

Internet2 Community Design Workshop Summary

Rick Summerhill
Director, Network Research, Architecture & Technologies
Internet2

19 June 2006

1 Overview

The Internet2 Community Design Workshop to discuss the new Internet2 Network was held on 15-16 June 2006 in Indianapolis. The primary goals of the meeting were: 1) to provide greater detail about the new network; and 2) to obtain feedback from the community about the proposed new network, including locations of proposed optical nodes where community members would connect to the network. Participants included representatives of U.S. regional networks that will connect institutions to the nationwide infrastructure and representatives from individual institutions, including researchers from academic disciplines that are expected to make early use of the advanced capabilities of the new Internet2 Network.

The workshop focused on the design of the new Internet2 Network and its many leading edge capabilities:

- The hybrid IP and Dedicated Wave System utilizing Level 3 Communications' optical fiber platform; optical equipment and fiber dedicated to Internet2, and sparing and equipment maintenance by Level 3, including its standard carrier commitment for circuit reliability on the wave system
- Community control of provisioning, measurement, and research support at layer 1
- Platform support for both highly experimental projects and production services; will enable both corporate and academic network research partnerships
- Initially provisioned with ten 10 Gbps wavelengths, with capacity up to 80 wavelengths (0.8 Tbps); scalability to 40 and potentially 100 Gbps interfaces
- Flexible add-drop wave capabilities for RON's and other networks
- Simplified and rapid wave provisioning through the national system
- Grooming capabilities through a highly flexible layer 1 system that enables sub channel provisioning at the lowest level SONET and Ethernet granularity
- Dynamic provisioning of sub channels and waves across the network within seconds – to establish, for the first time, dynamic high-end service provisioning to meet the needs of the Grid computing and experimental science communities.

The first afternoon session consisted of three segments on a) design and implementation, b) services and policy, and c) transition. An evening session consisted of partner presentations from Level 3 Communications and Infinera. The first portion of the second

day was spent reviewing key issues by participants on the first day. The participants split into breakout sessions to consider regional, connector and site specific details. A summary session was then held to review the breakouts. The meeting concluded with a discussion about an advisory structure for the new Internet2 infrastructure.

2 Network Design and Implementation

The first day's session on network design considered strategic objectives, requirements, and process. There was some discussion about Internet2's partner selection process, including concerns that the process was not as open as it could be. However, most in the community understood that a large representative group could not have participated in the detailed and time-compressed negotiations with Level 3 that led to the agreement under which the new network has been made possible.

The session also included a discussion of the architecture, engineering, network research, and partnership opportunities. Many attendees agreed that the architecture—the basic design of the network itself— provides opportunities for many network configurations and can support projects that are both highly experimental as well as those that require production quality capabilities. There was some concern that the regional and campus networks might not be able to bring the full suite of dynamic services to users in the near future, but it was noted that the basic circuit services will be available immediately, even if configured manually through the various network operation centers. The Infinera optical networking equipment allows for rapid provision of waves, and these should be available in hours.

Internet2 will keep spare installed interfaces available so that any request for a dedicated lightpath, either a full wave or a sub-channel, can be provisioned within hours

The architecture encourages aggregation through a simplified standard connection scheme consisting of two 10-Gbps wavelengths for each connector. Evolution to the standard connection scheme may take as long as three years. Internet2 has estimated that the cost of such an enhanced connection would be comparable to a single 10-Gbps IP connection to the current Abilene Network. There was much discussion about fees, not only for the standard connection, but also for incremental wavelengths. It was emphasized that the architecture is not final, nor have the Internet2 advisory groups finalized the overall business plan or the cost recovery models for individual services. However, it became apparent that the community needs detailed fee information as soon as possible. With a geographically dense deployment of optical equipment expected, the cost recovery model for waves will almost certainly be based on a per-mile, as opposed to a per-segment model.

Cost models will be clarified and published as quickly and broadly as possible in the appropriate forums.

There was considerable discussion about redundancy models, with potentially multiple connection points made available to each connector. The expected implementation plan is well positioned to support multiple connections and the final plan will clarify possible redundancy models.

The IP network was also discussed and the number of routers to be deployed in the network was considered. The current intention is to continue to use the Juniper routers deployed in the Abilene Network. The original plan discussed eight routers, with the other current routers to be deployed for new purposes. There were suggestions that a careful analysis of the latency requirements be conducted before such a decision is made.

The final network plan will clarify redundancy models and make such options available to the connectors on the network.

3 Network Services and Policy

The second session of the first day was a discussion of the services that could be provided by the new Internet2 Network. A plan to provide 500-Mbps of commodity network access as a bundled service was presented and much discussion centered on this aspect.

It became one of the most-discussed issues at the workshop. The consensus was that a commodity service might be offered, but that it should not be bundled in the standard connection model. A clear consensus emerged to form a working group on commodity services, which would seek input from the The Quilt Commodity Internet Services (CIS) program.

Commodity services will not be bundled into the standard connection offering and an advisory group will be formed to understand the impact of providing commodity services.

Other possible service offerings on the new Internet2 Network infrastructure were discussed, including the potential for a national content exchange fabric. There was discussion on clarifying this service, especially how it relates to a more general peering fabric. There was also discussion about the ability to create a dedicated health service/research network, and the ability to support other services such as VoIP and video services. There was some interest in these new services, but there also was concern that these might meet keep Internet2 from focusing its initial efforts of deploying core services. The general consensus was that the focus should be on building the network and working on the Abilene transition.

Internet2 will focus on the network infrastructure build-out, IP services, transition issues, policy, and business models, and leave additional considerations and services to advisory groups for further consultation.

Discussion of services also motivated an intense discussion of network usage policy, and in particular the anticipated conditions of use on the network. Some of the discussion was more closely related to Internet2 policy on membership and use of the network (participation) by various types of membership classes. There is an immediate need to clarify the conditions and policies of use on the network and that they should be very simple to implement.

Internet2 will create and publish a minimal network usage policy as soon as possible and ensure that it is simple to understand and easy to implement.

A case cited repeatedly was the situation where network A sits behind Regional Optical Network (RON) 1 and network B sits behind RON 2; what are the conditions for traffic between A and B? Several suggested an advisory group to consider the technical issues and any edge cases that might arise.

4 Transition Plans

The third session of the first day was on transition. An outline of a plan for transition from Abilene to the new Internet2 Network was discussed. Several participants commented on the vast amount of work required to make the transition a success, again emphasizing how important it is to focus on building the network.

5 Vendor Presentations

After dinner, there were two short presentations by Level 3 Communications and Infinera. The Level 3 presentation described services provided by Level 3 and then showed the proposed fiber routes for the Internet2 Network and how the Infinera equipment will be deployed. Level 3 emphasized the reliability of their current production network that uses Infinera equipment. The Infinera presentation summarized the differences and advantages of its approach to building optical networks, described current and near-term products and explained why its integrated component method is more reliable than traditional methods of building optical networking equipment.

6 Discussion on Connection Points

At the beginning of the second day of the workshop, a short review session was held. The main issues described above were outlined and discussed further. The discussion reinforced the conclusions of the previous day, highlighted in the bullets above. The workshop then went into breakout sessions organized by the proposed locations of optical nodes. The charge to the breakout groups was to identify regional needs or additional issues, and to clarify connection points. The sessions were organized as follows:

Group 1 – Boston; New York City; Philadelphia; Washington, D.C.

Group 2 – Raleigh; Nashville; Atlanta; Jacksonville

Group 3 – Pittsburgh; Cleveland; Chicago; Indianapolis

Group 4 - Baton Rouge; Houston; Tulsa; Kansas City

Group 5 - Salt Lake City; Denver; Albuquerque; Seattle; Portland; Los Angeles; Boise; San Diego

Based on the breakout group discussions, many of the individual locations for connections were clarified. There were no substantial changes to the cities proposed on the map, but some requests have been made for alternate sites, or sites where connections could be made in the future. Each of the facilitators of the breakouts reported out a short summary allowing people to comment or make suggestions.

7 Advisory Groups

The final session of the workshop dealt with technical advisory groups. A hierarchical style advisory structure (analogous to the Middleware Advisory Committee for Education, or MACE, structure successfully employed in Internet2's middleware efforts) was described, where an overall advisory group commissions working groups that may be either long-standing to provide advice on a regular basis, or of limited duration with very particular advisory goals. A group chaired by Paul Schopis of OARnet has been created to come back in a timely fashion with a suggestion for an advisory structure for the new Internet2 network infrastructure. The overall advisory group is expected to have regularly scheduled communications with the relevant councils of Internet2, and in particular with NPPAC. An executive committee consisting of senior executives from Internet2, Level 3, Infinera and other partner organizations will also be created.

A group from the community will suggest an advisory structure to provide technical advice on the Internet2 Network

8 Next Steps

The plan for the new Internet2 network will be updated based on the discussions at the workshop with deployment expected to begin late in the summer. In particular, Internet2 and Level 3 will use the results of the breakout sessions to finalize optical node locations. Every current Abilene connector should expect continued individual dialog about transition planning to start within the next two months.

The next group setting for sharing additional information is the upcoming Joint Techs workshop in Madison, Wisconsin (July 16-20); Internet2 will report progress to date and solicit additional feedback at that time. In addition, Internet2 will be working with the HOPI Technical Support Center along with early new network adopters to develop a series of workshops and other activities to address issues of delivering to campuses the capabilities enabled by the new nationwide infrastructure. Additional comments, suggestions and questions are welcome, at any time, at cdw@internet2.edu. As deployment of the network progresses, additional information will be available at <http://networks.internet2.edu/>.