Internet2 Network Services Overview

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Agenda

- Bespoke Network Services *(for HigherEd & Research)*
- Internet2 Network Services *(Building Blocks)*
- Cloud Connectivity *(Can not, not talk about cloud, can we?)*
- Insight Console *(Build your own)*

Services

LAYER 1 SERVICE

Point-to-point 10, 100 & 400G links and flexible grid spectrum to support private network needs.

LAYER 2 SERVICE

Effective and efficient wide area 100 gigabit Ethernet technology.

LAYER 3 SERVICE

For IP network and peer exchange needs.

PEER EXCHANGE

Provides institutions with access to commercial peers across the national footprint.

RAPID PRIVATE INTERCONNECT

Allows Internet2 connectors to present themselves for private peering at selected national peering locations.

R&E

Provides institutions with access to each other across the national footprint.

CLOUD CONNECT

Uses regional's infrastructure in conjunction with the Internet2 Network to reach cloud resources.

GLOBAL DDoS PROTECTION

Our cloud-based, volumetric DDoS mitigation service was procured on behalf of the community.

Networking for Cloud

I2PX

1. INTERNET2 PEER EXCHANGE

Use of the community's existing 10+ Tbps of peering capabilities to the major cloud providers for advanced access to cloud SaaS services. (e.g. Zoom or Office 365)

I2CC

2. INTERNET2 CLOUD CONNECT

Enabling the Internet2 and REN infrastructure to offer shared "direct-connect" private Layer 2 and Layer 3 access to Microsoft, Amazon, Oracle and Google cloud platforms up to 5Gbps at no additional fee. *(Cloud provider fees apply)*

I2RPI

3. INTERNET2 RAPID PRIVATE INTERCONNECT

Private interconnections at major peering points at low annual rates. Leverages current investment in local and national infrastructure to reach cloud providers, for dedicated access or improved resiliency. May be used to connect to any provider located at the peering point.

aws

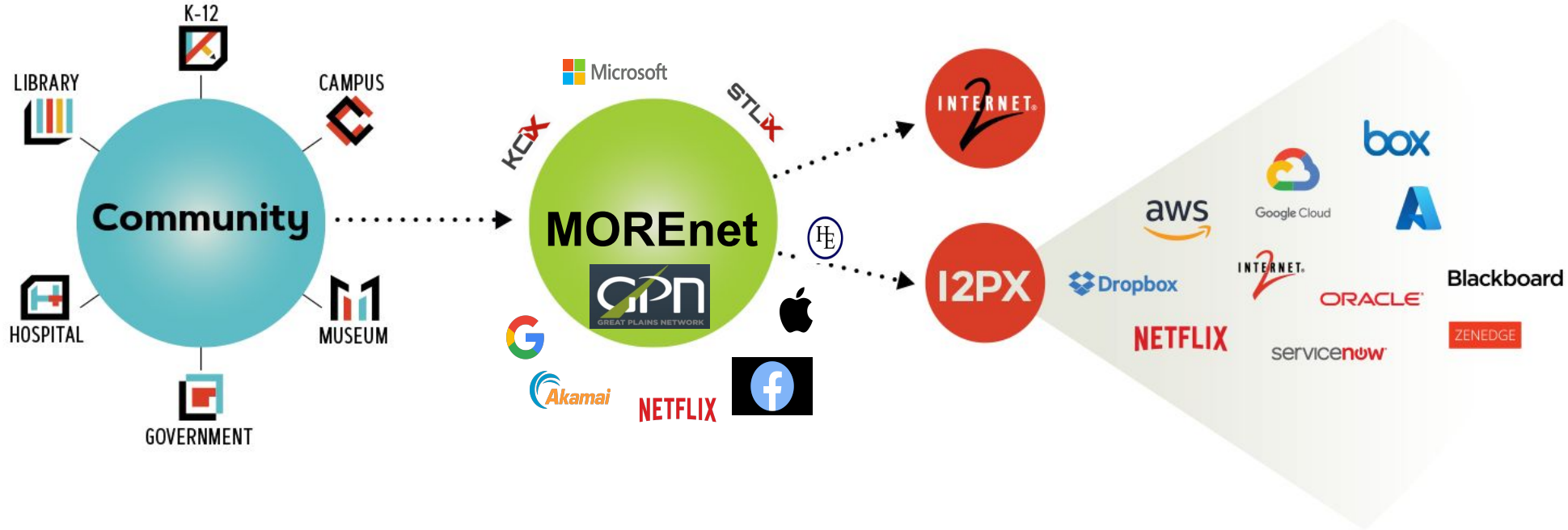
Google Cloud

ORACLE
FAST CONNECT

DESIGNED FROM THE GROUND UP TO MEET THE R&E NEEDS

Internet2 Peer Exchange

I2PX



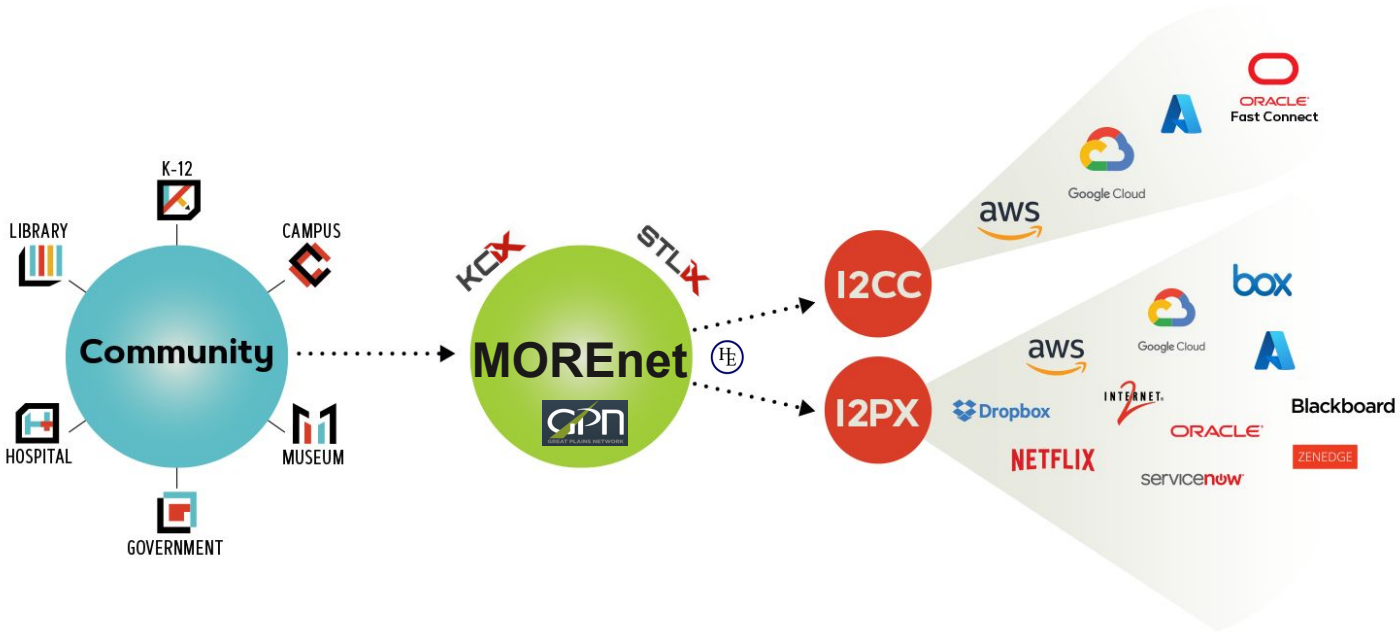
Allows REN to have high performing on-net access to cloud service providers, avoiding the commodity internet

Designed from the ground up to focus on hosting cloud providers most valued by the R&E community

Available to REN members today at no additional fee

Use Case: I2PX & Cloud Connect

- Community members leverage their existing Internet2 Network investments
- Directly augments commercial services demand
- Provides high-speed access to network-intensive off-net applications, such as social networking and high-definition video
- I2PX provides high performance, low latency, and efficient (often 1 hop) access to some of the top content destinations in the world including: Google, Zoom, Netflix, and other commercial content providers. The service supports IPv4 and IPv6. Transit between subscribers is not permitted.
- Individual community members can also use Cloud Connect for private connections to Amazon Direct Connect, Google Cloud Partner Interconnect, Microsoft Azure Express Route or Oracle Fast Connect services.



Nationwide Connectivity

Internet2 Cloud Connect

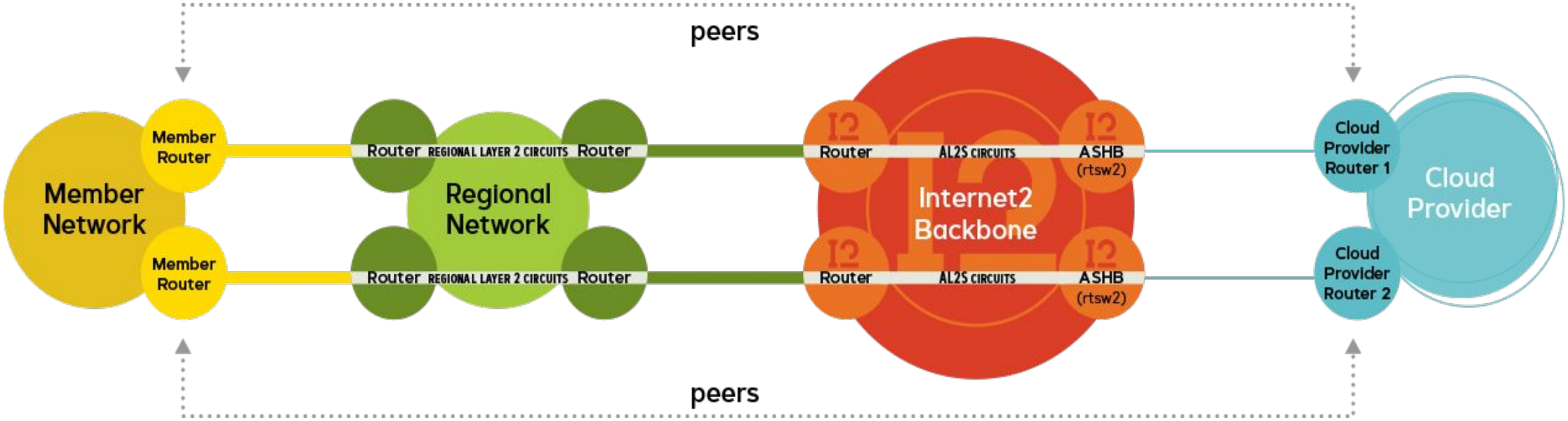
I2CC

NEW! **Los Angeles coming soon!**

Layer 2 Connection Option

Internet2 Cloud Connect

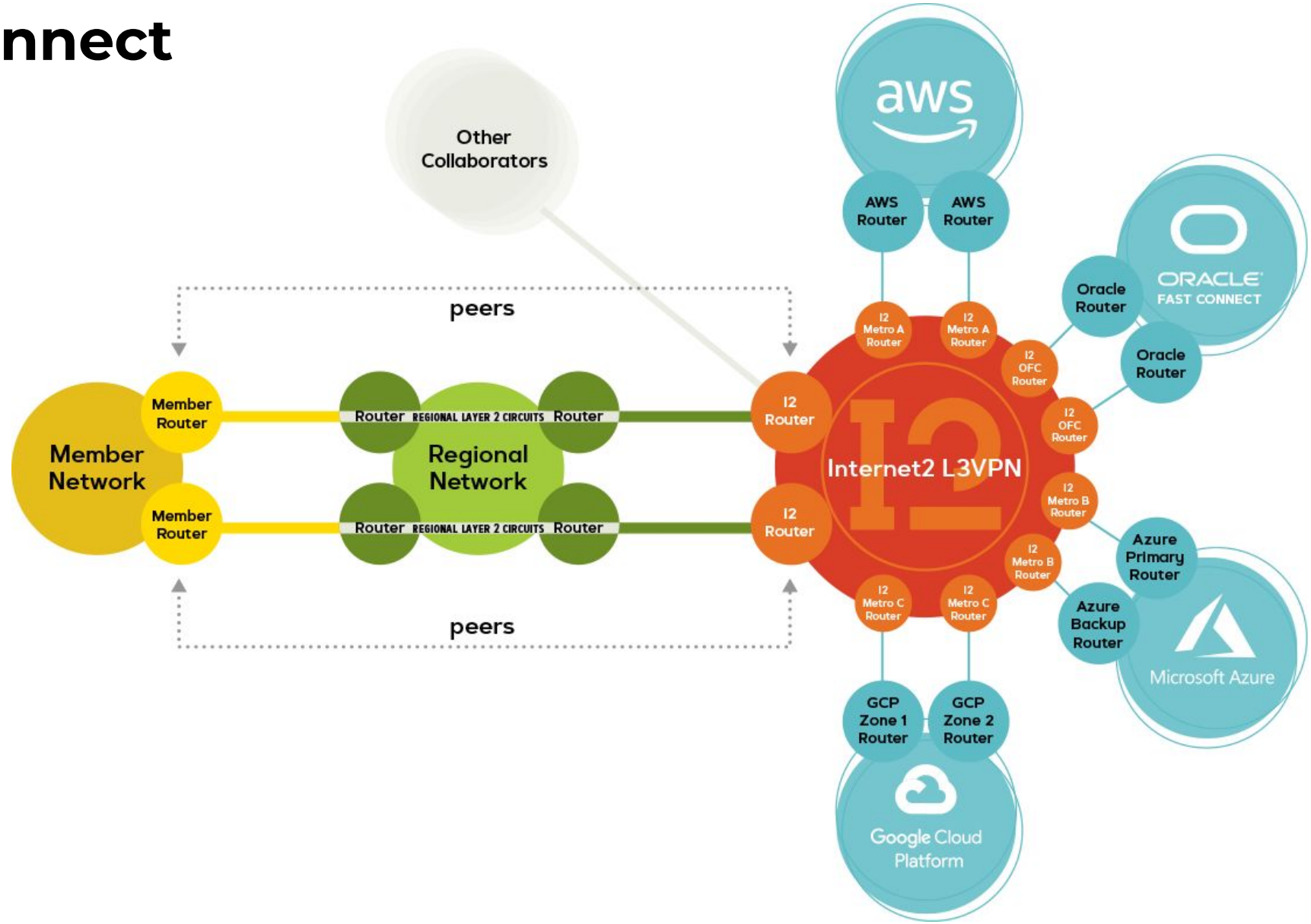
I2CC



Layer 3 Connection Option

Internet2 Cloud Connect

I2CC



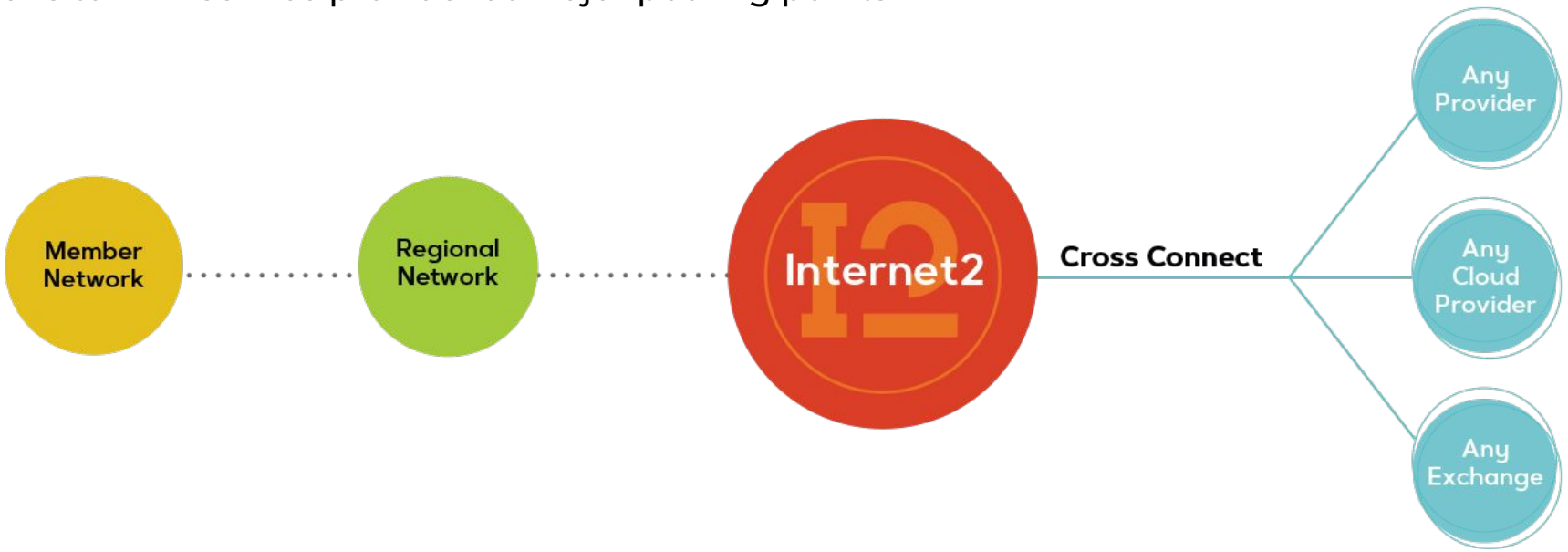
Flexible Connections to Any Provider

Internet2 Rapid Private Interconnect

I2RPI

Available through Network Connectors for an additional fee

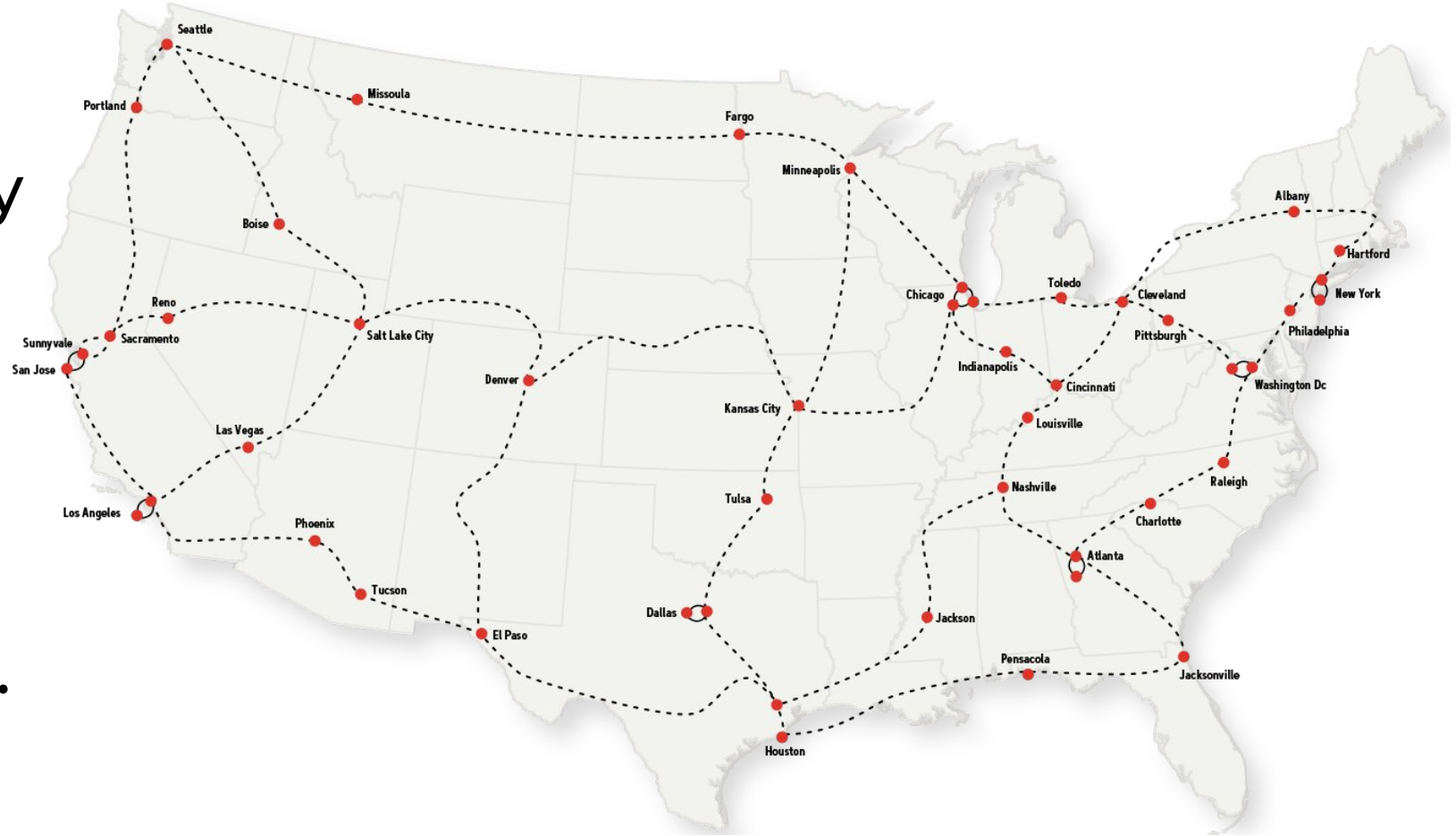
- Connect at Layer 2 or Layer 3
- Private 10G dedicated connections to Amazon Direct Connect, Google Cloud Interconnect, Microsoft Azure ExpressRoute, or Oracle Fast Connect services
- Private 10G dedicated connections to ANY service provider at major peering points



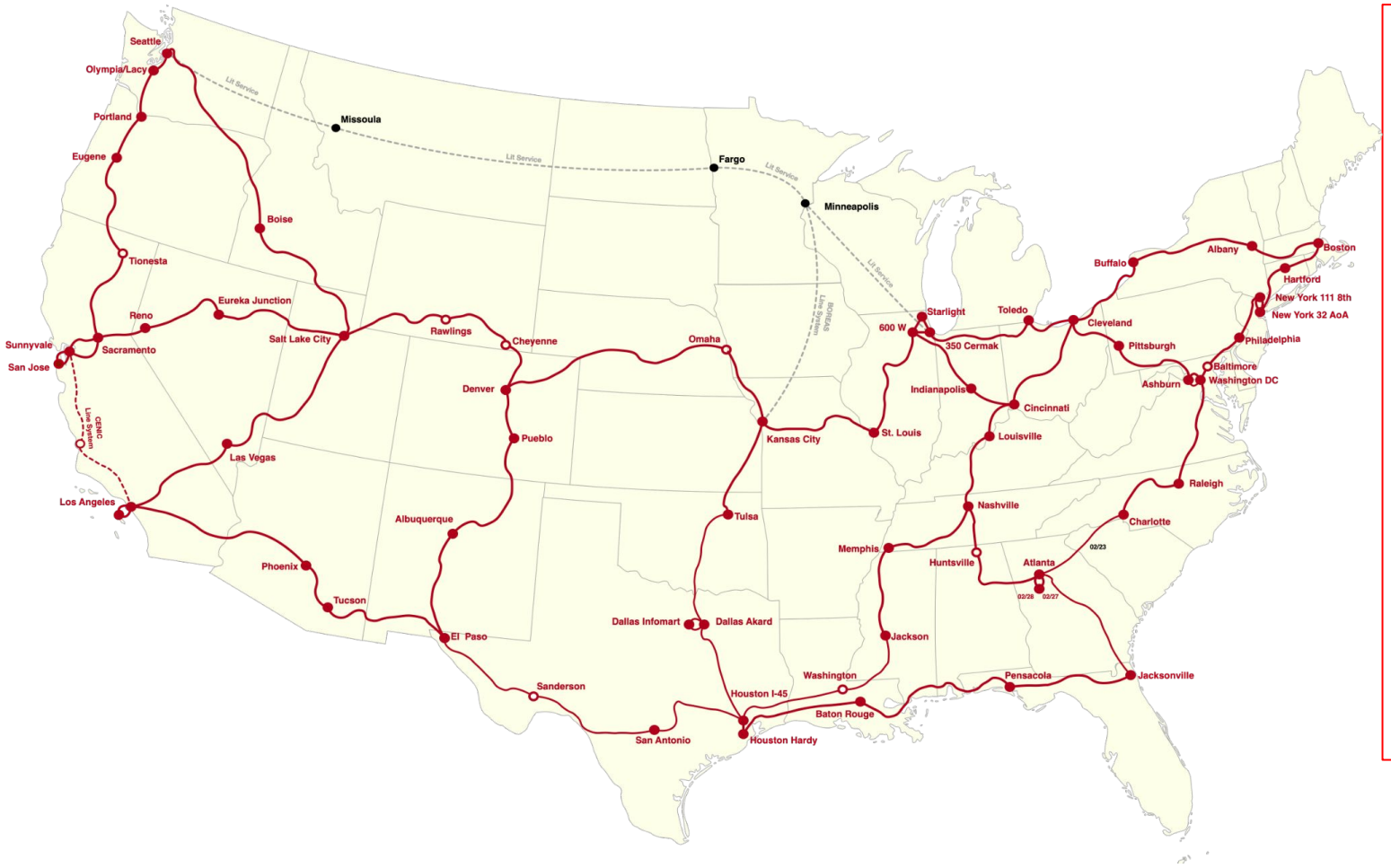
Nationwide Connectivity

Internet2 Rapid Private Interconnect

I2RPI can be used to provide private direct connects to any provider with some examples being 10G connections to SIP service providers, esports exchanges or other cloud providers.



Layer 1 Services



Stats

16,100 miles of optical fiber
Ultra SMF28 + a little eLEAF
Flexible with 74+ add/drop sites
Open line system, (not locked to a single vendor)

Backbone Waves (400G)

94 400 Gbps Backbone Circuits (WaveServer 5)
4 400 Gbps Backbone Coherent Pluggables

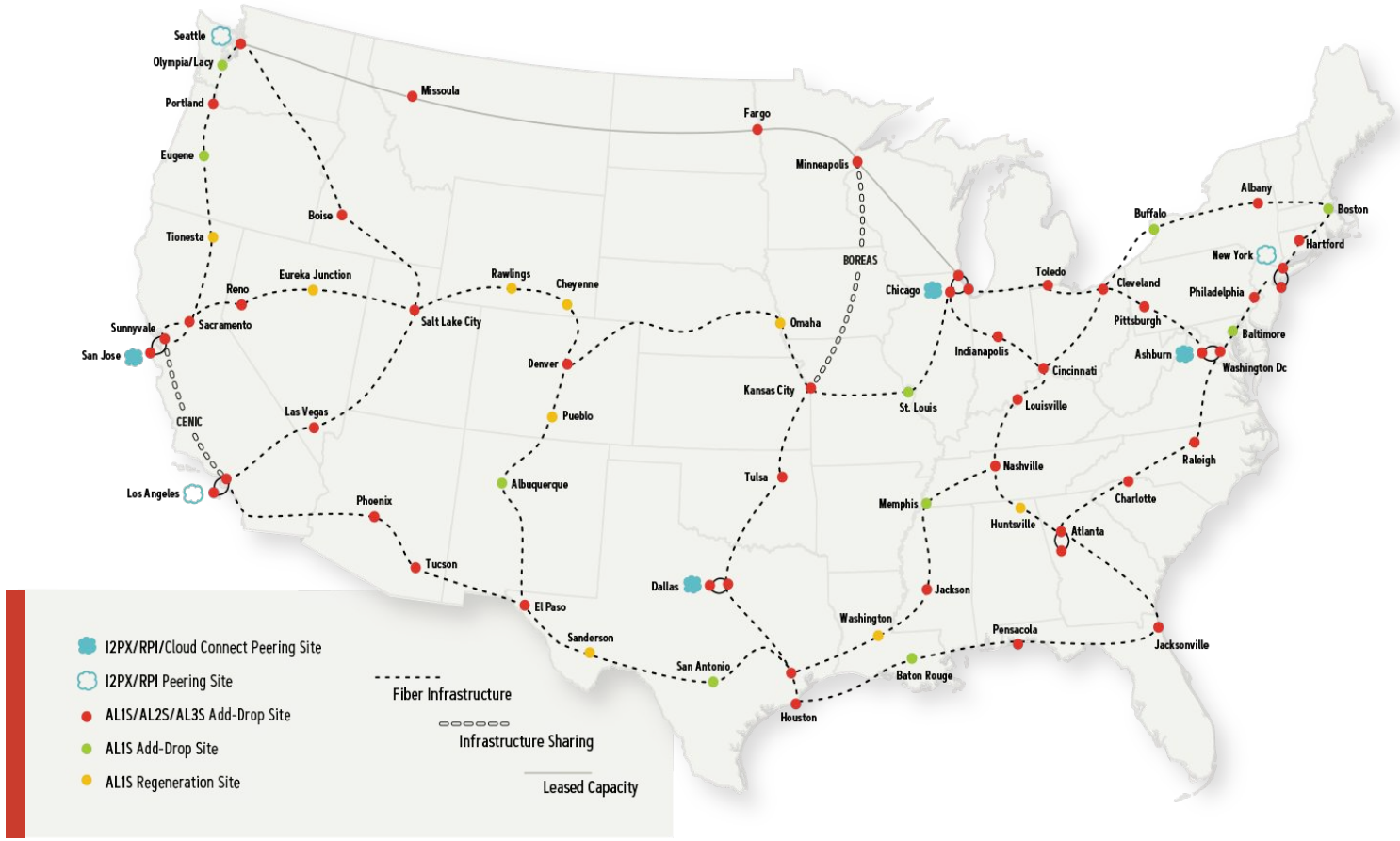
Foreign Waves

6 point-to-point alien waves

Customer Services

10 400 Gbps Circuits
50 100 Gbps Circuits
60 10 Gbps Circuits
7 Managed Spectrum (Community) 600-800 Gbps

Layer 2 and Layer 3 Services



I2 Cloud Connect

643 Connections

I2 RPI

42 10G Interfaces
2 100G Interfaces

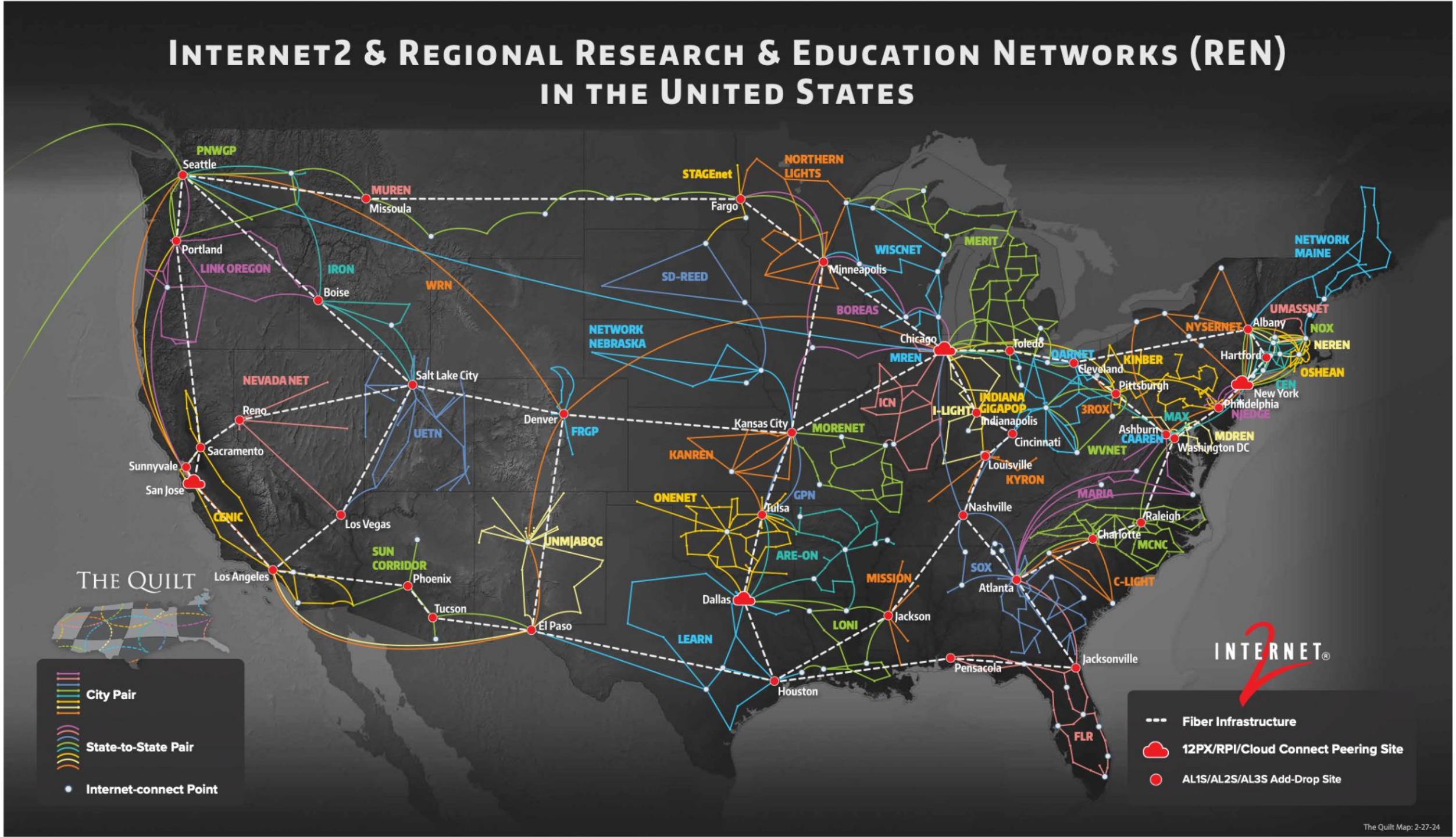
I2 DDOS

14 Subscribers
95 Tenants

I2 Insight Console (Past Year)

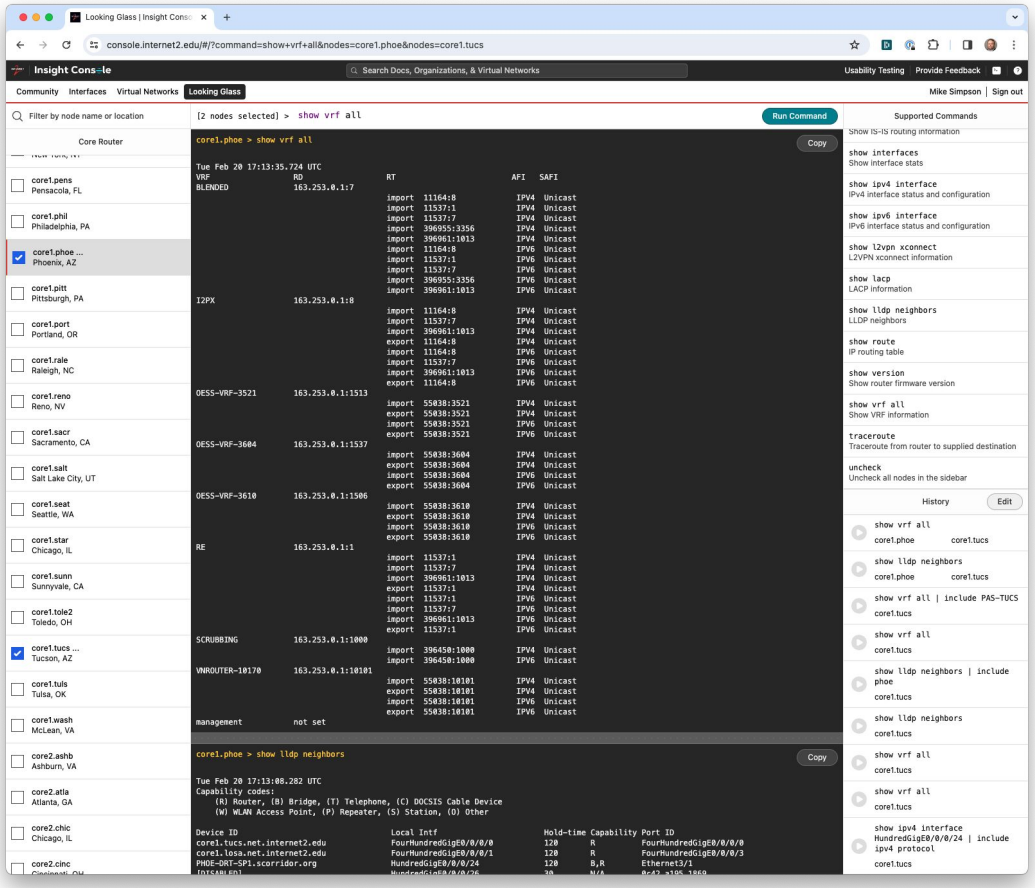
217 Layer 2 Connections Created or Updated
90 Layer 3 Connections Created or Updated
48,000 Looking Glass Queries Executed

Internet2 & Regional Research & Education Networks (REN) in the United States



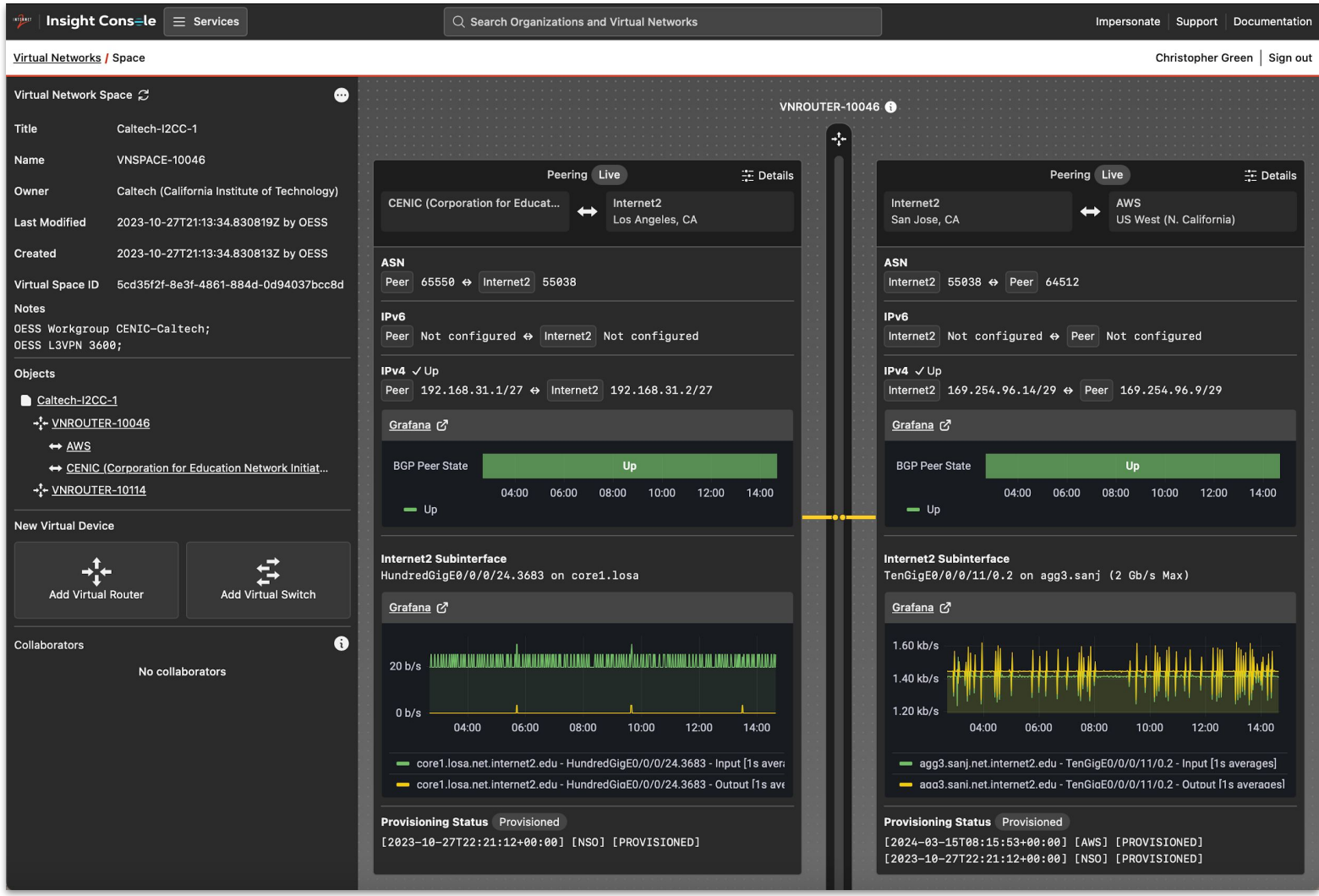
Insight Console *(Build your own)*

- **Goal**: A web-based tool for **visualizing**, **managing**, and **troubleshooting** all Internet2 **network services**.
- Authentication and authorization integrated with **Internet2 Identity Services** (a.k.a. “InCommon SSO”).
- Functions delivered since 2023:
  - **Looking Glass**: Run commands (in a safe and secure environment) against our production devices and get live results.
  - **Community**: Self-management of organizations, people, and roles.
  - **Interfaces**: Visualization of network ports and services.
  - **Virtual Networks**: Creation and management of L2 and L3 overlay networks, including CloudConnect.
  - **Routing Intentions**: Visualization and management of I2RE and I2PX routes and routing policy.
- Planned Functions:
  - **Routing Policy**: Control prefixes exchanged with peers



Virtual Networks

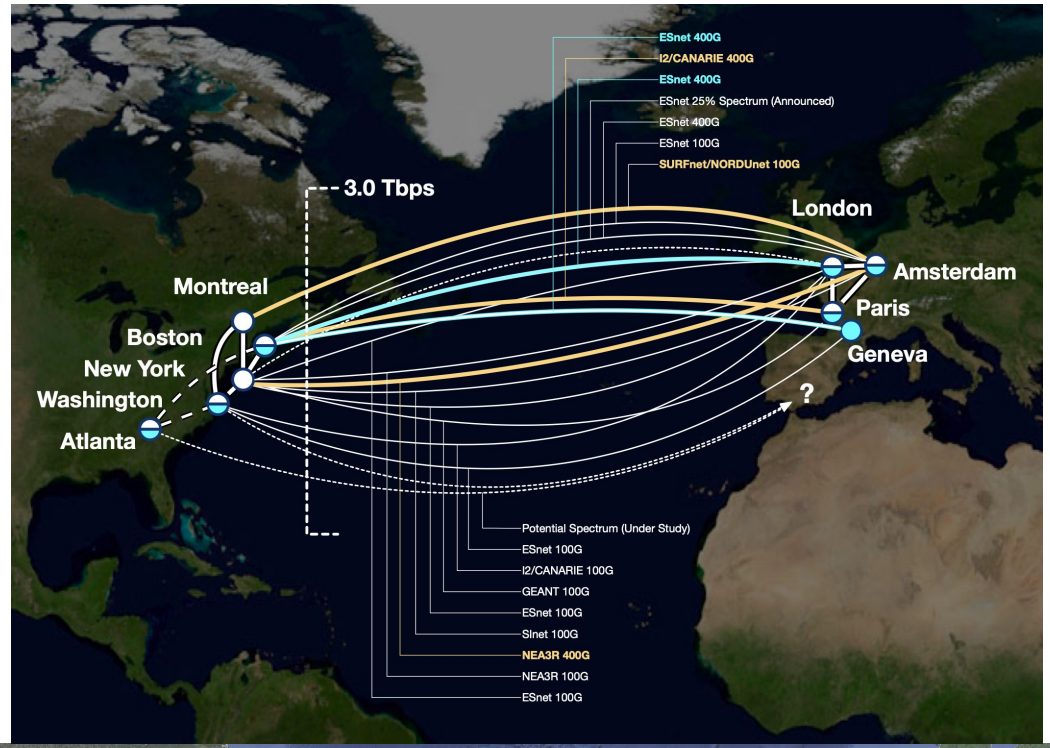
- **Visualization**, **management**, and **troubleshooting** for L2 and L3 **overlay networks**; a re-implementation and enhancement of similar functionality previously delivered via OESS/CloudConnect.
- **Virtual spaces** provide a canvas within which different organizations can **collaborate** on building overlays.
- **Virtual devices** (switches and routers) can be added to spaces to **establish** L2 and L3 overlays.
- **Virtual connections** can be added to devices to **connect** the overlays to interesting places: other Internet2 members or downstream sponsored parties, government and industry partners, cloud partners (AWS, Azure, GCP, OCI), etc.
- Provisioning of the overlay networks on Internet2's production network is handled via **Insight API** calls, with backend automation provided through **NTC Nautobot**, **Cisco NSO,** and other supporting tools.

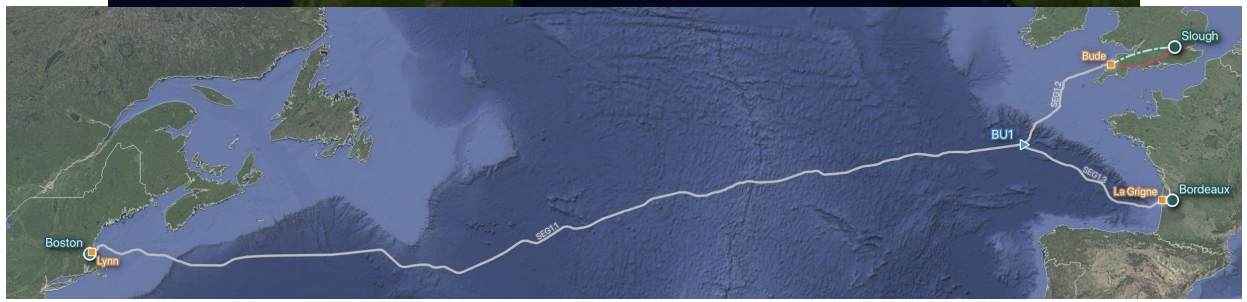


INTERNATIONAL NETWORKING and COLLABORATION

400G in the Atlantic

- A key part of the global ecosystem for R&E
- Continuity from European 400G networks to North American networks
- Amitié cable
- Part of Advanced North Atlantic
- Primarily a collaboration between CANARIE, ESnet, and Internet2; however success depends on all the ANA partners!
- ESnet also has two dedicated links as part of system
- First of Many Expected





NA-REX: Collaboration, Overlay

International Collaboration: NA-REX

- North American consortium of Exchange Point Operators, Connectivity Providers, Science Networks
- Improve coordination, establish common operating principles
- Leverage common toolsets, provisioning mechanisms
- Support dedicated links for experimental traffic, network research
- Initial links online:
  - Chicago and Seattle (dedicated)
  - Chicago and Los Angeles (dedicated)
- Links were successfully leveraged by Supercomputing NREs (Network Research Experiments) and OFCnet
- Currently planned:
  - Deployment of dashboard based on NetSage
  - Bring additional 400G links online
  - Restore API functionality to I2 Exchange Points (Q2)