



# WFO programme update – the enabler of AIOps on SURFnet ∞

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SURF

# | Introduction



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- UVA/SNE
- 7,5 years @SURF(net)
- Automation & Orchestration
- SCINET
- ML/AI
- Workflow Orchestrator Programme Technical Lead

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# | WFO programme update

# | What is the Workflow orchestrator?



**The workflow orchestrator is an opensource software framework that enables you to.....**

- .... define your (business) processes
- .... track and trace customer facing service lifecycle
- .... think about network services instead of network config
- .... streamline your provisioning
- .... clean up your data architecture
- .... integrate various sources of truth into a single-pane-view
- .... **orchestrate automations**

# | How does the workflow orchestrator work?



## The workflow orchestrator....

- .... helps you define the building blocks of your service in Python classes
- .... executes (atomic) functions, in order, to run a workflow
- .... forces you to think about data and sources of truth
- .... is a way through which you can solve resource contention
- .... lets you safely retry failed steps in order to recover from errors during provisioning
- .... is strictly typed by making use of [Pydantic](#) and [FastAPI](#) to keep your data sane
- .... is designed so you don't need front-end development skills to start working with it
- .... leverages the latest and greatest technology stack for web development in Python and JavaScript.
- .... **programme is a community of like minded colleagues, where we interact and share experiences**

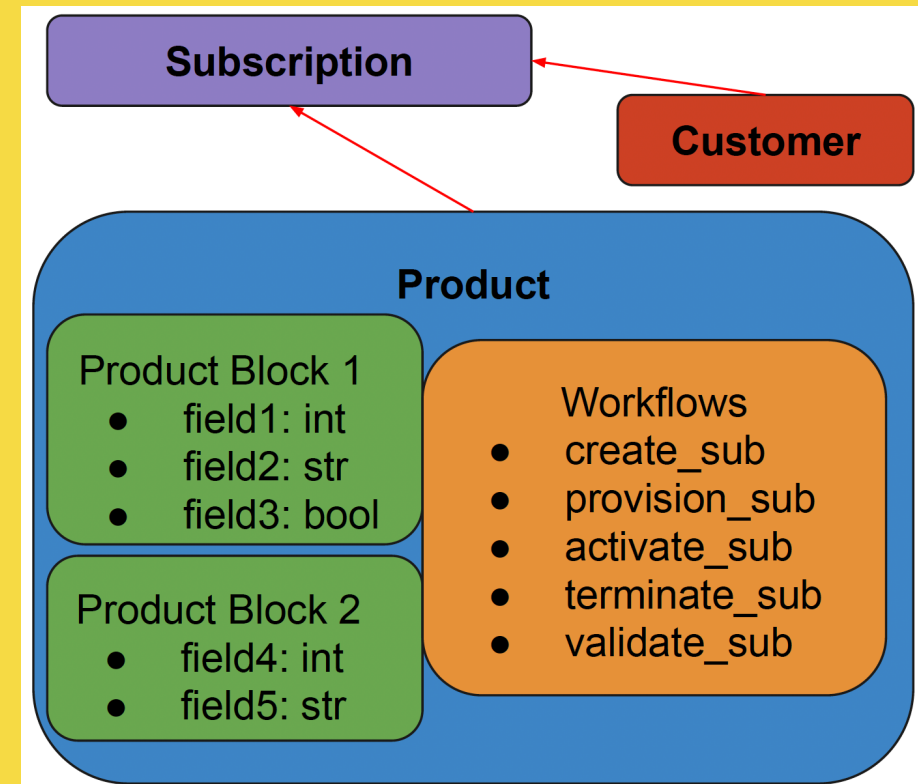
# Products and their building blocks



## Describing Services as "Domain models"

- Subscription: associates a customer with a product
- Product: a collection of product blocks and workflows
- Product block: a reusable collection of fields
- Workflow: an action that can
  - Modify the content of product blocks
  - Update the state of a subscription
  - Effect change in an external system.

Source: <https://github.com/workfloworchestrator>



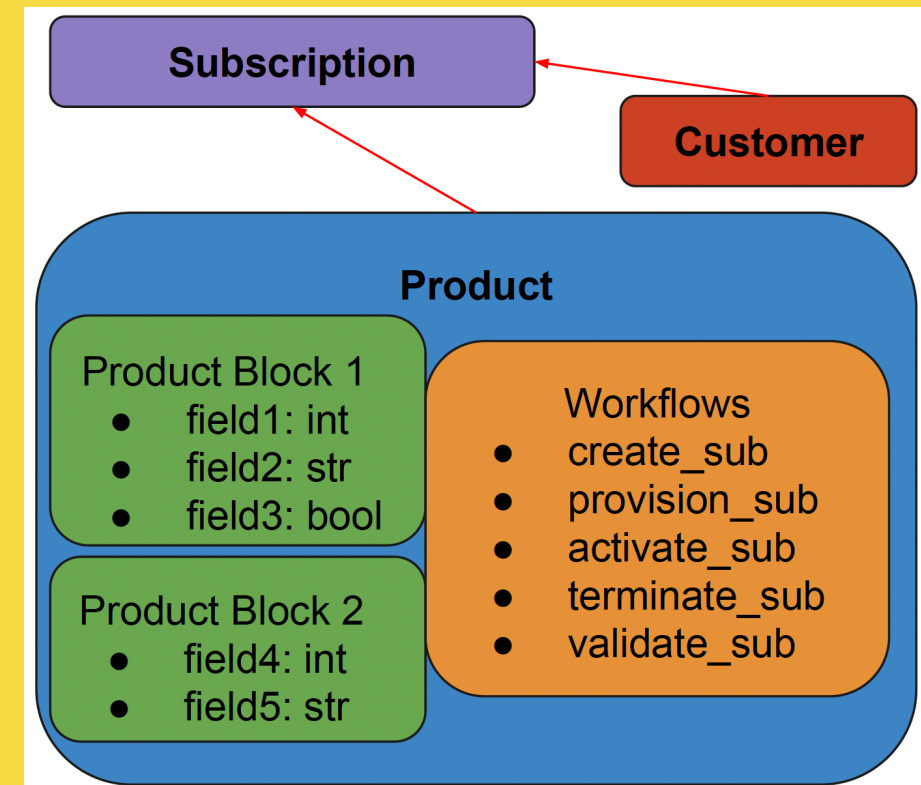
# Workflows act on subscriptions



## Workflows are the driver of network orchestration

- "Automation manager" in the context of subscription state
- Workflows instantiate, modify and terminate subscriptions
- Typical workflows are:
  - Creation: Create something new for a user/customer
  - Modify: Toggle a change and update a subscription and subsystems
  - Terminate: De-allocates resources

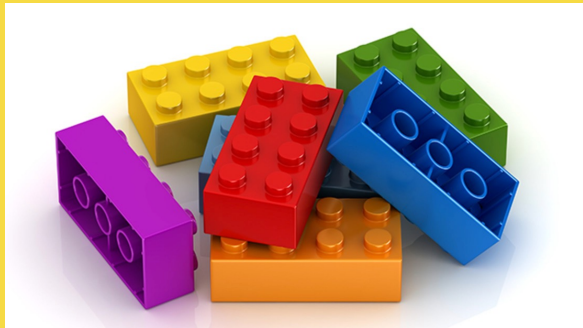
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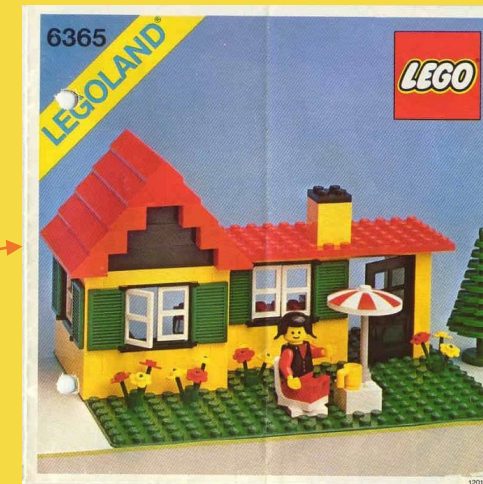
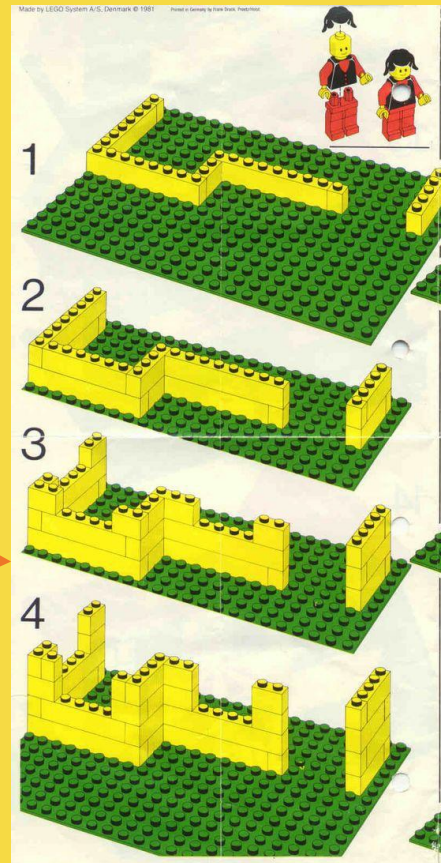


# | ... in other words.

Workflows gather resources from those systems and associates them together to create a subscription



Finite resources exist in other systems



Orchestrator contains the final product



# | If you are not convinced yet....



## Consider this...

- Since the introduction of the orchestrator SURF has experienced 0 outages due to copy-paste or similar errors
- The provisioning of a network service and the updating of all related OSS and BSS takes less than one minute
- The network no-longer is the source of truth, this means we have been able to introduce reliable self-service to our customers
- We don't need to log onto routers anymore to make network changes
- **The orchestrator enables network engineers to focus more on engineering, than network changes**

# | Opensourced in the workflow orchestrator programme



## Vital statistics:

- 11K downloads per month
- 28 stars on Github
- Active slack channel with over 50 participants from 9 different organisations
- Software ecosystem: Orchestrator core, UI components and various other libraries for NSO and NSI
- 3 tiered membership model: Partner, Graduate and Sandbox
- SURF, Esnet, Géant and Heanet(?) use it in production
- Being prototyped by: Canarie, University of Waterloo (Ca)
- Being investigated by: aarnet, SUNET, Belnet



# | What do you get when you become a member?



## **We welcome new participants!**

- Partner members are paired with Graduate members to help onboarding and kickstart the development experience
- Graduates are members who have successfully run a proof of concept and have a viable business case of implementing the orchestrator: (2 FTE). They will be assisted by Workflow orchestrator partners
- Sandbox members are companies who are prototyping the software, but have not made a choice to implement the software yet.

**All participants are enrolled on our slack channel and are able share experiences with each other.**

**The first user meeting will be hosted at TNC24 on Monday in the afternoon. Come by to meet with the other organisations and share experiences about Automation and Orchestration.**



# WFO the enabler of AIOps on SURFnet ∞

# | Workflow orchestrator at SURF

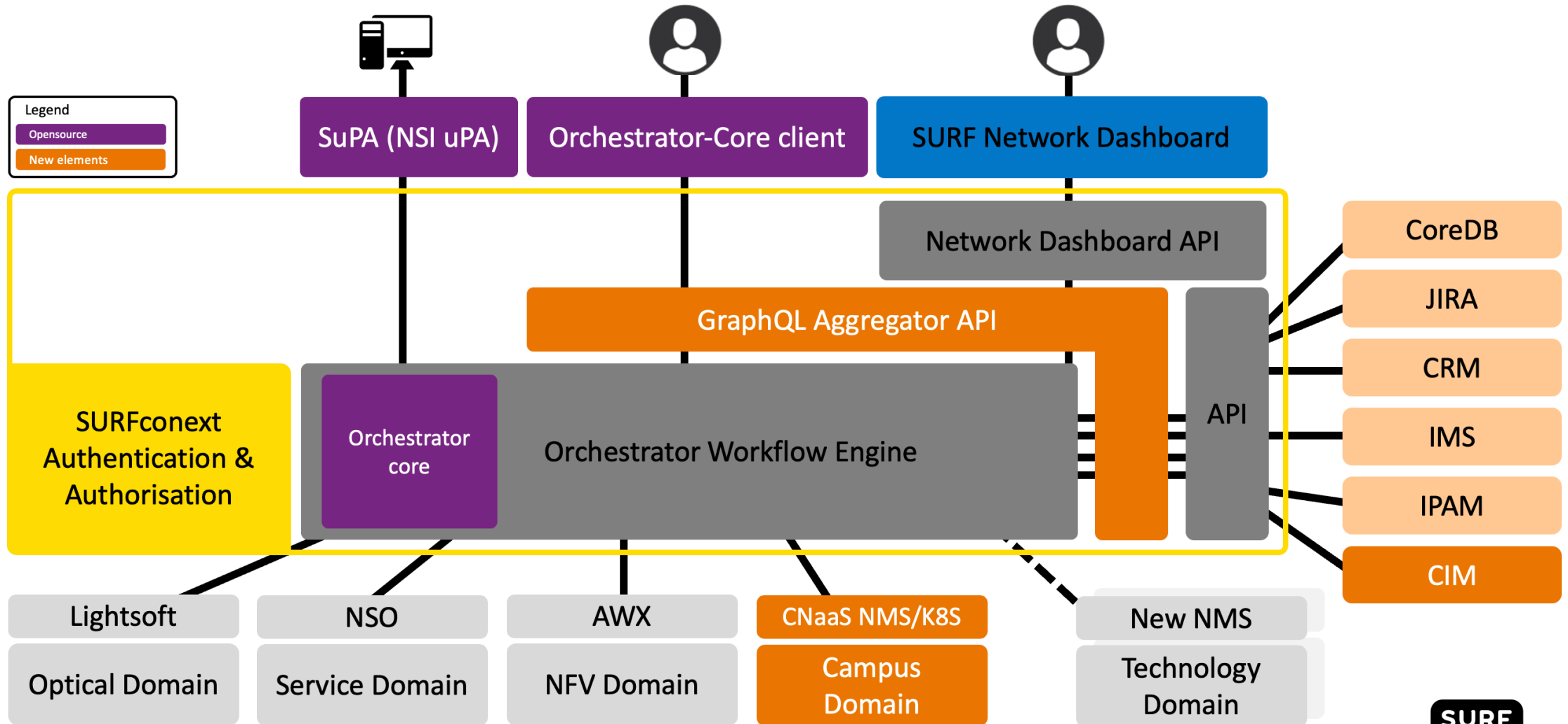


## Anno 2018:

- Since its inception in 2018 the SURF orchestrator has run over **25000** fully automated network changes
- This has resulted in almost **5200** customer facing subscriptions
- The orchestrator not only automates network provisioning, but also manages resources in OSS and BSS
- Data entry is fully automated and up to date!
- First time right network configurations are the norm and not incidental
- A wide variety of services that caters to high energy science, but also to small vocational colleges



# Software architecture



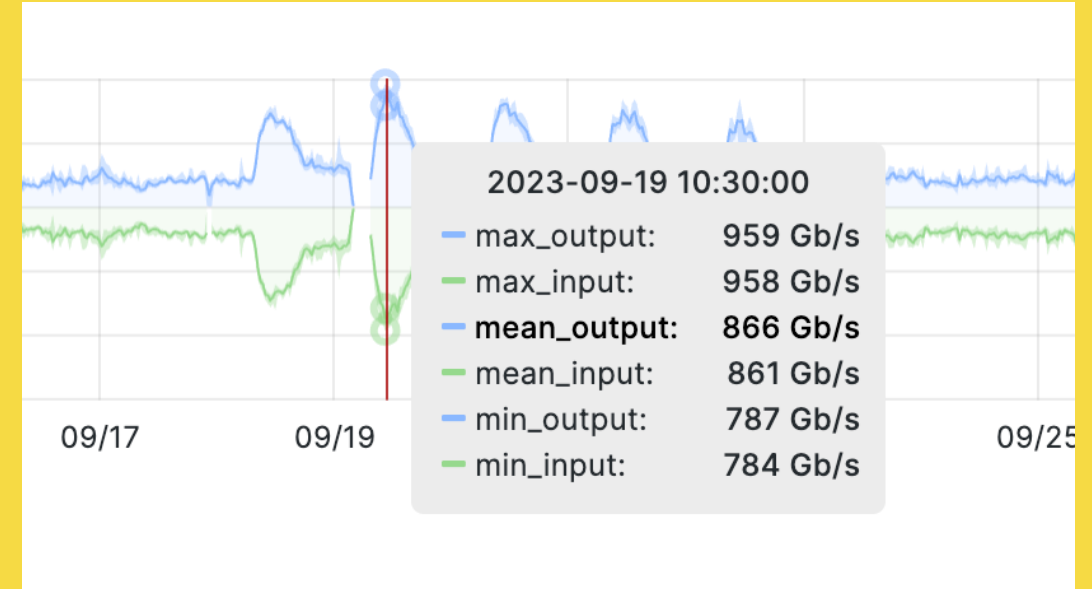


# A brief overview of the network

## SURFnet8

The eighth refresh of the network since the start of SURF(net):

- Optical 400G/100G DWDM, 10G CWDM - 13,000 KM of darkfibre
- 800G upgrade on the CERN link
- 400GE on NetherLight, 200GE (Aggregates) on Backbone
- Daily traffic peak almost 1 Tb/s:
- +/- 420 Gb/s commodity Internet
- +/- 550 Gb/s EVPN, L3VPN: LHC(ONE|OPN), Public clouds, etc
- SR/MPLS
- Juniper MX (Trio)
- 350 + PoP's in the Netherlands and Europe
- 8-9 % of the Dutch population on our network during the day



# | SURFnet ∞

## **Why not SURFnet 9?**

We are very happy with the stability and quality of the network. No need for a major hardware/software/architecture replacement, just a refresh and evolution.

## **MX204 shenanigans (2021)**

Is an excellent CPE device. Planned usage at SURF until at least 2028, perhaps even into the 2030s. Supports the 1GE – 100GE connectivity services and is 85% of our install base. Not suited for high bandwidth services. Staggered migration to a new CPE device, only when necessary.

## **Core devices upgrade and architecture change**

Disaggregation P vs PE devices, current network is PE only. Geographical redundancy (not just Amsterdam). Smaller devices, high capacity, high density, no more modular chassis(?)

## **Planning and Logistics**

Currently in the RFI phase, planning is to do the RFP in 2024 H1. First purchase in 2024 Q4 and install in 2025 H1

# | Homogenous vs Heterogenous



## Homogenous network architecture

- The current architecture supports **any** service and interface **anywhere** on the network
- Easy to operate and maintain
- Key to the introduction of Orchestration
- No longer scalable unless we do a full hardware refresh. Can you do 400GE and 1GE on a single box? (No, and you probably wouldn't want to either)
- Rigid architecture and contract. Large potential for wastage.

## Heterogenous network architecture

- Multi OS, Multivendor network, and P vs PE
- Investigating Broker model in RFI; we would like to be able to pick and choose vendors and devices
- Be more flexible in price and service offering: low bandwidth and cheap connectivity vs high bandwidth with QoS
- Leverage the power of NSO. The northbound api should remain stable
- Continuous evolution and upgrade, no more big bang upgrades

# | Operational challenges

## Running a multivendor Network

- Braindrain, **less** people have to do **more** work
- More engineering and integration between vendors
- How do you keep a single pane view on problems
- Different procedures for different boxes
- Network planning and capacity management

**How can we reduce the workload of our engineers and leverage the standardisation of our Automation and Orchestration platform, to overcome multivendor network challenges?**



# | Creating an intelligent network



## Relies on a sane data architecture and reliable sources of truth

- SURF validates all data across the network and OSS/BSS
- Precise definitions of services consistently provisioned across the network
- Data labelling is very precise and easy to correlate
- Large amounts of hi quality data
- **Fully orchestrated provisioning**

## Relies on clear use cases and well-trained algorithms

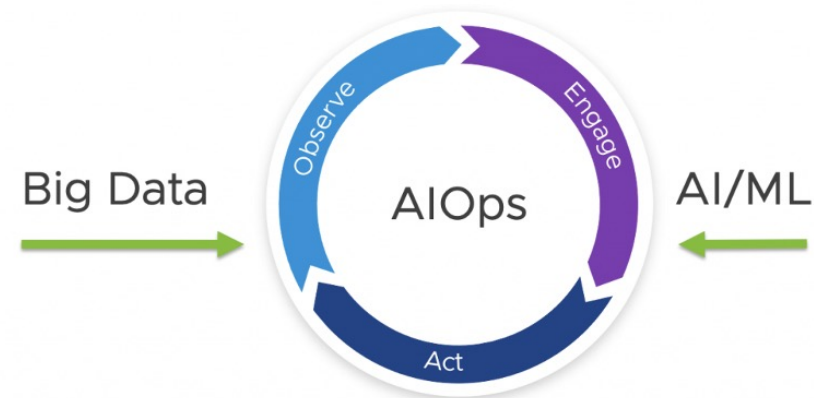
- Intelligence is relative – How far should you go?
- Training the algorithms towards the wrong outcomes will not result in “intelligence”
- What checks and balances do you need?

# | Intelligent network starting point



## AIOps

- *An AIOps platform combines big data and machine learning functionality to support all primary IT operations functions through the scalable ingestion and analysis of the ever-increasing volume, variety and velocity of data generated by IT. The platform enables the concurrent use of multiple data sources, data collection methods, and analytical and presentation technologies. - [Gartner](#)*
- Highly supervised human in the loop



# | Intelligent networks - long term evolution



## Creating a comprehensive network model

- Principle Component Analysis of the network – Make use of LLMs
- Create a virtual network model that enables engineers and architects to plan ahead for topology changes
- Enable network simulations to model network failures
- Use network simulations to drive just in time bandwidth planning and allocation
- Research resource optimisation through the network model that is able to optimise on multiple inputs: Capacity, costs, energy efficiency



# | Where do we start - use cases

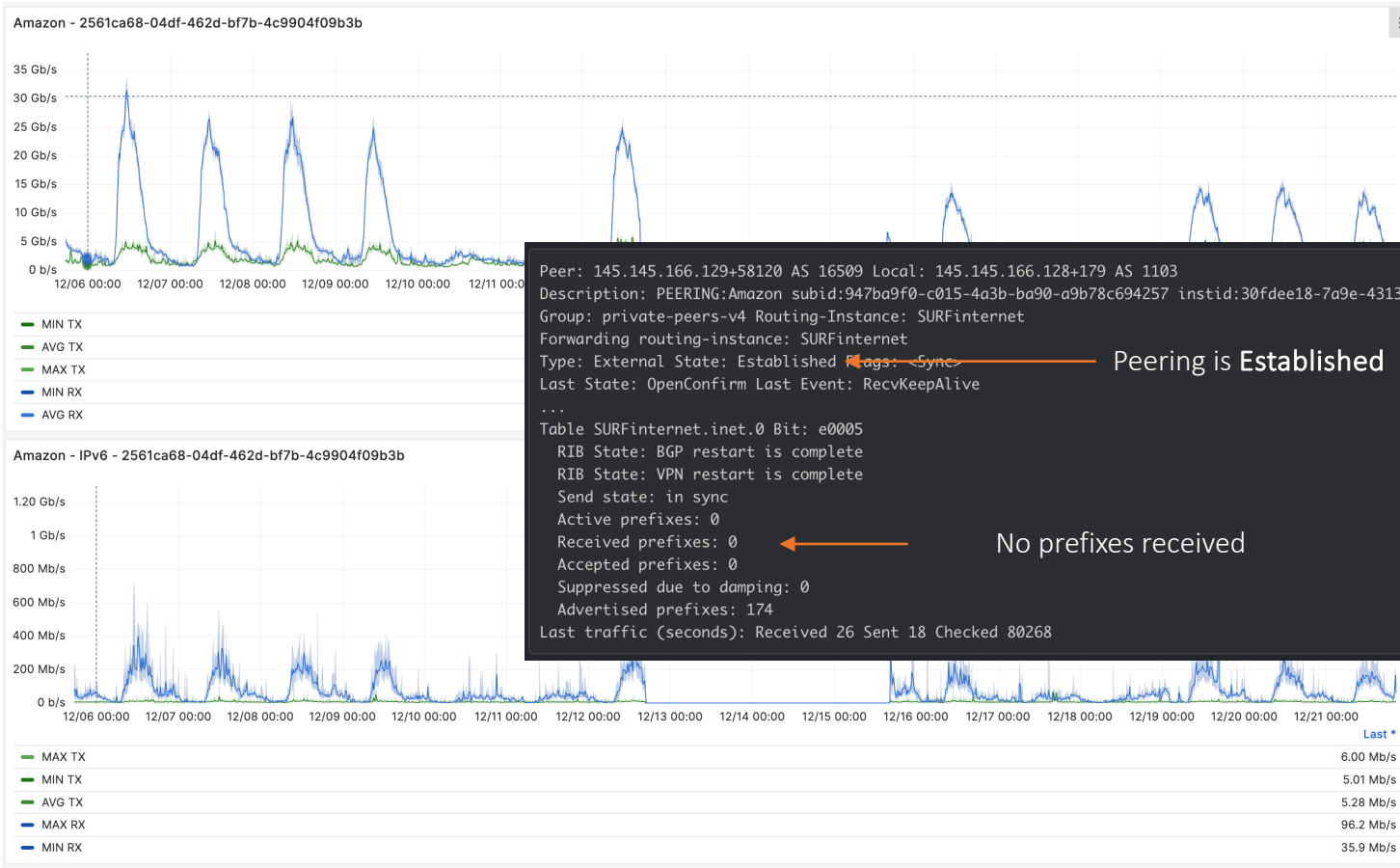
- Re-routing of traffic on interface/link failures
- Prefix filter updates based on PeeringDB
- Capacity management
- AI-chatbot in our networkdashboard to capture intent and translate it to self-service
- Troubleshooting suggestions and root cause analysis
- Energy efficient networking
- **Event correlation and anomaly detection**
- **Trend monitoring**



# Amazon scenario – event correlation



## Incident or not?



# Microsoft scenario – Trend monitoring

Incident or not?



# | Trend and event monitoring

## A tangible place to start

- Traditional monitoring has a single dimension
- Is the BGP session up?
- Is the interface up?

## A healthy service is described in multiple dimensions

- Are you receiving prefixes?
- Is traffic flowing at the correct levels?
- What is the baseline?
- When is a service healthy?
- What is a healthy service?



# | How are we going to start?

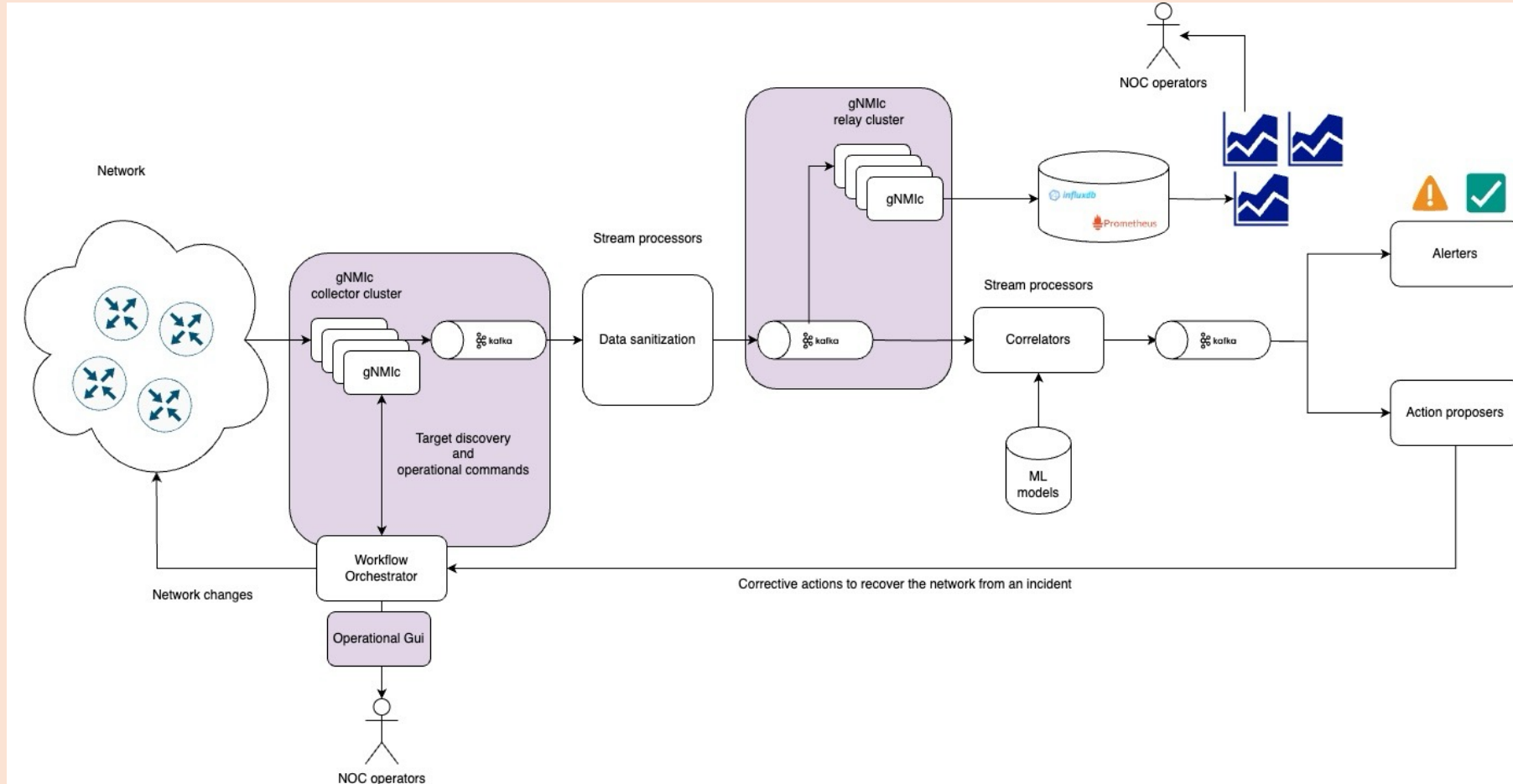
## Getting the basics right

- Redesign of our telemetry platform
- Make sure we get the right data with the right resolution
- Start “playing” with the data and creating simple ML models
- LSTM network traffic predictions are relatively accurate (0.96) – ideal for the peering use case



# An engineering solution....

We need a way to process real time data from routers in a vendor agnostic way to enhance our monitoring capabilities



# | Start small – think big

## AIOps and ML roadmap:

- Build a scalable streaming platform late 2023 and 2024
- late 2024 implement Peering event and trend monitoring to generate alerts
- Build out the operational use cases late 2024
- Start doing the Principal Component Analysis
- 2025 and beyond:
  - automatic reconciliation
  - energy efficiency
  - network simulation – digital twin








**Any questions?**

**Thanks!**

 Peter Boers

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## | Extra resources:

### Workflow orchestrator:

- <https://workfloworchestrator.org/orchestrator-core>
- For slack membership contact the board at:  
[workfloworchestrator.board@commonsconservancy.org](mailto:workfloworchestrator.board@commonsconservancy.org)  
or  
send me an email: [peter.boers@surf.nl](mailto:peter.boers@surf.nl)

