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Key Takeaway:

In order to succeed with network automation you must have a Network Source of Truth (NSoT)

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Who am I?

- Network Engineer ~20 yrs
- Last few years focussed on Network Automation
- Joined NS1/NetBox Labs ~18 months ago

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Agenda

- **Part One - Setting the scene**
  - Why the drive for network automation?
  - What is a Source of Truth and why do we need one?
- **Part Two - Tools**
  - Modern network automation architecture
  - Network documenter to network automator journey
  - Introducing NetBox
- **Part Three - Demo time**
  - Modelling a Site in NetBox and rendering a device configuration
  - Exploring the NetBox REST API and GraphQL
  - Putting it all together - a simple NetDevOps pipeline

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Agenda (continued)

- **Part Four - Wrap Up**
    - Shameless plug for NetBox Cloud!
    - What next?
    - Useful Resources
    - Q&A

As network complexity increases, automation becomes key to reliability

➡ Networks are becoming more dynamic and complex with more demand placed on network teams

➡ Manual processes ('ClickOps') are brittle and cause bottlenecks (provisioning, t-shoot)

➡ Inaccurate network data limits the ability to scale automation

65%
Network changes are performed manually

Gartner Market Guide for Network Automation Tools

40%
Network operations automated by 2025

Gartner Market Guide for Network Automation Tools

27%
Network Ops who feel they are successful(8% decrease YoY)

Network Management Megatrends 2022 - Shamus McGillicuddy, VP of Research, EMA

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The Benefits of Network Automation (For You)

- Lots of very valid business benefits, which is great.....but also.....

- It's easy to get started and you will have a lot of fun!

- It will make your life easier and save you time (automate the boring stuff)

- It will enhance your career (become a Network Engineering rock star!)

Network Source of Truth (SoT)

By **Andrew Lerner** | January 28, 2020 | 0 Comments

Networking **Just Published** **DevOps**

To align with digital business needs (i.e., *more, faster but with near 100% uptime*), we recommend networking professionals apply DevOps and infrastructure-as-code techniques. **We've written about this before and it entails treating network configurations as code** which will not only automate configuration, but also the validation phases, both in test and production. This is easy to say, but hard to achieve in practice. One key aspect of achieving this is to build a network source of truth (SoT).

Simply put, we believe organizations **must create and maintain a network source of truth**, starting with an authoritative network object inventory. The SoT is the single source (accessible via API) from which the automation tools will gather the data they need to execute the pipeline. The SoT represents the desired state of the network. If an on-device configuration file deviates from the SoT, then the on-device file should be investigated.

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What is a Network Source of Truth?

- Defines the *intended* state of the network represented as *structured data*
- Should act as a single consistent data set
- Adopting an NSoT requires a significant mental shift for network engineers away from describing the network in design documents and diagrams
- NSoT becomes the authoritative reference for the network and it's data *drives network automation*
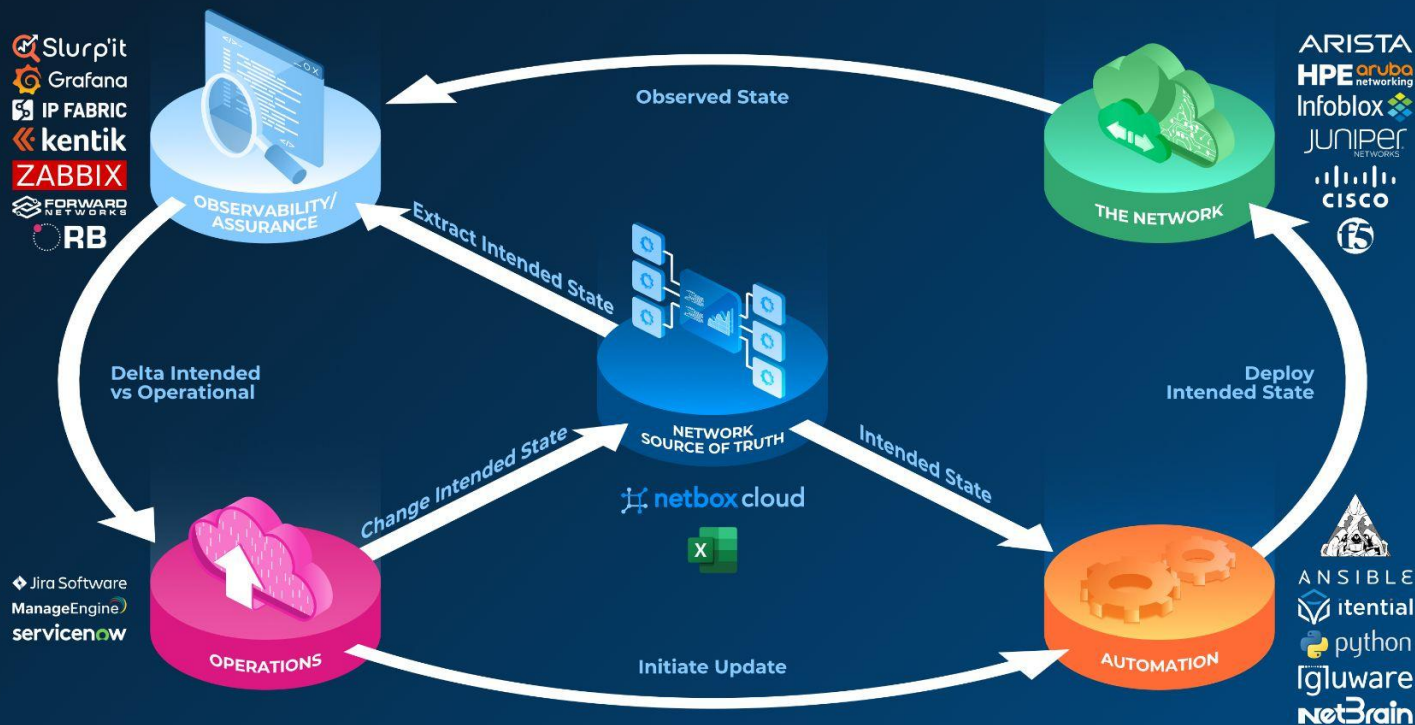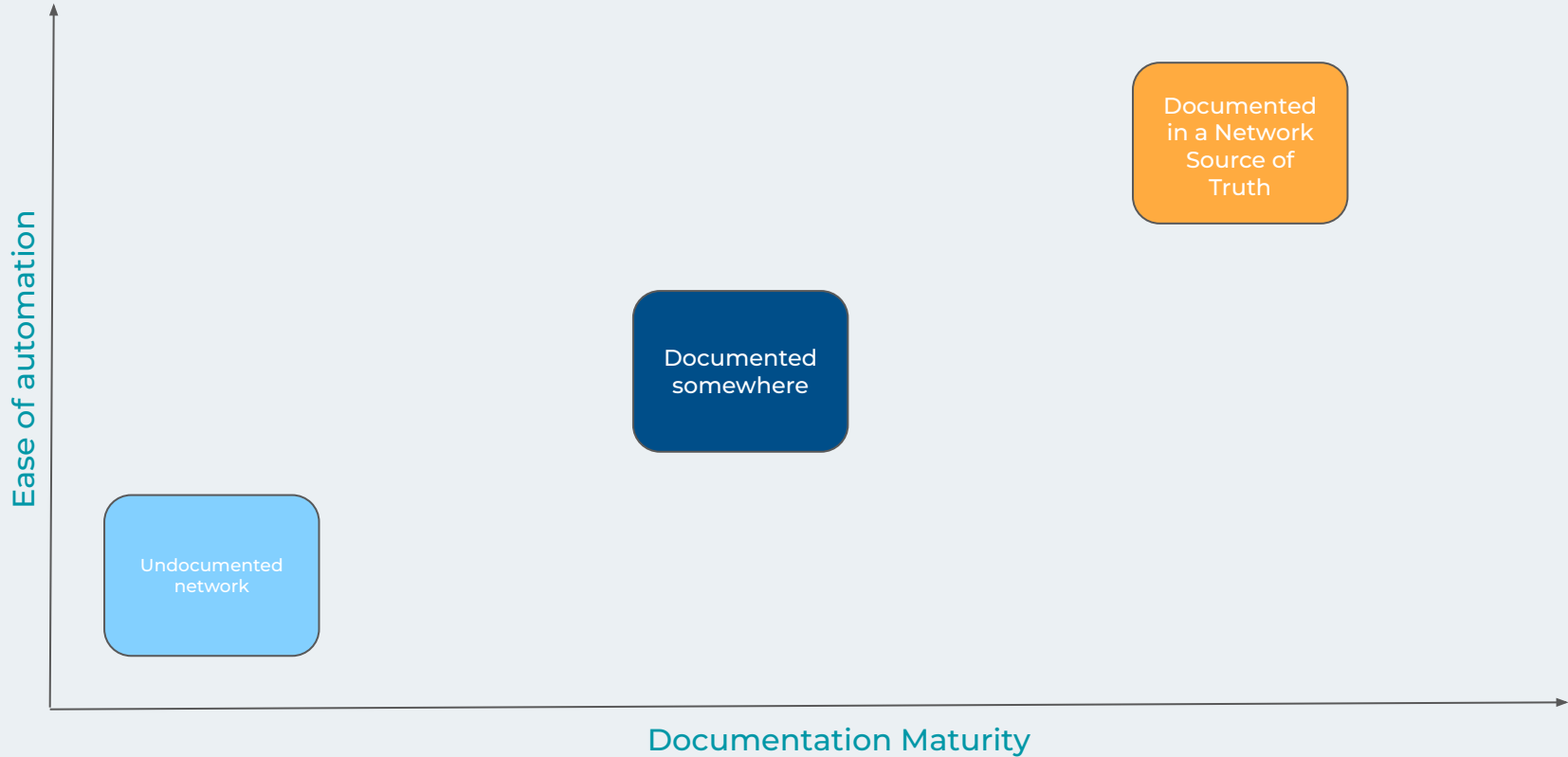
| Inventory |
| DCIM |
| IPAM |
| Configuration |
| Network Properties |
| Circuits |

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Modern Network Automation Architecture

Slurp'it
Grafana
IP FABRIC
kentik
ZABBIX
FORWARD NETWORKS
RB

Observed State

ARISTA
HPE aruba networking
Infoblox
JUNIPER NETWORKS
CISCO
f5

OBSERVABILITY/ ASSURANCE

THE NETWORK

Extract Intended State

Delta Intended vs Operational

NETWORK SOURCE OF TRUTH

Deploy Intended State

Change Intended State

Intended State

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X

Jira Software
ManageEngine
servicenow

OPERATIONS

Initiate Update

AUTOMATION

ANSIBLE
itential
python
gluware
NetBrain

Closed-Loop Network Automation Stack

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Documenter to Automator - a Journey

Ease of automation

Documentation Maturity

Documented in a Network Source of Truth

Documented somewhere

Undocumented network

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Simple Example - Track Config Drift

- Build *Intended* device configurations in NetBox using templates and save to a file

- Back up *actual* device configurations using Oxidized and commit files to a Git repo

- Get alerted by Oxidized in Slack/Teams when a device config has changed

- Run a 'diff' command on the two files to see the differences

```
diff configs/intended/AUSYD01-SW-1-Intended.cfg configs/actual/AUSYD01-SW-1-actual.cfg
8,9d7
< vlan 50
<   name NETMAN
119c117
<  ip address 10.0.0.10/26 255.255.255.192
---
>  ip address 10.0.0.11/26 255.255.255.192
129d126
< ntp server 192.168.4.11
```

- Run automation playbook/script to remediate

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NetBox - Your Network Source of Truth

Your system of record for network management & automation:

➡ Eliminate spreadsheets

➡ Break down DCIM & IPAM data silos

➡ Accelerate network automation (REST API, GraphQL, Webhooks etc)

➡ Everything is in NetBox and everything is correlated

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NetBox is Powered by a Massive Community

1,600+
Networking pros building, helping, sharing - 24x7

1,000s
Production installs

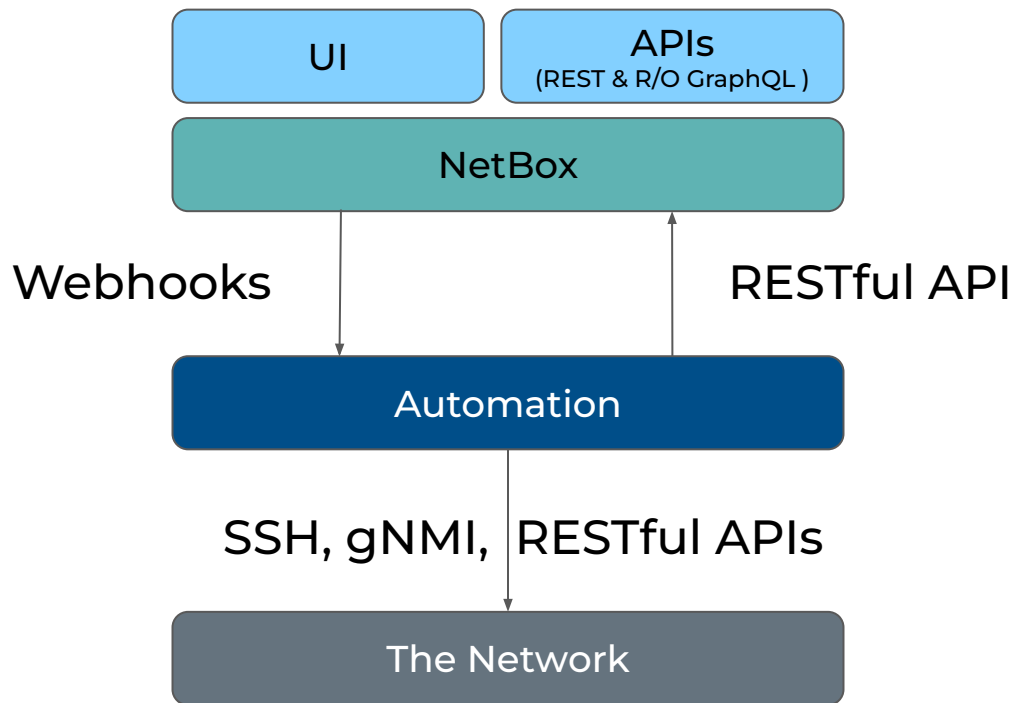Disney   JPMorgan Chase & Co.   IBM   The New York Times   SAP   TESLA

Everyone uses NetBox

13k+
GitHub ⭐
Widely loved by networking teams

11k+
Software commits
Feature complete, battle tested

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Getting Data In and Out of NetBox

NetBox REST vs GraphQL Example - VLANs

{REST}

```
# Multiple API GET requests to different
endpoints

# API request 1 - get the details for the device

GET /api/dcim/devices/?name=ceos-sw-1

# API request 2 - get the details of the site
using the name of the site returned by call 1

GET /api/sites/?name=ContainerLab

# API request 3 - get the list of VLANs for the
site, using the site ID returned from call 2

GET /api/ipam/vlans/?site_id=1
```

GraphQL

```
# Single POST request describing all the data required

POST /graphql/

query GetVlansPerDevice {
  device_list(name: "ceos-sw-1") {
    name
    site {
      name
      vlans {
        vid
        name
      }
    }
  }
}
```

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Vendor Agnostic Structured Data

Structured NetBox Data

Jinja Templates

Rendered Configs

```
{
    "name_servers": [
        "8.8.8.8",
        "9.9.9.9"
    ]
}
```

```
# Cisco_IOS.j2

{% for server in name_servers %}
ip name-server {{ server }}
{%- endfor %}
```

```
ip name-server 8.8.8.8
ip name-server 9.9.9.9
```

```
# Juniper_JunOS.j2

{% for name_server in name_servers %}
set system name-server {{ name_server }}
{% endfor %}
```

```
set system name-server 8.8.8.8
set system name-server 9.9.9.9
```

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Webhooks in NetBox

- NetBox can be configured to transmit outgoing webhooks to remote systems in response to internal object changes.

- For example configure a monitoring system to start monitoring a device when its operational status is changed to active

- Each webhook must be associated with at least one NetBox object type and at least one event (create, update, or delete).

- Users can specify the receiver URL, HTTP request type (GET, POST, etc.), content type, headers and an optional request body
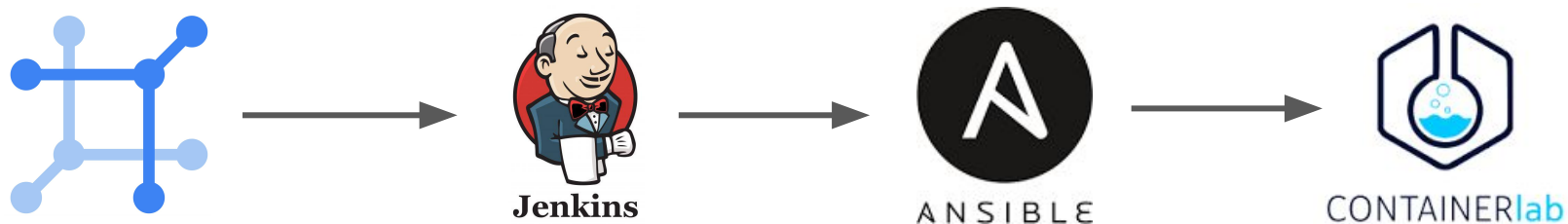
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A Simple NetDevOps Pipeline Demo

- User adds VLAN to NetBox
- Intended state is changed
- Webhook to Jenkins fires

- Pipeline is started
- Ansible container spins up
- Git repo cloned

- Code checked
- Playbook runs
- Intended state pulled from NetBox
- Change deployed to Network

- New VLAN configured on Arista cEOS devices

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NetBox Cloud Makes Network Management & Automation Easy

Ensuring Success

24x7 support from NetBox experts & maintainers

Comprehensive onboarding, training, & integration services from NetBox Expert Partners

Engaged & accessible practitioner community

Rock Solid Platform

Enterprise SLAs

Multi-region redundancy

Single sign on

Test environments

Customizable backup policies

Custom private connectivity options

Global deployment options

Massive Ecosystem

Dozens of integrations with the tools in your stack

Technology alliances with leaders in Network Automation

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NetBox Cloud: Run the Network, Not Your Tools

We:
- Configure
- Manage
- Upgrade
- Secure
- Maintain
- Optimize
- Support

Your engineers:

Use NetBox to accelerate network management & automation

🚀

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NetBox Cloud: Accelerate Network Management & Automation

*"Using NetBox Cloud has created a culture shift within our IT organization that has had **profound results on our ability to automate our network** and better serve the many stakeholders in our community."*

Felix Windt
CTO

80% fewer tickets

Tied to manual network changes at Dartmouth College after adopting NetBox

NetBox Cloud is trusted by

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What Next?

- Explore the NetBox REST API and GraphQL

- Build some simple Python scripts to interact with the API

- Build your own CI/CD pipeline in a lab environment (even on your laptop)

- Just get started - the possibilities are endless!

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Useful Resources

- **Code:** https://github.com/netboxlabs/netbox-devops
- **Docs:** https://docs.netbox.dev/en/stable/
- **NetBox Zero to Hero free course:** https://zerotohero.netbox.dev/
- **Lab Tools**
  - **Jenkins:** https://www.jenkins.io/
  - **Ansible:** https://www.redhat.com/en/technologies/management/ansible/network-automation
  - **Containerlab:** https://containerlab.dev/
- **Books:**
  - **Automating and Orchestrating Networks with NetDevOps** by Ivo Pinto and Faisal Chaudhry | Jun 30, 2023 | Cisco Press
- **Blog**: https://juliopdx.com/2021/10/20/building-a-network-ci/cd-pipeline-part-1/

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Thank you!

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Try **NetBox Cloud for Free**

Contact us:
sales@netboxlabs.com

Join the **NetBox Community**