Innovation, High Performance Computing, and Complex Networks: Challenges and Opportunities

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Challenges in Driving Innovation

Innovation is the primary basis of the ability of the U.S. to compete in the global economy.

Stability: *Vannevar Bush - There must be stability of funds over a period of years.*

Flexibility: *Vannevar Bush: Support of basic research in universities and research institutes must leave the control of the research to the institutions themselves.*

Integration: *Gathering Storm: Two key challenges are creating high-quality jobs for Americans and responding to the nation's need for clean, affordable, and reliable energy.*

Incentives: *Gathering Storm: Ensure that the U.S. is the premier place in the world to innovate.*

Addressing the Opportunities in New Mexico

New Mexico is developing a S&T Plan with the goal of making continuing, long-term investments in S&T by:

1) Making the case for recurring and capital investments
2) Defining areas for R&D investment including:
   Priorities and level of investment

Working groups in S&T Areas of Strength in NM:

- Aerospace
- Bioscience
- Energy, Environment, Water
- Information Technology
- Nanotechnology

High-performance computing provides an underlying foundation for all five areas

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Driving Innovation in New Mexico

- New Mexico's ability to compete is based on the remarkable scientific talent of our staff at the national labs and universities.
  - *$6B/yr Fed R&D investment in New Mexico*
- Researchers need premier R&D tools to compete
  - *Facilities at national labs and universities*
  - *New Mexico Computing Applications Center*
- The role of the State is to provide the ability to bridge the gap *(valley of death)* between Federally-funded basic R&D and the commercial sector.
  - *Integration of Federal, state, institutions, and businesses is critical to success.*

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Primary Directions

- Technology-based economic development (TBED) and support in NM
  - *Provide R&D support needed for NM businesses to grow*
  - *Attract large companies to NM*
  - *National and international partnerships*
- Education and workforce development
  - *K-12 - support STEM education (student internships and scholarships)*
  - *University education and research (develop our future S&T workforce)*
  - *Support professional development for teachers*
  - *Educate the public about STEM*
- Assistance to NM communities in solving problems
  - *Health, water, environment, clean energy, traffic, …*

Status

- Developed business plan and market analysis
  - *Only U.S. computing center targeting TBED*
- $18.7M state appropriations (FY08 + 09)
  - $11M supercomputer *(172 Teraflops peak theoretical speed)*
    - *Includes three 2.1 Teraflop exemplars at universities*
    - *Third fastest computer in the world (Top 500 Nov ¢07)*
  - $4.8M for gateway equipment
  - $2.9M for operations in FY09

Funding Request over 5 years:

$42M total from State of NM + $60M from other sources

+ $200M of in-kind contributions from members

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Computing System

SGI Altix ICE 8200 Cluster
14,336 Cores
(3 GHz Intel Clovertown)
28 TB local memory
172 TB File Storage
12 GB/s interconnect speed

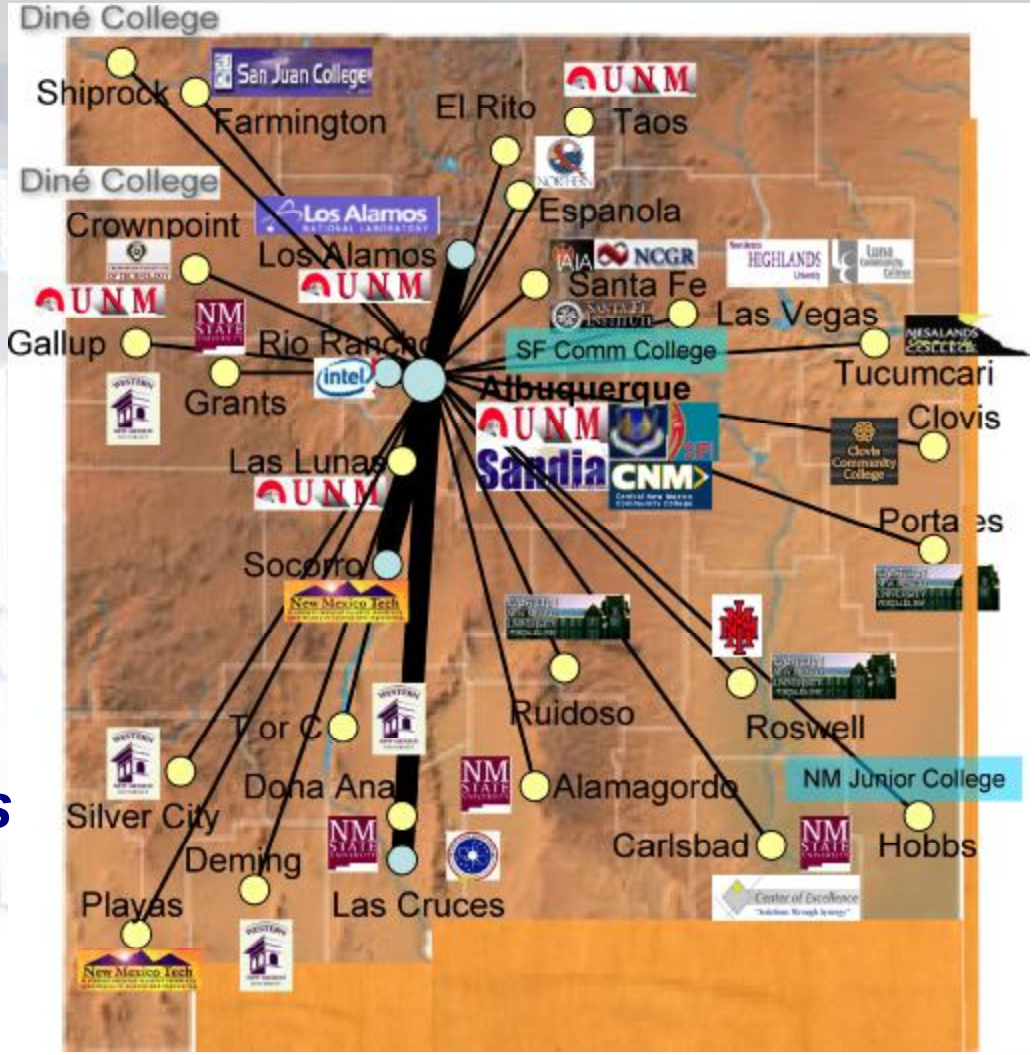
Delivered, Installed
and Running at
Intel Fab 7 Plant
in Rio Rancho, NM

Gateways for New Mexico

- Gateways at at all public colleges across New Mexico (44 sites)
- Bring small R&D businesses onto campus
- Support education across NM
- Support municipalities in NM

The Center is about connecting the people, science, education and jobs

(It's not about the computer)



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Gateways

- All colleges and universities (including branches) will be equipped as gateways:
  - *High-definition, high-speed videoconferencing*
  - *High-definition 3-Dimensional Powerwall display (~8' x 6')*
  - *Desktop computers with 3-D visualization screens*
  - *High-speed connectivity to NMCAC center in Albuquerque (NLR & I2)*
  - *Use visualization to excite K-12 kids about science*
  - *Use visualization as decision theater for business and communities*
- Universities can connect not only to their own branches, but to every college and university in NM.
  - *Enables a new mode for distance learning and collaboration*
  - *Provides ability to tailor courses for specific workforce development needs that can be taught across NM*

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Networks

- The NMCAC provides networks on several levels:
  - Network of university and lab staff joint appointments
  - Network with gateway institutions
    - Each campus serves both as a gateway to the Center and as a gateway to the public, local K-12 schools, local businesses, and communities.
  - Network to national and international institutions
  - Network of databases, algorithms, codes
  - Physical communications network:
    - NMCAC, telehealth, schools, libraries, museums, local telcoms, Qwest, state agencies, businesses, community groups, fiber-to-the-home, …

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Conclusions

The way programs like TIP are implemented is at least as important as the funding level.

– *It is not sufficient to simply provide dollars*

Success in innovation requires a full partnering relation between funding agencies and researchers

– *Multi-member partnerships can help maximize productivity*

– *Partnerships between Federal and State government can be important in driving innovation.*

Conditions for optimizing success are:
Stability, flexibility, integration, and incentives.

– *A good dose of common sense goes a long way*

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To achieve this goal requires a return to a trusting relationship between government, the public, business, and S&T institutions

Recommendations

The Technology Innovation Program must require NIST to:

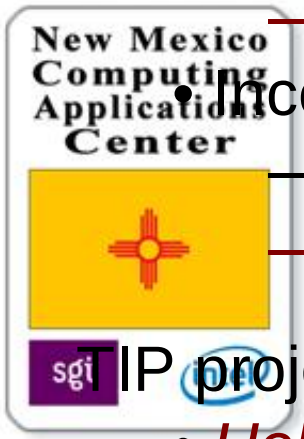
- *Provide stability (multi-year (3-5) year funding)*
- *Provide recipients some degree of flexibility (no micromanaging or undue controls)*

Proposals for TIP funding should address issues of:

- Integration:
  - *Relationship to and impact on other issues*
  - *Consideration of unintended consequences*
- Incentives
  - *What the proposers can provide*
  - *The path forward (requirements) for commercialization*

TIP projects should incorporate educational/public outreach

- *Help develop the next-generation workforce*
- *Inform the public on how their tax dollars are helping them*



Final Recommendation

As researchers, we have a responsibility to our children and the country to work with the public, legislators, and government officials to inform them about STEM issues and to provide them with the knowledge required to reach well-informed decisions that will affect the future well-being of the country and the world.

This is not about obtaining more funding for science - It is about ensuring a healthy future for the world

This will take time and dedication to achieve

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Every one of us needs to contribute in this effort