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ENERGY SCIENCES NETWORK

SENSE: SDN for End-to-end Networked Science at the Exascale

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U.S. DEPARTMENT OF ENERGY
Office of Science

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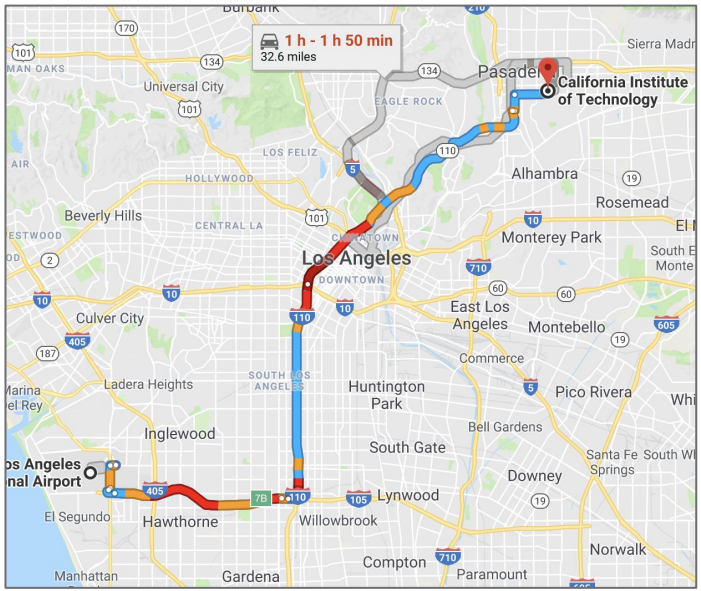
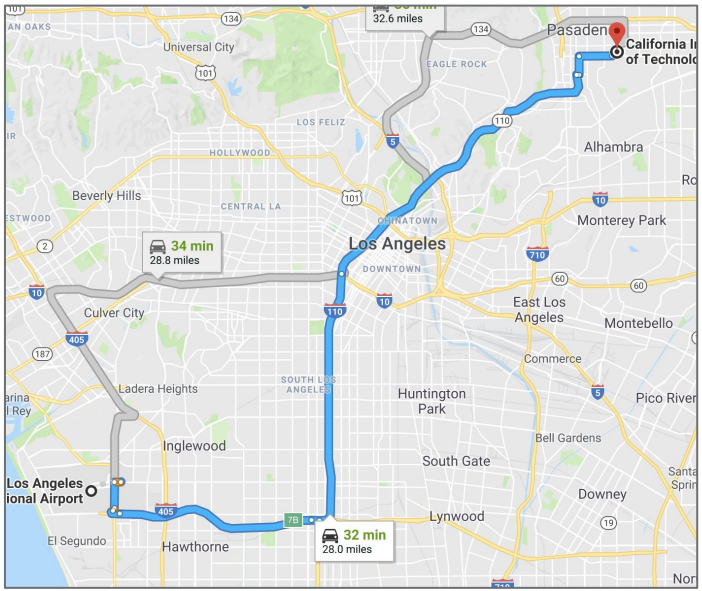
Intelligent Predictive and/or Deterministic Network Experience - When will I get home?



LAX– Caltech, 6 pm:
1 hr – 1hr 50 min



LAX– Caltech, 11 pm:
32 min

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SENSE - Vision and Objectives

- Big Science needs to coordinate (and often schedule) its utilization of distributed resources (compute, storage, instruments) in workflow specific ways.
- Distributed scientific workflows need end-to-end automation so the focus can be on science, and not infrastructure:
  - Manual provisioning and infrastructure debugging takes time
  - No service consistency across domains
  - No service visibility or automated troubleshooting across domains
  - Lack of real-time information from domains impedes development of intelligent services

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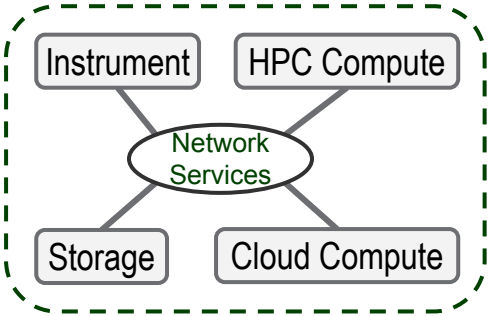
Identifying the Gaps

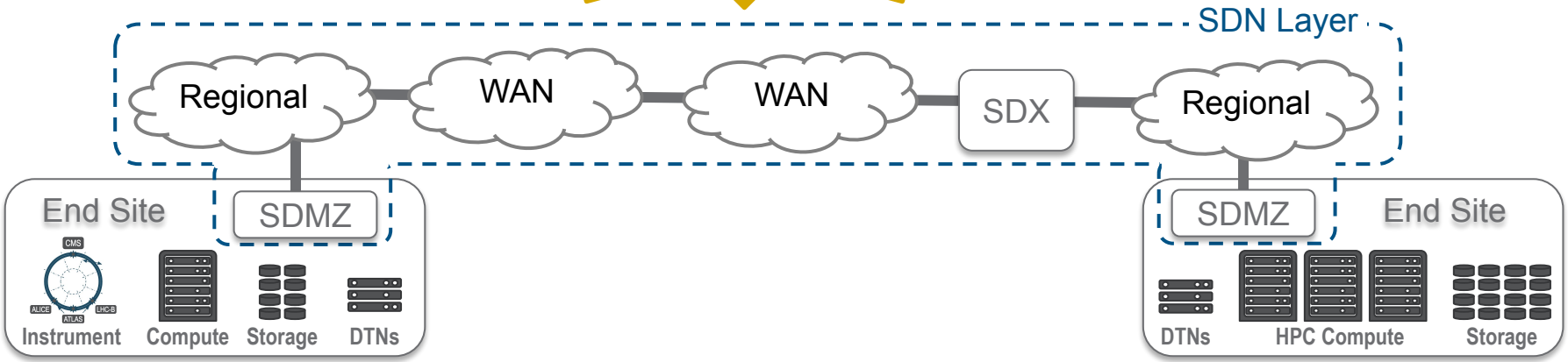


Science Workflow Specific Topology and Services

Application Workflow Agents

What goes here?

Need something to deal with Multi-Domain, Multi-Resource Distributed Infrastructure

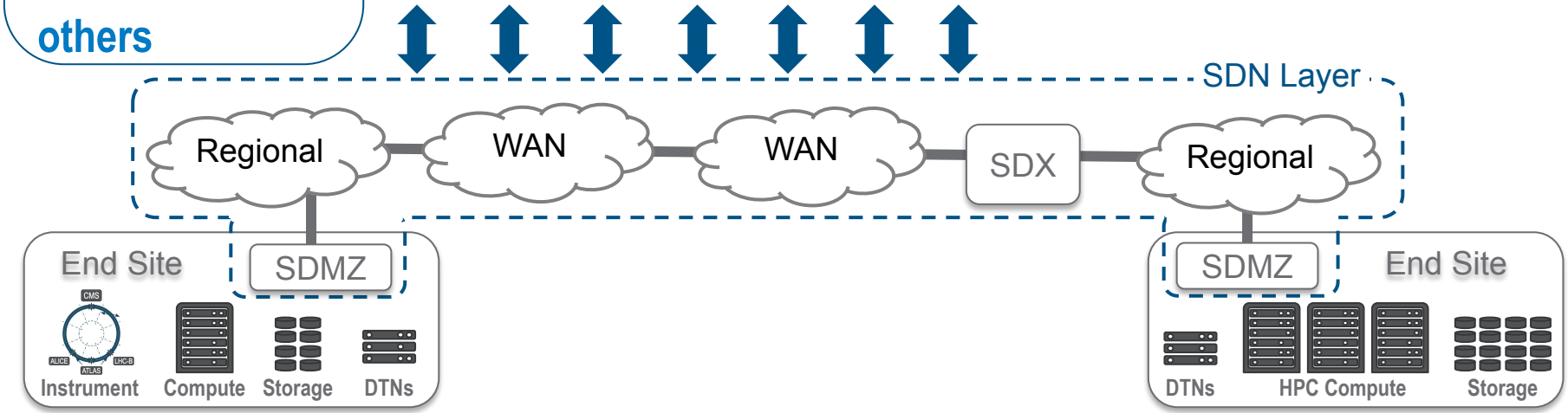


The ”SDN” Layer is Complex and Heterogenous

Control Plane
Internet2 OESS
ESnet OSCARS
OpenNSA
OpenDaylight
ONOS
PCE based
others

Data Plane/Services
Layer 1/2/3
Point-to-Point
Multi-Point
Layer 3 VPNs
QoS

Attached Distributed Resources
End Sites/SDMZs,
Clouds (Public, R&E, Edge)
HPC
Instruments
Storage/Data Lakes



SENSE - Filling in the Gaps

Application Workflow Agents

Designed for adaption to available "SDN" systems

SENSE native "Resource Manager" available if no current automation layer

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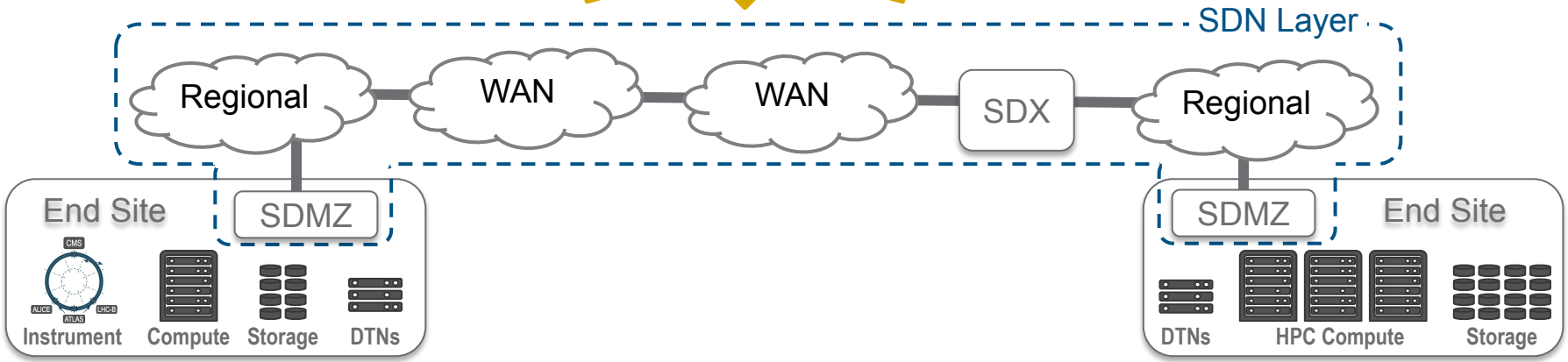
SENSE operates between the SDN Layer controlling the individual networks/end-sites, and science workflow agents/middleware



SENSE Solution Approach – SDN Layer Interactions

End-to-End model-based distributed resource reasoning and intelligent service orchestration

- Hierarchical service resource architecture
- Unified network and end-site resource modeling and computation
- Model based real-time control
- Application driven orchestration workflow
- End-to-end network data collection and analytics integration

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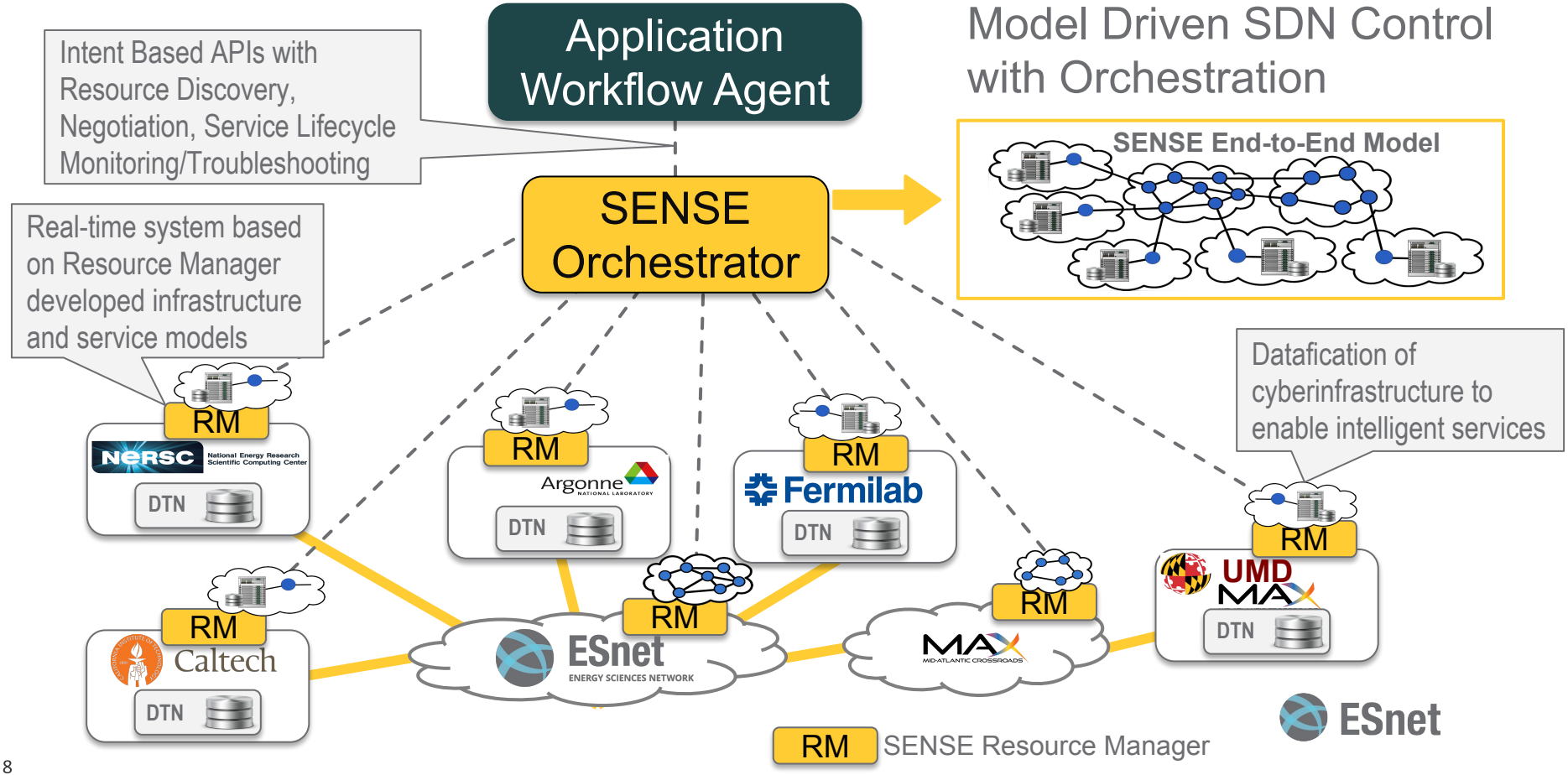
SENSE Architecture

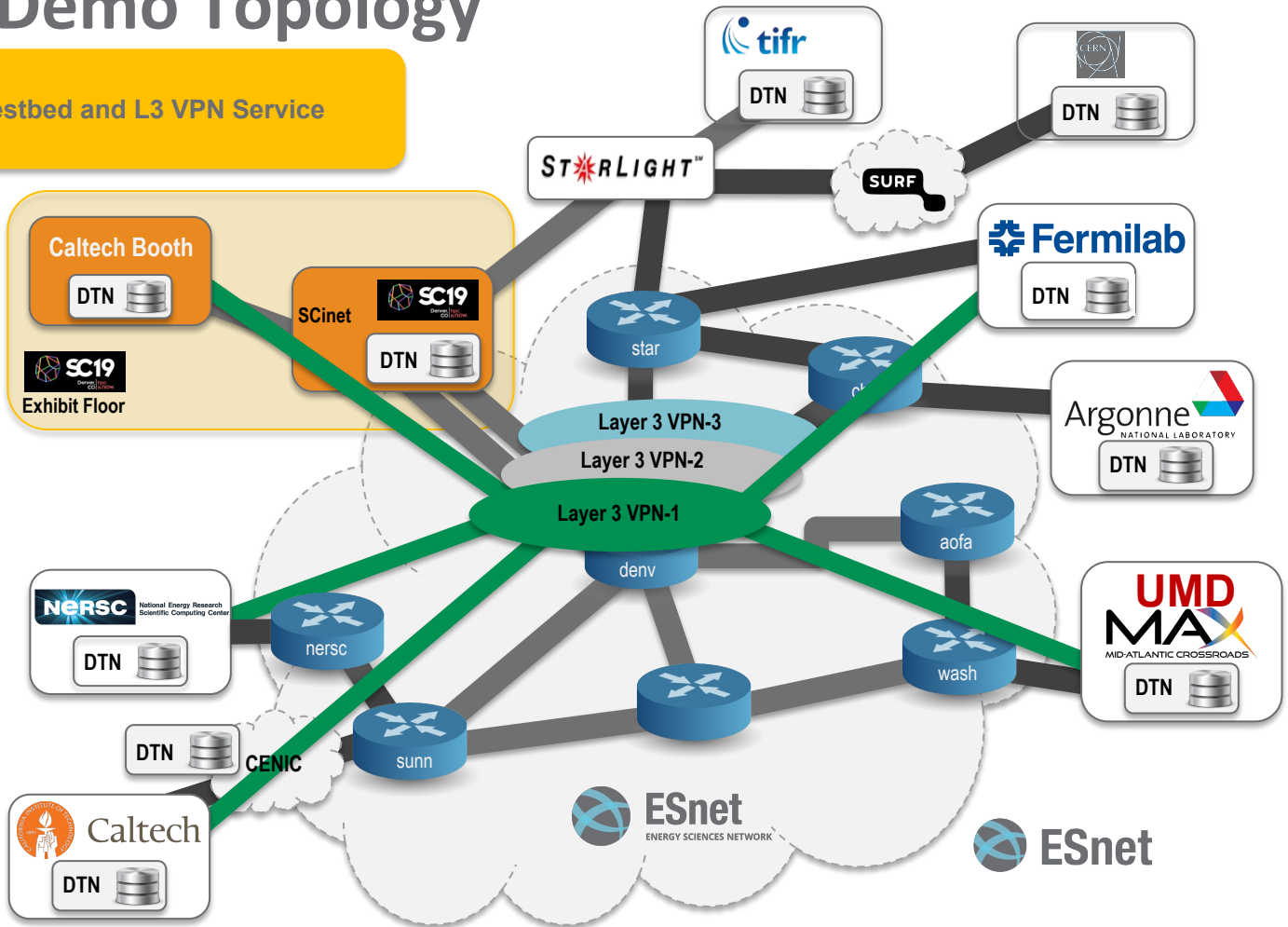


SENSE SC19 Demo Topology

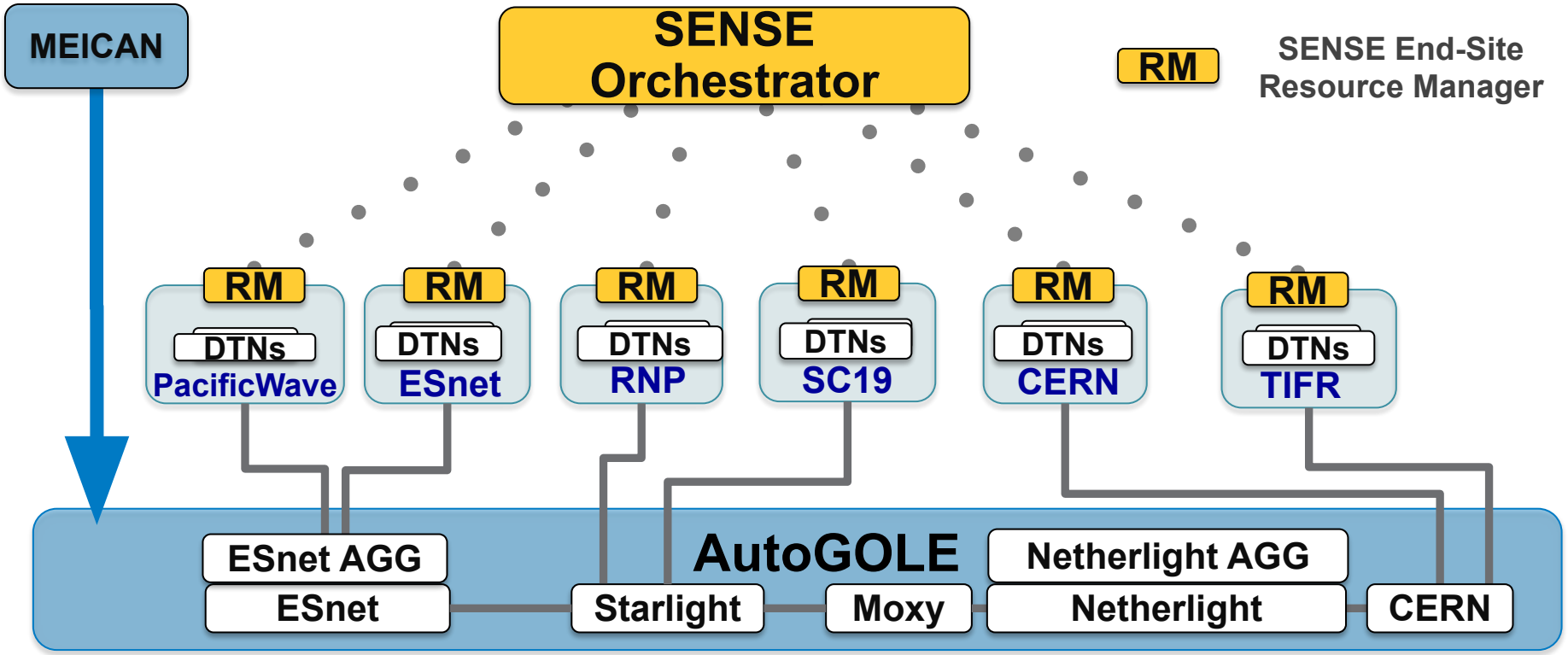
SENSE Testbed and L3 VPN Service

SENSE enabled resources at DOE Laboratories, Universities, Research Facilities, and SC19

Dynamic attachment of End Site resources to L3VPNs advertised by ESnet



SC19-NRE-020 Demonstration
Multi-Resource Orchestration via AutoGole and SENSE



SENSE – AutoGOLE Joint Interworking Demo → Candidate **Inter-regional Mediation Layer for Global Workflows** (as discussed in GNA-G)

SDN for End-to-end Networked Science at the Exascale (SENSE)

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SENSE Team

Backup Slides

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SENSE: SDN for End-to-end Networked Science at the Exascale

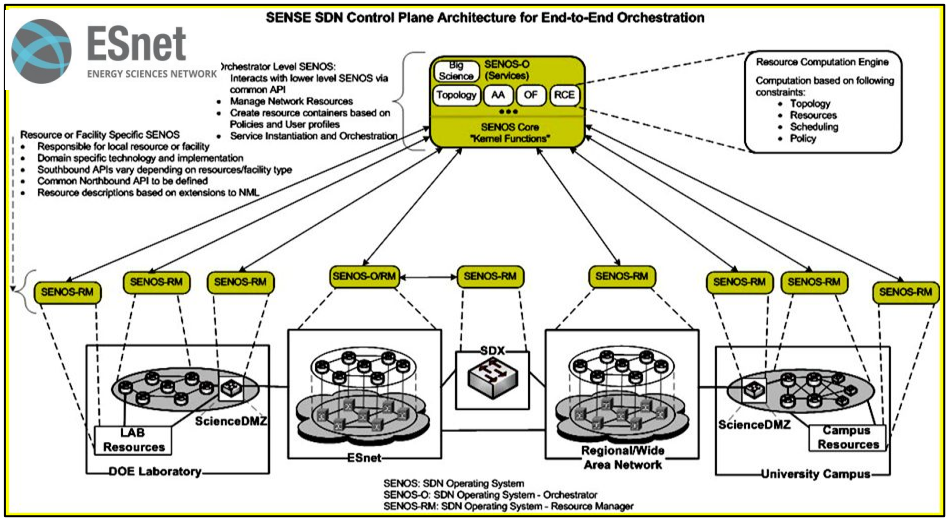
ESnet Caltech Fermilab LBNL/NERSC Argonne Maryland

Mission Goals

- Improve end-to-end performance of science workflows
- Enabling new paradigms, e.g., creating dynamic distributed “Superfacilities”

Comprehensive Approach - An end-to-end SDN Operating System with:

- Intent-based interfaces , providing intuitive access to intelligent SDN services
- Auto-provisioning of network devices and Data Transfer Nodes
- Network measurements, analytics, and feedback to build resilience



Use Cases

- Inter-DTN Priority Flows, LHC File Transfer Service (FTS), ExaFEL, Big Data Express, SENSE/AutoGole Integration (GNA-G)

Longer Term

- AI Optimized policy-guided E2E Orchestration

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