

ILLINOIS STATE  
UNIVERSITY

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High-Speed Internet2 Connectivity  
at  
Illinois State University

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Telecommunications and Networking

## 1 – Introduction

Historically, obtaining high-speed Internet2 connectivity outside of a major metropolitan market (such as Chicago, St Louis, Indianapolis, etc) has been unattainable for many higher education institutions due to the excessive costs associated with the installation and maintenance of high-performance circuits. But as the result of a recent partnership between Illinois State University and a regional research network called I-WIRE, this goal is now financially viable. Leveraging the I-WIRE partnership, this proposal describes how the University can seek high-speed Internet2 connectivity at substantially reduced costs when compared with traditional methods. At the same time, this proposal will expand upon the opportunities this new partnership brings to the institution.

## 2 – What is the Internet2?

Internet2 is the name given to a consortium of nearly two hundred fifty academic institutions, research organizations, government entities, and corporate interests across the United State that are collaborating to create the framework for the next generation Internet. The primary goal of Internet2 is to provide the environment for the research and the development of advanced Internet applications.

Internet2 officially emerged in 1997 under the direction ofUCAID (University Corporation for the Advancement of Internet Development). Since this time, much progress has been made to enhance the underlying backbone infrastructure sparking the development of newer, more advanced applications in the near decade that has followed. Many of these applications such as grid computing, telemedicine, group collaboration, etc., owe much of their success to the work that has been done through this consortium.

## 3 – Why Internet2?

So, why is Internet2 connectivity such an important resource to academia? In short, Internet2 provides an environment that is innovation friendly. But, the primary reason why Internet2 is so important has to do with collaboration. The following are examples of the contribution that Internet2 has made to the research community:

- creating a leading edge network capability for the national research community
- enabling the development of revolutionary Internet applications
- ensuring the rapid transfer of new network services and applications to the broader Internet community

[source: <http://internet2.centennialpr.com/why.asp>]

These efforts are not possible using the commercial Internet because that environment lacks the capacity and flexibility necessary to conduct the research possible under a dedicated, high-performance network. Applications developed and used within the Internet2 environment are not constrained to bandwidth or quality of service limitations all too familiar on the commercial Internet.

Those organizations unable to leverage access to Internet2 are at a competitive disadvantage to those that can. Members will more effectively attract quality researchers, instructors, and students because of the research opportunities available through Internet2. As technology continues to diminish the constraints of distance and time, these capabilities will become of greater value to those organizations that are successful in seeking or sustaining their leadership within the academic community.

### 4 – Illinois State University and Internet2

Upon inception of Internet2, Illinois State University explored the value of connectivity to this research network. In the spring of 1998, ECAT (the Executive Committee for the Advancement of Technology) authorized funding to seek affiliate membership toUCAID in an effort to assess the opportunities, capabilities, and costs of the newly formed Internet2 consortium. Although an affiliate member does not have Internet2 connectivity, it is entitled to participate in the research and planning activities of the consortium. The cost for affiliate membership at that time was \$10,000 annually.

In the fall of 1998, staff attended an Internet2 Consortium Meeting to learn more about what this organization could offer the University. Although there were many organizations represented, this meeting demonstrated that the consortium was far too new, disorganized, and without clearly defined goals to offer any immediate benefits to Illinois State. As a result, the University discontinued its affiliated membership the following year.

Although Internet2 did not yet yield opportunities for non-research intensive organizations in 1998, it was clear that the consortium was headed in the right direction and that it had strong support from the higher education community, research organizations, and the federal government. For these reasons, it was understood by the University that it was only a matter of time before Internet2 connectivity would become a critical asset for any institution with the need to collaborate in research.

### 5 – Traditional Internet2 Connectivity

As the Internet2 consortium grew and new research opportunities emerged, the University repeatedly explored the costs associated with full membership toUCAID and high-speed connectivity to the Internet2 backbone called Abilene. By 2000, it was understood that high-speed Internet2 connectivity was critical for an institution to fully exploit the resources on this network. At that time, high-speed Internet2 connectivity was defined as speeds up to OC-3 (155Mb/s). Today, high-speed Internet2 connectivity for institutions is typically gigabit Ethernet (1Gb/s or 1000Mb/s) which is over six times faster than OC-3. Some Internet2 members currently enjoy 10Gb/s connectivity. In the not so distant future, 100Gb/s connectivity will become available with the upcoming upgrades to the Internet2 backbone by Level 3 Communications.

To access Internet2, an institution must lease a dedicated high-performance circuit between the campus network and a gigaPoP to obtain high-speed connectivity. This usually requires an institution to lease a circuit from one or more LECs (Local Exchange Carrier) and possibly an IXC (Inter eXchange Carrier). To clarify, a LEC is a telecommunications provider (like Verizon) that provides telecommunications services such as local residential phone service. An IXC is a telecommunications provider (like AT&T) that provides long distance services and carries voice, Internet, or private network traffic between two or more LECs. An Internet2 gigaPoP is a location where the circuit terminates into network hardware and Internet2 traffic is exchanged between member institutions, regional networks, and the Internet2 backbone called Abilene.

At the campus, several pieces of hardware are needed to support the connectivity to Internet2. This includes an edge router, firewall, IPS (Intrusion Prevention System), and bandwidth management appliance. The edge router is used to interface the circuit to the campus network. The firewall is used to make sure that this high-performance circuit does not provide a high-performance back door to on-campus systems. The IPS appliance is used to block traffic to and from the campus network that matches threat signatures (ie: virus, worm, spyware, etc). Finally, the bandwidth management appliance is used to ensure that bandwidth is properly allocated amongst all applications to ensure that mission critical applications may function properly. The edge router, security appliances, and bandwidth management appliance are all pieces of equipment that would be purchased and supported by the University. It is important to understand that this equipment needs to be upgraded or replaced at regular intervals (3-5 years). Otherwise, growth, lack of new features, or lack of contractual support would greatly limit the capabilities of this connectivity as demand increased.

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Regardless of service provider or equipment needed, there are two cost components associated with obtaining Internet2 connectivity – installation and recurring. The following is a breakdown of installation costs associated with Internet2.

• LEC (Local Exchange Carrier)	\$1,000 - \$5,000 (1)
• IXC (Inter eXchange Carrier)	\$1,000 - \$10,000 (2)
• Internet2 gigaPoP	\$0-\$10,000 (3)
• edge router	\$20,000 - \$30,000 (4)
• firewall	\$40,000-\$60,000 (4)
• IPS (Intrusion Prevention System)	\$45,000-\$65,000 (4)
• bandwidth management appliance	\$40,000 - \$75,000 (4)
 TOTAL installation costs	 \$147,000 - \$255,000

- (1) this cost varies between LECs (ex: Verizon, Ameritech, etc)
- (2) this cost varies between IXCs (ex: AT&T, Sprint, Qwest, etc)
- (3) depending upon the costs for connectivity at a regional Internet2 gigaPoP
- (4) this cost can vary depending upon the scalability, throughput, and features of the product

Along with the installation costs are recurring costs for I2 connectivity. Below are the estimated annual costs for Internet2:

• LEC (Local Exchange Carrier)	\$20,000 - \$40,000 per year (1)
• IXC (Inte eXchange Carrier)	\$150,000 - \$300,000 per year (2)
• Internet2 gigaPoP	\$25,000 - \$50,000 per year (3)
• UCAID (full membership)	\$32,000 per year (4)
• Abilene CoU (Conditions of Use)	\$30,000 per year (5)
 TOTAL annual commitment	 \$257,000-\$390,000

- (1) depending upon the local telecommunications provider
- (2) depending upon the market where service is available
- (3) depending upon the costs for connectivity at a regional Internet2 gigaPoP
- (4) full membership was required to connect to an Internet2 gigaPoP
- (5) Abilene CoU (Conditions of Use) fee required when connecting directly to Abilene

These costs are all based upon recent quotes the University has obtained from each of the related entities for service where Verizon is the LEC, AT&T is the IXC, MREN is the Internet2 service provider, Cisco provides the router and firewall, Tipping Point provides the IPS, and Packeteer provides the bandwidth management appliance. Based upon these estimates, the University has not been able to seek high-speed Internet2 connectivity using traditional means in the current budget climate due to these excessive costs.

## 6 – The Illinois Century Network and Internet2

Since 1998, the ICN (Illinois Century Network) has been one of two ISPs (Internet Service Provider) that provide public Internet connectivity for the University. The ICN is a state funded regional network that supports the connectivity of higher education institutions, community colleges, K-12 school districts, libraries, hospitals, and government facilities throughout Illinois. Although primarily designed to provide network interconnectivity among these organizations, the ICN also provides member networks with access to the commercial Internet.

To access the ICN, an organization must contract with a LEC to lease a circuit between their network and a regional ICN POP (Point of Presence). To help keep the costs of leased circuits down, the ICN

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placed these POP sites throughout the state. One of these sites is located on the campus of Illinois State University. By hosting this POP, the University can connect directly to the ICN without the costs associated with seeking a leased circuit from Verizon.

During the fall of 2002, the University began talks with the ICN about seeking Internet2 connectivity as a way to leverage access through the campus POP. Through a program called SEGP (Sponsored Education Group Participant), a state network can provide Internet2 access for directly connected K-20 institutions. These organizations are not required to join Internet2 through the SEGP program, and therefore are not obligated to pay the annual dues with UCAID or the Abilene CoU (Conditions of Use) fees. For a state network to become qualified for SEGP, it is required to seek full Internet2 membership and connect to Abilene at a local gigaPoP. Due to the substantial cost savings of SEGP connectivity over dedicated leased line circuits, the ICN agreed to seek Internet2 membership and offer this service on behalf of K-20 for the state.

By the beginning of 2003, the ICN had joined the Internet2 consortium and had become a SEGP partner. Shortly afterwards, the ICN began to offer Internet2 connectivity to K-12 and higher education through this program. By mid 2003, the University received a grant from State Farm to aid in the University's efforts to seek Internet2 connectivity. Using these funds, the University leased an additional 30Mb/s of bandwidth from the ICN with the intent that it be made available for Internet2 applications.

- 30Mb/s @ \$4,500 per month (\$54,000 per year)

Although this augmented capacity provides the University with a modest amount of bandwidth for Internet2 services, it is not sufficient to support many of the applications being used for collaborative research initiatives within the Internet2 consortium. As such, substantially more capacity would be required to fully leverage these capabilities.

## 6 – I-WIRE

I-WIRE (Illinois Wired/Wireless Infrastructure for Research and Education) is a fiber-based communications infrastructure funded by the state of Illinois and others with the purpose of interconnecting research facilities in the Chicagoland area. These include ANL (Argonne National Laboratory), UIC (University of Illinois at Chicago), UIUC (University of Illinois at Urbana-Champaign), NCSA (National Center for Supercomputing Applications), the University of Chicago, IIT (Illinois Institute of Technology), NU (Northwestern University), and several collocation facilities in Chicago. I-WIRE is administered through partnerships between ANL and the University of Chicago. [source: <http://www.iwire.org>]

It is important to understand that I-WIRE is not based upon traditional lease circuits from the carriers. Instead, it is built upon a technology called WDM (Wave Division Multiplexing) which simply requires the use of dark fiber (ie: the carriers have no active electronics on both ends) between sites. In short, this means that I-WIRE requires only a few pairs of fiber between each POP. Using WDM devices at both ends of dark fiber pairs, up to 33 concurrent circuits can be provided over each pair ranging up to speeds of 10Gb/s per circuit if needed.

In 2004, funding became available through the state to extend I-WIRE from one of the collocation facilities in Chicago called StarLight to the PeoriaNEXT consortium. This organization consists of hospitals, universities, community colleges, the USDA (US Department of Agriculture), and others from the Peoria area for the purpose of collaborative research. The goal was to extend I-WIRE directly from Chicago to the PeoriaNEXT consortium in Peoria to extend the reach of their collaborations. Because NCSA (located in Champaign) and PeoriaNEXT wanted physical redundancy through I-WIRE to increase the survivability of their connectivity, the decision was made to extend this network between Peoria and Champaign as well. Using this approach, I-WIRE would extend from Chicago to Peoria through Champaign and then back to Chicago.

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To extend this network between their POPs at NCSA and PeoriaNEXT, I-WIRE needed a facility located between these sites where they could place digital repeaters for their optical network. As such, the University was contacted in February 2005 by I-WIRE to discuss our interest in hosting a POP site for this network. Throughout the spring and summer of 2005, several meetings took place between the University, I-WIRE, NCSA, and PeoriaNEXT to discuss a relationship between the University and these organizations. The goal was to establish a POP at Illinois State University so that I-WIRE could be extended between Peoria and Champaign.

As these conversations took place and it became clear that the University would host a POP site for I-WIRE, funding was committed in the fall of 2005 to begin the extension of the network between Peoria and Champaign. While discussing the details of how the POP would be managed and what requirements I-WIRE had of the facilities we were to provide, the University began to explore the capabilities and opportunities of this network. NCSA and PeoriaNEXT both wanted I-WIRE to provide them with access to other resources available through the StarLight peering facilities in Chicago. What resources could the University gain access to if it joined this research network as a partner?

As conversations took place over the spring of 2006, it became clear that I-WIRE represented a wonderful opportunity. It could provide the means to access the Internet2 and many other research networks using high-performance connections at a very reasonable cost. But I-WIRE was not a service provider. The University would need to connect to a service provider network that could provide these services through I-WIRE if we were to leverage this opportunity.

### 7 – MREN (Metropolitan Research in Education Network)

MREN (Metropolitan Research and Education Network) is a consortium of institutions dedicated to the maintenance of high-performance, broadband digital networks in support of research and education in the greater Chicago region. As such, MREN is committed to the implementation of advanced networking technologies required to meet the needs of its members. Although MREN's primary focus is to provide advanced digital communications for leading-edge research and educational applications, it also addresses more general networking requirements.  
[source: <http://www.mren.org/overview.html#MREN>]

As the University explored what service provider network could offer Internet2 connectivity as well as access to other research networks through I-WIRE, it became clear that interfacing to MREN would be required. MREN membership would provide the University with high-speed connectivity with the big ten universities in the Chicago area as well as many research labs and other state networks. And the place where this peering between the University and MREN would be established is at the StarLight POP facility at Northwestern University.

But to use MREN to leverage the capacity of I-WIRE, the University would need to seek membership. In the spring of 2006, several conversations took place between the University and MREN to discuss this goal. A tentative agreement was reached requiring Illinois State University to seek MREN membership and then share the cost of 10Gb/s connectivity with other MREN members for access to the StarLight POP. This cost was approximately \$28,800 per year per member institution but could change based upon the number of members or the capacity that MREN sought at StarLight.

### 8 – StarLight

StarLight is the name of the facility which provides interconnectivity among a large array of regional, national, and international research networks in the Midwest region of the United States. At this POP is where most of the world's research and instructional traffic is relayed.

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Because MREN and Abilene (the Internet2 backbone) both peer at this POP, StarLight provides the means for how the University can obtain high-speed Internet2 connectivity through I-WIRE. But just as critical, access to StarLight through MREN provides the University with high-speed connectivity to many other regional, national, and international research networks.

The following are regional research networks that are accessible through Starlight: [source: <http://www.startap.net/starlight/networks>]

- **CAVEwave** – UIC/EVL has a persistent 10GigE connection to the University of Washington in Seattle and the University of California, San Diego via its own private wavelength on the National LambdaRail (NLR). CAVEwave is dedicated to networking research and development. [10Gbps connection]
- **Fermi LightPath** – Fermi National Accelerator Laboratory [2 x 10Gbps and 2 x 1Gbps connection]
- **I-Light** – Indiana's Optical Fiber Network: A cross-state, university-owned fiber optic network linking IU at Bloomington, IUPUI and Purdue University to each other, the Internet and Internet2. I-Light comes to StarLight, where it connects with the TeraGrid.
- **I-WIRE** – Illinois Wired/Wireless Infrastructure for Research and Education: A state of Illinois-funded dark-fiber network connecting UIC, NU, ANL, NCSA, Illinois Institute of Technology, Illinois Century Network and University of Chicago. I-WIRE provides point-to-point lambda services between I-WIRE sites with a minimum of one 2.5Gbps lambda connectivity to StarLight.
- **MCNC/EnLIGHTened** – 10Gbps
- **MREN** – Metropolitan Research and Education Network: MREN is the oldest and most advanced GigaPoP servicing the Midwest. MREN sites are connected to StarLight [10Gbps connection]
- **OMNInet** – Optical Metro Network Initiative: The OMNI project was established to create a reference model for a wide-range of next generation metro communication services based on advanced photonic technologies. OMNI is a cooperative research partnership of iCAIR, Nortel, SBC, EVL at UIC, MCS at ANL and Canada's CANARIE. **OMNInet** is the world's most advanced metro network testbed and is based on leading-edge photonic technology including lambda switching.
- **Southern Light Rail** – A Georgia Tech non-profit corporation providing National Lambda Rail access to the Georgia Research Alliance universities, other regional universities, and governmental and private sector organizations involved in university research initiatives. [10Gbps connection]
- **TeraGrid** – TeraGrid is an NSF Major Resource Equipment (MRE) initiative for a distributed supercomputer. StarLight is the Illinois "hub" that connects a 40Gbps optical network (the DTFnet) between Chicago and Los Angeles; in August 2003, a 10Gbps link was installed between Chicago and Pittsburgh, which has since tripled to 30Gbps.
- **TransLight** – 10Gbps link between Seattle PNWGP and StarLight

The following are national research networks that are accessible through StarLight: [source: <http://www.startap.net/starlight/networks>]

- **UCAID/Abilene** – U.S. University Corporation for Advanced Internet Development (UCAID) [3 x 10Gbps connection]
- **DREN** – Defense Research and Education Network, U.S. Dept. of Defense [1Gbps connection]
- **ESnet** – Energy Sciences Network, U.S. Dept. of Energy [1Gbps and 10Gbps connections]
- **National LambdaRail** – A national infrastructure for research and experimentation in networking technologies and applications. [2 x 10Gbps connections]
- **NISN** – NASA Integrated Services Network [622Mbps connection]
- **UltraScience Net** – UltraScience Network, U.S. Department of Energy [20Gbps connection]
- **USGS** – U.S. Geological Survey Network, U.S. Dept. of Interior [45Mbps connection]

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The following are international research networks that are accessible through StarLight: [source: <http://www.startap.net/starlight/networks>]

- **ASNet** – Research Network of Academia Sinica, Taiwan [2.5Gbps connection]
- **CA\*net4** – An advanced optical network of the Canadian Network of the Advancement of Research, Industry and Education (CANARIE) [3 x 10Gbps connection]
- **EuroLink/TransLight** – The NSF-funded Euro-Link initiative currently provides a 10Gbps link between StarLight and the Netherlands; 5Gbps is for Abilene/CA\*net/GEANT research and education router-based production traffic and 5Gbps for StarLight/NetherLight switch-based networking traffic.
- **JGN-II (Japanese Gigabit Network II)** – [10Gb/s connection]
- **GLORIAD-China/CSTNet** – The Beijing to Hong Kong section of GLORIAD is connected at 2.5Gbps. From Hong Kong to Chicago, the Chinese Academy of Sciences (CAS)'s CSTNet now comes to Chicago at 155Mbps.
- **GLORIAD-Russia** – As part of GLORIAD, the Russian Backbone Network (RBN) is connected from Russia via Amsterdam to New York and then over CA\*net4 to Chicago at 622Mbps.
- **HARNET** – Hong Kong Academic and Research Network, managed by the Joint Universities Computer Centre (JUCC) [1Gbps connection]
- **KREONet2/KOREN** – Korea Research Environment Open Network 2 (KREONet2) and Korean advanced REsearch Network (KOREN)
- **SINET** – Japan's Science Information Network (SINET) [1 Gbps connection]
- **SURFnet** – SURFnet is the Research and Education Network of the Netherlands, and has a 10Gbps connection to StarLight. SURFnet also manages "NetherLight," StarLight's "sister" facility in Europe, and carries the international traffic of CESNET, the national R&E network of the Czech Republic, which maintains a 10Gbps link to NetherLight. SURFnet also carries international traffic of NORDUnet, the R&E network of Sweden, Denmark, Finland, Iceland and Norway, which maintains a 10Gbps link to NetherLight.
- **TaiwanLight/TWAREN** – The optical service of Taiwan's R&E network TWAREN (formerly TANet2) [5Gbps connection]
- **UKLight** – The advanced optical networking initiative of the United Kingdom [10Gbps connection]

As demonstrated by the above lists of regional, national, and international networks that peer at StarLight, the opportunity to conduct research through high-speed connectivity provided through I-WIRE and MREN is substantial. Capacity between these networks is also worth noting. This connectivity is almost always measured in Gb/s (gigabits per second). For a frame of reference, a single Gb/s could be used to copy twenty-five standard length MP3 files per second.

### 9 – Internet2 Connectivity through I-WIRE

With the creation of an I-WIRE POP on campus has come the opportunity to seek connectivity through MREN at the StarLight POP as the means for high-speed Internet2 connectivity. For these reasons, the University has negotiated with Argonne National Laboratory to obtain high-speed connectivity through I-WIRE to MREN in exchange for hosting a POP on behalf of I-WIRE.

In short, the following are the terms of the agreement:

- at no cost, the University will provide and maintain a space for use as the I-WIRE POP at Illinois State University
- at no cost, the University will provide all connectivity, power, and air conditioning for the equipment required by I-WIRE

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- at no cost, I-WIRE will provide two 1Gb/s circuits from the campus POP to MREN at the StarLight POP
- the University will be responsible for costs associated with the maintenance and replacement of interface cards required to provide the University with connectivity through I-WIRE
- at a future time, the University may seek the expansion of capacity within I-WIRE by installing more line cards at the campus and StarLight POP facilities as long as this capacity is available and not already committed

This agreement was approved by both the University and Argonne in March 2006. Since this time, the I-WIRE POP was established on campus in July 2006 and the circuits for MREN were provisioned shortly afterward in August. As stated previously, in order for the University to use these circuits for Internet2 connectivity, Illinois State University must join MREN. Once membership has been obtained, MREN will begin exchanging Internet2 traffic between campus and Abilene over this connection through I-WIRE. Because the University retains connectivity to the ICN, SEGP status still applies meaning that there is still no need to fund full Internet2 membership or pay the CoU (Conditions of Use) fees.

The following is a breakdown of installation costs associated with Internet2 connectivity through I-WIRE to MREN. Note that these costs are based upon activating a single 1Gb/s circuit to MREN.

• LEC (Local Exchange Carrier)	\$0 (1)
• IXC (Inter eXchange Carrier)	\$0 (1)
• Internet2 gigaPoP	\$0 (2)
• edge router	\$0 (3)
• firewall	\$55,000 (4)
• IPS	\$55,000 (4)
• bandwidth management appliance	\$0 (5)
 TOTAL installation costs	 \$110,000

- (1) I-WIRE serves the role of LEC and IXC and requires no installation fee (except for growth)
- (2) MREN requires no installation fee
- (3) reusing equipment from a previous project
- (4) high performance equipment purchased from a State Farm grant
- (5) due to the size of the circuit, no bandwidth management appliance is being considered at this time

The following is a breakdown of recurring costs associated with Internet2 connectivity through I-WIRE to MREN:

• LEC (Local Exchange Carrier)	\$0 (1)
• IXC (Inter eXchange Carrier)	\$0 (1)
• I-WIRE maintenance contract	\$5,000 (2)
• UCAID membership	\$0 (3)
• Abilene CoU	\$0 (4)
• Internet2 gigaPoP	\$28,800 (5)
 TOTAL annual commitment	 \$33,800

- (1) I-WIRE serves the role of LEC and IXC and requires no recurring fee
- (2) I-WIRE owns the equipment at the POP but the University pays annual maintenance on the line cards used to interface to campus network
- (3) The University does not need to join UCAID as a full member since we can still leverage Internet2 access through SEGP even when connecting directly through MREN
- (4) Because the University obtains Internet2 access through SEGP, MREN is responsible for the costs associated with the Abilene CoU (which is shared amongst the group)

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- (5) MREN is the regional Internet2 gigaPoP; membership requires the University to pay a share of the cost for maintaining the 10Gb/s connection to StarLight

When comparing the traditional costs for Internet2 connectivity with how the University currently obtains this access, Internet2 connectivity through I-WIRE provides over 33 times more capacity at half the cost than Internet2 connectivity through the ICN. See below:

- Internet2 connectivity through ICN: 30Mb/s Internet2 @ \$4,500/month (\$54,000 per year)
- Internet2 connectivity through I-WIRE: 1Gb/s (1000Mb/s) Internet2 @ \$2,400/month (\$28,800 per year)

When compared to traditional forms of Internet2 connectivity (see section 5 – Traditional Internet2 Connectivity), Internet2 connectivity through I-WIRE demonstrates a savings up to \$140,000 in installation costs and over \$350,000 a year in annual recurring costs for the same amount of capacity. Using these figures, the value of the connectivity provided by I-WIRE can be measured to be worth nearly \$400,000 annually. If capacity is grown or other forms of access are sought, this value will grow respectively. These estimates do not reflect the value of I-WIRE and MREN when factoring in access to the multitude of other research networks available to the University beyond Internet2.

In the spring of 2006, Telecommunications and Networking submitted a request to the Provost for enhancement funds to support Internet2 connectivity. These funds were granted with the intent that they would support the cost of MREN membership through FY09. At this point, Telecommunications and Networking would like to proceed with seeking MREN membership by October 2006 using the enhancement funds provided by the Provost with the intent of delivering this new Internet2 capacity to the University by January 2007. It is critical that this effort conclude by January 2007 as funds from State Farm to support the existing 30Mb/s of Internet2 connectivity through the ICN will be depleted by the end of the year.

### 10 – Marketing Internet2

It is not enough to provide high-speed Internet2 connectivity as it serves no value unless exploited by the University. Thus to help institutions market this connectivity,UCAID along with university, affiliate and corporate members have developed a program called Internet2 Days.

Internet2 Days is a campus-based program of events to demonstrate the potential of advanced network applications. It provides a program of speakers and hands-on experience with actual applications being developed by Internet2 members to build interest among faculty and staff at member institutions. [source: <http://apps.internet2.edu/Internet2-Days.php>]

After the new Internet2 circuit is operational, the intent would be that the University would host Internet2 Days on campus to help make researchers aware of the opportunities made available by this enhanced connectivity using a combination of internal and outside speakers and presenters. The University would then begin working with these researchers to aid them in their efforts to seek collaborators.

### 11 – CIREN (Central Illinois Research in Education Network)

Once the new, high-speed Internet2 circuit for campus is active and researchers have been made aware of its potential, the University will then begin to pursue the creation of a local consortium called CIREN. The goal behind this new organization is to bring Internet2 connectivity to other research entities in the immediate Bloomington-Normal market leveraging the SEGP program sponsored by the ICN.

CIREN would benefit Illinois State University by increasing the number of local research partners, placing the University in a leadership role for local research, and giving it the means to share the costs

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for this connectivity with others. These partners could include other local universities, community colleges, public and private K-12, hospitals, and so on.

As the value of this connectivity grows at the University and among the members of CIREN, this consortium could purchase additional modules for the WDM hardware used by I-WIRE at the campus and StarLight POPs to increase overall network capacity. The resources provided through CIREN to the local research community will most assuredly help attract researchers to this market and allow it to effectively compete for resources against the PeoriaNEXT consortium and research entities in Champaign.

### 12 – Proposed Implementation Schedule

To realize the opportunities of I-WIRE, the following schedule defines the chain of events described in this proposal and the timeframes for each milestone.

- |   |               |
|---|---------------|
| • build I-WIRE POP on campus                        | July 2006     |
| • provision circuits through I-WIRE to MREN         | August 2006   |
| • begin testing 1Gb/s link through MREN             | October 2006  |
| • make new Internet2 circuit through MREN available | January 2007  |
| • drop 30Mb/s Internet2 connection through the ICN  | January 2007  |
| • host Internet2 Day                                | February 2007 |
| • begin developing CIREN                            | March 2007    |
| • expand MREN connectivity through CIREN            | unknown       |

This schedule is contingent upon when the University actually seeks MREN membership.

### 13 – Conclusion

The new partnership between Illinois State University and I-WIRE represents an incredible opportunity for this institution to participate in collaborative research and seek new grants previously unattainable. With connectivity to many regional, national, and international research networks beyond Internet2, the value of this new connectivity cannot be overemphasized. Marketing this new access will be key to how the University can exploit it. Creating a consortium of local research partners will provide the institution with the means to provide means to sustain and grow this new resource for years to come..

But, it is important to understand that all of these benefits will come at a cost. As the University leverages this new capacity to seek new opportunities, new resources will be required to enhance the campus network infrastructure to support applications such as gigabit Ethernet to the desktop, 10Gb/s Ethernet within the backbone of the campus network, and 10Gb/s Ethernet connectivity for select server farms. Without these enhancements, these future opportunities will be constrained to the network capacity currently provided.