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Internet2 at 20: Alive and kicking

After building 8.8Tbit OpenFlow-based SDN network linking university researchers, Internet 2 pivots to R&D, new apps, cloud services.

By Andy Patrizio

Network World | Feb 29, 2016 3:02 AM PT

Nearly 20 years after its launch, Internet2 is quietly humming along on university campuses across the country, doing its R&D work and connecting researchers who might otherwise not be able to share information so readily.

Contrary to any misinterpretations of the Internet2 mission statement, it was not intended to be a replacement or "new" Internet. And because it has been rather quiet lately, some people may have mistakenly figured it was dead.

Internet2 started out to improve bandwidth to research universities, but it evolved into offering a whole range of services, because if it stuck to just bringing high-speed networks to universities, once they had the high-speed networks, Internet2 would be irrelevant. So it branched out. And because of that, people lost track of what Internet2 was about.

"It has a bit of an identity crisis. When they first set it up they made a mistake naming it Internet2. It sounded futuristic and forward-looking but people would eventually ask what happened to Internet3 and Internet4," says Nathaniel Borenstein, chief scientist with Mimecast, a cloud-based email provider who is also involved in Internet2 development.

+ 5 YEARS AGO: Internet2 milestones +

One of the goals of Internet2, after building the high-speed network, was to then bring together researchers who might otherwise be working in isolation or have little to no connection.

"In this country, there are lots of research institutions with lots of clever people that are by default utterly unaware of each other's work," said Borenstein. "Internet2 has a way of bringing them together and making these services more widely available."

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mistake naming it Internet2. It sounded futuristic and forward-looking ... ”

Nathaniel Borenstein, chief scientist with Mimecast

Many campuses have separate connections to the regular Internet and Internet2, and that's for a good reason: to keep Internet2 free from the bandwidth hogs of the regular Internet so researchers can have the full bandwidth for their work and not be slowed down by Netflix subscribers.

Dave Lambert

"One thing to always remember about Internet2 is it's a complicated ecosystem that starts with the university network and aggregates into state and regional networks and then a national network and connects to research networks all over the world," says Dave Lambert, president and CEO of Internet2, the company behind the consortium.

Mark Askren

Mark Askren, vice chancellor for information technology and CIO of the University of Nebraska-Lincoln, is generous in his praise of Internet2's past and where it's headed. "I think Internet2 is working great. It's accomplished its initial mission of providing state of the art, high-speed, reliable, cost-efficient research networking for its members.

"What we're seeing now is it's not just the connectivity, it's what we do with it," he adds. "Our faculty have been collaborating [with researchers] across the country and around the world on research for many years. What we're seeing now is the rest of us on campus can benefit from this ubiquitous connectivity and look to leverage the cloud."

The bottom line, he said, is they still need that high-speed connectivity, because it doesn't matter where the servers are, what matters is that you have the connectivity to reach it.

Let it flow

Many of the technologies that constitute the regular Internet are up to 30 years old, such as TCP/IP, Ethernet and sendmail. Internet2 has been building new high speed network connections using a clean sheet design, so as not to be encumbered with technologies dating back to the Carter Administration.

Internet2 has in aggregate 8.8 terabits of capacity on the network, with 100 gigabit connections to participating universities, all via an OpenFlow/SDN network. Virtualized networking and OpenFlow came out of National Science Foundation projects at Stanford University.

"Internet2 became the first all-OpenFlow network providing support for end users," says Lambert. "We've been fully on OpenFlow for two years. The impact that has had in catalyzing open networking foundations and creation of open networks has been very important."

Luca Prete, a deployment engineer with Open Network Laboratories (ON.Lab), said OpenFlow's SDN design is great within its own network, but it still needs to communicate with legacy networks. That's a technology his company provides.

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"SDN networks work very well in an isolated world but there wasn't a way before to let them communicate with the external world," he says. "It's not about greenfield deployments. There's no one saying, `I completely throw away my network and deploy an SDN network from scratch.' You need to go incrementally. This is something SDN-IP can do for you."

He also said Internet2 has a tool called FlowSpace Firewall to enable network slicing and virtualization, which means concurrent experiments can run on the same network with production traffic.

Identity Management and Federation

One of the more interesting non-bandwidth projects to come from Internet2 is Shibboleth, a form of single sign-on where once you log in, the network handles connections to any site requiring a login.

For example, say you sign on to Amazon, eBay or Overstock from your personal PC. The Shibboleth system would pass along all of your information to the site through a back channel, so there would be no need to have a login and password. Your ISP in this case would handle the introduction and connection.

Unfortunately, Shibboleth was never meant for commercial use, it was for Internet2-connected schools' own internal federation, says Lambert. The Shibboleth technology did make it to commercial use in the form of SAML, an XML-based language for exchanging authentication information. Lambert says we are beginning to see consumer equivalents of that now, such as using your Facebook login on other sites and in mobile apps and that he would "like to see federated identity become more widely-deployed technology."

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NSF FUNDING

The National Science Foundation began funding the creation of five new supercomputing centers. At the same time, the NSF established NSFNet, a network connecting the centers to each other and to other campus networks using TCP/IP.

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Timeline JS
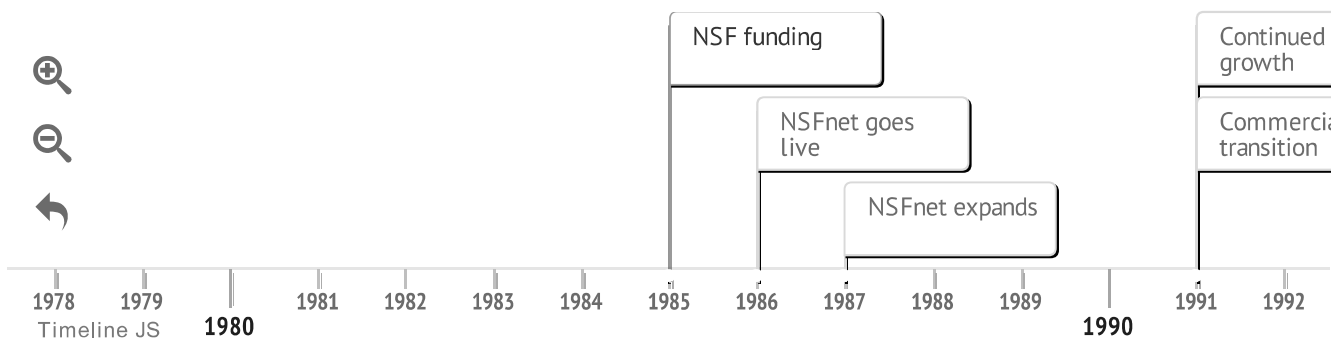
Askren says identity management is as important to researchers as connectivity, processing and storage. "In a world where we leverage the cloud for research collaboration, it becomes extremely important that we have effective identity management to validate who we are and security concerns out there. It needs to be effective and unencumbering," he says.

Internet2 has come up with two new secure means of identity federation. The first is InCommon, a federated identity management service with the ability to connect different people from multiple institutions. Individual institutions usually operate with their own silos of data, all requiring a separate identity and login. InCommon provides the ability to share credentials between research institutions.

Second is TIER, or Trust In Education Research, an upgrade to InCommon and other identity management technologies like identity and access management (IAM), providing a consistent interface across the different schools and providing scalability for large scale identity management and data sharing.

This is needed because researchers are dealing with more and more data. For example, UNL is participating in the Large Hadron Collider project, and "the extremely large amounts of data it generates would not have been possible without the high-speed connections Internet makes available," says Askren.

Cloud computing

Another big push in recent years has been to cloud services, both inside and outside of the university. Lambert notes that Amazon's cloud services are a very important part of anyone's ecosystem. "Many bioinformatics and genomics databases have been built in AWS, so it's important to get fastest access to those services," he says.

To help universities, Internet2 created a program called Internet2 Net+ services. It works with universities to find cloud services most useful to that school and then develop a relationship that is intended to improve the functionality of those services to the university. Internet2 then helps negotiate a business arrangement between the cloud service provide and the school.

"There really isn't a business model for universities. In most cases, the professor has to pay for a cloud service with his credit card. Net+ makes a more effective service offering catered to the needs of Internet2 providers and addresses billing and authentication," says Lambert.

Askren also likes the new effort around cloud services, because schools were lagging behind private industry in their embrace of the cloud. "Net+ helps gain access to services like Box and others that provide important parts of our transition to the cloud for greater scale and efficiency, but I believe we will go further than that in terms of providing more services through the cloud as we move away from each university being a silo of its own technical services," he says.

The one tech buzzword not on the minds of Internet2 users is Big Data. That's because Big Data is about sucking up vast quantities of data and then analyzing the heck out of it. "That's a natural commercial model. In the research world, it's more ad hoc and less commercially motivated," says Borenstein.

"Academia is about publishing papers and getting grants. You don't get that by manipulating data to yourself. You get more by using other people's data. They compete on the discoveries and credit," he adds.

The future

Internet2 is not going away even though it has accomplished what it set out to do when it started in 1996, to provide high-speed connectivity and discovery to university researchers. It's merely transitioning to the next stage.

"It started with bandwidth but now it's about network-based services," says Borenstein, such as tools for collaboration, like video conferencing and high-end resource sharing.

+ A LOOK BACK: <u>A timeline of Internet2</u> +

It also means researchers will talk more, thanks to Internet2. "Twenty years ago, research was a scientist holed up in his lab. That grew to putting a bunch of the research in an institute. Now it is organized at the global level. Many now spend hours each day communicating via video conferencing tools like Zoom, which came out of an Australian university," says Lambert.

Askren looks forward to global collaboration thanks to Internet2's new emphasis on cloud services. "We are engaging in partnerships around the globe. Having that connectivity and identity services and professional development and leadership Internet2 offers provides a framework to improve on all those things," he says.

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Andy Patrizio is a freelance journalist based in southern California who has covered the computer industry for 20 years and has built every x86 PC he's ever owned, laptops not included.
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