



U.S. DEPARTMENT
of ENERGY



ESnet WFO: Year in review

ESnet's automation & orchestration for 2025-6

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June 8, 2026 | TNC 26 | Helsinki, Finland

The background is a solid light blue color. It features a central point from which numerous thin, white, curved lines radiate outwards, resembling light trails or fiber optic paths. Interspersed among these lines are many small, out-of-focus white circles of varying sizes, creating a bokeh effect. The overall aesthetic is clean, modern, and tech-oriented.

Five Workflows

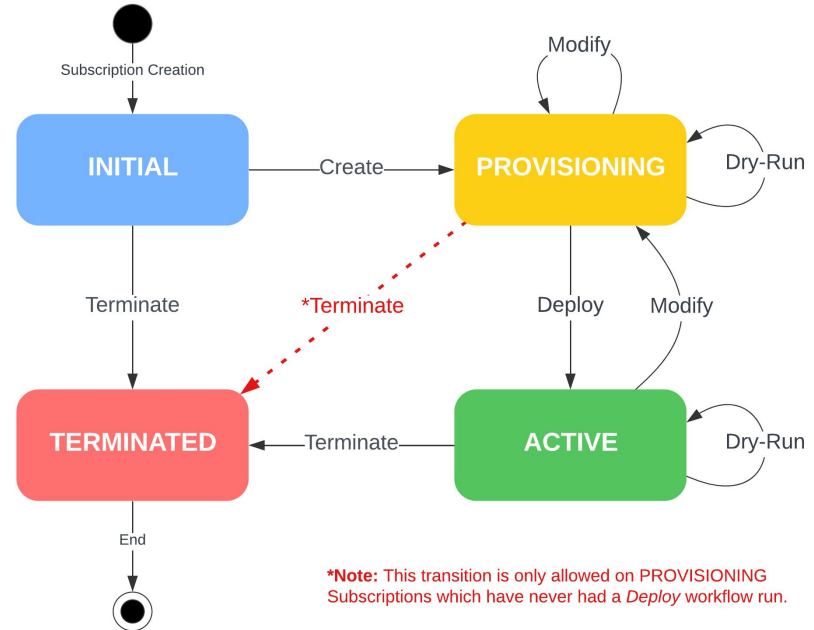
The Five Workflow Model

Five workflows

Create, Dry-run, Modify, Deploy, Terminate
(and Validate)

State Transitions

Represent current operational state of Subscriptions



Challenges and Limitations (Why 5wf?)

- Stuck Workflows
- Self-service issues
- Clicking “abort” button
- Requires manual database fix by dev team
- Network engineers can’t troubleshoot during maintenance windows outside of dev working hours

The screenshot displays the Workflow Orchestrator interface. At the top, it shows 'Workflow Orchestrator' and 'Local Development' in a yellow box. A status bar on the right indicates 'Engine is RUNNING' with a green checkmark and '0' errors. A progress bar shows the workflow is currently suspended. The main area lists three workflow steps:

- Generate port description and assemble payload for NSO**: success - 6/3/2025, 3:28:44 PM. Duration: 00:00:00.
- NSO Yang-patch Dry Run**: success - 6/3/2025, 3:28:45 PM. Duration: 00:00:00.
- Confirm NSO Dry Run Results**: suspend - 6/3/2025, 3:28:45 PM. Duration: 00:00:00.

The 'Confirm NSO Dry Run Results' step is expanded, showing 'NSO 'dry run' results' with a JSON snippet:

```
devices {
  global-settings {
    ned-settings {
      allu-sr {
        transaction {
          config-abort-warning "Cannot modify the port binding, remove the port binding first" (

```

Below the JSON, there is a checkbox labeled 'Confirm NSO 'dry run' results' which is currently unchecked. A 'Resume workflow' button is visible at the bottom right of the workflow view. The bottom of the interface shows the next steps: 'Confirm NSO Dry Run Results' (pending) and 'Yang-patch NSO'.

Lessons learned

- Users took a lot of time to get used to new MOP
- Office hours were helpful (sometimes)
- Validation workflow challenges
 - Out-of-sync Subscriptions have big impacts on the DB
 - Stale Subscriptions in non-deployed state
- Testing had to be changed/updated in a big way
 - Effort is ongoing to increase coverage & speed (with unit/mockings)

Dynamic L3VPN

$$\frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

P

O

0 1446 440

$$E = mc^2$$

$$\frac{1}{s^2} \frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$$

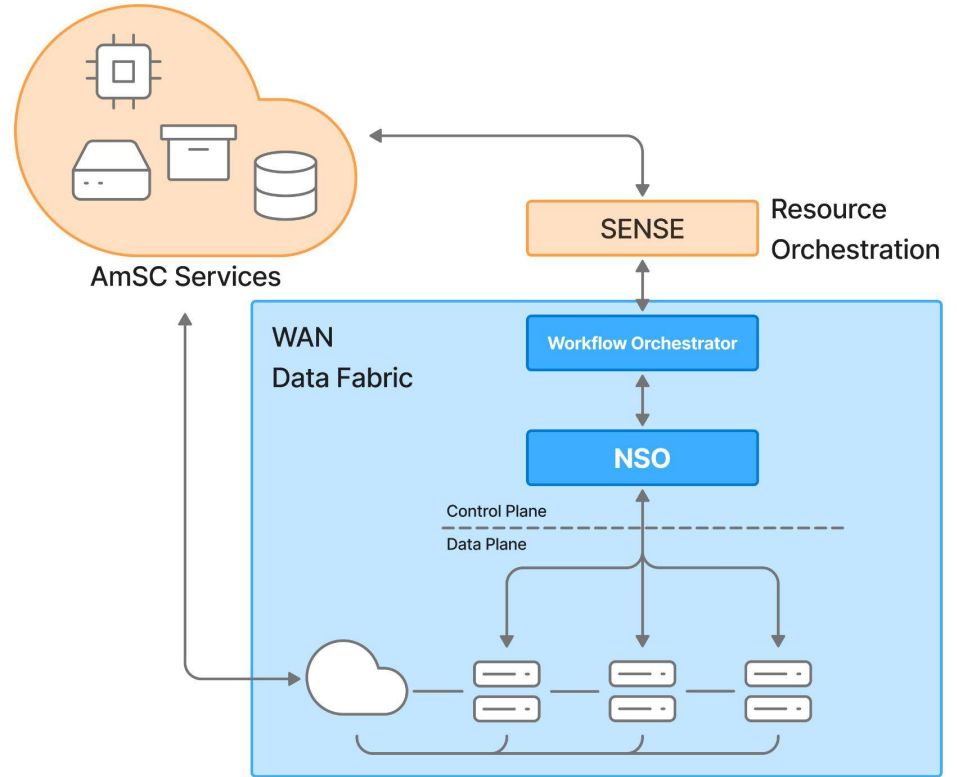
New Product

Supporting AmSC

- Previously ESnet had hard-coded VPRN instances
- First time external users can create subscriptions using the WFO REST API
- New endpoints
- Authn/z is a temporary (...) solution
 - Limited access to workflows via API keys

L3VPN for AmSC

- Connect sites to cloud services



Internal Prefix List

$$\frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$



0 1446 440

$$E = mc^2$$

$$\frac{1}{s^2} \frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$$

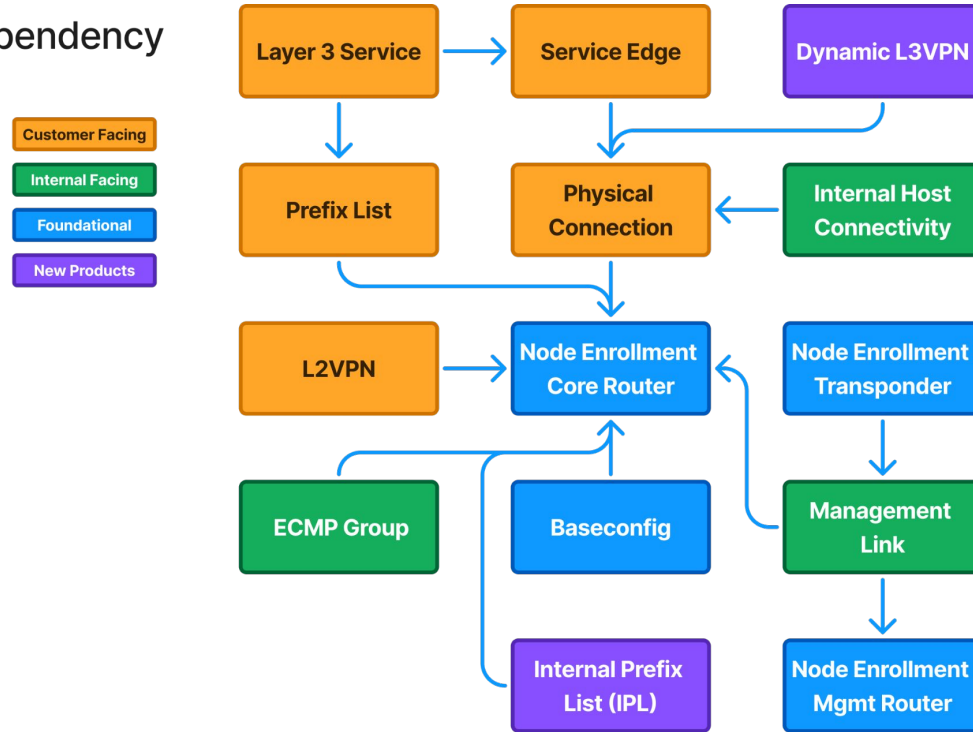
New Product (IPL)

Long-time pain point

- Required major changes to “boilerplate” config
- Bulk operations
- Re-ordering of product dependency graph
- Broke existing test implementation *completely*.

Where IPL fits in ESnet product map

Product Dependency Model



IPL Lessons learned

- Only “half” the necessary config is pulled out of NSO boilerplate
 - (EXPLAIN)
- Have existing unit/mock/integration test suite for coverage
 - Should be quick enough to iterate for development
 - Maintain sanity when creating new products, refactors
- Test in production-like environment as early as possible
 - Feature flags were discussed, but not used
- Consider if WFO is the right place for a “Product”
 - We’ve been at this a while, and still make the wrong choice sometimes...

It's not all bad...

- IP Prefix changes are the most requested kind of update from our users
- In the past, boilerplate necessitated a **full software release** of NSO to deploy prefix updates
 - IPL provides self-service
- In hindsight, WFO may not have been the system of choice for IPL
- BUT our users did get value from it

Other progress

- Lots of refactors
- Changing to use graphql where possible to communicate with IMS
- Investigating replacing our in-house built IMS (ESDB) with Nautobot
- Design more externally-accessible services

Questions?