Information Technology Committee
Randall Thursby, CIO, NDUS
June 29, 2010

Mr. Chairman and members of the Committee, my name is Randall Thursby, CIO, North Dakota University System.

Today I will provide a brief report on three topics. They are the data warehouse project, directory services, and our directional efforts involving Business Process On-line Services for email and calendar services. The latter two are part of the NDUS Integrated Services project.

DATA WAREHOUSE

At the March meeting of the committee Rich Lehn, Assistant to the CIO, reported on the NDUS data warehouse project. This project is progressing as anticipated and we are ahead of schedule to have the production server operational and initial data loads completed by the end of August. As part of this project we are also addressing the need to improve the NDUS data reporting capabilities, the accuracy of reporting, and the key component, the data itself.

NDUS INTEGRATED SERVICES

The objectives of the Integrated Services initiative are to: 1) improve the integration of System-wide applications; 2) provide a more consistent end user experience for students, faculty and staff System-wide; 3) improve coordination of resources, applications and processes System-wide; and 4) provide better support for collaborative students.

The first major step in the Integrated Services Project is the implementation of an active directory single forest/domain. This is being done in phases to accommodate the few institutions already using active directory. The common namespace and initial production active directory will be in operation by the end of July.

A single domain structure has many advantages, but first and foremost is simplicity. By simplifying the complexity of a system's architecture we can reduce risk, provide for improved services, and create efficiencies in application integration.

The second step has been to consolidate and improve email and calendar services for faculty, staff and students. At the March meeting it was reported we planned to have the decision made on direction made by the end of June 2010. The recommendation was made by the NDUS CIO Council Microsoft Exchange be the platform for faculty and staff mail and calendar services. Previously a recommendation had been made that Microsoft Live@edu be the platform for student email. After reviewing the time to implementation, cost, and future capabilities a decision was made to move forward with the use of the Microsoft Business Process On-line Services offering. This is essentially Exchange in the cloud but also includes limited Sharepoint and Office Communications Services (OCS). This offering is an option under the Microsoft Campus Agreement that provides significant discounts to colleges and universities.

Mr. Chairman, that completes my testimony.

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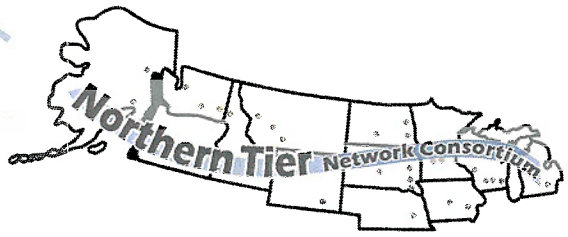
NLR



A proposal for a

United States Unified Community Anchor Network

ciena

cisco

GlobalNOC Global Research Network Operations Center

infinera

JUNIPER NETWORKS

A Proposal for a

United States Unified Community Anchor Network

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Proposal for a **United States Unified Community Anchor Network** submitted to the Department of Commerce National Telecommunications and Information Administration (NTIA)

Internet2 and NLR, both non-profit organizations, propose the creation of the **United States Unified Community Anchor Network** (**U.S. UCAN**). This national-scale network will construct the middle mile essential to connect all community anchor projects funded by BTOP with each other, and with more than 66,000 other anchors, to ensure a seamless national fabric of high-performance, open networks.

To: Internet2 and National LambdaRail Community Leaders

From: Doug Van Houweling, Internet2 President and CEO
Glenn Ricart, National LambdaRail President and CEO

Re: Internet2 and National LambdaRail Joint National Telecommunications and Information Administration (NTIA) Broadband Technology Opportunities Program (BTOP) Proposal

Date: April 9, 2010

Dear Colleagues,

As you may know, National LambdaRail (NLR) and Internet2 have been working together for the past few months to develop a joint national proposal to the Broadband Technology Opportunities Program (BTOP) administered by the National Telecommunications and Information Administration (NTIA) in the U.S. Department of Commerce. This program was funded in February 2009 with $4.7 billion by the American Reinvestment and Recovery Act (ARRA) to enhance broadband connectivity to underserved areas and community anchor institutions nationwide which includes: K–12 schools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations.

The Internet2 and NLR national proposal articulates the need for the development of a so-called "U.S. Unified Community Anchor Network" (U.S. UCAN), which would provide the essential national infrastructure to complement and link together regional community anchor networks funded through BTOP as well as our existing regional network members and network connectors. The goal is to provide the high performance national networking capable of fully supporting all 200,000 community anchor institutions across the U.S.—three times as many institutions as our networks serve today.

Internet2 and NLR are working together because we believe BTOP provides a historic opportunity for the research and education networking community to come together and apply our respective assets, expertise and experience for the greater good, addressing a critical need of tremendous significance for the country as a whole while continuing to serve our members and users.

Through the dedication and hard work of many of our staff and partners, our joint team successfully filed this application with the NTIA on March 25, 2010. We

wanted to take this opportunity to highlight some key points about the final filing as well as provide you detailed content from the submitted proposal.

The top key points include:

- U.S. UCAN builds on strong public-private partnerships. Direct proposal partners include: the Northern Tier Networking Consortium, Indiana University Information Technology Services (IU), Ciena, Cisco, Infinera, Juniper, NLR and Internet2;
- The proposal seeks the development of a 100-gigabit-per-second "middle mile" infrastructure (i.e., network enhancements to Internet2 and NLR that can support U.S. UCAN) optimized to connect all community anchor institutions across the U.S. which would catalyze the adoption of next-generation Internet applications—most importantly in life-changing fields such as telemedicine, public safety, and distance education;
- U.S. UCAN's infrastructure would leverage the non-profit model, existing assets and proven expertise of NLR and Internet2 (and partners) to serve community anchor institutions with next-generation networking and collaboration support to fulfill their needs;
- U.S. UCAN would ensure that the tens of thousands of new community anchor institutions connected via regional BTOP proposals have the bandwidth and capabilities they need on the national level to collaborate not just across state but around the world;
- U.S. UCAN is far more desirable than commercial network operators because it would enable next-generation services like IPv6 and multicasting; would be built with abundant capacity headroom to support high-bandwidth applications and users; would be operated transparently including its finances; and would provide unique support for end-to-end network performance;
- It is estimated that U.S. UCAN would initially be able to connect over 100,000 anchor institutions, serving over 35 million individuals and will be capable of serving the remaining U.S. anchors;
- The proposal includes expansion of the community's optical capabilities to increase resiliency and capacity of the Internet2 and NLR networks including the acquisition of nearly 12,000 miles of newly lit fiber. The proposal seeks a resilient set of fiber paths through the middle of the country where there is the highest demand with new capabilities also added across the Northern Tier and through the south and east;
- The capabilities also include 100G Ethernet on many of the network segments and new routers and switches in the NLR and Internet2 networks to distribute the 100G capabilities to regional network members and connectors;

- U.S. UCAN is expected to cost approximately $97 million to deploy, of which 64.61% was proposed to be funded by BTOP and 35.39% would be funded through cost-matching by Internet2, NLR and its partners;
- The proposal received over 30 strong letters of support from regional network collaborators and from key organizations like the American Association of Community Colleges and the National Emergency Number Association.
- Internet2 and NLR intend to work with the expanded community contemplated by U.S. UCAN, if funded, to develop a sensible model for how U.S. UCAN will operate and be structured while also assuring Internet2 and NLR can continue to serve their founding principles.

We have been communicating with the governance councils and many members throughout the process of developing this proposal to seek both feedback and support. We want to extend our deep gratitude for their help during this extraordinarily busy time for their valuable input. The direct feedback to our approach as well as the letters of support we received from many members have helped to make our proposal markedly stronger.

We know that there are likely many questions about various detailed aspects of the proposal. During the coming months, there will be opportunities for one-on-one discussion as well as group discussions. As always, please don't hesitate to get in touch with us directly via phone or email. We will try to answer your questions as fully as we can.

We are optimistic about our prospects of funding for this important project and should we be selected, it is clear there is still much work ahead of us in collaboration with our members to bring the vision of U.S. UCAN to fruition. We look forward to engaging in these discussions with you in the coming months.

Thank you again for your support.

Sincerely,

Douglas E. Van Houweling
President and CEO
Internet2

Glenn Ricart
President and CEO
National LambdaRail

United States Unified Community Anchor Network (U.S. UCAN)

Executive summary

Comprehensive communities must be connected not just locally, but nationally. The U.S. Unified Community Anchor Network (U.S. UCAN) proposal presents a great opportunity and addresses a critical problem. Without U.S. UCAN, community anchors connected by other BTOP projects (as well as other anchors) will only be able to use advanced broadband applications locally and not nationwide. Anchors will be unable to use advanced broadband applications with the vast majority of other anchors in the U.S., and will be limited to communications with just nearby anchors. Internet2 and NLR, working with partners in 50 states, propose this national infrastructure project to tie together all anchor networks funded by BTOP, link them to 66,000 anchors already using Internet2's and NLR's networks, and provide a unique and cutting-edge national middle mile 100 gigabit interconnect optimized for community anchor use of advanced broadband applications. U.S. UCAN will benefit more than 100,000 community anchors in all 50 states initially (and eventually all or virtually all anchors), including schools, community colleges, universities, libraries, health institutions, public safety entities, local government, public media and other community centers. It will provide much needed upgrades and extensions to the non-profit networks operated by Internet2 and NLR, which constitute the "interstate highway" for advanced broadband applications for anchors, and which would be the foundation for U.S. UCAN.

U.S. UCAN will ensure that community anchors can connect with each other nationwide, rather than just locally, with respect to advanced broadband applications, including telepresence, distance education, telemedicine and job training. For example, if this project is funded,

> (i) Countless rural hospitals with at-risk newborns or persons needing an immediate diagnosis will not be limited to engaging in advanced applications with just nearby hospitals, but can do so with the nation's top hospitals;
>
> (ii) Emergency 911 centers will be able to exchange data nationwide;
>
> (iii) Underprivileged youth can take a course, or learn a life skill, from the best instructors in the nation; and
>
> (iv) Unemployed citizens can, via video conferencing, interview for jobs, or receive job training, from anywhere in the U.S., rather than just in their local area.

While commercial backbones are sufficient for certain Internet uses, as to advanced broadband applications for community anchors, there is a market failure. Commercial networks are far too congested to support, and are not optimized for, advanced broadband applications for community anchors like telepresence and telemedicine. Commercial networks also do not provide the necessary transparency required to immediately

troubleshoot application-crippling problems across networks. They also do not generally offer next-generation Internet technologies like IPv6 and IP multicast, which are critical to certain applications.

Internet2 and NLR's networks currently permit more than 66,000 U.S. community anchors to connect to each other for advanced broadband applications. This BTOP project is critical because these networks urgently need significant upgrades and extensions (i) to support the ever-growing number of users and the increase in the bandwidth needed for continually-evolving advanced applications, and (ii) in light of the BTOP program itself, which will drive even further network traffic to these national networks, as the BTOP winners, who will collectively add tens of thousands of anchors to their networks, either already connect to these national networks (e.g., Merit, MCNC, and I-Light) or almost certainly will want to do so. This proposal will add 11,811 new, diverse 100 Gbps-capable route miles, and upgrades over 10,000 existing network route miles to 100 Gbps.

This proposal expands the model used today by Internet2 and NLR for 66,000 anchor institutions, of ensuring national connectivity for them for advanced broadband applications, to 45,000 to 65,000 more anchors initially, and eventually all or virtually all anchors (while also ensuring there are sufficient upgrades to continue to adequately serve the original 66,000 anchors). It is precisely this model of Internet2, NLR and the R&E community that the FCC stated in its National Broadband Plan "should be expanded to other community institutions" and that doing so "would offer tremendous benefits." See Supplementary Materials. If funded, these networks will jump start the goal of connecting all 200,000+ U.S. community anchors to a high- performance network.

Thus, this project glues the winning BTOP projects together as a whole. Simply put, this project does not compete with other BTOP projects; it completes them. It will also be a building block that attracts more local investment even for non-funded BTOP projects, as such projects will be more valuable if they are connected to non-profit networks that can support national connections for the advanced broadband applications anchors need (Internet2's and NLR's prior, more limited, upgrades motivated tremendous investment by others in local networks). This project makes BTOP a winner for Americans everywhere, while catalyzing the adoption of transformational broadband applications that can fundamentally improve education, health care, public safety, and job-creating economic innovation. This project compliments other sustainable broadband adoption proposals, as more people will want to use broadband if its benefits are greater.

When used by research universities, this project will support the growing demands of data- intensive e-science, thereby helping to uncover new energy sources, reduce cardiovascular disease, and help with cancer research. It can also serve as a test bed for advanced network technologies like dynamic circuit provisioning, which will spur economic growth and the creation of new applications, businesses and jobs. Internet2, NLR, and their over 30 regional and state networking collaborators (RONs) have a strong history of providing advanced networking to anchors. Individuals associated with these organizations played key roles in developing NSFNet in the 1980's, and transforming NSFNet into the commercial Internet in the 1990's. For nearly 15 years, Internet2 and NLR networks have been the solution for RONs connecting to community anchors seeking advanced broadband capabilities. Today, they provide cutting-edge networking for the research community, and have expanded their reach to K12 schools, community

colleges, libraries, museums, science centers, performing arts centers, hospitals, and other health clinics. They know the needs of anchors, the technology and applications, and how to ensure sustainable business models.

This proposal commits to the open Internet recommendations of BTOP and the FCC and also commits to making these networks completely transparent. U.S. UCAN will have measurement and trouble shooting tools that allow all operational aspects of the network to be published on the web in near real-time.

The proposed services include a point-to-point, nationwide optical and routed IP network to last mile providers for community anchors. The minimum peak load network bandwidth capacity is 100,000 Mbps. We expect

> (i) Connections to this infrastructure from regional middle-mile providers in the range of 1,000 to 100,000 Mbps, and
>
> (ii) Pricing in the range of $21 per Mbps/month to $2 per Mbps/month for such connections. The proposed network is Wireline – Fiber-optic Cable. To ensure access to next-generation Internet protocols, the infrastructure will be built as both IPv6 and IPv4 native.

U.S. UCAN will provide service to the entire U.S. and will reach community anchors through RONs and extensions serving all 50 states. This project acquires 11,811 miles of newly lit fiber. At the outset, it will reach over 100,000 anchors, serving over 35,000,000 Americans (students, doctors, patients, library visitors, public safety officers, etc.). The infrastructure will be capable of serving the remaining U.S. anchors.

This project is expected to cost a total of $96,793,607, of which $62,540,162 (64.61%) is funded by BTOP and $34,253,445 (35.39%) is cost matching. This project is expected to create or save 1,052 job years in advanced manufacturing and technical engineering.

The named partners include Internet2, NLR (private not for profit), the Northern Tier Networking Consortium (public partners), Indiana University Information Technology Services (IU) (public partner), Ciena, Cisco, Infinera, and Juniper (private for-profit), and other collaborators include over 30 RONs, who will all provide technology, equipment and connections to the anchors. The American Association of Community Colleges, the National Emergency Number Association, and many other groups support this proposal.

See **Figure A**, "**U.S. UCAN Fiber Routes,**" pages 16–17, for a detailed map of the proposed network.

Project purpose

U.S. UCAN addresses a critical problem. Community anchors must be able to use advanced broadband applications with other anchors nationwide, not just with nearby anchors. Commercial backbones are not the answer. U.S. UCAN will ensure that initially more than 100,000 anchors (including those connected to Round 1 winners, which otherwise would have only local connectivity for advanced applications) will have necessary national connectivity. Eventually, virtually all anchors will have such national connectivity using U.S. UCAN. This project has broad significance in every state, and

for every type of community anchor, and will have a more far reaching—and national—impact on health care delivery, education and children than any other single CCI project.

U.S. UCAN addresses all five BTOP statutory purposes. It will provide nationwide high-performance connectivity to universities, community colleges, K–12 schools, libraries, hospitals and health clinics, museums, science centers, public media, public safety, local government and other community organizations across every part of the nation, including federally designated economic development areas, Native American reservations, and areas unserved and underserved by broadband.

SUPPORTING COMMUNITY ANCHORS BROADBAND NEEDS: This project addresses this purpose to a greater extent than other CCI projects because of its national reach—benefitting more than 100,000 anchors initially. U.S. UCAN will connect medical and healthcare providers through regional partners and projects funded by the FCC's Rural Health Care Pilot Program. Providers will be able to share critical resources and connect to over 100 university medical centers that deliver cutting-edge care, clinical research and continuing medical education. Through U.S. UCAN, they will also have access to the National Institutes of Health, the National Library of Medicine, the Mayo Clinic, and the VA. Connection to an advanced network can transform healthcare. For example, to receive the best neonatal care, fragile, premature babies born at Adena Regional Medical Center in rural Ohio used to have to endure a costly, dangerous helicopter ride to Nationwide Children's Hospital in Columbus, as well as separation from their mothers. But now, due to high-definition videoconferencing, Columbus-based specialists examine babies, review x-rays and lab results, and consult with Adena doctors without moving the babies. Funding this proposal will allow Children's Hospital to offer its expert neonatal care to any rural hospital in the U.S.

Using videoconferencing and other advanced collaboration tools, community colleges with specialty training programs can offer classes to a nationwide audience, improving job skills and employment prospects for thousands. An advanced nationwide network also connecting schools can transform learning experiences for millions of children. Recently, oceanographer Dr. Bob Ballard took 5th grade students on a virtual trip aboard a research vessel via high-definition videoconferencing. Undersea images of the Lost City, a series of mid-Atlantic hydrothermal vents, were beamed to the students' classroom from undersea robotic explorers, transporting students into an immersive underwater learning environment. Funding this proposal will allow Dr. Ballard to bring the ocean depths to every classroom in the country.

IMPROVE BROADBAND TO PUBLIC SAFETY: U.S. UCAN will enable linkage of emergency 911 centers (PSAPs) as part of an effort to create a national Next Generation 911 system (proposed by the FCC's National Broadband Plan and a BTOP proposal by NENA (Easygrant ID 68730). Funding this BTOP proposal as well as NENA's will provide 911 centers with access to a nationwide network with the reliability and capabilities necessary to enable nationwide Next Generation 911 systems, which will significantly enhance public safety.

STIMULATING DEMAND, ECONOMIC GROWTH, JOB CREATION, AND ACCESS TO BROADBAND FOR CONSUMERS IN UNSERVED AND UNDERSERVED AREAS: Advanced networking capabilities will not only enable data-intensive e-science research in our universities, but also serve as a testbed for new network technologies such as dynamic circuit provisioning, expanding the frontiers of Internet technology and enabling scientific discovery that for decades has been a significant driver of innovation, economic growth and job creation. As U.S. UCAN reaches over 50 million Americans through community anchor organizations, users will be exposed to advanced applications like telepresence and demand for broadband at home will increase. Every year, as one million college students graduate from campuses equipped with the most advanced broadband, they will take their broadband expectations to new jobs and homes, further stimulating adoption. Internet2 and NLR have over 12 years' experience providing a high-performance national network backbone to the R&E community. During that time, the availability of these networks stimulated over $1 billion in local investments to acquire nearly 25,000 miles of local fiber in over 30 states. The resulting Regional Optical Networks (RONs) are operated by many BTOP first-round winners. Just as investment in RONs followed the "pull" of the national backbones, we can expect another round of investment to be triggered by U.S. UCAN. The resulting fiber builds can be configured to share fiber strands between R&E networks and private ISPs offering expanded broadband service to unserved and underserved consumers.

U.S. UCAN will join the nation's public libraries to each other and to other community facilities and resources, and many unserved or underserved citizens use public libraries and public computer centers to search for jobs and to fill out application forms. U.S. UCAN-connected libraries with videoconferencing equipment will be able to offer face-to-face remote job interviews as well as other employment-related services.

Recovery Act and other governmental collaboration

The U.S. UCAN project has significant synergies with a number of other Recovery Act programs relating to advanced networking at the National Science Foundation, NOAA, the Department of Energy, and the Department of Health and Human Services. The NSF ARI-R2 program will fund university and regional networking projects as part of its "cyberinfrastructure" efforts to support science. The 100 gigabit U.S. UCAN backbone will serve those projects and improve their effectiveness through enhanced capacity. The NSF MRI-R2 program is likely to include projects investing in scientific disciplines relying on large data flows capabilities, including a pilot set of research university campuses collaborating with data from the Large Hadron Collider and other high energy physics projects. The U.S. UCAN backbone will transfer that data from university to university at far greater capacity than can be done today. NOAA is using Recovery Act funds to build increased networking capacity among its data centers and research sites, and plans to use Internet2 to provide the underlying network connections (with a contract expected to be in place before the award of BTOP funds). The U.S. UCAN backbone will make those NOAA investments more valuable by enhancing the backbone connections. The Department of Energy's "Energy Sciences Network" (ESnet) will use $70 million of ARRA funds to upgrade its network to 100 gigabit capacity. ESnet currently rides on Internet2 infrastructure, and ESnet connects (peers) with the Internet2 network to connect researchers in Energy Labs with researchers in universities. If both the ESnet and

Internet2 backbone networks are upgraded to 100 gigabits at the same time, there can be cost savings, synergies, and improved efficiencies for both networks by "learning together." (There are no currently deployed 100 gigabit production networks in the research community; these two networks would be the first.)

In all of these cases, these investments, combined with access to the U.S. UCAN backbone, is likely to expand the involvement of smaller universities in national research efforts, thereby enhancing economic opportunities in their communities. In addition, this is likely to enhance early, primary, secondary, and post-secondary education and increase the competitive achievements of the U.S. educational system in all of these areas regardless of geography or demographics. Finally, the Department of Health and Human Services is investing major ARRA funds to develop and promote the use of electronic medical records. Internet2's network currently connects over 100 academic medical centers, the NIH, and the Department of Veterans Affairs. The U.S. UCAN network, as it connects more hospital and other health-related community anchor institutions, would be fully capable of transmitting medical records, including those requiring high bandwidth transmission because of file size (X-rays, MRIs, and other images).

Fit with BTOP CCI priorities

PRIORITY 1: U.S. UCAN proposes to ensure national connectivity for advanced broadband applications for more than 100,000 anchors across the U.S. initially. U.S. UCAN will immediately serve and benefit the 66,000 anchors connected by our regional partners today, the 14,500 new anchors which will be served by BTOP Round 1 grants announced as of 3/11, and an estimated 30-50,000 additional anchors that will be connected by additional round one and two BTOP projects. Furthermore, the U.S. UCAN service will be prepared to handle all 200,000+ anchor institutions.

PRIORITY 2: This project is a public-private partnership. Internet2, NLR, and Northern Tier are non-profit entities, as will be the U.S. UCAN entity. Indiana University (IU) is a public entity. Ciena, Juniper, Infinera and Cisco are for-profit entities. Many government entities are served by the network (anchor institutions, public safety entities) and state-run schools (and systems) operate the regional networks that will connect to U.S. UCAN in many of the states.

PRIORITY 3: U.S. UCAN will deploy infrastructure throughout the United States, including infrastructure in economically distressed areas. Access to uncongested high-speed networking and combined tools set will make anchor institutions in economically distressed areas served by U.S. UCAN and its partners more effective.

PRIORITY 4: 1,152 of the proposed anchor institutions are community colleges. As the American Association of Community Colleges noted in their letter of support, "The U.S. UCAN proposal will provide the national infrastructure that will serve as the foundation for connecting all of the nation's community anchor institutions, including community colleges, to each other through a linked, high-performance network that enables advanced applications... U.S. UCAN would jump start an effort to get all community colleges connected to each other, nation-wide at gigabit speeds or higher..."

PRIORITY 5: 6,183 of the proposed anchor institutions are public safety entities.

PRIORITY 6: U.S. UCAN has commitments (including existing contractual relationships that can and will be migrated to this network) from many member universities, as well as the following state and regional networks: 3ROX, CENIC, CIC OmniPoP, Drexel University, GPN, Indiana GigaPoP, KyRON, LEARN, LONI, MAGPI, MAX, MCNC, Merit Network, MREN, NOX, NYSERNet, Inc., Oregon Gigapop, Pacific Northwest GigaPoP, SoX, Univ. of Memphis, Univ. of South Florida/Florida LambdaRail, LLC, Univ. of Utah/Utah Education Network (UEN), MATP (Mid-Atlantic Terascale Partnership), Western Regional Network (WRN), North Carolina Partnership, and the Front Range GigaPoP to utilize the Middle Mile components. Since no funds in this proposal go to Last Mile components, we satisfy the requirement that less than 20% of costs of the project go to rural areas.

PRIORITY 7: This proposal contributes 35.39% in non-federal cost match, $34,253,445 out of the total budget of $96,793,607.

Description of the involvement of the partners listed above in the project

Please note: This section represents a strawman proposal for one possible governance structure for U.S. UCAN. The actual structure will require substantial input from community members, partners and from organizations representing the various community anchor institutions that U.S. UCAN is designed to serve.

The proposed project will be a national "middle mile" backbone, linking regional "middle mile" networks, which in turn connect anchor institutions. As such, local community participation will be indirect, both through improved connectivity, and through membership in organizations such as Internet2. It is expected that the growth in connectivity to additional anchor institutions will be accomplished through affiliation with U.S. UCAN, which will acquire the needed networking capabilities from Internet2 and NLR. U.S. UCAN will be incorporated as a not-for-profit organization governed by organizations representative of anchor institutions.

The Internet2 President and CEO will be the overall project director. For purposes of this project, the President and CEO of NLR, the Chair of NTNC, the Assoc. VP. of Networks of IU, and the 4 vendor representatives, all co-directors, report to Internet2's CEO. Day-to-day management of the project will fall to a coordinating technical team led by the Internet2 Executive Director of Network Services and will include the NLR Director of Engineering and Operations, the Chair of the NTNC Technical Committee, and the IU Director of Global Research NOC Engineering. Each member of the coordinating technical team will be responsible for managing and coordinating the build-out and operation of their corresponding network components. Internet2 will be responsible for coordination between the partnering organizations required to achieve the unified project goals. U.S. UCAN will be a new organization that will create a convening and coordinating function for anchor institution constituencies that do not have a direct

governance role in Internet2 or NLR. U.S. UCAN will set policy standards, market U.S. UCAN services and add capabilities and capacity to Internet2 and NLR's current services. The U.S. UCAN organization will not own or operate the national network to be created by the BTOP proposal; that will be done through NLR, Internet2, and NTNC. However, future additions to the network may be accomplished by asking Internet2 and NLR to make them or having U.S. UCAN engage other parties to do so.

The partners envision an 11-member Board for U.S. UCAN with 2 members named by Internet2, 2 members named by NLR, 2 members elected by the state and regional optical networks, and 5 members named by organizations associated with community anchors (e.g., the American Library Association or the National Governor's Association). The staff of U.S. UCAN would market the network to community anchors, arrange for community meetings, maintain liaisons with associations related to community anchors, keep metrics on the performance and utilization of the network, and handle inquiries on how specific-purpose point-to-point connections can be made. U.S. UCAN will not own or operate the network and it will refer those interested in connections to their state or regional optical network.

Fees will primarily be directly assessed through the state and regional optical networks because they will connect community anchor institutions. The partners envision that a small per institution per year surcharge will be needed to cover the operations of U.S. UCAN and the additional costs being shouldered by the national networks. U.S. UCAN may also seek other sources of funding; the FCC, the NTIA, or even a direct congressional appropriation would be potential sources of additional funding.

As a result of the U.S. UCAN proposal, Internet2, NLR, and NTNC will also be able to more effectively serve their middle mile/last mile network partners with enhanced connectivity between anchor institutions across the country. The respective memberships of Internet2, NLR, and NTNC will grow to include new anchor institutions from the R&E community. Through its operational coordinating role, IU will be able to better understand networking needs and operational challenges across the country, thus improving the value proposition of the IU Global NOC.

Internet2 and NLR will share revenues that result from providing these capabilities to U.S. UCAN in proportion to their contributions to establishing this network facility. Details of this partnership have been worked out in the form of a memorandum of understanding between Internet2 and NLR. The formula will be based on fraction of cash contribution and fraction of in- kind contribution associated with both partners. The NTNC benefits from expanding the network to include 100Gbps waves and to close it into a ring. IU will benefit in the form of fees paid for coordinating NOC services. Ciena Cisco, Infinera, and Juniper have been selected to provide equipment for specific sections of the U.S. UCAN infrastructure.

Please note: This section represents a strawman proposal for one possible governance structure for U.S. UCAN. The actual structure will require substantial input from community members, partners and from organizations representing the various community anchor institutions that U.S. UCAN is designed to serve.

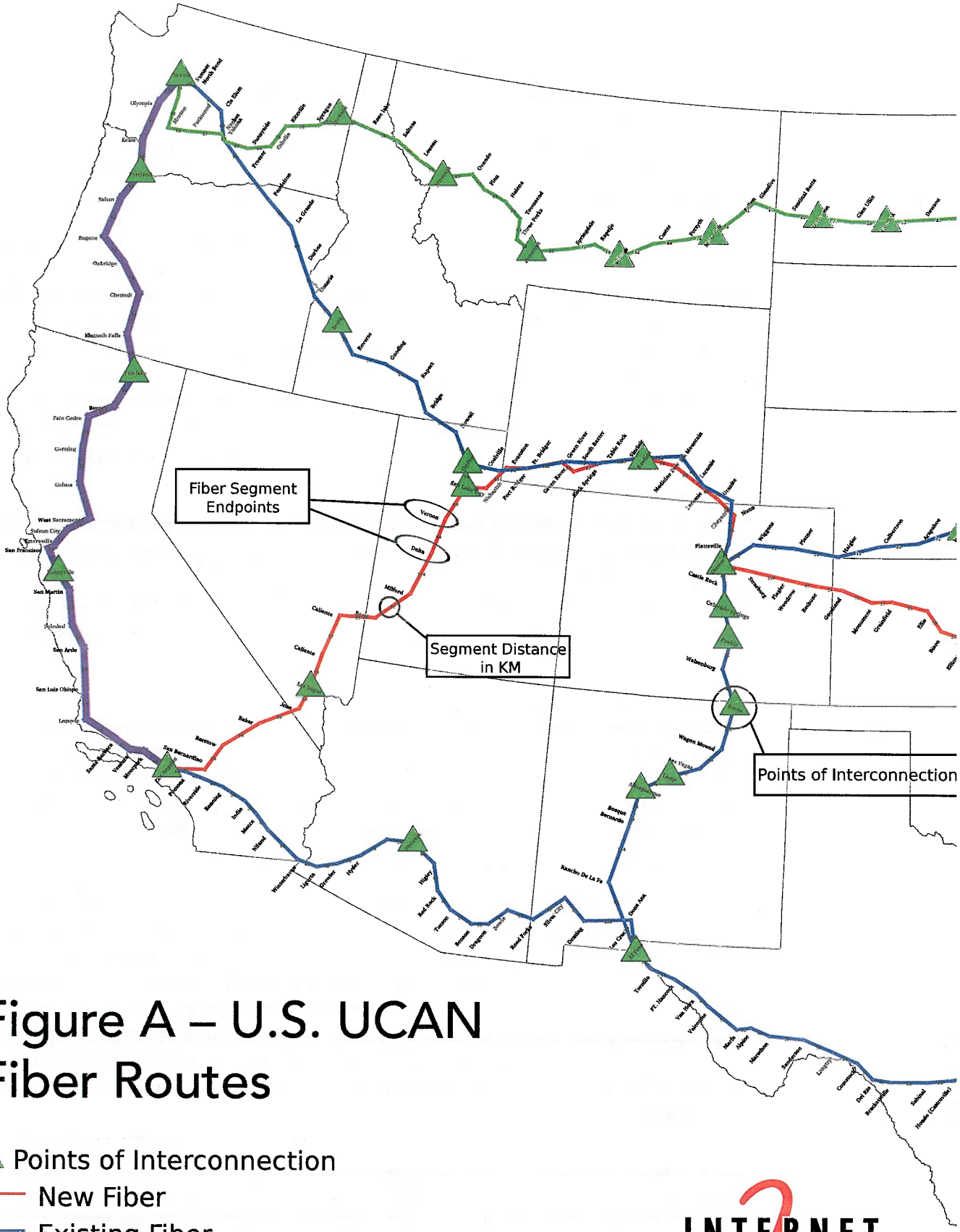

Figure A – U.S. UCAN Fiber Routes

- ▲ Points of Interconnection
- New Fiber
- Existing Fiber
- New & Existing Fiber (common path)
- New Fiber via Nothern Tier Partnership

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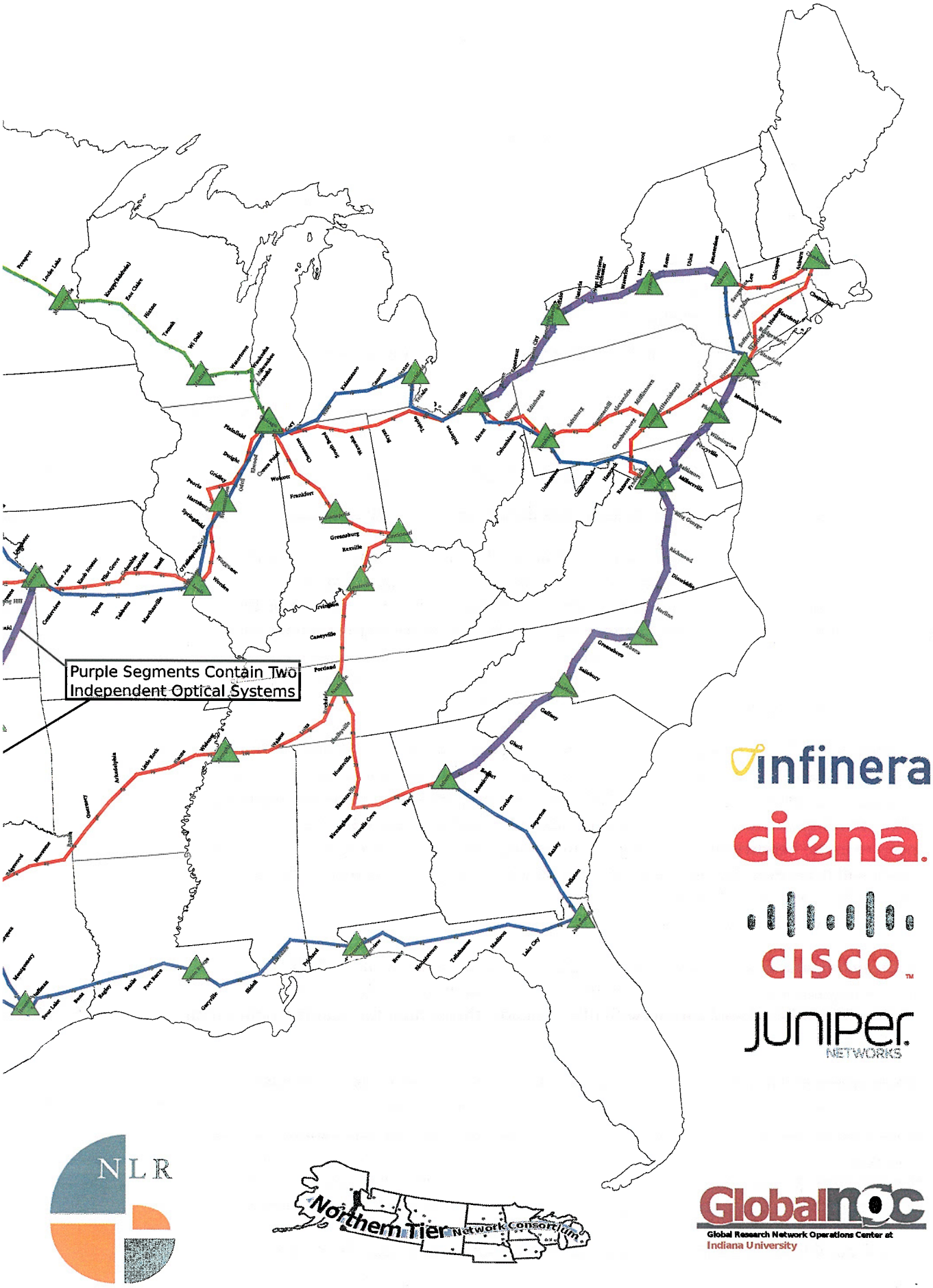

Purple Segments Contain Two Independent Optical Systems
infinera
ciena
cisco
JUNIPER NETWORKS
NLR
Northern Tier Network Consortium
GlobalNOC
Global Research Network Operations Center at Indiana University

Project impact

If funded, U.S. UCAN will have the most far-reaching impact of all CCI projects. It will, among other things,

(i) Allow comprehensive communities to be connected nationally and globally, rather than just locally;

(ii) benefit orders of magnitude more community anchors than other CCI projects (benefitting more than 100,000 community anchors initially in comparison to other projects that benefit 100's of anchors);

(iii) Act as the glue for the BTOP program, and tie all other funded CCI projects together and thereby make each of those projects far more valuable to users;

(iv) Jump start the implementation of Recommendation 8.22 of the FCC's National Broadband Plan;

(v) Complement the activities of sustainable adoption programs; and

(vi) Incentivize build-outs in areas that do not receive BTOP funding.

Other funded CCI projects will provide local networks that will permit community anchors to use advanced broadband applications with nearby anchors but not with anchors throughout the nation. It is not sufficient that anchors have great connectivity to just anchors in the next county, as they need reliable connections to other anchors, resources and people in the next state, across the nation, and internationally. For the reasons discussed in the Level of Need section, commercial backbones are not a viable solution to this problem. If funded, U.S. UCAN is such a solution.

Internet2's and NLR's non-profit networks already permit more than 66,000 community anchors in the U.S. to connect to each other for advanced broadband applications. These networks, however, are in urgent need of significant upgrades and extensions requiring BTOP funding due to the ever-growing number of broadband users, the tremendous increase in the bandwidth needed for advanced applications, and because of BTOP itself, which will drive even further traffic to these national non-profit networks. This proposal would add 11,811 new, diverse 100 Gbps-capable route miles, and upgrades over 10,000 existing network route miles to 100 Gbps.

With such upgrades and extensions, U.S. UCAN will enable more than 100,000 community anchors initially, and eventually all or virtually all 200,000+ anchors, to use advanced broadband applications with other anchors throughout the country, rather than just locally.

When connected to U.S. UCAN, anchors will have access to seamless, coordinated high performance networking from end-to-end, from coast to coast, from continent to continent. They will be able to use, across the nation, advanced applications such as telepresence, telemedicine, distance learning and very large file transfer (in acceptable time frames). As a result, these communities will benefit from better education, globally-connected libraries, improved health care, and more effective public safety operations.

Indeed, rural hospitals need to use such advanced applications with the top hospitals

in the country, not just nearby hospitals; public safety organizations during a national disaster must use such applications in communication with other such organizations across the nation; community colleges, universities and schools do not want to be limited to using such applications with only nearby educational facilities, and libraries' offerings will be far more valuable and diverse if they can communicate using such applications with other libraries across the nation.

By providing the interstate highway that links all of these BTOP projects together, this project makes each local BTOP project far more complete and valuable to its users. Specifically, this project would tie together all anchor networks funded by BTOP, link them to 66,000 community anchors already connected to the non-profit networks operated by Internet2 and NLR, and provide a unique and cutting-edge national middle mile 100 Gbps interconnect optimized for advanced broadband applications. Such an advanced network would spur innovation, create jobs and economic growth, and deliver improved education, health care, and public safety services to the nation.

The U.S. UCAN national backbone will reach anchor institutions through our regional partner research and education networks, as well as other BTOP-funded anchor networks. For example, current partners for Internet2 and NLR include Merit in Michigan, MCNC in North Carolina, and I-Light in Indiana—all first round BTOP winners. The U.S. UCAN will allow high performance traffic to flow between these winners, nationwide, who are already connected to the network, but who also need this network to be upgraded.

We will also permit, at very reasonable costs, all other BTOP-funded anchor networks to connect to U.S. UCAN, as well as anchor networks (schools, libraries) operated by local governments and other non-profits. Anchor institutions will want to be connected to those networks, as they will receive immediate benefits from U.S. UCAN—high performance connectivity both nationally and internationally.

Thus, U.S. UCAN will immediately serve and benefit the 66,000 anchor institutions connected by our regional partners today, the 14,500 new anchor institutions which will be served by BTOP Round One grants announced as of March 11, 2010, and an estimated 30-50,000 additional anchors that will be connected by additional Round One and Two BTOP projects. Accordingly, by the time the BTOP projects come on-line, well over 100,000 anchor institutions will be connected through regional networks to U.S. UCAN and will have access over high performance networks to the world.

This proposal expands the model used today by Internet2 and NLR for 66,000 anchor institutions—of ensuring national connectivity for them for advanced broadband applications—to approximately 45,000 to 65,000 more institutions initially, and eventually all or virtually all anchors (while also ensuring there are sufficient upgrades to continue to adequately serve the original 66,000 anchors). And, it is precisely this model of Internet2, NLR and the R&E community that the FCC stated in its National Broadband Plan (NBP) "should be expanded to other community institutions" and that doing so "would offer tremendous benefits."

Supplementary materials

In terms of people benefited by this project, based on the percentages of currently connected higher education and K12 schools alone, we estimate that the 66,000 currently

connected community anchors serve as many as 25 million people (50% of the 18 million students in higher education, 33% of the 48 million K12 students). When both rounds of BTOP projects are added to U.S. UCAN, the reach will extend to well over 50 million people, particularly when users of libraries, and employees and patients in hospitals are included.

Given that more than 100,000 community anchors will benefit immediately from U.S. UCAN (which are almost half of the community anchors in the U.S.), countless underserved and unserved consumers will also benefit from U.S. UCAN.

Moreover, by enabling advanced applications with nationwide connectivity in community colleges, schools, and libraries, U.S. UCAN will expose millions of Americans to new and productive uses of broadband, stimulating demand and broadband adoption. This project complements sustainable broadband adoption proposals of other applicants, as far more people will want to use broadband if its benefits are greater (and that will certainly be true if this project is funded, given the national connectivity that will then exist).

In addition, this project benefits both winning BTOP projects as well as areas that did not receive funding. It will create a solid foundation upon which more investment, more anchor connections, and more benefits to more people can be built. By gluing together the separate BTOP projects into a whole, this project will be a building block for more local investment even for BTOP applications that were not funded, as such projects will be more valuable if they are connected to non-profit networks that can support national (not just local) connections for the types of advanced broadband applications community anchors need.

The U.S. UCAN would benefit businesses and third party providers in comprehensive communities across the nation, as it would accept traffic from other BTOP anchor projects that provide connections or access to transport for business Internet traffic or even for consumer residential service in their communities. U.S. UCAN will abide by the interconnection requirements of BTOP.

U.S. UCAN will have broad impact everywhere in the United States. It does not compete with other BTOP projects. It completes them.

Vulnerable populations

Through this proposal, U.S. UCAN, in cooperation with its partner regional networks, seeks to offer services to all fifty states. From this perspective vulnerable populations should be fairly represented, however given UCAN's focus on bringing advanced opportunities to public sector institutions such as libraries and public schools, as apposed to focusing on residential and commercial broadband, funding this proposal will increase the quality of broadband access for those populations of lower income, as well as populations likely to receive Internet training and access in the context of a community facility such as a library.

Level of need

As discussed elsewhere in this application, community anchors need to use advanced broadband applications with other anchors throughout the nation, and not just

with nearby institutions. The other BTOP projects receiving funds only ensure that community anchors can use advanced applications with nearby collaborators.
To connect those BTOP "winners," and 66,000 other anchors to each other for reliable national connectivity for advanced broadband applications, this national-scope BTOP project needs to be funded. As discussed below, commercial backbones are not a viable alternative. In Recommendation 8.22 of the National Broadband Plan, the FCC stated that the model used by Internet2, NLR and the state and regional research and education networks to provide the kinds of advanced broadband applications that community anchors need—should be expanded to include all anchors. For the past 15 years, state and regional networks (RONs), including several first round BTOP award winners such as Merit, MCNC, and I-Light, who directly connect to community anchors, use the Internet2 and NLR non-profit networks to ensure that the anchors these RONs reach can use advanced applications with each other throughout the nation. As to advanced broadband applications, with respect to each of the critical needs of community anchors discussed below, commercial networks cannot meet those needs; only the national non-profit networks can. U.S. UCAN involves an efficient means of providing such national connectivity, through upgrades of existing facilities and new dark fiber IRUs.

1) NETWORKS OPTIMIZED TO SERVE COMMUNITY ANCHOR NEEDS, AND AVOIDANCE OF CONGESTION: Commercial backbones are not optimized for the use of advanced broadband applications by community anchors. Because of commercial providers' business models, their networks deliberately run near capacity, which ensures that they maximize profits. This, however, produces congestion, which in turn causes packet loss and increases jitter. Such problems often go unnoticed with respect to the type of applications that are at the core of commercial providers' business, namely e-mail and other applications that do not need to run over uncongested networks.

However, congestion, packet loss and jitter cause completely unreliable and unacceptable performance for community anchors that want to use advanced broadband applications. For example, a high-definition two-way video conference (telepresence) will not work on a congested network. The screen "pixelates" when packets are dropped. The sound is not synchronized. This congestion matters: it is not enough to buy end-user video equipment; you need networks that actually support high definition video and massively large file transfers. Commercial networks also do not accommodate "bursty" applications, such as the transfer of very large medical files with images. By contrast, Internet2, NLR, and their regional partners have operated networks for years that ensure that bursty applications are as reliable as any other application. The U.S. UCAN built on these networks would continue this operational model. The number of broadband users is growing rapidly, while the amount of broadband consumption per user is also increasing at tremendous rates. The CTO of AT&T stated in 2009 that its backbone will need to be extensively upgraded (far quicker than ever before) just to meet the needs of AT&T's existing users, and he further added that there are limits to the amount of upgrades that are even possible. His comments demonstrate that commercial networks will have difficulty just keeping up with the needs of their core residential users in the years to come. AT&T's core users, of course, are not anchor institutions using advanced broadband applications. The gap between the requirements of community anchors that need to use advanced broadband applications, and the capabilities of commercial networks, is widening.

The national non-profit networks, conversely, focus on ensuring that community anchors can use advanced broadband applications with other anchors across the nation. Thus, given their core mission, Internet2 and NLR will use the BTOP funding to make certain that congestion, jitter, and packet loss will be non-issues with respect to these networks. The proposal will ensure a 100 Gbps IP backbone, with significant expansion capabilities for future growth, which will be sufficient to meet the national connectivity needs of community anchors with respect to advanced broadband applications. While some commercial carriers may offer advanced applications through one-off, proprietary solutions, such as a virtual private network for a medical link, these create so-called "walled gardens" that do not scale or provide cost efficiencies that non-profit community anchors require. These "dedicated network" solutions are extremely expensive to build and, at best, can only be used by a finite number of institutions thus impeding possible collaborations between many institutions, which directly undermines the needs of those institutions and the public in general.

2) TRANSPARENCY: Given the critical nature and time-sensitivity of many advanced broadband applications used by community anchors, network transparency is a necessity. A typical physical network path connecting one doctor to a remote colleague requires crossing several so called "administrative network domains," meaning the connection could include any number of commercial network providers. Each of these commercial providers do not share network performance data as they consider it competitive and proprietary information. Since a problem can occur on any one of these "network links" without transparency on the entire "end to end" path, it is very difficult to troubleshoot and fix any application problems. Without the ability to seamlessly troubleshoot and resolve these issues across networks, the advanced broadband application can be significantly hindered. The result is an unpredictable, frustrating experience for the doctors involved who would likely decide against adopting and using the technology in the future.

The national, regional and local non-profit networks, on the other hand, have a tradition of operating open networks in a collaborative fashion. These networks have also developed and deployed a suite of open-source network performance tools that optimize applications and trouble-shoot problems, especially across networks hops. The U.S. UCAN commits to operating under these same principles and will publish network statistics in near real time on publicly available websites. Problem resolution and problem avoidance are far more easily managed because the root of the problems can be immediately pinpointed by interested parties. Network problems are commonly prevented and quickly resolved when they do occur.

3) IPv6 AND MULTICAST: Anchor institutions need Internet Protocol version 6 (IPv6) and multicast capabilities that commercial Internet backbones today do not routinely deploy. These technologies make more efficient use of networks, enable more efficient video broadcasting and file transfer, and are essential to the growth and expansion of the Internet. U.S. UCAN will deploy IPv6 and multicast. Internet2 and NLR networks have operated with IPv6 since their inception. Very few commercial networks deploy IPv6 and multicast, and while both are extremely important the discussion here will focus on IPv6. The emerging Nationwide Health Information Network (NHIN) will need to support the huge proliferation of medical records among healthcare providers and enabling technology organizations. The model for transferring electronic medical records

is peer-to-peer. As the IPv4-based Internet exhausts its supply of IPv4 addresses, more and more devices will lose their native IP addresses, and will be aggregated into shared IP addresses via the use of devices such as network address translation (NAT) gateways. This forced aggregation into shared addresses will dramatically increase the technical and operational challenges to ensuring that the NHIN can operate as planned. To ensure a sufficient number of unique IP address, thereby ensuring the flexibility of true peer-to-peer transfers in this area, requires the transition to IPv6 as IPv4 addresses are exhausted. The national non-profit networks that will underpin U.S. UCAN are IPv6 ready and, as a community, its members can provide the technical support and knowledge required for the widespread adoption and deployment of IPv6 during this major transition in Internet technology.

4) ADDITIONAL SUPPORT: Community anchors need more than just infrastructure to support their advanced broadband applications. Significant work must be done at the applications and services levels to make the deployment of advanced broadband to anchors meaningful. By way of examples only, (i) at the applications level, anchors often require expertise, demonstrations, help centers and engineers who can "tune" applications, sometimes with the intent of increasing the bandwidth available to an application to better serve the user, while not constraining it; and (ii) at the services level, the identity management software and inter-institution trust systems referred to as "middleware," and which allow users to use a single password to access protected resources and to collaborate among institutions, allow for far greater, and more efficient, collaboration and resource/idea sharing among users, while providing protection against unauthorized access. Unlike commercial networks, the national non-profit networks regularly engage in these types of application-related activities and are pioneers in developing and providing such middleware infrastructure.

One example of the needs this BTOP proposal aims to address comes from the current network path between a hospital in Indiana and a specialized health care facility in Texas. Both institutions have (last-mile) high-speed connectivity to their commercial Internet providers, but until and unless the U.S. UCAN becomes a reality, they cannot reliably use advanced broadband applications with each other. Several fundamental problems prevent the two health care facilities today from using their high-speed Internet connections to improve patient care. Their current commercial service providers do not cooperate to ensure reliable end-to-end service, nor do they do optimize their networks and operations to support advanced applications. The round trip time via the Internet for a packet traveling from the one location to the other is approximately 40 ms. If there was a packet loss of 1% along the path, transfers of files would be limited to less than .4 Mb/s, regardless of the network bandwidth. This means that it would take 3 hours to transfer a 500MB MRI study compared to less than a minute with no packet loss and only a 100Mb/s network connection. A consulting physician is unlikely to want to wait 3 hours to be able to view such a file especially in a life or death ER situation. A 1% packet loss rate is not rare for commercial networks. When it does occur in the commercial world, engaging a local ISP to troubleshoot such a problem would be a challenge. A user needing to coordinate and engage four or five networks along the path to coordinate a remedy is almost unthinkable. U.S. UCAN is far less likely to have any packet loss, and in those rare instances when it does, it will have a common network operations center that understands how such impairments can dramatically impact the performance of critical applications,

and has existing relationships with last mile providers of U.S. UCAN to coordinate troubleshooting and problem resolution.

There is no comparable commercial Internet backbone service available today that offers what U.S. UCAN will offer to anchors nationwide. If BTOP is to realize its full vision, this project is essential.

Description of network openness

Within the limitations of the underlying facilities acceptable use policies (see supplemental information), the middle mile infrastructure funded through this proposal will provide public Internet access on equal terms to all potential users, within reasonable business and technical limits. The proposal also offers a peering service designed to directly interconnect UCAN users with peers on the public Internet. A managed network service interconnecting Unified Community Anchor Network members will also be available.

Users of the network will be able to select and contract with any ISP of their choosing for transport across the middle mile infrastructure. Through open cross-connects to providers, users will be able to leverage the access points on the middle mile infrastructure at key Internet exchange points and other carrier facilities to access the provider of their choice.

Access capacity to the public Internet, and the peering service, will operate in a transparent fashion. All management practices, including those that have the potential to impact network performance, will be published on the UCAN web site. In addition, customer visibility into the real-time operations of network elements will be made available via a secure web interface (this is a practice that Internet2 has pioneered and will extend to all of the network funded by this proposal).

Access to the peering service, for the purpose of interconnecting with UCAN, will be offered on a non-discriminatory basis (typically using a settlement-free model). Networks seeking access to UCAN via the peering service will be required to meet reasonable peering requirements (i.e., multiple common locations, reasonable speeds, etc.).

Access to the UCAN managed service will be limited to community anchor institutions.

Real-time access to operations data will include the ability to run non-disruptive commands on the network devices that comprise UCAN, the peering service, and access to the public Internet. This access will be publicly available. This level of transparency is a key to enabling the successful cross-domain deployment of advanced network applications. If a network impairment is suspected, the operators of a regional network are empowered to see under the covers of UCAN to determine its health and performance. Beyond being transparent in operations, UCAN will be instrumented with Internet2 Performance Nodes. These performance nodes actively test the network to determine end-to-end performance, as well as serving as a test point to aid network operators in identifying the source of network impairments. Data collected by the performance nodes will be availably to all users of UCAN as well as network researchers and industry worldwide. UCAN's performance nodes will join an existing global deployment of approximately 200 additional nodes, providing network operators and researchers access to performance data beyond UCAN.

System design

The proposed network is fiber-based to support the high volume of aggregated network traffic flowing between the regional networks and the community anchor institutions.

A community-owned 20-year IRU on a pair of fiber on a national footprint. A fully resilient optical system to provide the community with 100Gbps DWDM capabilities A resilient routed IP service that sits atop the optical system

Fiber acquisition

Securing long-term fiber IRUs helps provide a long-term asset that can be efficiently leveraged toward future capacity upgrades in support of community anchor traffic growth. U.S. UCAN has surveyed the regional connectors who provide service to community anchor institutions and identified nation-wide fiber routes that will augment their connectivity and enhance their capability to provide advanced services. U.S. UCAN will have access to 20-year IRUs for fiber from both Allied Fiber and Level(3) Communications along the routes detailed in the provided network maps. In addition, U.S. UCAN will leverage the existing IRU on the current NLR fiber footprint to provide long term resilient fiber paths on a significant portion of the national footprint.

Optical Network The U.S. UCAN optical system will provide a highly reliable and redundant Dense Wavelength Division Multiplexing (DWDM) optical platform that will allow for rapid and flexible service provisioning to the U.S. UCAN community. The system will support multiple 10Gbps, 40Gbps and 100Gbps wavelengths along most of the nationwide footprint. In addition to diversity at the fiber level, the U.S. UCAN network will provide DWDM services atop the fiber on diverse and resilient optical systems along most of the project footprint. The U.S. UCAN partners also propose to upgrade the Northern Tier Network between Chicago and Seattle to provide increased wavelength capacity and 100Gbps capability. New fiber acquisitions will be equipped with optical equipment that will provide both regional and nation-wide redundancy.

U.S. UCAN has surveyed a number of optical vendors, and has elected to partner with Infinera, Ciena, and Cisco Systems to provide a concrete design for newly acquired fiber paths. This design has informed the project budget, but it is understood that U.S. UCAN will go through a formal procurement process in order to leverage changes in cost or capabilities.

IP network

U.S. UCAN will provide access to two fully redundant nation-wide IP networks. U.S. UCAN partners Internet2 and National Lambda Rail will contribute their backbone IP routers to the project build and fund platform upgrades that will enable 100 Gbps routed service. In addition, both networks will be augmented by additional Layer3 nodes at strategic locations across the national footprint. Regional networks will aggregate Community Anchor Institutions and have the option of peering with one or both IP networks to obtain redundancy. Having diverse service providers on diverse routing platforms provides an incredible amount of resiliency to the Community Anchor Institution community.

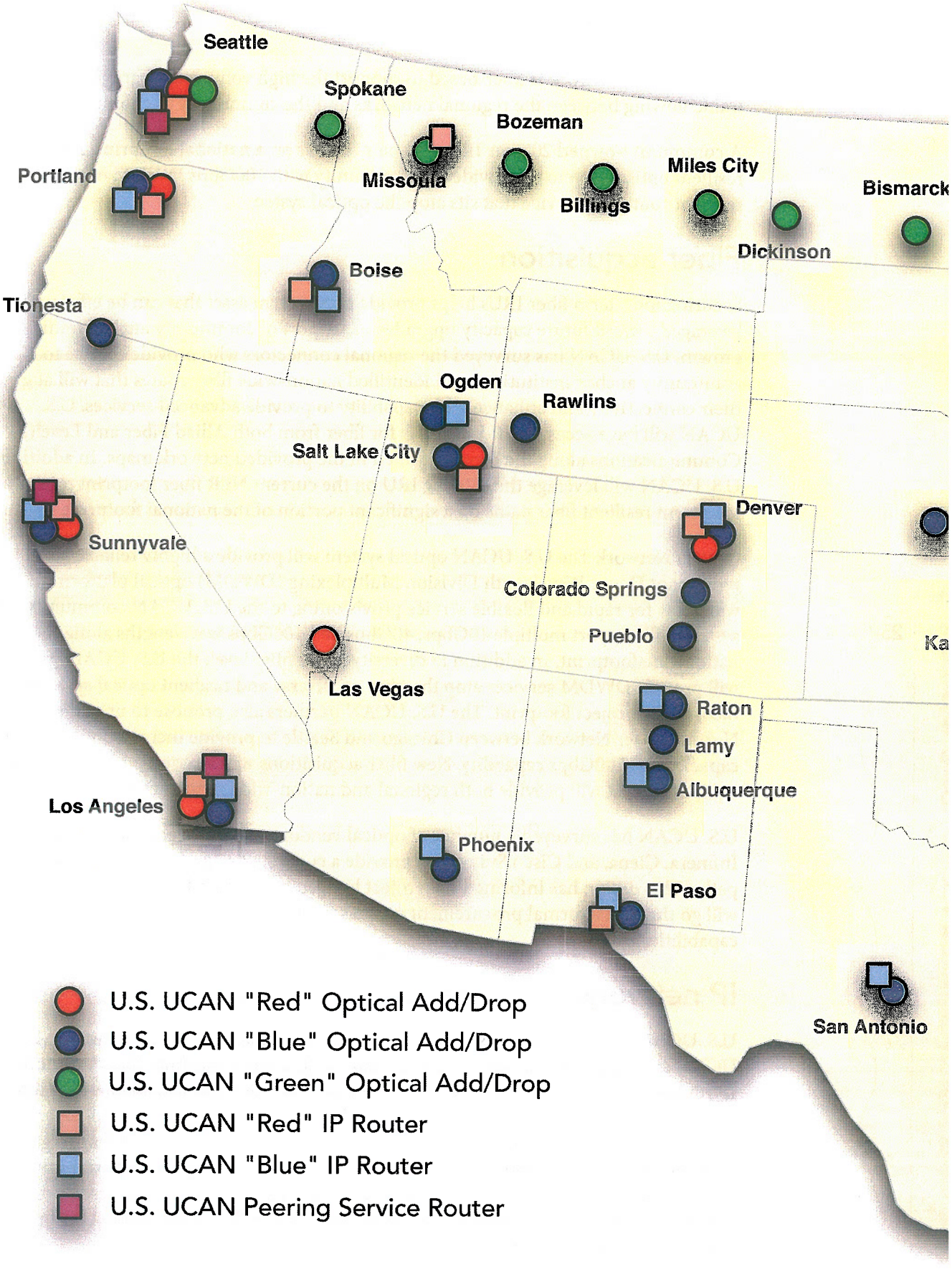
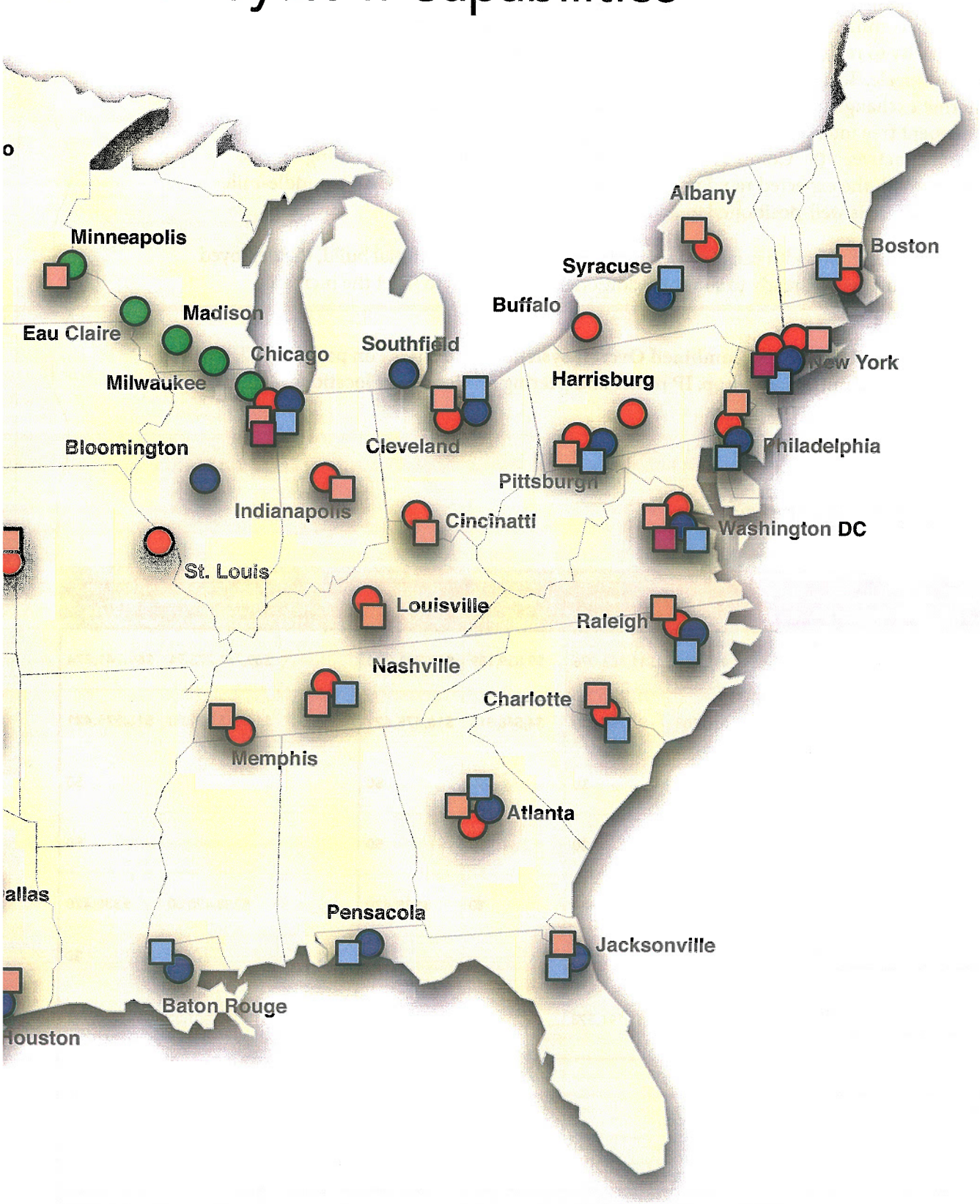

Seattle
Spokane
Bozeman
Missoula
Miles City
Billings
Bismarck
Portland
Dickinson
Boise
Tionesta
Ogden
Rawlins
Salt Lake City
Denver
Sunnyvale
Colorado Springs
Pueblo
Las Vegas
Raton
Lamy
Albuquerque
Los Angeles
Phoenix
El Paso
San Antonio
U.S. UCAN "Red" Optical Add/Drop
U.S. UCAN "Blue" Optical Add/Drop
U.S. UCAN "Green" Optical Add/Drop
U.S. UCAN "Red" IP Router
U.S. UCAN "Blue" IP Router
U.S. UCAN Peering Service Router

Figure B – U.S. UCAN Combined Overall System Capabilities



U.S. UCAN will provide Commodity Internet service to its participants via L2VPN transport to one or more Commercial ISP(s). In addition, the U.S. UCAN network will provide a commercial peering service functionality. This will allow the U.S. UCAN community to realize the cost- benefits of settlement free peering arrangements on a national-scale. To accomplish this, U.S. UCAN will place six new routers at Commercial Internet exchange points across the country with the express purpose of obtaining settlement free interconnect with commercial peers. U.S. UCAN will provide L2VPN transport between the Community Anchor regional networks and the peering service routers. With the expected rapid rate of broadband adoption, U.S. UCAN's middle-mile infrastructure is well-positioned to add capacity and capability.

As broadband bandwidth usage grows, pushing the limits of the initial build, the deployed infrastructure will be ready to support additional wavelengths to meet the increased demand.

See **Figure B**, "**U.S. UCAN Combined Overall System Capabilities**," on pages 26–27, for a map detailing optical add/drop, IP router and peering service router locations.

Budget summary

Budget	Federal Funding Request	Matching Funds (Cash)	Matching Funds (In-Kind)	Budget TOTAL	Last Mile Allocation	Middle Mile Allocation	Allocated TOTAL
Network & access equipment (switching, routing, transport, access)	$48,499,019	$11,383,096	$9,859,159	**$69,741,274**		$69,741,273.94	**$69,741,274**
Outside plant (cables, conduits, ducts, poles, towers, repeaters, etc.)	$9,826,508	$2,200,000	$4,548,913	**$16,575,421**		$16,575,421.00	**$16,575,421**
Buildings & land (new construction, improvements, renovations, lease)	$0	$0	$0	**$0**			**$0**
Customer premise equipment (modems, set-top boxes, inside wiring, etc.)	$0	$0	$0	**$0**			**$0**
Billing and operational support systems (IT systems, software, etc.)	$270,736	$67,684	$0	**$338,420**		$338,420.00	**$338,420**
Operating equipment (vehicles, office equipment, other)				**$0**			**$0**
Engineering/Professional services (engineering design, project management, consulting, etc.)	$3,943,869	$6,194,593	$0	**$10,138,462**		$10,138,461.55	**$10,138,462**
Testing (network elements, IT system elements, user devices, test generators, lab furnishings, servers/computers, etc.)				**$0**			**$0**
Site preparation				**$0**			**$0**
Other	$0	$0		**$0**		$0.00	**$0**
TOTAL BROADBAND SYSTEM: Cost share percentage:	$62,540,132 64.61%	$19,845,373 20.50%	$14,408,072 14.89%	$96,793,576	$0	$96,793,576	$96,793,576

A Proposal for a

United States Unified Community Anchor Network