still commence until all of these PEs have been investigated

Teaming with vendors enables a healthy ecosystem

Looking to the Future: Testing

- As the applications are ported and test cases are developed, researchers are integrating them into Pavilion
- This will assist with downstream testing activities extending beyond Acceptance (e.g., platform update testing)
- This will also assist with easy transitioning of test cases from the developers to the testers (team member load balancing)

Porting Status



Good early progress

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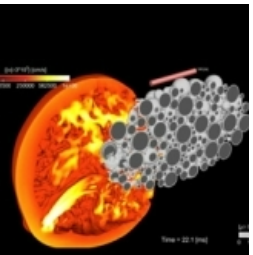

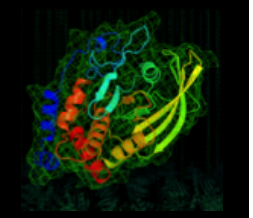

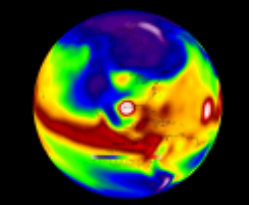

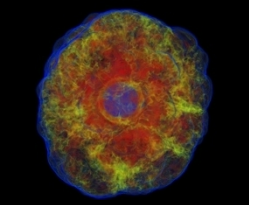

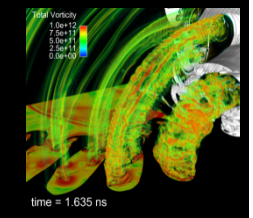

Questions?

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