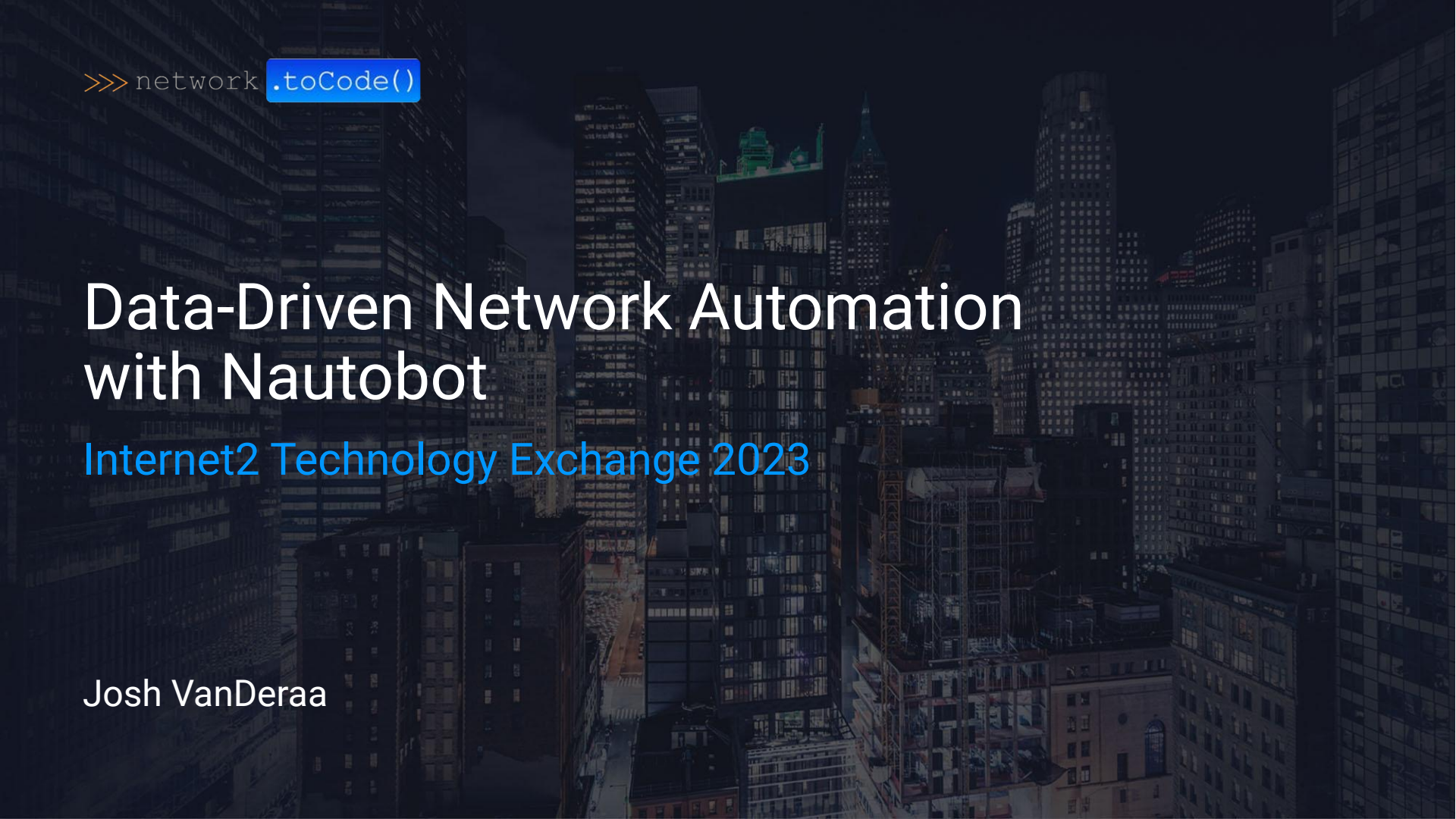
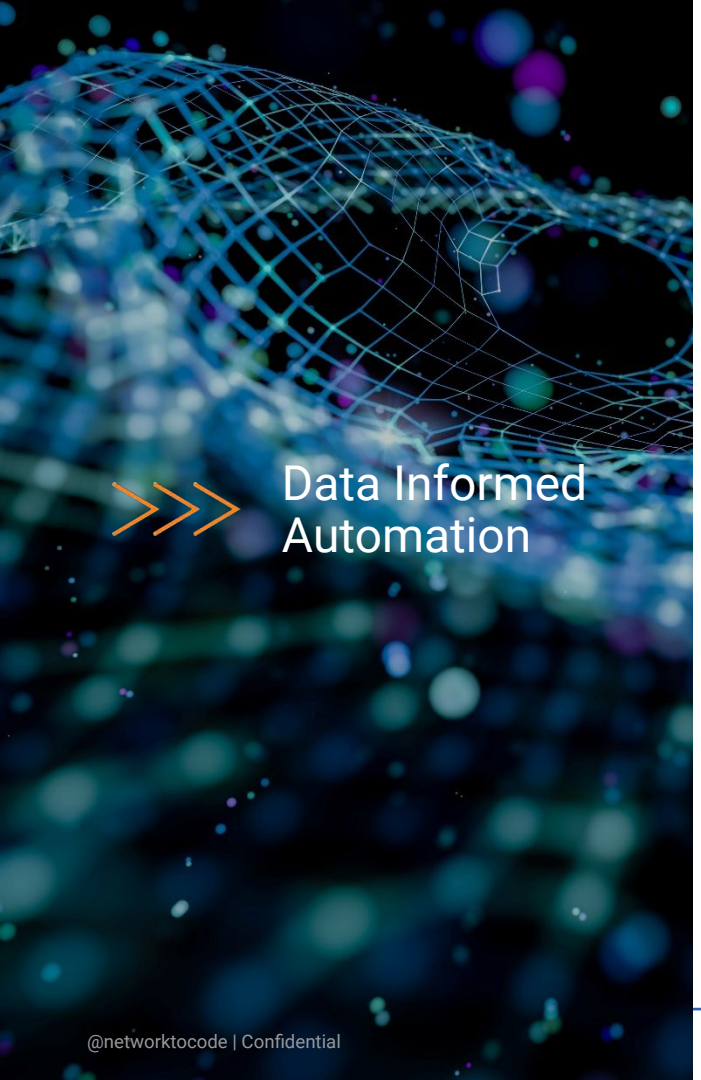


Data-Driven Network Automation with Nautobot

Internet2 Technology Exchange 2023

Josh VanDeraa



Quick Intros

Nautobot Introduction

Nautobot: Core Capabilities

Nautobot: Golden Configuration

Nautobot: Device Lifecycle

Nautobot: Circuit Maintenance

>>> Introductions

Karl Newell *(Network Software Architect, Internet2)*

Experience

- 20+ years in the IT industry
- 8+ years in networking
- Focus in automation for 4+ years
  - NGI automation
  - Insight Console

>>> Introductions

Josh VanDeraa *(Managing Consultant)*

Experience

- 24 years in the networking industry
- 13 years in large retail
- Travel, Managed Services, and Consulting experience since
- Focus in automation for 8+ years

Twitter: @vanderaaj LinkedIn: https://www.linkedin.com/in/josh-vanderaa/

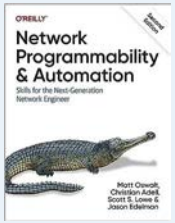
>>> network .toCode()

CISCO CERTIFIED DEVNET Professional

(MN)NUG Minnesota Networking User Group

Cisco DEVNET 500

Who is Network to Code



Network Automation Solutions Provider

We are laser-focused on helping companies transform the way their networks are deployed, managed, and consumed using network automation and DevOps technologies.

A Diverse Team, with Deep Expertise

Engineers and developers in network automation, software and security, with leadership from vendors, integrators, and top tier consulting firms - all drive value to our clients.

Nautobot

Our data first approach motivated us to develop Nautobot. A purpose built network source of truth and automation platform offering superior flexibility, extensibility and control that caters to any network design.

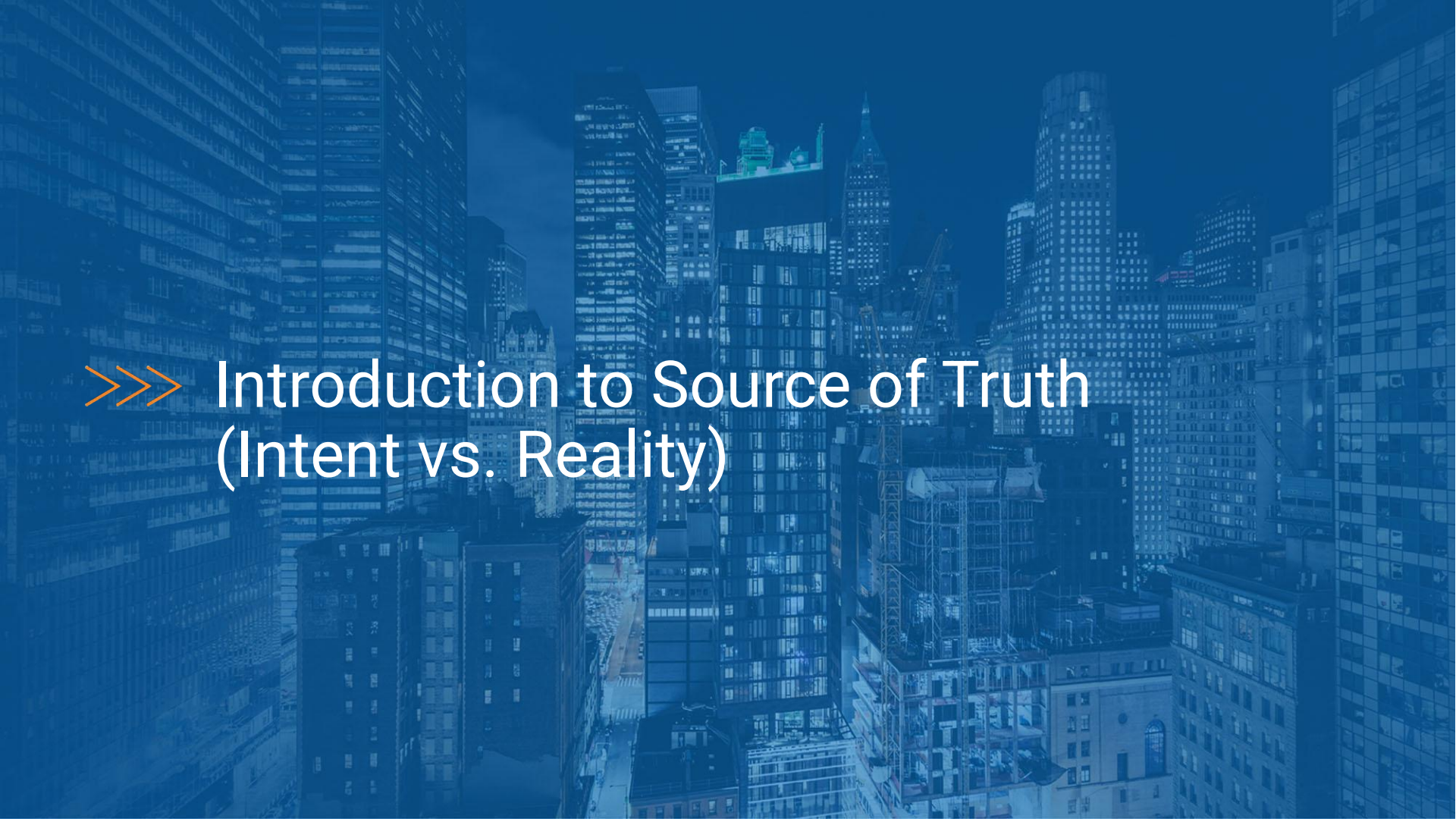
Driven by Community & Industry Collaboration

Rooted in Community, NTC believes Industry-wide collaboration is the catalyst needed for true innovation. Host 28,000+ members and 300+ channels at slack.networktocode.com

Industry Recognized Thought Leaders

Working with clients across all industries and geographies, we promote a vendor- and tool-agnostic approach, making automation a reality for any network.

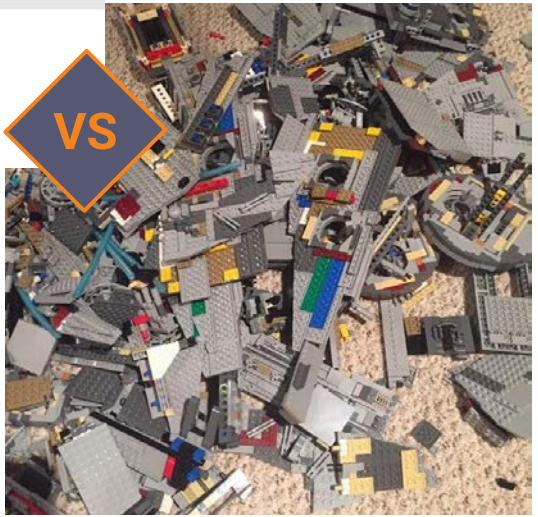
Nautobot In Use



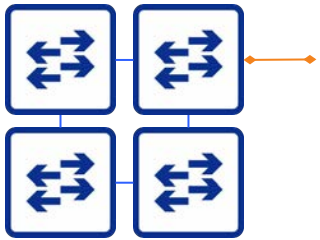
Introduction to Source of Truth (Intent vs. Reality)

Understanding Source of Truth

- Source of Truth is all about intentions and planning.
- It is about the expected state.
- Source of Truth data drives parts, labor, and configurability.



>>> Understanding Network Configuration Data (cont'd)



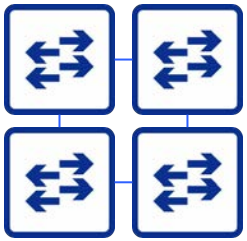
```
interface Ethernet1
description connects to WAP-HQ-Bldg-5-Floor-3-Closet-1
switchport mode access
switch access vlan 5
```

Data Point	Value
Interface	Ethernet1
Description	connects to WAP…
Mode	access
VLAN	5

Data

Designs should drive configuration

>>> Understanding Network Configuration Data (cont'd)



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interface Ethernet1
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switchport mode access
switch access vlan 5
```

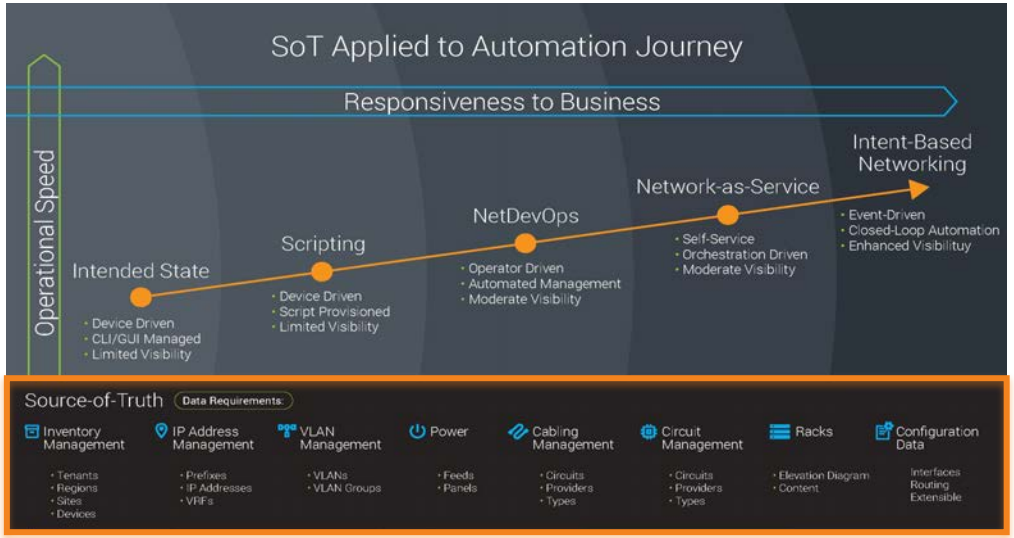
Data Point	Value
Interface	Ethernet1
Description	connects to WAP...
Mode	access
VLAN	5

Data

Designs should drive configuration

>>> Source of Truth is the Foundation

- Enables data-driven network automation
- De-couples CLI syntax and API calls from data
- Enables vendor-agnostic network automation
- Allows architects and engineers to focus on network designs
- Provide traceability and history of the Source of Truth



More data, more insights.

Intent vs. Reality

Intent - the ***desired*** state of the network.

Reality - the ***discovered*** state of the network.

nautobot

servicenow CMDB

YAML

VS.

IP FABRIC NETWORK INFRASTRUCTURE INTELLIGENCE

FORWARD NETWORKS

solarwinds

Grafana

servicenow Discovery

Note: The Nautobot SSoT framework can be used to synchronize data from any tool (intended and reality) into Nautobot based on use case and desired outcomes.

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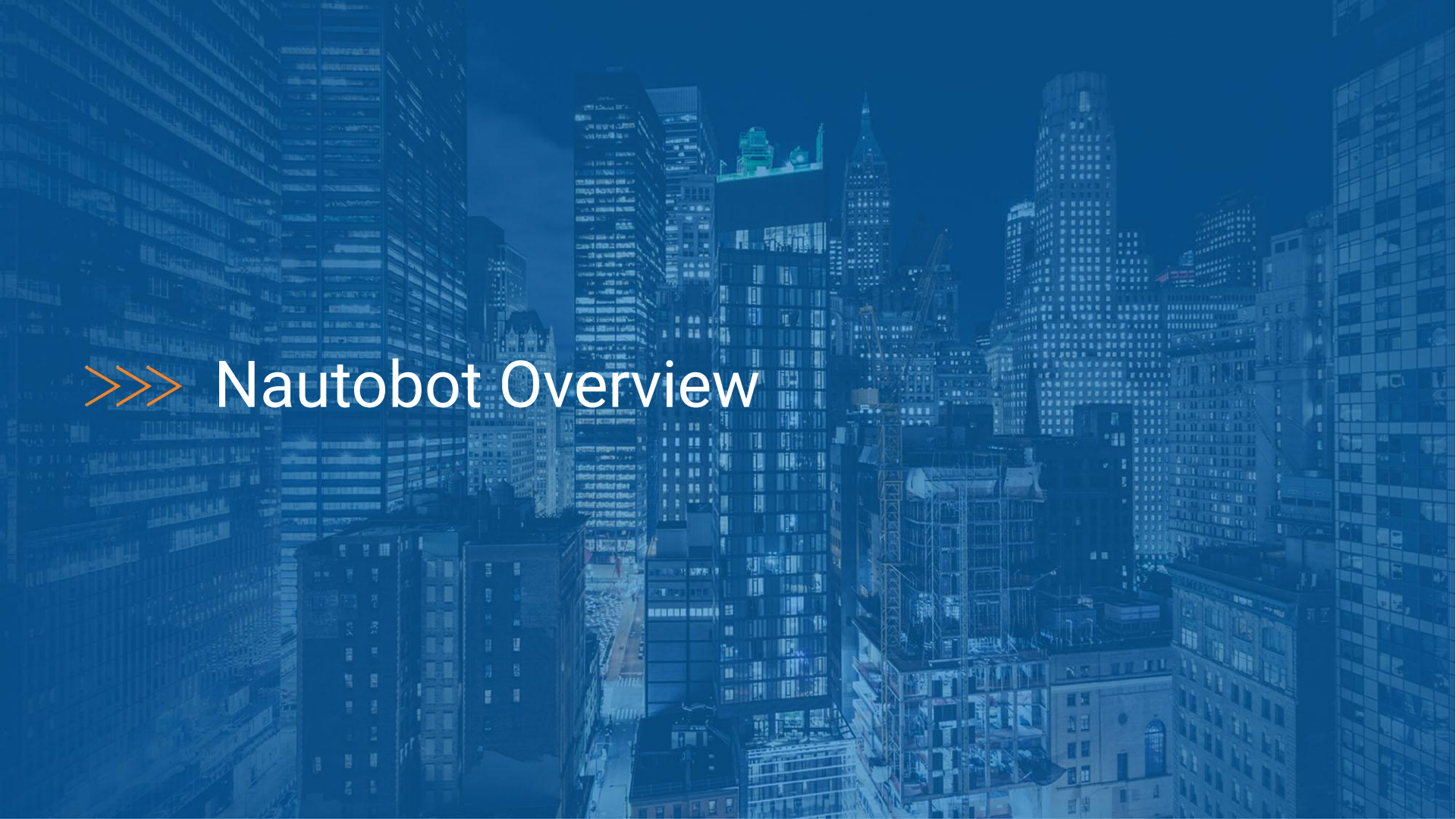
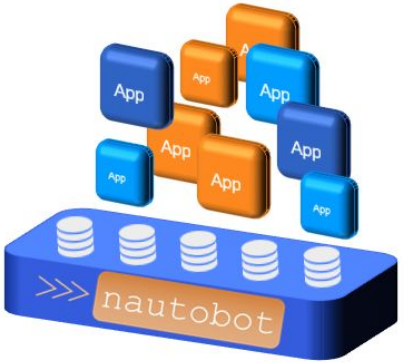


Nautobot Overview

>>> About Nautobot

Source of Truth and Network Automation Platform

- Open source community project created in 2021
  - *Apache 2 License*
- Sponsored by Network to Code
- Purpose-built to **drive network automation**



>>> Nautobot Use Cases

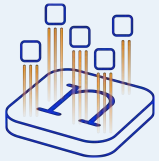
Network Source of Truth

- Devices
- IP Addresses
- VLANs
- ASN
- ...
- Custom

- User-Defined Relationships
- Custom Fields
- Data Validation
- Git as a Data Source

Network Automation Platform

- Use Open Source Apps
- Build Custom Apps
- Save 70% development time using the platform



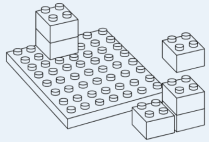
Powered by APIs and NetDevOps extensibility & integrations

{ REST }

GraphQL

webhooks

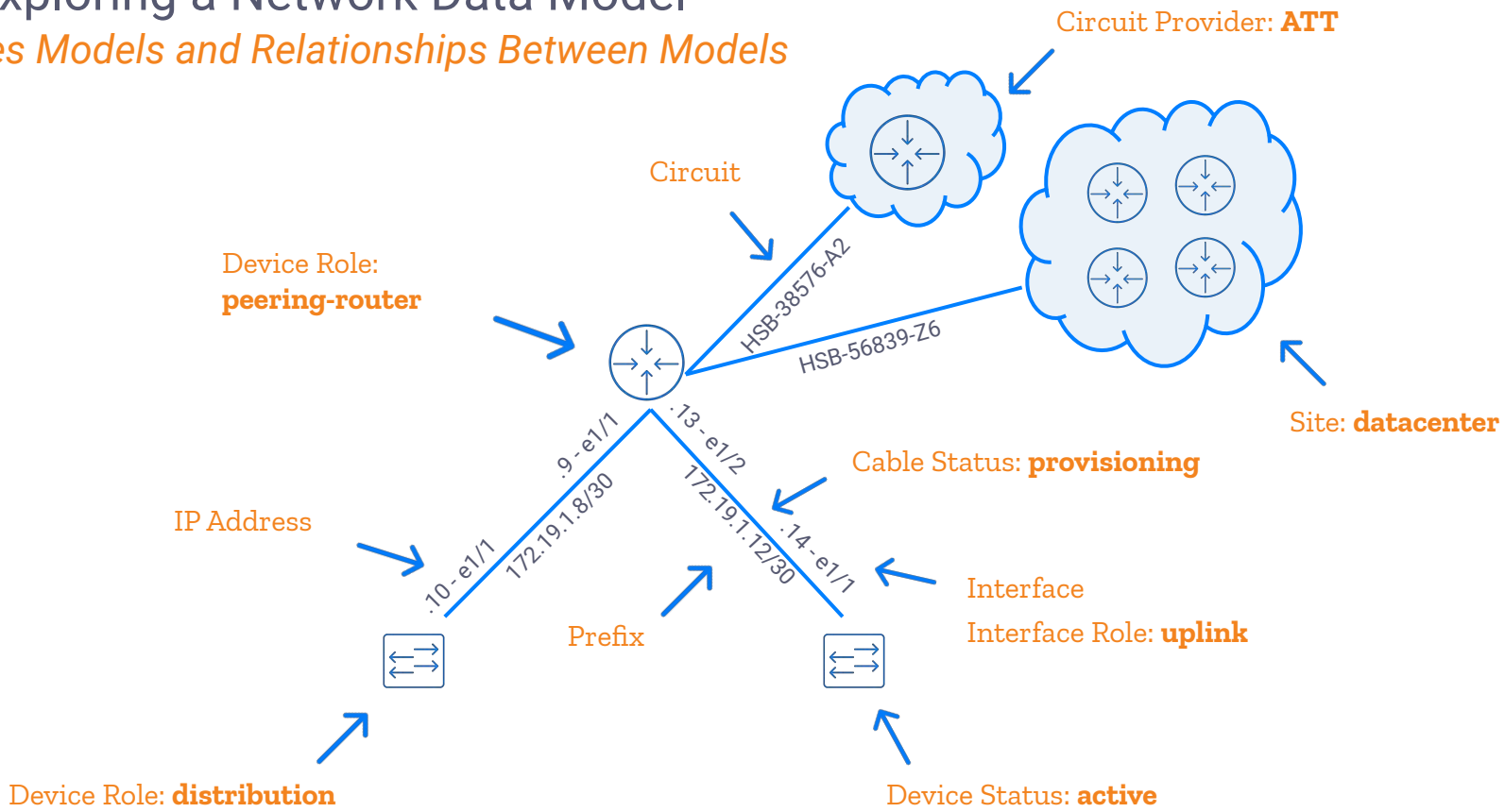
git



Extensible Plugin System

>>> Exploring a Network Data Model

Includes Models and Relationships Between Models



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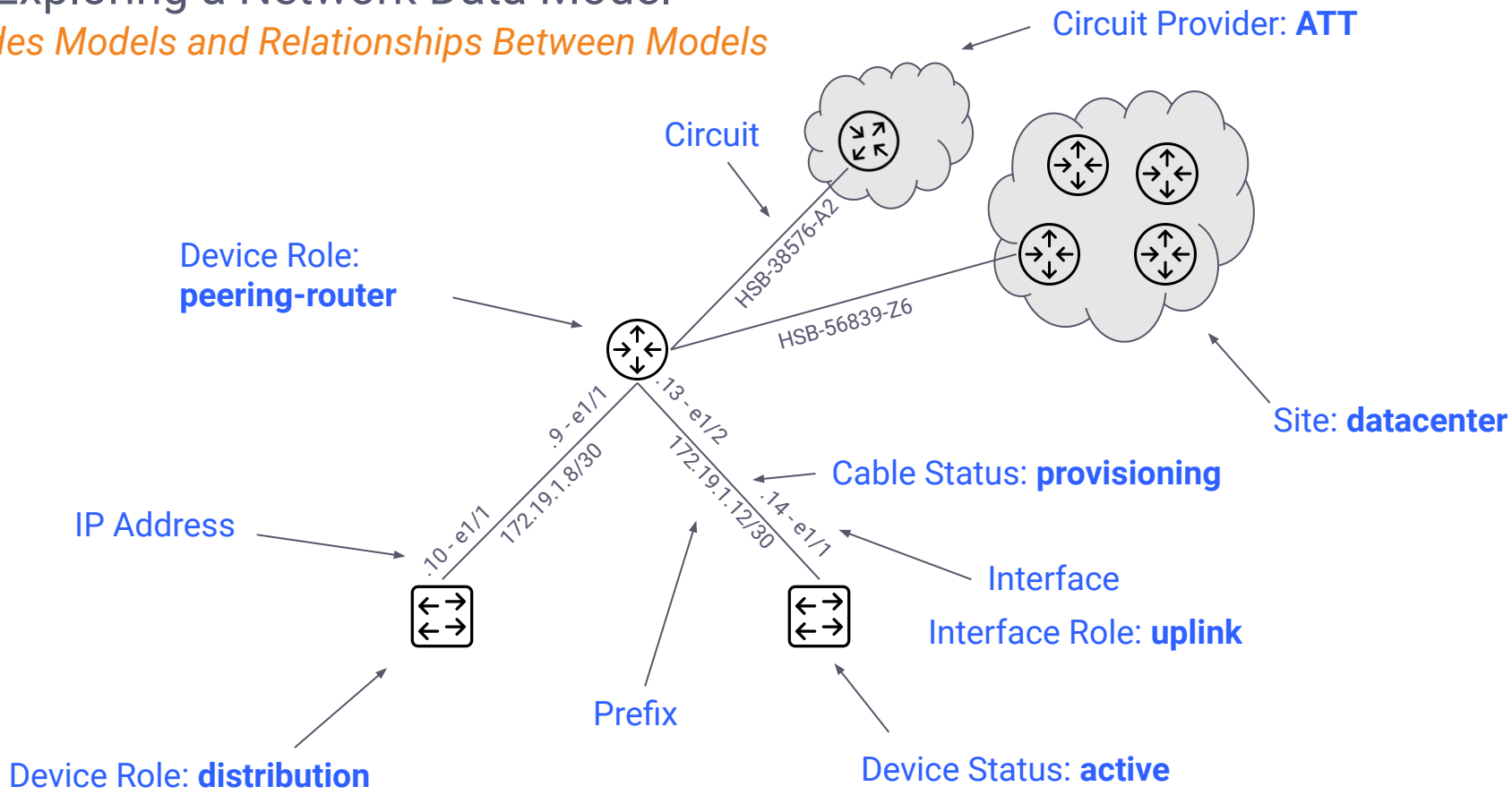
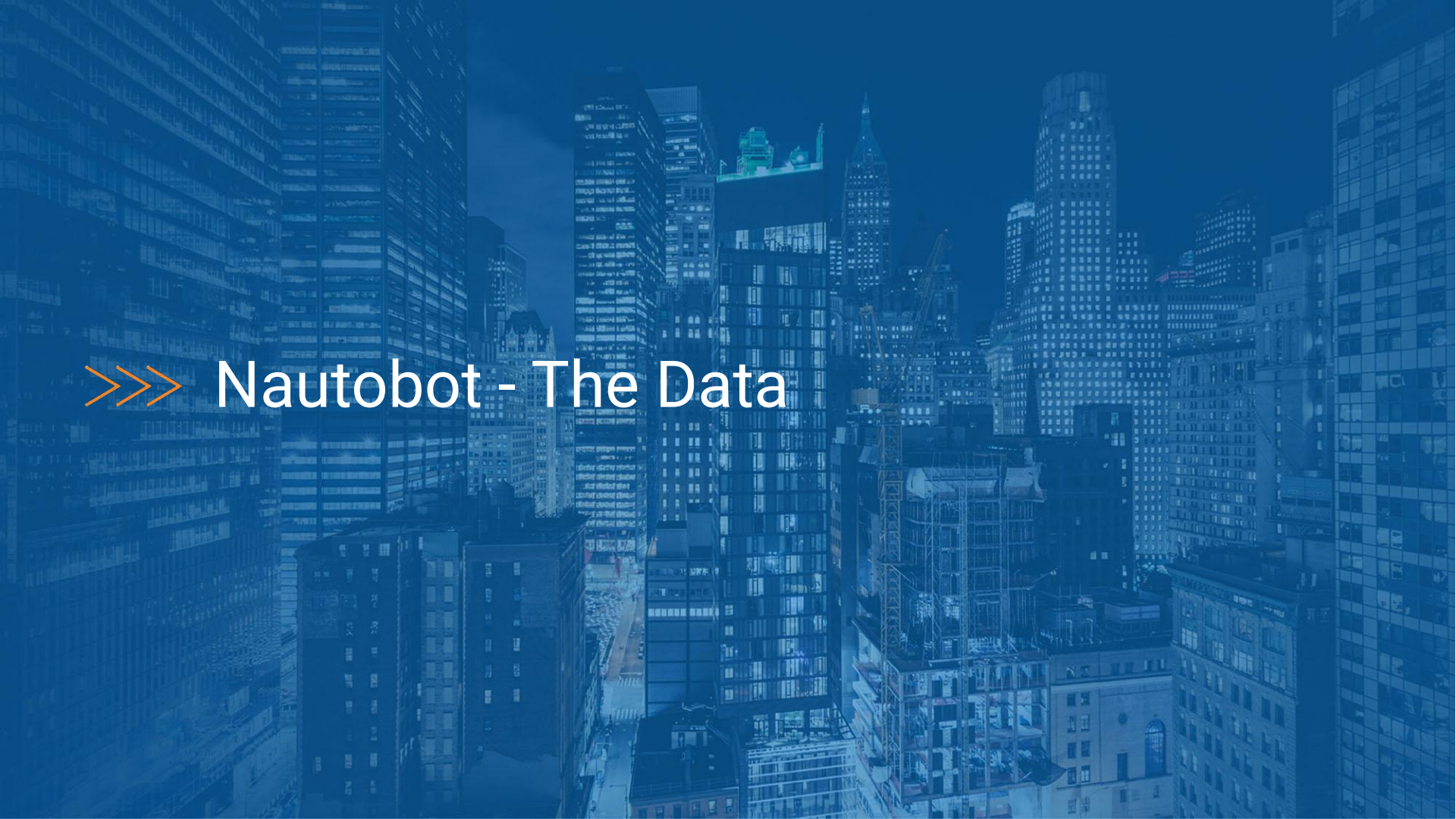
Includes Models and Relationships Between Models

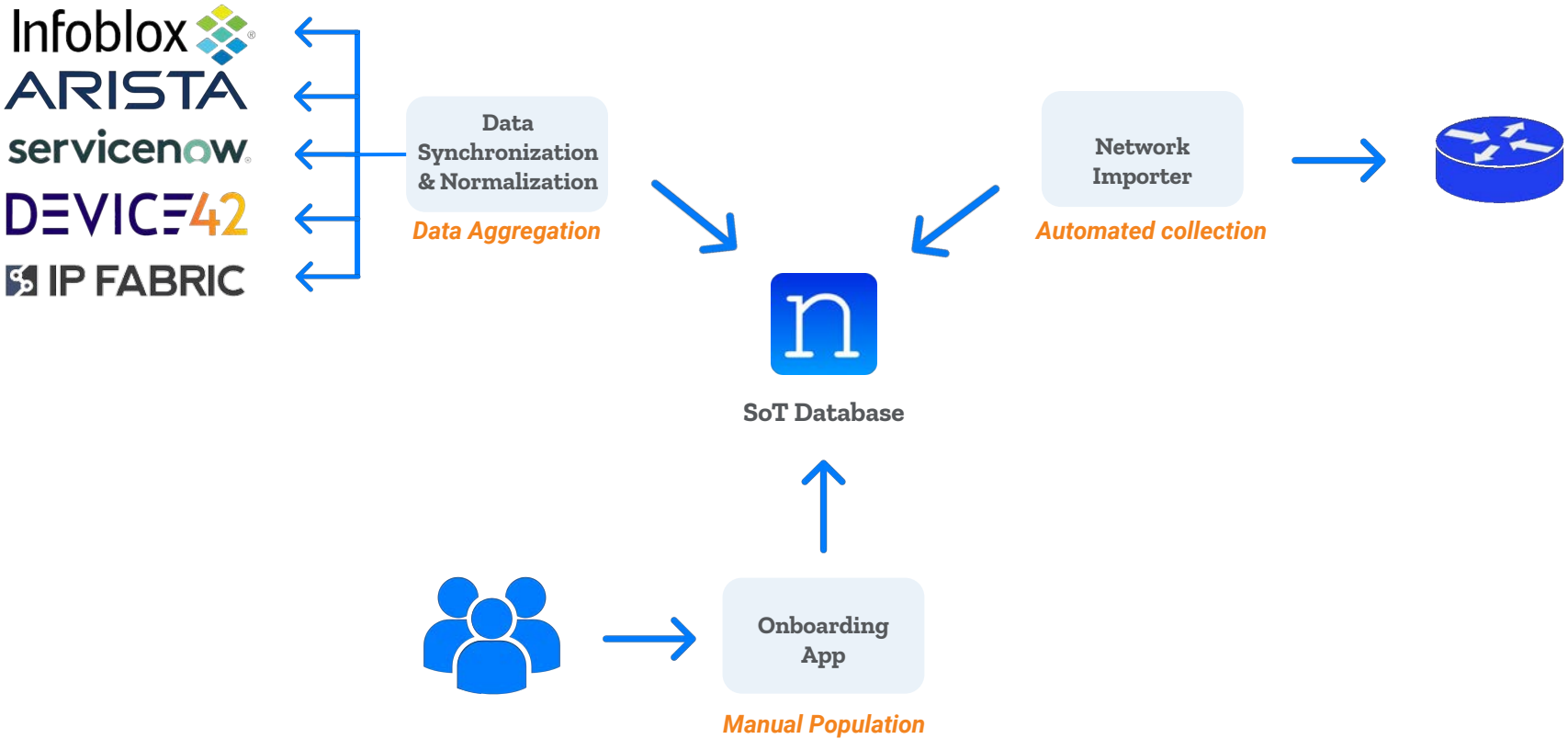




Nautobot - The Data

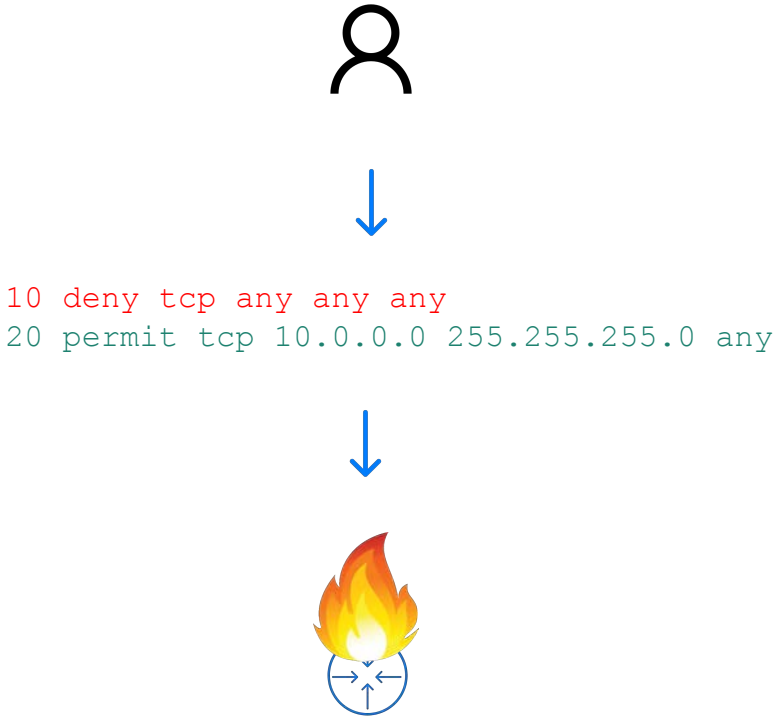
>>> How is the SoT Populated?

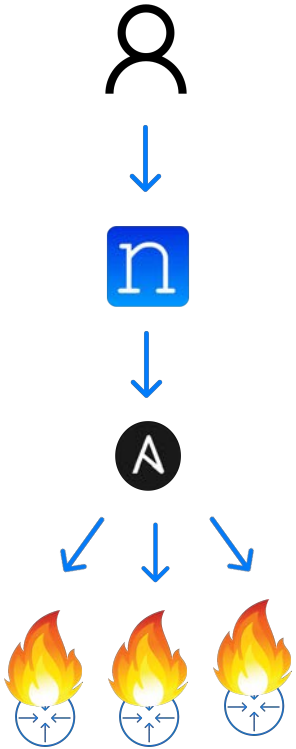
Nautobot provides several methods to get you up and running quickly



>>> The Need for Valid Data

"Automation is only as good as the data that drives it." --Anonymous





>>> Extensibility Features Summary

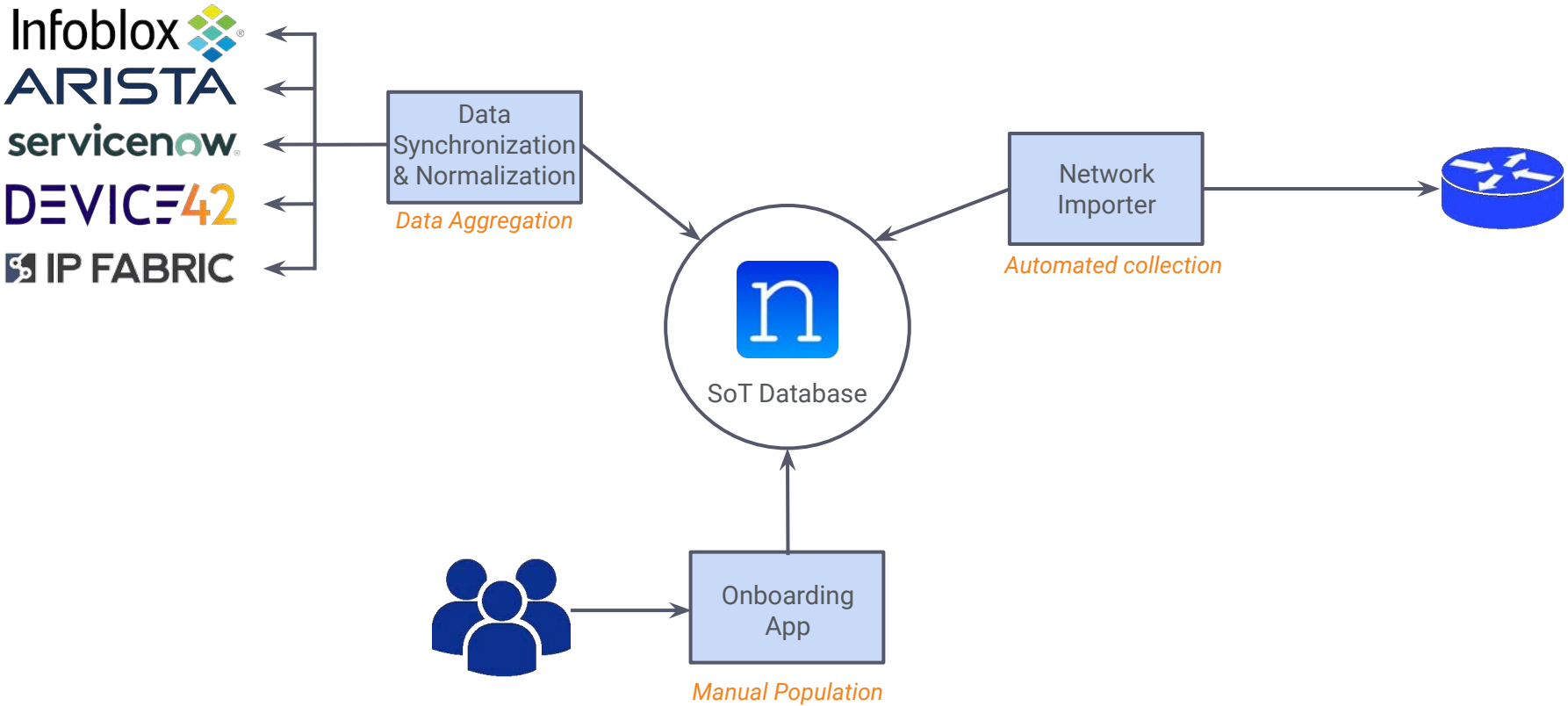
Tailor Nautobot to your network design requirements

- Status
- Tags
- Dynamic Groups
- Secrets
- Git as a Data Source
- Relationships
- Export Templates

- Config Contexts
- Config Contexts JSON Schemas
- Jobs
- Computed Fields
- Custom Fields
- Custom Links
- Custom Models, UI & APIs

>>> How is the SoT Populated?

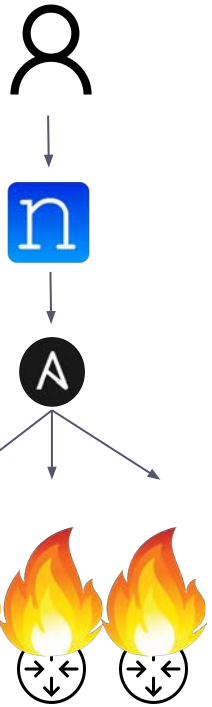
Nautobot provides several methods to get you up and running quickly



>>> The Need for Valid Data

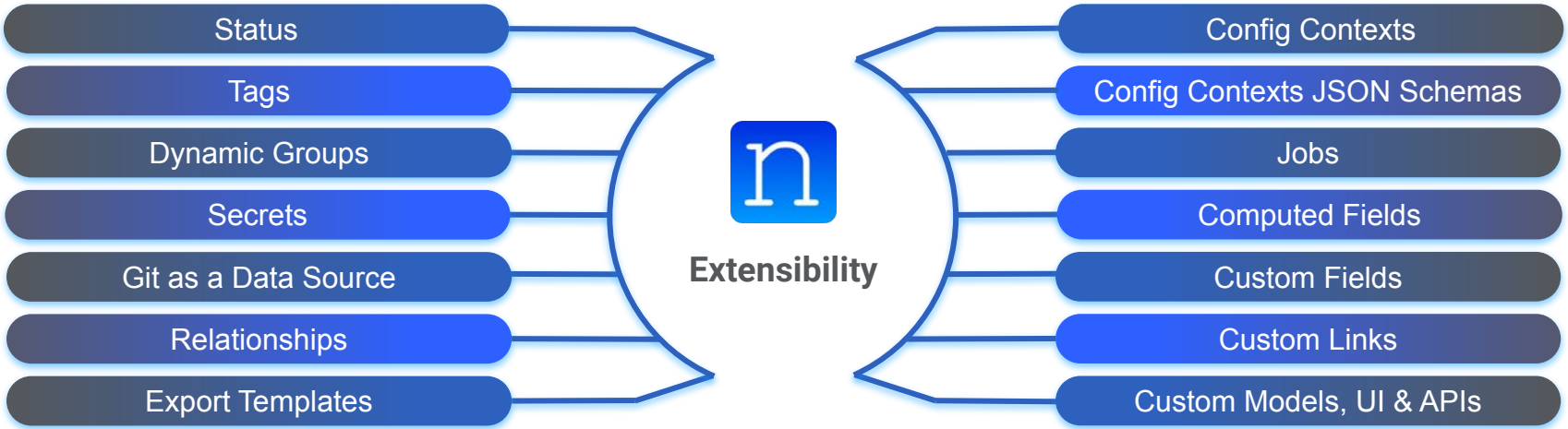
"Automation is only as good as the data that drives it." --Anonymous

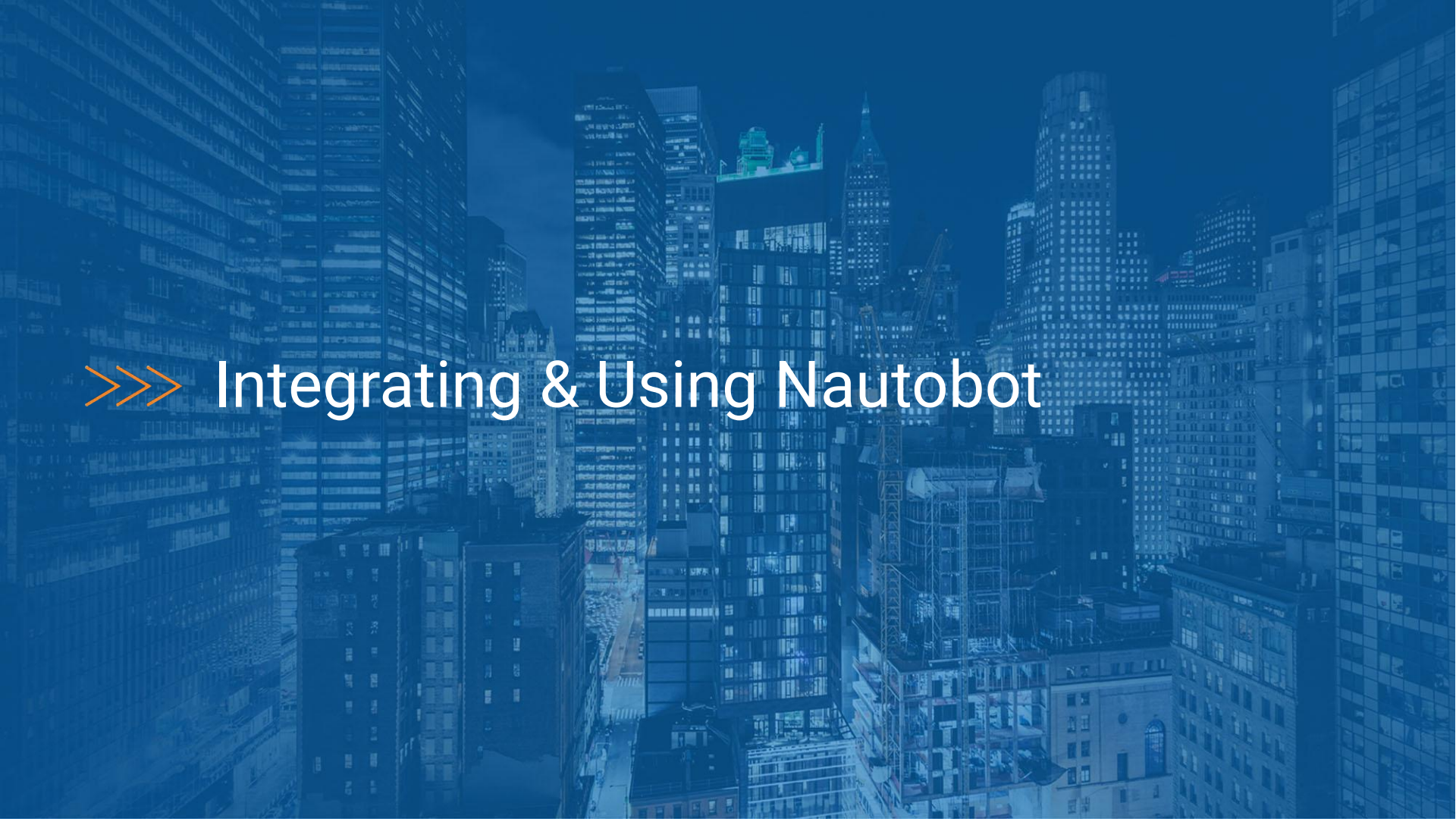
```
10 deny tcp any any any
20 permit tcp 10.0.0.0 255.255.255.0 any
```



>>> Extensibility Features Summary

Tailor Nautobot to your network design requirements





Integrating & Using Nautobot

>>> What's Next After Data Population?

Nautobot offers a variety of ways to leverage the platform, here are a few suggestions to start:

Populate interface descriptions to describe what is connected informed by the SoT

Leverage ChatOps to retrieve information via your favorite chat application

Tracking circuit maintenance events

Begin tracking device lifecycles programmatically

>>> Nautobot Apps

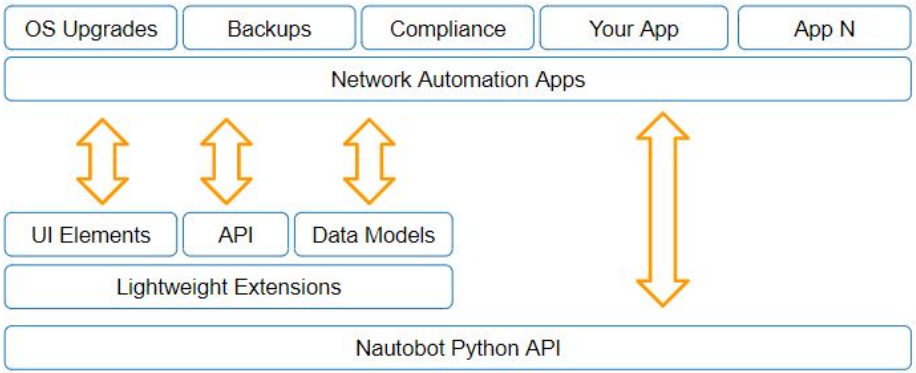
Nautobot Apps (aka plugins) allow developers to invent and implement entirely new functionality.

Apps break into two levels of overall functionality, extensions and apps.

Can provide:

- Models (and integration with core)
- Views
- REST APIs
- Inject content into core pages
- Data Validation

Plugins are Python packages which are installed by the Nautobot user.



>>> Nautobot's Growing App Ecosystem - Over 25 Apps to Date

Ansible ChatOps
Perform common Ansible AWX/Tower operations using ChatOps

Arista CloudVision ChatOps
Perform common CloudVision operations using ChatOps

Arista CloudVision SSoT
Synchronize data between Nautobot and CloudVision

IP Fabric ChatOps
Perform common IPF operations using ChatOps

Capacity Metrics
Expose key data in Nautobot as Prometheus endpoints

Circuit Maintenance
Dynamically manage circuit maintenance notifications in Nautobot

Golden Configuration
Automate backups, generate configs, and perform configuration compliance

Data Validation
Add validation rules to ensure corporate standards and proper data hygiene

Device Onboarding
Simplifies onboarding and re-onboarding devices into Nautobot

Grafana ChatOps
Retrieve any Grafana panel directly from Chat

Device Lifecycle Management
Track EOL, software versions, and contract data in Nautobot

Meraki ChatOps
Perform common Meraki operations using ChatOps

Nautobot ChatOps
Perform common Nautobot operations using ChatOps

Cisco ACI ChatOps
Perform common ACI operations using ChatOps

Welcome Wizard
UI wizard that simplifies getting started with Nautobot

Version Control
Add Git concepts such as branch, merge, and PR directly into Nautobot

Single Source of Truth
Pluggable framework that enables 3rd party data synchronization with Nautobot

IP Fabric Single Source of Truth
Synchronize data between Nautobot and IP Fabric

Infoblox Single Source of Truth
Synchronize data between Nautobot and Infoblox

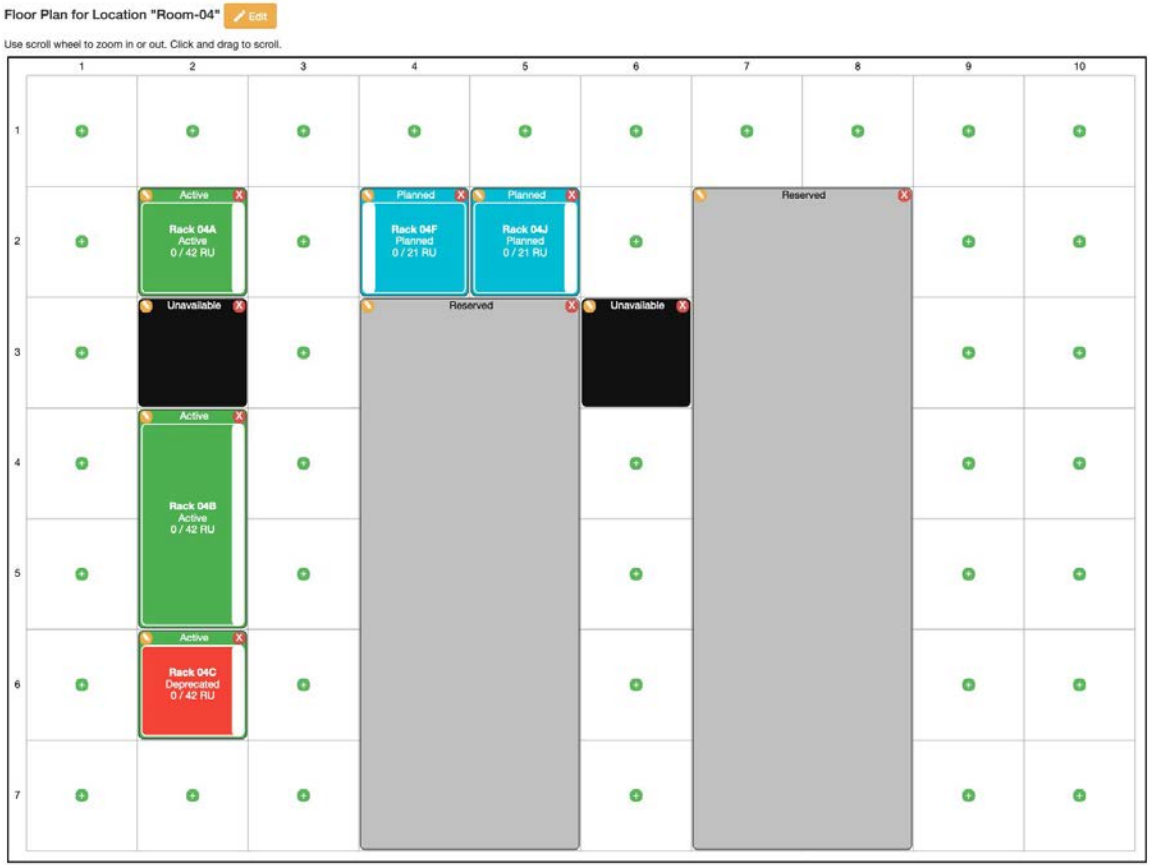
ServiceNow SSoT
Synchronize data between Nautobot and Infoblox

Partner Integrations | Standalone Solutions | Custom Development

Nautobot as a platform compliments any network automation strategy.

go.nautobot.com/apps

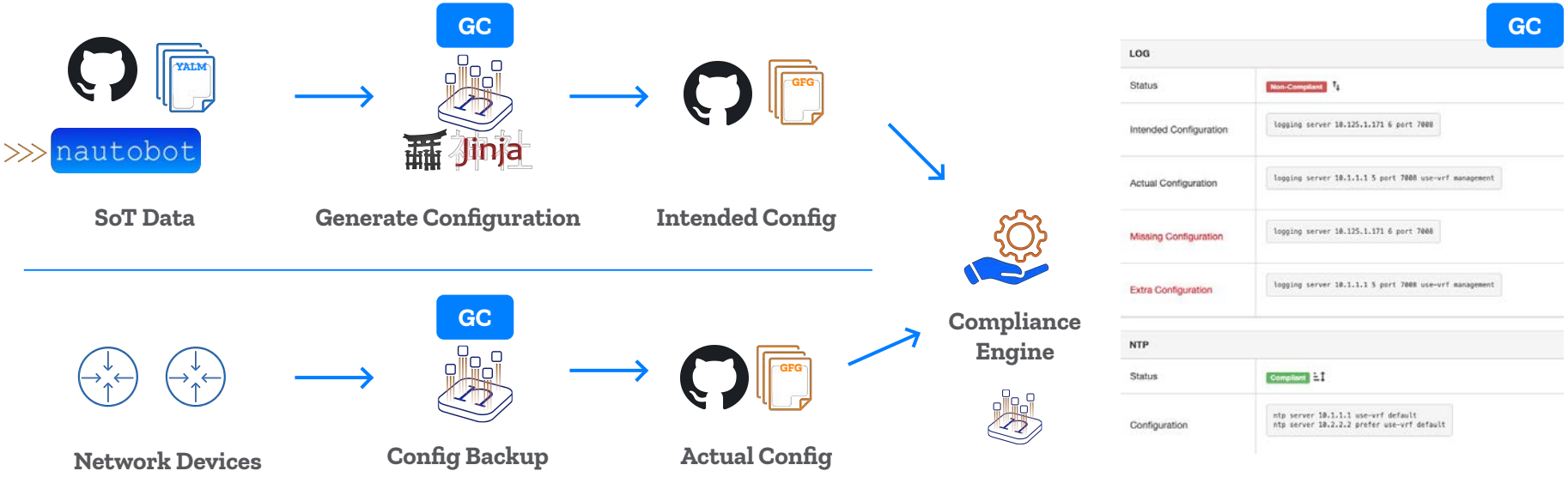
Nautobot App - Floor Plan Plugin



Configuration Compliance

Config Compliance - Fully Leveraging Golden Config

- **Intended configuration:** generated with **Jinja2 templates and the Nautobot Golden Config App**, pushed to a Git repo
  - Data comes from YAML files and data in Nautobot via a GraphQL query (SoT Aggregation Query)
- **Configuration Backups: Nautobot Golden Config App**, pushed to a Git repo
- **Config Compliance: Golden Config Nautobot App** pulls intended and backup configs from repos and analyzes them according to the defined rules



Configuration Compliance - UI Screenshots

Dashboard View

Device	aaa	acl	bgp	dns
nyc-spine-01.infra.ntc.com	✗	✓	✓	✓
jcy-spine-01.infra.ntc.com	✗	✓	✓	✗
jcy-spine-02.infra.ntc.com	✗	✓	✓	✗
nyc-spine-02.infra.ntc.com	✗	✓	✓	✓
jcy-rtr-01.infra.ntc.com	✗	✓	✓	✗
nyc-leaf-02.infra.ntc.com	✗	✓	✓	✓
jcy-bb-01.infra.ntc.com	✗	✓	✓	✗
nyc-leaf-01.infra.ntc.com	✓	✓	✓	✓
nyc-bb-01.infra.ntc.com	✓	–	✓	–
nyc-rtr-02.infra.ntc.com	✓	–	✓	–
nyc-rtr-01.infra.ntc.com	✓	–	✓	–

Delete Selected

Status Page

Backup Config

Aggregate Data

Intended Config

Run Job

Compliance Details

Device Compliance Views

Configuration Compliance - nyc-spine-01.infra.ntc.com

Feature Navigation: Compliant | Non-Compliant | Clear

Arista EOS - ntp	Arista EOS - snmp	Arista EOS - aaa
Arista EOS - intf	Arista EOS - host	Arista EOS - dns

AAA

Status: Non-Compliant

Intended Configuration:

```
aaa authorization exec default local
no aaa root
username ntc privilege 15 secret sha512 $6$I96u7PN2rdf8y1xH$1Iq523MXOQlfsZDiFPmZiSOvpfFsCpH.EuSblMyQvokhVfCqreJLHbzFlG6SPHzbL1mIElnDIm8Px6Jw55IN1/
management api http-commands
   protocol http
   protocol unix-socket
   no shutdown
management api gnmi
   transport grpc default
      port 830
```

Actual Configuration:

```
aaa authorization exec default local
no aaa root
username ntc privilege 15 secret sha512 $6$pE5h.iNjTivxKHaV$TW7CKUWP5YLQANyqliRuumMVLi6lEP7a3kKGv8MWduRTRNoTWSe4jiHRvHxko0UbfiixGCkA.zFaKNfKBdeK./
management api http-commands
   protocol http
   protocol unix-socket
   no shutdown
management api gnmi
   transport grpc default
      port 830
```

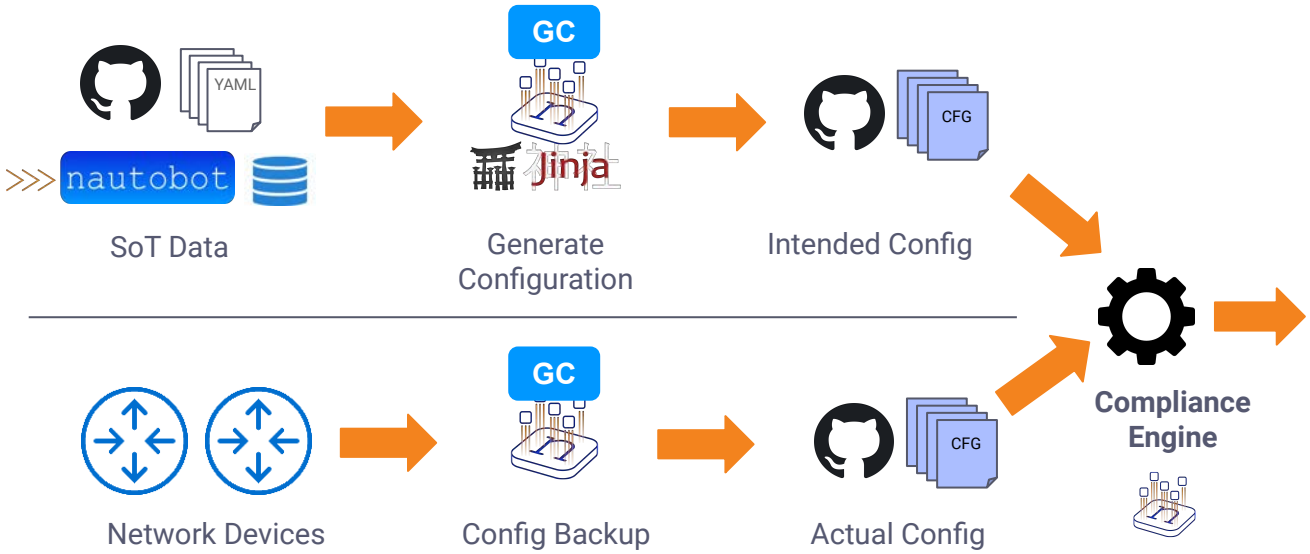
Missing Configuration:

```
username ntc privilege 15 secret sha512 $6$I96u7PN2rdf8y1xH$1Iq523MXOQlfsZDiFPmZiSOvpfFsCpH.EuSblMyQvokhVfCqreJLHbzFlG6SPHzbL1mIElnDIm8Px6Jw55IN1/
```

Extra Configuration:

```
username ntc privilege 15 secret sha512 $6$pE5h.iNjTivxKHaV$TW7CKUWP5YLQANyqliRuumMVLi6lEP7a3kKGv8MWduRTRNoTWSe4jiHRvHxko0UbfiixGCkA.zFaKNfKBdeK./
```

Config Compliance - Fully Leveraging Golden Config



>>> Configuration Compliance - UI Screenshots

Dashboard View

Device	aaa	acl	bgp	dns
nyc-spine-01.infra.ntc.com	✗	✓	✓	✓
jcy-spine-01.infra.ntc.com	✗	✓	✓	✗
jcy-spine-02.infra.ntc.com	✗	✓	✓	✗
nyc-spine-02.infra.ntc.com	✗	✓	✓	✓
jcy-rtr-01.infra.ntc.com	✗	✓	✓	✗
nyc-leaf-02.infra.ntc.com	✗	✓	✓	✓
jcy-bb-01.infra.ntc.com	✗	✓	✓	✗
nyc-leaf-01.infra.ntc.com	✓	✓	✓	✓
nyc-bb-01.infra.ntc.com	✓	–	✓	–
nyc-rtr-02.infra.ntc.com	✓	–	✓	–
nyc-rtr-01.infra.ntc.com	✓	–	✓	–

Delete Selected

Status Page

Device	Backup Status	Intended Status	Compliance Status	Actions
jcy-bb-01.infra.ntc.com	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	
nyc-leaf-01.infra.ntc.com	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	
jcy-bb-01.infra.ntc.com	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	May 4, 2022 1:26 p.m.	

- Backup Config
- Aggregate Data
- Intended Config
- Run Job
- Compliance Details

Device Compliance Views

Configuration Compliance - nyc-spine-01.infra.ntc.com

Feature Navigation: Compliant | Non-Compliant | Clear

Arista EOS - ntp	Arista EOS - snmp	Arista EOS - aaa
Arista EOS - intf	Arista EOS - host	Arista EOS - dns

AAA

Status: Non-Compliant

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```
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no aaa root
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   protocol http
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   no shutdown
management api gnmi
   transport grpc default
      port 830
```

Actual Configuration:

```
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username ntc privilege 15 secret sha512 $6$pE5h.iNjTivxKHaV$TW7CKUWP5YLQANyqliRuumMVLi6lEP7a3kKGv8MWduRTRNoTWSe4jiHRvHxko0UbfiixGCkA.zFaKNfKBdeK./
management api http-commands
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Missing Configuration:

```
username ntc privilege 15 secret sha512 $6$I96u7PN2rdf8y1xH$1Iq523MXOQlfsZDiFPmZiSOvpfFsCpH.EuSblMyQvokhVfCqreJLHbzFlG6SPHzbL1mIElnDIm8Px6Jw55IN1/
```

Extra Configuration:

```
username ntc privilege 15 secret sha512 $6$pE5h.iNjTivxKHaV$TW7CKUWP5YLQANyqliRuumMVLi6lEP7a3kKGv8MWduRTRNoTWSe4jiHRvHxko0UbfiixGCkA.zFaKNfKBdeK./
```


Device Lifecycle Management

>>> Hardware Notices

Hardware Notices

Name	Reference	Release Date	End of Sale	End of Support	End of Software Releases	End of Security Patches	Documentation
Inventory Part: WS-SUP720-3BXL - End of support: 2018-01-31	WS-SUP720-3BXL	2011-04-12	2013-01-30	2018-01-31	2013-12-01	2016-12-01	
Device Type: DCS-7150S-24 - End of support: 2024-12-01	DCS-7150S-24	2021-11-09	2021-12-01	2024-12-01	2023-12-01	2023-12-01	
Device Type: Catalyst 6509-E - End of support: 2025-10-31	Catalyst 6509-E	2005-02-15	2020-10-30	2025-10-31	2021-10-30	2023-10-30	

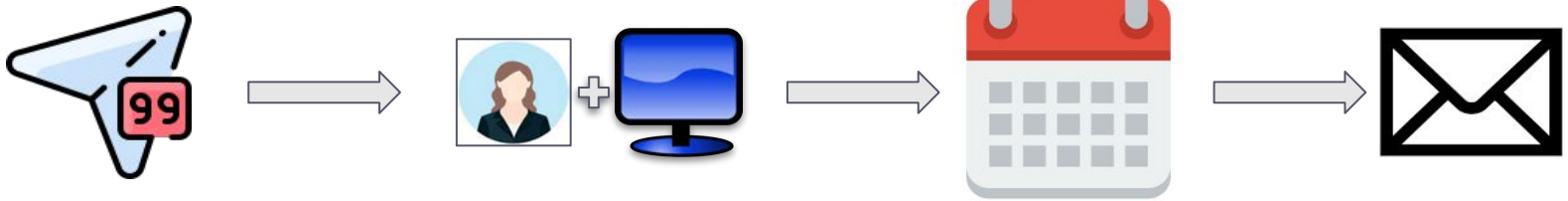
>>> Software Lifecycle

Software List

Name	Version	Alias	Device Platform	Release Date	End of Software Support	Long Term Support	Pre-Release
Arista EOS - 4.24.8M	4.24.8M	—	Arista EOS	2021-10-11	2023-04-05	✓	✗
Arista EOS - 4.26.4M	4.26.4M	veos-lab	Arista EOS	2021-12-12	2024-04-15	✓	✗
Cisco IOS - 12.2(33)SXI14	12.2(33)SXI14	Cat6500-Sup720	Cisco IOS	2014-09-22	2017-08-31	✓	✗
Cisco IOS - 16.9.1	16.9.1	Fuji-16.9.1	Cisco IOS	2018-07-19	2023-04-05	✗	✗
Cisco IOS - 720 ROMMON 8.5(4)	720 ROMMON 8.5(4)	—	Cisco IOS	2010-01-12	2015-04-30	✓	✗

Circuit Maintenance

>>> Manual Process



NSP sends maintenance notification

1

Network engineer parses notification and manually updates systems

2

Network engineer enters maintenance info on calendar

3

Network engineer emails internal group to notify of maintenance

4

5 Maintenance window updates

. . . x 100s-1000s of circuits

Automated Solution

1

NSP sends maintenance notification

nautobot

2

Circuit Maintenance
Fetch, Parse & Populate

3

4

Maintenance ID: ntt-VNOC-12345678

Created Jan. 14, 2022 · Updated 7 hours ago

Circuit Maintenance | Change Log

Info	
Name	ntt-VNOC-12345678
Description	NTT Communications (AS2914) URGENT Maintenance Notification: [VNOC-1234-c0wb3ll]
Status	CONFIRMED
Start Time	Oct. 14, 2022 5:00 a.m.
End Time	Oct. 15, 2022 7:13 a.m.
Acknowledged	False

Circuits

ID	Status	Impact
ntt-104265404093023273	Active	NO-IMPACT
ntt-104539051754046505	Active	OUTAGE
ntt-38942604185879593	Active	OUTAGE

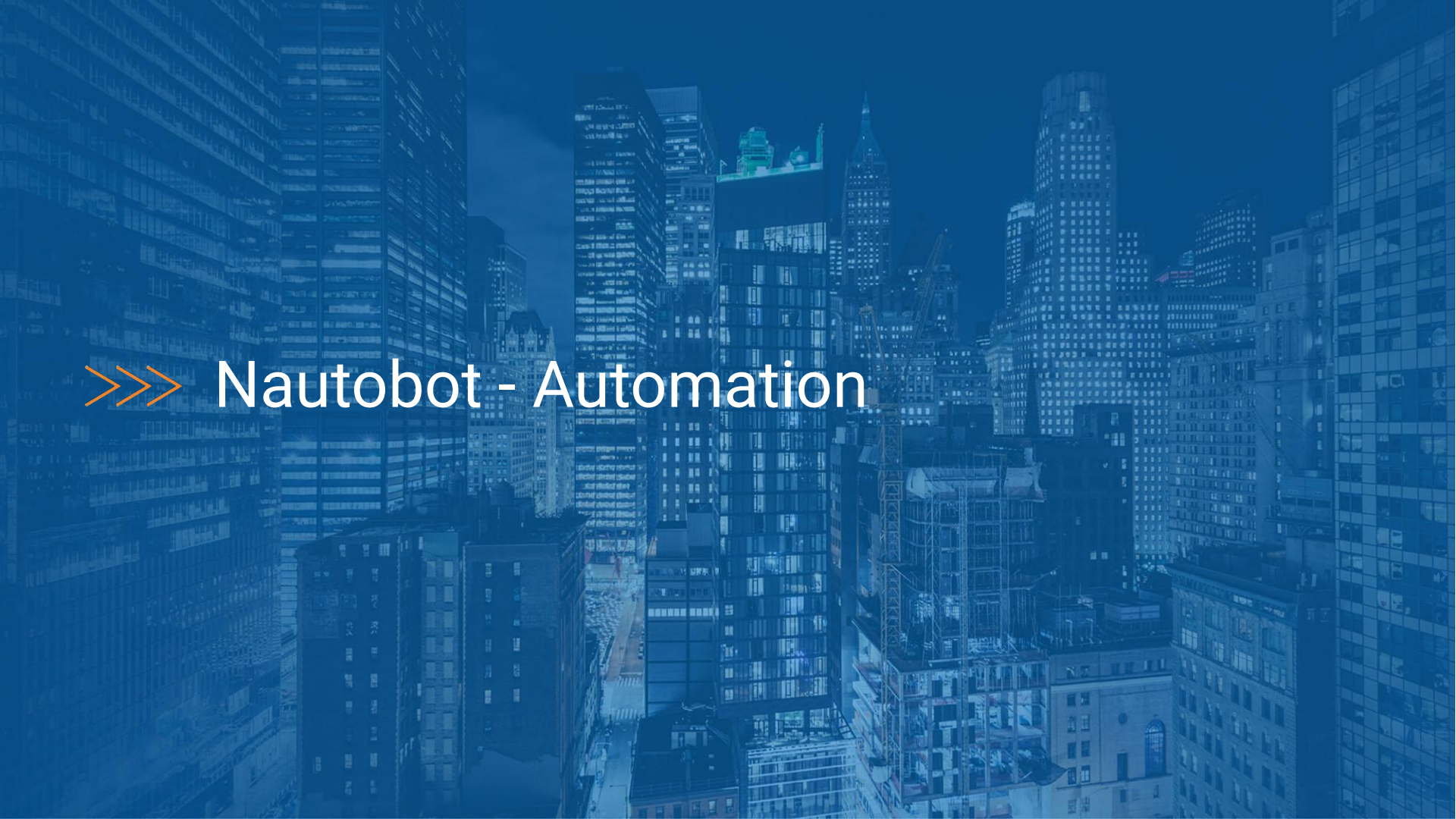
Automatically organized maintenances in Nautobot

Workflow Example 1:

Monitoring System Automation

Workflow Example 2:

Drain the plane on circuit


Nautobot - Automation

>>> Network Automation

Nautobot Jobs

Run Jobs defined in Python from Nautobot itself. Provides an inventory methodology and direct access to the data needed to automate.

Ansible Content Collection

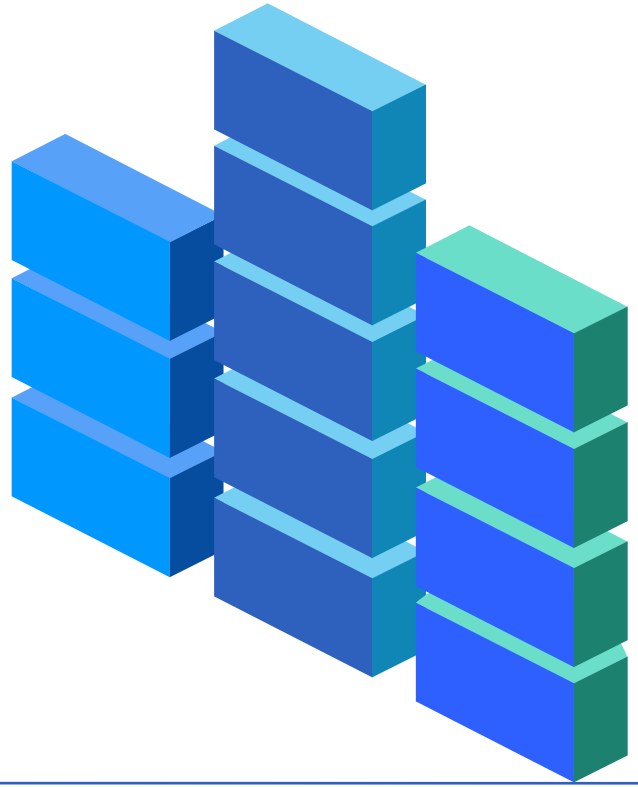
Ansible Content Collection for Nautobot provides methods for retrieving data through lookup plugins, using Nautobot as an Inventory, and Modules to update Nautobot as necessary.

Python SDK

Python SDK - pynautobot, that interacts with Nautobot, and builds itself dynamically based on what applications are installed to Nautobot.

Go-Nautobot | Terraform

Go-Nautobot for working with GoLang. Terraform provider for working within Terraform.



>>> Nautobot Actions

Webhook

Sends off customized webhook payload to a webhook receiver

Jobhook

Think Webhook, but instead Nautobot launches a Job, with context data of what was changed. Allowing interactions with multiple systems and gathering data from other sources if needed

Ansible EDA

Ansible EDA is monitoring the Nautobot changelog and receives events on object changes, then Ansible kicks into gear!


Demo

>>> Demos

Ansible Content Collection

- Review of Ansible Inventories Available
- Get the next available IP Address, within a Tagged range

Python SDK

- Nornir Inventory
- Gather data using the GraphQL interface

>>> Nautobot Summary - **THANK YOU**

Nautobot Source of Truth

- Source of Truth for Network (Infrastructure) Data
  - Automate from the Data
  - Relationships of Devices, Interfaces, Circuits
- Extend capabilities through Nautobot Apps
- Consolidate Network Automation Power Tools and build your own Jobs where you get enterprise logging and JobResults capabilities
- Integrate with tooling via APIs and SDKs

https://www.networktocode.com

https://demo.nautobot.com