



# 2021 HFIP Meeting: HPC

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# Overview



- Technology
  - Processors
    - Modern x86 processors
    - GPU/Accelerators
    - Arm/A64FX
- Platforms
- Software
  - Exascale
  - Containerization



# Processors

- x86
  - 64 cores per socket
    - 128 PCI4e Lanes
    - 4TB of Memory
- GPUs
  - One-third of the top100 contain GPUs
  - Multi-Instance, AI and Compute focus
  - Available from Intel, AMD, NVIDIA
- Specialized Accelerators/Processors
  - Development of new domain focused processors

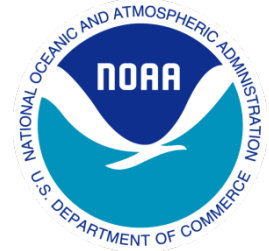


# Processors

- Arm/A64FX
  - The fastest supercomputer in the world is ARM based
  - Adoption continues across industry
    - Raspberry Pi – Apple M1 – Fujitsu – NVIDIA
  - ARM standards continue to evolve and increase feature set
  - A64FX adds High-Bandwidth Memory (32GB)
- Risc-V is evolving in the same way



# Platforms



- Traditional and Cloud
  - Cloud platforms continue to grow in capability, favorable performance of FV3GFS benchmarks
  - Interconnects continue to improve/evolve
  - Merging of toolsets across these platforms can change the way we use compute and will influence how software infrastructure is deployed



# Cloud R&D HPCS

- Cloud Investigation completed at end of FY19 (GDIT)
  - 7 vendors evaluated
    - Usability
    - Performance
    - Cost models
    - Portability
    - Scalability
  - FV3 Model was able to run with minor performance impact
    - Native and Container
- Program started increasing cloud support infrastructure in 2018
- Cloud Task Order issued in FY20 and FY21
  - 3 vendors: Amazon, Microsoft, Google
- Uniform access through ParallelWorks

# NOAA's High Performance Computing Future Locations and Systems

## Phoenix, AZ

- Backup/Development Operational (12,100 Tflops)

## Fairmont, WV

- Development HPC
- Hera (5,300 Tflops)
- 48,000K Monthly Compute Hours

## Princeton, NJ

- R&D Post-Processing & Analysis
- NOAA CI Grant HPC
- TBD

## Manassas, VA

- Primary Operational System (12,100 Tflops)

## Boulder, CO

- Development HPC
- Jet (1,795 Tflops)
- 40,300K Monthly Compute Hours

## Oak Ridge, TN

- Research HPC
- Gaea (5,300 Tflops)
- 96,100K Monthly Compute Hours

## Starkville, MS

- NOAA CI Grant HPC
- Orion (5,000 Tflops)
- Estimated 50,000K Monthly Computer Hours



Operational HPC Systems (current/2020)



Research and Development (R&D) HPC Systems



Cooperative Institute Grant Funded High Performance Computing



# Software



- Exascale
  - No coherent Fortran-only strategy in community
  - ECP, DSL, C++
  - Need to address multiple processor options, languages, fault tolerance, etc.
  - Evaluation of multiple paths underway
- Containerization of Software
  - Performance impacts of containers is greatly reduced
  - Allows for more rapid deployment and integration of traditional HPC, AI/ML, and tailored workload stacks
  - Singularity is currently available within the R&D HPC





# Opportunities for Training/Development



- GPU Bootcamp
  - <https://www.gpuhackathons.org/event/noaa-ai-science-bootcamp>
  - Applications close November 24
  - Virtual Event December 10
- Hackathons
  - Held to events in FY21
  - Next event in the spring
- Incubator Projects
  - Call for Proposals in December



# Emerging Trends in HPC



- Increasing heterogeneity in hardware and software
- Increasing choices requires additional flexibility to allow for integration and rapid development for emerging and growing workloads



# The Future of NOAA HPC



- **Uniform growth** across R&D and Operations to meet mission needs
- Effectively **Invest and Innovate** with Technology
  - Gain capacity and capability through modern architectures and software methodologies including cloud computing
- Build towards the future state as a continuum of computing that supports simulating the entire Earth System for Weather, Water and Climate Prediction
- **Modernization** that embraces continuous User Input (“User First” focus)