

Enabling Innovation on the Campus

An opportunity for leading US research universities to collaborate in creating a common platform for innovation

A Legacy of Innovation

The research and education (R&E) community played a leading role in the creation of the modern Internet and the applications that have made it one of the most transformational technologies of the last hundred years. The seminal network investments of campus network leaders and the capabilities they built spurred

unprecedented innovation, applied research and data-intensive science. This, in turn, led to the global transformation on which our current information-based economy is built.

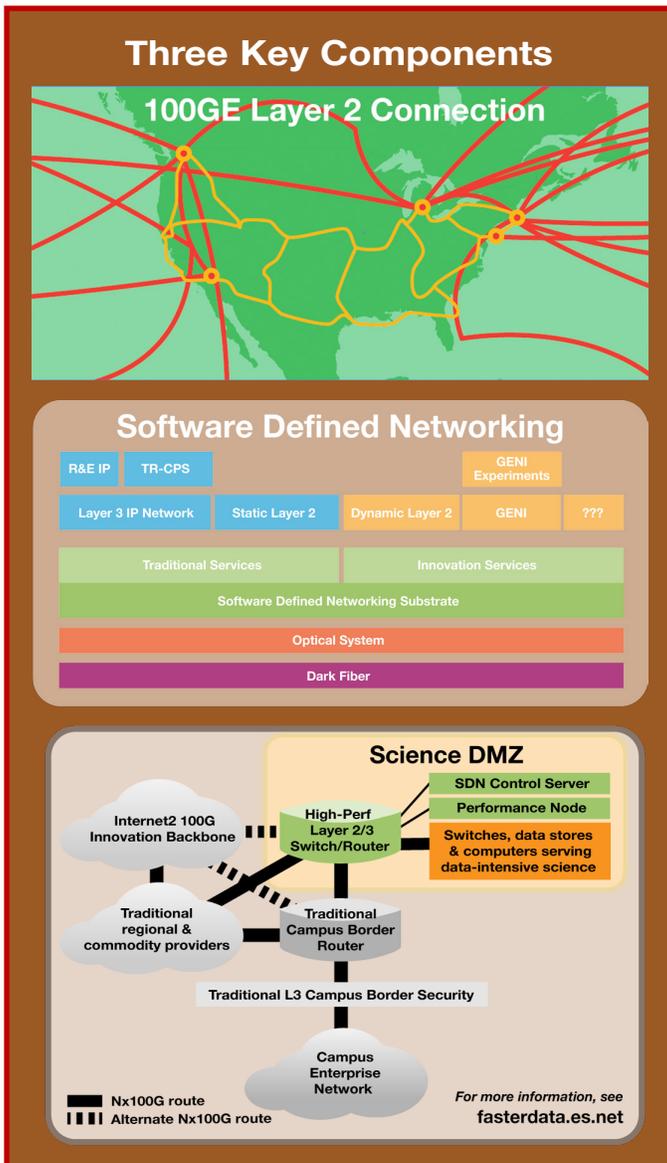
- Unconstrained bandwidth availability, enabling widespread application development and delivery
- A deeply programmable environment where compute, storage, visualization and transport capabilities can be driven by applications
- Solutions that overcome traditional bottlenecks, passing high-bandwidth traffic and allowing performance monitoring

Creating an environment where innovation can once again flourish will fuel a new cycle of economic partnership and development, help our leading universities attract and nurture the innovators of tomorrow, and solidify the long-term competitiveness of U.S. education.

What Is an Innovation Campus?

As the Internet2 community seeks to once again create an innovation-friendly environment, the “Innovation Campus” is a key building block. An Innovation Campus:

- Creates an environment of open and unconstrained bandwidth throughout campus, regional and national networks
- Re-architects the campus network to support large scientific data flows (by building a “Science DMZ,” for example)
- Deploys software-defined networking (SDN) and OpenFlow capabilities to allow SDN-enabled application deployment
- Upgrades network connections to the nationwide R&E networking fabric with SDN and 100GE support
- Integrates network-awareness into adaptive applications
- Develops and deploys tools and best practices to solve end-to-end network performance issues



A New Innovation Platform

The Internet2 community, working together, can create a new Innovation Platform for R&E. Campuses can work with Internet2 and advanced regional networks to construct conditions that will spur a whole new era of innovation:

Innovation Platform—Three Key Components

To build a new Innovation Platform, the R&E community must combine new technologies and services to provide a leading-edge, end-to-end architecture and a unique set of unified capabilities at the national, regional and campus levels.

(1) 100GE Layer 2 Connection

As Innovation Platform partners, Innovation Campuses need to provide an upgrade path, based on the needs and requirements of their constituencies, to support end-to-end 100GE connectivity between their campuses and the Internet2 Network. Where a campus connects to the Innovation Platform via 100GE from an advanced regional network, the advanced regional network must participate in the Innovation Platform as well.

In addition, the Innovation Campus needs to provide a reliable Layer 2 transport network within the campus networking environment. This Layer 2 network will become both increasingly interconnected with higher-layer services, and increasingly programmable, to integrate with advanced applications—allowing the capabilities and suite of services to evolve quickly.

(2) Software Defined Networking (SDN)

Innovation Campuses can support community and application innovations by making a long-term commitment to implement SDN technologies and supporting advanced applications for research groups that request it.

Innovation Campuses can also foster an environment for innovation by providing access to programmable network capabilities, affording researchers the ability to build and manage end-to-end VLANs—from within the campus, through the regional network, and across the Internet2 backbone to other regional networks, campus networkers and researchers. Often this capability will be provided using OpenFlow standards, but other SDN standards are suitable as well. This is likely to include support for a GENI Rack, as part of the larger GENI project.

As SDN capabilities expand to include production-grade virtualization and “slicing,” researchers should be able to load their SDN applications directly onto the network platform at the local, regional, national and global level.

(3) Science DMZ

The Science DMZ model, developed by the **Department of Energy’s ESnet**, is a dedicated portion of an Innovation Campus’s network, located as close to the network perimeter as possible, that serves only high-performance science applications and is directly connected at 100GE to the larger Innovation Platform. The equipment, configuration and security policies of the Science DMZ are optimized for science applications—not for general-purpose or “enterprise” computing. A Science DMZ must include support for end-to-end performance diagnosis and verification. More info on Science DMZ can be found at ESnet’s website: fasterdata.es.net.

Partners Acting with Common Purpose

Innovation Campuses are crucial partners in the effort to build an Innovation Platform that provides the advanced architecture the R&E community needs to deliver fundamentally transformational solutions.

An exceptional example of this partnership—and an exemplary Innovation Campus pilot site—is **Indiana University**, who has partnered with Internet2 to create two cutting-edge SDN control applications.

Open Exchange Software Suite (OESS) provisions virtual circuits across the national Internet2 backbone, allowing researchers to request direct, inter-domain circuits with distant colleagues and begin transferring data in seconds. Another innovation originating from this partnership is FlowSpace Firewall (FSFW), virtualizing OpenFlow-enabled switches and smoothly orchestrating switch governance between multiple controllers without interference.

As these examples illustrate, the new Innovation Platform will produce a new breed of solutions for some of R&E’s most pressing challenges—from the rising cost of education to the increasing globalization of research—as well as a new range of *possibilities*. Possibilities that will move beyond the R&E community to provide positive outcomes for our society. We believe our community can once again help to define a *global* path forward, together.

Internet2 staff stand ready and willing to assist in any way possible, including brainstorming with you, if that is helpful in tackling this new challenge. We are also happy to work with you in preparing proposals in response to recently announced NSF solicitations that can potentially fund part of this ambitious agenda.

More Information

To learn more about becoming an Innovation Campus pilot site and positioning your campus as a key player in helping to shape our community’s future, email innovation@internet2.edu.