NOAA Software Engineering for Novel Architectures (SENA) Project

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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!