



Internet2 Innovation Platform FAQ

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Internet2 Innovation Platform

What is the Internet2 Innovation Platform?

The **Internet2 Innovation Platform** is a combination of new technologies and services that provide a leading-edge, end-to-end architecture and a unique set of unified capabilities at the national, regional and campus level to create an environment for innovation in research and education.

What does the Innovation Platform architecture include?

Long-term, the Innovation Platform architecture is envisioned to create an end-to-end networking environment that will enable new and unique applications in addition to supporting current science requirements. The platform architecture includes critical building blocks for an end-to-end environment between campuses that will:

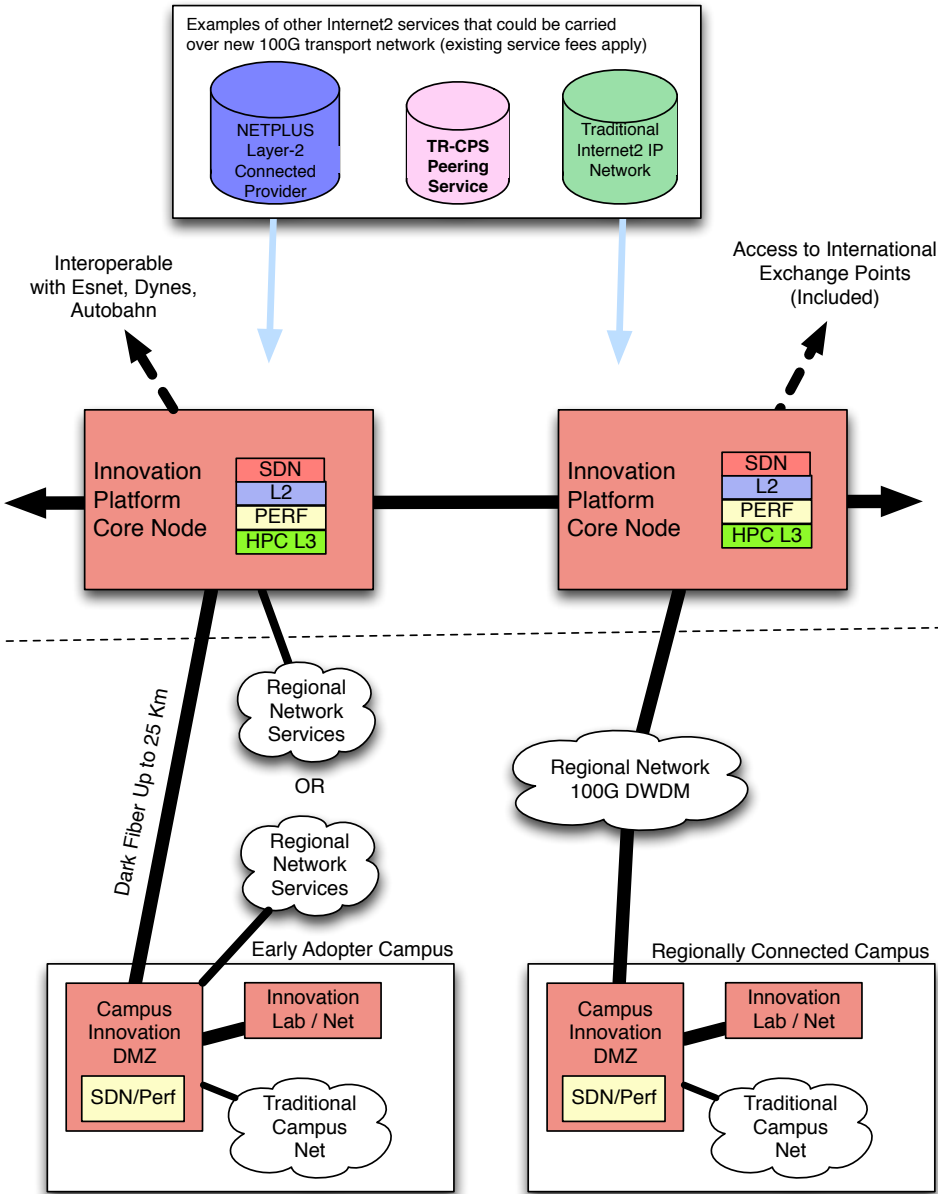
- Introduce massive amounts of bandwidth through a 100GE Layer 2 connection
- Address traditional bottleneck and aggregation points to pass high-bandwidth traffic and provide performance monitoring/verification through implementation and support of a Science DMZ, a model developed by the Department of Energy's ESnet (see question below for more)
- Introduce software defined networking (SDN) capabilities to support the development and deployment of new applications.

How does one begin participation in the Innovation Platform?

Participants must commit to implementing the *three key components* of the innovation platform architecture over the next three years: 100GE Layer 2 connection, SDN and Science DMZ. Sites must commit to substantially implementing two of the three components by the end of 2012 to be a pilot site.

What are the different types of connections that are supported as part of the Innovation Platform?

The diagram below indicates the types of connections that are initially expected as part of the Innovation Platform. While there will be a range of connections, we expect the basic components—a 100GE Advanced Layer 2 port and a Science DMZ on connecting campuses—to be consistent characteristics of each Innovation Platform connection.



What is Internet2’s new Advanced Layer 2 Service?

The Advanced Layer 2 Service is a reliable Layer 2 transport environment that provides a flexible end-to-end, high-bandwidth and deeply programmable environment where research, education and innovation of new applications can flourish. The Advanced Layer 2 Service builds on Internet2’s NDDI/OS3E initiative to provide network connections that can be used to easily create VLANs with a range of characteristics, with reachability throughout the network, regional networks, campuses and partners like ESnet, GÉANT and other inter-domain enabled global networks.

What are the long-term capabilities of the Internet2 Advanced Layer 2 Service?

This is a network built to support applications innovation by assuring substantially overprovisioned capacity, deep programmability of the network itself and cloud infrastructure to support applications development. It is fundamentally a reliable Layer 2 transport network that will become increasingly interconnected with higher-layer services and increasingly programmable to integrate with advanced applications. At its introduction, the network will allow creation of VLANs between any two ports on the network using a simple web interface. The VLANs can range in size from 0 to 100 Gbps and can last from minutes to indefinitely. Through the web-provisioning tool, VLANs can be provisioned within the network and can also be extended to Internet2's ION service, the NSF-sponsored DYNES sites, ESnet, GÉANT and USLHCnet-enabled sites.

What are the initial Advanced Layer 2 Services characteristics associated with the Innovation Platform?

Bandwidth – The network will support up to 100GE from every researcher to every other researcher by provisioning 100GE from the campus lab directly to a 100 Gbps national backbone. A commitment to be part of the Innovation Platform assures limited aggregation and abundant headroom.

Programmability – The network will increasingly allow SDN applications to be deployed across campus, regional and national network components, allowing new paradigms of advanced applications to develop.

VLANs – The network supports user-configurable and easy-to-create point-to-point VLANs between users on the Innovation Platform.

Reachability – Through the same user-configurable provisioning tool, the network includes interoperability with other multi-domain Layer 2 networks, including ESnet, Internet2 ION/DYNES, USLHCnet and GÉANT Autobahn.

Where can I get additional technical information on Internet2 Advanced Layer 2 Service?

Information will be posted at <http://www.internet2.edu/network/services> as it becomes available.

What is a Science DMZ?

A model developed by the Department of Energy's ESnet, a Science DMZ is an architecture change to the border of the network on the campus to allow higher performance network flows, network programmability and performance verification. For the Innovation Platform instance, the campus builds a Science DMZ by installing a 100GE switch, a performance node server and software, and an SDN server just outside the traditional campus security border. From this Science DMZ, connections to the existing campus border as well as 100GE capabilities for VLANs to reach campus innovation centers can be provisioned.

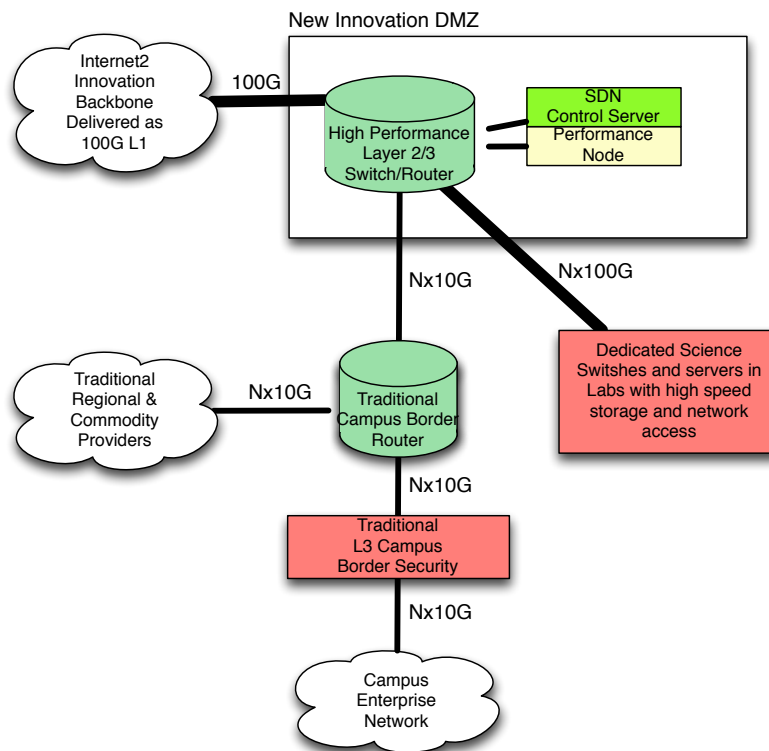
The Science DMZ model includes end-to-end performance diagnosis and verification, and is a critical component of a true end-to-end environment for applications development. Campuses that participate are asked to commit to create a Science DMZ border area on their campus and to extend the 100GE network to at least one major research lab or innovation center in each of the next three years. The campus should also commit to deploying SDN-capable switches and supporting hardware and participating in SDN training during the three-year period.

More information on Science DMZ can be found at ESnet’s website: fasterdata.es.net.

Can you show an example of what a Science DMZ might look like?

Typically, a Science DMZ will include a 100GE-capable Layer-2 switch, with an uplink port facing the Internet2 Network. Some campuses may also choose switches that have Layer 3 capabilities to enable the border routing functions. Additional 10G, 40G and 100G ports facing labs on the campus may also be provisioned. Finally, a number of 10G ports would be interconnected to the campus’s existing “outside” border routers.

To enable dynamic switching of VLANs, software defined programmability and performance monitoring, two Linux servers with 10G interfaces to the Science DMZ switch are required to allow installation of the perfSONAR toolkit and the SDN toolkit.



Internet2 Advanced Layer 2 Service

How much will ports on the new Advanced Layer 2 Service portion of the Innovation Platform connection cost?

The Internet2 Advanced Layer 2 Service will offer 10G and 100G switch ports. 100G ports will be available for connections used to build Innovation Platform campus links. 10G ports are available for other purposes.

Port	Cost
10G access port	\$ 40,000/year
100G access port	\$165,000/year
Additional 10G port on same switch	\$ 30,000/year

What is included in these fees to the new Advanced Layer 2 Service?

Each Advanced Layer 2 Service connection fee includes the port on the switch, the operating cost for the network and the capacity on the backbone to build Layer 2 VLANs to any other site on the Advanced Layer 2 Service.

At its start, what endpoints are reachable on Internet2's Advanced Layer 2 Service?

Every other port on the Advanced Layer 2 Service is reachable from each port on the network. In addition, Internet2 maintains other connections that will also be reachable from the Advanced Layer 2 Service, including Starlight, PACWave, Atlantic Wave, MANlan, WIX, and AMpath, interconnecting with global facilities including the GLIF, GÉANT, APAN and USLHCNet networks, and over 100 other national research and education networks (NRENs).

Does an Internet2 Advanced Layer 2 Service connection include access to the Internet2 advanced IP network or the TransitRail Commercial Peering Service (TR-CPS)?

Internet2 can provision other services over the Advanced Layer 2 Service network, however fees for capacity on those services are separate and require separate agreements and fees.

How will the software defined networking and programmability work? When?

As Internet2 is able to add a virtualizing capacity and programmability to the network, the ability for community members to request a network slice to install their own software will be finalized. This may require some software development to support the desired virtualization as well as the

necessary GENI programming interfaces. Once the virtualization strategy is developed and tested, it will be made generally available to the platform users with a developer’s kit that allows innovators to begin creating applications for the network. It is hoped this capability can come online late in 2012.

Are there working groups for this program that I can get involved in?

Internet2’s Network Technical Advisory Committee (NTAC) has formed a group related to software defined networking. They can be reached at wg-sdn@internet2.edu.

Additionally, Internet2’s Architecture and Operations Advisory Council (AOAC) has a working group for the Innovation Platform that can be reached at aoac@internet2.edu.

I am a researcher, how do I learn more?

Please contact the Research Support team at rs@internet2.edu.

I am a campus IT leader, a regional network leader , an SDN software developer, a potential corporate partner—how do I learn more?

Please contact innovation@internet2.edu.

Information on Support for GENI Projects

How is the Innovation Platform coordinated with the National Science Foundation and the GENI program?

Internet2 has negotiated a memorandum of collaboration with the GENI program office, supported by the National Science Foundation, to align the two initiatives. Under the agreement, Internet2 will allocate capacity on the national Innovation Platform to support GENI experiments and will develop GENI support capabilities to allow innovations from GENI to move into the ubiquitous, end-to-end environment supported by the Innovation Platform.

How does the Internet2 Advanced Layer 2 Service support GENI?

In its early stages, GENI researchers can use the Internet2 Advanced Layer 2 Service to interconnect their GENI projects using Layer 2 VLANs. As the SDN capabilities of the platform expand to include production-grade virtualization and “slicing” capabilities, GENI researchers will be able to load their SDN applications directly onto the platform. Because the platform will include intentional SDN capabilities from the national backbone through the regional network to the campus border and into labs, the new environment will be the largest end-to-end SDN environment ever created for network research.

For Campuses and CIOs

If a campus or university system wants to be part of the Innovation Platform, what do they need to do?

At a practical level, the first commitments required to participate in the Innovation Platform include:

- Obtaining 100G access to the new Internet2 Advanced Layer 2 Service
- Making a commitment to build a Science DMZ with software defined networking
- Establishing performance support on the campus with a long term commitment to implement SDN technologies and support advanced applications deep into the campus

Connectivity is open to all parties that wish to request a connection. The first step is to establish a connection to the nearest access node. Internet2 can make Innovation Platform connections available in over 51 locations throughout the country. Requests for nodes are being solicited now (April, 2012). To seed the network, Internet2 is considering placement of nodes alongside the ten existing IP network nodes as a baseline. These first nodes will begin rolling out in June, 2012. After that, Internet2 will insert new nodes within three months of a commitment from a campus. Working together with the campus, Internet2 and a regional provider that the campus may choose will plan a 100G circuit path from the Internet2 Network to the campus border.

Advanced Layer 2 Service Technical Questions

What is internet2's commitment to backbone headroom on the Advanced Layer 2 Service? Is a 100G backbone enough?

Internet2 will monitor the backbone regularly and run reports weekly to look for dropped packets and/or heavily loaded links. The backbone will be a mesh of links between each node and will have much more than 100G available between any two nodes at a given time. Internet2 will commit to maintain no less than 50% available overhead, or 50G on all national backbone links between nodes on the Advanced Layer 2 Platform for at least 95% of the time each week. If usage begins to impinge on available capacity, Internet2 will augment the backbone.

Will the backbone include bandwidth reservation capability?

The software developed to run the Advanced Layer 2 Service provisioning will support bandwidth reservations as soon as a supported SDN interface allows it. In the meantime, Internet2's bandwidth headroom policy will assure outstanding performance.

What platform will the Advanced Layer 2 Service use for the 100G SDN backbone switches?

As of February 1, 2012, Internet2 has an RFP under evaluation to select a primary vendor.

How does this Advanced Layer 2 Service relate to Internet2 ION, DYNES, OS3E and other services like ESnet's OSCARS and GÉANT's Autobahn?

Internet2 allows interoperability and reachability across all of its Layer 2 services, and partners like ESnet and GÉANT. When a user creates a VLAN on any of Internet2, GÉANT or ESnet's networks, all of the Innovation Platform ports will be reachable. The Advanced Layer 2 Network is built on the technologies developed through NDDI and OS3E and will replace them. Over time, DYNES and ION will also be integrated and supplanted by the Innovation Platform architecture and the Advanced Layer 2 Network.

What is an example of how I might bring my regional network onto my 100G link to support my existing Internet2 and regional traffic?

Regional traffic can either continue to connect at the campus border on an existing connection, or can be connected through an additional port on the Internet2 Innovation Platform switch in the nearest POP. In either case, full reachability to the regional's network can be achieved either through the campus border DMZ or by bringing the regional traffic to the campus over the 100G link.

Will Internet2 recommend a platform for use in the Science DMZ at my campus border?

Internet2 would be happy to work with campuses to assist in the design of appropriate hardware for the Science DMZ. Internet2 encourages campuses to adopt the platform they are most comfortable supporting through their standard procurement processes. A list of successful implementations completed by campuses will be available from Internet2.

If I have a pair of dark fiber available from my location to an Internet2 POP, how far can the 100G connection reach from the Internet2 point of presence to my point of presence?

The current maximum reach of 100G Ethernet is through 100GBase-ER4 interfaces that have a reach of 40KM over a pair of single mode fiber. More typical links use 100GBase-LR4, which has a reach of 10KM.

Have questions that aren't answered here?

Check <http://internet2.edu> or email innovation@internet2.edu.