ESnet Update

DOE SC Exascale Requirements
Review: High Energy Physics

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ESnet Background

1. ESnet is a special-purpose mission network, funded by Congress to support scientific goals of the Department of Energy.
2. We see networking as a means to an end: scientific productivity.
3. We aim to create a world in which discovery is unconstrained by geography.

ESnet

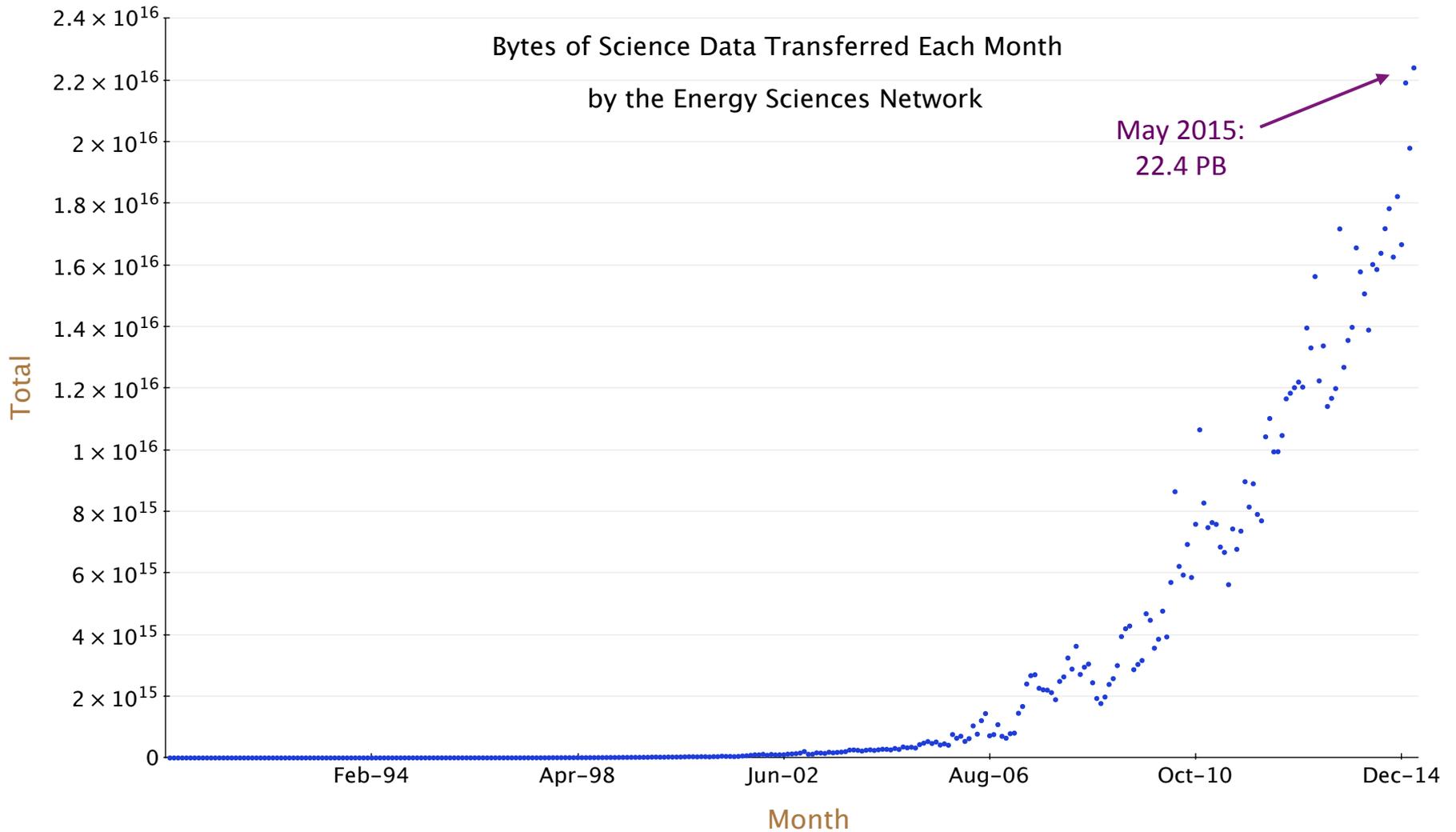# ESnet's close relationship with HEP goes back 30 years, to the origin of the facility.
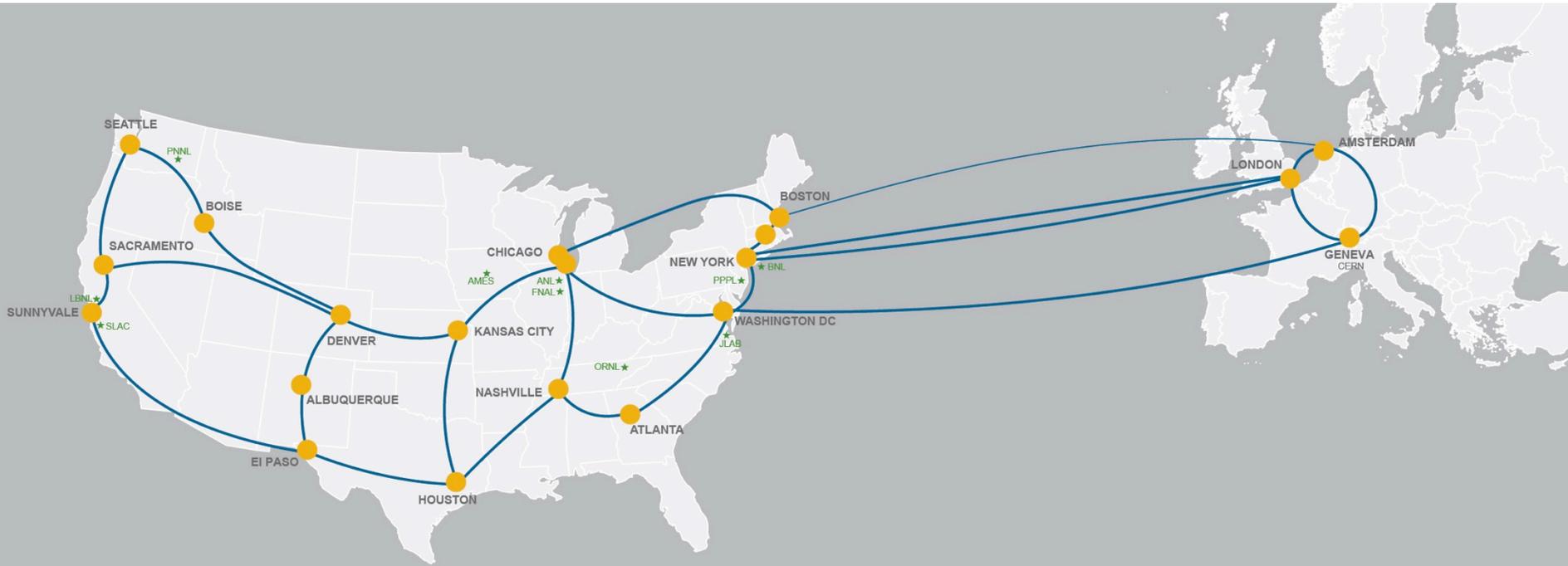
Recent collaborations: 340Gbps transatlantic extension to support LHC Run 2 (plus all SC science missions); direct connections to US universities for LHC science.

80% of ESnet traffic originates or terminates outside the DOE complex.
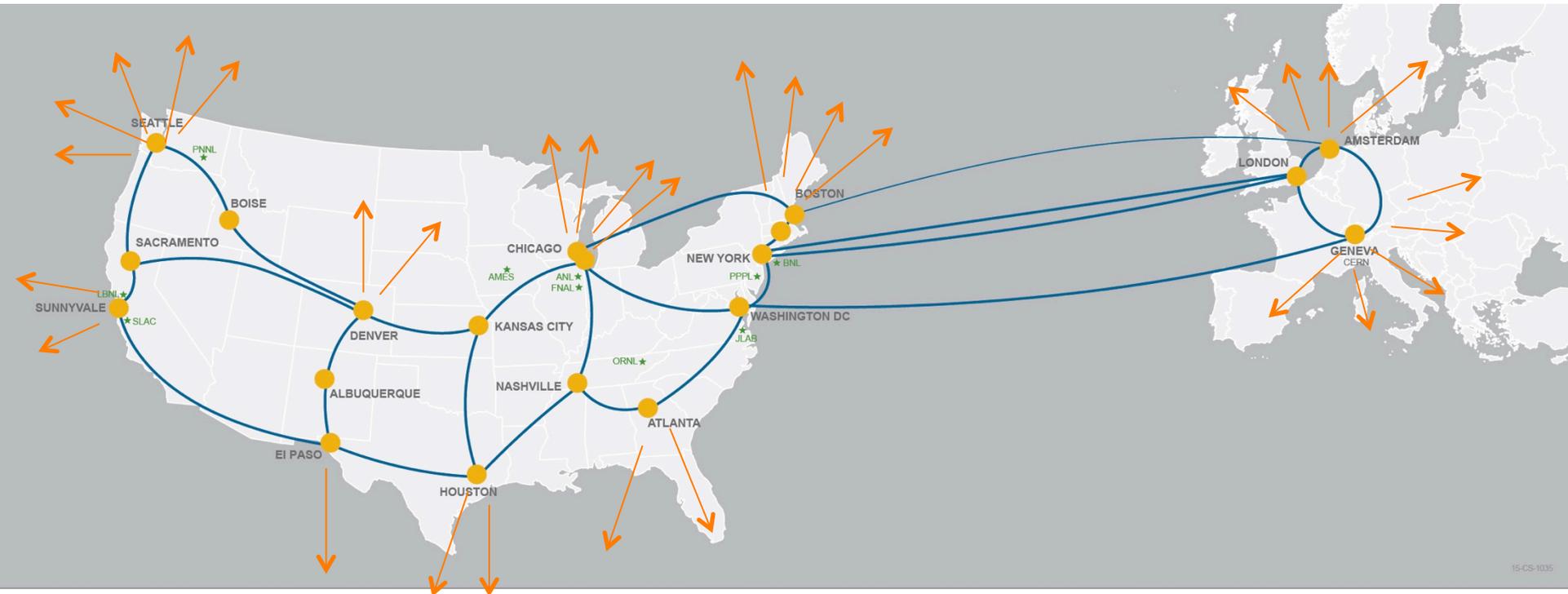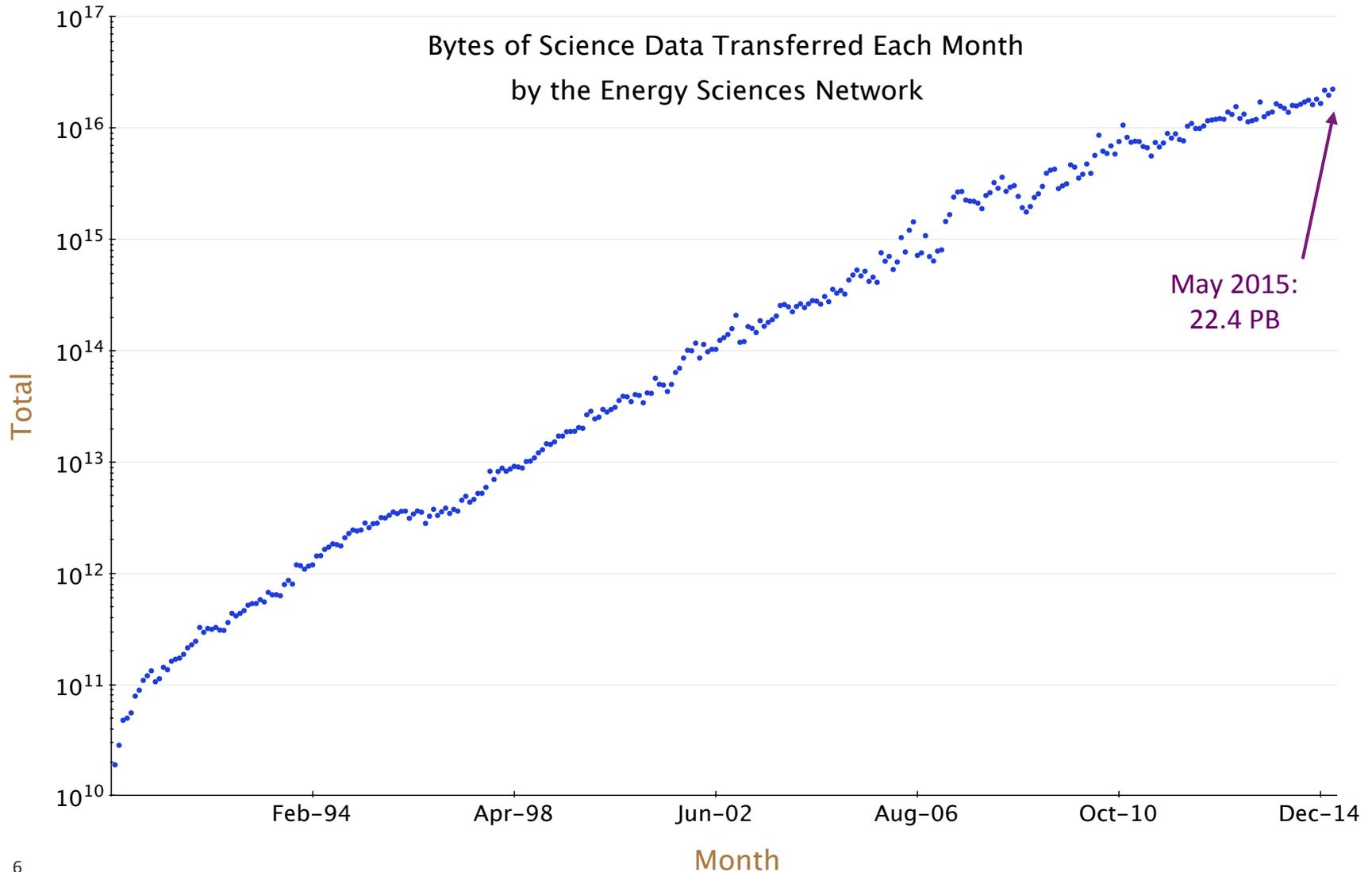

A significant fraction is generated or consumed by LHC collaborators - in the US and around the world.

ESnet traffic growth on a linear scale:

Bytes of Science Data Transferred Each Month
by the Energy Sciences Network

May 2015:
22.4 PB

On a log scale, growth is declining slightly, but still twice the rate of the commercial Internet.

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May 2015:
22.4 PB

Evolution of LHC data model implies growing faith in global networks.

In chronological order

1. Copy as much data as is feasible to analysis centers worldwide, with hierarchical distribution scheme ('Monarc' model, deterministic flows).

2. Relax the hierarchy, and rely on optimistic caching.

3. Use 'federated data stores' to fetch *portions* of relevant data sets from remote storage (anywhere), just before they're needed.
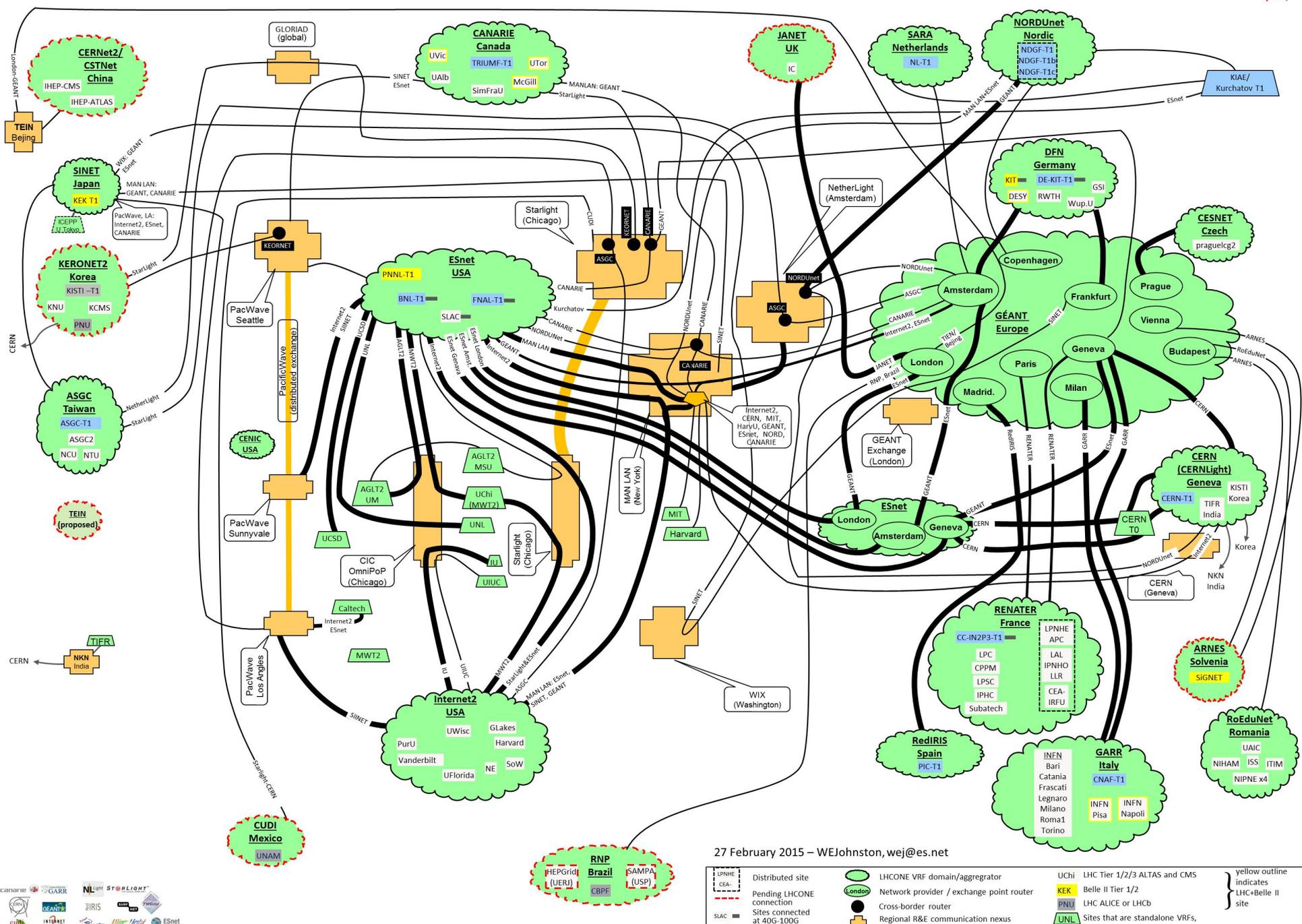
This evolution implies growing faith in networks, and growing opportunity for Future Internet Architectures such as SDN, NDN.

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To support this evolving data model, national research networks have built a vast overlay.

LHC Open Network Environment (LHCONE):

- dedicated and isolated network overlay for LHC experiments
- gives consistent, high-performance access for LHC computing centers
  - extensive use of virtual circuits
- 30 networks (with ESnet as core participant), dozens of universities
- an international highway system optimized for LHC flows
  - custom global instrument, but also a *collaboration*

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LHCONE: A global infrastructure for the High Energy Physics (LHC and Belle II) data management


27 February 2015 – WEJohnston, wej@es.net

Also see http://lhcone.net for details.

LPNHE / CEA-	Distributed site		UChi	LHC Tier 1/2/3 ALTAS and CMS
	Pending LHCONE connection	London	Network provider / exchange point router	KEK	Belle II Tier 1/2
SLAC	Sites connected at 40G-100G		Cross-border router	PNU	LHC ALICE or LHCb
	Broadcast VLAN		Regional R&E communication nexus w/ switch providing VLAN connections	UNL	Sites that are standalone VRFs

LHCONE VRF domain/aggregrator

yellow outline indicates LHC+Belle II site

Communication links: 1/10, 20/30/40, and 100Gb/s

This architecture (instruments and computation coupled by networks) now spreading outside HEP: 'super-facilities.'

Experimental facilities are being transformed by new detectors, advanced mathematics, robotics, automation, advanced networks.
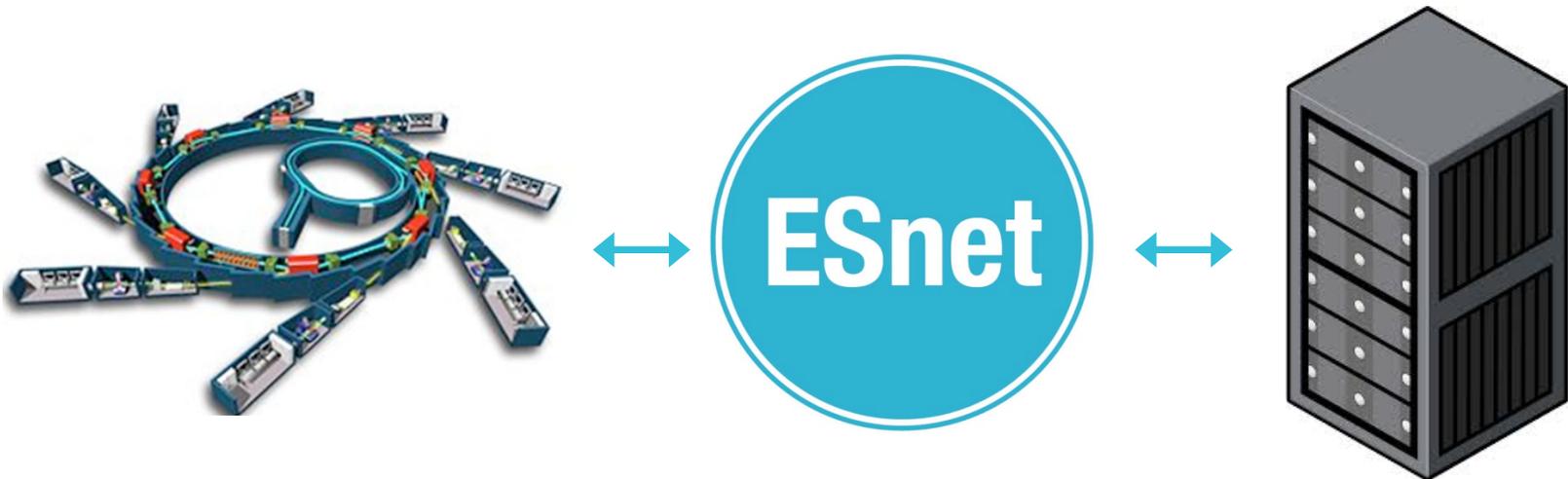
Clear networking trends that can inform your planning over the next 5-10 years:

1. Abundant Capacity (88 x 100G)
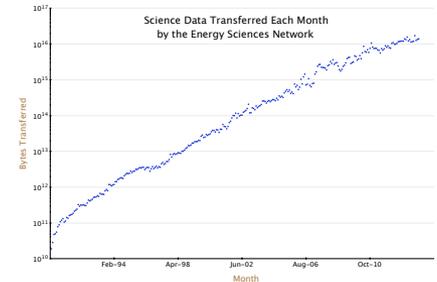

2. Programmability

3. Campus architectures optimized for data mobility

The major questions driving ESnet research and development projects:

1. How can we continue to scale up and handle **exponential traffic growth** with linear budgets?

2. Can we create useful abstractions to enable productive **interaction** between **science applications** and the network?

3. Can we turn ESnet into a **programmable platform** that is **operationally supportable**?

Thank you! [metzger@es.net]

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