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ENERGY SCIENCES NETWORK

Science Data and the NDN paradigm

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U.S. DEPARTMENT OF ENERGY

Office of Science

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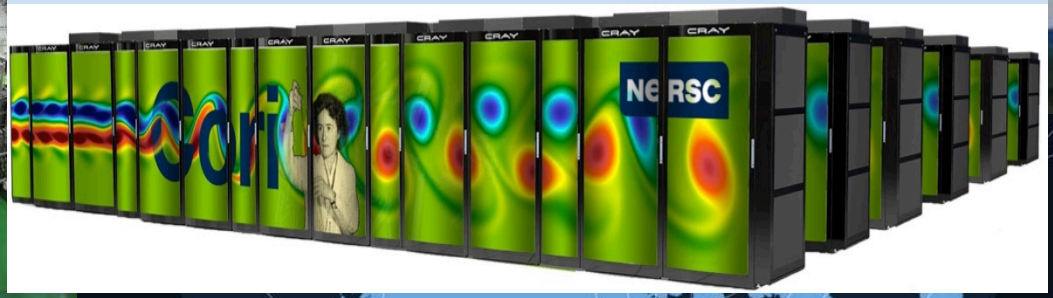
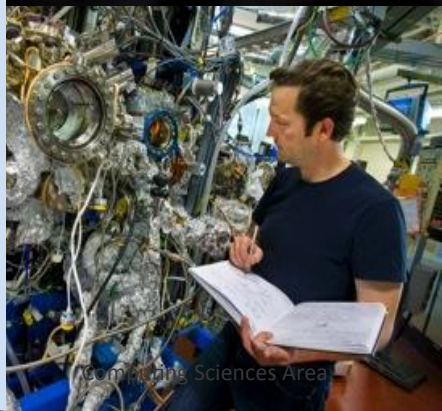
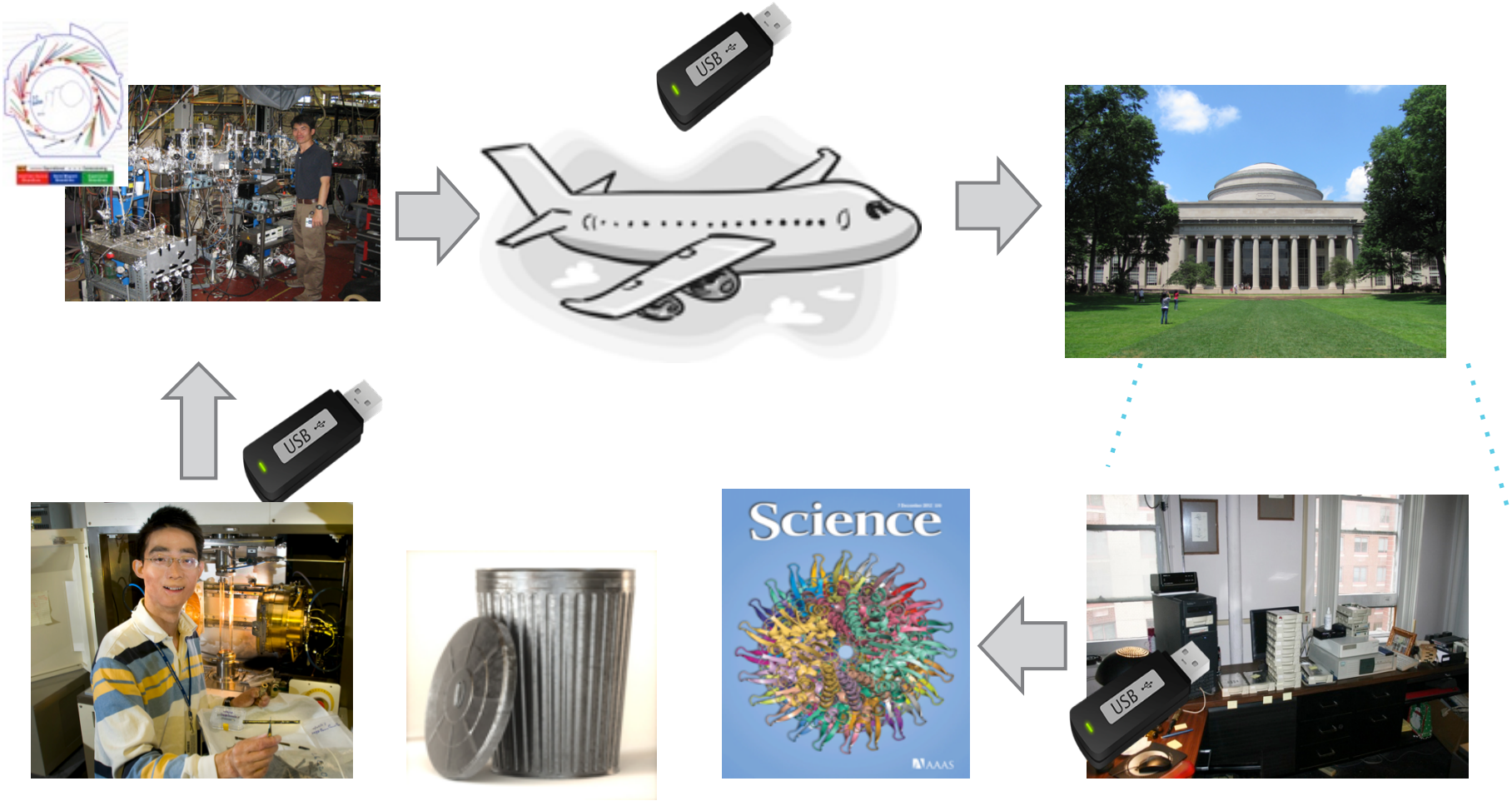
Experimental and observational science deals with big and small instruments, and a lot of data!



- Data volumes are increasing faster than Moore's Law
- New algorithms and methods for analyzing data
- Infeasible to put a supercomputing center at every experimental facility



All too common process of discovery



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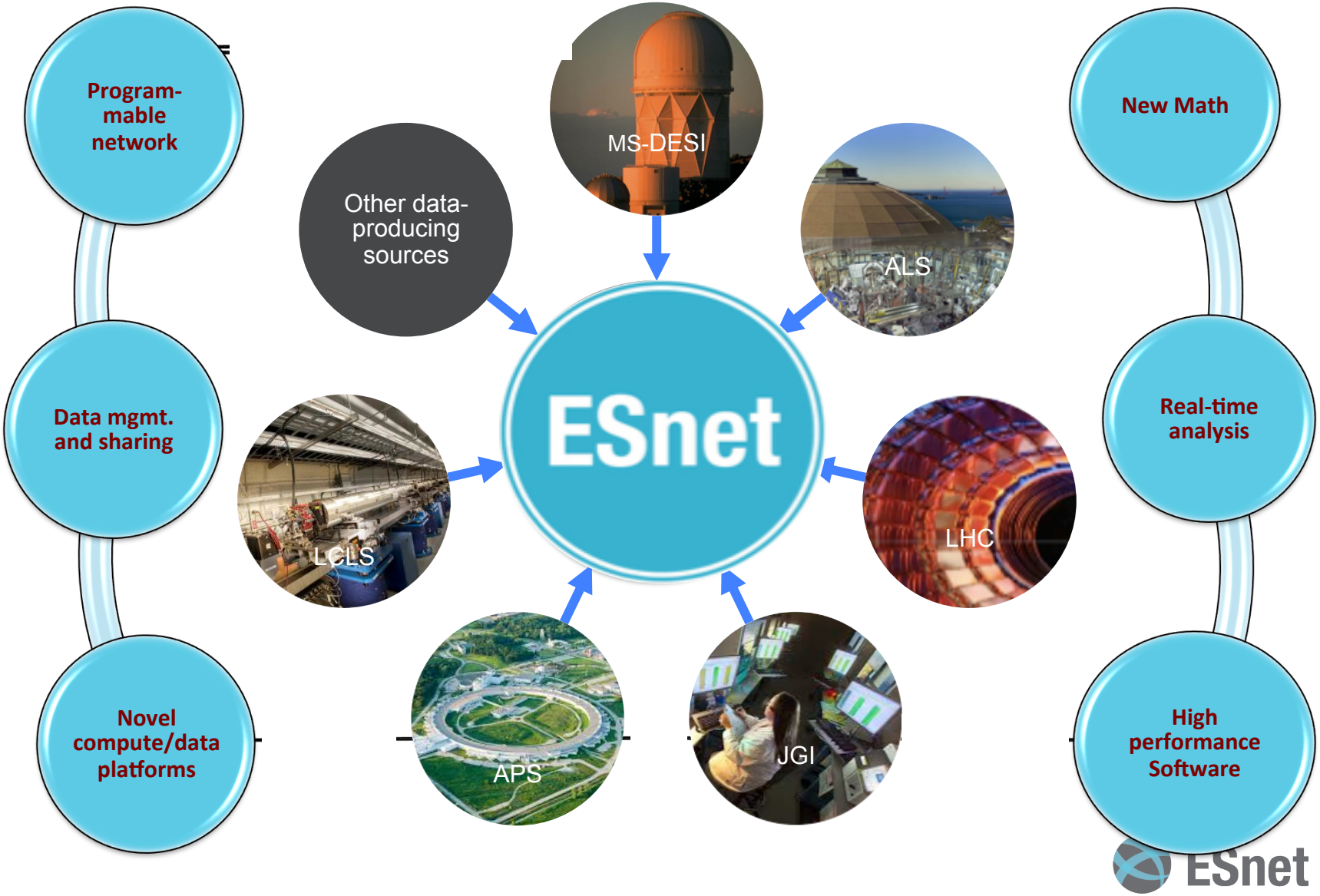
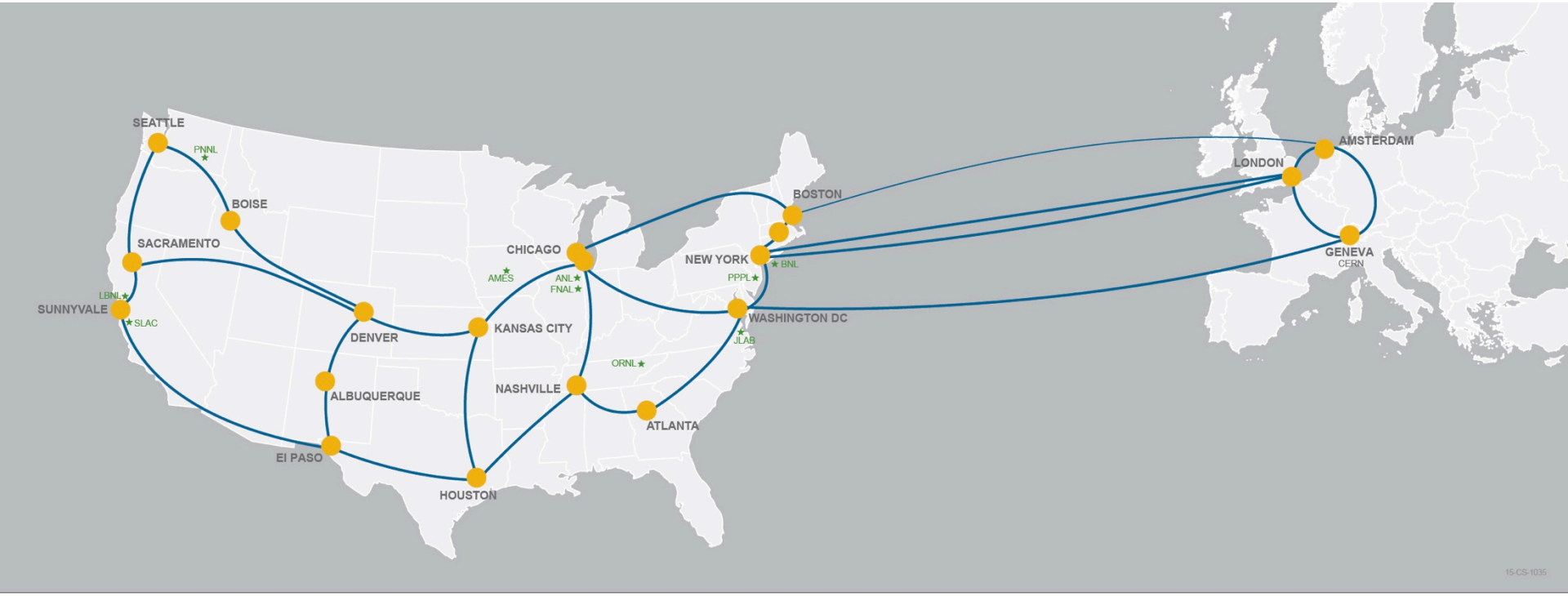
‘Superfacility’ Vision: A network of connected facilities, software and expertise to enable new modes of discovery

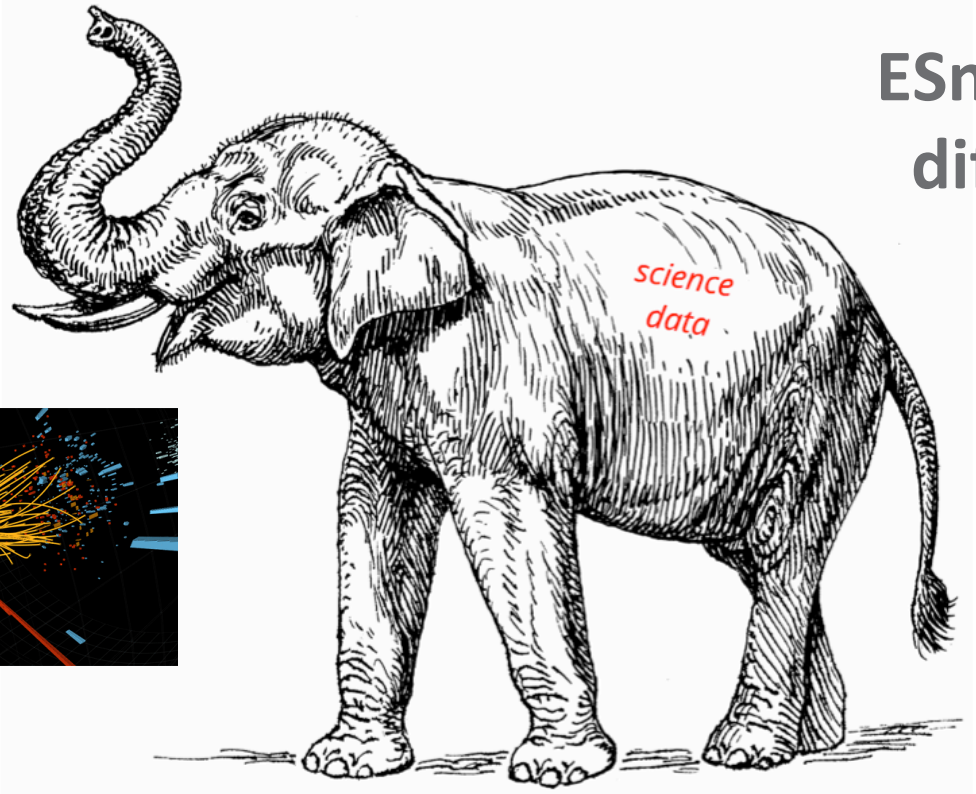


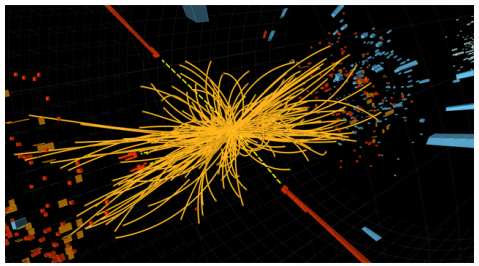
ESnet is a dedicated mission network engineered to accelerate a broad range of science outcomes.

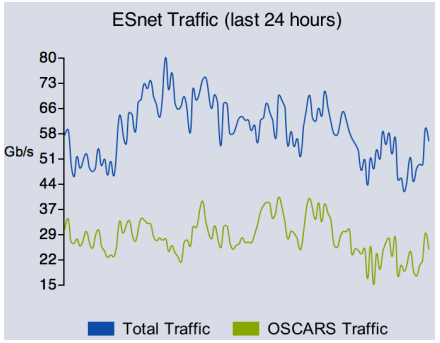


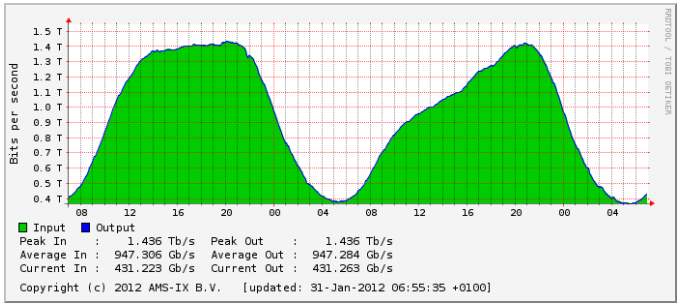
We do this by offering unique capabilities, and optimizing the network for data acquisition, data placement, data sharing, data mobility.

ESnet is designed for different goals than general Internet.

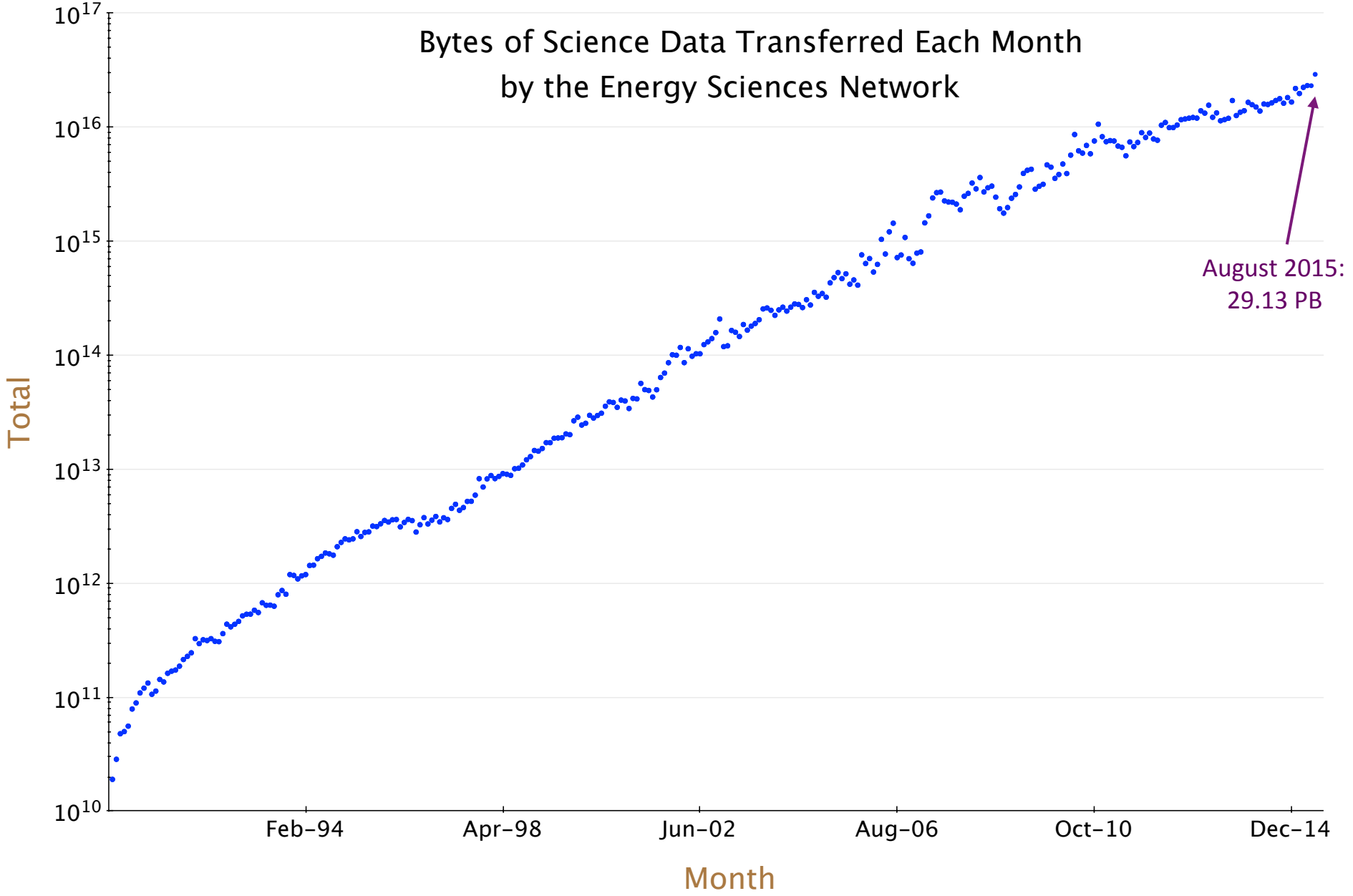




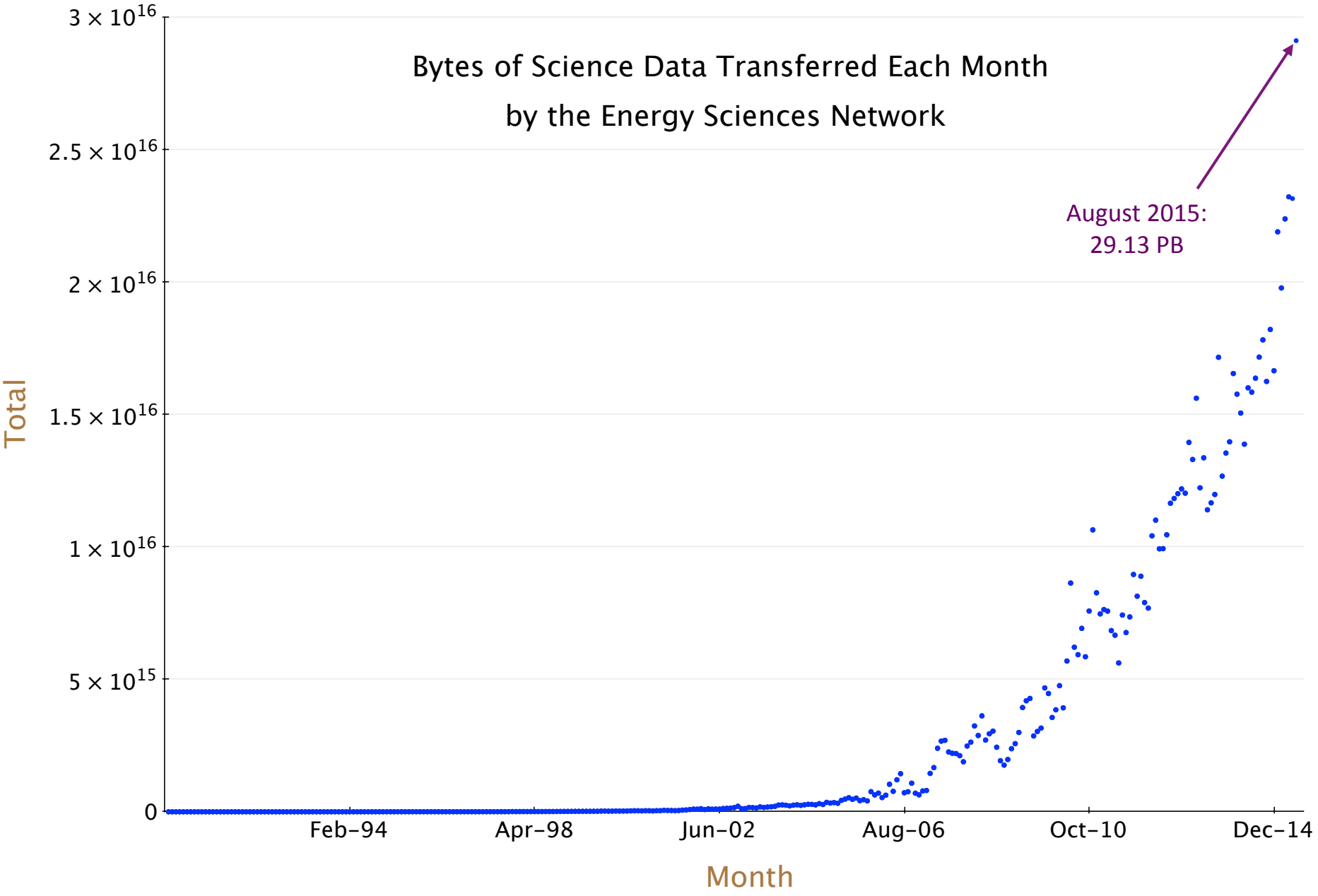




Lots of data to move around



Lots of data to move around (contd.)



High-level objectives for scientific data: alignment with NDN approach

- Radically simplify how scientific users manage, move and manipulate large, distributed, science data repositories, but with **high-throughput end2end**
- Abstract the storage and network capability and location dependence from the user-data interaction
- Enable the ability for users to specify and retrieve portions of data the workflow needs
- Create a secure, scalable framework based on integrated data management and network transport

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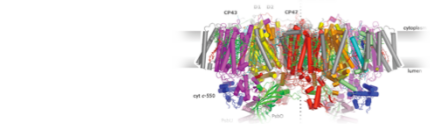
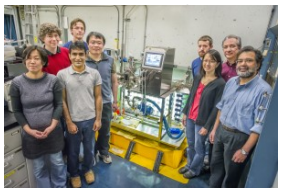
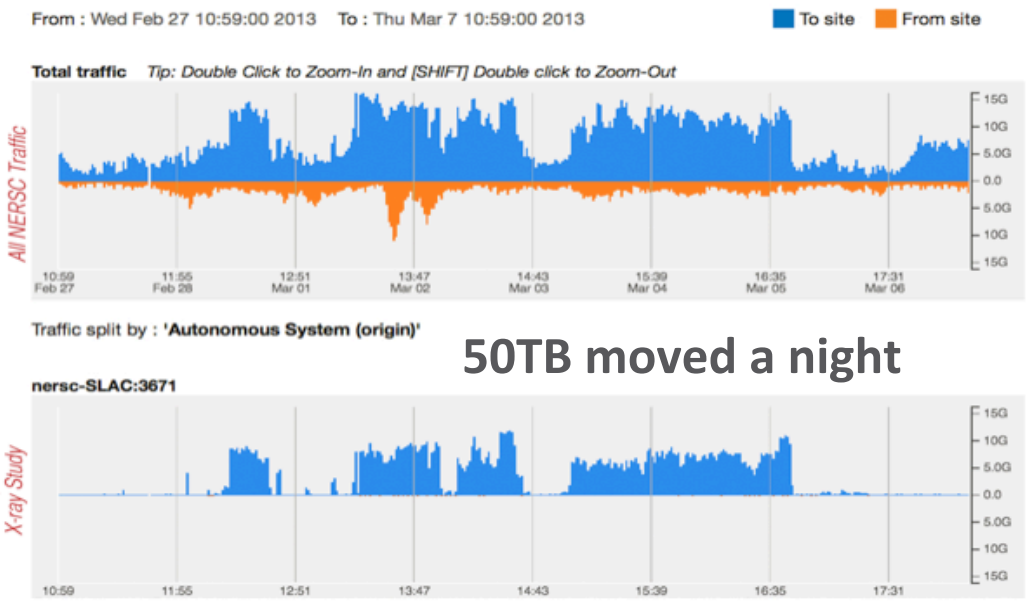
Use Case #1

Researchers from Berkeley Lab and SLAC conducted protein crystallography experiments at LCLS to investigate photoexcited states of PSII, with near-real-time computational analysis at NERSC.



LCLS ⟷ ESnet ⟷ NERSC





50TB moved a night

"Taking snapshots of photosynthetic water oxidation using femtosecond X-ray diffraction and spectroscopy," *Nature Communications* 5, 4371 (9 July 2014)

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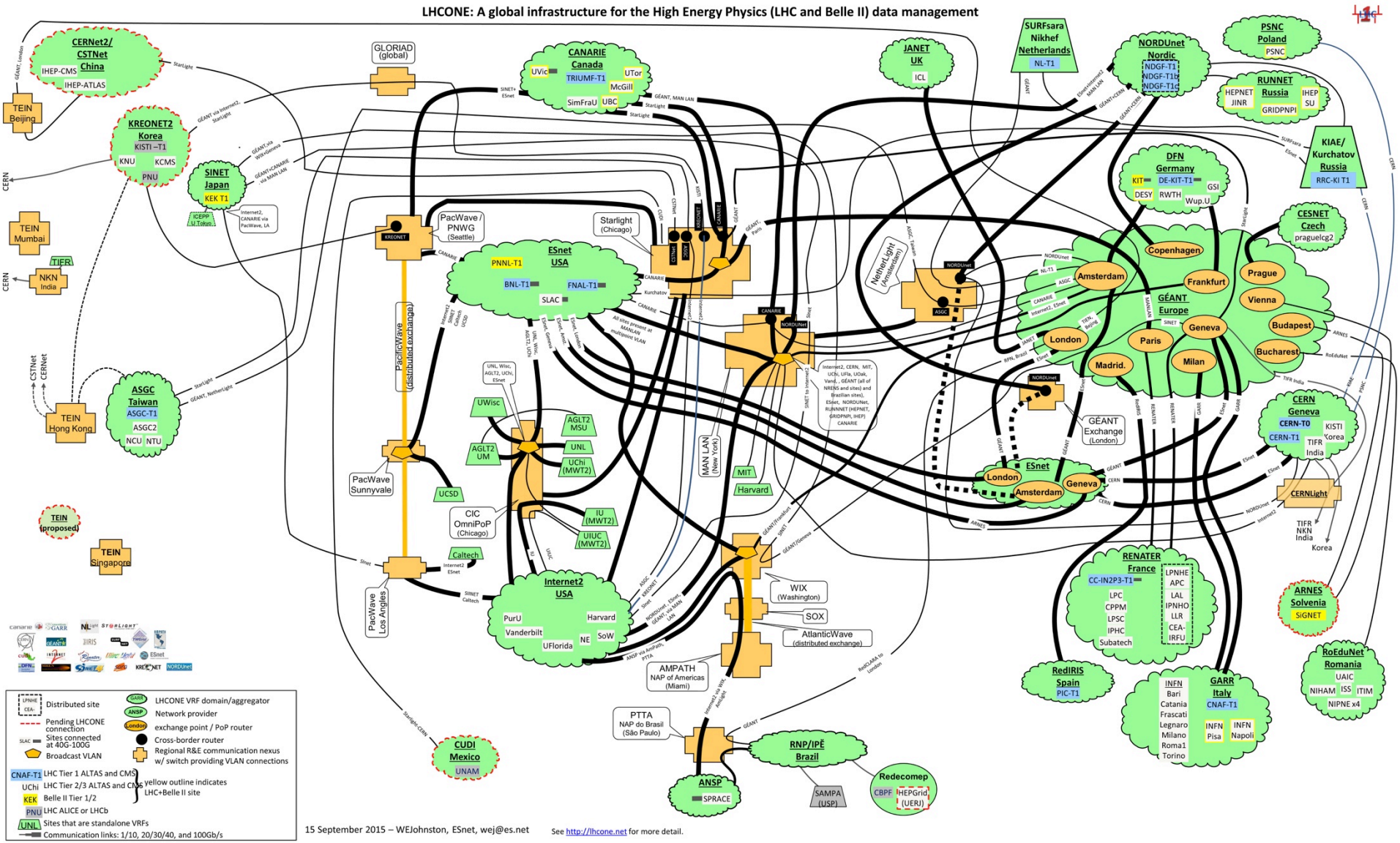
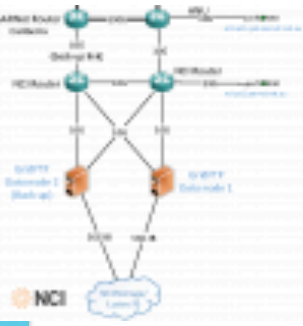
Use Case #2: LHCONE data – multiple replicas, global reach



Use Case #3: International Climate Data

aarnet Australia's Academic and Research Network · DFN Deutsches Forschungsnetz · ESnet Energy Sciences Network · GÉANT · Internet2 · Jisc · SURFnet



Perception of limitations of NDN motivating research questions

1. If I am moving 50TB of data through a single path, from an experiment to a storage facility, I really do not want to cache it at every intermediate NDN node
   - What is the right strategy for allocating disk resources to caching? What if one data transfer consumes all cache resources or there is not enough space?
2. What is the performance of the end-to-end data transfer? How can I get line rate **throughput**?
3. How do I leverage the knowledge of network capability in choosing the transfer path? How do I build in the knowledge of underlay into the NDN overlay?
4. How do I leverage network programmability to do the above?
5. And many other questions….

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Where are we at?

- Collaboration with Christos and Colorado State – high-powered NDN devices between three representative climate sites as a testbed
  - Susmit working on answering some of the high-level objectives as described
- HEP and ASCR interest in NDN from a research perspective – paper earlier this year @ CHEP, and Phil will talk about next-steps right after
- Interest in expanding a federation of high-powered NDN devices with the right strategy for caching and data management
- Combining NDN with SDN – we have a next-gen SDN testbed across US and Europe – can we combine that to provide the right primitives for high-performance NDN?
  - Lets do iterative experimentation and improvement!!!!!!!

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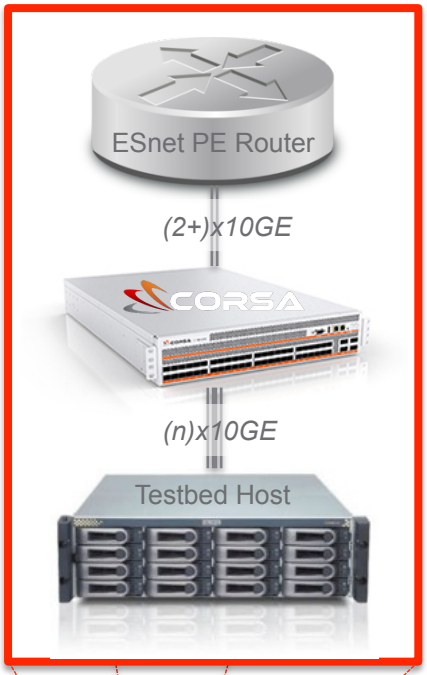
ESnet SDN Testbed

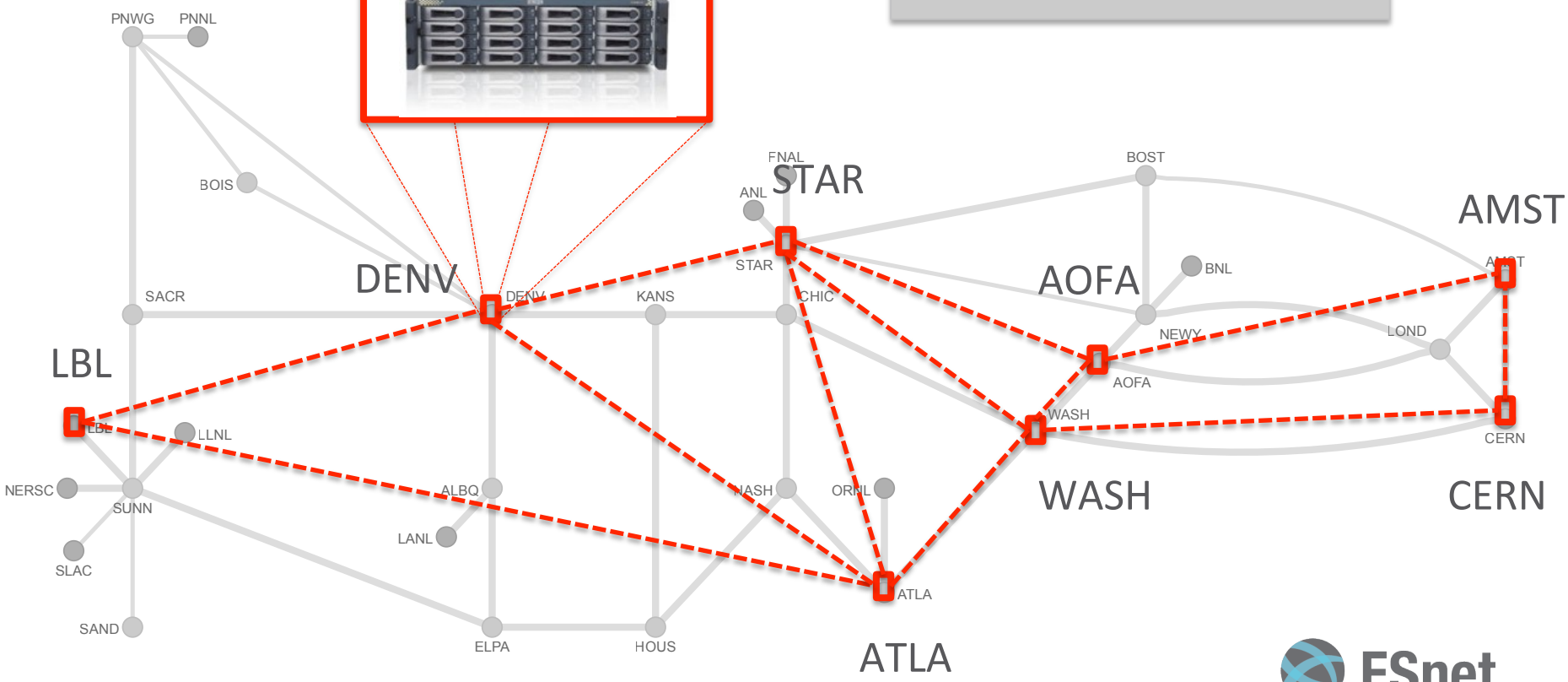


Status Update:

- Testbed deployed at all locations
- QoS support verified, press release next week
- ENOS demo on Testbed @ SC

Deployed SDN Testbed node locations

Deployed SDN Testbed connectivity overlay (using OSCARS circuits)



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Thank you!

- Please feel free to email me with questions, comments or arrows at

imonga at es dot net

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