

OmniPoP 2016-2021 Evaluation Report

April 2021

PART I: EXECUTIVE SUMMARY

The Big Ten Academic Alliance (Alliance) OmniPoP Network is the fiber-optic network serving the 15 members of the Alliance. Created in 2006, the OmniPoP Network is a collection of fiber optics, network devices, and colocation facilities in Chicago. OmniPoP grew out of the earlier, collective purchase of a ring of fiber by the Alliance Chief Information Officers in 2004. OmniPoP provides essential high-speed connectivity to its membership both directly and through its external regional and national network partners and service providers.

This evaluation is being conducted pursuant to an established Alliance program review policy and in accordance with a set five-year schedule. The following goals influenced the review structure and process:

1. Present accomplishments for past 5-year period, 2015-2020;
2. Identify and present strategic priorities for 2021-2026;
3. Identify technical goals and priorities for next five years;
4. Identify business and operational goals and priorities;
5. Evaluate business operations and opportunities for process improvements; and
6. Assess adequacy of the process used to estimate annual OmniPoP savings.

To accomplish these goals, in consultation with the chairs of the Technical Advisory Council (TAC) (Jay Ford, University of Iowa, chair; William (Tom) Johnson, Indiana University, past chair; and Melissa Xiong, University of Minnesota, chair elect) and the CIO liaisons to OmniPoP (Steve Fleagle, University of Iowa; Don Welch, Pennsylvania State University), Alliance staff developed and implemented the evaluation plan. The review process was structured to be consultative and to seek feedback and input from stakeholders, regional network partners and other key partners. These included: the TAC engineers who are their institutions' managers and interface with the network; GlobalNOC, OmniPoP's operations center; university and vendor business contacts; Internet2; Lumen Technologies (formerly CenturyLink and Level3); the Big Ten Network; and service and network partners such as WiscNet, the Great Plains Network and others.

The primary themes that emerged from the surveys, interviews and conversations conducted as part of this review are:

1. The OmniPoP community enjoys a uniquely rich collaborative relationship providing access to deep subject matter expertise across the member and affiliate institutions, enabling networking solutions, joint initiatives and strategic leadership.
2. The network is a very valuable resource that contributes to the organizational missions of its members and regional and national partners.
3. Although the OmniPoP Network saves its members money, that is not the primary reason or benefit of participation. The responsiveness of the network and community is critically important and would be worth a premium.
4. OmniPoP provides important service benefits, through peering opportunities and elective services, and is a critical enabler of collaboration and consultation across the member network and with regional and national partners.
5. Important accomplishments since 2015 include securing the fiber lease extension, planning and preparing for the equipment refresh, and adopting a new budget model.
6. Priorities and goals for 2021-2026 include implementing the equipment refresh; strategic leveraging of Internet2's Next Generation Infrastructure; sustaining and protecting the existing value of the network and OmniPoP community; and evaluating opportunities related to the national research networking landscape.

One TAC member aptly summarized sentiments heard repeatedly throughout the review process regarding the broader impact of the OmniPoP Network as follows:

“The OmniPoP approach to collaboration is not just valuable for networking solutions directly to our members, it is also a model that each of us can hold up proudly in national conversations where we have the opportunity to share our successes and be leaders in national strategy formulation. Being part of OmniPoP successes makes us better national and global contributors and brings positive attention back to our member institutions as a result. While collaboration is certainly a common theme across R&E communities, we have something special here that is not readily found elsewhere, and we look forward to helping it thrive well into the future.”

2015-20 strategic accomplishments

The 2010-2015 OmniPoP evaluation identified six strategic priorities to be pursued in 2016-2020. Those priorities are set forth in italics below, which are followed by the actions taken in pursuit of those goals since 2015.

1. *Promote use and improve visibility to our partners and users:* Created a description of the OmniPoP Network for researchers' use in grant proposals.
2. *Continue to explore strategic partnerships and opportunities:* Explored interest and feasibility of an OmniPoP East Network and began discussions to revisit the Great Plains Network partnership.
3. *Protect existing fiber:* Secured a 10-year extension of the network's fiber optic lease.
4. *Develop mitigation strategy for DDOS and other cyber-attacks:* Secured a license for a Distributed Denial of Service (DDOS) mitigation contract.
5. *Monitor and evaluate technologies that may impact future infrastructure:* Secured the NSF Global Environment Network Innovations (GENI) grant to connect OmniPoP to the Midwest OpenFlow Crossroads Initiative and partnered with WiscNet to provide the Wisconsin Regional Internet Peering Service.

In addition to the actions that occurred in response to the priority setting in the last evaluation, the following accomplishments occurred in the past five years:

6. Developed a new budget model that streamlines processes, reduces administrative effort and increases the accuracy of financial operations.
7. Built capital reserves and completed a planning process for a hardware refresh of the network.
8. Participated in Internet2's next generation infrastructure (NGI) planning and evaluated and made decisions about how OmniPoP will participate in the NGI.
9. Completed important operational improvements for the network.

2021-2026 strategic priorities:

The evaluation process, including insights from CIOs, TAC members, and key stakeholders, produced the following set of strategic priorities for the next five years:

1. Safeguard and steward the unique and highly valuable OmniPoP collaborative community;
2. Complete the hardware refresh of the OmniPoP Network;
3. Implement and strategically leverage Internet2's Next Generation Infrastructure;
4. Review and refresh business and operational resources with the goal of supporting the efficient, well-documented management of the network;
5. Increase TAC's and the Alliance staff's interactions with key partners in the form of more regular standing business meetings to support existing strong relationships and capture collaborative opportunities; and

6. Explore expanded services and other opportunities.

PART II: OVERVIEW OF OMNIPOP

OmniPoP is a collaborative fiber-optic network operating shared resources for the mutual benefit of the participating Alliance institutions. Network infrastructure includes member owned fiber cabling throughout downtown Chicago which connects to a shared switching infrastructure located at a pair of redundant locations in the Chicago metropolitan area. This shared resource knits together the members' own regional optical networks and provides shared connectivity to national and international network infrastructure.

Currently, OmniPoP capabilities include 2x100Gbps connectivity to the national Internet2 research backbone, as well as direct 100Gbps connections to other higher education and research peers such as ESNet. The design of OmniPoP provides multiple access points and built-in redundancy that helps limit network downtime due to unforeseen fiber optic cable damage or equipment failure. OmniPoP provides services to faculty and researchers that allow them to share bandwidth-intensive applications (such as high-definition video) and massive research datasets between regional, national, and global collaborators. In addition, OmniPoP provides access to common good services such as the WiscNet peering service and TeliaSonera Internet peering service.

Background:

The name "OmniPoP" was coined at the network's inception in 2006 and was defined to mean "a gigaPoP of gigaPoPs" where PoP stands for "point of presence" of networking equipment. As such, OmniPoP was envisioned as:

- A place where members can place and/or share their networking equipment.
- A place to develop a rich mesh of various services and peerings between members as well as external entities.
- A framework to provide common and elective services to the members.

OmniPoP Governance and Oversight:

[A Memoranda of Agreement](#) describes the governance and oversight of OmniPoP, which includes the following:

- OmniPoP Executive Board: The OmniPoP Executive Board (EB) consists of the CIOs from the Alliance member universities that participate as full members of the OmniPoP. The EB sets the strategic vision, reviews and approves policies and finances, and approve technical service and architectural proposals.
- Technical Advisory Council (TAC): Consists of two representatives from each OmniPoP member university and a representative from the OmniPoP operator (currently Indiana's Global Research Network Operations Center/GRNOC). Supported by the Alliance headquarters staff, the TAC recommends strategic technical plans, changes to services and architectures, approves routine purchases and service contracts, and is a key partner in the preparation of annual OmniPoP budgets. The TAC meets monthly and TAC Chairs meet twice a month and as otherwise necessary.
- Tactical Technical Team: Consists of up to six TAC members who work with the OmniPoP operator and the BTAA-HQ on day-to-day technical coordination of operational issues.

Members: All Alliance universities are OmniPoP members except the University of Maryland, University of Nebraska, and Rutgers University. OmniPoP members are assessed an annual fee for base services, set by TAC and approved by the member CIOs. Currently the annual membership fee is \$50,000, which has been unchanged since 2016. Members may also choose to participate in elective services, for which they are assessed separately.

Affiliates: OmniPoP affiliates are those institutions or organizations that procure services from or otherwise do business with (e.g., network peering) OmniPoP, but are not OmniPoP members. Affiliates include the University of Maryland, University of Nebraska, Rutgers University and

WiscNet. The current annual affiliate fee is \$17,000, which has been unchanged since 2016. Affiliate status must be approved by the OmniPoP Executive Board and Affiliates do not have voting rights on the board.

OmniPoP Technical Architecture:

- Two co-owned high-performance, full-featured switches with routing capability are located at two diverse facilities in downtown Chicago (600 West Chicago and Starlight, 710 North Lakeshore Drive). All fiber has presence in both facilities. By terminating fiber in OmniPoP facilities, OmniPoP avoids costly monthly fiber cross connect fees.
- Each member can request 1GE, 10GE or 100GE line-rate port on each network switch as deemed necessary by their institutions.
- Direct peering established between all Alliance member universities campus networks or Regional Optical Networks (RONs) is encouraged.
- 2 X 100GE connectivity (including **Internet2 Peering Exchange** – I2PX) to Internet2; with the Internet2 NGI, the network will go to 2x4x100GE connectivity in Q2 2021.
- Other direct peering with ESN (Large Hadron Collider), MREN (Metropolitan Research & Education Network) and Big Ten Network is available.

OmniPoP Base Services for Members:

- Ports: Base services for OmniPoP members initially included “birthright” 1GE and 10GE ports on each of the two OmniPoP switch/routers and one 100GE on the switch of their choice for no additional cost. In 2020, TAC recommended that the birthright port entitlement be eliminated to create a simplified accounting process for calculation of maintenance costs and indirect overhead costs. The OmniPoP Board approved and this will go into effect in the FY22 OmniPoP budget. As a result, Members will pay maintenance costs for all ports held by their institutions.
- Peering: OmniPoP members have the opportunity to connect to all the OmniPoP negotiated peering arrangements.
- Elective Services: OmniPoP members may purchase elective services as structured by the TAC

OmniPoP Elective Services for Members:

- WiscNet Peering: OmniPoP members have the option of utilizing this peering service to access a number of Internet content providers present in the Chicago area. Members taking advantage of this service are assessed fees via the same cost-share model as used for the Internet2 connectivity service.
- TeliaSonera: members can purchase this commodity Internet drainage service via a cost-share model.
- Additional ports: With the network hardware update and the elimination of 1GE and 10GE ports in early 2020, OmniPoP members may purchase additional 100GE ports on the switches. TAC will determine cost-recovery prices for these ports.
- Co-location: OmniPoP members may also utilize space in the OmniPoP facility to co-locate their own equipment. Members are assessed a charge proportional to their power and space utilizations in the suite.
- DDoS: members have the option to purchase the Radware Distributed Denial of Service (DDoS) mitigation service through a contract with Internet2.

OmniPoP Services for Affiliates:

Affiliates have the opportunity to establish peerings with mutually agreeable OmniPoP peers and to purchase the same elective services offered to members.

Common Network Services:

Common Network Services include network applications and external connections to other networks that are procured collectively and available for use by all OmniPoP participants.

OmniPoP Regional Network Partners:

- **BOREAS-Net:** The Broadband Optical Research, Education and Science Network is a collaboration of four major research institutions in the upper Midwestern United States: Iowa State University, the University of Iowa, the University of Minnesota, and the University of Wisconsin-Madison.
- **ICCN:** The InterCampus Communications Network of the University of Illinois is a broadband network that serves its three campuses in Urbana, Chicago and Springfield.
- **I-Light and Indiana GigaPoP:** I-Light is the State of Indiana's optical network for higher education. The Indiana GigaPoP manages I-Light.
- **MiLR and Merit Network:** Michigan LambdaRail is a high speed, fiber data network built by the three public research universities in Michigan: University of Michigan, Michigan State University, and Wayne State University and operated by Merit Network, the research and education network for the state of Michigan.
- **Northern Lights GigaPoP:** An advanced regional networking initiative for research and education operated by the University of Minnesota.
- **OARnet:** OARnet is the broadband network and services organization for the state of Ohio. It serves research, education and public service institutions including universities, colleges, K-12, hospitals, public broadcasting, and state and local government.
- **WiscNet:** Wisconsin's Research and Education Network, an affiliate member of OmniPoP, is a broadband network based in Madison that serves most of the colleges and universities in Wisconsin as well as most K12 school districts, library systems, the State of Wisconsin, many local and municipal governments, hospitals and non-profit affiliated organizations.

OmniPoP Operator – Role of GRNOC (GlobalNoc):

OmniPoP has selected and contracted with GRNOC at Indiana University as the OmniPoP operator. GRNOC is responsible for operational activities which include but are not limited to: performing usual and customary NOC activities, maintaining OmniPoP hardware owned by the founding partners, configuration management of such hardware, tracking and troubleshooting of events, and operations reporting.

Role of the Alliance Headquarters:

The Big Ten Academic Alliance is the legal entity for the OmniPoP Network and serves as its administrative operator. As such, the Alliance acquires and holds OmniPoP service agreements, including the Master Service Agreement with the OmniPoP Operator, and any common assets (e.g., physical property, licenses, leases or co-location agreements). Additionally, the Alliance purchases and holds insurance for OmniPoP assets on behalf of the Network and its members and affiliates. Alliance staff oversees and implements service agreements, licensing agreements, and other goods and services contracts for the Network. The Alliance conducts OmniPoP's business operations such as creating and maintaining the OmniPoP budget, creating and executing the invoice process, and is the main point of contact for business operations.

PART III: 2016-2020 STRATEGIC PRIORITIES & ACCOMPLISHMENTS

The 2015 OmniPoP Evaluation identified the following five strategic priorities for 2016-2020:

1. Promote use and improve visibility to our partners and users.
2. Continue to explore strategic partnerships and opportunities.
3. Protect existing fiber.
4. Develop mitigation strategy for DDOS and other cyber-attacks.
5. Monitor and evaluate technologies that may impact future infrastructure.

A summary of the activities and accomplishments related to these 2016 to 2020 strategic priorities is provided below.

Priority #1: Promote use and improve visibility to our partners and users.

To serve OmniPoP's primary goal of supporting research efforts, the 2015 evaluation identified two goals: 1) create standard [language that can be used in grant proposals](#) that describes the network facilities and assets, which TAC did, and 2) continue outreach to campus research communities and other consortium collaborative activities. As a part of this evaluation process, TAC has identified the need to update this grant proposal language to reflect equipment upgrades and current peerings and network connections. With respect to the second outreach goal, a common observation is that because OmniPoP consistently performs as expected, it can be somewhat invisible to those that rely upon it. TAC does not typically engage in outreach to the university research communities beyond the maintenance and operation of the networking infrastructure. It remains an open matter whether additional intentional engagement with researchers and university research leadership should be pursued and, if so, how to approach that work.

Priority #2: Continue to explore strategic partnerships and opportunities.

In 2015, TAC identified exploring the extension of the network to the east coast as a possible strategic opportunity to facilitate connection with consortium members Rutgers University, University of Maryland and Pennsylvania State University. Specifically, TAC expressed an interest in "reaching out to other regional aggregation points, such as MAX to determine if there are mutually beneficial opportunities for collaboration in support of these institutions. Similar to the direct connections to ESNet that we have established, we should continue to look for other interconnection opportunities that will help support and improve opportunities for our researchers and other campus community members." These conversations occurred and ultimately this extension is not being actively pursued based on the east coast Alliance universities' ability to get to the OmniPoP through other regional networks.

Recently, OmniPoP's partnership agreement with the Great Plains Network (GPN) has begun to be re-examined. Members of the TAC chairs group are in the process of discussing the reciprocal agreement between the two networks with representatives from GPN and the University of Nebraska-Lincoln (UNL). UNL gains access to the Big Ten Network (BTN) through the 10G port that connects GPN to OmniPoP. The parties are evaluating whether the 10G port will be decommissioned and the related question of how UNL's access to BTN would be preserved, as well as exploring whether there are other mutually beneficial strategic opportunities for the two regional networks to pursue. Those conversations are ongoing at this time.

Priority #3: Protect existing fiber assets.

In 2017, Level3 presented a proposal for a 10-year expansion of the fiber optic network lease held by OmniPoP. On October 13, 2017, a contract with Level3 was executed, providing OmniPoP with an IRU lease through 2034. Level3 was subsequently purchased by CenturyLink, which was later renamed Lumen.

Priority #4: Develop mitigation strategy for DDOS and other cyberattacks.

In 2017, four member universities obtained an elective Distributed Denial of Service (DDOS) mitigation service through a contract with Internet 2. The original DDOS provider was Zenedge (subsequently purchased by Oracle). Because of dissatisfaction with that Zenedge/Oracle, Internet2 contracted with Radware to provide this service. OmniPoP is a subscriber of the Radware DDOS service, with three OmniPoP members participating in this service (University of Illinois, University of Chicago, Northwestern University).

Priority #5: Monitor and evaluate technologies that may impact future infrastructure.

GENI: *Global Environment for Network Innovations*, provides a virtual laboratory for research and education networking and distributed systems. In 2014, GENI awarded a grant to the Big Ten Academic Alliance to support connecting OmniPoP to the Midwest OpenFlow Crossroads Initiative (MOXI). MOXI linked several Midwest regional networks to the GENI backbone and was intended to enable collaboration with GENI rack deployment projects. In 2018, TAC voted to decommission the MOXI project based on its low use by members. On May 31, 2018, the MOXI project was retired.

WRIPS: *WiscNet Regional Internet Peering Service*, is a network peering service. Shortly after 2000, WiscNet engineers began investigating the concept of *peering* – connecting directly with other networks of interest and bypassing expensive commodity internet providers such as ATT and Qwest. By eliminating the networks in the middle, performance also improves as networks talk directly to each other, thus providing the almost unheard-of combination of lower cost and better performance. In 2004, WiscNet signed a contract and installed equipment in the Chicago Equinix facility to begin their own peering efforts which showed early promise. Peering was bringing the expected cost savings in commodity internet avoidance, but the cost of maintaining the presence at the Equinix facility was substantial, which negated some of that advantage.

The OmniPoP efforts which began in 2006 provided a number of opportunities to share what WiscNet had started with a number of others in the upper Midwest. The installation of shared OmniPoP equipment joined those partner networks and brought an opportunity to share connections, including WiscNet's peering connections. A vital piece of the puzzle was the purchase of the Chicago fiber rings (the precursor to the creation of OmniPoP). Once equipment and fiber were in place, WiscNet was able to start adding interested OmniPoP partners and WRIPS was born.

Additional Strategic Accomplishments 2015-2020

In addition to the activities and accomplishments described above, OmniPoP achieved several other significant accomplishments in the past five years. These accomplishments are described below.

New budget model:

In FY19, OmniPoP implemented a new budget model which was developed by the Alliance with TAC and consultant Martin, Hood and Associates. The new budget model streamlined processes, significantly reduced the amount of effort required to administer business operations and increased the accuracy of the budget. In the first year of the new budget model, staff identified variances of approximately \$90K in previously unrecovered costs and \$22K in overcharges by vendors.

Hardware refresh capital & infrastructure planning:

Starting in FY18, the Big Ten Academic Alliance OmniPoP members began to build capital expense reserves for a network hardware refresh in FY21 projected to cost 1.8 million dollars. Annually, approximately \$525,000 was collected in FY18 through FY20, which created capital reserves of approximately \$1.4 million. Those reserves were sufficient to cover the updated estimated project cost of \$1.3 million in new hardware plus an

additional \$160,000 in port maintenance costs, which displaces current total maintenance costs, resulting in lower port maintenance fees. A competitive bid process was used to identify the hardware supplier. The PIER Group was the successful vendor with a total bid of \$998,749.07. The overall project cost was \$1,142,917 million, inclusive of services, power, additional equipment, and a port maintenance service agreement. The refresh was completed in early spring 2021.

Internet2 Next Generation Infrastructure planning:

After an extensive planning process, Internet2 announced its Next Generation Infrastructure Platform (NGI) and accompanying NGI Service Model. Upon the recommendation of its Technical Advisory Council (TAC), the OmniPoP Executive Board chose the Large Platform option (up to 2 x 400GE). With fees of 400K/YRC, the Large Platform will offer four times the capacity for the same price OmniPoP currently pays for 2 x 100 GE.

To benefit from the increased 400GE capacity OmniPoP will purchase equipment that is compatible with that infrastructure, specifically 400GE line cards. The 400G line card is likely to cost double the 100G line cards, approximately \$495,000. It is likely that OmniPoP would only need a single card initially. TAC anticipates that there will be a “pay as you go” model for the 400G card which would allow OmniPoP to pay for a lesser number of usable ports instead of activating all 24 ports at once.

In April 2020, the OmniPoP Executive Board approved continuation of an annual capital reserves call in FY21 and FY 22 for the equipment upgrades needed to utilize the increased 400G capabilities. Because of the lower-than-anticipated pricing obtained for the hardware refresh, some existing reserves will offset the costs for 400G line cards purchase.

Operational Improvements:

Over the past five years the TAC, in partnership with the Alliance headquarters and GlobalNOC, administered a number of process and operational improvements. These include the following:

- Improved port use tracking;
- Discontinued the birthright port entitlement;
- Increased engagement and management of relationship with CenturyLink (now Lumen).

PART IV: SUMMARY OF EVALUATION FEEDBACK

Goals for this five-year review, along with relevant stakeholders and evaluation mechanisms were identified at the outset of this review process. The goals included:

1. Evaluate OmniPoP functions, services & value
2. Assess the adequacy of the Alliance headquarters’ support of OmniPoP & TAC, including seeking input on business operations and evaluate opportunities for process improvements
3. Gather stakeholder input necessary to:
 - Report on activity and accomplishments for 2015-2020
 - Identify strategic goals and priorities for 2021-2026
 - Identify business and operational goals and priorities

TAC chairs and Alliance staff surveyed the TAC and key partners, as well as conducted interviews with selected partners. Common themes emerged from these consultations around the focal areas of: value of the network; accomplishments since 2015; and strategic goals and priorities for the next five years. These findings and themes were discussed with the Alliance CIOs, whose guidance was incorporated in this final report. The evaluation themes can be summarized in the following way:

1. The OmniPoP community enjoys a uniquely rich collaborative relationship providing access to deep subject matter expertise across the member and affiliate institutions, enabling networking solutions, joint initiatives and strategic leadership.
2. The network is a very valuable resource that contributes to the organizational missions

- of its members and regional and national partners.
3. Although the OmniPoP Network saves its members money, that is not the primary reason or benefit of participation. The responsiveness of the network and community is critically important and would be worth a premium.
 4. OmniPoP provides important service benefits, through peering opportunities and elective services, and is a critical enabler of collaboration and consultation across the member network and with regional and national partners.
 5. Important accomplishments since 2015 include securing the fiber lease extension, planning and preparing for the equipment refresh, and adopting a new budget model.
 6. Priorities and goals for 2021-2026 include implementing the equipment refresh; strategic leveraging of Internet2's Next Generation Infrastructure; sustaining and protecting the existing value of the network and OmniPoP community; and evaluating opportunities related to the national research networking landscape.

a. Technical Advisory Council (TAC)

TAC representatives from all but one OmniPoP member and all affiliate members completed an evaluation survey seeking feedback on the network. The survey asked respondents to identify significant strategic accomplishments of the past five years, strategic goals for the next five years, and feedback on the operation, business support, and value of the OmniPoP to their universities. The following summarizes the TAC survey results and full responses can be found [here](#).

Significant strategic accomplishments of past five years:

- IRU lease extension – 93%
- Building of capital reserves for hardware refresh – 80%
- New budget model – 67%
- DDOS mitigation software – 27%

Notably, 94% of TAC respondents indicated that they believed that OmniPoP did not miss any significant opportunities in the past five years.

When asked about the importance of the network to their institutional missions:

- 83% of TAC members responded that OmniPoP is very or somewhat important to the research mission;
- 76% responded that OmniPoP is very or somewhat important to the education mission; and
- 64% responded that OmniPoP is very or somewhat important to the engagement mission.

With respect to the most significant ways OmniPoP serves those missions, TAC members indicated that OmniPoP provides essential and cost-effective connectivity and peering. The following statements illustrate common themes in TAC members' survey responses, nicely summarizing the impact of OmniPoP expressed throughout the evaluation process both by TAC members as well as key partners:

"The OmniPoP provides a critical collaborative opportunity for a large number of R&E institutions throughout the upper Midwest. Through that collaborative power we can create connectivity solutions that would not be available to any of us individually. Regional peering, R&E network connectivity, shared commodity internet access, and DDOS mitigation strategies are some of the specific initiatives that provide direct value to our organization. The real power here is bringing the humans together to pursue joint initiatives but it would not be possible without the OmniPoP technical solutions around which we commune on a regular basis."

"The OmniPoP provides us with access to networks such as Internet2 and member peering that allows our researchers to collaborate with peers by sending large amounts of research data at

high speeds. Through the OmniPoP's colocation space offering, we are able host our own equipment which enhances our ability to provision additional private network circuits to support research (such as dedicated waves for the NCSA) and community engagement (our public media station, for example). Our ability to transit Internet traffic at the 100 Gbps scale and privately connect to Microsoft Azure through OmniPoP (Internet2 Cloud Connect) provides our faculty and staff with fast and highly available connectivity to learning applications hosted in the cloud."

"The OmniPoP approach to collaboration is not just valuable for networking solutions directly to our members, it is also a model that each of us can hold up proudly in national conversations where we have the opportunity to share our successes and be leaders in national strategy formulation. Being part of OmniPoP successes makes us better national and global contributors and brings positive attention back to our member institutions as a result. While collaboration is certainly a common theme across R&E communities, we have something special here that is not readily found elsewhere and we look forward to helping it thrive well into the future."

When asked if there are additional ways that OmniPoP could support or facilitate university missions, one TAC member identified the management of CIENA gear and purchase of CIENA parts or other DWDM gear more cheaply as additional benefits that could be pursued. The remaining TAC members responded that there are no additional ways that the network could support or facilitate university missions.

Big Ten Academic Alliance Headquarters Support:

- TAC Members reported being very satisfied with staff support of TAC (81%), equipment/services purchases (75%), annual budget process (73%), business interface with providers and contract negotiations (60%), invoices and billing (67%), overall support and service (80%).
- One TAC member reported a neutral satisfaction with the headquarters support of business interface with providers and contract negotiations.
- No TAC Members reported being anything other than somewhat or very satisfied with BTAA HQ support.

b. Key Partners

In addition to the TAC members, the following key partners were engaged as part of this evaluation process, either through surveys and/or interviews:

- GlobalNOC/Indiana University
- Internet2
- Big Ten Network (BTN)
- Great Plains Network (GPN)
- Lumen (previously CenturyLink)
- WiscNet
- Northwestern University and the Metropolitan Research and Education Network (MREN)
- Michigan Education Research Information Triad (MERIT)

Value of Relationship with OmniPoP:

All but one of the regional and national partners interviewed reported a very high level of satisfaction with their partnership with OmniPoP and its member universities, each identifying specific benefits to their organizations. Merit was the one partner that reported a neutral value of the OmniPoP network to its organization. Recurring comments from OmniPoP's partners noted the highly respected technical and strategic expertise within the OmniPoP community and the importance of being a part of this collaborative community. The following excerpts are examples of this feedback:

As network owner I-Light, Gigapop – services from OmniPoP are critical to servicing the higher education needs of those networks. Access to other providers/connectivity; caching, peering, all those things are critical to them that they get through OmniPoP. (GigaPoP/I-Light)

OmniPoP provides connectivity to vital networks that come together in Chicago, and just as importantly, connects us to each other to enable top quality collaborative initiatives. (WiscNet)

OmniPoP is continually a model of successful collaboration we hold up for comparison when new collaborative efforts are being considered. Particularly when talking with national groups, we use OmniPoP to show what can be done when good folks come together. It's surprising at times how uncommon these models are. (WiscNet)

OmniPoP has been a critical enabler of Internet2's collaboration with its member universities. OmniPoP's team has been critical in helping member universities leverage research, cloud and educational tools. We appreciate the close and cordial working relationship with the OmniPoP. We value both formal interactions at OmniPoP technical and CIO meetings and informal interactions with OmniPoP staff and community members. (Internet2)

As a resource, it is extremely beneficial to the networkOmniPoP cut costs and allows BTN to produce more events..... Last April, BTN won a technical Emmy – couldn't do it without the OmniPoP Network. (Big Ten Network)

Strategic Accomplishments & Goals

There was a general consensus among OmniPoP's key partners that the most important accomplishments of the past five years were:

1. Fiber renewal
2. Hardware refresh capital and strategic planning

OmniPoP's partners also identified the accomplishments of the network's expanding service portfolio (e.g., Cloud Connect, DDOS) and collaborative efforts to provide services across the network (e.g., Telia from WiscNet).

Part V: Investment and Estimated Average Savings FY2016-20

Cost and Estimated Average Savings Information for 2015-2020				
Fiscal Year	Total Investment	Average Investment per Member	Total Savings	Average Savings per Member
2015-16	\$1,614, 519	\$106,892	\$8,003,700	\$533,580
2016-17	\$1,649,310	\$108,903	\$8,003,700	\$533,580
2017-18	\$1,769.259	\$116,885	\$8,840,000	\$631,428
2018-19	\$2,024,710	\$134,981	\$9,050,104	\$646,436

PART VI: SUMMARY OF FY 2021-2026 STRATEGIC PRIORITIES

Priority #1: Steward and Protect the OmniPoP Collaborative Community

Often accompanying the expression of the high value of the OmniPoP Network was a recognition of its unique collaborative community and longevity. Key to the success of OmniPoP is maintaining its strong

community participation and trusted peer network. Careful stewardship and protection of these valuable assets is a top and foundational priority for the network.

Priority #2: Complete OmniPoP Network Hardware Refresh

Completion of the hardware refresh by end of FY2021 is a top priority for the network. This work includes upgrading to MX10008s, discontinuing 10G ports and transition services to new or existing 100G ports. The equipment for this refresh has been purchased and testing has been completed. Installation was completed in early spring 2021.

Priority #3: Implement and strategically leverage the Internet2's Next Generation Infrastructure (NGI)

Internet2 has indicated that the Next Generation Infrastructure will be completed in late 2021. OmniPoP has chosen the Large Platform option, which offers up to 2 x 400GE. The new model represents a quadrupling of the capacity for the same price. OmniPoP will have flexibility to use 800G of connectivity. To benefit from this increased capacity, OmniPoP will need to purchase equipment that is compatible with that infrastructure. TAC has begun to evaluate and plan for those future equipment costs. Internet2's NGI provides the opportunity for OmniPoP members to have expanded connectivity, cloud access and software/automation/telemetry.

Priority #4: Update business and operations documents

As noted previously, the OmniPoP Board voted to eliminate the birthright policy and the equipment refresh will discontinue the use of 10G ports. These operational changes need to be reflected in the network's official business documents, such as the governing Memorandum of Agreement, budget records, and other documentation. Accordingly, in consultation with the TAC, the Alliance headquarters will conduct a thorough review of the Network's business records to make these updates and any other necessary amendments. Proposed amendments will be reviewed by TAC and ultimately submitted to the Board for its consideration and decision making. Similarly, the OmniPoP description used for grant proposals will be updated to reflect the network's current capabilities and services and shared with the Alliance senior research officers.

Priority #5: Increase TAC's and the Alliance staff's interactions with key partners

Along with the recurring theme of the high-value and satisfaction of their partnership with OmniPoP, many of Network's regional network providers and partners indicated that they would find value in more regular interactions with the Alliance staff and TAC. Prior to this review, TAC and Alliance staff began to hold quarterly meetings with Lumen. As a part of this review, communication with the Great Plains Network has increased and strategic conversations are ongoing. Quarterly or bi-annual meetings will be established with the Big Ten Network, GlobalNOC and Internet2, as well as other partners as needed.

Priority #6: Explore expanded services and other opportunities

Several of OmniPoP's key partners identified strategic priorities for the next five-year period that are relevant to their organization's interaction and relationship with the network. Many of those priorities involved the exploration of additional services that the network might offer members and affiliates. These include:

- Explore services such as expanded connectivity, cloud access, automation, and telemetry;
- Work with the Big Ten Network as they evaluate adding redundancy for members and affiliates' connections to the BTN;
- Engage with GlobalNOC to evaluate product and services such as OESF software, automation, data analytics, dashboards and other services; and
- Continue exploration of mutual benefits and strategic collaborative opportunities for OmniPoP

and GPN.

PART VII: CONCLUSION

What began as a collective purchase of fiber in Chicago in 2004 has grown to become much more than shared network infrastructure. Now in its fifteenth year, OmniPoP is lauded by its members and its regional and national partners as a unique community – both a physical network and a dynamic information technology collaborative – that provides an incredible high degree of responsiveness, value and leading network expertise. The value of the OmniPoP collaborative extends beyond the Big Ten Academic Alliance universities through the service and leadership of TAC members and CIOs within the national information technology community. As one CIO summarized OmniPoP’s value, the responsiveness of the network and collaborative community would be worth a premium price and yet it also saves its members money. Through this evaluation, the OmniPoP community has identified new opportunities to explore to preserve and deepen the value and impact of this collaboration in the next five years. The Alliance staff and TAC chairs are grateful for all those participated and contributed to this evaluation.