NERSC's Contributions to the World's Supercomputing Community

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My Random Thoughts over 100,000,000+x Performance Improvement
“Old Timer” Prerogatives

• These are my thoughts based on
  • Many supercomputers, storage systems, facilities, users, projects, …
  • Three world class HPC organizations
  • Working in industry, national centers, government, academia
  • Many relationships and colleagues
• I may have some details wrong – but I am sure the message is correct
  • We old timers may not remember things correctly, but we do remember the important things to pass along
  • So, let me know the correct details later if you will
• I will comment on what I am interested and what I remembered
  • If you are not interested in it, sorry
• I do not want to demean any of the many other great HPC organizations and their contributions

But this is NERSC’s birthday today after all
My Definition of “NERSC”

• To me, NERSC means
• NERSC Clients and Users
• NERSC Philosophy
• NERSC Staff
• NERSC Resources
• NERSC Funders
• NERSC Leaders
• NERSC Academic Partners
• NERSC Associates, Collaborators and Friends
At SC 07, Dr. Ray Orbach, DOE’s Undersecretary for Science, said in his plenary session

“NERSC was … and is today, the best run … computing facility in the world”
Historical Perspective
National Production Supercomputing Programs

DOE NERSC (&Esnet)

NAS.NASA

NSF

Previous Individual Center Systems

NCAR/CISL

DOD HPCmod

DOE

Leadership OLCF, ALCF

ASCI-LI, NL, LANL, SNL

GSFC

NCS, SDSC, PSC, JVN, CTC

XSEDE (TG)

UTK, TACC

NERSC’s Greatest Legacies

**NERSC is the First Multi-discipline Nationally based HPC resource for Diverse, Open Science**

- Only local/center based supercomputing before
  - e.g ARC, LeRC, ARL, UCB,
- Contemporary shared supercomputing was single discipline before
  - e.g NCAR, MFECC, …
- NERSC taught the rest of the HPC community how to do it
  - e.g NASA, NSF, DOD, other DOE, ….
- International Supercomputing
NERSC’s Greatest Legacies

NERSC Made Massively Parallel Processing into Production Supercomputing

• Previous MPP systems were prototyping/experimental/exploratory
• The T3E became the major production computing resource at NERSC in 1996
• NERSC, and the NERSC Users, were the first major site to commit its production and future only the distributed, highly parallel computing
  • Majority of use, effort and funding
• Within 1 year of the full T3E, all disciplines were using much more time and had larger allocations on the parallel system than on all the vector system combined.
• Now, there is only MPP computing within the Supercomputing community
NERSC’s Great Legacies

**NERSC’s Focus on Science First**

- Exceptional customer service is an integral part of NERSC
- NERSC held as the “standard candle” for high quality services
- Increases science team’s productivity
- A lot of hard work and innovation goes into excellent customer service and production
- Many methods adopted by others including Leadership Facilities
NERSC’s Great Legacies

NERSC and Partners Helped Create New Software Capabilities

- MPI enhancements and use
- Data Management
- Visualization
- Adaptive and load balancing techniques
- I/O and storage
- Programming Models
- Cyber Protection
- Applications
  - Astrophysics, Climate, Materials, ….
NERSC’s Great Legacies

NERSC merged Big Compute and Big Data
Decades Before We Knew to Call it Big Data

• T3E and PDSF arrived at NERSC on the same day in 1996 and started production the same year
• HPSS collaboration
• Global Unified Parallel File System
  • Envisioned at NERSC – others said it could not be done
    • Need shown when T3E was in service
  • Emulated elsewhere – i.e. Spider, NCSA, DOD,….
  • Many others tried but failed before NERSC showed it was possible
• More data comes to NERSC than leaves
• A high percentage of stored data is actually used
NERSC’s Great Legacies

**NERSC Focus on Real Performance**

- Real time to solution for real problems = real sustained performance
- System choices (back to MFECC) was always driven by science needs
- SSP method is adapted in many places
  - DOD HPC Mod, NCSA, Australian Met, ….
NERSC’s Great Legacies

NERSC is the best at showing its real impact on scientific progress

• It is hard to show science impact
• NERSC has been showing its impact for a long time
  • Volume
  • Uniqueness
  • Unexpected
• Many other organizations leverage it and benefit from it
NERSC’s Great Legacies

NERSC and LBNL Helped Re-invigorated Federal Supercomputing Funding – Particularly for Open Science

• Circa 2004 - Earth Simulator just announced
• Informal meeting at LBNL with a new Office of Science appointee Ray Orbach (not yet confirmed)
• We discussed the issues, the importance, the motivations and the benefits of increased HPC investment
• Since that time, the Federal budget for High End Computing has doubled since that discussion
• The open computational science share of funding more than doubled
NERSC’s Great Legacies

NERSC Systems Are Entirely Open and on the Internet – NERSC created New Cyber-protection Methods to Enable This

• Implemented and enhanced *Bro* (Vern Paxson)
• NERSC showed high performance, unencumbered networking with the philosophy of “Monitor and React rather than Risk”
  • Major systems are not behind slow, disruptive firewalls
• Science DMZ implemented and proven by ESnet and NERSC
• NERSC Influenced policy to remain open and efficient while others restricted
• Monitor and React is only viable if it works. NERSC remained in service when many other sites were down for compromises.
  • Technology and expertise
NERSC’s Great Legacies

Serving the Grand Challenges and the overall Computational Community

- Persistent support for all types of computing
- DOE INCITE program started at NERSC to serve at scale
  - Colliding Black Holes and others
  - Showed great steps forward can be done by giving large resources to well qualified teams
- Resource management for really big, large work and lots of smaller jobs was solved
- Missing middle has no better place to work than NERSC
NERSC’s Great Legacies

**NERSC Focus on Science First**

- Exceptional Customer Service is an integral part of NERSC
- NERSC held as the “standard candle” for high quality services
  - A required chapter in any “Best Practices” document
NERSC’s Great Legacies

**NERSC Re-invigorated HPC at Berkeley**

- When NERSC arrived, no one at Berkeley was using NERSC
- Within 5 years, Berkeley had the largest share (by institution) of NERSC allocations
- Built strong programs, with Berkeley, to attract new computationally focused staff
- Synergies enabled many new discoveries and insights and at least one Nobel Prize
NERSC and Vendors

- Clearly a give and take relationship
- LLNL/NERSC BVSS is the model acquisition method for many places
  - Holistic evaluation
- NERSC helped many vendors be better that then benefits all other customers
  - Cray (in all its variations) – vector, MPP, data
  - IBM – SP at scale, Power IH architecture, GPFS, HPSS, …
  - Networking Vendors – Force 10, Juniper, …
  - Storage Vendors -
- NERSC made some hard decisions, but in retrospect, they were the right decisions
  - Cray Computer, IBM, SGI, …
- SSP method assures real, meaningful performance for applications
- NERSC provides honest, fair and meaningful opinion
NERSC Diaspora

• A person recently told me that a measure of impact of an Organization is the diaspora of its alumni

• NERSC benefited from the diaspora of others and developed “best practices” by importing people who knew the best practices
  • Being one of the best helps get the people with the best practices

• NERSC staff have made many other organizations richer
  • NERSC alumni have gone on to work at other centers, industry and commercial, academia and government
  • Some even return to NERSC and LBNL after their “sabbaticals”
My Summary of NERSC

- NERSC was there first
- NERSC is there the longest
- NERSC is open science at unprecedented scales and impact
- NERSC is a perennial leader of the Supercomputing Community
- The Nation, DOE and the Supercomputing Community should be proud of NERSC and thankful for NERSC
I have some other interests now. So, I am happy to paraphrase Ray today.

NERSC is today, and will be in the future, one of the two best run HPC computing facilities in the world.

I will let you guess which is the other facility.

Happy 40th Anniversary NERSC!!!
COMMENTS?
WHAT DID I MISS?
WHAT DID I GET WRONG?
WHAT ARE YOUR LEGACIES?