

# On being a U.S. UCAN connector: An R&E perspective

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## Introduction

This paper is intended to provide input for a connector agreement for U.S. UCAN from the perspective of the R&E networking technical community. The intent is to recognize and acknowledge the unique attributes of traditional R&E networks, and derive a common set of requirements and standards that can be applied to other organizations that want to serve Community Anchor Institutions (CAIs) and connect to U.S. UCAN. It was drafted by a small group formed under the auspices of the Internet2 Network Technical Advisory Committee (NTAC), in response to a request by Internet2 staff.

Since education users are community anchors in the NTIA and FCC definition, the authors assume that all existing Internet2 connectors (and the CAIs already connected through them<sup>1</sup>) will connect to U.S. UCAN. Furthermore, it is assumed that those connectors will be parties to any U.S. UCAN connector agreement that is developed. The following discussion also applies to multiple advanced regional networks that aggregate as a single connector entity (such as CIC's OmniPoP).

Many connectors currently serve some or all of the groups defined as CAIs. Programs such as Internet2's Sponsored Education Group Participants (SEGP) program and the FCC's Rural Health Care Pilot Program (RHCPP) encourage "non-traditional" constituents to participate in national R&E networking, through the connector serving their area. Of the groups included in the definition of CAIs, community support organizations and public safety entities are not currently widely<sup>2</sup> supported by Internet2.

The next section provides a summary of the key issues derived from discussions within the group and feedback from other NTAC members. Following that, the appendices provide additional information and examples from the community discussion<sup>3</sup>.

## Key Issues

### Participation in the community

First and foremost, it is important to recognize that the connector agreement in question is an

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<sup>1</sup>Note that the Internet2 BTOP proposal reported that 66,000 CAIs are already served by existing connectors.

<sup>2</sup>Some connectors (such as WiscNet) provide Internet2 service to city, county and state governments

<sup>3</sup>Note that specific values in the appendices (e.g. those for performance parameters) are intended as examples. If such parameters are included in a final connector agreement, the NTAC should be engaged to discuss and recommend specific values.

agreement between members of a community, as opposed to a commercial fee for service arrangement. The cooperation, flexibility, transparency and cost-effectiveness that has made R&E networking successful derive primarily from the community model. Accordingly, new connectors should be prepared to join the community and participate fully in the governance process.

### **Independence of connectors**

At the same time, the community consists of a diverse set of entities whose organizational structures and charters vary widely. The U.S. UCAN framework should foster the cooperation necessary for delivering reliable end-to-end services while at the same time providing the flexibility to allow connectors to function as independent businesses without hindrance.

### **Breadth of CAI community served**

As some existing connectors expand the constituencies they serve, it is important to keep in mind that not all connectors will serve all CAIs in their geography. The connector agreement should reflect the fact that new and existing connectors may choose to serve some or all CAI groups. Where connectors currently exist, they should have the right of first refusal for those groups they choose to serve within the territory that they operate.

### **Service Options**

A service matrix should be developed that lists the super-set of services currently available from the various members of the community, as well as those under development. This will aid in the development and provisioning of end-to-end services that include multiple organizations, and serve as a guide to new connectors. *Appendix A* provides a straw-man service matrix. One important note is that connectors are not required to provide all services described in the matrix.

### **Operational cooperation**

Prospective connectors should agree to some level of operational cooperation that is flexible enough to include a diverse set of connector needs and circumstances. The overall goal should be to establish strong bilateral relationships between Network Operations Centers (NOCs) that allow for proactive identification and correction of performance issues and outages in the timeliest possible manner. *Appendix B* provides some recommended processes.

Well defined NOC-NOC processes (such as the sharing of ticket information, etc.) should be established by new connectors. Numerous best practices in this area already exist within the R&E community. These processes should allow for extensive coordination between NOCs, but at the same time need to be kept flexible enough so that the NOCs can organize their business in the way that makes sense for them.

One example that illustrates this type of business flexibility is the issue of NOC responsiveness. Rather than specify that a connector must have a 24/7 NOC, a target should be about an agreed upon level of service (such as response to a level X incident in Y minutes, etc.). This allows a connector to meet the service target without constraining the method used.

## **Service Levels**

In order to ensure quality end-to-end services, some measurable performance criteria need to be met by each connector in order to meet a set of overall system performance goals. These criteria should be expressed in terms of targets.

With a reasonably common set of performance measurement tools, good NOC-NOC communication, and engagement in a governance system that sets the targets, the community can provide a high-quality end-to-end service and avoid punitive Service Level Agreements that might be appropriate in a commercial fee for service environment.

## **Performance Criteria and Measurement**

There are certain network performance criteria that are characteristic of R&E networks: low latency, low jitter, low packet loss, high headroom, etc. Bi-lateral targets for these (and others, as needed) should be specified for both connectors and the backbone. *Appendix C* and *Appendix D* provide a few examples.

In order to verify compliance with the service targets described above, connectors should provide a transparent view into the performance of their networks. Connectors should also provide well-managed test points at a suitable number of locations in their network to allow partner NOCs to run diagnostics and troubleshoot performance issues. The R&E community has invested in developing open-source tools that meet some or all of these criteria, and these tools should be exploited where possible. See *Appendix E* for examples.

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## Appendix A - Service Matrix

<i>Service</i>	<i>Description</i>	<i>Comments</i>
Managed Service	Shared IP service available to all CAIs	This is the U.S. UCAN equivalent of the IP service traditionally provided to R&E entities by Internet2.
Internet Peering	A service that provides premium connectivity to large content providers and ISPs that peer with U.S. UCAN	Entities wanting to take advantage of the U.S. UCAN open access policy would peer to this service.
IP version 6	The next generation Internet Protocol standard	
Multicast	Provides efficient support for streaming applications	
Circuit service	A dedicated bandwidth service between two endpoints (point-to-point) or between multiple endpoints (multi-point)	Dynamically configured point-to-point circuits are currently supported by Internet2 (the ION service)
Jumbo frames	All equipment should be configured to allow large frames to ensure maximum performance for those applications that can take advantage of them	Existing Internet2 policy: <a href="http://globalnoc.iu.edu/i2network/maps--documentation/policy-statements.html">http://globalnoc.iu.edu/i2network/maps--documentation/policy-statements.html</a>

## Appendix B - Operational Coordination

This appendix provides a few recommendations for coordination between Network Operations Centers.

1. Connector is responsible for accepting requests for assistance from their downstream CAIs, and are responsible for contacting the upstream U.S. UCAN NOC as appropriate. Connector shall adhere to community-defined best practices for coordinating the resolution of network impairments of the end-to-end path with the CAI, U.S. UCAN NOC, and other networks as required.
2. In order to promote maximum transparency, both the connector and Internet2 will coordinate to make available detailed information concerning the performance of an end-to-end path that transits connectors' infrastructure to network operations personnel acting on the behalf of the end-to-end path user. This information shall include details

such as interfaces statistics, error rates, capacity, (optionally the type, model, and software of each device), etc., so long as the disclosing of this information does not create a significant security or operations risk.

3. Connector and Internet2 shall use community-specified open source tools to provide end-to-end performance information. In addition, they shall provide well-maintained test probes on their infrastructure that allow the U.S. UCAN NOC to use them for troubleshooting and active monitoring.
4. The "regional carrier" or "local access carrier" in any one area may be one or more entity, however, the "designated" connector for a given CAI category must present a single point of contact, monitoring, and visibility to the national carrier and a cohesive set of services to the CAIs.
5. Existing R&E connectors should provide information on their public web pages as to whether or not any of the above recommendations are supported.

### Appendix C - Performance Targets

<i>Function</i>	<i>Target</i>	<i>Comments</i>
Packet Loss	8.5x10 <sup>-8</sup> %	<a href="http://sd.wareonearth.com/~phil/issues.html">http://sd.wareonearth.com/~phil/issues.html</a>
Latency	125 ms (one way)	Based on Cisco Telepresence design criteria: <a href="http://www.cisco.com/en/US/docs/solutions/Enterprise/Video/telepresenceaag.html">http://www.cisco.com/en/US/docs/solutions/Enterprise/Video/telepresenceaag.html</a>
Jitter	10 ms (peak-to-peak)	Based on Cisco Telepresence design criteria: <a href="http://www.cisco.com/en/US/docs/solutions/Enterprise/Video/telepresenceaag.html">http://www.cisco.com/en/US/docs/solutions/Enterprise/Video/telepresenceaag.html</a>

### Appendix D - Performance Measurement and Routing Information

<i>Function</i>	<i>Description</i>	<i>Example Tools</i>	<i>Comments</i>
Read-only access to routers	Tool that allows for read-only interrogation of router functions	GRNOC Router Proxy, Visible Backbone	Connector and backbone should provide on all core routers
End-to-end performance information	Tools that allow active measurement between two points on the network	PerfSONAR	Connector and backbone should provide at major points of presence
Routing information	Tools that allow access to routing information from a	Looking Glass server	Connector and backbone should provide at major

	certain point on the network		points of presence
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## Appendix E - Capacity Planning

Connector and Internet2 shall maintain sufficient performance capability along paths that support CAI end systems consistent with the requirements of advanced applications. This requirement is intended to preserve one of the fundamental performance characteristics of community anchor networks.

<i>Function</i>	<i>Target</i>	<i>Comments</i>
Increased inspection of link	20% utilization for hours per day	
Mitigation	30% utilization for hours per day	Includes link upgrades, traffic engineering, etc.

## Appendix F - New Services

The following were discussed during the course of the development of this document as potential new services that may be proposed, mainly due to the unique requirements of new CAIs:

<i>Service</i>	<i>Description</i>	<i>Comment</i>
Resilient service	Provides a secondary backup path that can be utilized automatically upon failure of the primary path	The current Internet2 backbone does not support this type of service directly
Rapid Provision and Reconfiguration service	Provides Public Safety and Healthcare with additional bandwidth resources to deal with urgent issues in a time of national, state or local emergency	May consist of some or all of: provisioning additional bandwidth across the regional and national backbone, setting QoS to prefer Healthcare and PS traffic, allowing "bursting" of traffic from the local area to the regional provider(s).
Priority service	Provide the ability to prioritize traffic based on protocol type or other criteria.	The U.S. UCAN Managed Service is a best effort service that provides equal treatment of all traffic presented to the U.S. UCAN backbone. For CAIs that require priority or guaranteed

		service, U.S. UCAN private network or dedicated circuit service options should be explored.
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## **Appendix G - Non-services**

It is recommended that the following services not be included in the connector agreement:

1. Content Filtering is not a backbone service. Content Filtering is and should be based upon local community standards and needs to be managed at that level.
2. When edge services are required, such as end to end encryption with the health care and public safety areas, either the CAIs themselves or the connector may provide those services. They must be coordinated at a national level to ensure interoperability.