WYOMING LEGISLATIVE SERVICE OFFICE

Research Memo

07 RM 012

Date: **January 25, 2007**

Authors: **Don Richards, Research Manager**

Re: **Independent Impressions of the Proposed NCAR and University of Wyoming Supercomputing Partnership**

ISSUE

1. Summarize impressions and comments from an independent, objective observer with experience in federal and academic budgeting and the structure and use of supercomputers relating to the proposed University of Wyoming supercomputing partnership.

[At legislative request, LSO contacted a professor of computer science with first-hand experience in the structure, operation, and use of supercomputers. LSO provided all materials available to the Legislature as of January 24, 2007 to the professor that relate to the proposed partnership between the National Center for Atmospheric Research (NCAR) and the University of Wyoming to build a supercomputer center near Cheyenne, Wyoming. Later, LSO conducted a conference call with the professor with the intent to obtain a third-party impression of the proposed relationship, expected benefits, and one observer's suggestions for insuring accountability of taxpayer revenue and expand the requester's understanding of this proposal. Below is a summary of the remarks, potential questions, and limited impressions from a third-party with expertise in the area of supercomputing.]

SUMMARY

- **General Benefits.** In sum, the professor believes the proposal, as described to him, is an "exciting" opportunity for both the State of Wyoming and the University of Wyoming. He added that an opportunity to be selected for federal collaboration through the National Science Foundation is always good. Such a relationship could conceivably develop into deeper collaboration in a number of areas, based upon the professor's experiences.

  - ✓ According to the professor contacted, it is difficult to quantify both the short-term and long-term potential benefits to the State that would likely be achieved by locating a supercomputer within the State and near the University. Nonetheless, the potential impact can be summarized in at least three categories:

    - Economic development generated by a small number of jobs for the operation of the proposed facility;

    - An enhanced ability to attract people – researchers, students, and entrepreneurs to the area and University; and

    - Most importantly, the environment of research that could potentially yield substantial benefits. The professor noted that fundamental opportunities have historically risen beyond the computing performed by a supercomputer located near other universities, e.g., the University of Illinois. Historically, location and operation of a supercomputer

has presented opportunities to find ways to categorize, archive, and search huge datasets. As a result of this environment, tangible "spin-offs" could be traced back to universities with relationships with a supercomputing facility. Two examples include (a) the creation of Mosaic, an early web browser prior to Internet Explorer, and (b) the creation of Google, an Internet search engine.

- **General Background.** The professor explained that "computation science is now being seen as equivalent in importance and research quality as the traditional experimentation, scientific method and theoretical science." He noted that "computers in general, and high performance and super computers in specific, have allowed scientists to perform experiments and discover things that are otherwise impossible with traditional experimental or theoretical methods." As a tangible example, he offered the following explanation, "…using computational fluid dynamics techniques, tens of thousands of variations of air foil (wing) design can be tested and evaluated in hours or days on a super computer. This same amount of experimentation in a wind tunnel using scale models would have taken years or decades and involved tens of thousands of man hours. In other fields, like geology or nuclear physics, experiments can be performed that would be otherwise impossible. Computational science has opened up whole new fields of research and led to many significant discoveries." He summarized this point by indicating, "…computational science as a totally new approach to science, research, and discovery. It is not just the ability to do current research or science a lot faster, it has extended our abilities in a fundamental way."

  - ✓ According to the professor, it is difficult to compare the size and capacity of different supercomputers because of differences in architecture. From the materials available, it appears that this proposal offers an interesting architecture using many, smaller, less expensive processors. If the size approaches the higher capacity estimates (a petaflop) it would be among the largest supercomputers in the world – competing with those in Japan. If, on the other hand, the computer does not achieve that top capacity, the computer would still be quite sizeable, comparable to others at existing research facilities.

  - ✓ In the professor's viewpoint, a supercomputer of this type might be expected to have a ten to fifteen year lifespan, if left unchanged. Given the number of processors, each with a typical lifespan of perhaps five to eight years, it is possible that a couple dozen processors could need replaced at any single point in time. Finally, if the architecture of the supercomputer works well for certain classes of computations and if it is scalable, it is possible that this type of computer could be expanded in the future.

- **Capacity Discussion.** In the opinion of the professor, and recognizing the lack of firsthand knowledge on the status of UW research, he suspected that University of Wyoming computational researchers in various subject areas could easily be expected to fully use at least 20 percent of the computing capacity, as included in the proposal. Reportedly, other similar supercomputers have queues for researchers around the nation, and sometimes these queues can be long.

- **Issues for Potential Legislative Exploration.** The professor raised a limited number of issues that the Legislature may wish to explore with the University in the interest of accountability and to insure proper oversight of taxpayer revenues. His comments are summarized below:

  - ✓ The Legislature may wish to consider requiring the University of Wyoming and the Business Council to specifically identify the educational goals that would directly tie to: (a) the economic development goals of the state and (b) the direct impact of the supercomputer. According to the professor, there would likely be benefits to the intellectual economy, culture, and community, as well as potential spin-off effects raising an interest in math and science in primary and secondary education within the state.

That said, the professor felt it reasonable for the Legislature to require the University and the Business Council to: (a) establish specific goals that directly tie to the expected benefits of the supercomputer and (b) require an annual report that demonstrates specific achievements of the supercomputer as they relate to the established goals and mission, both educationally and for purposes of economic development.

- ✓ Second, in the opinion of the professor and based upon the materials available, it appears that at least one-third of the capital construction costs will be borne by the state as well as some operational expenses. Given that, the proposed provision of 20 percent of the computing capacity "may be low" in the professor's opinion. Therefore, inquiry into this area by the Legislature may be worth consideration.

- ✓ Finally, with respect to any potential future expansions, the professor suggested that the State should expect that the arrangement for the costs of expansion and use of any potential future computing capacity be renegotiated at that time of the expansion and not necessarily be subject to the provisions of the original partnership.

ADDITIONAL POINTS IDENTIFIED BY LSO RESEARCH STAFF

At direction to review the limited materials available outlining the specifics of the proposed supercomputer, LSO Research staff identified two issues that may warrant further inquiry.

- ✓ A January 24, 2007 memo from the University states, "Remember that though *NCAR will own the facility*," (emphasis added). Additional material provided via an individual legislator without a specific source, but titled, "National Center for Atmospheric Research" states, "University of Wyoming will own the facility." The Legislature may wish to resolve this apparent conflict. (See Attachments A and B.)

- ✓ Second, in the same January 24th memo from the University, it states, "The notion here is that NCAR and UW have formed a partnership under which *the partnership* will have an allocation of the supercomputer capacity of 20%." (emphasis added) The memo adds, "So, combining the efforts of the partnership and these individual efforts, Wyoming will have access to more than 20% of the capacity of the facility." (See Attachment A.) Based on these statements, it is not clear whether UW, or the partnership, will have the base 20 percent allocation. Particularly in light of the advisory professor's comments in this area, the Legislature may wish to inquire as to the definitions of the "partnership" and the proposed allocation of the supercomputing capacity.

If you have further questions, do not hesitate to contact LSO Research Staff at 777-7881.