Data Transfer Node Resource Manager

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What Problem(s) are We Solving

- **End-to-end network service automation**
  - Manual provisioning
  - No service consistency across domains
  - No service visibility across domains
- **Application-Network interaction missing**
  - Ability for science workflows to drive service provisioning
  - Programming APIs usually not intuitive and require detailed network knowledge, some not pre-known
  - Detailed network information needed, usually not easily available
- **Multi-domain service visibility and troubleshooting**
  - Data APIs across domains for applications, users, network administrators
  - Performance, service statistics, topology, capability etc.
  - Exchange of ‘scoped’ and authorized information
- **Alignment with security policies @ the end-site**

Core Idea

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End-to-end, multi-domain provisioning automation and resource orchestration

SENSE: SDN for End-to-End Networking @ Exascale

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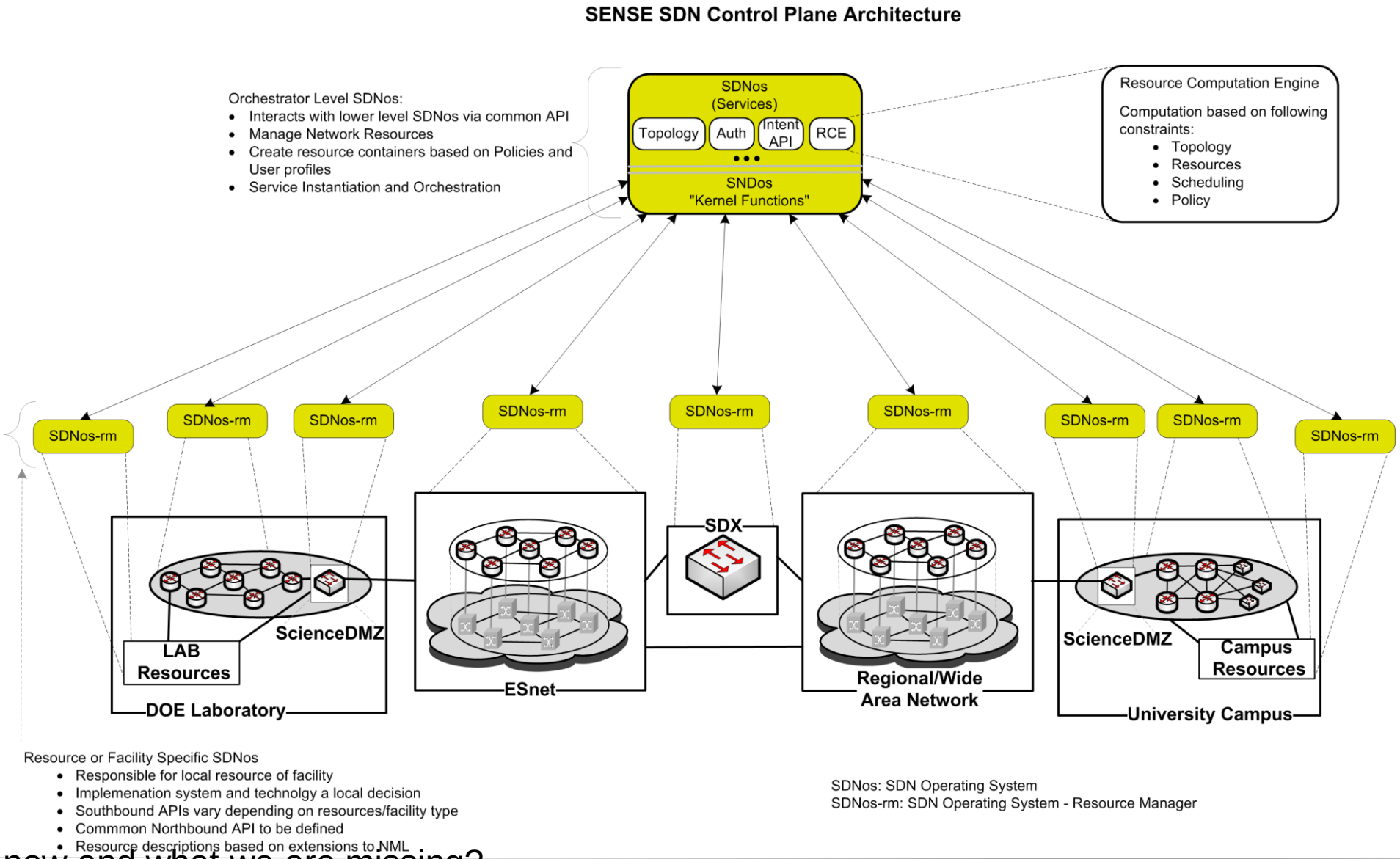

Where we are now and what we are missing?

- Still in early project phase (1st year/3 year) and we keep up with changes.

Role of DTNs in SENSE

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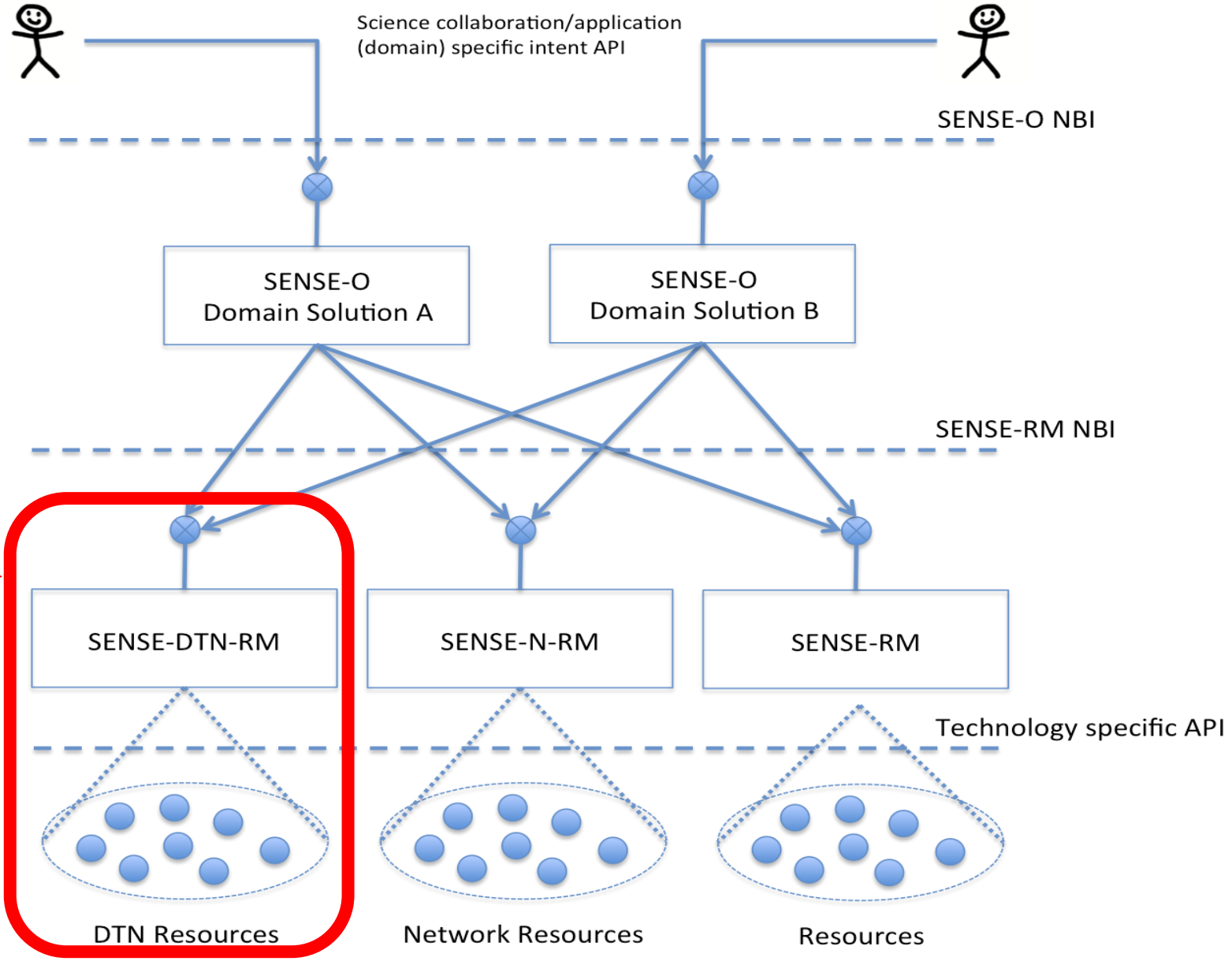
A **Data Transfer Node** (DTN) is a server that constitutes the endpoint of a data transfer. Key Functionality:

- Flow Termination
- End system (auto) configuration and monitoring

DTN-RM(s):

- Resources: OS, software configuration, switching components (OVS ports, traffic limits, flow moderation) etc.



End-Site Orchestration

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Science DMZ Flow Management

- Route to right flows to the right DTNs, vlan or more granular flow identification using OF;
- Support multi-science Science DMZ, with resource allocation and traffic steering;

DTN Autoconfig

- VLAN configuration on the NIC; Private or public IP address configuration of L2 or L3 VPNs
- Other configuration like TCP window size, might be a stretch
- OVS configuration and QoS configuration
- Flow steering and ACLs to connect to the internal file system over different NICs

End-Site Orchestration (cont.)

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What is next:

- Normalize APIs with SENSE-RM northbound interface
- Begin to Integrate DTN-RM and SENSE-RM
- Expose topology in MRML format
- Fairshare between different orchestrators
- Continue to extend DTN-RM functionality in the SENSE context
- Implement Site Level Service to work with other controllers: ODL, Kytos, ONOS, etc…
- End-To-End monitoring, measurement and management
- RPM based installation, release as Open Source

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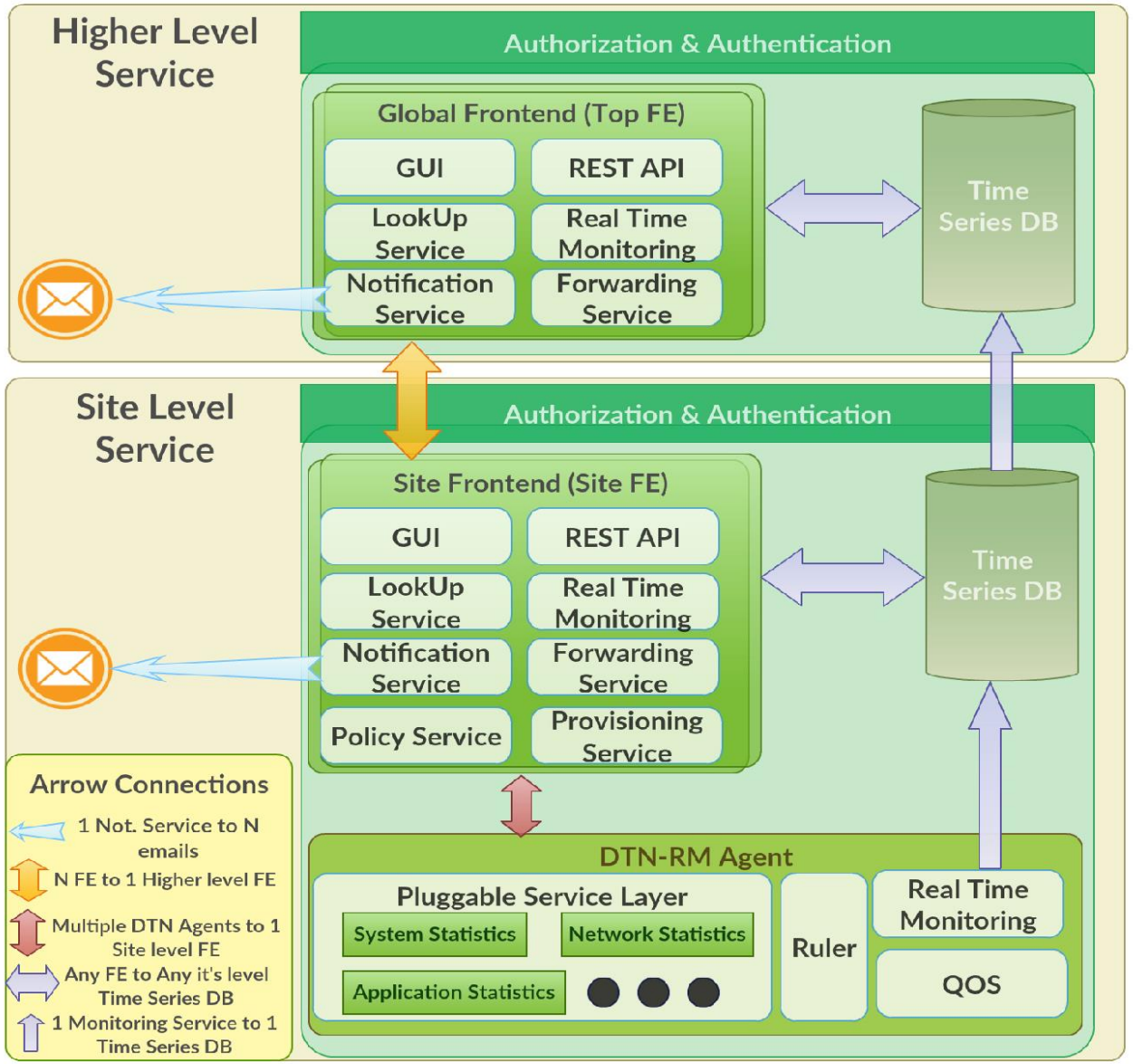

SENSE Scoped definitions

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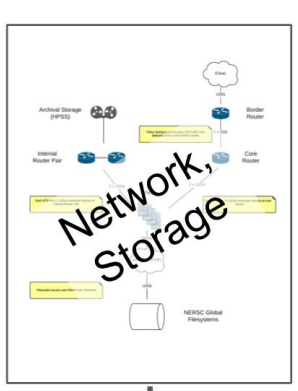
- End-to-End (network point of view)
  - DTN NIC to DTN NIC, across Science DMZ, WAN(s), Open exchange points (ideally)
- Multi-domain
  - Multiple administrative domains, independent policies and authorizations
- Provisioning automation

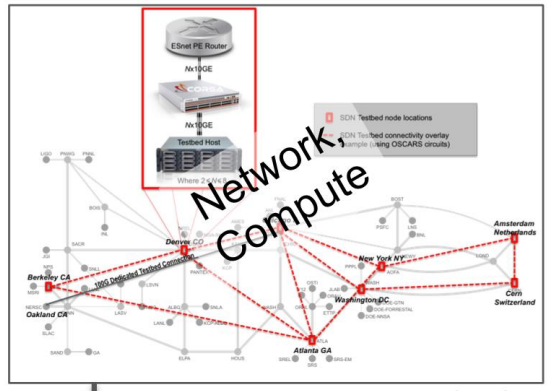
  Bring-up and management of services without interrupt-driven human involvement
- Resource orchestration

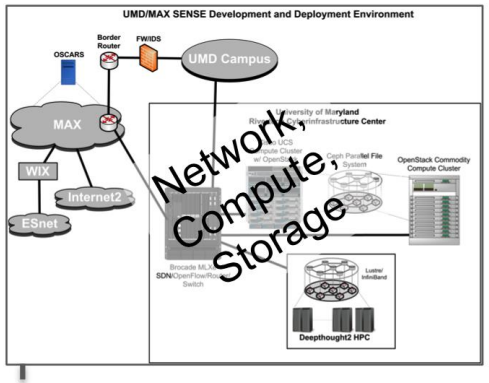
  Allocation and reservation of resources including compute, storage and network (mainly)

Flying Start: Leveraging prior work

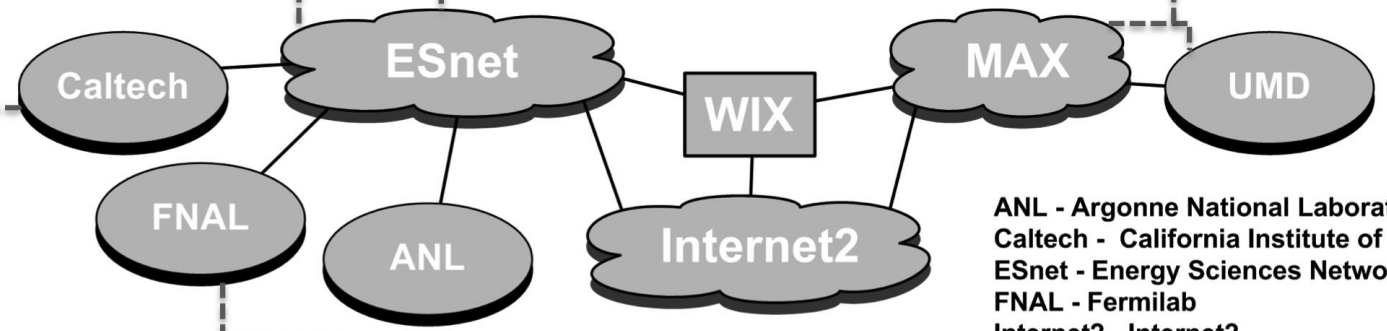
- Modeling
  - RAINS project
- Testbed
  - Existing compute and DTN equipment@sites
  - ESnet SDN testbed across US/Europe
- SDN Software
  - ENOS and ODL concepts and some components from ESnet



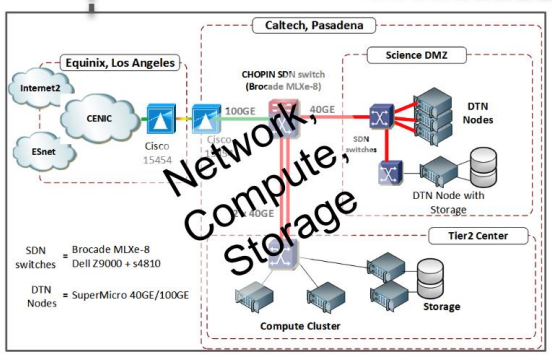


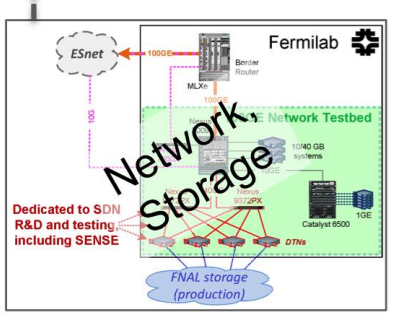


Actual Environment for SENSE Project



ANL - Argonne National Laboratory
Caltech - California Institute of Technology
ESnet - Energy Sciences Network
FNAL - Fermilab
Internet2 - Internet2
MAX - Mid-Atlantic Crossroads
UMD - University of Maryland
WIX - Washington International Exchange





See SENSE demo at SC17!

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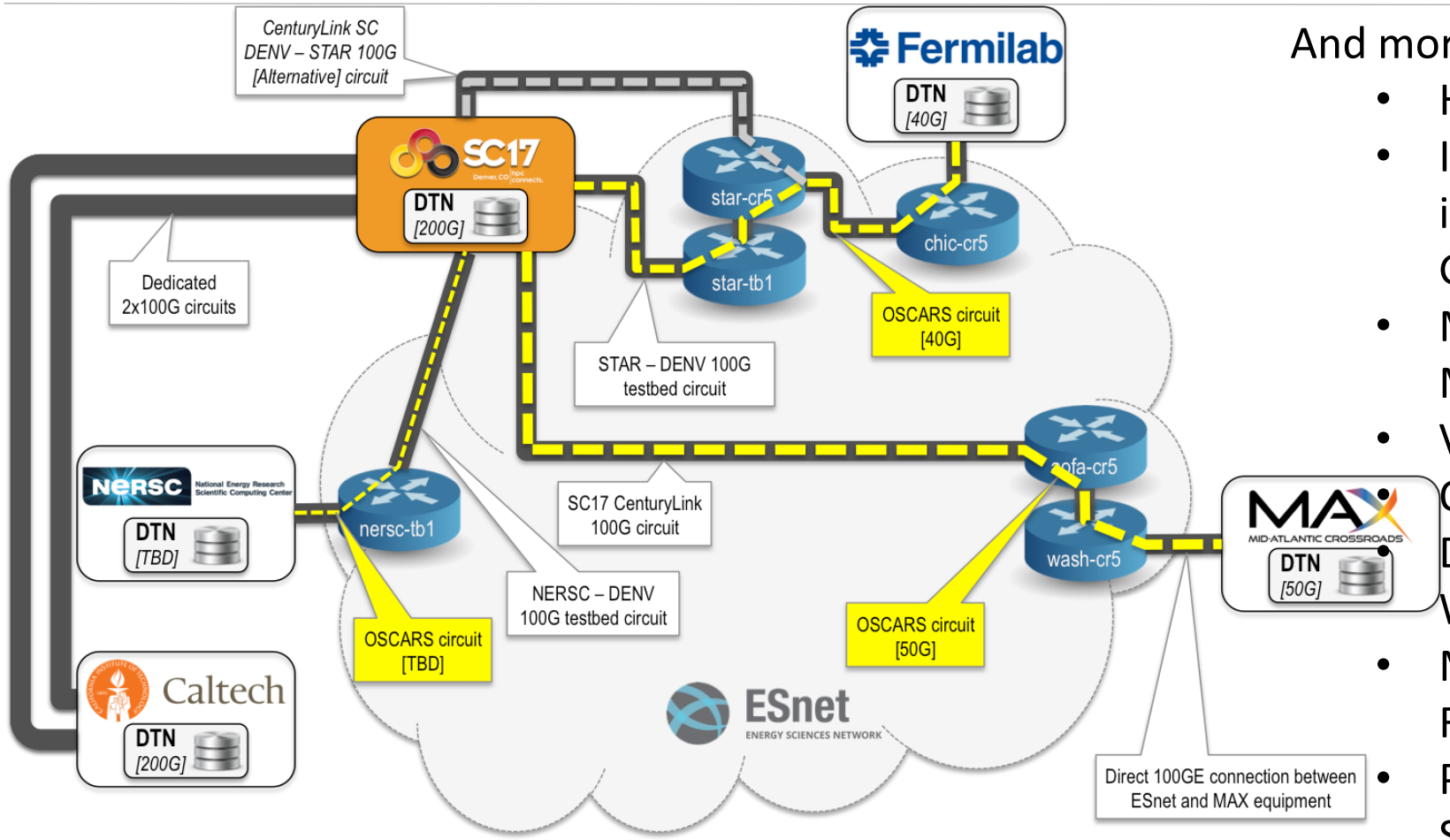

And more demos:

- HEPCloud distributed caching demo
- Improved Monitoring and Performance in the Network Data Plane for the LHC Grid
- Multi-Purpose GP-GPU Cluster for Machine Learning Fast Prototyping
- Virtual Reality and Machine learning
- Quantum Networks: First light
- Data Center Interconnects (DCIs) and WaveServers
- Multi-Domain, Multi-Controller, Multi-Resource SDN application
- PRP Multi-Institution Hyper-Converged ScienceDMZ
- High Throughput Flows Between North and South Hemispheres Using Kytos
- ….

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