11th Annual Global LambdaGrid Workshop

Robert P. Vietzke, Executive Director, Network Services, Internet2

NDDI & the OS3e

A distributed open LIGHTPATH NETWORK built on SDN/Openflow technology

Today's NDDI/OS3E talk:

- Very much a work in progress and just a beginning!

- Background on motivation and enablers

- Network Design and Deployment Initiative (NDDI)
  - Partners / Program Structure
  - Long term Goals

- The Open Sciences, Scholarship and Services Exchange (OS3E)
  - Capabilities
  - Technical primer
  - Timeline
  - Policy Objectives

- Open Questions, Next Steps & Discussion

Motivation: Internet2's Seven focus areas

Advanced network and network services leadership

Services at scale:
Services "above the network"

U.S. UCAN – Community Anchor Network Program

Industry partnership development and engagement

Global reach and engagement

Research community development and engagement

National/Regional Partnership

INTERNET 2

Internet2 BTOP-funded Upgrade

- Interconnection Site

- Upgraded 100 Gbps IP/MPLS/iON Network with 10 Juniper T1600's
- Upgraded peering service network with 6 Juniper MX960's
- Deployment of a new layer-2 service on NDDI/OS3E network
- Enhanced research programs and support

INTERNET 2

Network Development and Deployment Initiative (NDDI)

Partnership that includes Internet2, Indiana University, & the Clean Slate Program at Stanford as contributing partners. Many global collaborators interested in interconnection and extension

Builds on NSF's support for GENI and Internet2's BTOP-funded backbone upgrade

Seeks to create a software defined advanced-services-capable network substrate to support network and domain research [note, this is work in progress]

Components of the NDDI Substrate

- 30+ high-speed Ethernet switches deployed across the upgraded Internet2 network and interconnected via 10G waves

- A common control plane being developed by IU, Stanford, and Internet2

- Production-level operational support

- Ability to support service layers & research slices

BLADE NETWORK TECHNOLOGIES

64 x 10G SFP+   1.28 Tbps non-blocking
4 x   40G QSFP+   1 RU
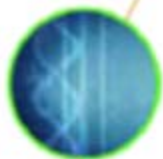
INTERNET 2

The NDDI Control Plane

- The control plane is key to placing the forwarding behavior of the NDDI substrate under the control of the community and allowing SDN innovations

- Eventual goal to fully virtualize control plane to enable substrate slices for community control, research and service development

- Will adopt open standards (e.g., openflow)

- Available as open source (Modified Berkley Apache 2.0 License)
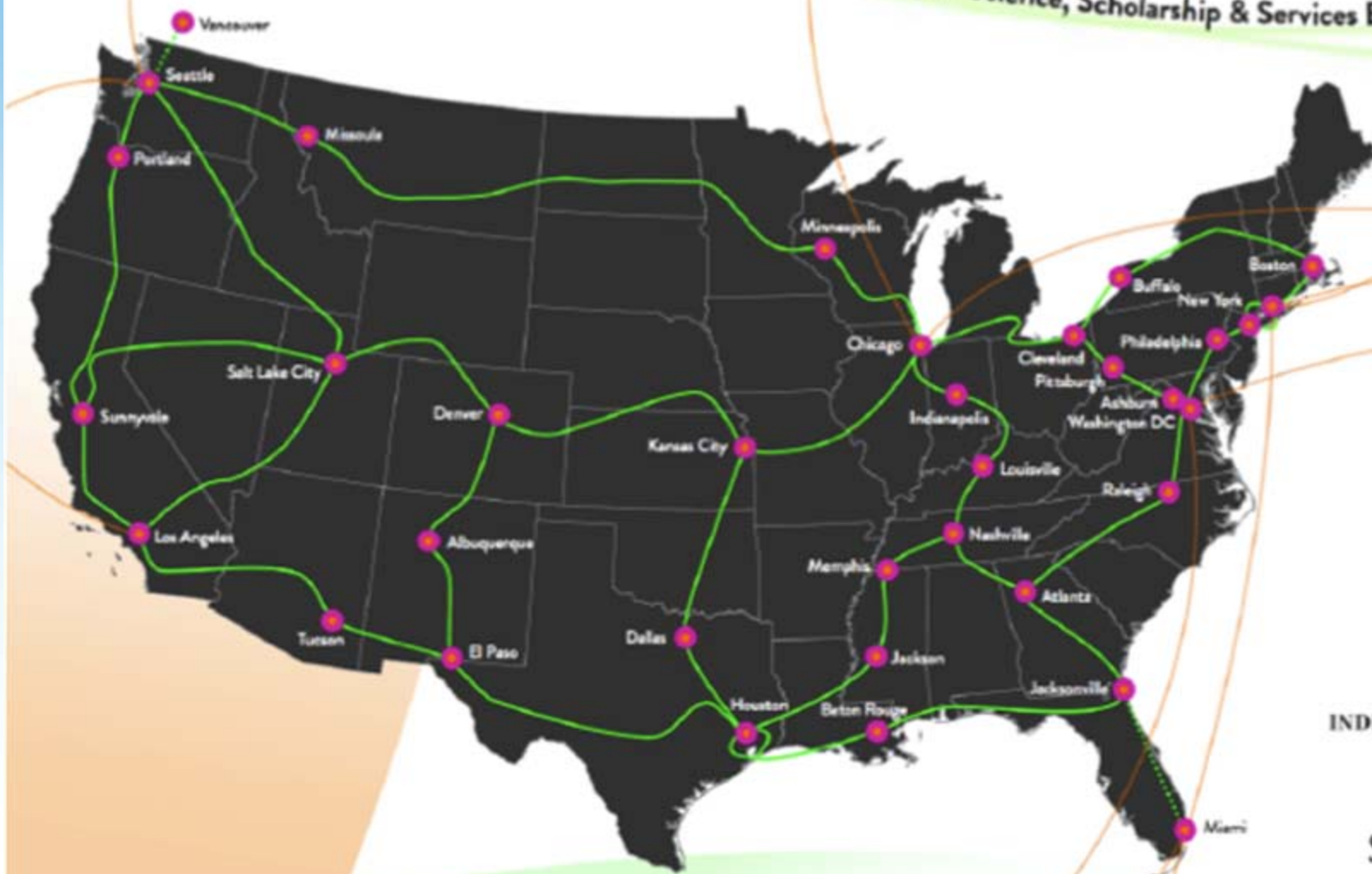
INTERNET 2

Open Science, Scholarship and Services Exchange (OS3E)

- An example of a community defined network service built on top of the NDDI substrate.

- The OS3E will connect users at Internet2 POP's with each other, existing exchange points and other collaborators via a flexible, open layer 2 network.

- A nationwide distributed layer 2 "exchange"

  - Persistent layer 2 vlans with inter-domain support

- Production services designed to support the needs of domain science (e.g., LHCONE, DYNES, DyGIR etc)

- Will support open interdomain standards

- Available as open source (Modified Berkley Apache 2.0 License)

INTERNET2

OE-SS

Workgroup: Example

Home > Details > Interdomain > Endpoints > **Primary Path** > Backup Path > Scheduling > Provisioning

Path
Choose a primary path from the map below by clicking on links between nodes.

(Proceed to Step 5: Backup Path)

Summary

Description
Example

Bandwidth
300 Mbps

Type
Local

Status
Planning

Endpoints

Interface	VLAN
Chicago - 2	452
Atlanta - 3	478

Primary Path
Chic-Losa
Atla-Losa

Legend:
- ● Selected Endpoint
- ● Unselected Endpoint
- ● Endpoint Being Viewed
- ▬ Primary Path
- ▬ Secondary Path
- ▬ Primary and Secondary Path
- ▬ Unselected
- ▬ Down

(Suggest Shortest Path)

GlobalNOC
Global Research Network Operations Center

Internet2 Network

OE-SS

Summary

Description
Test

Endpoints

Interface	VLAN
IBM Test Switch - 42	12
IBM Test Switch - 48	24

Bandwidth
500 Mbps

Type
Local

Status
deploying

Edit Circuit

Remove Circuit
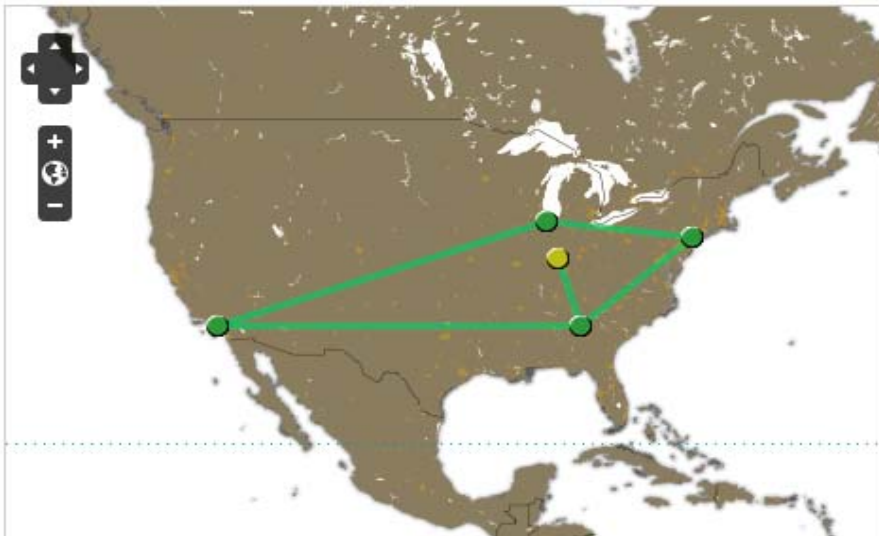
Traffic | Scheduled Events | Historical Events

[Traffic graph showing input/output values from Sep 10 20:00 to Sep 13 8:00, with y-axis values 2, 2, 1, 500 m, 0]

input   output

Past 3 Days

Legend:
- Selected Endpoint
- Unselected Endpoint
- Endpoint Being Viewed
- Primary Path
- Secondary Path
- Primary and Secondary Path
- Unselected
- Down
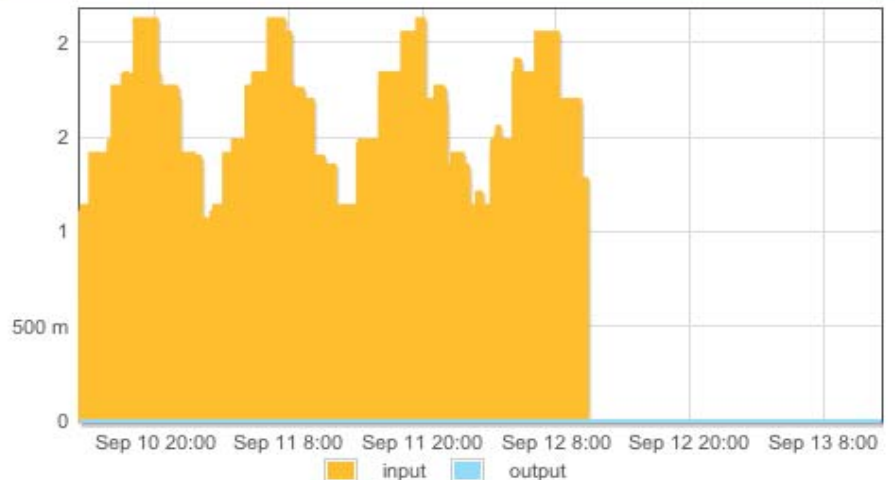
Timeline

April, 2011	Early Program Announcement
May-September	Hardware, Controller selection
	Substrate development
October, 2011	First Deployment and Domestic Demo
	Link Policy & funding discussion
	Next site group selection
	iNDDI engagement
November, 2011	Expanded Deployment
	Inter-domain capabilities
January, 2011	Large scale domestic deployment

Support for Network Research

- NDDI substrate control plane key to supporting network research
  - at-scale, high performance, researcher-defined network forwarding behavior
  - virtual control plane provides the researcher with the network "LEGOs" to build a custom topology employing a researcher-defined forwarding plane
- NDDI substrate will have the capacity and reach to enable large testbeds

INTERNET 2

Making NDDI global…

- Substrate will support IDC (i.e., it will be inter-domain capable)

    - Expect interconnection with other OpenFlow testbeds as a first step (likely staticly)

- While the initial investors are US-based, NDDI seeks global collaborators on the substrate infrastructure as well as control plane features

- Currently collecting contact information for those interested in being a part of NDDI

    - please send e-mail to nddi-intl@internet2.edu

INTERNET
2

"Open"

- Although it may be disruptive to existing business models, we are committed to extending a policy-free approach within the OS3E service

- Each individual node should function like an "exchange point" in terms of policy, cost, capabilities

- Inter-node transport scalability and funding needs discussion and may be separate

- Internet2 would like to position this service on the forefront of pushing "open" approaches in distributed networks.

INTERNET2

Robert P. Vietzke, Executive Director, Network Services
rvietzke@internet2.edu

Discussion