Questions/Comments and Responses for MT-NTN C2 Proposal:

INTELLECTUAL MERIT
Question/Comment 1: *Provide a detailed plan for educating and training users at the participating institutions with regards to the cyberinfrastructure enhancements.*

Response 1 – Plan for User Education/Training:
The goal of the proposal is to extend and enhance the current backbone network infrastructure by connecting four strategic partners and locations within Montana, and thus significantly leveraging on recent investments made in the Northern Tier Network Consortium. The cyber-infrastructure enhancement proposed will increase the bandwidth available to these sites and provide impact on all networking activities. Ongoing and planned networking activities within these communities (as described in the proposal, funded through other sources including EPSCoR funds) will be enhanced, including access to remote resources, real time collaboration opportunities, and outreach activities that are web or electronically based.

Once these communities are connected to the Northern Tier Network, and through that to the Pacific Northwest Gigapop, we will work cooperatively with each node for expanded training and education by giving them opportunity to participate in regional meetings and workshops that are held each year for participating institutions. These meetings/workshops focus on both the technical aspects of network design and deployment as well as state-of-the-art efforts in collaboration tools, data management and data storage, disaster recovery and security. Information technology leaders on each of these campuses will be invited to participate and become members of the communities of information technology experts. In addition, staff from the Pacific Northwest Gigapop are available to visit each institution to assess the current usage of cyberinfrastructure tools and techniques in use and make suggestions for taking full advantage of these resources.

INTELLECTUAL MERIT
Question/Comment 2: *Reviewers were not clear on the breadth and scope of involvement of the Data Center. Please elaborate on the utility of the Data Center with regards to the proposed project.*

Response 2 – State Data Center:
The proposal outlines a plan to bridge a network gap to enable the use of the newly completed State Data Center in Miles City (MCDC). This opportunity provides a new, “green”, cost effective site for use by UM/MSU entities, including individual researchers, to host computational facilities, data storage, and/or network aggregation points. With dedicated 10Gbps connections from the campuses in Missoula and Bozeman directly into the MCDC, primary or backup facilities located there would be accessible with the same access (or in some cases greater) speed supported to facilities located on the campuses.

The State of Montana recently completed two new data centers, a “primary” in Helena and a “secondary” in Miles City. Both facilities are state-of-the-art in terms of security, backup power management, and overall energy utilization. The State is now actively encouraging use of their Centers by non-commercial entities such as those in the Montana University System. They have developed a standard contract and price list that outlines the terms and conditions for use,

following typical data center hosting arrangements based in terms of rack space, power, etc. The capabilities, cost, and green aspects make the MCDC a very attractive hosting option to UM and MSU, especially as compared to a much more costly retrofit of existing buildings. The granularity of the available hosting options, from space in a rack to multiple racks, makes use of the MCDC feasible for large enterprise class facilities or smaller researcher or project specific facilities.

The major technical hurdle that this proposal would overcome is the network connectivity gap in local loop access from existing UM/MSU Northern Tier network facilities to the MCDC. UM/MSU have multiple 10Gb waves available from their campuses to the Northern Tier hut in Miles City, and that hut is drop/add capable, but the network has yet to be extended from the hut to the MCDC about 0.75 miles away. The proposed project would bridge the gap with fiber, extending the NT 10Gb waves all the way into the MCDC. Once the network gap is bridged, any MUS entity, including individual researchers, could place equipment in the MCDC and have it be accessible at very high speed (10Gb) from campus. The 10Gb speed is important, because this allows existing high speed compute/storage interconnects (e.g., 2.0Gbps fiber channel) to be implemented across large distances without loss of functionality. Major cost barriers for research project use in particular would be essentially eliminated. The only cost would be the standard MCDC hosting cost, a cost competitive with that of retrofitting an office or wet lab to serve as a compute facility. Thus, although the current proposal would not place any specific compute facilities in the MCDC, it lowers the cost of using this facility for a wide range of computation and data storage needs to a level affordable by the typical researcher or research project.

The network access/data aggregation opportunity is similar. To promote network access for research and/or education purposes in the region, the key is to extend the Northern Tier network out of the Northern Tier hut, where access is rigidly controlled, and into a more open facility such as the MCDC. MCDC will host connections by the telecommunications companies that serve the area, and will also likely provide access to a tower, which will support point/point wireless connections. Examples cited in the proposal are to use network access/data aggregation capabilities to connect Miles Community College (about 0.60 miles away) and/or Dawson Community College (about 80 miles away). Other options would be to connect to new research sites associated with large river systems (e.g., the Yellowstone River flows through Miles City), energy development (especially wind farm, coal, and coal bed methane), and habitat and environmental issues.

INTELLECTUAL MERIT

Question/Comment 3: *Reviewers were unclear about the expected scientific research drivers that would require 10Gbps links. Please elaborate.*

Response 3 – Research Drivers Requiring 10Gb:

There are two important advantages to a 10Gbps link, one from a network engineering and cyberinfrastructure perspective and the other from a research project perspective. From a general CI perspective the importance of a 10Gbps connection is that this level of connectivity allows the components of a scientific facility to be placed in different locations, yet operate as one. The most obvious examples are computation and storage elements. Traditional processing and storage elements can be separated and replicated (e.g., for fault tolerance, disaster recovery, load balancing) but they needed to be connected at high speeds that have

traditionally had specific distance limitations (e.g., links running at 2.0Gbps but limited to 100 meters or less). Today these specialized, but distance constrained technologies, can be replaced by cheaper, standard Ethernet connections if the Ethernet can sustain transfer rates of at least 2.0-5.0Gbps. Thus, dedicated 10Gbps network connections between the campuses and the MCDC can support CI visions such as having a researcher at one site "steering" computation processes running at a remote compute facility, a computation facility producing results at one site but also mirroring them in real time to other sites, or an architecture which actively, and in real time, blends activities of computation and storage facilities at multiple locations (e.g., UM, MSU, MCDC).

Though this upgrade in connectivity will benefit all investigators and students within the region, two areas of research can be identified for which increased bandwidth can be particularly important: environmental and ecosystem science and health and biomedical sciences research. While very few individual research applications today can fully utilize a dedicated 10Gbs link, the aggregate demands of multiple related applications running simultaneously can begin to push this limit. For example, the Virtual Observatory and Ecological Informatics System (VOEIS) of our NSF EPSCoR RII Track-2 grant with Kentucky requires networking infrastructure to support the deployment of vast numbers of remote sensors. These sensors are designed to monitor various aspects of an ecosystem, and are constantly expanding and improving in the range and rates of monitoring capabilities. In order for researchers to understand changes that may be occurring on local, regional, or global scales, the data collected by the sensors must be communicated accurately and in near real time to processing elements. As the sensors evolve, connecting the distributed sensors to local data collection points distant from the data aggregation sites at MSU and UM will require more and more network bandwidth. The more bandwidth that is available, the lower the latency, and the higher the reliability, therefore, the higher the quality of data that can be collected. Better data collection translates directly into improvements in the quality of data that is distribute and available to be used by the researchers studying the underlying ecosystem. By virtue of relative proximity to ecosystems of interest MSU and UM have the potential to be national leaders in ecosystem research. However without the requisite connectivity to state-of-the-art sensor networks in these areas, Montana's efforts will be less effective. Continued investment will allow Montana to be a major player in the deployment and utilization of remote sensing techniques based on real-time observation of ecosystems of national and international interest.

Another key application is extending high speed connectivity into rural locations to support research related to specific health conditions, especially those that affect rural populations disproportionately. This research is closely aligned with other federal programs that focus on improving health care for rural, indigenous, and lower socioeconomic populations. This proposal will enhance research opportunities by leveraging collaboration with a Montana recipient of a FCC Rural Health Care Pilot Project award—the Health Information Exchange of Montana (HIEM). HIEM is a consortium that includes UM as a member and thus, an "eligible participant" in their network. HIEM is building significant fiber based networking infrastructure in northwest Montana (www.hiemontana.org/fcc.html). The proposed buildout to Pablo will not only connect Salish Kootenai College (SKC) there, but will also present the opportunity for UM/MSU and HIEM to "bridge" their networks at that location for mutual advantage.

EVALUATION AND ASSESSMENT PLAN

Question/Comment 4: *There is no specific plan for evaluation and assessment other than the mention of leveraging the recently awarded NSF EPSCoR Track-2 proposal by selectively tracking the activities of students and faculty at these institutions that take part in research partnerships, outreach activities and workforce development. An evaluation plan is a requirement of the solicitation. Provide a comprehensive plan for evaluation and assessment, consistent with the solicitation upon which this proposal is based.*

Response 4 – Evaluation and Assessment Plan:

The plan for direct evaluation and assessment of the success of the projects outlined in the proposal is obvious: the plan to implement the network buildout in Miles City is successful, if and when we extend the NT network to support multiple 10Gb waves from the campuses to the MCDC; the plan to implement the network buildout in Billings is successful, if and when we extend the NT network to support multiple 10Gb waves from the campuses to a suitable aggregation point in Billings; and, the plan to implement the buildout to SKC is successful, if and when we extend the NT network to create a suitable high speed connection to SKC. In each case the assessment and evaluation of the direct success of the proposed CI project is a simple, direct measurement—were we able to, within time and budget, build the network extensions that we proposed to build?

What is also described in the proposal goes beyond this, in also attempting to judge the secondary and indirect impacts of the projects. Part of this is very straightforward, measured over time: how many and what type of uses/users do we see on the new Miles City, Billings, and Pablo/SKC links? Again, the measurement involves simply maintaining a complete and comprehensive inventory of uses/users. The part of this that is less straightforward, inherently linked to other activities, and the involvement of the groups mentioned in the proposal, is a much more subjective judgment of whether the level of activity that was spawned is sufficient to support the claim that this activity “stimulated competitive research”.

MANAGEMENT PLAN

Question/Comment 5: *The proposed Management Plan consists of a listing of the people who will be part of the management team. Please submit a detailed plan for management, consistent with the solicitation.*

Response 5 – Management Plan:

Background: As noted in the proposal, the management team for the Northern Tier network project and the extensions outlined in the EPSCoR proposal have UM and MSU representatives participating at three levels:

-CIO level science and technology leadership: UM/Ray Ford, MSU/Gwen Jacobs, responsible for overall vision and strategy, plus the official details of budgeting, procurement, and expense management.

-Network management: UM/Stan Harris, MSU/Tom Morrison, responsible for day-to-day tactics, operational supervision, and day-to-day details of budgeting, procurement, and expenses.

-Network engineering and operations: UM/Dick Thompson, MSU/Bob Underkofler, responsible for new designs and on-going operations.

Though UM and MSU participate as equal partners in decision making, an MOU signed by UM and MSU designates UM as the point of contact and official entity charged with fiscal details, procurement, and contract execution related to the NT network. Simply put, UM and MSU share in the decision-making, network operation, and split costs 50/50, however, UM handles the paperwork and accounting.

This is the general basis upon which the Northern Tier network design and implementation has been built. The proposed projects would build on the NT network, and thus utilize the same structure. In NT network matters UM officially acts as a single point of contact for vendors, granting agencies, etc. We assume that this same approach will be used in the various sub-projects involved in the EPSCoR proposal.

Management of Proposed Network Buildouts: There are three CI projects identified in the EPSCoR proposal, each representing networking buildouts from the Northern Tier network, including ones in Miles City, Billings, and to Salish Kootenai College in Pablo. A detailed management plan is outlined below.

Already Complete: 1) The Leaders have decided on overall priorities and have selected specific projects for focus (as evidenced by the inclusion of these three specific projects in the proposal). 2) The Engineers have agreed on a basic approach to each project, resulting in initial design, specifications, estimated costs, etc., (again, as evidenced by the inclusion of much of this initial information in the proposal).

Following Proposal Funding – Design and Implementation: 3) The Managers and Engineers will agree on specific project implementation details and a tentative schedule for review and approval at all three managerial levels. 4) The Managers will agree on a specific acquisition strategy related to those elements that need to be procured in order to satisfy the specifications. UM's Manager will translate this strategy into specific procurement activity (e.g., RFPs) led by UM. 5) When bids are received they will be reviewed at all levels, and consensus will be reached as to what bids should be accepted, what services purchased, and what contracts awarded. UM's Manager will complete the official procurement processes accordingly. If vendor contracts are involved UM's legal staff will lead the legal review. 6) As individual element procurements are completed all members of the team will be notified, so that service, managerial, and technical schedules can be revised, if needed. 7) The UM Manager will oversee the delivery, implementation and/or placement of procured items, assisted by the Engineers as needed. The UM Manager will assure that accounting, cash flow, and other recording keeping is updated accordingly. The Managers will update and/or revise the schedule as needed. The Managers and Engineers will assure that each extension of the network is integrated appropriately into pertinent on-going monitoring and maintenance systems. 8) The UM Manager, assisted by the Engineers, will determine when initial implementation is complete and initiate the appropriate paperwork. The Leaders will review that paperwork and assure that reporting requirements are met, with the UM Leader taking the formal lead in report submission.

Following Initial Implementation – Operation and Maintenance: 9) The Managers and Engineers will divide on-going responsibilities for network monitoring and maintenance. 10) The Leaders and Managers will take appropriate steps to launch education, training, and outreach programs to promote use of the new facilities. 11) The Leaders and Managers will assure that on-going reporting requirements are met.