NOAA Software Engineering for Novel Architectures (SENA) Project

Leslie Hart

9/9/2015

Funding Language

"NOAA will acquire software engineering support and associated tools to re-architect NOAA's applications to run efficiently on next generation ***fine-grain*** HPC architectures."

What is “fine-grain”

From a recent procurement document: “Fine-grain architecture (FGA) is defined as: a processing unit that supports more than 60 concurrent threads in hardware (e.g. GPU or a large core-count device).” *(of course “traditional” architectures are getting to this point as well)*

Overarching Goals

- Prepare codes for a future production architecture
  - Monitor architectural evolution
- Maintain codes in a way that subject matter experts can still modify the code
- Monitor (and participate as appropriate) evolving standards
- Codes should still be viable for current (traditional) architectures
  - It is expected that code optimizations will increase performance on traditional architectures
- Develop expertise within NOAA

Leadership Team - NOAA-wide

Leslie Hart - OCIO

V Balaji - GFDL

Rusty Benson

Mark Govett - ESRL/GSD

Tom Henderson

John Michalakes - NCEP

Priorities

Models:

WRF (ARW/NMM), MPAS or FV3, GFDL Climate, NMMB

Programming Research:

Algorithm development, Programming approach

Standards:

OpenACC, OpenMP, LLVM

Challenges

- Lack of standards across divergent architectures
- Large quantity of legacy codes
- Access to developmental platforms
- Uncertainty of performance gains
- Finding qualified staff

Technical Issues

- Language (is Fortran/MPI still the right choice)
- Multiple layers of parallelism
  - Task, Thread, Vector
- Memory footprint of current fine-grain devices
- Atmospheric codes tend to have little data reuse

Implementation

Develop/cultivate relationships with vendors such as Intel, NVIDIA, etc

Work with internal tools such as source-to-source translators to implement single source as much as possible

Work with compiler vendors to ensure directive based approaches are feasible

Develop small test environment coupled with access to larger government funded machines (DOE, NSF, NASA)

- Hardware, Compilers, Tools

Status

Funding distributed to GFDL, ESRL/GSD, NCEP
    Hiring in process at all three institutions
Acquiring test systems
Beginning/continuing work on models
Evaluating OpenACC and OpenMP versus source-to-source translation

Synergy

- NOAA's Next Generation Global Prediction System (NGGPS) Program
- NSCI
  - NOAA is a "Deployment" agency
    - Develop mission-based HPC requirements to influence the early stages of the design of new HPC systems and will seek viewpoints from the private sector and academia on target HPC requirements *(of course this is a software and hardware problem)*

Conclusion

The SENA project is just starting, it is an attempt to consolidate and accelerate existing NOAA projects

The efforts and results will be useful even in the event that fine-grain architectures do not become as price/performance competitive as some have anticipated

Thank You!