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ENERGY SCIENCES NETWORK

Network Orchestration at ESnet

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on behalf of Marc Körner

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Orchestration and Core Data

Energy Sciences Network (ESnet)
Lawrence Berkeley National Laboratory

Cisco Automation Developer Days

New York, NY
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U.S. DEPARTMENT OF ENERGY
Office of Science

BERKELEY LAB

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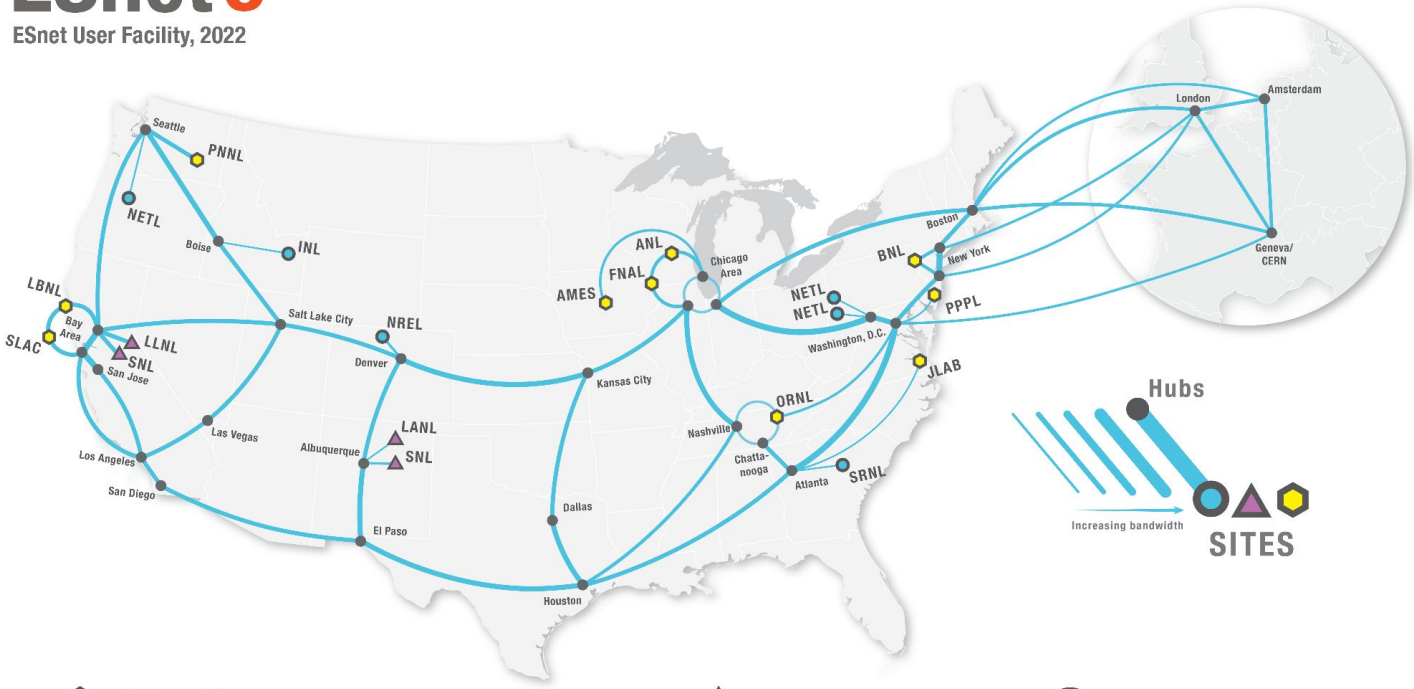
ESnet User Facility, 2022



Office of Science National Laboratories

AMES	Ames Laboratory (Ames, IA)
ANL	Argonne National Laboratory (Argonne, IL)
BNL	Brookhaven National Laboratory (Upton, NY)
FNAL	Fermi National Accelerator Laboratory (Batavia, IL)
JLAB	Thomas Jefferson National Accelerator Facility (Newport News, VA)
LBNL	Lawrence Berkeley National Laboratory (Berkeley, CA)
ORNL	Oak Ridge National Laboratory (Oak Ridge, TN)
PNNL	Pacific Northwest National Laboratory (Richland, WA)
PPPL	Princeton Plasma Physics Laboratory (Princeton, NJ)
SLAC	SLAC National Accelerator Laboratory (Menlo Park, CA)

NNSA Laboratories

LANL	Los Alamos National Laboratory (Los Alamos, NM)
LLNL	Lawrence Livermore National Laboratory (Livermore, CA)
SNL	Sandia National Laboratory (Albuquerque, NM; Livermore, CA)

Other DOE Laboratories

INL	Idaho National Laboratory (Idaho Falls, ID)
NETL	National Energy Technology Laboratory (Morgantown, WV; Pittsburgh, PA; Albany, OR)
NREL	National Renewable Energy Laboratory (Golden, CO)
SRNL	Savannah River National Laboratory (Aiken, SC)

ESnet in numbers:

Thousands of miles of fiber cables, including transatlantic cables

380 locations with racks and equipment to track

346 Core links between routers

300 Customer facing Interfaces, 123 of which are 100G

Multi Platform environment with lots of interoperability needs

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What is orchestration?

Orchestration is defined as the automated arrangement, coordination, and management of computer systems, middleware, and services within the network.

-- Wikipedia

Workflow management implementing a repeatable pattern of steps for user-based interactions within our operations support system;

Automated service provisioning to programmatically change configuration across network, compute, and application resources.

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Why is Orchestration important for ESnet?

- Consistent and unified configurations
- Enhance network reliability, resiliency, and robustness
- Allows to manage a larger network
- Eliminate human errors
- Better use of human resources
- Planning safety

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ESnet Network Orchestration and Automation

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Joe the Planner

Eric the Engineer

servicenow

ESDB

Orch

NSO

Stardust

ESnet Network

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(1) Design network and import bulk data

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(2) Plan and populate service

Eric the Engineer

(1) Assigned task

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(3) Instantiate service

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(1) Fetch service data

(4) Update service data

Orch

(2) Apply network intent and create services

NSO

(3) Apply network configuration

Eric the Engineer

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Eric the Engineer

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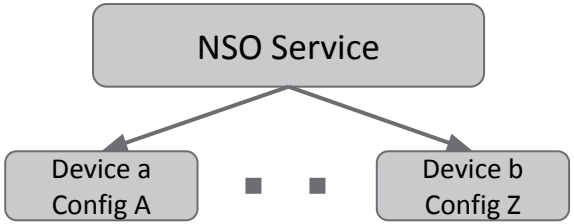
NSO features used by ESnet

Architectural features:

- Device agnostic configuration
- Service centric abstraction
  - configure 1, 2, n devices



Other stuff which comes in handy:

- Data verification and validation
- Service decommissioning and rollbacks

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ESnet's NSO implementation in numbers

Service models: **33**

Services instantiated:

- Devices: 325
- System: 155
- Port: 1705
- BBL: 199
- Bridge: 401
- Host: 161
- LSP: 151
- VPLS: 1
- L3-Interface: 923
- L3-Customer: 277
- L3-Peer: 252
- L3-Transit: 369

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Future work

- Move tier 3 services into Workflow Orchestrator whenever possible
- Make overall service design a multi layer approach
- Refactor existing services following a 2-tier service paradigm whenever possible
- Further build out more granular multi-tier service design and architecture

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Questions...

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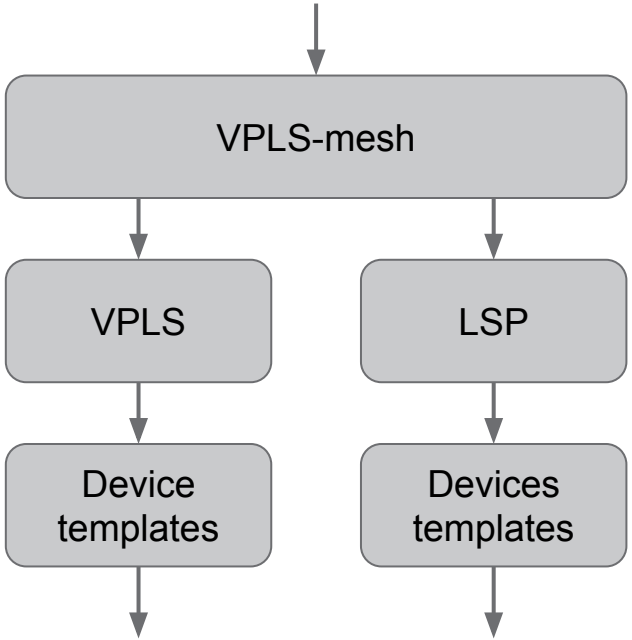
VPLS-mesh (NSO service layering)

- Stacked service architecture
- Part of the VPLS service / package
- Instantiating a fully meshed VPLS instance and its LSPs



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Eric the Engineer

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Offloading "umbrella" services into the Workflow Orchestrator

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Tier 3 Orch

Tier 3 NSO

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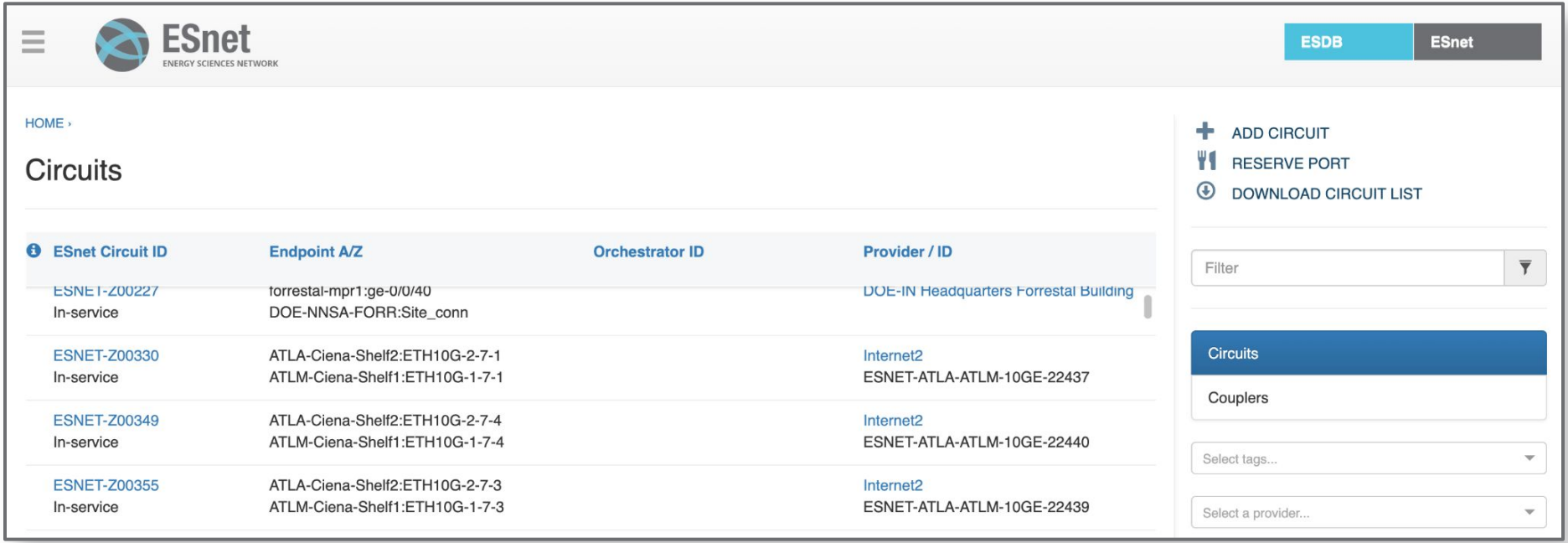
ESDB GUI



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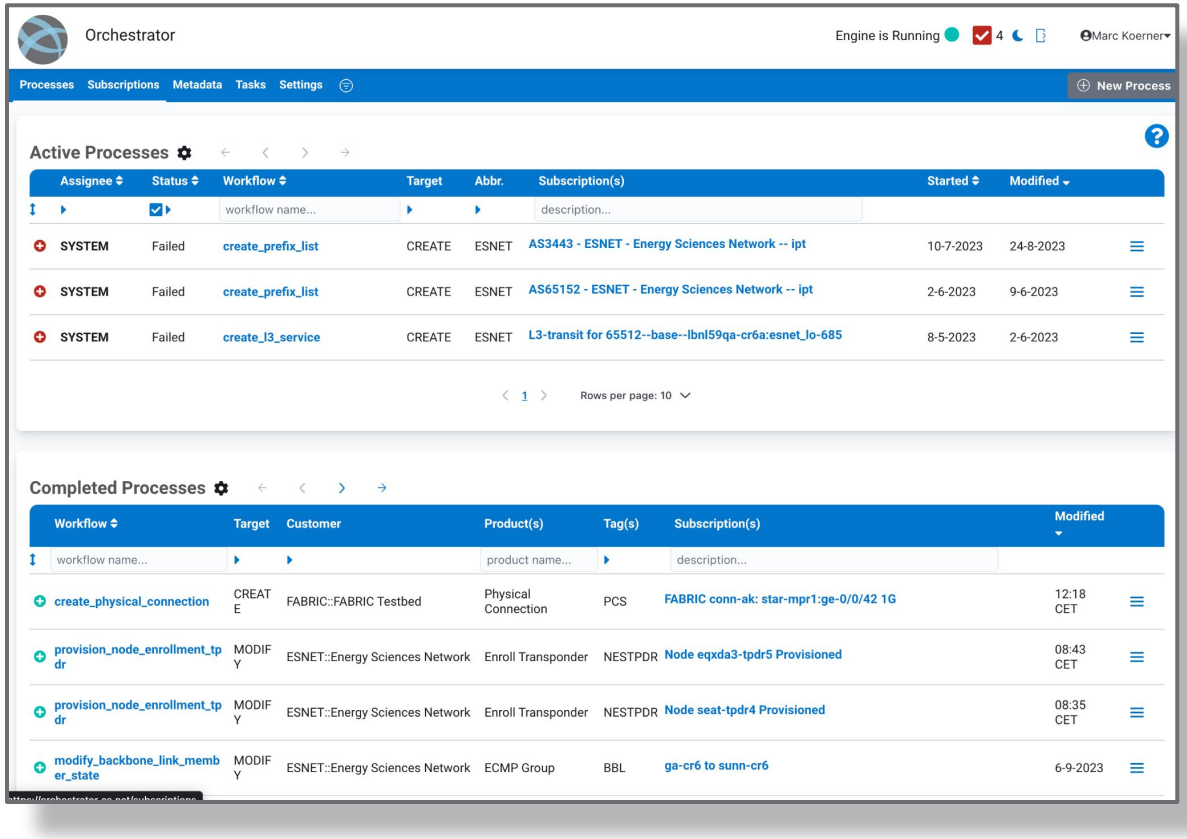
Orch GUI



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