



ESnet

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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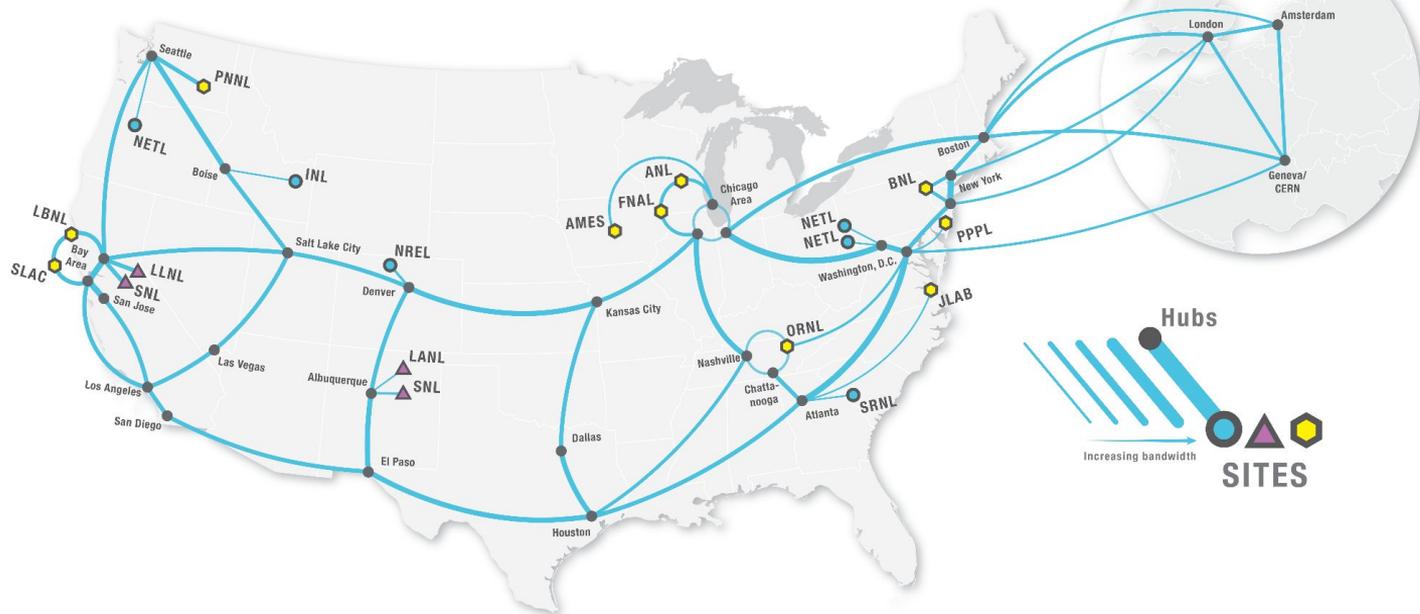


U.S. DEPARTMENT OF
ENERGY
Office of Science



ESnet 6

ESnet User Facility, 2022



ESnet in numbers:

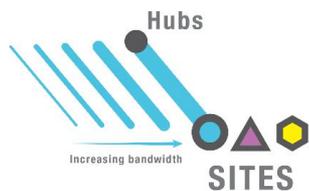
Thousands of miles of fiber cables, including transatlantic cables

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



Office of Science National Laboratories

- AMES** Ames Laboratory (Ames, IA)
- ANL** Argonne National Laboratory (Argonne, IL)
- BNL** Brookhaven National Laboratory (Upton, NY)
- FNAL** Fermilab National Accelerator Laboratory (Batavia, IL)
- JLAB** Thomas Jefferson National Accelerator Facility (Newport News, VA)
- LBL** 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)

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;

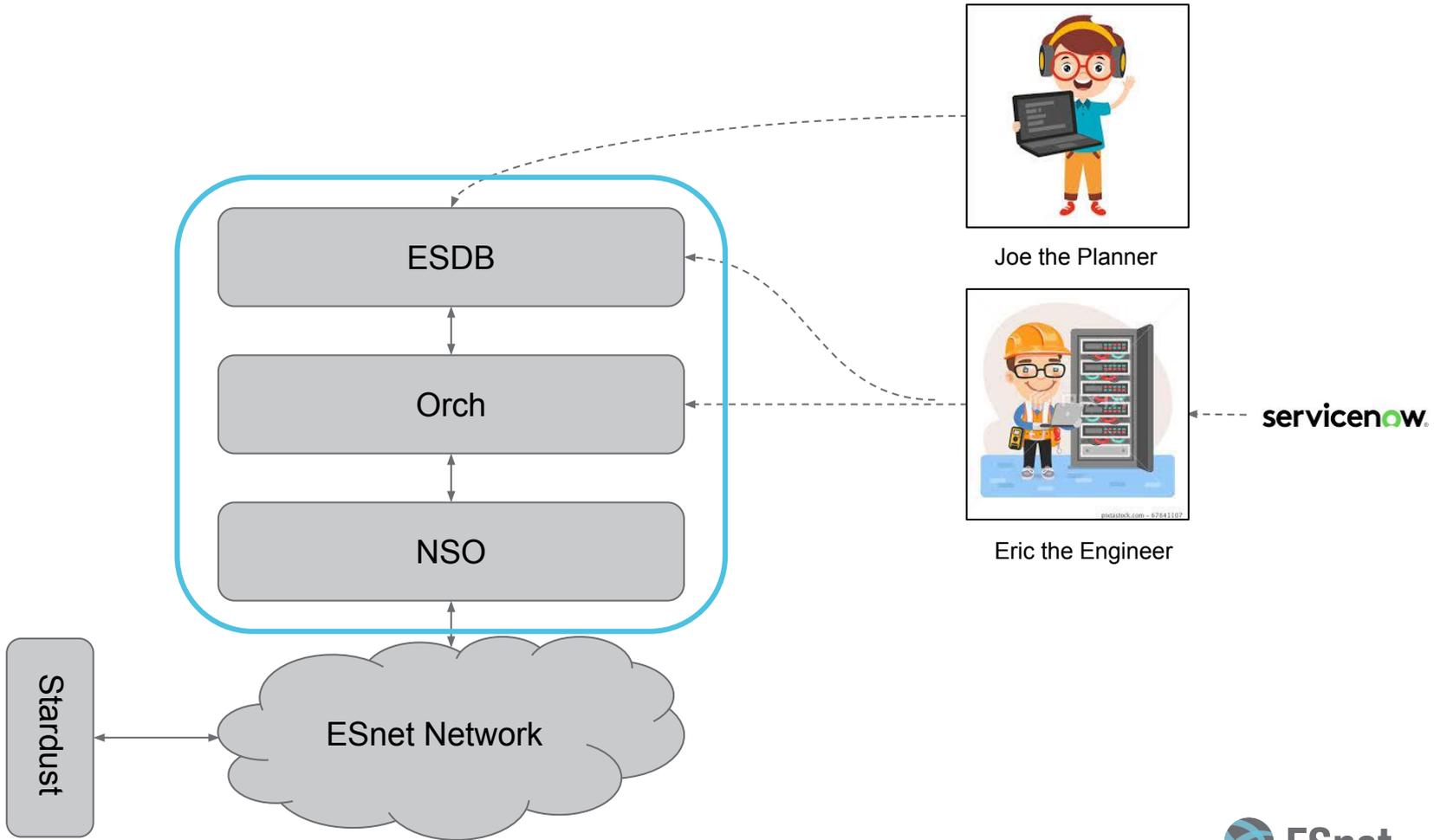
Automated service provisioning to programmatically change configuration across network, compute, and application resources.

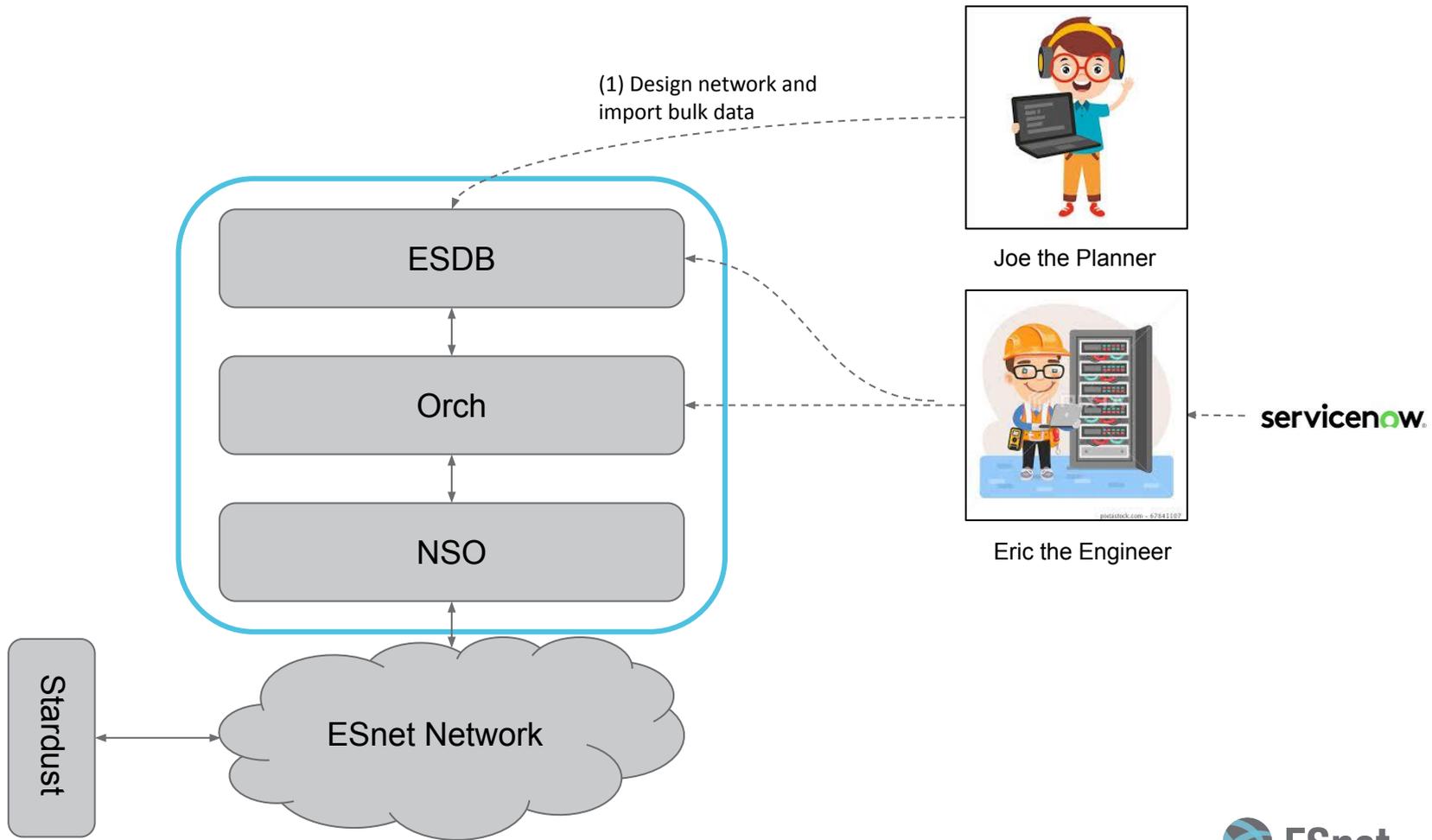
Why is Orchestration important for ESnet?

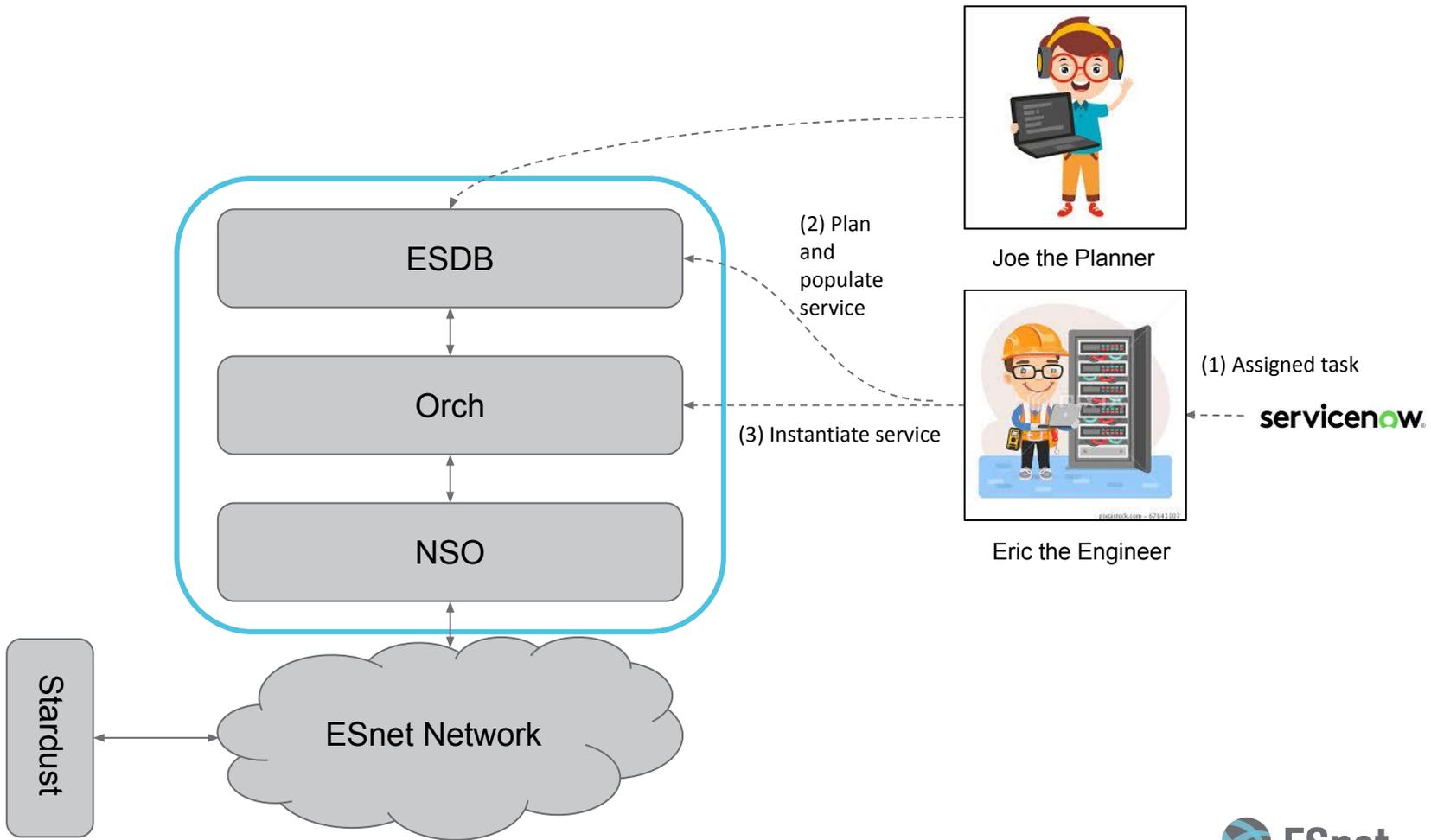
- Consistent and unified configurations
- Enhance network reliability, resiliency, and robustness
- Allows to manage a larger network
- Eliminate human errors
- Better use of human resources
- Planning safety

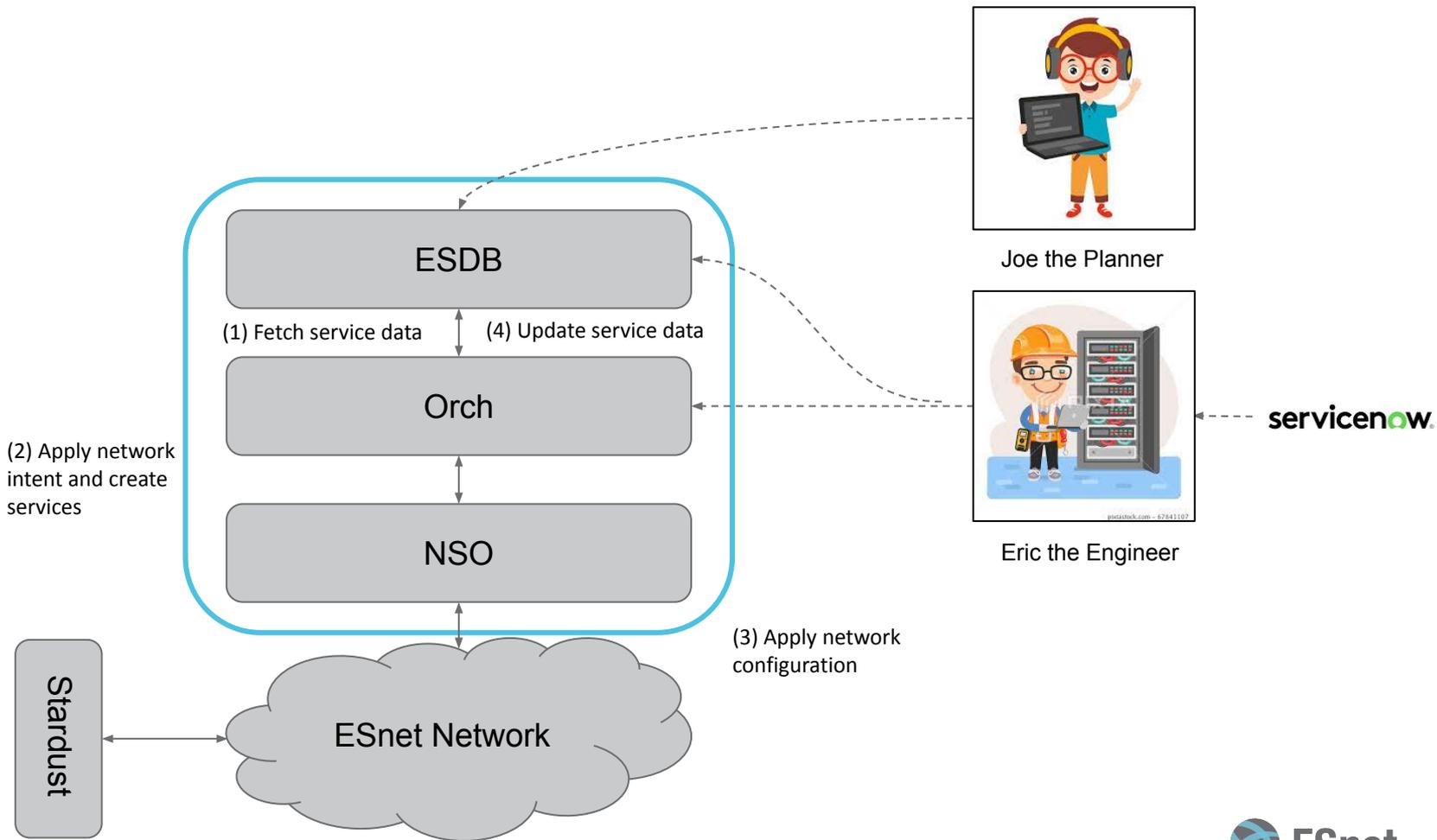
ESnet Network Orchestration and Automation

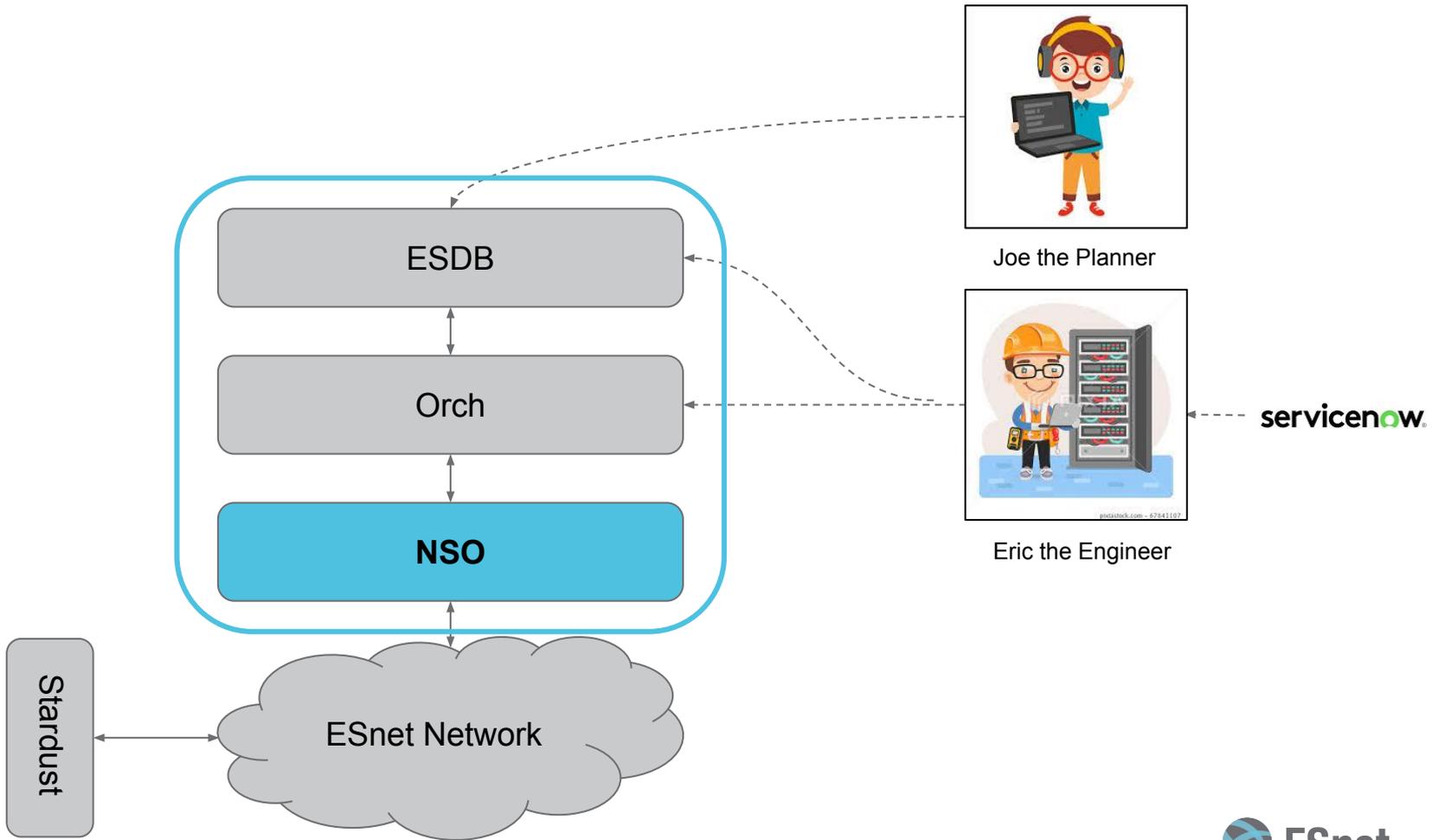








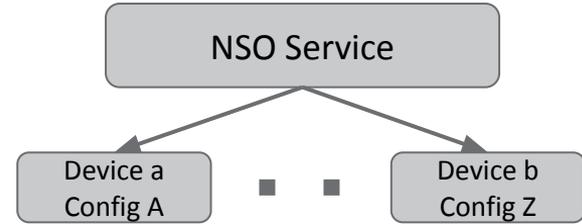




NSO features used by ESnet

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

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

Future work

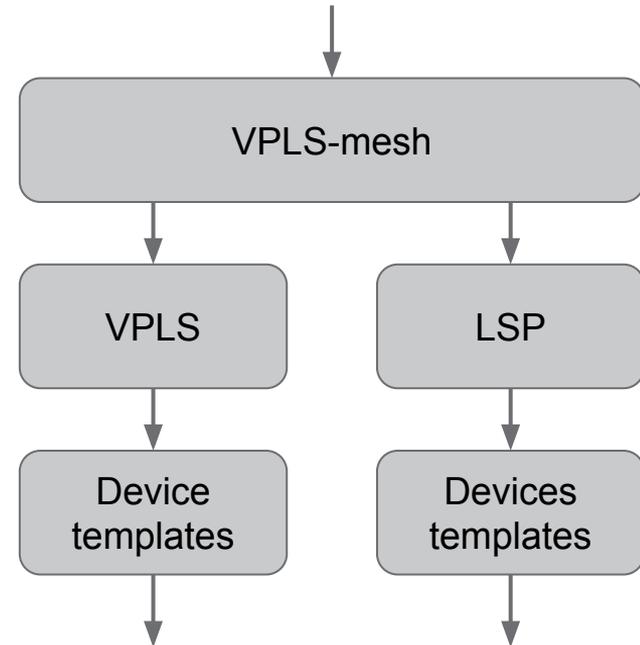
- Move tier 3 services into Workflow Orchestrator whenever possible
- Make overall service design a multi layer approach
- Refactor existing services following a 2-tier service paradigm whenever possible
- Further build out more granular multi-tier service design and architecture

Questions...

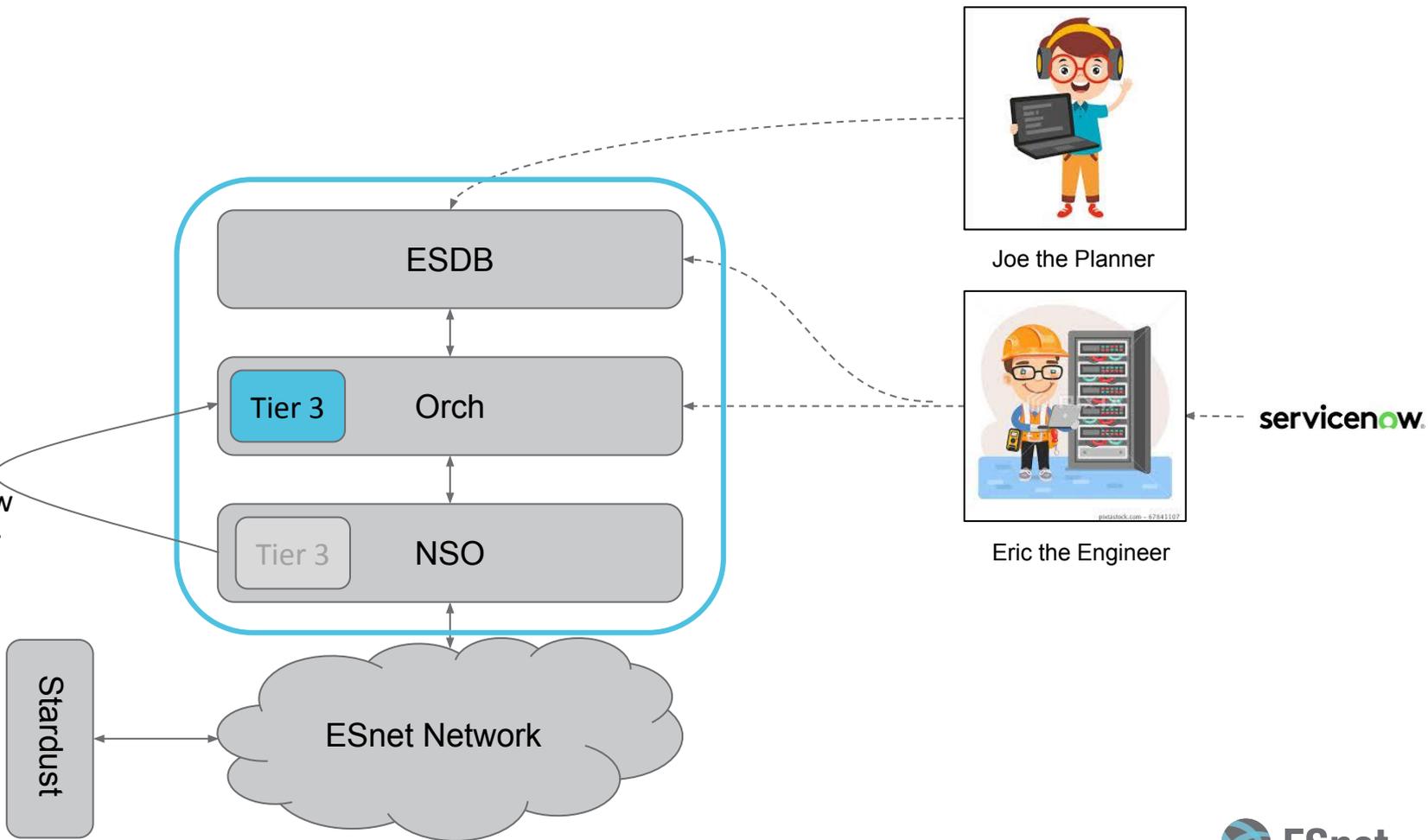


VPLS-mesh (NSO service layering)

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



Offloading
“umbrella”
services into
the Workflow
Orchestrator



ESDB GUI

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Circuits

ESnet Circuit ID	Endpoint A/Z	Orchestrator ID	Provider / ID
ESNET-Z00227 In-service	torrestal-mpr1:ge-0/0/40 DOE-NNSA-FORR:Site_conn		DOE-IN Headquarters Forrestal Building
ESNET-Z00330 In-service	ATLA-Ciena-Shelf2:ETH10G-2-7-1 ATLM-Ciena-Shelf1:ETH10G-1-7-1		Internet2 ESNET-ATLA-ATLM-10GE-22437
ESNET-Z00349 In-service	ATLA-Ciena-Shelf2:ETH10G-2-7-4 ATLM-Ciena-Shelf1:ETH10G-1-7-4		Internet2 ESNET-ATLA-ATLM-10GE-22440
ESNET-Z00355 In-service	ATLA-Ciena-Shelf2:ETH10G-2-7-3 ATLM-Ciena-Shelf1:ETH10G-1-7-3		Internet2 ESNET-ATLA-ATLM-10GE-22439

+ ADD CIRCUIT

🔧 RESERVE PORT

⬇️ DOWNLOAD CIRCUIT LIST

Filter ▼

Circuits

Couplers

Select tags... ▼

Select a provider... ▼

Orch GUI

The screenshot displays the Orch GUI interface. At the top, the 'Orchestrator' logo is on the left, and the status 'Engine is Running' with a green dot, a red checkmark, and a notification icon with '4' is on the right. Below the header is a navigation bar with 'Processes', 'Subscriptions', 'Metadata', 'Tasks', and 'Settings'. A 'New Process' button is on the right. The main content is divided into two sections: 'Active Processes' and 'Completed Processes'. Both sections have a search bar and navigation arrows. The 'Active Processes' table lists failed system processes. The 'Completed Processes' table lists successful workflow executions.

Active Processes

Assignee	Status	Workflow	Target	Abbr.	Subscription(s)	Started	Modified
SYSTEM	Failed	create_prefix_list	CREATE	ESNET	AS3443 - ESNET - Energy Sciences Network -- ipt	10-7-2023	24-8-2023
SYSTEM	Failed	create_prefix_list	CREATE	ESNET	AS65152 - ESNET - Energy Sciences Network -- ipt	2-6-2023	9-6-2023
SYSTEM	Failed	create_l3_service	CREATE	ESNET	L3-transit for 65512--base--lbnl59qa-cr6a:esnet_lo-685	8-5-2023	2-6-2023

Rows per page: 10

Completed Processes

Workflow	Target	Customer	Product(s)	Tag(s)	Subscription(s)	Modified
create_physical_connection	CREATE	FABRIC::FABRIC Testbed	Physical Connection	PCS	FABRIC conn-ak: star-mpr1:ge-0/0/42 1G	12:18 CET
provision_node_enrollment_tpd	MODIFY	ESNET::Energy Sciences Network	Enroll Transponder	NESTPDR	Node eqxda3-tpdr5 Provisioned	08:43 CET
provision_node_enrollment_tpd	MODIFY	ESNET::Energy Sciences Network	Enroll Transponder	NESTPDR	Node seat-tpdr4 Provisioned	08:35 CET
modify_backbone_link_member_state	MODIFY	ESNET::Energy Sciences Network	ECMP Group	BBL	ga-cr6 to sunn-cr6	6-9-2023