The Quilt

OpenFlow Enabled Network Switch Equipment

Request for Proposals

May 2012

ALL MATERIALS SUBMITTED AS CONFIDENTIAL BY THE PROVIDER WILL BE KEPT CONFIDENTIAL WITHIN THE QUILT.

Table of Contents

I.   Introduction: What is The Quilt?

The Quilt, Inc. (The Quilt) is a collaboration of advanced regional network organizations. It is a dynamic forum where leaders from throughout the advanced research and education network community build on the intellectual capital and best practices of network service providers worldwide. Based on the participants' combined experiences in operations and development of leading edge technologies, The Quilt aims to influence the national agenda on information technology infrastructure, with particular emphasis on networking. Through this coalition, The Quilt promotes delivery of networking services at lower cost, higher performance, greater reliability, and heightened security. The Quilt derives support and funding solely from its participants. It also relies on significant volunteer contributions from its participants to support the organization and its priorities.

The Quilt plays a respected and trusted role within the networking and broader information technology communities. It maintains this role by engaging providers, federal agencies, and its participants in diverse projects and interest groups.

As of March 2012, The Quilt participant base includes 29 regional non-profit network aggregators within the United States. For a full listing and description of each of the current Quilt participants, please see http://www.thequilt.net/index.php/about-us/the-quilt-participants.

The Quilt represents a well-defined group of advanced networking organizations that serve leading U.S. higher education institutions and other research and education entities. These institutions both create and utilize cutting-edge technology and applications which increase the

2

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need for additional bandwidth capacity for these institutions. Quilt members, along with the institutions they serve comprise our "Authorized Quilt Buyers".

There is a well-defined track record of success for companies who have created meaningful partnerships with this leading-edge networking community. Quilt organizations and the institutions they connect are consistently early adopters of new technologies, including but not limited to network technologies and ways of implementing them. The Quilt also leads the curve in finding new ways to organize networks to multi-organizational benefit. Our unsurpassed level of expertise in the customer community has been a valuable resource to our industry partners.

Many Authorized Quilt Buyers ("AQB") are required to purchase their services through a competitive RFP process. By leveraging The Quilt's RFP process, many AQBs are able to omit their own RFP processes, which can relieve providers from generating individual RFP responses for each of our members and institutions. An example of the Authorized Quilt Buyers list is provided in Appendix 1 of this RFP document.

II.   Goals of the 2012 OpenFlow Switch RFP

One of the missions of the research and education community is to engage with its many partners, including industry, to design, develop and support experimental, leading edge technologies in order to drive advancements in academic networking and research.   The goals of this RFP effort are to:

- define a preferred set of configurations for OpenFlow enabled equipment for the research and education community

- provide a sensible set of switch options for Regional and campus networks to purchase OpenFlow enabled equipment

- promote and enable software -defined networking capabilities to scale to more regional and campus networks by leveraging our community's collective experience and interest in software-defined networking

- identify and partner with equipment providers who are creating a new development platform around the ideas of OpenFlow

III.   Preparing and Submitting a Response

All interested providers must submit a non-binding Letter of Intent to respond to the RFP no later than **Friday, May 18, 2012.** RFP questions and responses will only be accepted from providers that have submitted a Letter of Intent. The Letter of Intent should be sent

3

electronically and addressed to Jen Leasure at jen@thequilt.net and include the following information:

- A statement that your company is planning to submit a response to the RFP
- The lead person's name, title and contact information along with signature

Responses must contain all information that the Responder wishes to be taken into account in evaluating their submission. The information must be responsive to all requested criteria listed in this RFP. The text of the RFP response must be provided electronically in PDF format and delivered electronically (email) to:

Jen Leasure
President
The Quilt
2442 NW Market Street #68
Seattle, Washington 98107
jen@thequilt.net

No later than 5:00 PM eastern daylight time on Friday, June 8, 2012. Responses received after that will not be considered.

For questions and requests for clarifications and/or additional information regarding this call for information, please contact the above at:
Phone: 206.782.1091
Email: jen@thequilt.net

IV.   Response Selection and Award Process

a.   Preliminary Evaluation

The responses will first be reviewed to determine if mandatory requirements are met. Failure to meet mandatory requirements may result in the response being rejected.

b.   Response Evaluation

An evaluation committee will be comprised of Quilt member organization engineering staff with extensive experience operating and managing advanced networks as well as extensive experience with OpenFlow. The committee may review and contact references, request oral presentations, or conduct an onsite visit and use the results in rating the responses.

4

For the purposes of evaluation, "costs" will refer to the complete life cycle cost of the equipment and services required to fulfill all mandatory requirements. Separable costs associated with "desirable" or "optional" functionality will not be included in the calculation. However, these costs, and the availability of this functionality, may be taken into consideration in developing an overall evaluation of a response. The contract award, if made, will be made on the basis of the best cost/benefit value ratio as determined by The Quilt and as informed by the evaluation committee. The decision of The Quilt to make an award to one bidder or to make no award at all is final. Bidders may not contest the award.

C. Right to reject responses and negotiate contract terms

Through this RFP mechanism, The Quilt is interested in understanding the features of current OpenFlow-enabled switches from switch vendors. Responses must address the following general criteria:

- Responsible and responsive information that meets or exceeds specifications in all sections of this RFQ document, including submission of data requested;

- Ability to deliver services in the time period requested;

- Demonstrated ability to provide responsive, flexible, and reliable services;

- Demonstrated experience in providing same or similar services;

- Demonstrated technical expertise in the particular areas required by The Quilt; and

- Positive feedback from references

The evaluation of the responses and names of other bidders will not be made available to bidders at any time, whether before or after award, if any.

Notwithstanding any other provision of this RFP, the review committee expressly reserves the right to:

- Conduct discussions with any or all Bidders for the purpose of clarification of proposals;

- Accept, reject, or negotiate any or all proposals or the terms of any proposal, or any parts thereof, for the purpose of obtaining the best and final offer;

- Cancel or amend this RFP or issue other Requests for Proposals;

- Select a Bidder or Bidders based on the review team's analysis and evaluation of proposals submitted. The review team reserves the right to request presentations of proposals if the participating organizations feel further information is appropriate to the decision-making process.

5

- Select no proposals at all.

- Select multiple proposals.

- Cancel an award if a Bidder fails to negotiate in good faith and execute definitive written documents necessary to effectuate the transactions contemplated hereby in a manner consistent with the project's timeline.

Should The Quilt select a respondent to enter into a contract with, the respondent will be required to sign a Master Service Agreement with The Quilt. The primary function of this agreement is to codify the pricing the provider will extend to the Authorized Quilt Buyer. A current list of Authorized Quilt Buyers for equipment is located in Appendix 1. This agreement will be used as the basis for contract development after an award is made. The agreement does not need to be submitted with a proposal.

The switch equipment purchased from and delivered to an AQB will be established by a service contract **directly between the switch provider and each AQB**. The Quilt is neither involved in this process nor is it a signatory to the service contract. We expect the switch provider to have a standard agreement that will be the focal point of contractual negotiations between the provider and an AQB. This agreement will be based simply on the provider standard contract with the inclusion of The Quilt-based pricing outlined in the agreement between The Quilt and the provider.

d. Response to the RFP Specifications

The Responder shall explain in sufficient detail how their equipment and services meet the requirements and specifications stated in this RFQ. All sections of this RFQ should be addressed, whether such services are offered or not.

e. General Instructions on Preparing Costs

All costs for the proposed solution must be included, with the exception of shipping and handling unless these charges are expected to exceed $1000 USD. Pricing should be broken out in a base cost that meets the basic requirements and then a supplemental cost to meet the additional requirements listed for campus core, campus edge and regional core. All costs are expected to be valid from 120 days from the due date of the responses.

V.   Basic Requirements for OpenFlow Switch Hardware

Please describe how the products and that are represented in the RFP response support the OpenFlow protocol specification as maintained and published by the Open Networking Foundation - https://www.opennetworking.org/. Overall, a thoughtful response will indicate

6

how the products included as part of the response support OpenFlow today, as well as what support can be anticipated in future updates.

1. **Switch characteristics**

    a. Should be able to support at least one of the following four platforms. Please describe all port configuration options per platform and associated costs per configuration. If you are able to support more than 1 platform, please respond to the following criteria for each platform being bid.

        a1. Multiple <1Gbps, 1Gbps and 10Gbps ports (no minimums)

        a2. Multiple 1Gbps and 10Gbps ports (minimum 4 10Gbps ports)

        a3. Multiple 10Gbps and 40Gbps ports (minimum 4 10Gbps ports)

        a4. Multiple 10Gbps and 100Gbps ports (minimum 4 10Gbps ports)

    b. Interfaces must make use of pluggable optics and should NOT disable the use of third-party pluggable optics.

    c. Power Requirements (Note: low draw power consumption switches preferred).

        c1. Should support 120-240V AC power supplies

        c2. Should support -48V DC power supply. Note that AC-only switches will require additional detail on options to support DC requirements.

        c3. Should have an option for redundant power supplies

        c4. Should have hot swappable power supplies

    d. Should be rack-mountable in standard 19" racks. Please list other options for mounting if available.

    e. Describe RU options for switches.

    f. Target at least 1GB of shared packet buffers. If the switch does not support at least 1 GB of shared packet buffers, provide more detail on what level of shared packet buffers is available.

2. **OpenFlow**

    a. Do you have written documentation for your OpenFlow implementation? If so, can it be provided either publicly or confidentially, as part of the RFP? If not, when do

7

you expect to be able to provide it? Written documentation could include, release timelines, internal processes, executive support, etc...

b. OF 1.2 and future versions

    b1. Must have firmware support for OpenFlow spec 1.0 with all required actions and functions implemented.

    b2. Please provide a date for when you expect to receive internal approval to move forward with implementation of OpenFlow 1.2. If you can't provide a date, please describe the process that you will be following to decide on support for OF 1.2 and future versions.

    b3. If you have implemented any proprietary or non-standard extensions to the OpenFlow protocol, please describe them.

c. Indicate if the cost of updates related to OpenFlow is included in the quoted prices.

3. OpenFlow Rules

a. Support for at least 3000 wildcard flows is preferable but not required. Please describe any switch options that meet the other criteria of this RFP but have a lower wildcard flow limit. Please specify actual table sizes.

b. Must support wildcard flow entries in hardware

    b1. Must support IP src/dest and MAC address wildcard match rules in hardware

    b2. Should support Hardware wildcard matches on all OpenFlow tuples

c. Should support OFP_LOCAL rules to allow traffic to be received by the local device

d. Should Support NORMAL action to forward packets

e. Should support Enqueue action to forward through a queue

    e1. A mechanism to configure the queues must be made available to the software

f. Should support rewrite of fields in hardware

4. OpenFlow Integration Characteristics

This set of requirements is aimed at understanding the integration of OpenFlow with other features of conventional switches.

8

a. Should support non-OpenFlow traffic separated from the OpenFlow traffic. Note that separation could take the form of different vlans

b. Must support the assignment of IEEE 802.1Q tags to routed sub-interfaces.

c. Must support jumbo frames of at least 9000 bytes – should also be an OpenFlow characteristic

d. Please describe any implementation limitations such as number and types of rules that are in the fastpath vs. software switched

e. Must support QoS

    a. 802.1p CoS

    b. DiffServe QoS (RFC2998)

    c. Ingress and Egress rate limits

f. Must support 802.1D Spanning Tree for non OpenFlow traffic

g. Should support 802.1D Spanning Tree for OpenFlow traffic

5. **Security**

a. Must support Access control lists for traffic to and from the switch CPU (CLI, SNMP, OpenFlow, etc.)

b. Must support RADIUS authentication for CLI access

c. Should support "secure channel" (TLS) communication between switch and controller. If not currently supported, please provide roadmap for supporting this feature.

6. **Support**

a. Must have OpenFlow Firmware with production level technical support, similar to non-OpenFlow support

b. Must have options for hardware replacement and field technical support

7. **General Measurement and Monitoring**

a. Must support OpenFlow statistics messages

9

b. Must support SNMP monitoring

    b1. Must Support SNMP v2

    b2. Should support SNMP v3

    b3. Must support the standard IF-MIB

    b4. Should support per-VLAN, per-interface interface statistics

c. Must support remote management and firmware upgrades

8. Interoperability

a. Briefly describe your efforts to verify interoperability with other vendors supporting OpenFlow. What methods have you used to validate interoperability by utilizing a third party interop testing group such as the InCNTRE interop lab?

b. Please provide results of interoperability tests and the status of OpenFlow certification as applicable.

VI. Response Requirements

1. Proposals should be organized in the same sequence as this RFP with responses referencing the appropriate corresponding RFP item(s). Bidders should respond to each item at the level of detail at which each is presented or list a variance with a particular item and propose alternate terms, and as applicable, supply any supportive detail. Responses not conforming to the proper format or failure to respond to any and all items in this RFP may result in a Bidder's disqualification and/or rejection of the proposal, at the discretion of the OpenFlow Enabled Network Switch Review Committee.

   Cover Letter - The Bidder should indicate its interest in the project and highlight the key points of its proposal. Contact information for the Bidder's representative including name, title, phone number, and email must be included. The cover letter should be an executive summary, no more than two (2) pages.

   The Bidder should include company history, number of key employees by discipline, company locations, location of office(s) where this project will be managed, length of time its company has provided similar services and/or materials, and other relevant information.

2. Where the Bidder is requested to supply information, include that information in the body of the proposal, or reference that it is an attachment.

10

3. Proposals must be submitted in electronic format sent via email attachments to jen@thequilt.net. Please include contact information for a representative of your company who is authorized and able to address any questions about your proposal. Include the contact's name, title, phone number and email address.

4. Proposals will be evaluated on the assumption that the proposed prices are a Bidder's most favorable terms.

5. Any information released either verbally or in writing prior to the issuance of this RFP shall be deemed preliminary and not binding upon the participating organizations in any manner.

6. Anticipated Timeline

   The following timetable outlines the anticipated schedule for the RFP, the purchase process and the contract process. The timing and the sequence of events resulting from this RFP may vary.

   a. Distribute RFP – Week of May 7, 2012
   b. Non-binding Letter of Intent to respond to the RFP due - Monday, May 21, 2012
   c. Responses due - Friday, June 8, 2012
   d. Announcements –July 20, 2012
   e. OpenFlow Switch Master Services Agreement Signed – August 31, 2012
   f. OpenFlow Switch AQP Now Authorized to Sell Under Quilt Pricing Agreement-–August 31, 2012

11

Appendix 1. Authorized Quilt Buyers List for Equipment as of May 9, 2012

Code	Quilt Participant	Organization (Educational)
1.01	3ROX	Carnegie Mellon University
1.02	3ROX	Pennsylvania State University
1.03	3ROX	University of Pittsburgh
1.04	3ROX	West Virginia University
2.00	ABQG	Albuquerque GigaPoP
2.01	ABQG	University of New Mexico
3.00	CEN	Connecticut Education Network
4.00	CENIC	California Institute of Technology
4.01	CENIC	California Maritime Academy
4.02	CENIC	California Polytechnic State University, San Luis Obispo
4.03	CENIC	California State Polytechnic University, Pomona
4.04	CENIC	California State University, Hayward
4.05	CENIC	California State University, San Bernardino
4.06	CENIC	Chancellor's Office/Long Beach
4.07	CENIC	Chancellor's Office/WestEd
4.08	CENIC	CSU Bakersfield
4.09	CENIC	CSU Channel Islands
4.10	CENIC	CSU Chico
4.11	CENIC	CSU Dominguez Hills
4.12	CENIC	CSU Fresno
4.13	CENIC	CSU Fullerton
4.14	CENIC	CSU Long Beach
4.15	CENIC	CSU Los Angeles
4.16	CENIC	CSU Monterey Bay
4.17	CENIC	CSU Northridge
4.18	CENIC	CSU Sacramento
4.19	CENIC	CSU San Marcos
4.20	CENIC	CSU Stanislaus
4.21	CENIC	Humboldt State University
4.22	CENIC	San Diego State University
4.23	CENIC	San Francisco State University
4.24	CENIC	San Jose State University
4.25	CENIC	Sonoma State University
4.26	CENIC	Stanford University
4.27	CENIC	University of California Davis
4.28	CENIC	University of California Irvine
4.29	CENIC	University of California Los Angeles
4.30	CENIC	University of California Office of the President
4.31	CENIC	University of California Riverside
4.32	CENIC	University of California San Francisco
4.33	CENIC	University of California Santa Barbara
4.34	CENIC	University of California Santa Cruz

4.35	CENIC	University of California, Berkeley
4.36	CENIC	University of Nevada, Las Vegas
4.37	CENIC	University of Nevada, Reno
4.38	CENIC	University of Southern California
5.00	FLR	Florida International University
5.01	FLR	Florida LambdaRail
5.02	FLR	University of Miami
5.03	FLR	Florida Atlantic University
5.04	FLR	Florida Gulf Coast University
5.05	FLR	Florida Institute of Technology
5.06	FLR	Florida State University
5.07	FLR	Nova Southeastern University
5.08	FLR	University of Central Florida
5.09	FLR	University of Florida
5.10	FLR	University of North Florida
5.11	FLR	University of South Florida
5.12	FLR	University of West Florida
6.00	Front Range	Adams Twelve Five Star Schools
6.01	Front Range	Adams County School District 14
6.02	Front Range	Ault-Highlands School District
6.03	Front Range	Aurora Public Schools
6.04	Front Range	ARTstor
6.05	Front Range	Auraria Higher Education Center
6.06	Front Range	Boulder County
6.07	Front Range	Boulder Regional Emergency Telephone Service Authority (BRETSA)
6.08	Front Range	Boulder Valley School District (BVSD)
6.09	Front Range	City of Boulder
6.10	Front Range	Briggsdale School District
6.11	Front Range	Brighton School District 27J
6.12	Front Range	City and County of Denver
6.13	Front Range	City of Fort Collins
6.14	Front Range	City of Longmont
6.15	Front Range	City of Loveland
6.16	Front Range	Centennial Board of Cooperative Educational Services
6.17	Front Range	Cherry Creek Schools
6.18	Front Range	Colorado Association of Research Libraries
6.19	Front Range	Clear Creek School District
6.20	Front Range	Colorado Community College System
6.21	Front Range	Colorado Department of Higher Education
6.22	Front Range	Colorado Mountain College
6.23	Front Range	Colorado School of Mines
6.24	Front Range	Colorado Telehealth Network
6.25	Front Range	Colorado State University System
6.26	Front Range	Community College of Denver
6.27	Front Range	Denver Health
6.28	Front Range	Denver Museum of Nature and Science

13

6.29	Front Range	Denver Open Media
6.30	Front Range	Douglas County School District
6.31	Front Range	EAGLE-Net Alliance
6.32	Front Range	East Central Board of Cooperative Education Services
6.33	Front Range	Fountain-Fort Carson School District 8
6.34	Front Range	Fort Lewis College
6.35	Front Range	Elbert County School District Elizabeth C-1
6.36	Front Range	Front Range Community College
6.37	Front Range	Harrison School District
6.38	Front Range	Larimer County
6.39	Front Range	Liberty Common Schools
6.40	Front Range	Metropolitan State College of Denver
6.41	Front Range	National Oceanic and Atmospheric Administration Boulder
6.42	Front Range	Park School District (Estes Park)
6.43	Front Range	Platte Valley Schools
6.44	Front Range	Prairie School District
6.45	Front Range	State of Colorado
6.46	Front Range	Platte River Power Authority
6.47	Front Range	Poudre School District
6.48	Front Range	Ridgeview School
6.49	Front Range	Science and Technology in Atmospheric Research (STAR) Institute
6.50	Front Range	St. Mary's Academy
6.51	Front Range	St Vrain Valley School District
6.52	Front Range	Thompson School District
6.53	Front Range	United States Antarctic Program
6.54	Front Range	University NAVSTAR Consortium (UNAVCO)
6.55	Front Range	University Corporation for Atmospheric Research
6.56	Front Range	University of Colorado Boulder
6.57	Front Range	University of Colorado Colorado Springs
6.58	Front Range	University of Colorado Denver
6.59	Front Range	University of Colorado Hospital
6.60	Front Range	University of Denver
6.61	Front Range	University Information Systems
6.62	Front Range	University of Northern Colorado
6.63	Front Range	University of Wyoming
6.64	Front Range	Weld County School District RE-1 (Gilcrest)
6.65	Front Range	Weld County School District RE-3J (Keenesburg)
7.00	Great Plains Network	Kansas State University
7.01	Great Plains Network	South Dakota Board of Regents
7.02	Great Plains Network	South Dakota School of Mines and Technology
7.03	Great Plains Network	University of Arkansas Medical Sciences
7.04	Great Plains Network	University of Arkansas, Fayetteville
7.05	Great Plains Network	University of Arkansas, Little Rock
7.06	Great Plains Network	University of Kansas
7.07	Great Plains Network	University of Kansas, Center for Research
7.08	Great Plains Network	University of Missouri - Columbia
7.09	Great Plains Network	University of Missouri - Kansas City

7.10	Great Plains Network	University of Missouri – Rolla
7.11	Great Plains Network	University of Missouri - St Louis
7.12	Great Plains Network	University of Nebraska-Lincoln
7.13	Great Plains Network	Wichita State University
8.00	Indiana GigaPoP	Indiana Univ
8.01	Indiana GigaPoP	Indiana University
8.02	Indiana GigaPoP	Purdue University
8.03	Indiana GigaPoP	Washington University in St. Louis
9.00	KanREN	Kansas Research and Education Network
9.01	KanREN	Univ of Kansas
9.02	KanREN	Kansas State University
9.03	KanREN	Wichita State University
9.04	KanREN	Emporia State University
9.05	KanREN	Fort Hays State University
9.06	KanREN	Pittsburg State University
9.07	KanREN	University of Kansas Medical Center
9.08	KanREN	Johnson County Community College
9.09	KanREN	Washburn University
9.10	KanREN	Baker University
9.11	KanREN	Central Christian College
9.12	KanREN	Hesston College
9.13	KanREN	Barton County Community College
9.14	KanREN	Colby Community College
9.15	KanREN	Fort Scott Community College
9.16	KanREN	Garden City Community College
9.17	KanREN	Highland Community College
9.18	KanREN	Baldwin City USD 348
9.19	KanREN	Burlingame USD 454
9.20	KanREN	Central Heights USD 288
9.21	KanREN	Chapman USD 473
9.22	KanREN	Doniphan West USD 111
9.23	KanREN	Fredonia USD 484
9.24	KanREN	Frontenac USD 249
9.25	KanREN	Great Bend USD 428
9.26	KanREN	Kansas School for the Deaf
9.27	KanREN	Kansas State School for the Blind
9.28	KanREN	Kaw Valley USD 321
9.29	KanREN	Mission Valley USD 330
9.30	KanREN	Pittsburg USD 250
9.31	KanREN	Riverside USD 114 (Formerly Wathena & Elwood USD)
9.32	KanREN	Silverlake USD 372
9.33	KanREN	Troy USD 429
9.34	KanREN	Wellsville USD 289
9.35	KanREN	West Franklin USD 287
9.36	KanREN	State Library of Kansas
9.37	KanREN	Associated Colleges of Central Kansas
9.38	KanREN	Kansas Law Enforcement Training Center (KLETC)

9.39	KanREN	Mount Saint Scholastica
9.40	KanREN	University of Kansas Endowment Association
10.00	KyRON	Eastern Kentucky University
10.01	KyRON	Kentucky Community and Technical College System
10.02	KyRON	Kentucky State University
10.03	KyRON	Northern Kentucky University
10.04	KyRON	University of Kentucky
10.05	KyRON	Western Kentucky University
11.00	LEARN	Baylor College of Medicine
11.01	LEARN	Rice University
11.02	LEARN	Stephen F. Austin
11.03	LEARN	Texas A&M University
11.04	LEARN	Texas Tech University
11.05	LEARN	University of Houston
11.06	LEARN	University of Texas at Austin
12.00	LONI	Louisiana Optical Network Initiative
13.00	MAX	Catholic University of America
13.01	MAX	Gallaudet University
13.02	MAX	George Washington University
13.03	MAX	Georgetown University
13.04	MAX	Johns Hopkins University
13.05	MAX	Morgan State University
13.06	MAX	University of California, D.C.
13.07	MAX	University of California, ISI/East
13.08	MAX	University of Illinois, ACCESS
13.09	MAX	University of Maryland
13.10	MAX	University of Maryland, Baltimore
13.11	MAX	University of Maryland, Baltimore County
13.12	MAX	University of Maryland, College Park
13.13	MAX	University of Southern California, ISI--East
13.14	MAX	University System of Maryland
13.15	MAX	Washington Research Library Consortium
14.00	MCNC	Appalachian State University
14.01	MCNC	Barton College
14.02	MCNC	Bennett College
14.03	MCNC	Campbell University
14.04	MCNC	Catawba College
14.05	MCNC	Chowan College
14.06	MCNC	Davidson College
14.07	MCNC	Duke Marine Laboratory
14.08	MCNC	Duke University
14.09	MCNC	East Carolina University
14.10	MCNC	ECU Brody School of Medicine
14.11	MCNC	Elizabeth City State University

14.12	MCNC	Elon University
14.13	MCNC	Fayetteville State University
14.14	MCNC	Gardner-Webb University
14.15	MCNC	Greensboro College
14.16	MCNC	Guilford College
14.17	MCNC	High Point University
14.18	MCNC	Johnson & Wales University - Charlotte Campus
14.19	MCNC	Johnson C. Smith University
14.20	MCNC	Lenoir-Rhyne University
14.21	MCNC	Louisburg College
14.22	MCNC	Meredith College
14.23	MCNC	NC Agricultural & Technical State University
14.24	MCNC	NC Central University
14.25	MCNC	NC School of the Arts
14.26	MCNC	NC State University
14.27	MCNC	NCSU Cooperative Extension Services: Plymouth & Fletcher Locations
14.28	MCNC	North Carolina Independent Colleges and Universities
14.29	MCNC	Peace College
14.30	MCNC	Queens College
14.31	MCNC	Shaw University
14.32	MCNC	St. Augustine's College
14.33	MCNC	UNC-Asheville
14.34	MCNC	UNC-Chapel Hill
14.35	MCNC	UNC-Charlotte
14.36	MCNC	UNC-General Administration
14.37	MCNC	UNC-Greensboro
14.38	MCNC	UNC-Pembroke
14.39	MCNC	UNC-Wilmington
14.40	MCNC	University of North Carolina General Administration (UNC-GA)
14.41	MCNC	Wake Forest University
14.42	MCNC	Western Carolina University
14.43	MCNC	Wingate University
14.44	MCNC	Winston-Salem State University
15.00	Merit	Michigan State University
15.01	Merit	Michigan Tech University
15.02	Merit	University of Michigan
15.03	Merit	Wayne State University
15.04	Merit	Western Michigan University
16.00	MOREnet	Missouri Research and Education Network
16.01	MOREnet	Missouri University of Science and Technology
17.00	MREN	Bradley University
17.01	MREN	DePaul University
17.02	MREN	Iowa State University
17.03	MREN	Northwestern University

17.04	MREN	University of Chicago
17.05	MREN	University of Illinois-Chicago
17.06	MREN	University of Illinois-Urbana
17.07	MREN	University of Iowa
17.08	MREN	University of Notre Dame
17.09	MREN	University of Wisconsin- Madison
17.10	MREN	Columbia College
17.11	MREN	Illinois Century Network
17.12	MREN	Illinois Rural Health Network
17.13	MREN	Loyola University of Chicago
17.14	MREN	National Center for Supercomputing Applications
17.15	MREN	Northern Illinois University
17.16	MREN	Illinois State University
17.17	MREN	Southern Illinois University
18.00	Network.Virginia	George Mason University
18.01	Network.Virginia	William & Mary, College of
18.02	Network.Virginia	Hampton University
18.03	Network.Virginia	Institute of Advanced Learning and Research (Longwood University)
18.04	Network.Virginia	James Madison University
18.05	Network.Virginia	Thomas Jefferson High School for Science and Technology
18.06	Network.Virginia	Norfolk State University
18.07	Network.Virginia	Old Dominion University
18.08	Network.Virginia	University of Richmond
18.09	Network.Virginia	University of Virginia
18.10	Network.Virginia	Virginia Bioinformatics Institute (Virginia Tech)
18.11	Network.Virginia	Virginia Commonwealth University
18.12	Network.Virginia	Virginia Institute of Marine Science
18.13	Network.Virginia	Virginia Internet2 Studio (Virginia Tech)
18.14	Network.Virginia	Virginia Tech
18.15	Network.Virginia	VT Applied Research Corporation (Virginia Tech)
18.16	Network.Virginia	Radford University
18.17	Network.Virginia	Mid-Atlantic Research Infrastructure Alliance
18.18	Network.Virginia	Virginia Community College System
19.00	Northern Lights GigaPoP	Univ of Minnesota
19.01	Northern Lights GigaPoP	North Dakota State University
19.02	Northern Lights GigaPoP	South Dakota State University
19.03	Northern Lights GigaPoP	University of North Dakota
19.04	Northern Lights GigaPoP	University of South Dakota
19.05	Northern Lights GigaPoP	South Dakota School of Mines
20.00	NoX	Boston College
20.01	NoX	Boston Univ
20.02	NoX	Boston University
20.03	NoX	Brandeis University
20.04	NoX	Brown University
20.05	NoX	Dartmouth College

20.06	NoX	Harvard University
20.07	NoX	Massachusetts Institute of Technology
20.08	NoX	Northeastern University
20.09	NoX	Tufts University
20.10	NoX	University of Connecticut
20.11	NoX	University of Maine
20.12	NoX	University of Massachusetts-Amherst
20.13	NoX	University of New Hampshire
20.14	NoX	University of Rhode Island
20.15	NoX	University of Vermont
20.16	NoX	Woods Hole Oceanographic Institution (WHOI)
20.17	NoX	Yale University
21.00	NYSERNet	Binghamton University, SUNY
21.01	NYSERNet	Columbia University
21.02	NYSERNet	Cornell University
21.03	NYSERNet	New York University
21.04	NYSERNet	Rensselaer Polytechnic Institute
21.05	NYSERNet	Rochester Institute of Technology
21.06	NYSERNet	Stony Brook University
21.07	NYSERNet	Syracuse University
21.08	NYSERNet	University at Albany, SUNY
21.09	NYSERNet	University at Buffalo, SUNY
21.10	NYSERNet	University of Rochester
22.00	OARnet	Air Force Institute of Technology
22.01	OARnet	Antioch College/Antioch University
22.02	OARnet	Ashland University
22.03	OARnet	Baldwin-Wallace College
22.04	OARnet	Belmont Technical College
22.05	OARnet	Blufton College
22.06	OARnet	Bowling Green State University
22.07	OARnet	Capital University
22.08	OARnet	Case Western Reserve University
22.09	OARnet	Cedarville College
22.10	OARnet	Central Ohio Technical College
22.11	OARnet	Central State University
22.12	OARnet	Cincinnati State Community College
22.13	OARnet	Clark State Community College
22.14	OARnet	Cleveland Institute of Art
22.15	OARnet	Cleveland Institute of Music
22.16	OARnet	Cleveland State University
22.17	OARnet	College of Mount St. Joseph
22.18	OARnet	College of Wooster
22.19	OARnet	Columbus State Community College
22.20	OARnet	Cuyahoga Community College
22.21	OARnet	David N. Myers College
22.22	OARnet	Denison University
22.23	OARnet	DeVry Institute of Technology

19

22.24	OARnet	Edison State Community College
22.25	OARnet	Franciscan University
22.26	OARnet	Franklin University
22.27	OARnet	Hebrew Union College
22.28	OARnet	Heidelberg College
22.29	OARnet	Hiram College
22.30	OARnet	Hocking Technical College
22.31	OARnet	James Rhodes Technical College
22.32	OARnet	Jefferson Community College
22.33	OARnet	John Carroll University
22.34	OARnet	Kent State University
22.35	OARnet	Kenyon College
22.36	OARnet	Lake Erie College
22.37	OARnet	Lakeland Community College
22.38	OARnet	Lorain County Community College
22.39	OARnet	Malone College
22.40	OARnet	Marietta College
22.41	OARnet	Marion Technical College
22.42	OARnet	Medical College of Ohio
22.43	OARnet	Methodist Theological School in Ohio
22.44	OARnet	Miami University
22.45	OARnet	Mount Union College
22.46	OARnet	Mount Vernon Nazarene College
22.47	OARnet	Muskingum Area Technical College
22.48	OARnet	Muskingum College
22.49	OARnet	NEOUCOM
22.50	OARnet	North Central State College
22.51	OARnet	Northwest State Community College
22.52	OARnet	Notre Dame College
22.53	OARnet	Oberlin College
22.54	OARnet	Ohio Dominican College
22.55	OARnet	Ohio Northern University
22.56	OARnet	Ohio State University, The
22.57	OARnet	Ohio University
22.58	OARnet	Ohio Wesleyan University
22.59	OARnet	Otterbein College
22.60	OARnet	Owens Community College
22.61	OARnet	Payne Theological Seminary
22.62	OARnet	Pontifical College Josephinum
22.63	OARnet	Shawnee State University
22.64	OARnet	Siegal College of Judaic Studies
22.65	OARnet	Sinclair Community College
22.66	OARnet	Southern State Community College
22.67	OARnet	Stark State College of Technology
22.68	OARnet	Terra Community College
22.69	OARnet	Tiffin University
22.70	OARnet	Univ.of Rio Grande/Rio Grande CC
22.71	OARnet	University of Akron
22.72	OARnet	University of Cincinnati

20

22.73	OARnet	University of Dayton
22.74	OARnet	University of Findlay, The
22.75	OARnet	University of Northwestern Ohio
22.76	OARnet	University of Toledo, The
22.77	OARnet	Urbana University
22.78	OARnet	Ursuline College
22.79	OARnet	Walsh University
22.80	OARnet	Washington State Comm.College
22.81	OARnet	Wilberforce University
22.82	OARnet	Wilmington College
22.83	OARnet	Wittenberg University
22.84	OARnet	Wright State University
22.85	OARnet	Xavier University
22.86	OARnet	Youngstown State University
23.00	OneNet	Arkansas Research and Education Optical Network (ARE-ON)
23.01	OneNet	Arkansas State University
23.02	OneNet	Arkansas Tech University
23.03	OneNet	Bacone College
23.04	OneNet	Cameron University
23.05	OneNet	Carl Albert State College
23.06	OneNet	Connors State College
23.07	OneNet	East Central University
23.08	OneNet	Henderson State University
23.09	OneNet	Langston University
23.10	OneNet	Mid-America Bible College
23.11	OneNet	Murray State College
23.12	OneNet	Northeastern Oklahoma A&M College
23.13	OneNet	Northern Oklahoma College
23.14	OneNet	Northwestern Oklahoma State University
23.15	OneNet	Oklahoma Baptist University
23.16	OneNet	Oklahoma Christian University
23.17	OneNet	Oklahoma City Community College
23.18	OneNet	Oklahoma Panhandle State University
23.19	OneNet	Oklahoma State Regents for Higher Education
23.20	OneNet	Oklahoma State University
23.21	OneNet	Oklahoma Wesleyan University
23.22	OneNet	Oral Roberts University
23.23	OneNet	Redlands Community College
23.24	OneNet	Rogers State University
23.25	OneNet	Rose State College
23.26	OneNet	Seminole State College
23.27	OneNet	Southeastern Oklahoma State University
23.28	OneNet	Southern Arkansas University, Magnolia
23.29	OneNet	Southern Nazarene University
23.30	OneNet	Southwestern Oklahoma State University
23.31	OneNet	St. Gregory's University
23.32	OneNet	Tulsa Community College

21

23.33	OneNet	University of Arkansas at Fort Smith
23.34	OneNet	University of Arkansas at Monticello
23.35	OneNet	University of Arkansas at Pine Bluff
23.36	OneNet	University of Arkansas Cooperative Extension Service
23.37	OneNet	University of Arkansas Medical Sciences
23.38	OneNet	University of Arkansas, Fayetteville
23.39	OneNet	University of Arkansas, Little Rock
23.40	OneNet	University of Central Arkansas
23.41	OneNet	University of Central Oklahoma
23.42	OneNet	University of Oklahoma
23.43	OneNet	University of Science & Arts of Oklahoma
23.44	OneNet	University of Tulsa
23.45	OneNet	Western Oklahoma State College
24.00	Oregon GigaPoP	Eastern Oregon University
24.01	Oregon GigaPoP	Oregon Inst of Technology
24.02	Oregon GigaPoP	Oregon State University
24.03	Oregon GigaPoP	Oregon University System
24.04	Oregon GigaPoP	Portland State University
24.05	Oregon GigaPoP	Southern Oregon University
24.06	Oregon GigaPoP	Umatilla-Morrow Educ Service Dist
24.07	Oregon GigaPoP	University of Oregon
24.08	Oregon GigaPoP	Western Oregon University
24.09	Oregon GigaPoP	Willamette Educ Service Dist
25.00	OSHEAN	Ocean State Higher Education Economic Development and Administrative Network
26.00	Pacific Northwest	Montana State University - Bozeman
26.01	Pacific Northwest	Oregon Health & Science University
26.02	Pacific Northwest	Portland State University
26.03	Pacific Northwest	Seattle Community College District
26.04	Pacific Northwest	Seattle Pacific University
26.05	Pacific Northwest	University of Alaska
26.06	Pacific Northwest	University of Hawaii
26.07	Pacific Northwest	University of Idaho
26.08	Pacific Northwest	University of Montana
26.09	Pacific Northwest	University of Washington
26.10	Pacific Northwest	Washington State University
27.00	SoX	Abraham Baldwin Agricultural College
27.01	SoX	Alabama Supercomputer Authority
27.02	SoX	Albany State University
27.03	SoX	Armstrong Atlantic State University
27.04	SoX	Atlanta Metropolitan College
27.05	SoX	Auburn University
27.06	SoX	Augusta State University
27.07	SoX	Bainbridge College
27.08	SoX	Clayton State University

22

27.09	SoX	Clemson University
27.10	SoX	C-Light Regional Optical Network (Clemson University Research Foundation)
27.11	SoX	College of Coastal Georgia
27.12	SoX	Columbus State University
27.13	SoX	Dalton State College
27.14	SoX	Darton College
27.15	SoX	East Georgia College
27.16	SoX	Emory University
27.17	SoX	Florida Atlantic University
27.18	SoX	Florida State University
27.19	SoX	Fort Valley State University
27.20	SoX	Gainesville State College
27.21	SoX	Georgia Board of Regents (PeachNet)
27.22	SoX	Georgia College & State University
27.23	SoX	Georgia Gwinnett College
27.24	SoX	Georgia Highlands College
27.25	SoX	Georgia Institute of Technology
27.26	SoX	Georgia Perimeter College
27.27	SoX	Georgia Southern University
27.28	SoX	Georgia Southwestern State University
27.29	SoX	Georgia State University
27.30	SoX	Gordon College
27.31	SoX	Kennesaw State University
27.32	SoX	Macon State College
27.33	SoX	Medical College of Georgia
27.34	SoX	Medical University of South Carolina
27.35	SoX	Middle Georgia College
27.36	SoX	Mississippi State University
27.37	SoX	Morehouse School of Medicine
27.38	SoX	Morehouse School of Medicine
27.39	SoX	North Georgia College & State University
27.40	SoX	Savannah State University
27.41	SoX	SCLR (South Carolina Light Rail)
27.42	SoX	Skidaway Institute of Oceanography
27.43	SoX	South Georgia College
27.44	SoX	Southern Polytechnic State University
27.45	SoX	University of Alabama at Birmingham
27.46	SoX	University of Alabama Huntsville
27.47	SoX	University of Alabama Tuscaloosa
27.48	SoX	University of Georgia
27.49	SoX	University of Miami
27.50	SoX	University of South Carolina
27.51	SoX	University of Tennessee
27.52	SoX	University of West Georgia
27.53	SoX	Valdosta State University
27.54	SoX	Vanderbilt University
27.55	SoX	Waycross College

23

28.00	Utah Education Network	Brigham Young University
28.01	Utah Education Network	Idaho State University
28.02	Utah Education Network	Salt Lake Community College
28.03	Utah Education Network	Univ of Utah
28.04	Utah Education Network	University of Utah
28.05	Utah Education Network	Utah State University
29.00	WiscNet	Wisconsin Research and Education Network