How to use this deck

Name:

Network Automation Workshop Deck

Purpose:

This slide deck is part of a training course designed as an introduction to Ansible for network engineers and operators. The slides are meant to be taught in conjunction with hands-on exercises with a lab topology of Automation controller + 4 network devices.

Last updated:

Sep 21, 2021 (check history for older versions)

What this deck is for?

This deck corresponds to the prescriptive exercises available on https://ansible.github.io/workshops/exercises/ansible_network/

The upstream source for exercises and provisioner are provided on https://github.com/ansible/workshops

What this deck is not for?

This is not a replacement for Red Hat training. This is a small "taste" of Ansible Automation Platform and meant to help people understand what is possible for network engineers with automation. Please refer to https://www.redhat.com/en/services/training-and-certification for official training

Google Slides source link (Red Hat internal):

https://docs.google.com/presentation/d/1PIT-kGAGMVEEK8PsuZCoyzFC5CIzLBwdnftnUsdUNWQ/edit?usp=sharing

Red Hat
Ansible Automation
Platform

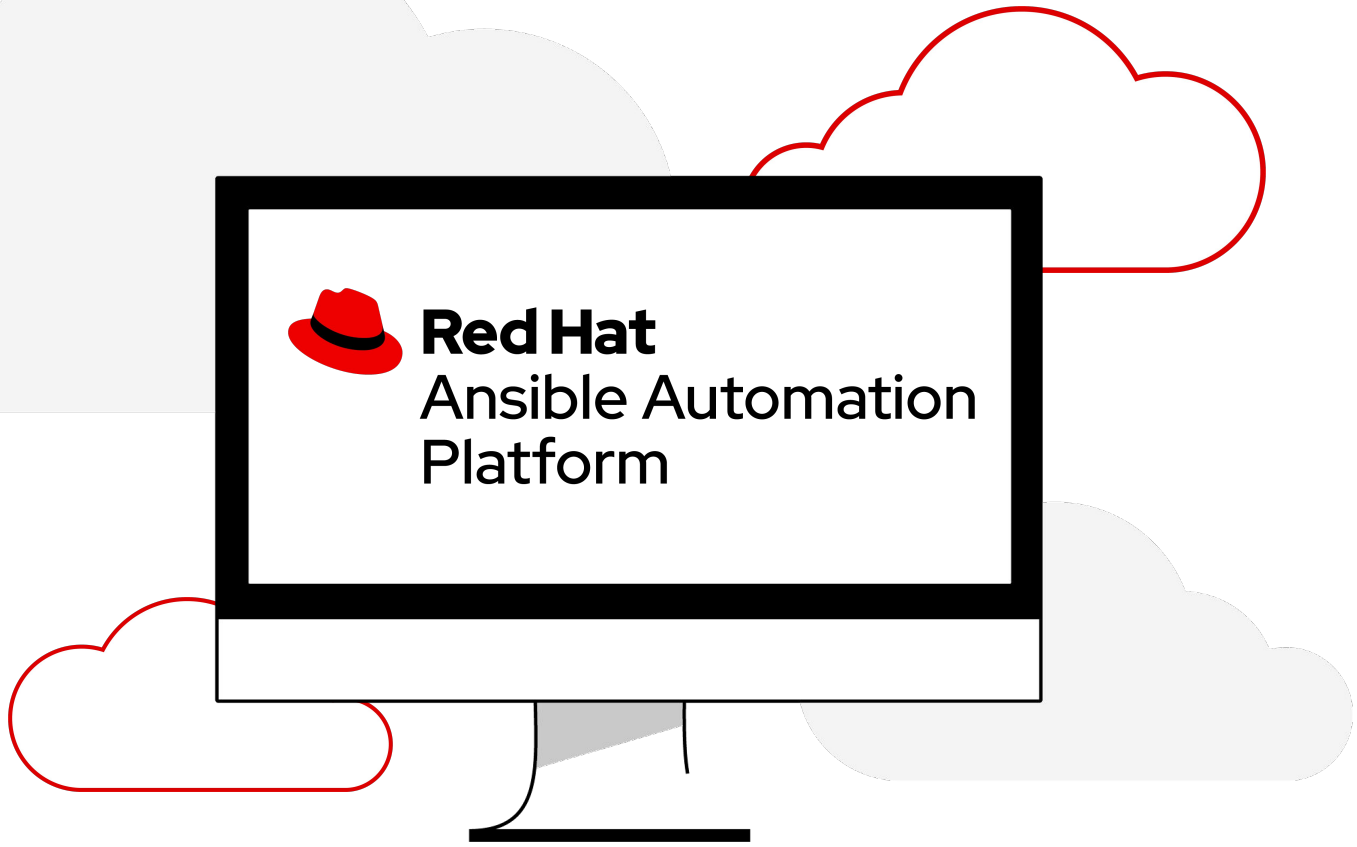
Network Automation Workshop

Introduction to Ansible for
network engineers and operators

Housekeeping

Understanding the format of this class

- Timing
- Breaks
- Takeaways



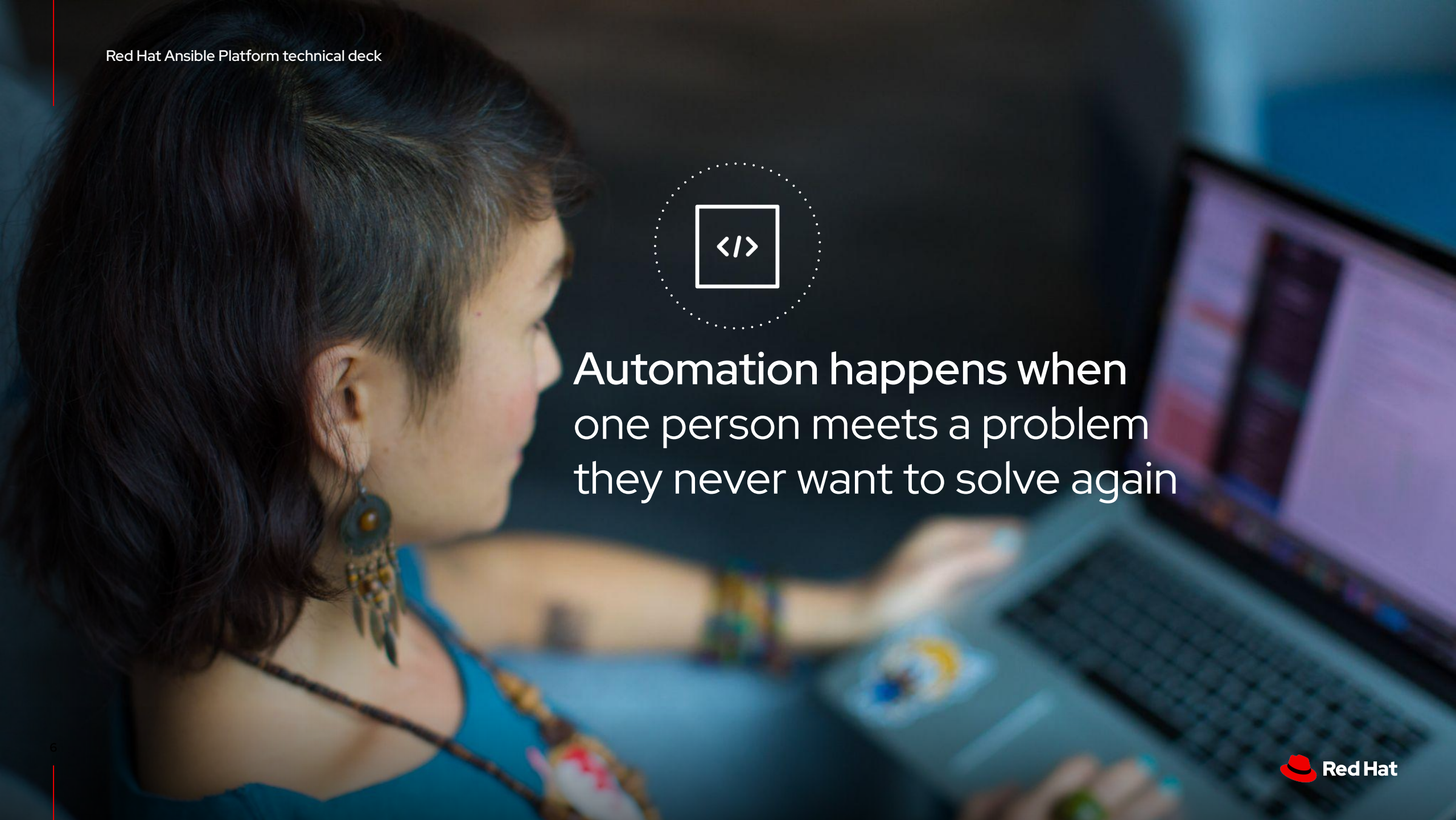
What you will learn

- Introduction to Ansible automation
- How Ansible works for network automation
- Understanding Ansible modules and playbooks
- Executing Ansible playbooks to make configuration changes
- Gather information (Ansible facts)
- Network Resource Modules
- Using Automation controller to operationalize automation for your enterprise
- Major Automation controller features - RBAC, workflows

Introduction

Topics Covered:

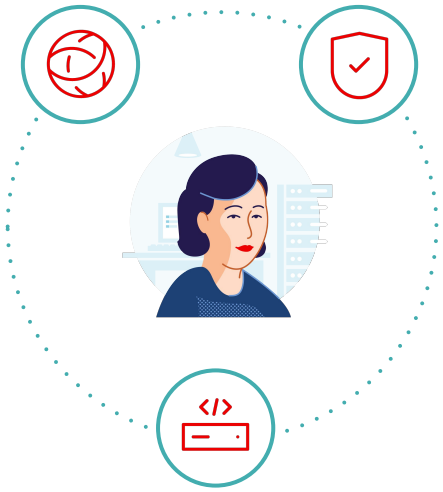
- What is the Ansible Automation Platform?
- What can it do?
- Why Network Automation?
- How Ansible Network Automation works



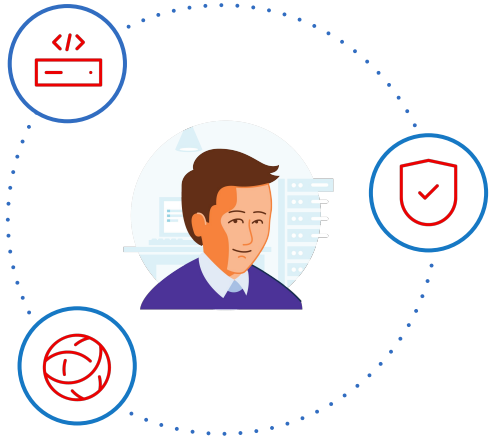
Automation happens when
one person meets a problem
they never want to solve again

Many organizations share the same challenge

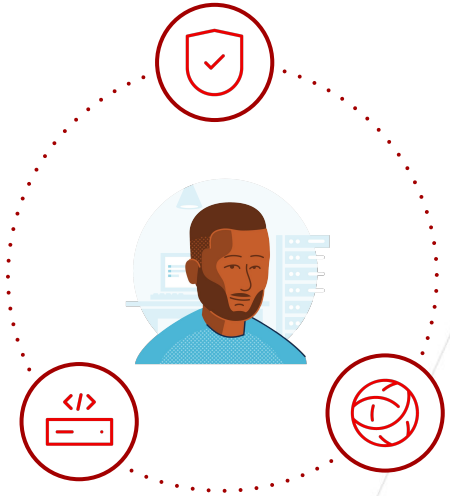
Too many unintegrated, domain-specific tools



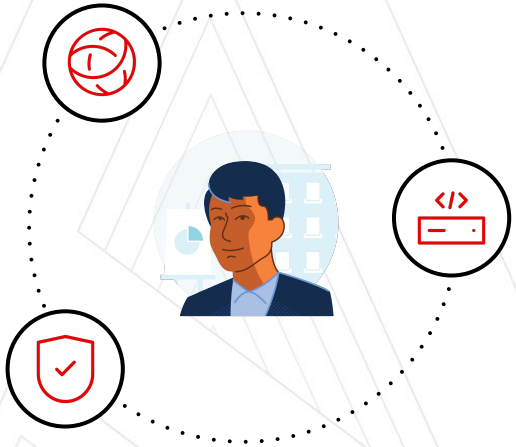
Network ops



SecOps

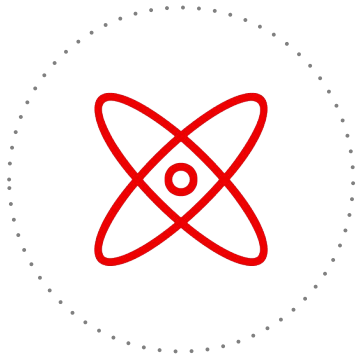


Devs/DevOps



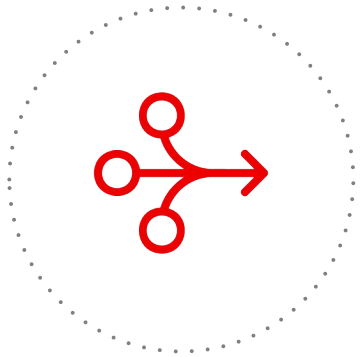
IT ops

Why the Ansible Automation Platform?



Powerful

Orchestrate complex processes at enterprise scale.



Simple

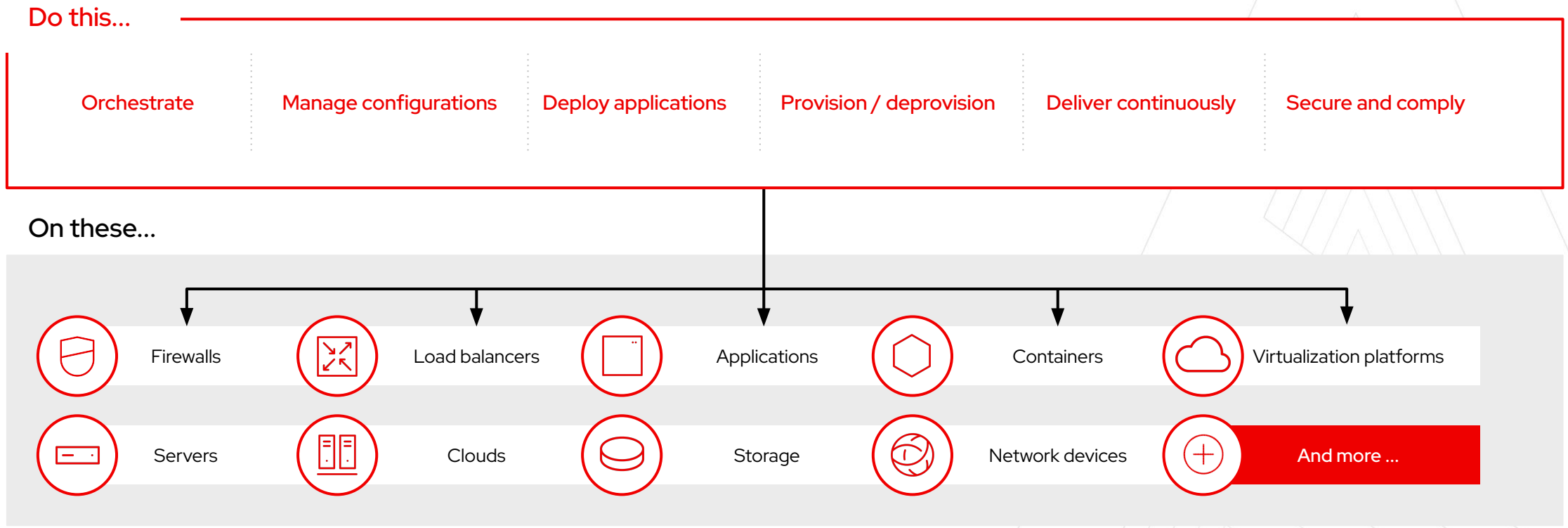
Simplify automation creation and management across multiple domains.

Agentless

Easily integrate with hybrid environments.

Automate the deployment and management of automation

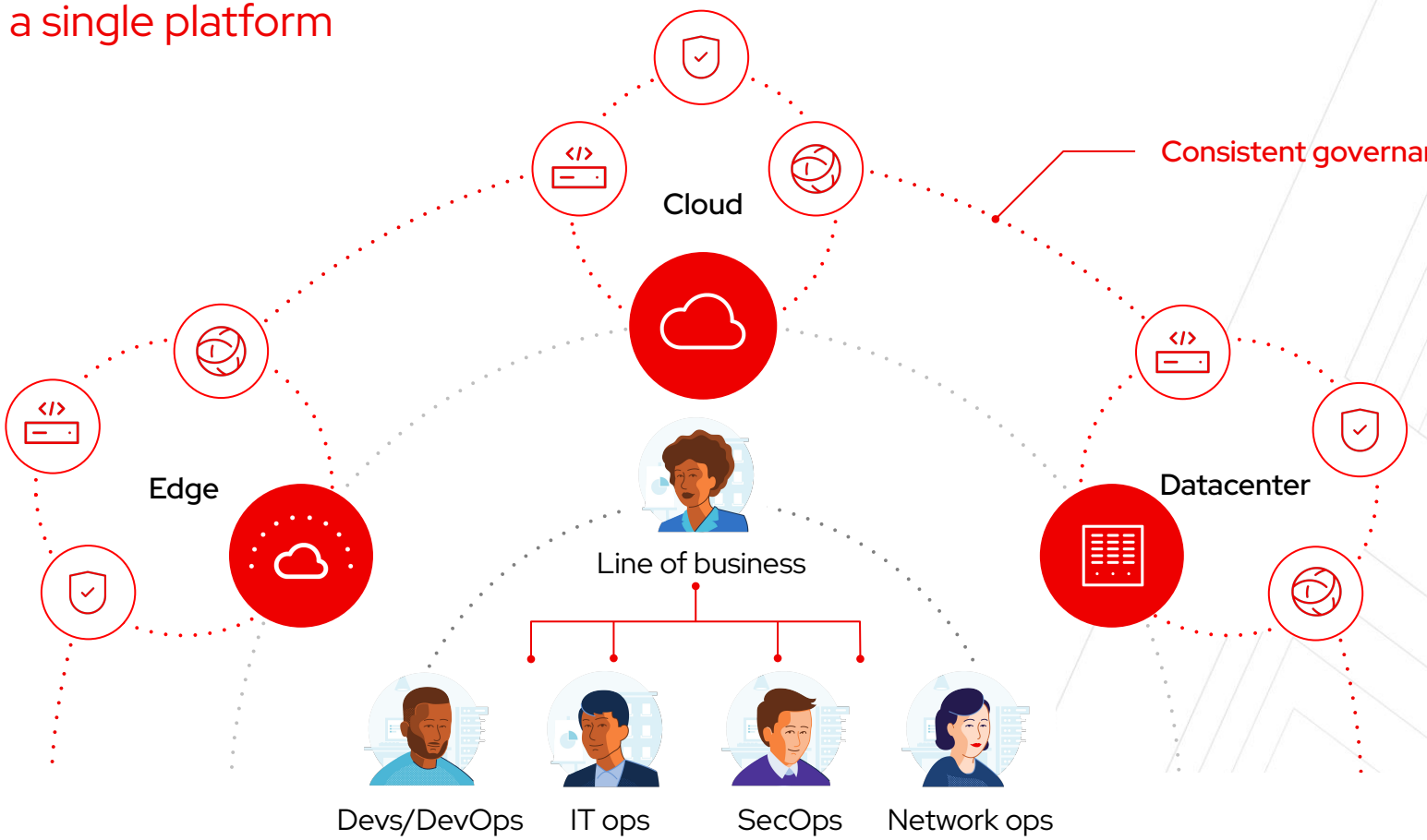
Your entire IT footprint



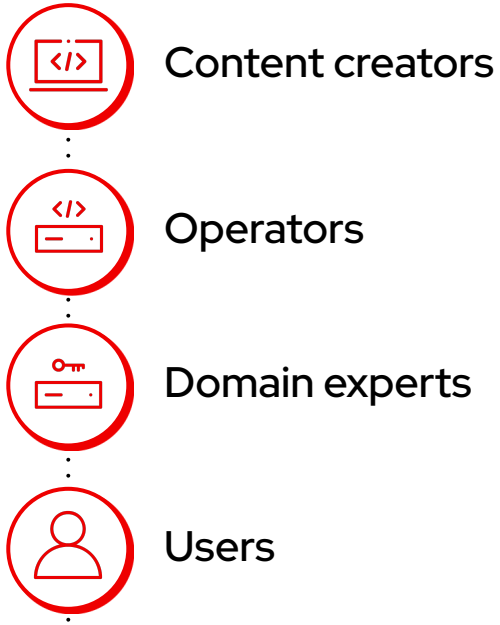
Red Hat
Ansible Automation
Platform

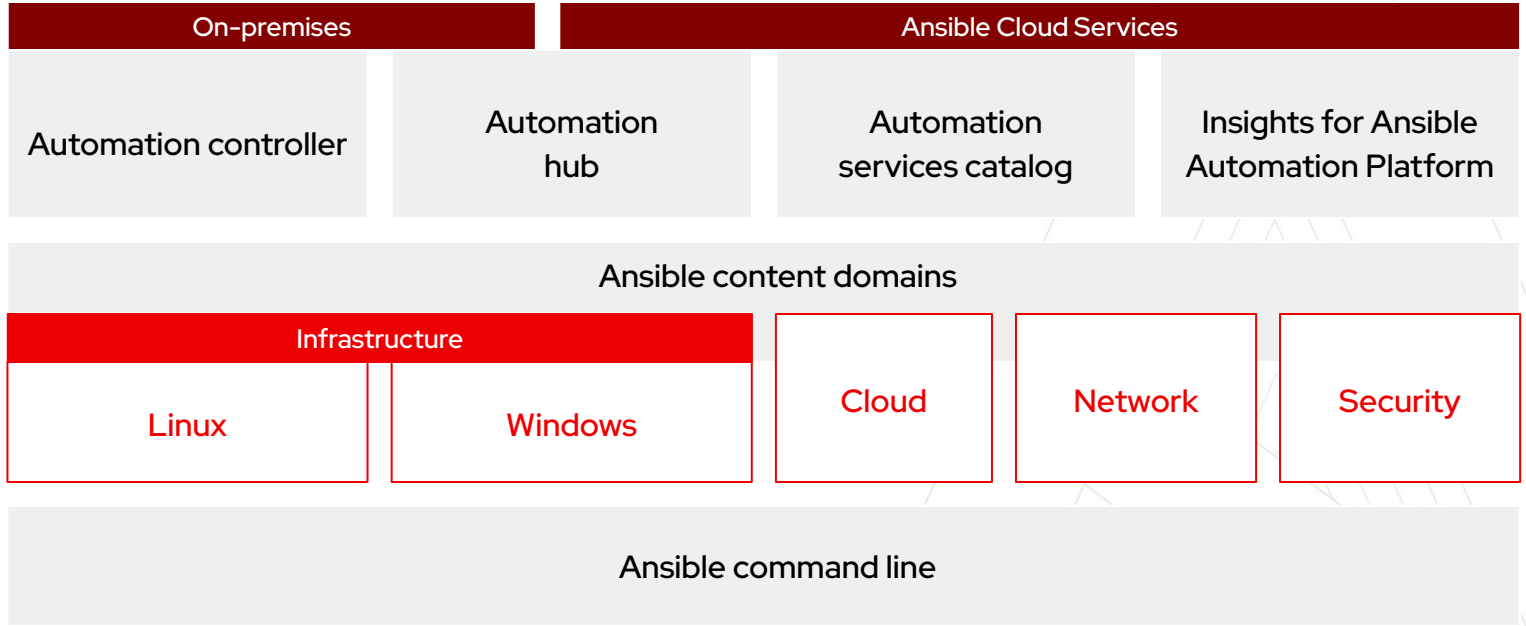
Break down silos

Different teams a single platform

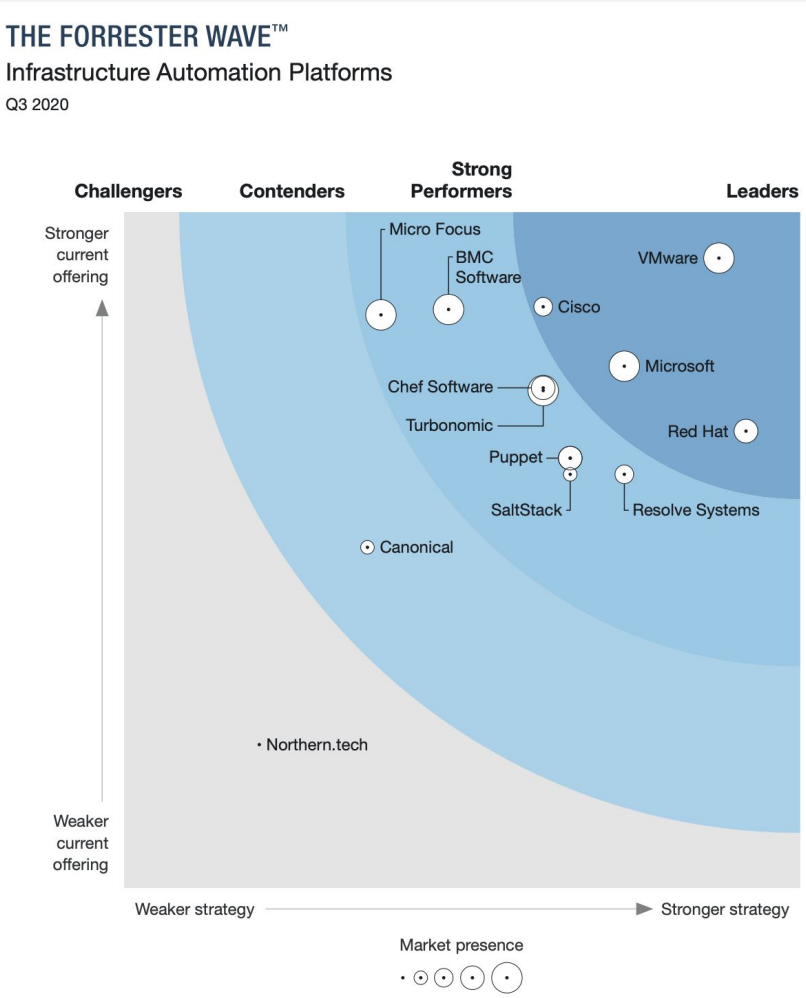


Red Hat Ansible Automation Platform





Fueled by an open source community



Red Hat named a Leader in The Forrester Wave™

Infrastructure Automation Platforms, Q3 2020

Received highest possible score in the criteria of:

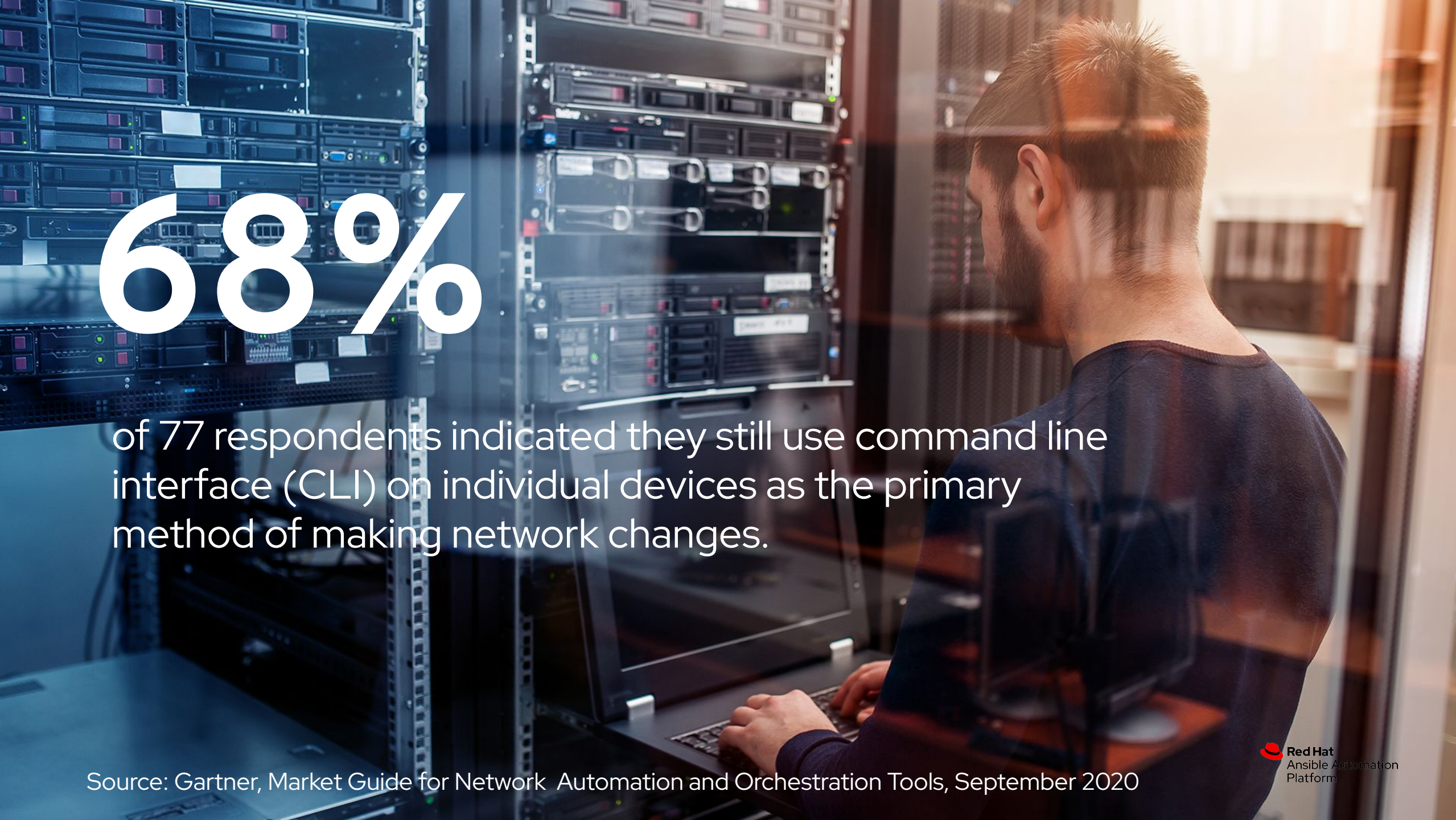
- Deployment functionality
- Product Vision
- Partner Ecosystem
- Supporting products and services
- Community support
- Planned product enhancements

- "Ansible continues to grow quickly, particularly among enterprises that are automating networks. The solution excels at providing a variety of deployment options and acting as a service broker to a wide array of other automation tools."
- "Red Hat's solution is a good fit for customers that want a holistic automation platform that integrates with a wide array of other vendors' infrastructure."

Source:
Gardner, Chris, Glenn O'Donnell, Robert Perdonii, and Diane Lynch. "The Forrester Wave™: Infrastructure Automation Platforms, Q3 2020." *Forrester*, 10 Aug. 2020.

Use-Case

- Network Automation



68%

of 77 respondents indicated they still use command line interface (CLI) on individual devices as the primary method of making network changes.

Source: Gartner, Market Guide for Network Automation and Orchestration Tools, September 2020

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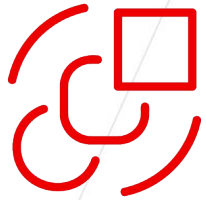
Ansible Automation
Platform

Why hasn’t networking changed?

Networking vendors are the trusted advisors



PEOPLE

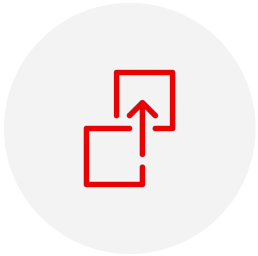
- Domain specific skill sets
- Vendor oriented experience
- Siloed organizations
- Legacy operational practices

PRODUCTS

- Infrastructure-focused features
- CLI-based interfaces
- Siloed technologies
- Monolithic, proprietary platforms

Next generation networking

Automation to effectively manage increasing diversity and scope



Edge / IoT Devices

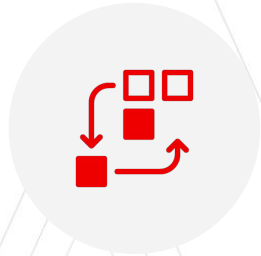
New device types entering networks at scale, with distributed computing.

Hybrid cloud

Numerous deployment forms across the globe

Digital transformation

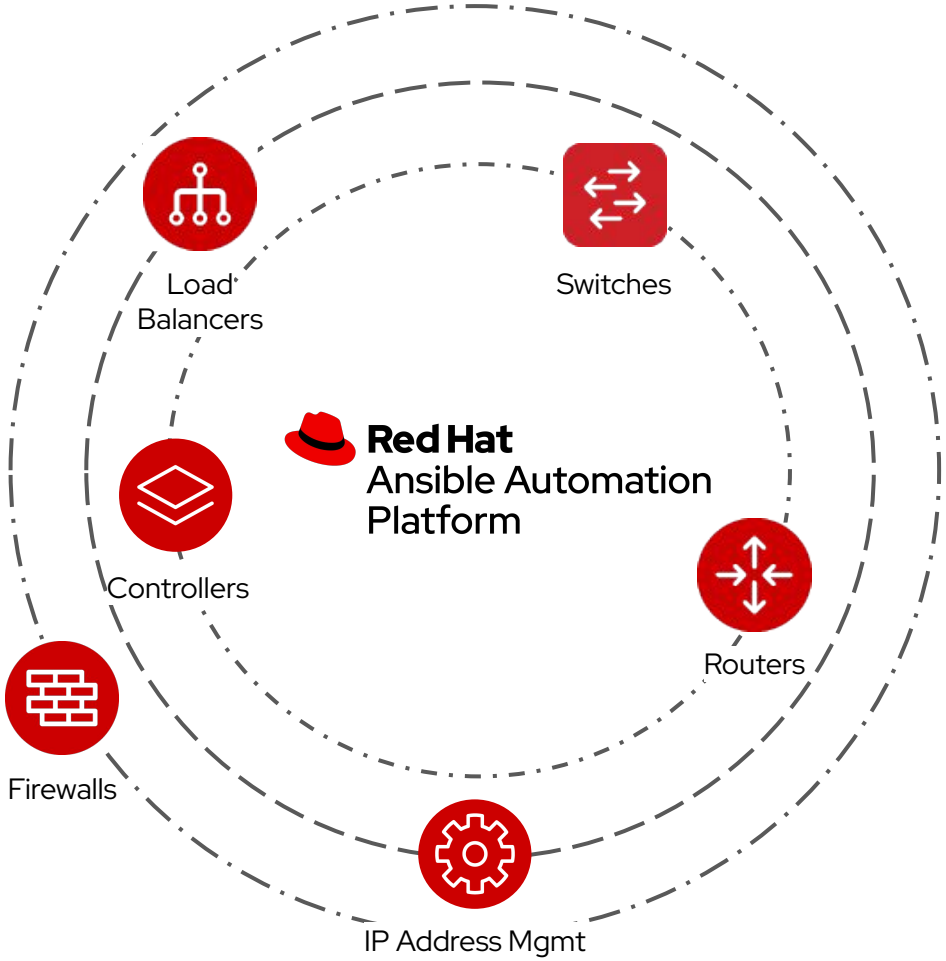
Responding with new applications is only as fast as the slowest process



Data-intensive computing

Artificial intelligence, digital applications and growing data driving connectivity

What is Ansible Network Automation?



Ansible network automation is our content domain focused on networking use cases. The goal is to provide network teams with the tools and an operational framework to implement next-generation network operations, manage network infrastructure-as-code, and better support digital transformation by connecting teams across the IT organization.

Ansible network automation is a set of Certified Content Collections designed to streamline and operationalize network operations across multiple platforms and vendors.

Modernize and scale network operations

Choose what network tasks to automate at your own pace

TRADITIONAL NETWORK OPERATIONS

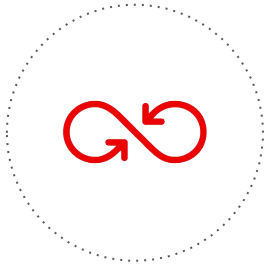
- Traditional culture
- Risk averse
- Proprietary solutions
- Siloed from others
- “Paper” practices, MOPs
- “Artisanal” networks

NEXT-GEN NETWORK OPERATIONS

- Community culture
- Risk-aware
- Open solutions
- Teams of heroes
- Infrastructure as code
- Virtual prototyping / DevOps

What does it do?

Automate your network with a single tool

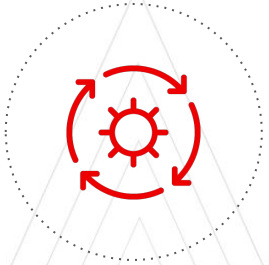


Configuration Management

Platform agnostic configuration management to standardize and enforce best-practices.

Infrastructure Awareness

Track network resources through facts gathering, to perform preventive maintenance, reducing outage risks and costs of unnecessary hardware-refresh.



Network Validation

Examine operational state to to check network connectivity and protocols and enhance operational workflows to help measure network intent.

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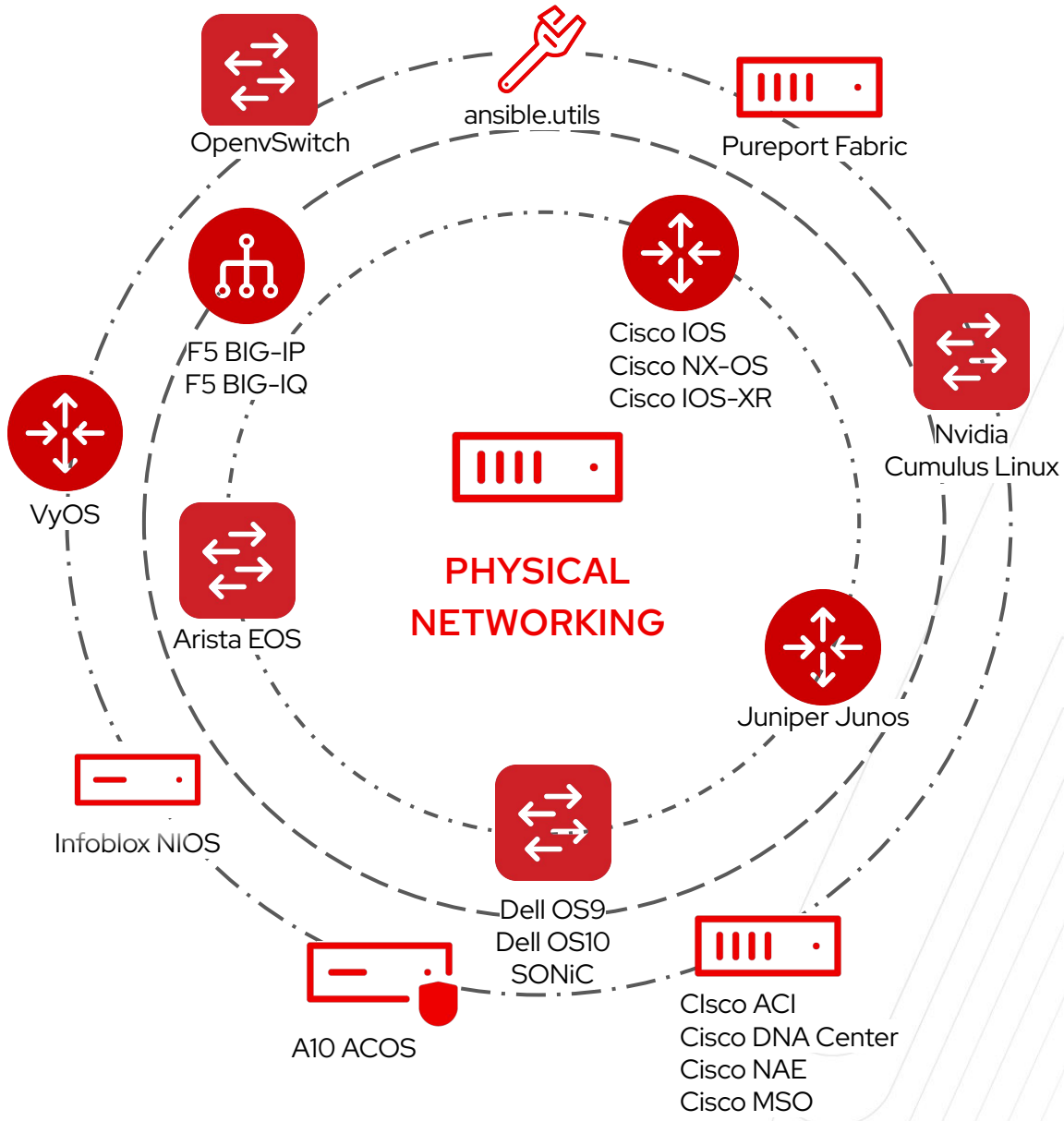
Platform

What is it for?

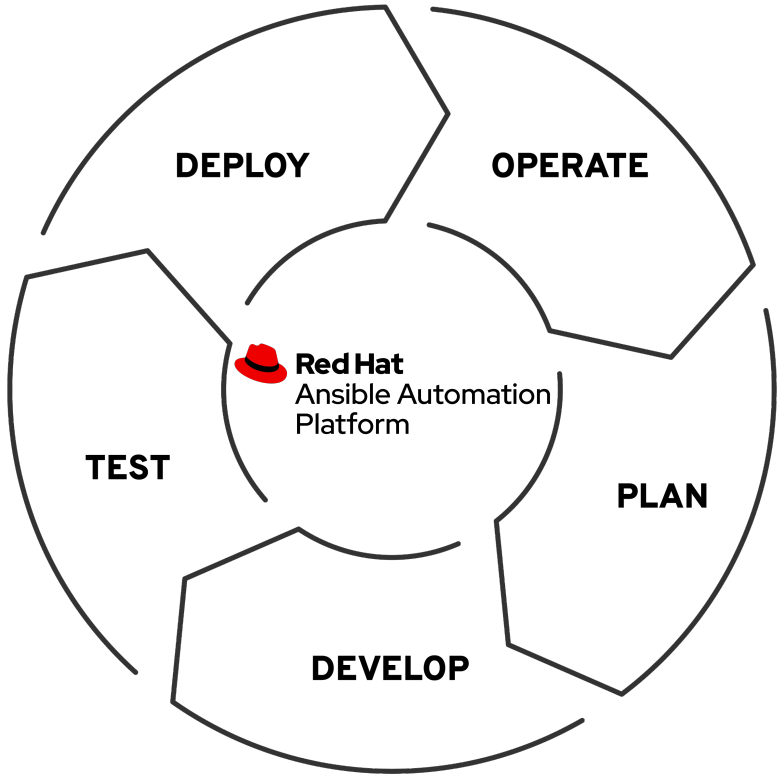


VIRTUAL
NETWORKING

SDN
CONTROLLER

Start Small, Think Big

Three high-level benefits for successful network operations



Configuration Management

- Automate backup & restores
- Scoped Config Management

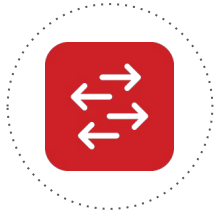
Infrastructure Awareness

- Dynamic Documentation
- Compliance and traceability

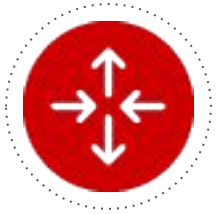
Network Validation

- Validate operational steady-state
- Roll back if configuration changes don’t meet goals

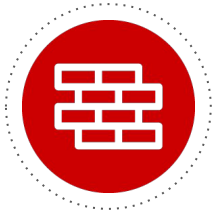
Ansible Network Ecosystem



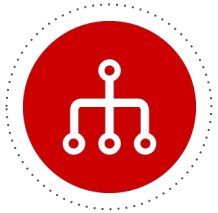
SWITCHES



ROUTERS



ENTERPRISE FIREWALLS

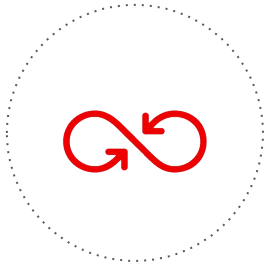


LOAD BALANCERS

CONTROLLERS

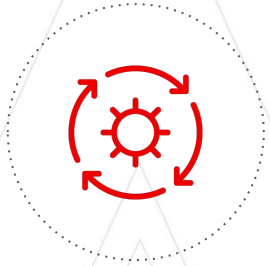
IP ADDRESS MGMT

Deep diving on use-cases



Configuration Management

Infrastructure Awareness



Network Validation

Config Backup and Restore

Scoped Config Management

Dynamic Documentation

Automated NetOps

Operational State Validation

Network Compliance

Network Automation Journey

Complexity

OPPORTUNISTIC

How can we simplify a task or set of tasks?

- Backup & Restore
- Dynamic Documentation

SYSTEMATIC

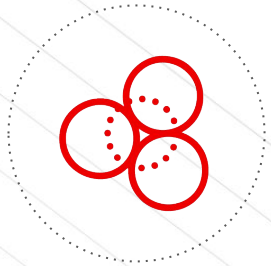
How do we centralise our processes?

- Scoped Config Management
- Network Compliance

INSTITUTIONALIZED

How do we orchestrate our processes?

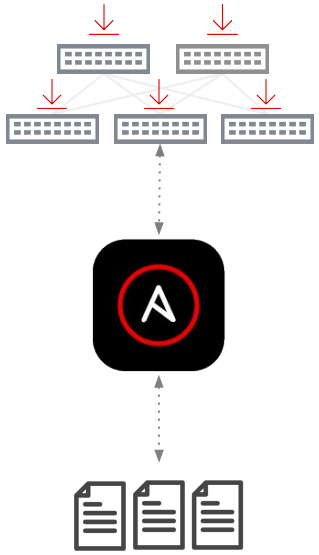
- Operational State Validation
- Automated NetOps



Ansible Network Automation

Start Small

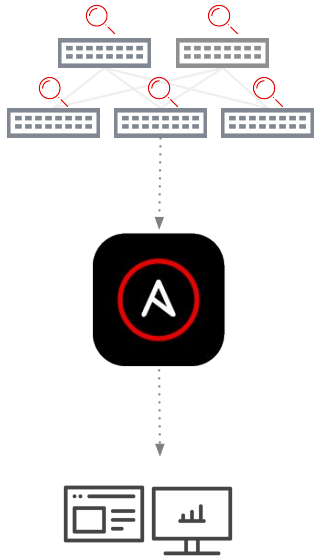
Quick automation victories for network engineers



Config Backup and Restore

Ubiquitous first touch use case

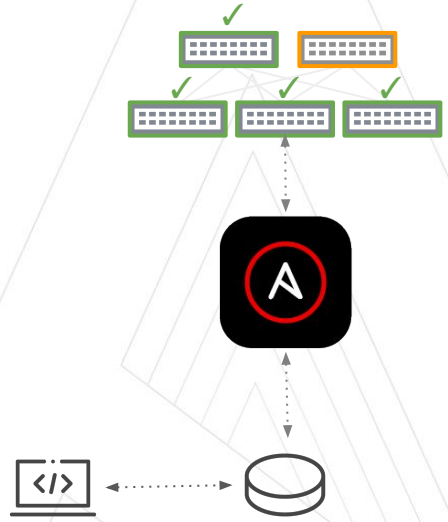
- Gain confidence in automation quickly
- First steps towards network as code
- Quickly recover network steady state



Dynamic Documentation

Use Ansible facts to gain information

- Read-only, no production config change
- Dynamic Documentation and reporting
- Understand your network



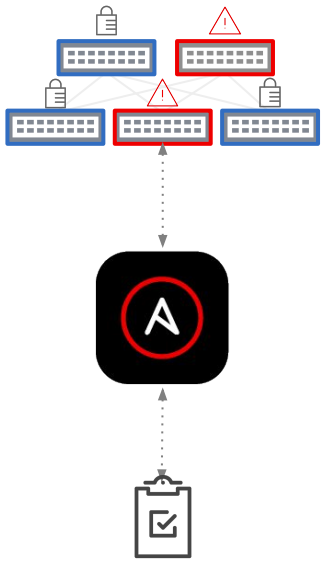
Scoped Config Management

Focus on high yield victories

- Automate VLANs, ACLs and SNMP config
- Introduce source of truth concepts
- Enforce Configuration policy

Think Big

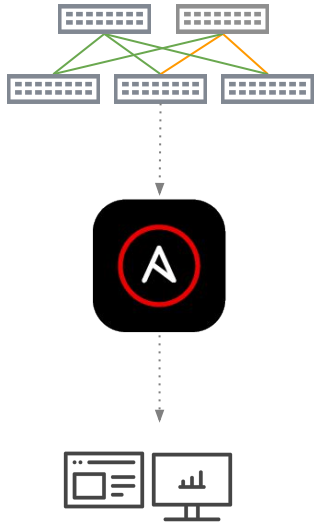
Institutionalizing automation into your organization



Network Compliance

Respond quickly and consistently

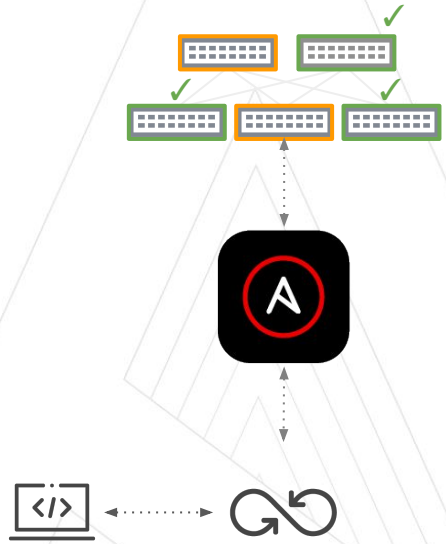
- Security and config compliance for network
- Remove human error from security responses
- Enforce Configuration policies and hardening



Operational State Validation

Going beyond config management

- Parsing operational state to structured values
- Schema validation and verification
- Enhance operational workflows



Automated NetOps

Infrastructure as code

- Data centric automation
- Deploy configuration pipelines
- GitOps for Network Automation

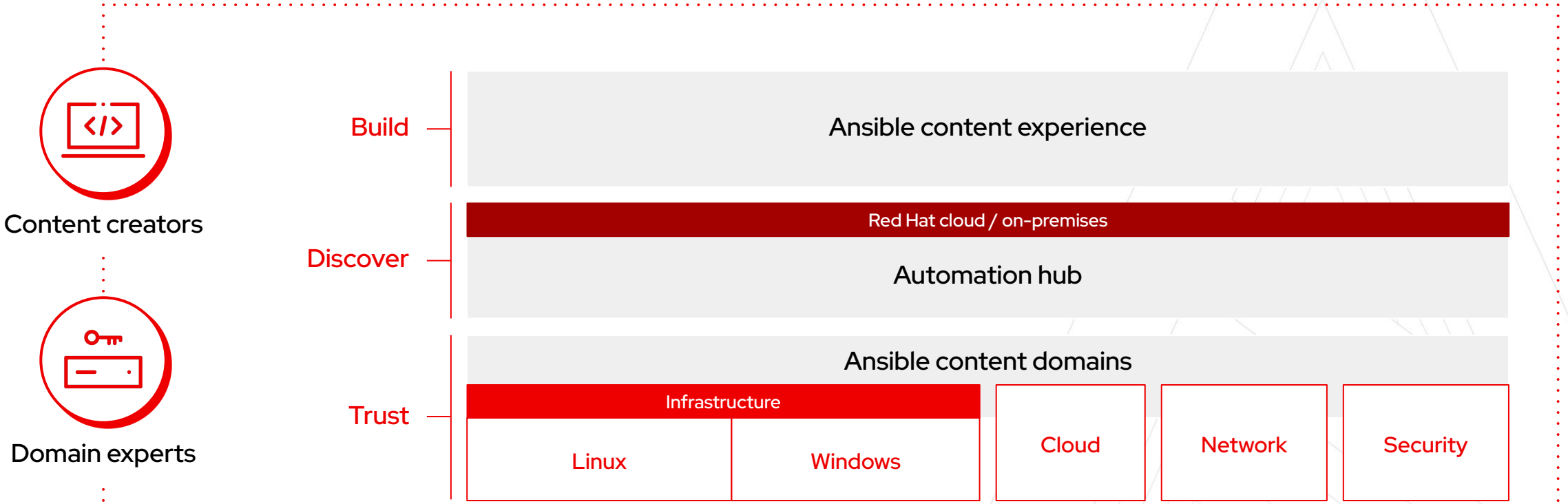
Section 1
Ansible Basics

Topics Covered:

- Understanding Inventory
- An example Ansible Playbook

Create

The automation lifecycle



Red Hat
Ansible Automation
Platform

Ansible playbooks

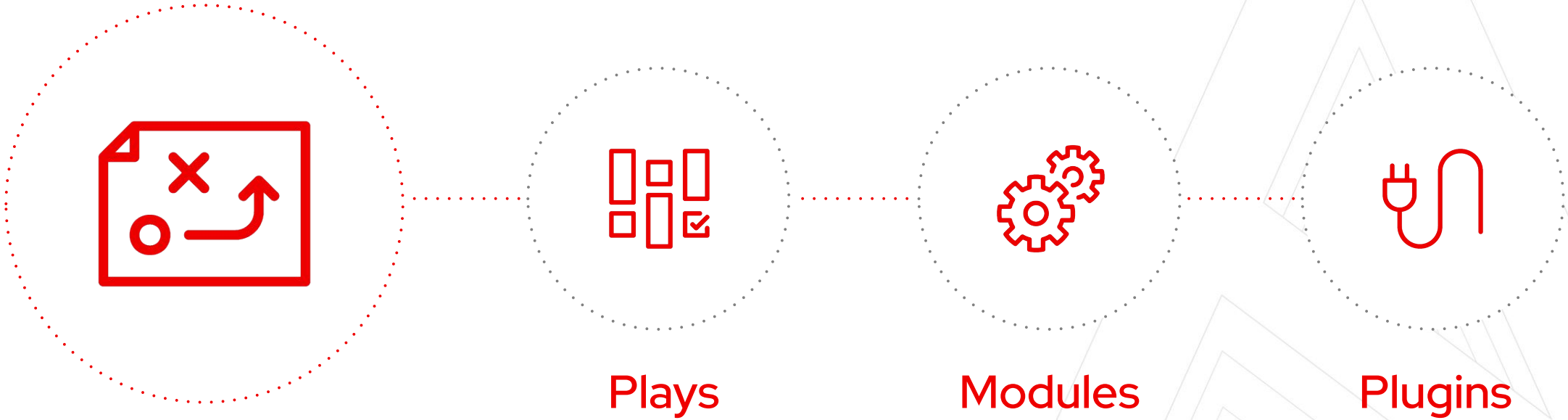
```
---
- name: install and start apache
  hosts: web
  become: yes

  tasks:
    - name: httpd package is present
      yum:
        name: httpd
        state: latest

    - name: latest index.html file is present
      template:
        src: files/index.html
        dest: /var/www/html/

    - name: httpd is started
      service:
        name: httpd
        state: started
```

What makes up an Ansible playbook?



Ansible plays

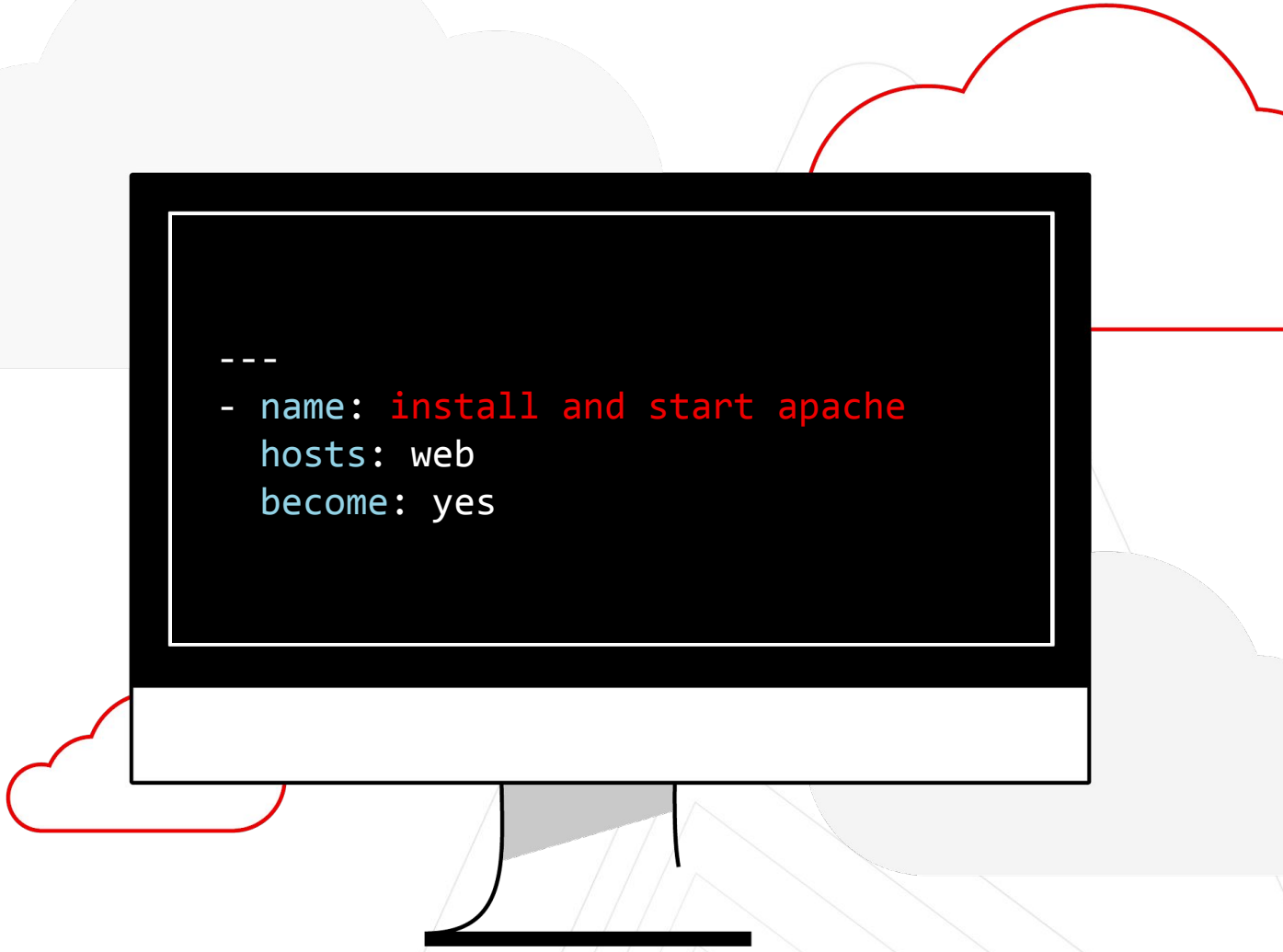
What am I automating?

What are they?

Top level specification for a group of tasks. Will tell that play which hosts it will execute on and control behavior such as fact gathering or privilege level.

Building blocks for playbooks

Multiple plays can exist within an Ansible playbook that execute on different hosts.



Ansible modules

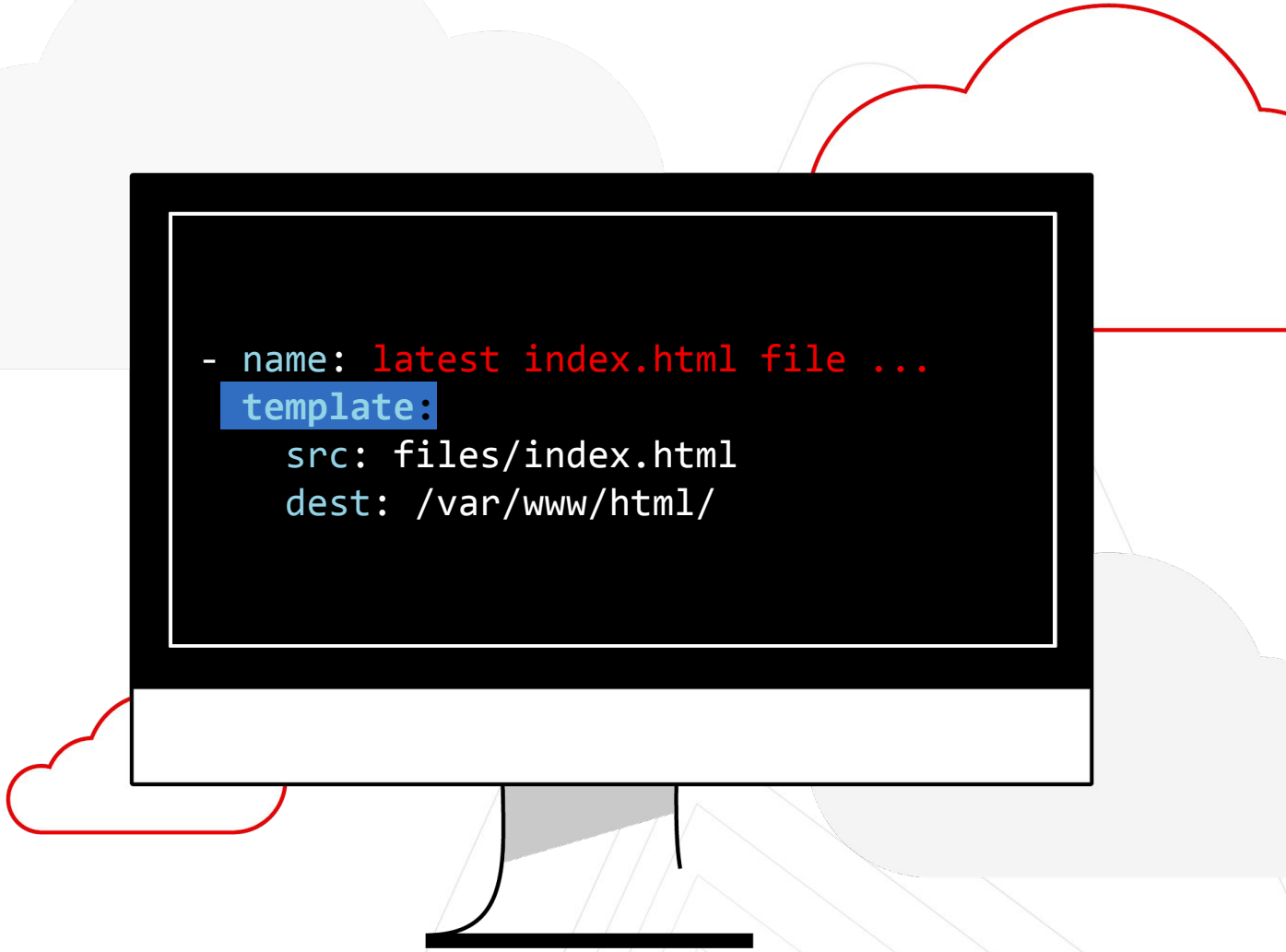
The “tools in the toolkit”

What are they?

Parametrized components with internal logic, representing a single step to be done.
The modules “do” things in Ansible.

Language

Usually Python, or Powershell for Windows setups. But can be of any language.

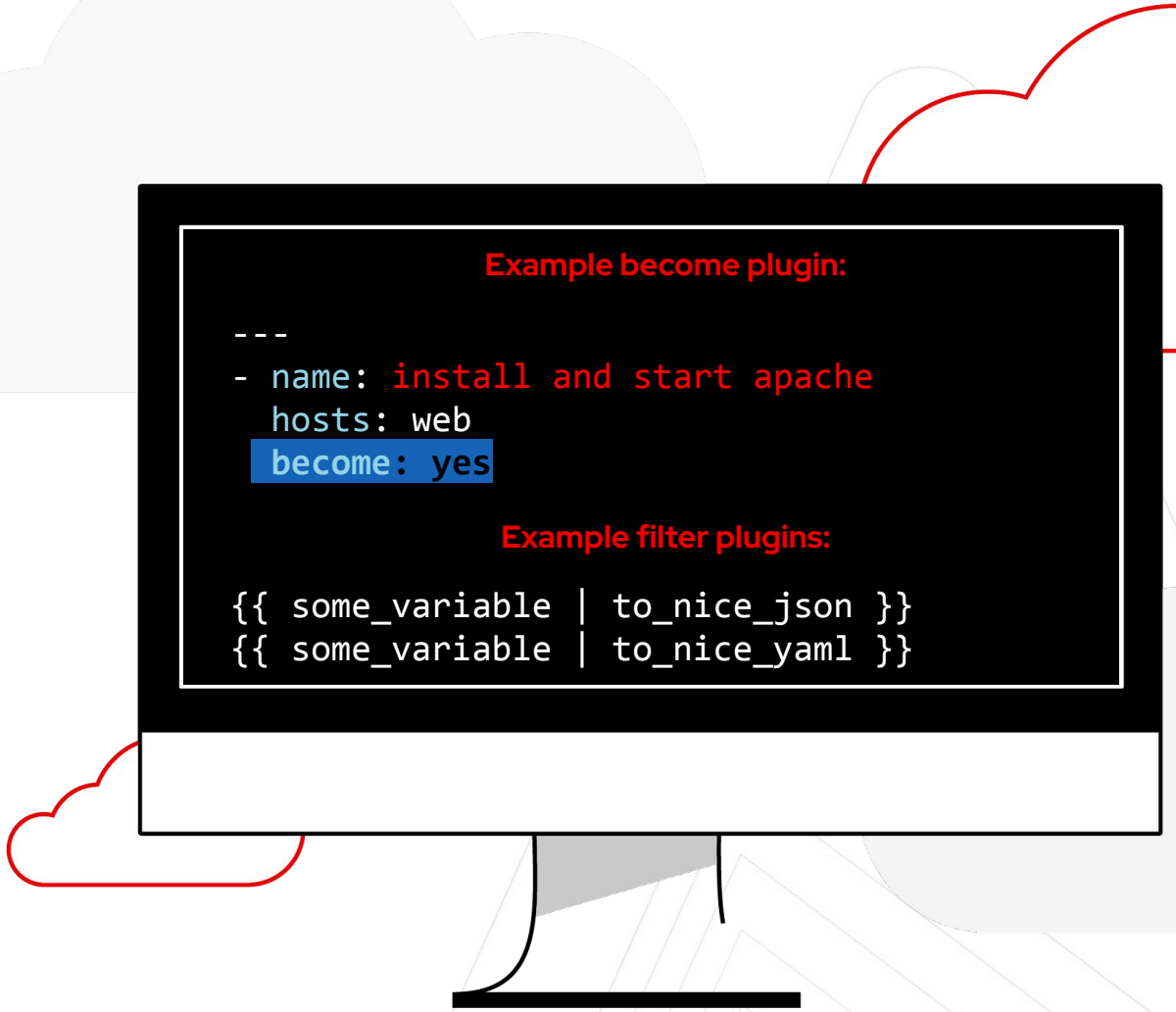


Ansible plugins

The “extra bits”

What are they?

Plugins are pieces of code that augment Ansible’s core functionality. Ansible uses a plugin architecture to enable a rich, flexible, and expandable feature set.



Ansible Inventory

The systems that a playbook runs against

What are they?

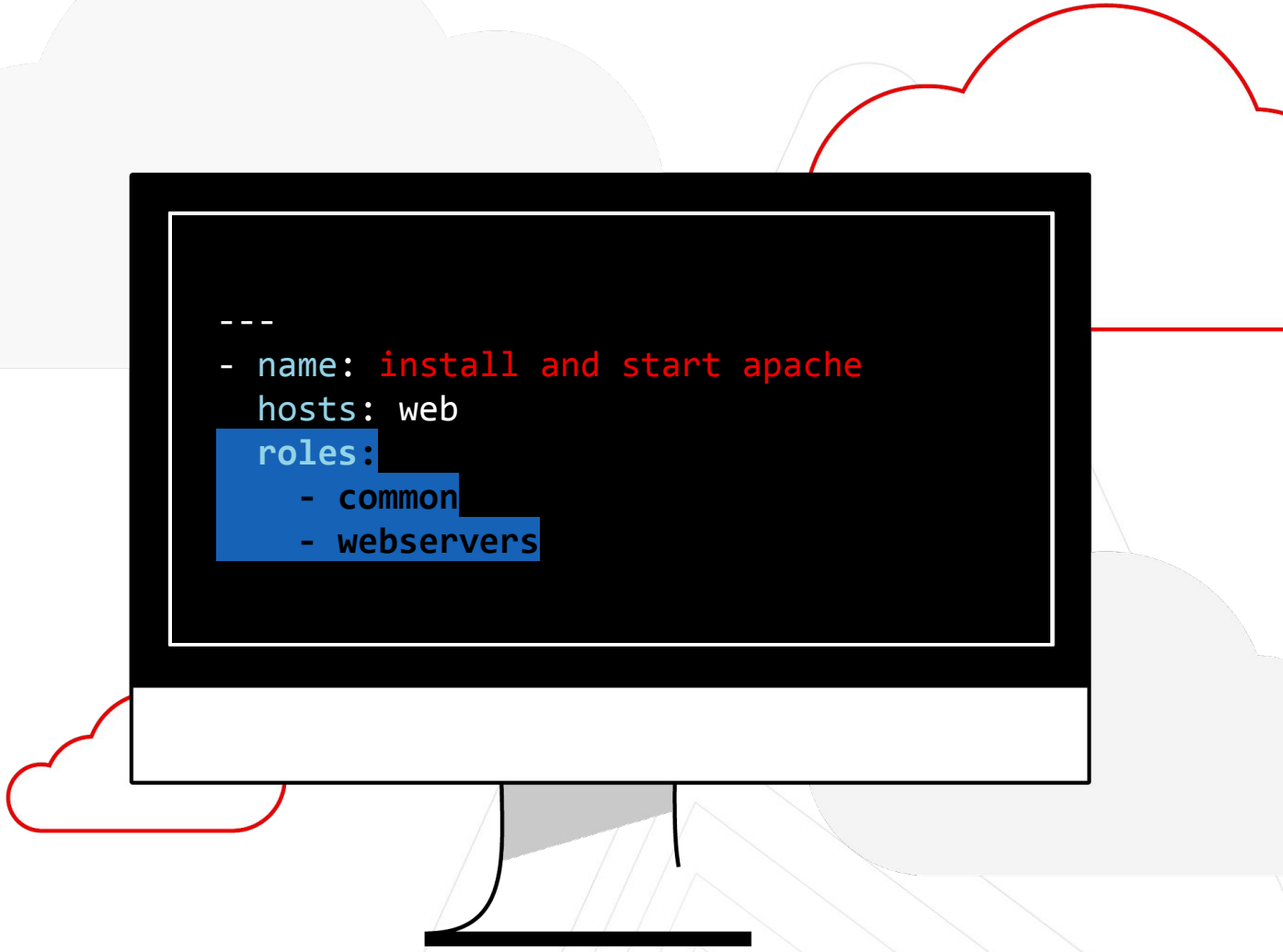
List of systems in your infrastructure that automation is executed against

Ansible roles

Reusable automation actions

What are they?

Group your tasks and variables of your automation in a reusable structure. Write roles once, and share them with others who have similar challenges in front of them.



Collections

Simplified and consistent content delivery

What are they?

Collections are a data structure containing automation content:

- Modules
- Playbooks
- Roles
- Plugins
- Docs
- Tests

```
nginx_core
├── MANIFEST.json
├── playbooks
│   ├── deploy-nginx.yml
│   └── ...
├── plugins
├── README.md
└── roles
    ├── nginx
    │   ├── defaults
    │   ├── files
    │   │   └── ...
    │   ├── tasks
    │   └── templates
    │       └── ...
    ├── nginx_app_protect
    └── nginx_config
```

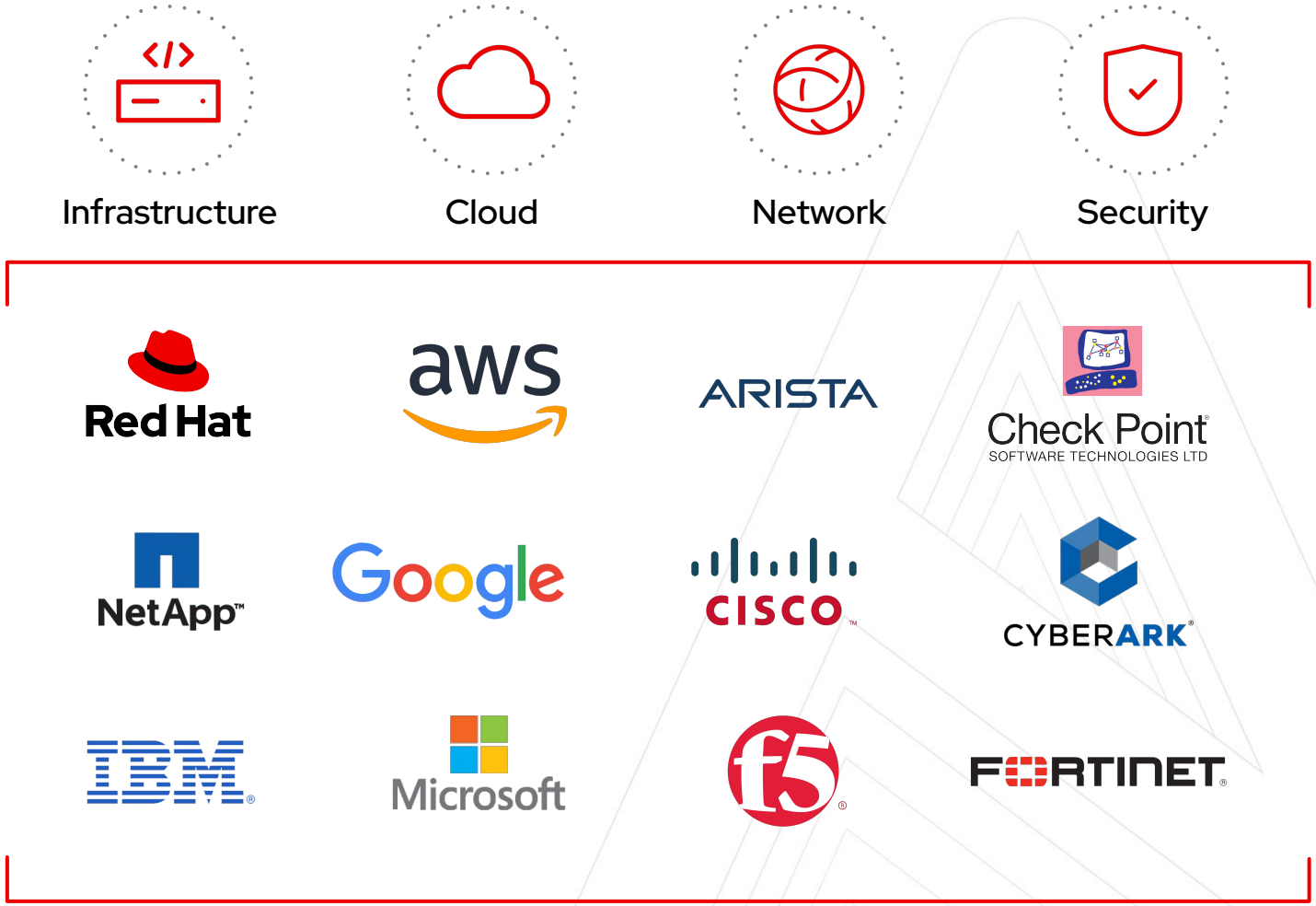
deploy-nginx.yml

```yaml
---
- name: Install NGINX Plus
  hosts: all
  tasks:
    - name: Install NGINX
      include_role:
        name: nginxinc.nginx
      vars:
        nginx_type: plus

    - name: Install NGINX App Protect
      include_role:
        name: nginxinc.nginx_app_protect
      vars:
        nginx_app_protect_setup_license: false
        nginx_app_protect_remove_license: false
        nginx_app_protect_install_signatures: false
```

90+

certified platforms



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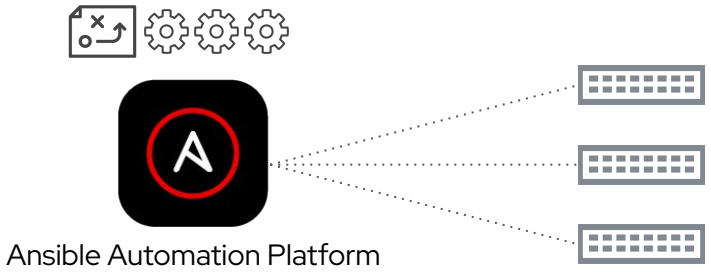
How is network automation different?

Network Automation compared to servers

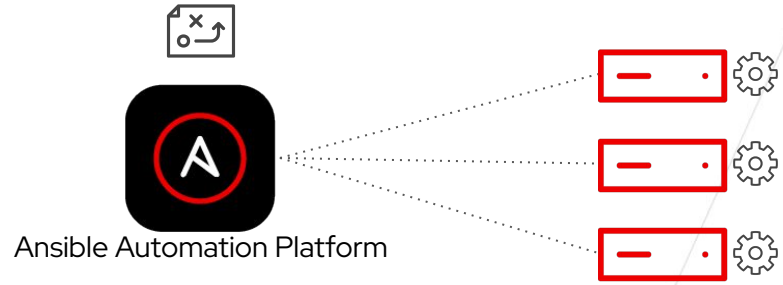
Module code is executed locally on the control node



Local Execution

Network Devices / API Endpoints

Module code is copied to the managed node, executed, then removed



Remote Execution

Linux / Windows Hosts

Network Connection Plugins

Use your vendor connection of choice

`ansible_connection`

- **`netconf`** – XML over netconf

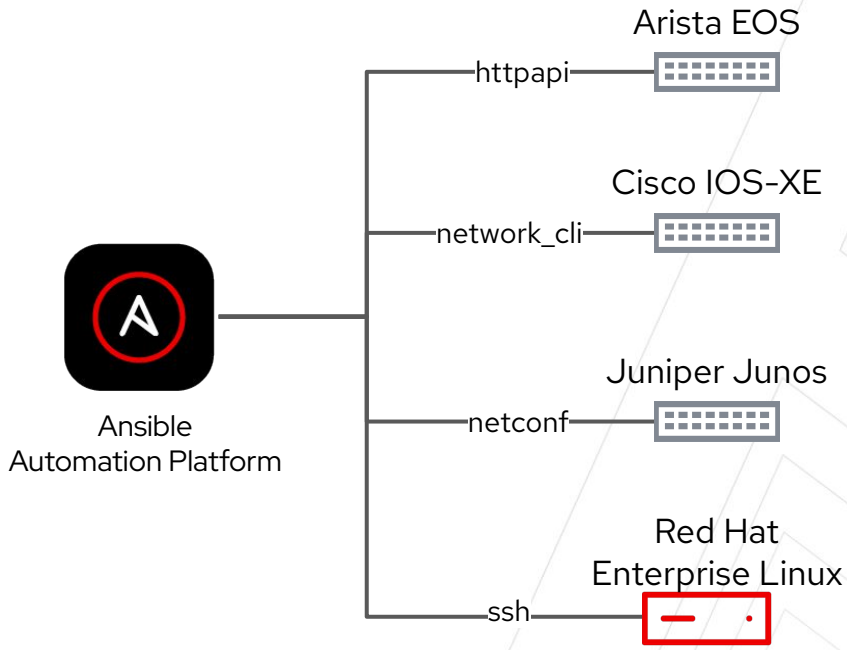
  example: Juniper Junos

- **`network_cli`** – command line over SSH

  example: Cisco IOS-XE, Arista EOS

- **`httpapi`** – vendor API

  example: Arista eAPI, Cisco NX-API



https://docs.ansible.com/ansible/latest/plugins/connection.html

Understanding Inventory

```
rtr1 ansible_host=18.220.156.59
rtr2 ansible_host=18.221.53.11
rtr3 ansible_host=13.59.242.237
rtr4 ansible_host=3.16.82.231
rtr5
rtr6
```

Understanding Inventory - Groups

There is always a group called **"all"** by default

```
[cisco]
rtr1 ansible_host=18.220.156.59 private_ip=172.16.184.164
[arista]
rtr2 ansible_host=18.221.53.11 private_ip=172.17.229.213
rtr4 ansible_host=3.16.82.231 private_ip=172.17.209.186
[juniper]
rtr3 ansible_host=13.59.242.237 private_ip=172.16.39.75
```

Groups can be nested

```
[routers:children]
cisco
juniper
arista
```

Understanding Inventory - Variables

```
[cisco]
rtr1 ansible_host=18.220.156.59 private_ip=172.16.184.164
[arista]
rtr2 ansible_host=18.221.53.11 private_ip=172.17.229.213
rtr4 ansible_host=3.16.82.231 private_ip=172.17.209.186
[juniper]
rtr3 ansible_host=13.59.242.237 private_ip=172.16.39.75

[cisco:vars]
ansible_user=ec2-user
ansible_network_os=ios
ansible_connection=network_cli
```

Host variables apply to the host and override group vars

Group variables apply for all devices in that group

A Sample Ansible Playbook

```
---
- name: configure VLANs
  hosts: cisco
  gather_facts: false
  tasks:
    - name: VLANs task
      cisco.nxos.vlans:
        config:
        - vlan_id: 5
          name: WEB
        - vlan_id: 10
```

- A playbook is a list of plays.
- Each play is a list of tasks.
- Tasks invoke modules.
- A playbook can contain more than one play.

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Lab Time

Exercise 1 - Exploring the lab environment

red.ht/network-workshop-1

In this lab you will explore the lab environment and build familiarity with the lab inventory.

Approximate time: 10 mins

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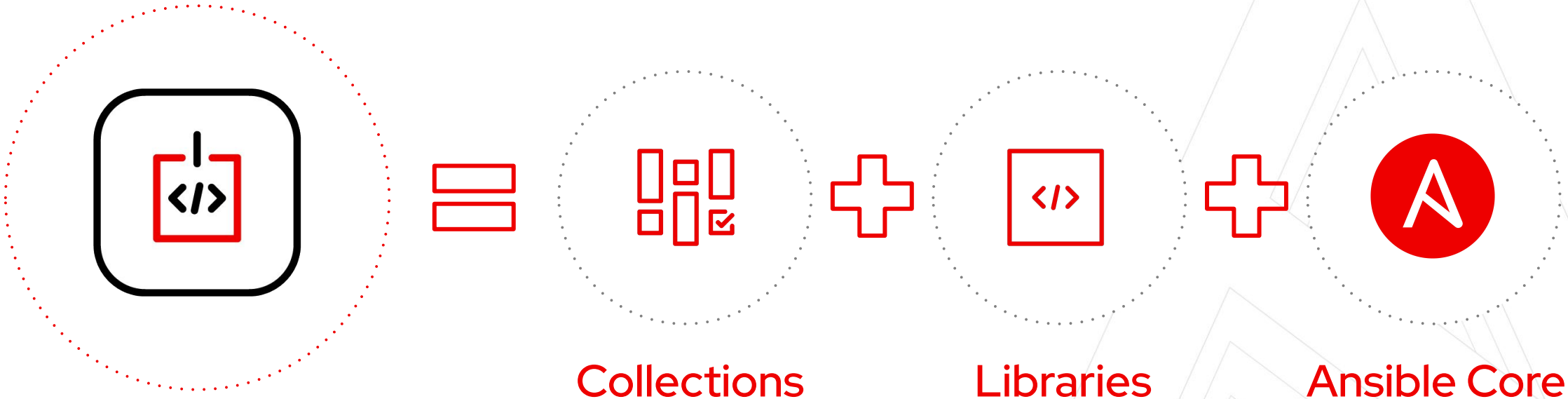
Section 2
Executing Ansible

Topics Covered:

- An Ansible Play
- Ansible Modules
- Execution Environments
- Running an Ansible Playbook

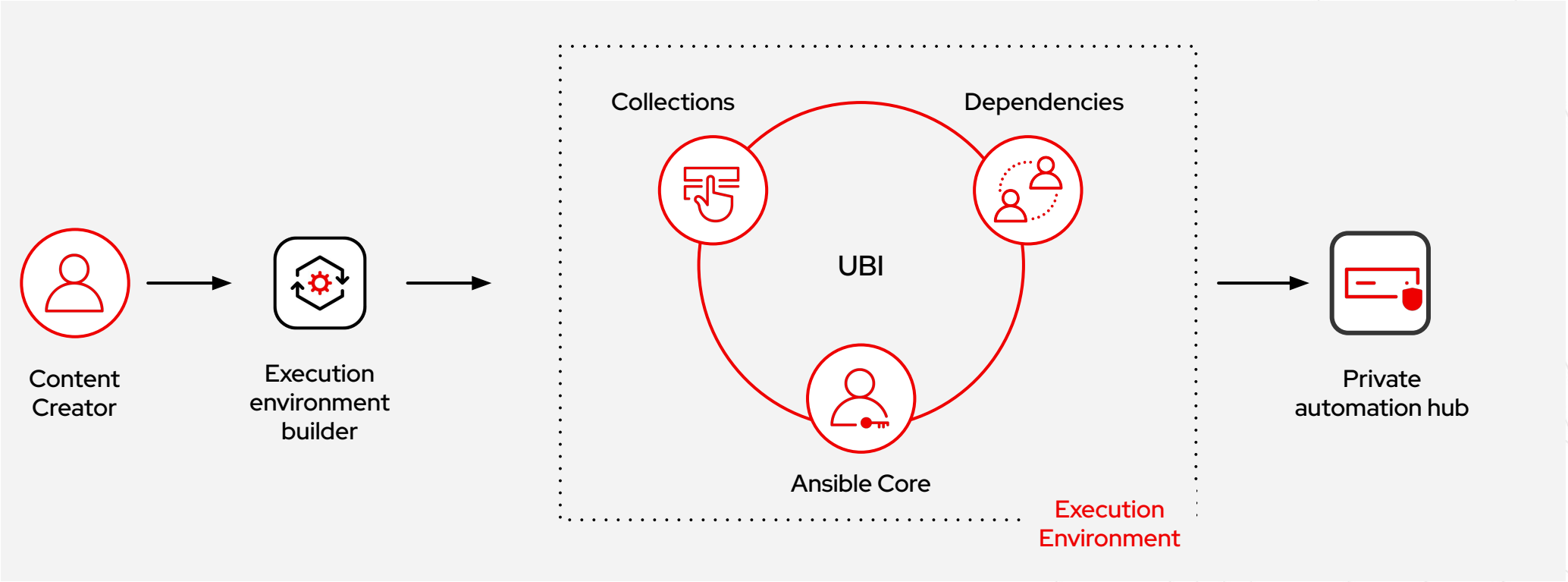
Automation Execution Environments

Components needed for automation, packaged in a cloud-native way



Build, create, publish

Development cycle of an automation execution environment



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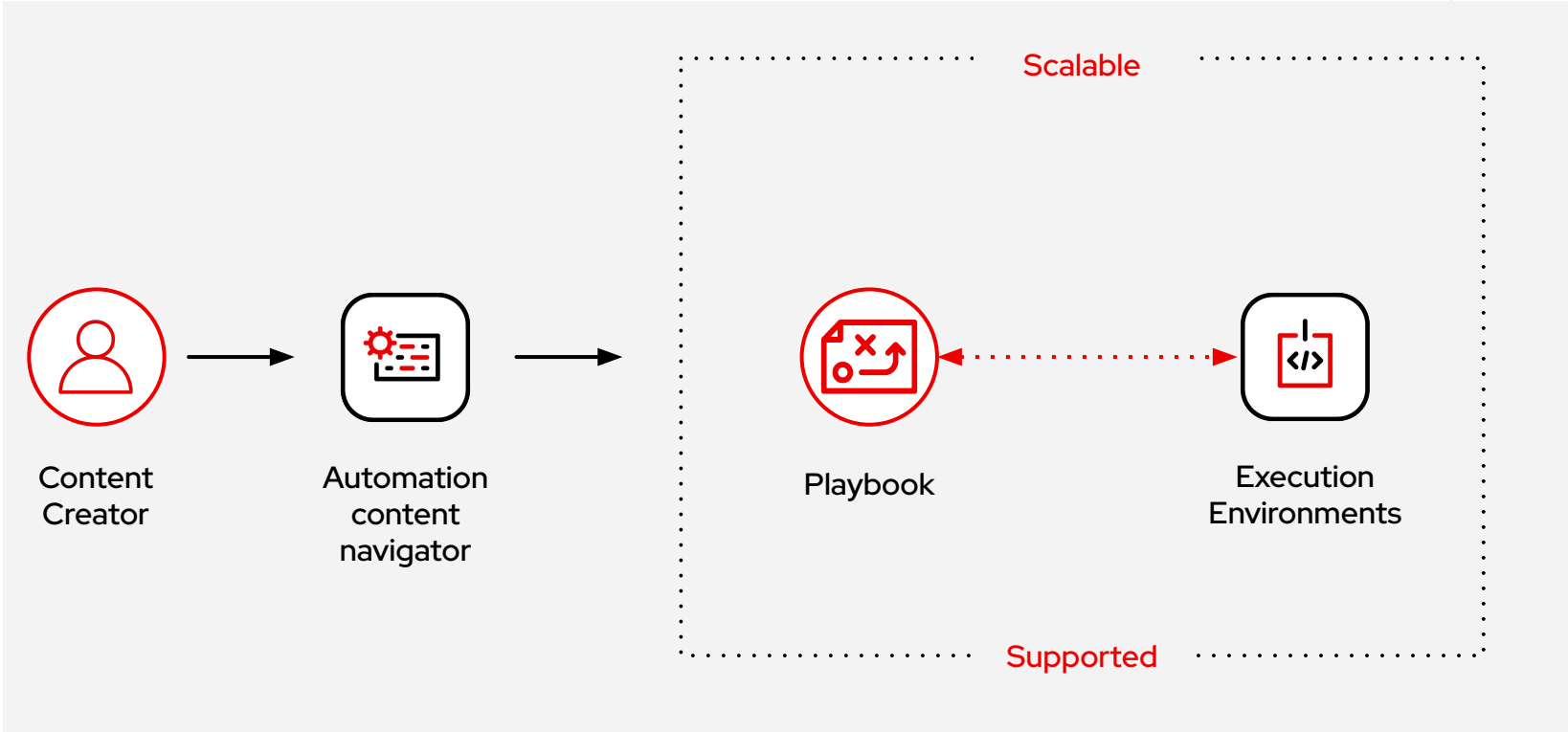
Develop, test, run

How to develop, test and run containerized Ansible content



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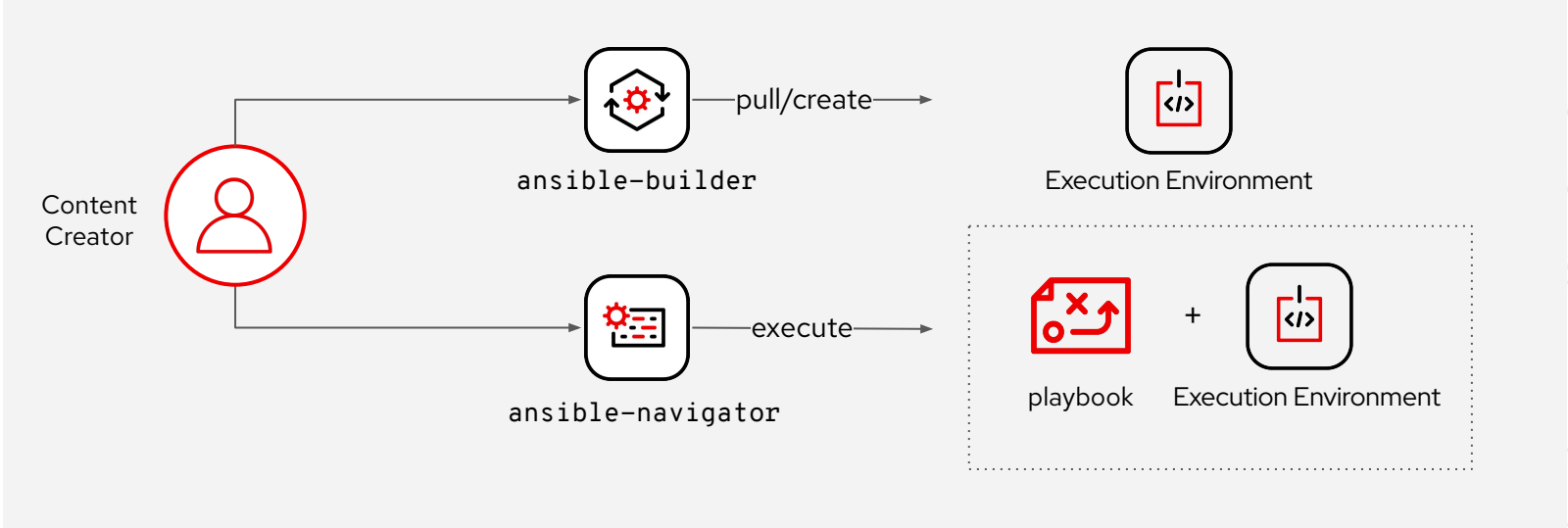
Builder and Navigator



Another Ansible Playbook Example

```
---
- name: snmp ro/rw string configuration
  hosts: cisco
  gather_facts: false

  tasks:
    - name: ensure snmp strings are present
      cisco.ios.config:
        lines:
          - snmp-server community ansible-public RO
          - snmp-server community ansible-private RW
```

Ansible Playbook - Play definition

- The **name** parameter describes the Ansible Play
- Target devices using the **hosts** parameter
- Optionally disable **gather_facts**

```
---
- name: snmp ro/rw string configuration
  hosts: cisco
  gather_facts: false
```

Modules

Modules do the actual work in Ansible, they are what gets executed in each playbook task.

- Typically written in Python (but not limited to it)
- Modules can be idempotent
- Modules take user input in the form of parameters

```
tasks:
  - name: ensure snmp strings are present
    cisco.ios.config:
      lines:
        - snmp-server community ansible-public RO
        - snmp-server community ansible-private RW
```

Network modules

Ansible modules for network automation typically references the vendor OS followed by the module name.

- namespace.collection.facts
- namespace.collection.command
- namespace.collection.config
- namespace.collection.resource

More modules depending on platform

Arista EOS = arista.eos.

Cisco IOS/IOS-XE = cisco.ios

Cisco NX-OS = cisco.nxos

Cisco IOS-XR = cisco.iosxr

F5 BIG-IP = f5networks.f5_bigip_bigip.

Juniper Junos = junipsnetworks.junos.

VyOS = vyos.vyos.

A playbook run

Where it all starts

- A playbook is interpreted and run against one or multiple hosts - task by task. The order of the tasks defines the execution.
- In each task, the module does the actual work.

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Running an Ansible Playbook

Using the latest ansible-navigator command

What is ansible-navigator?

ansible-navigator command line utility and text-based user interface (TUI) for running and developing Ansible automation content.

It replaces the previous command used to run playbooks “ansible-playbook”.

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ansible-navigator

Bye ansible-playbook, Hello ansible-navigator

How do I use ansible-navigator?

As previously mentioned, it replaces the ansible-playbook command.

As such it brings two methods of running playbooks:

- Direct command-line interface
- Text-based User Interface (TUI)

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ansible-navigator

Mapping to previous Ansible commands

ansible command	ansible-navigator command
`ansible-config`	`ansible-navigator config`
`ansible-doc`	`ansible-navigator doc`
`ansible-inventory`	`ansible-navigator inventory`
`ansible-playbook`	`ansible-navigator run`

ansible-navigator

Common subcommands

Name	Description	CLI Example	Colon command within TUI
collections	Explore available collections	ansible-navigator collections --help	:collections
config	Explore the current ansible configuration	ansible-navigator config --help	:config
doc	Review documentation for a module or plugin	ansible-navigator doc --help	:doc
images	Explore execution environment images	ansible-navigator images --help	:images
inventory	Explore and inventory	ansible-navigator inventory --help	:inventory
replay	Explore a previous run using a playbook artifact	ansible-navigator replay --help	:replay
run	Run a playbook	ansible-navigator run --help	:run
welcome	Start at the welcome page	ansible-navigator welcome --help	:welcome

Running a playbook

```yaml
---
- name: snmp ro/rw string configuration
  hosts: cisco
  gather_facts: false

  tasks:
    - name: ensure snmp strings are present
      cisco.ios.config:
        lines:
          - snmp-server community ansible-public RO
          - snmp-server community ansible-private RW
```

```
[student1@ansible networking-workshop]$ ansible-navigator playbook.yml --mode stdout

PLAY [snmp ro/rw string configuration] *****************************************************

TASK [ensure snmp strings are present] *****************************************
changed: [rtr1]

PLAY RECAP *********************************************************************************
rtr1                       : ok=1    changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

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Displaying output

```
[student1@ansible networking-workshop]$ ansible-navigator playbook.yml --mode stdout -v
Using /home/student1/.ansible.cfg as config file

PLAY [snmp ro/rw string configuration] *****************************************

TASK [ensure that the desired snmp strings are present] ************************
changed: [rtr1] => changed=true
  ansible_facts:
    discovered_interpreter_python: /usr/bin/python
  banners: {}
  commands:
  - snmp-server community ansible-public RO
  - snmp-server community ansible-private RW
  updates:
  - snmp-server community ansible-public RO
  - snmp-server community ansible-private RW

PLAY RECAP *********************************************************************
rtr1           : ok=1    changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

Increase the level of verbosity by adding more "v's" -vvvv

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Lab Time

Exercise 2 - Execute your first network automation playbook

red.ht/network-workshop-2

In this lab you will use Ansible to update the configuration of routers. This exercise will not have you create an Ansible Playbook; you will use an existing one.

Approximate time: 15 mins

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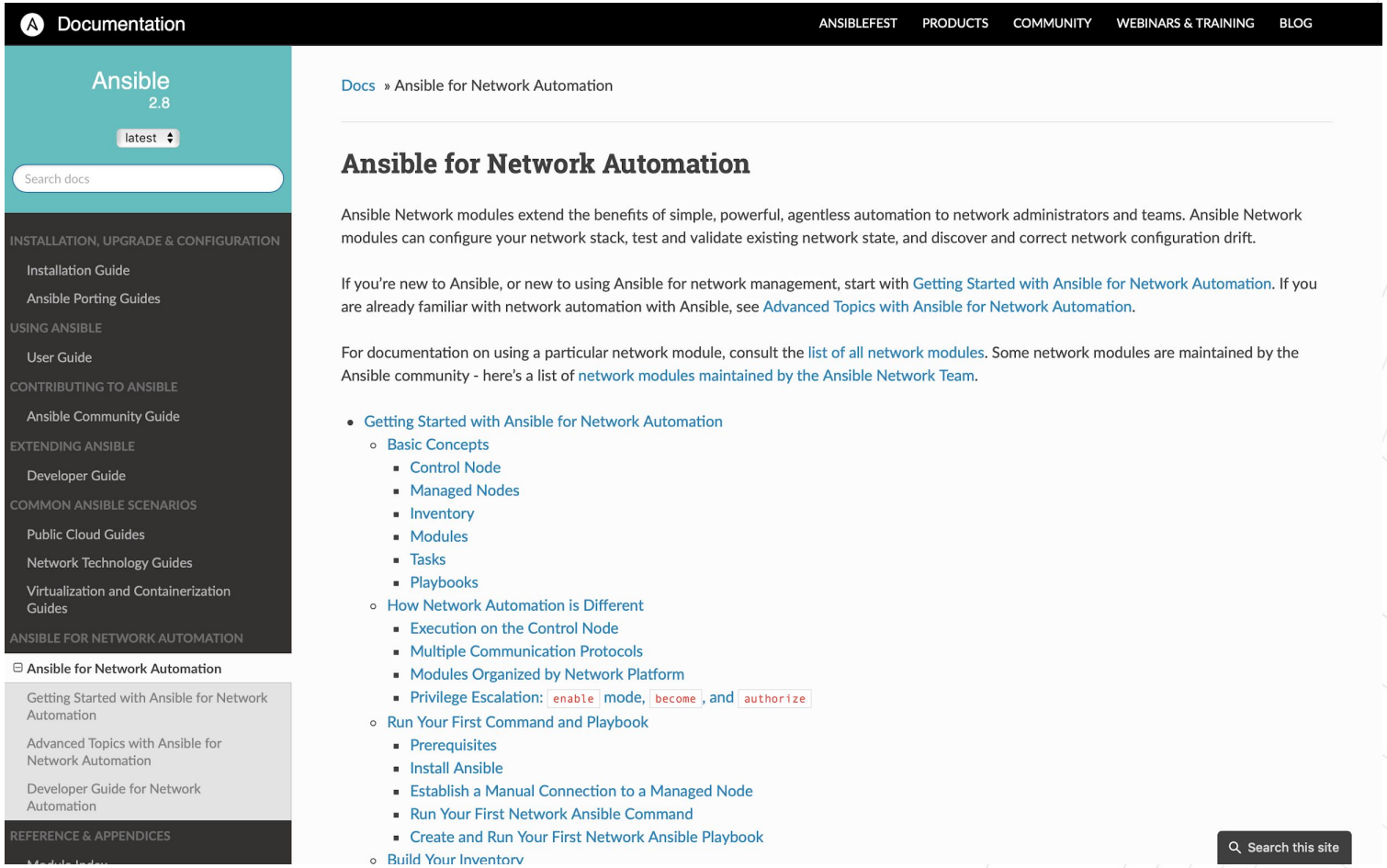
Section 3
Network Facts

Topics Covered:

- Ansible Documentation
- Facts for Network Devices
- The debug module

“Ansible for Network Automation” Documentation



red.ht/NetworkDocs

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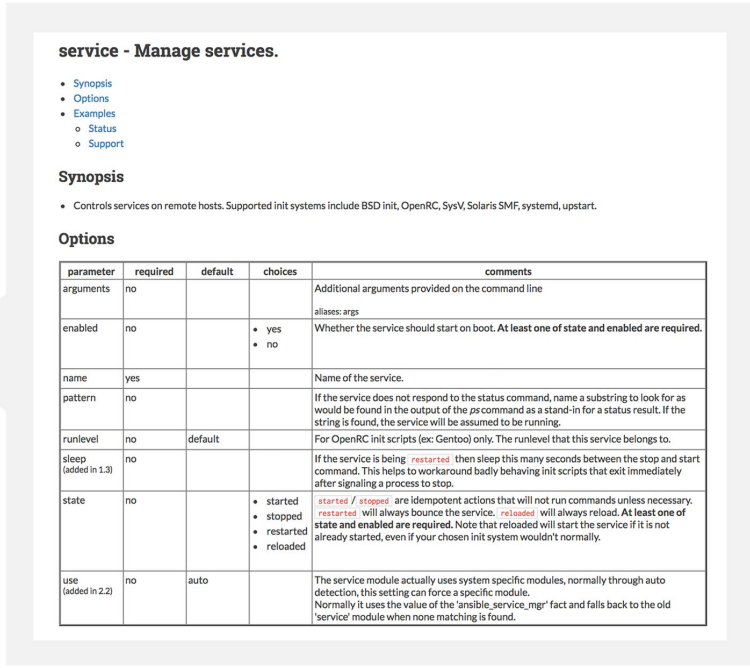
Module Documentation

- Documentation is required as part of module submission
- Multiple Examples for every module
- Broken into relevant sections

Docs » Module Index

Module Index

- All Modules
- Cloud Modules
- Clustering Modules
- Commands Modules
- Crypto Modules
- Database Modules
- Files Modules
- Identity Modules
- Inventory Modules
- Messaging Modules
- Monitoring Modules
- Network Modules
- Notification Modules
- Packaging Modules
- Remote Management Modules
- Source Control Modules
- Storage Modules
- System Modules
- Utilities Modules
- Web Infrastructure Modules
- Windows Modules



service - Manage services.

- Synopsis
- Options
- Examples
  - Status
  - Support

Synopsis

- Controls services on remote hosts. Supported init systems include BSD init, OpenRC, SysV, Solaris SMF, systemd, upstart.

Options

parameter	required	default	choices	comments
arguments	no			Additional arguments provided on the command line aliases: args
enabled	no		• yes • no	Whether the service should start on boot. **At least one of state and enabled are required.**
name	yes			Name of the service.
pattern	no			If the service does not respond to the status command, name a substring to look for as would be found in the output of the *ps* command as a stand-in for a status result. If the string is found, the service will be assumed to be running.
runlevel	no	default		For OpenRC init scripts (ex: Gentoo) only. The runlevel that this service belongs to.
sleep (added in 1.3)	no			If the service is being `restarted` then sleep this many seconds between the stop and start command. This helps to workaround badly behaving init scripts that exit immediately after signaling a process to stop.
state	no		• started • stopped • restarted • reloaded	`started` / `stopped` are idempotent actions that will not run commands unless necessary. `restarted` will always bounce the service. `reloaded` will always reload. **At least one of state and enabled are required.** Note that reloaded will start the service if it is not already started, even if your chosen init system wouldn't normally.
use (added in 2.2)	no	auto		The service module actually uses system specific modules, normally through auto detection, this setting can force a specific module. Normally it uses the value of the 'ansible_service_mgr' fact and falls back to the old 'service' module when none matching is found.

https://docs.ansible.com/

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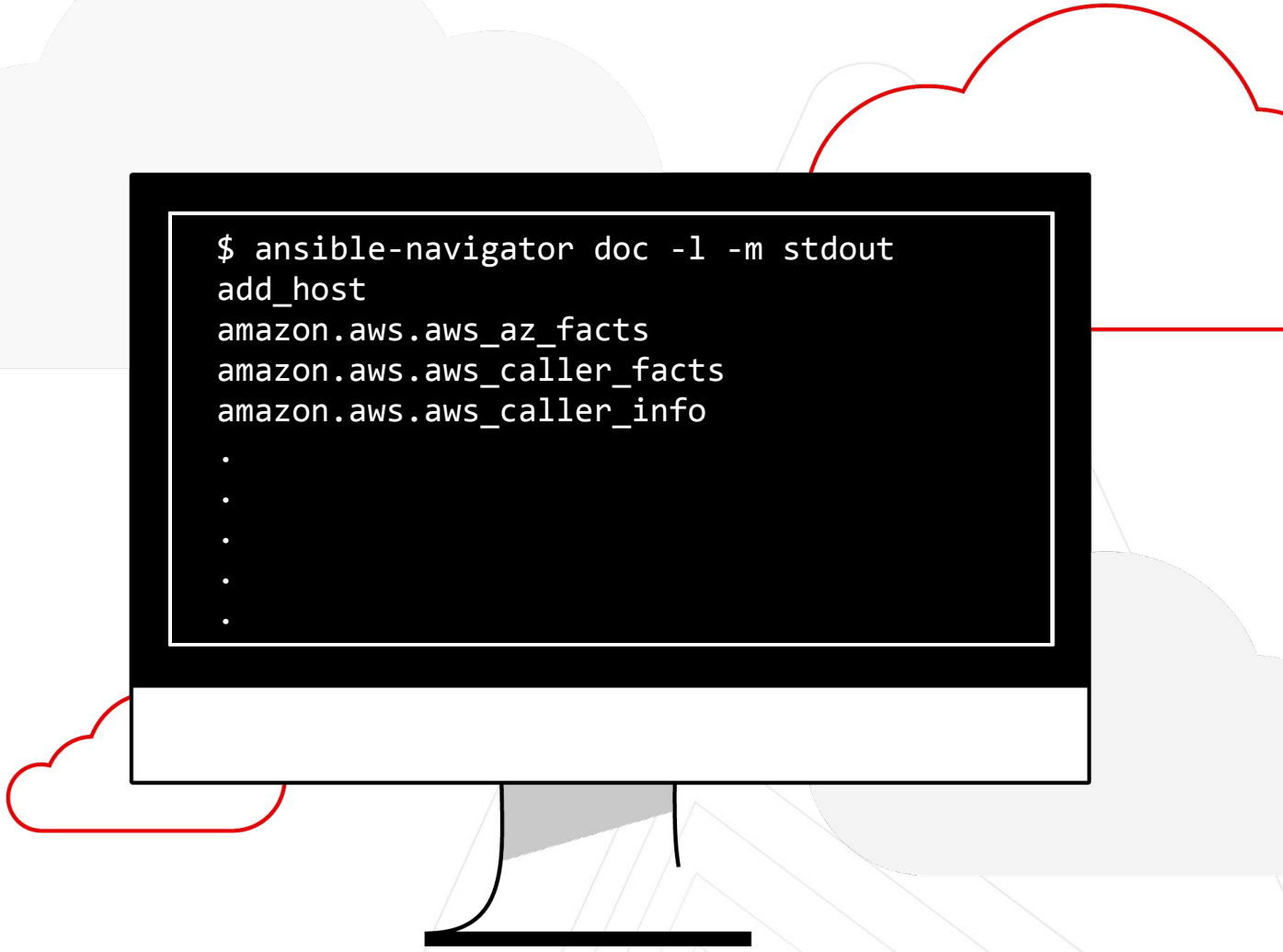
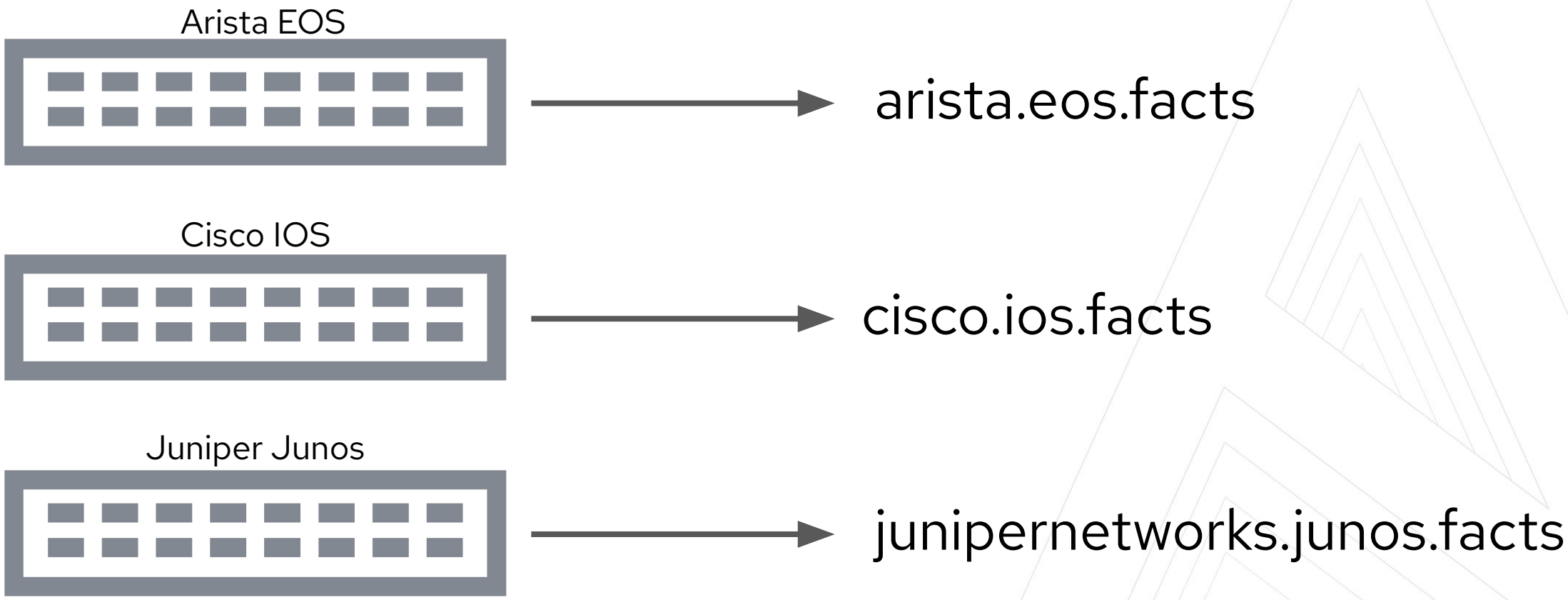
Accessing the Ansible docs

With the use of the latest command utility ansible-navigator, one can trigger access to all the modules available to them as well as details on specific modules.

A formal introduction to ansible-navigator and how it can be used to run playbooks in the following exercise.



Fact modules



What are facts?

Structured data, the Ansible way

```
cisco# show version
Cisco IOS XE Software, Version 16.09.02
Cisco IOS Software [Fuji], Virtual XE Software
(X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 16.9.2,
RELEASE SOFTWARE (fc4)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.



<<rest of output removed for slide brevity>>
```

Cisco IOS output

```
cisco# ansible -m ios_facts cisco
cisco | SUCCESS => {
    "ansible_facts": {
        "ansible_net_iostype": "IOS-XE",
        "ansible_net_version": "16.09.02",
        "ansible_net_serialnum": "9L8KQ482JFZ",
        "ansible_net_model": "CSR1000V",



<<rest of output removed for slide brevity>>
```

Ansible output

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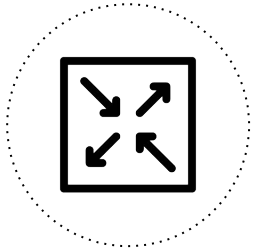
Ansible Automation Platform facts

Network automation begins and ends with **facts**



Network native configuration

Convert to structured data

```
"ansible_facts": {
  "ansible_net_iostype": "IOS-XE",
  "ansible_net_version": "16.09.02",
  "ansible_net_serialnum": "9L8KQ482JFZ",
  "ansible_net_model": "CSR1000V",

<<rest of output removed for brevity>>
```

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Displaying output - The “debug” module

The **debug** module is used like a "print" statement in most programming languages. Variables are accessed using "{{ }}" - quoted curly braces

```
- name: display version
  debug:
    msg: "The IOS version is: {{ ansible_net_version }}"

- name: display serial number
  debug:
    msg: "The serial number is: {{ ansible_net_serialnum }}"
```

Working with Ansible facts

1. Gather facts

```yaml
- name: gather eos facts
  arista.eos.facts:
    gather_subset: config
    gather_network_resources: vlans
```

2. Use facts

```yaml
- name: print out vlans
  debug:
    var: ansible_network_resources.vlans
```

or

```yaml
- name: gather eos facts
  arista.eos.vlans:
    state: gathered
  registered: vlanfacts
```

```yaml
- name: print out vlans
  debug:
    var: vlanfacts
```

Simple and common approach

Arista EOS

```
---
- name: retrieve eos facts
  arista.eos.facts:
   gather_subset: config
   gather_network_resources: all
```

Cisco IOS-XE

```
---
- name: retrieve ios facts
  cisco.ios.facts:
   gather_subset: config
   gather_network_resources: all
```

Juniper Junos

```
---
- name: retrieve junos facts
  junipernetworks.junos.facts:
   gather_subset: config
   gather_network_resources: all
```

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Working with Ansible facts

2. Use facts

```
- name: print out vlans
  debug:
    var: ansible_network_resources.vlans
```

or

```
- name: print out vlans
  debug:
    var: vlanfacts
```

3 Displayed Results

```
- name: dmz
  state: active
  vlan_id: 5
- name: voip
  state: active
  vlan_id: 10
- name: desktop
  state: active
  vlan_id: 30
```

playbook

terminal output window

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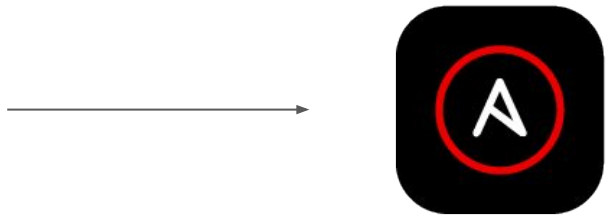
Running the Ansible Playbook with verbosity

```
$ ansible-navigator run facts.yml --mode stdout

PLAY [gather information from routers] *****************************************

TASK [gather router facts] *****************************************************
ok: [rtr1]

TASK [display version] *********************************************************
ok: [rtr1] =>
  msg: 'The IOS version is: 16.09.02'

TASK [display serial number] ***************************************************
ok: [rtr1] =>
  msg: The serial number is: 964A1H0D1RM

PLAY RECAP *********************************************************************
rtr1        : ok=3    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

Structured data is malleable

Create customized network reports

```
ansible_facts:
  ansible_net_api: cliconf
  ansible_net_fqdn: rtr2
  ansible_net_gather_network_resources:
  - interfaces
  ansible_net_gather_subset:
  - default
  ansible_net_hostname: rtr2
  ansible_net_image: flash:EOS.swi
  ansible_net_model: vEOS
  ansible_net_python_version: 2.7.5
  ansible_net_serialnum:
D00E130991A37B49F970714D8CCF7FCB
  ansible_net_system: eos
  ansible_net_version: 4.22.0F
  ansible_network_resources:
    interfaces:
    - enabled: true
      name: Ethernet1
    - enabled: true
      name: Loopback0
<<rest of output removed for slide
brevity>>
```



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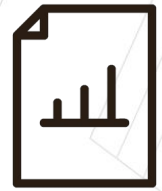

Customized Report

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Build reports with Ansible Facts

Hostname	Model Type	Mgmt0 IP Address	Code Version
n9k	Nexus9000 9000v Chassis	192.168.2.3	7.0(3)I7(1)
n9k2	Nexus9000 9000v Chassis	192.168.2.4	7.0(3)I7(1)
n9k3	Nexus9000 9000v Chassis	192.168.2.5	7.0(3)I7(1)
n9k4	Nexus9000 9000v Chassis	192.168.2.6	7.0(2)I7(1)
n9k5	Nexus9000 9000v Chassis	192.168.2.7	7.0(3)I7(1)
n9k6	Nexus9000 9000v Chassis	192.168.2.8	7.0(3)I7(1)

Lab Time

Exercise 3 - Ansible Facts

red.ht/network-workshop-3

Demonstration use of Ansible facts on network infrastructure.

Approximate time: 15 mins

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Section 4
Resource Modules

Topics Covered:

- Resource modules
- state: merged
- state: gathered

Network Automation Modules

How do we interact with network devices?

command		run arbitrary commands
facts		retrieve information
config		generic catch-all configuration and templating
resource		read and configure specific network resources

Network Automation Modules

How do we interact with network devices?

command

namespace.collection.**command**
Cisco IOS -> `cisco.ios.command`

facts

namespace.collection.**facts**
Arista EOS -> `arista.eos.facts`

config

namespace.collection.**config**
Juniper Junos-> `junipernetworks.junos.config`

resource

namespace.collection.**module**
Cisco IOS-XR-> cisco.iosxr.acls

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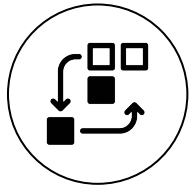
Network resource modules

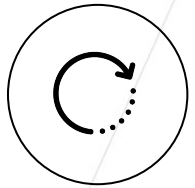
Managing device state across different devices and types

Configuration to code



Built-in logic with commands and orchestration

Vendor-agnostic data model



Bidirectional with configuration to facts and facts to configuration

Lab Time

Exercise 4 - Ansible Network Resource Modules

red.ht/network-workshop-4

This exercise will cover configuring VLANs on Arista EOS by building an Ansible Playbook using the arista.eos.vlans module.

Approximate time: 15 mins

Section 5
Automation controller

Topics Covered:

- What is Automation controller?
- Enterprise Features

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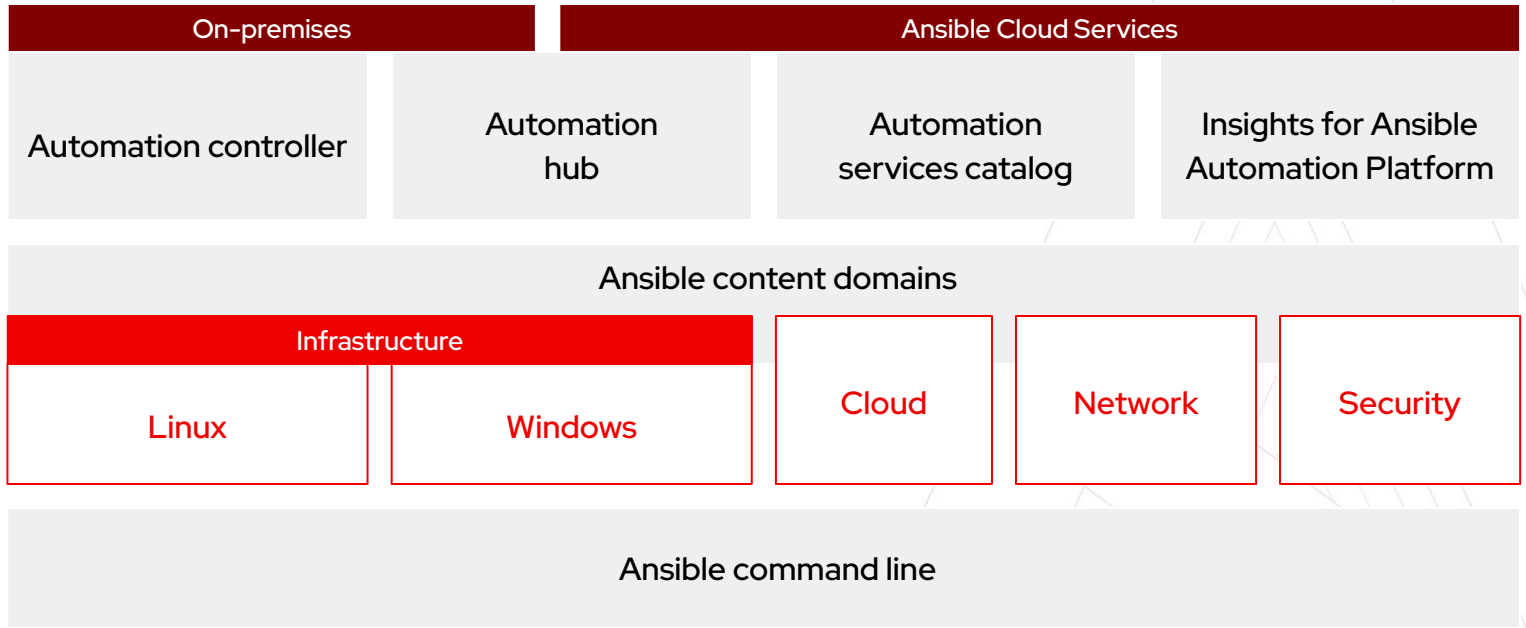
- Content creators
- Operators
- Domain experts
- Users



Fueled by an open source community

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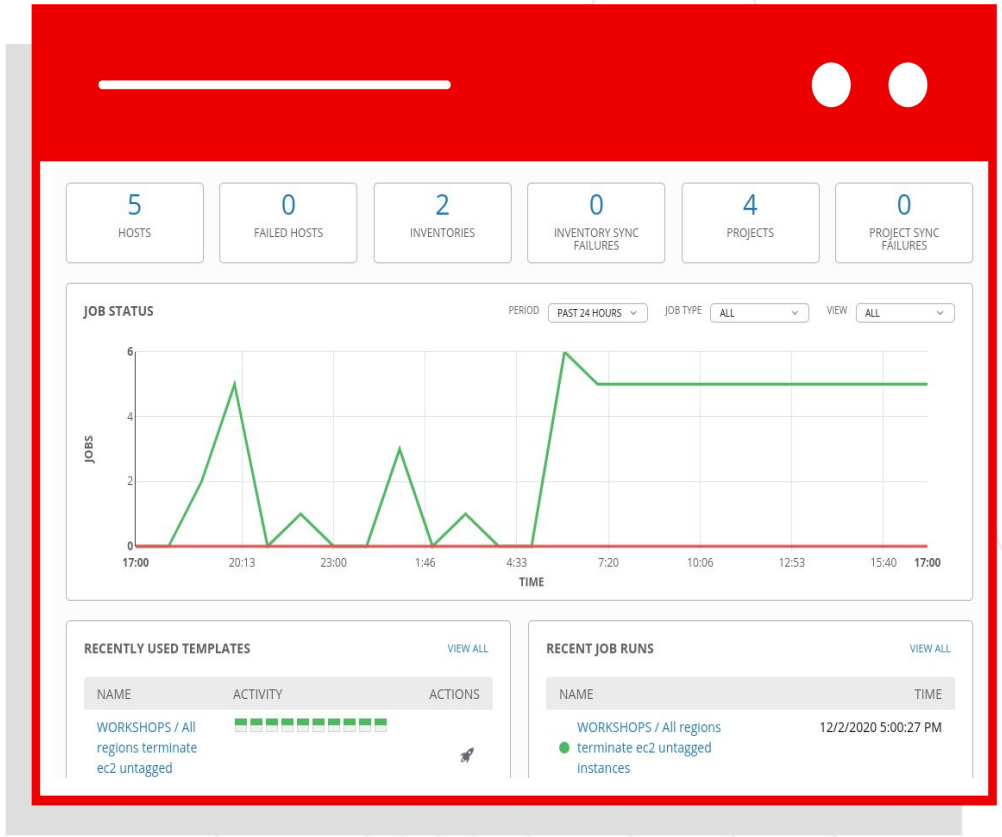
What is Ansible Automation Controller?

Ansible Automation Controller is a UI and RESTful API allowing you to scale IT automation, manage complex deployments and speed productivity.

- Role-based access control
- Deploy entire applications with push-button deployment access
- All automations are centrally logged
- Powerful workflows match your IT processes



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Automation controller

Push button

An intuitive user interface experience makes it easy for novice users to execute playbooks you allow them access to.

RESTful API

With an API first mentality every feature and function of controller can be API driven. Allow seamless integration with other tools like ServiceNow and Infoblox.

RBAC

Allow restricting playbook access to authorized users. One team can use playbooks in check mode (read-only) while others have full administrative abilities.

Enterprise integrations

Integrate with enterprise authentication like TACACS+, RADIUS, Azure AD. Setup token authentication with OAuth 2. Setup notifications with PagerDuty, Slack and Twilio.

Centralized logging

All automation activity is securely logged. Who ran it, how they customized it, what it did, where it happened - all securely stored and viewable later, or exported through Automation controllers API.

Workflows

Automation controller's multi-playbook workflows chain any number of playbooks, regardless of whether they use different inventories, run as different users, run at once or utilize different credentials.

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Lab Time

Exercise 5: Explore Automation controller

red.ht/network-workshop-5

Explore and understand the Automation controller lab environment.

Approximate time: 15 mins

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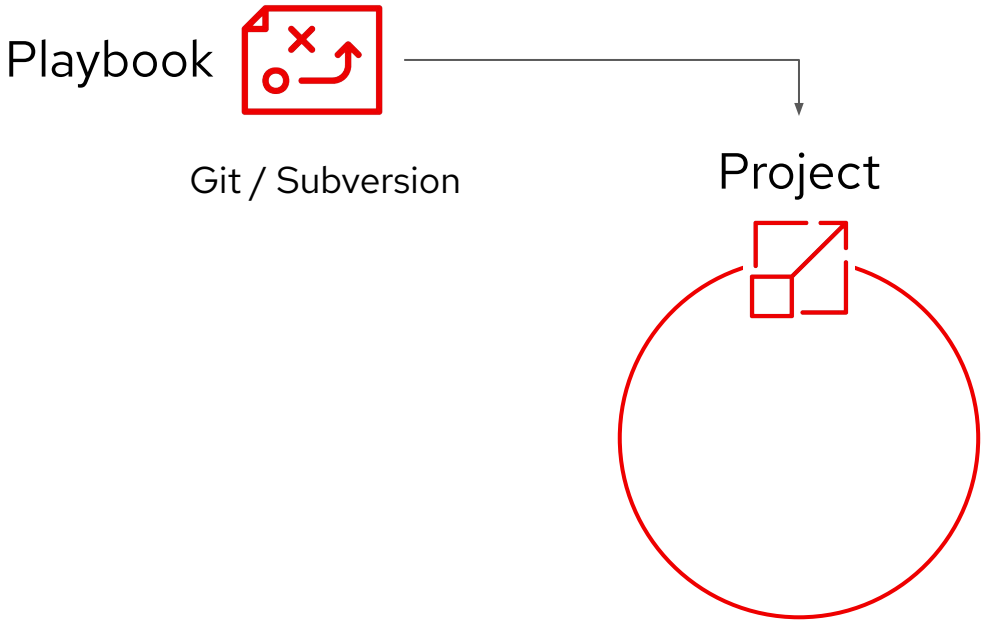
Section 6
Job Templates

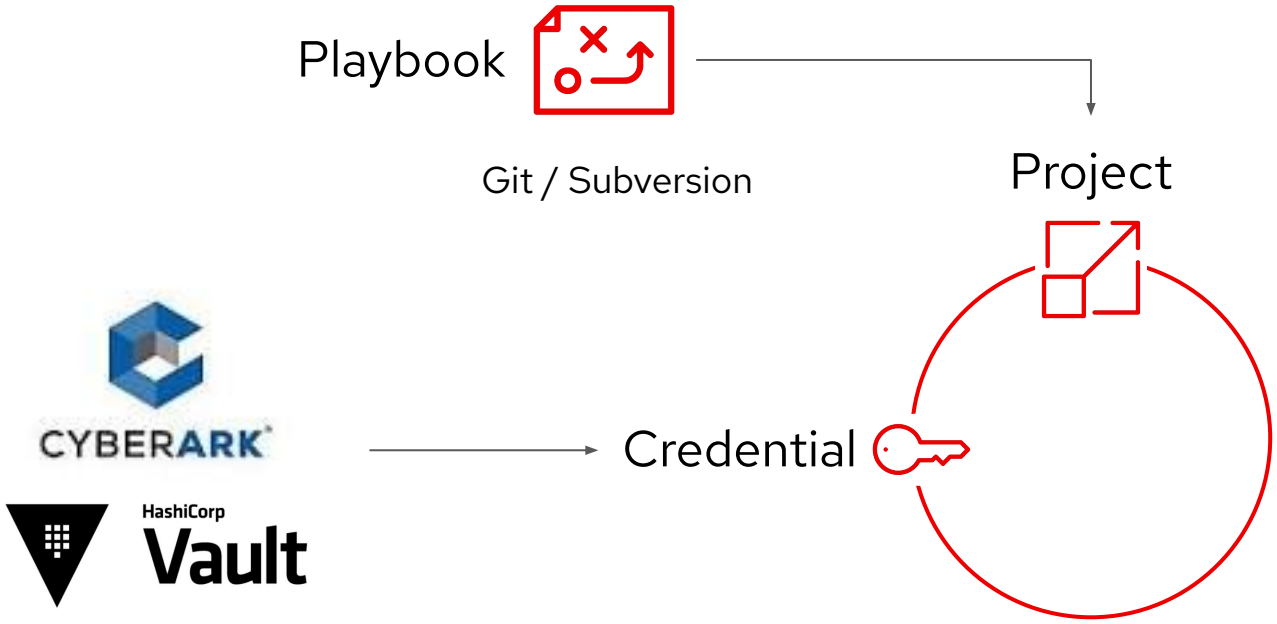
Topics Covered:

- Job Templates
  - Inventory
  - Credentials
  - Projects

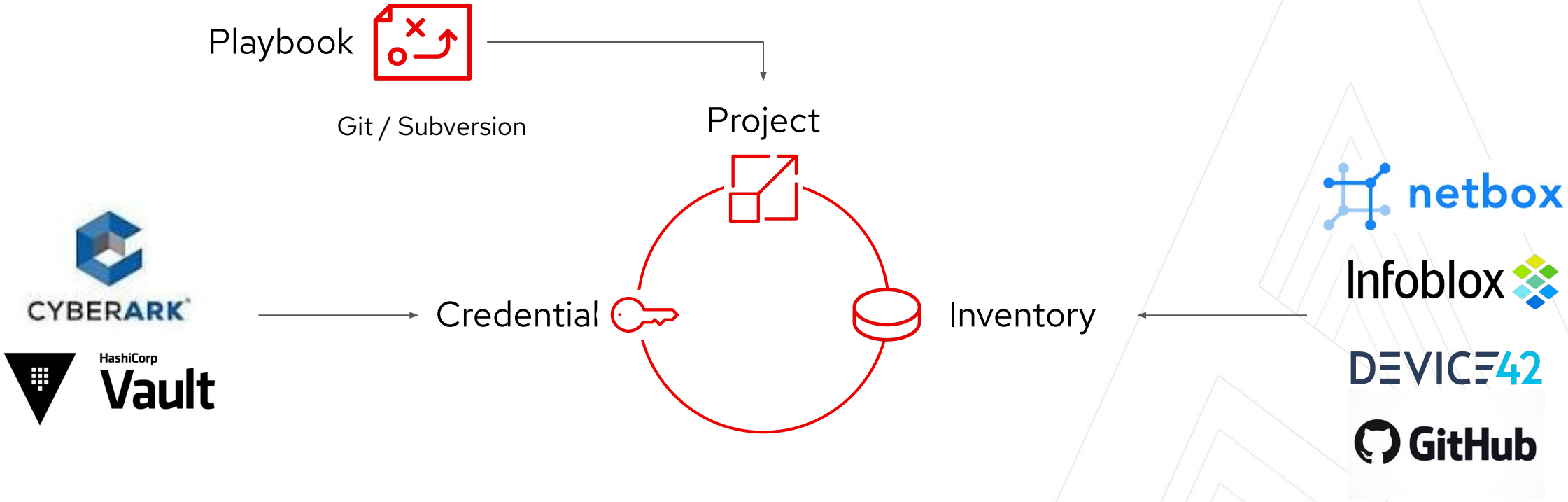
Anatomy of an Automation Job



Anatomy of an Automation Job



Anatomy of an Automation Job



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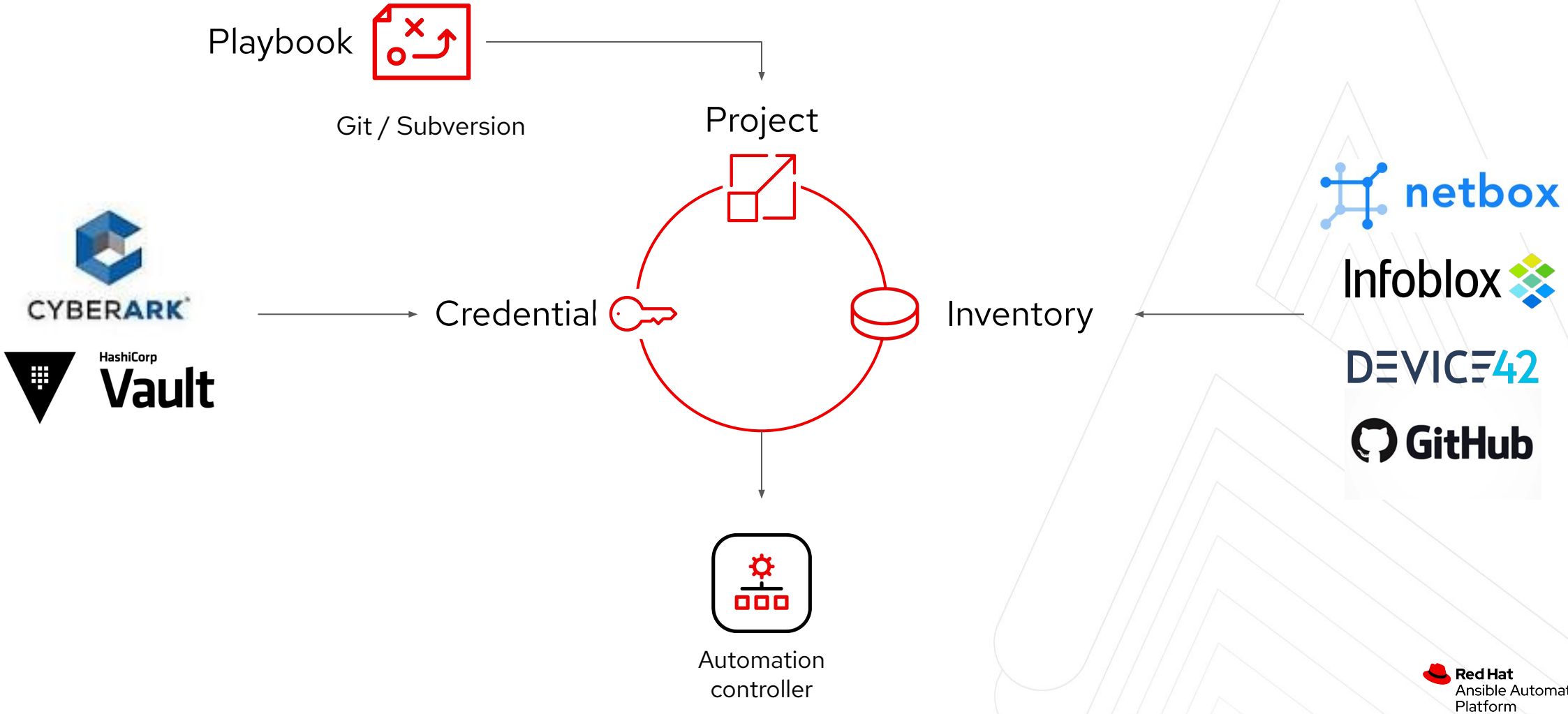
Anatomy of an Automation Job



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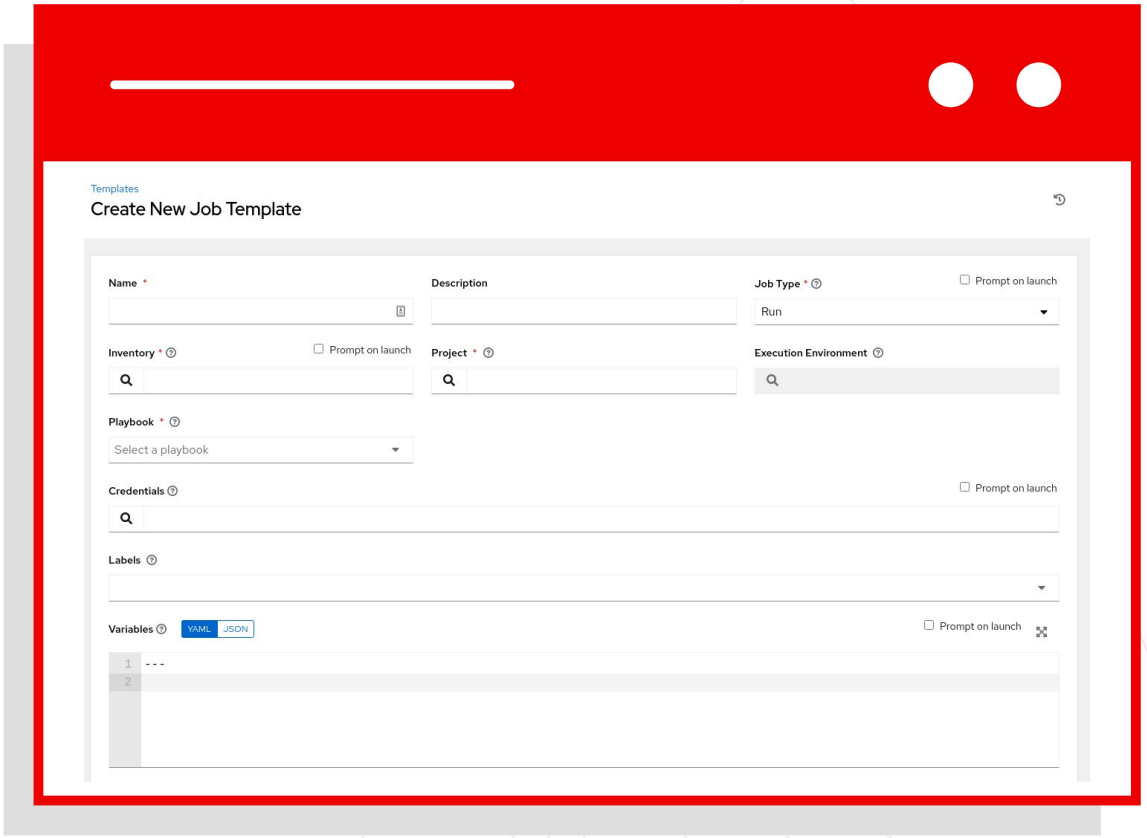
Job Templates

Everything in Automation Controller revolves around the concept of a **Job Template**. Job Templates allow Ansible Playbooks to be controlled, delegated and scaled for an organization.

Job templates also encourage the reuse of Ansible Playbook content and collaboration between teams.

A **Job Template** requires:

- A **Project** which contains Ansible Playbooks
- An **Inventory** to run the job against
- A **Credential** to login to devices.



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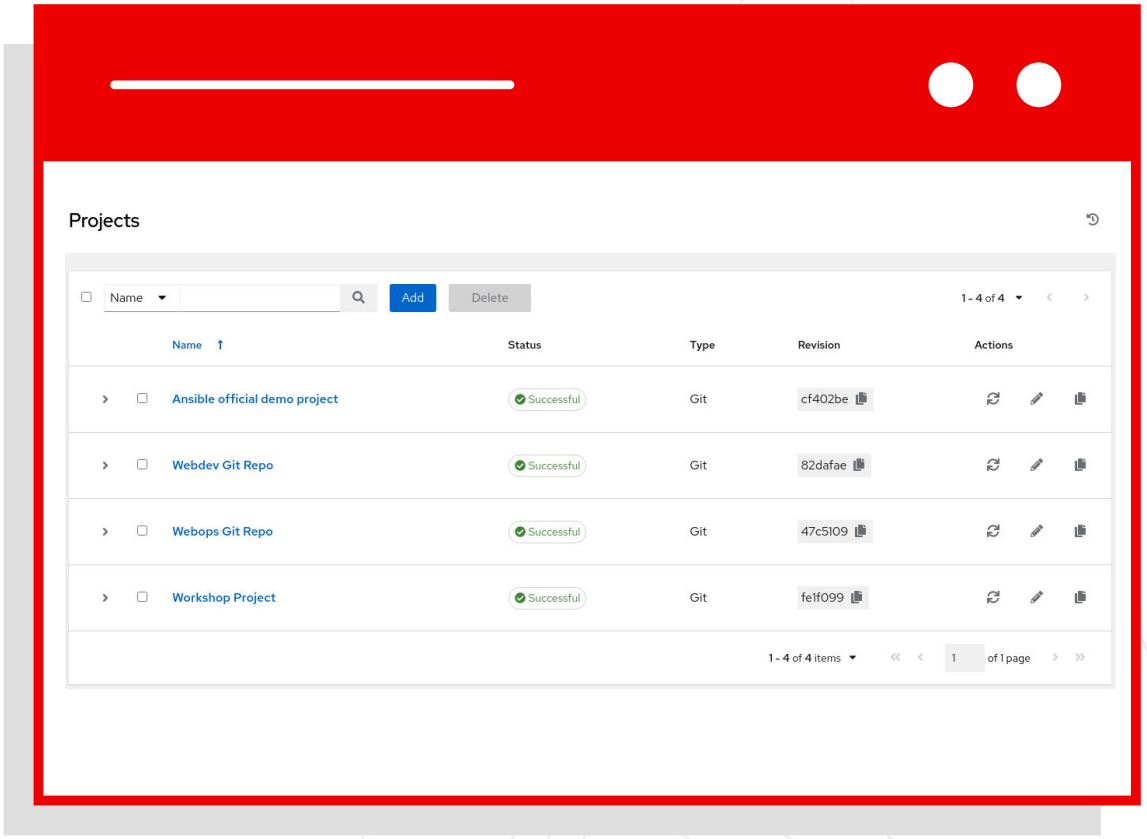
Project

A project is a logical collection of Ansible Playbooks, represented in Ansible Automation Controller.

You can manage Ansible Playbooks and playbook directories by placing them in a source code management system supported by Automation controller including Git, and Subversion.



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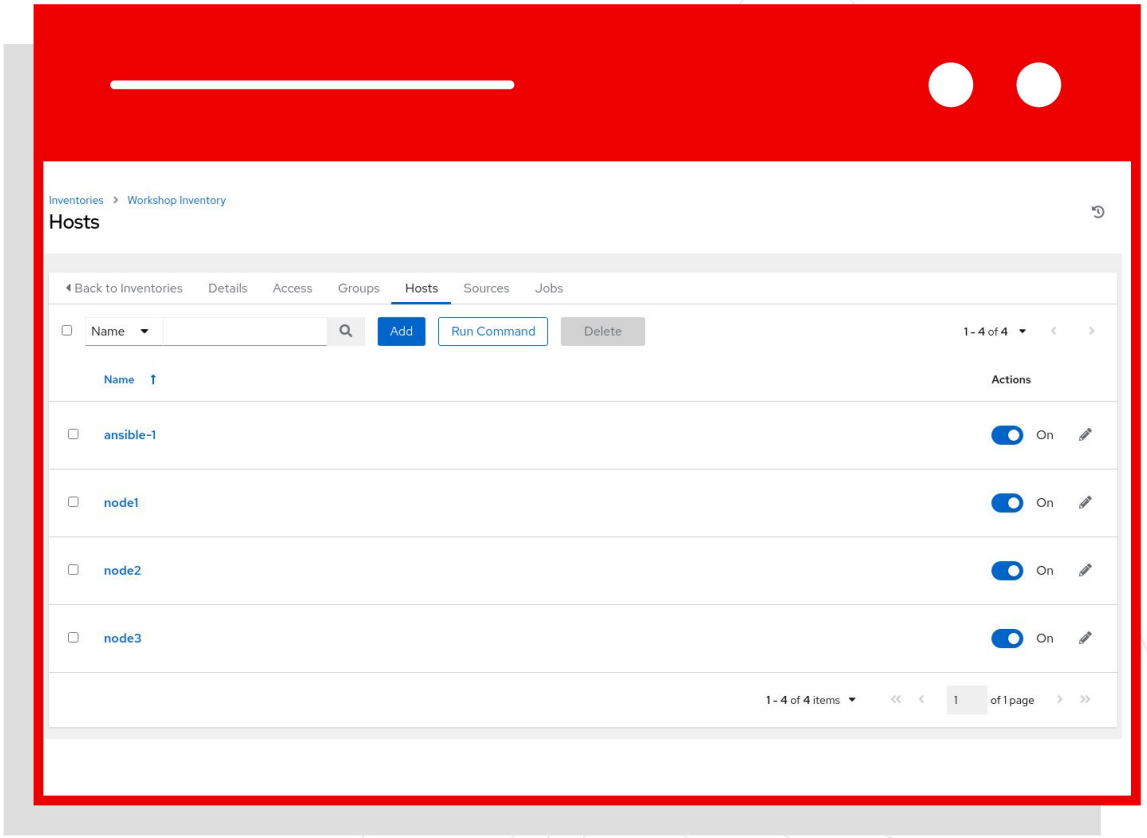
Inventory

Inventory is a collection of hosts (nodes) with associated data and groupings that Automation Controller can connect to and manage.

- Hosts (nodes)
- Groups
- Inventory-specific data (variables)
- Static or dynamic sources



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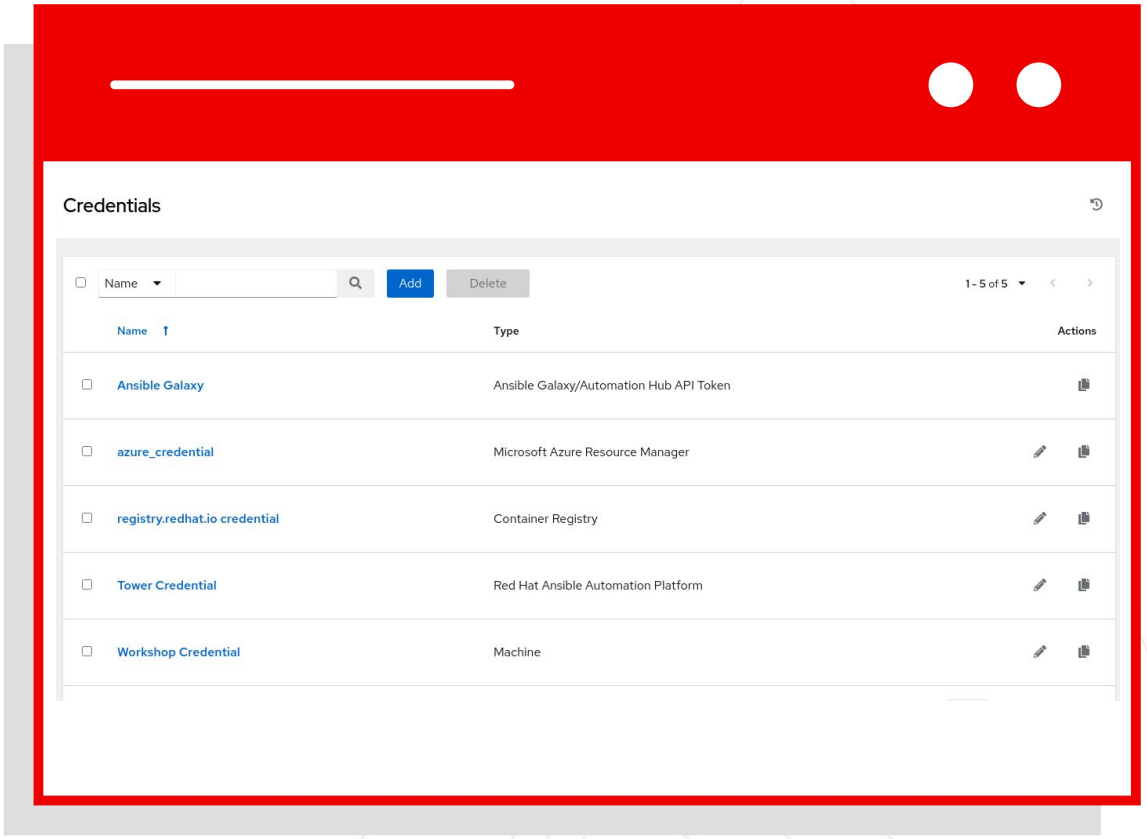
Credentials

Credentials are utilized by Automation Controller for authentication with various external resources:

- Connecting to remote machines to run jobs
- Syncing with inventory sources
- Importing project content from version control systems
- Connecting to and managing network devices

Centralized management of various credentials allows end users to leverage a secret without ever exposing that secret to them.



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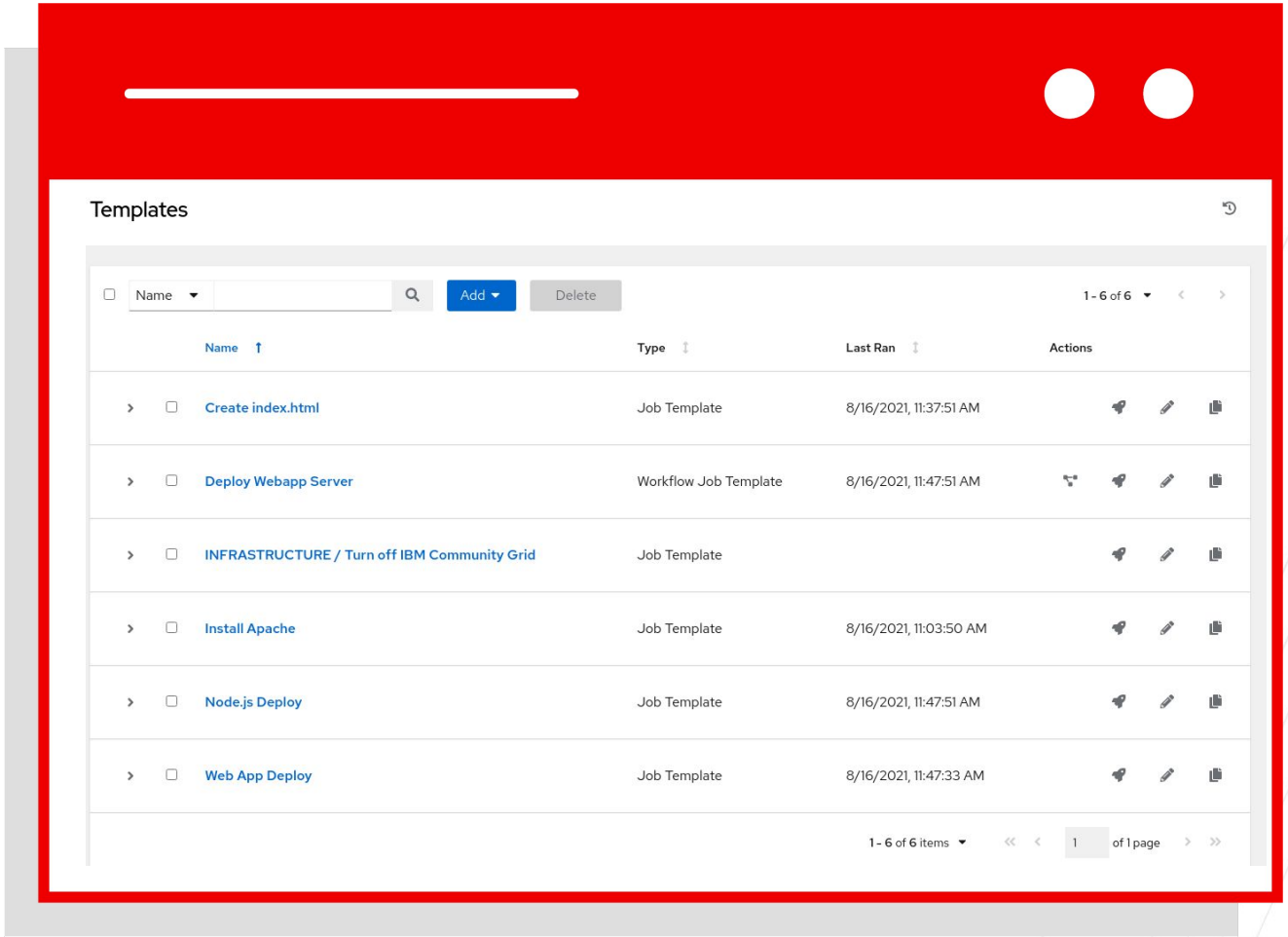
Expanding on Job Templates

Job Templates can be found and created by clicking the **Templates** button under the *Resources* section on the left menu.



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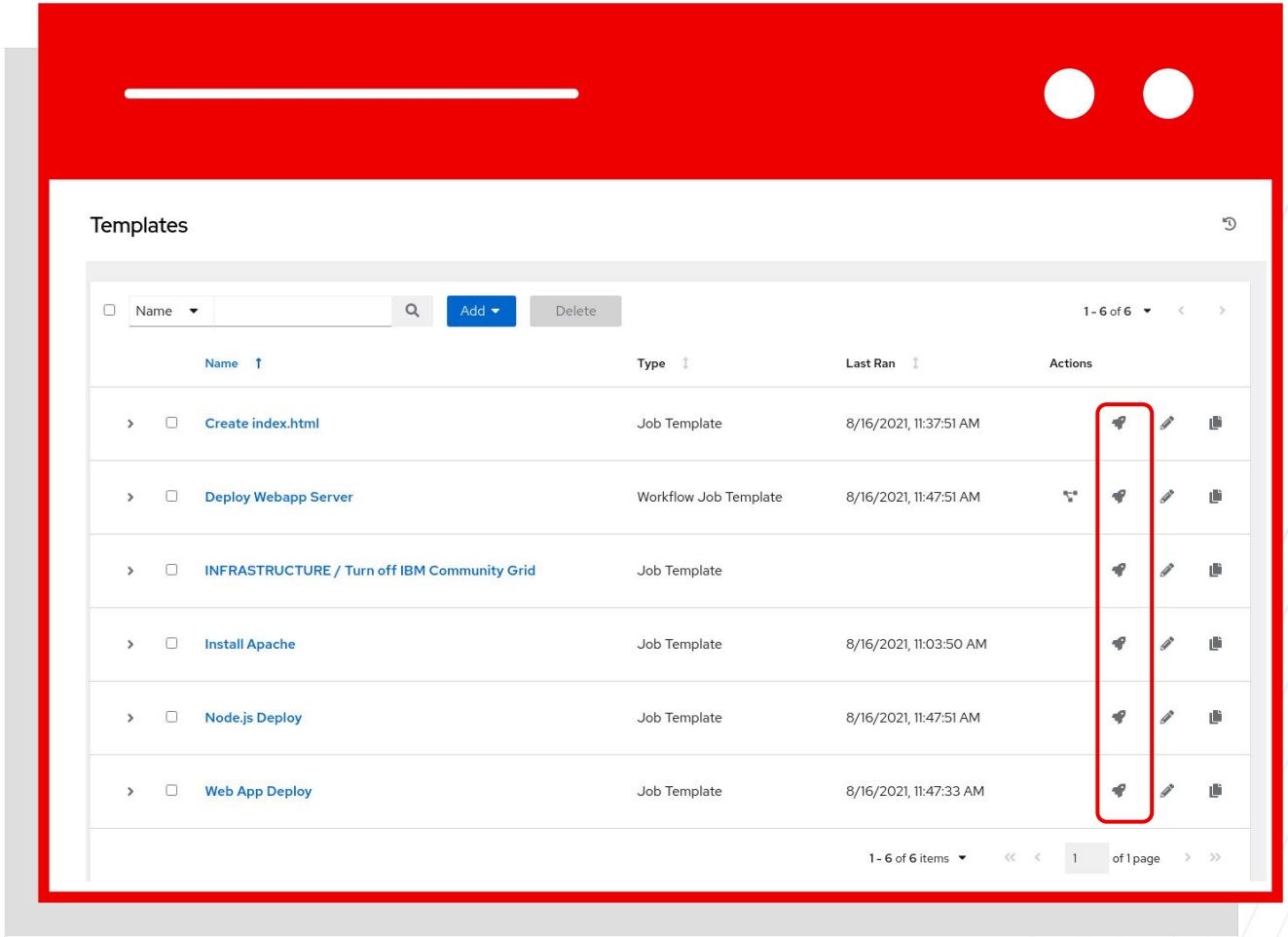
Executing an existing Job Template

Job Templates can be launched by clicking the **rocketship button** for the corresponding Job Template



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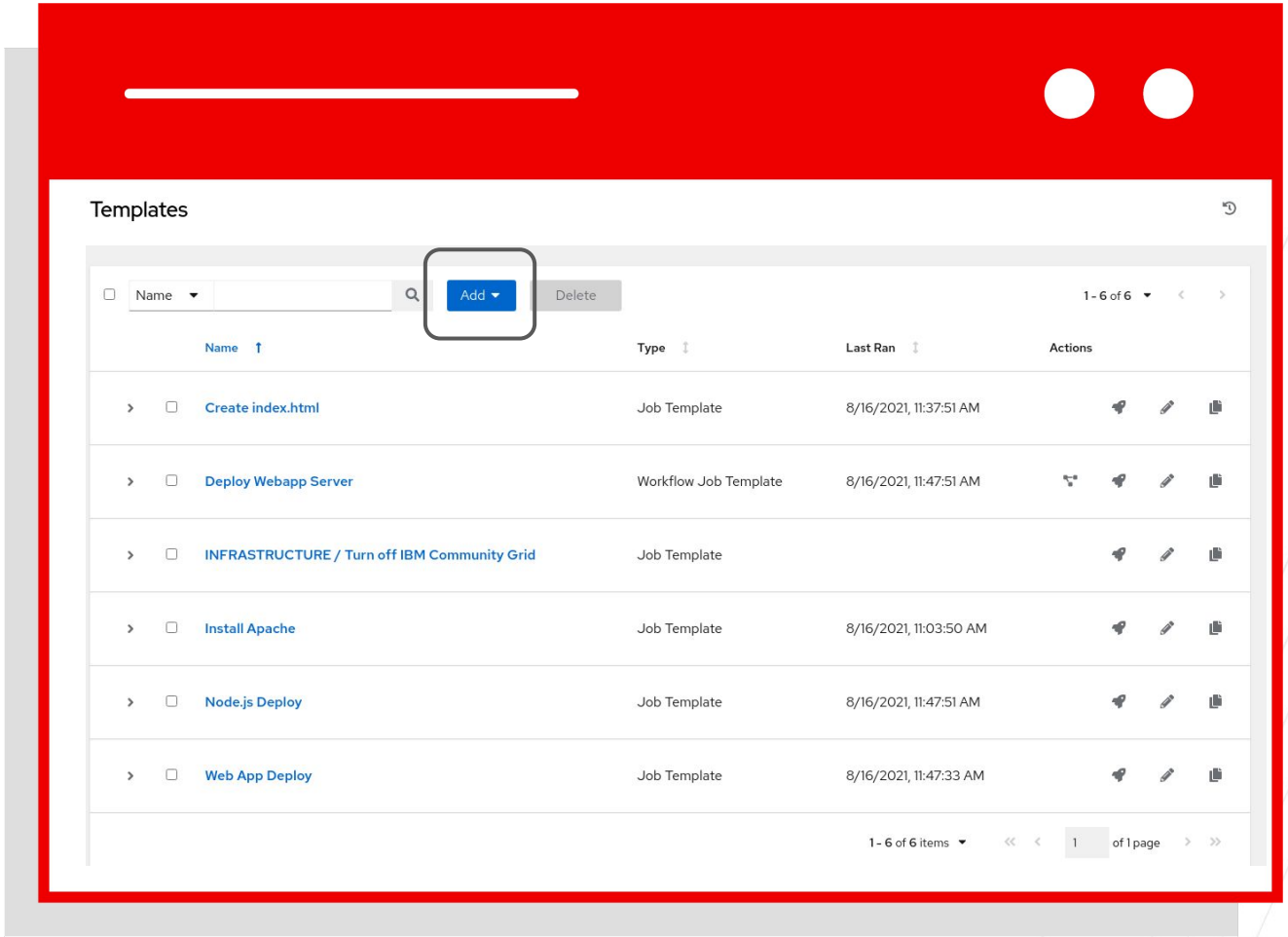
Creating a new Job Template (1/2)

New Job Templates can be created by clicking the **Add button**



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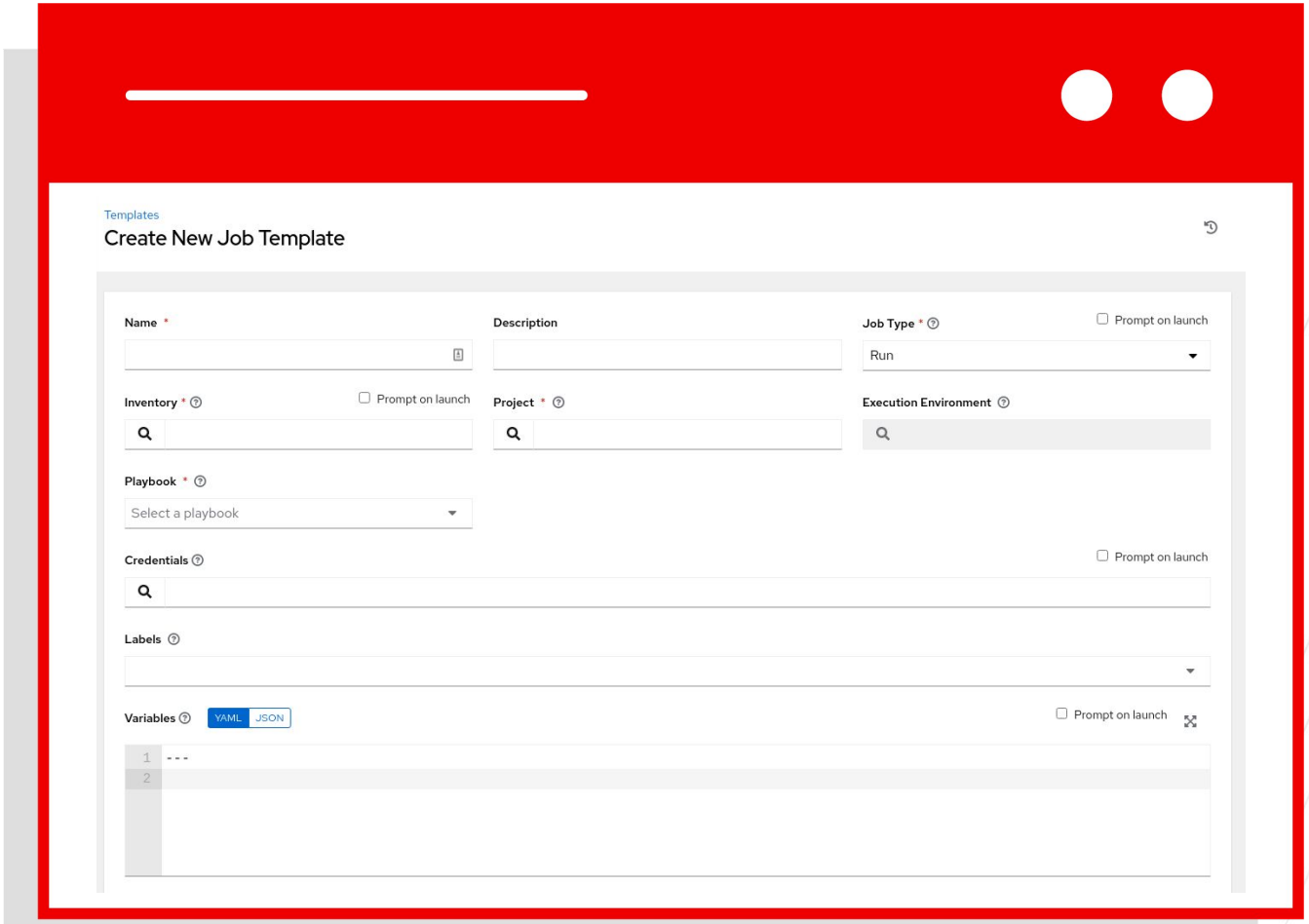
Creating a new Job Template (2/2)

This **New Job Template** window is where the inventory, project and credential are assigned. The red asterisk * means the field is required .



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Lab Time

Exercise 6: Creating an Automation controller Job Template

red.ht/network-workshop-6

Demonstrate a network backup configuration job template with Automation controller.

Approximate time: 15 mins

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Section 7
Survey

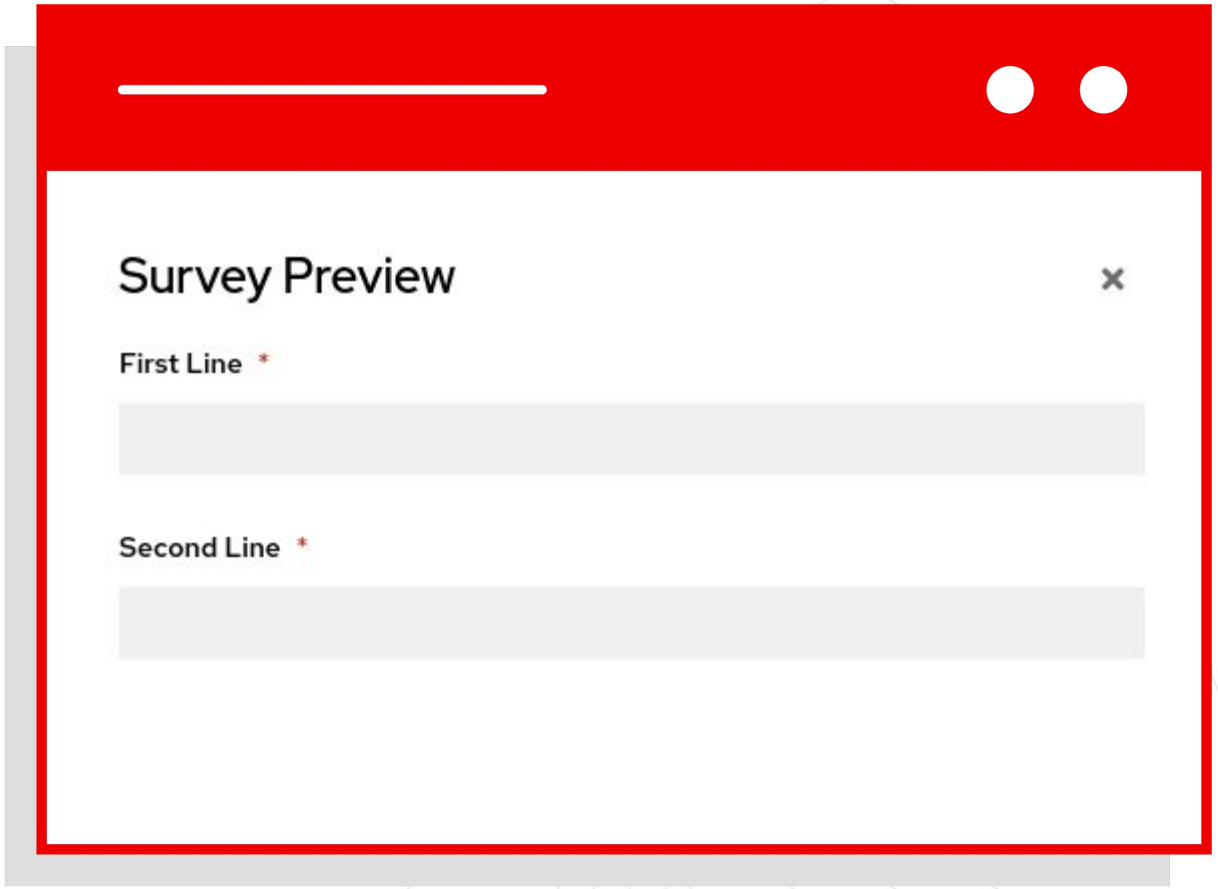
Topics Covered:

- Understanding Extra Vars
- Building a Survey
- Self-service IT with Surveys

Surveys

Controller surveys allow you to configure how a job runs via a series of questions, making it simple to customize your jobs in a user-friendly way.

An Ansible Controller survey is a simple question-and-answer form that allows users to customize their job runs. Combine that with Controller's role-based access control, and you can build simple, easy self-service for your users.



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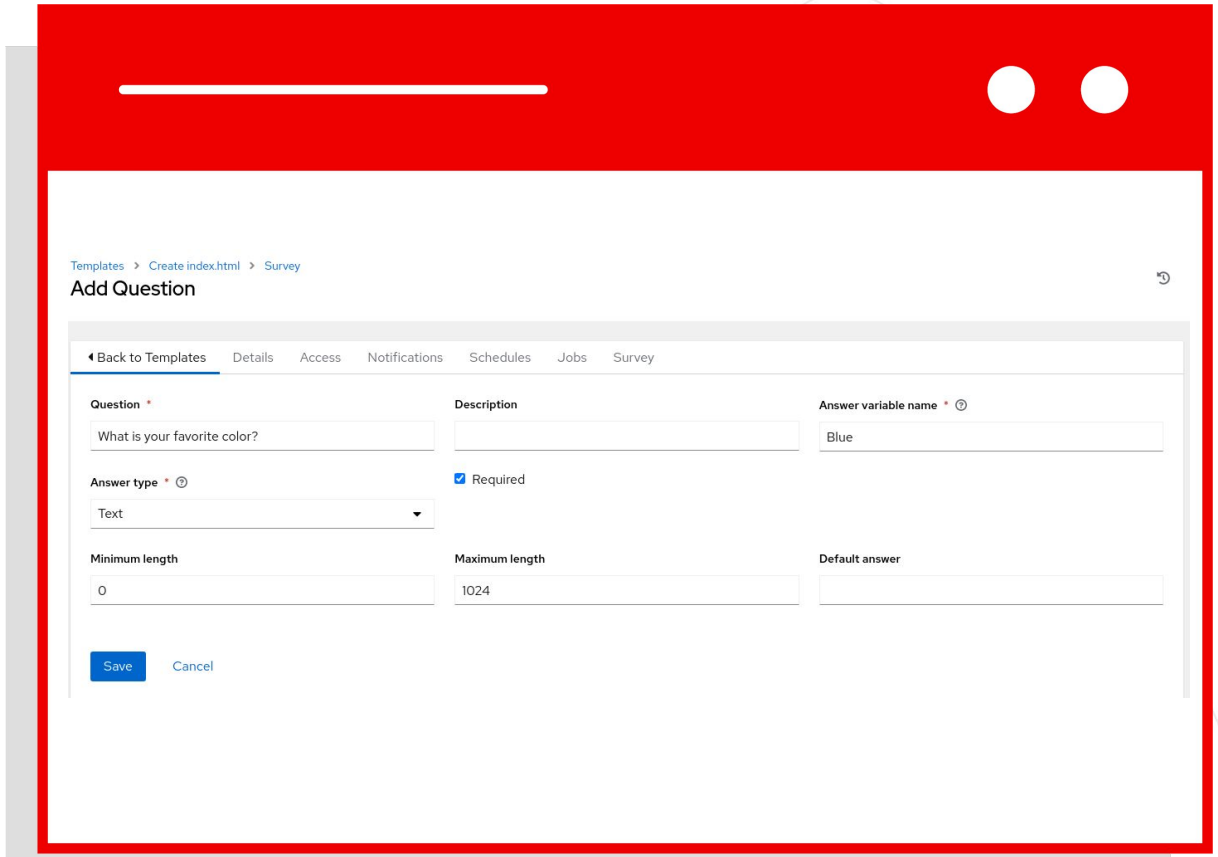
Creating a Survey (1/2)

Once a job template is saved, the survey menu will have an **Add** button

Click the button to open the **Add Survey** window.



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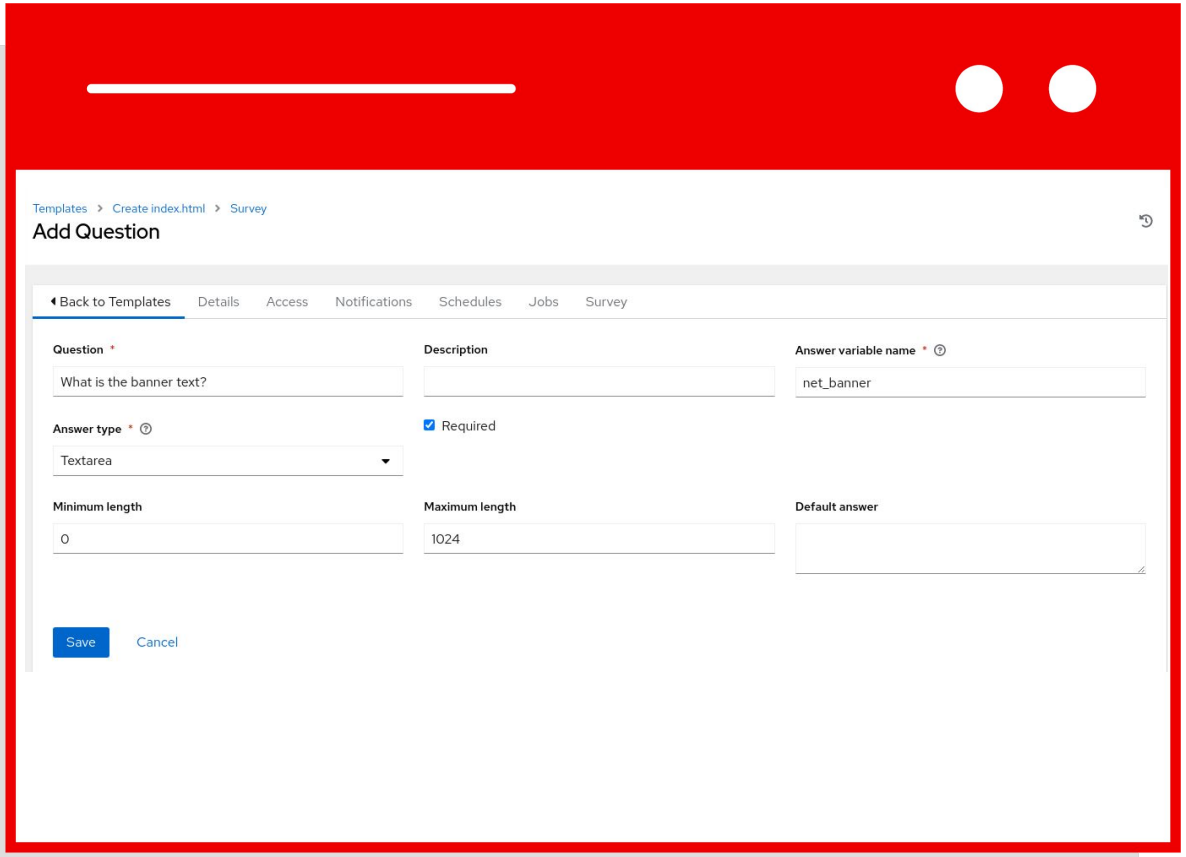
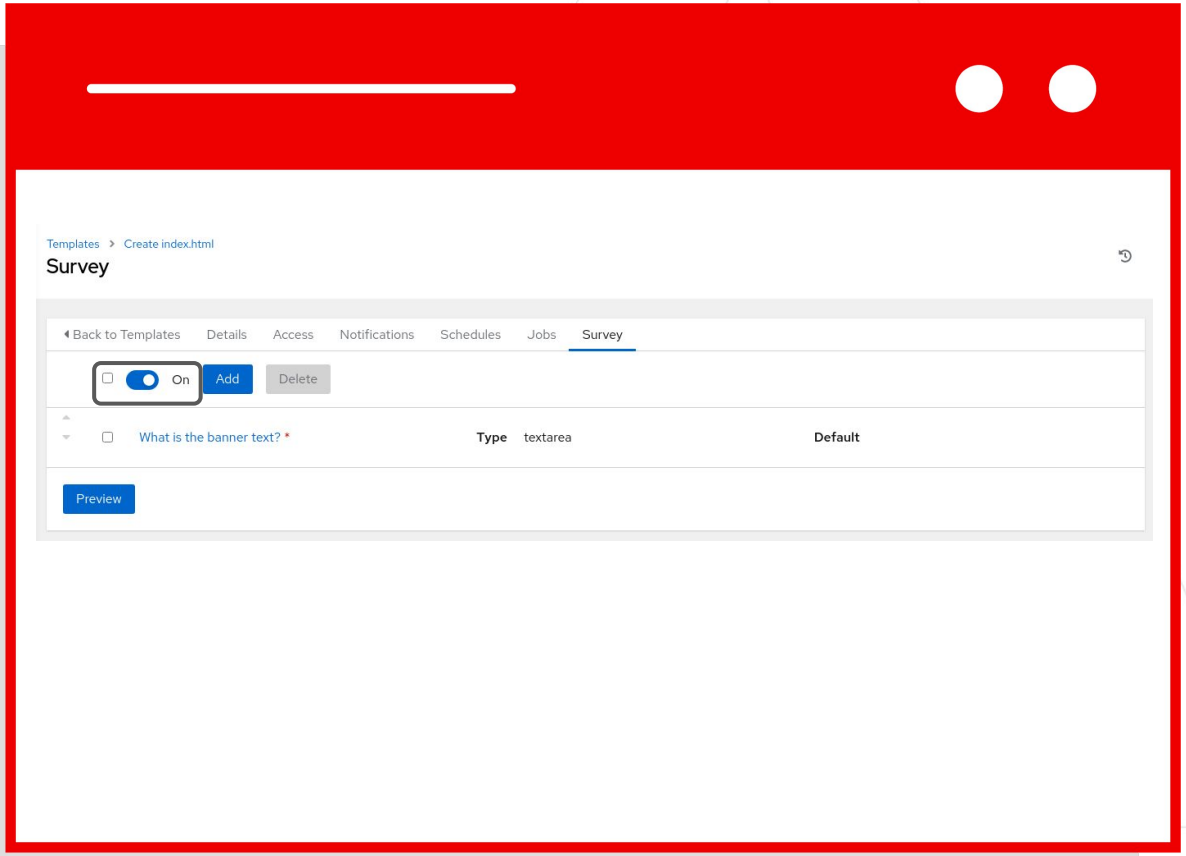
Creating a Survey (2/2)

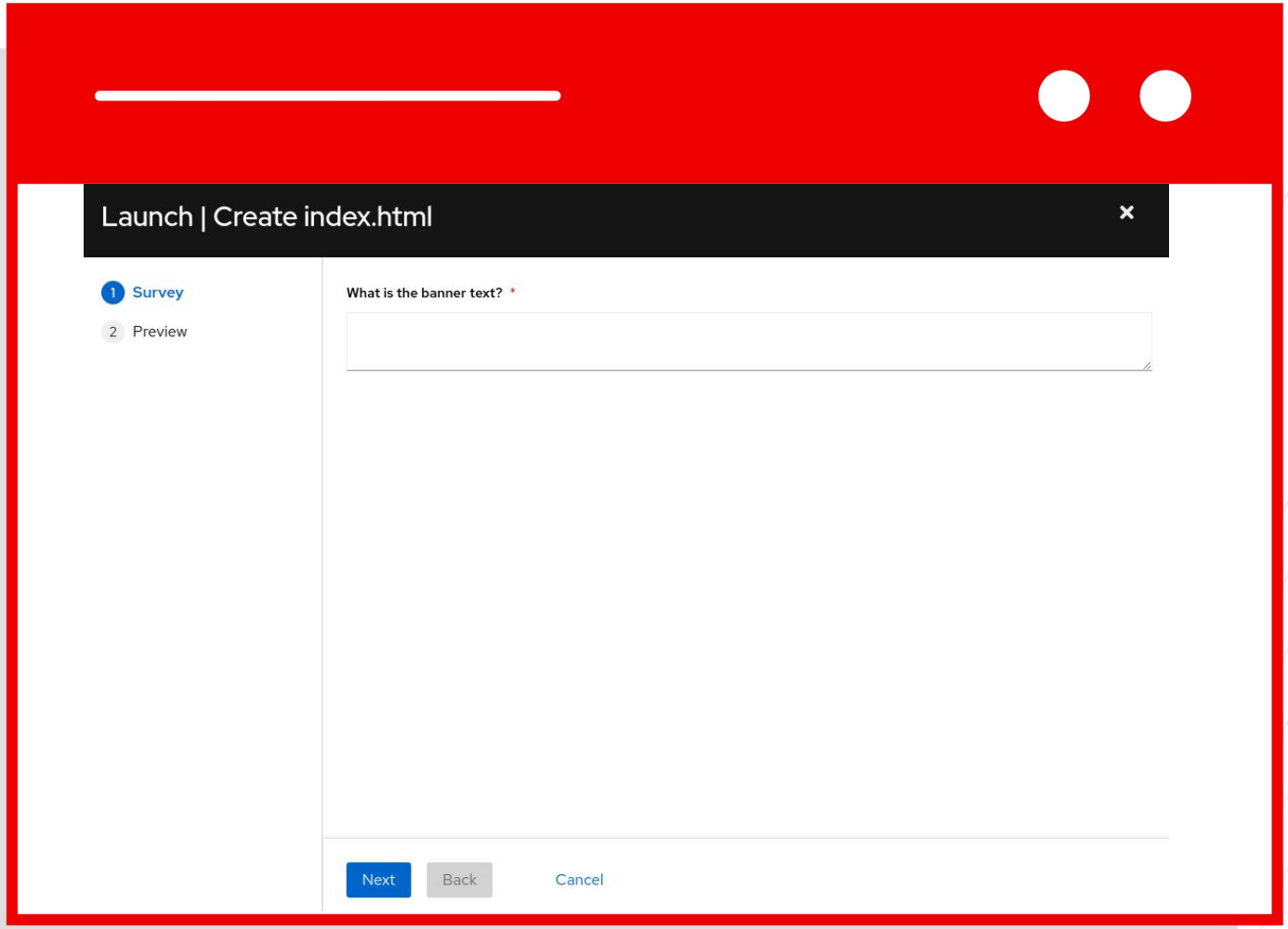
The **Add Survey** window allows the job template to prompt users for one or more questions. The answers provided become variables for use in the Ansible Playbook.





Using a Survey

When launching a job, the user will now be prompted with the survey. The user can be required to fill out the survey before the job template will execute.



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Lab Time

Exercise 7: Creating a Survey

red.ht/network-workshop-7

Demonstrate the use of Automation controller survey feature.

Approximate time: 15 mins

Section 8
RBAC

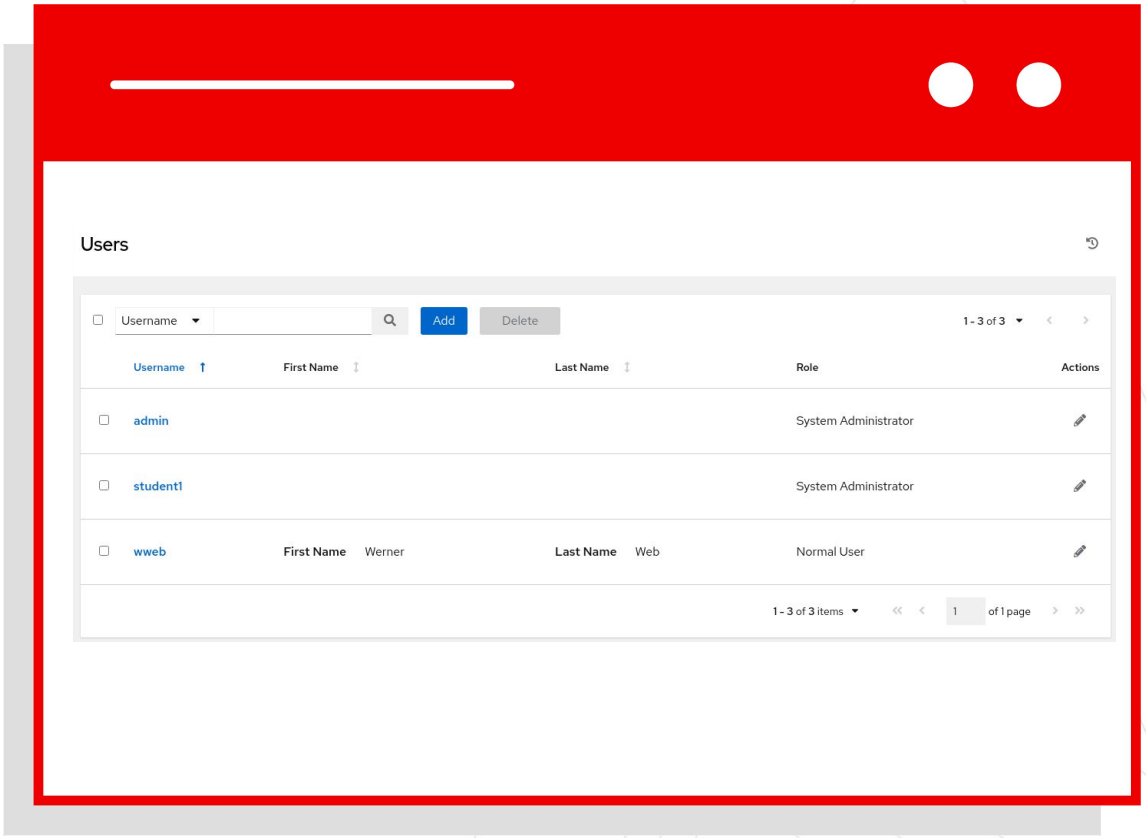
Topics Covered:

- Understanding Organizations
- Understanding Teams
- Understanding Users

Role-based access control

How to manage access

- Role-based access control system:
  Users can be grouped in teams, and roles can be assigned to the teams.
- Rights to edit or use can be assigned across all objects.
- All backed by enterprise authentication if needed.



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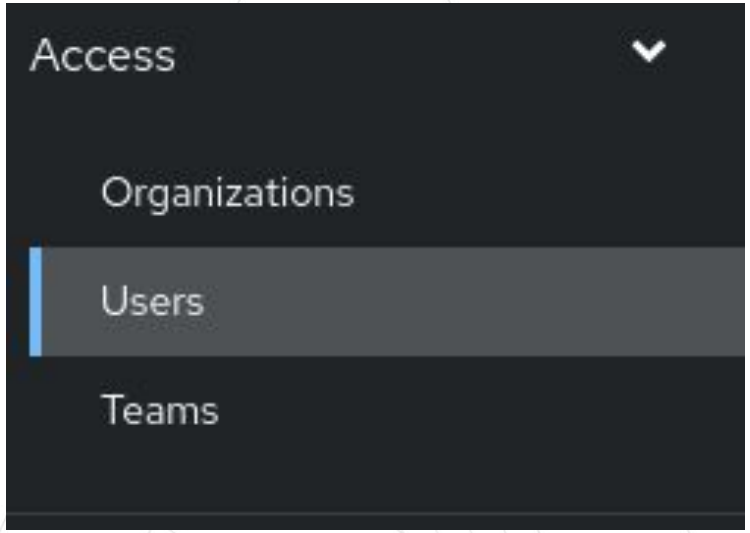
User Management

- An **organization** is a logical collection of users, teams, projects, inventories and more. All entities belong to an organization.

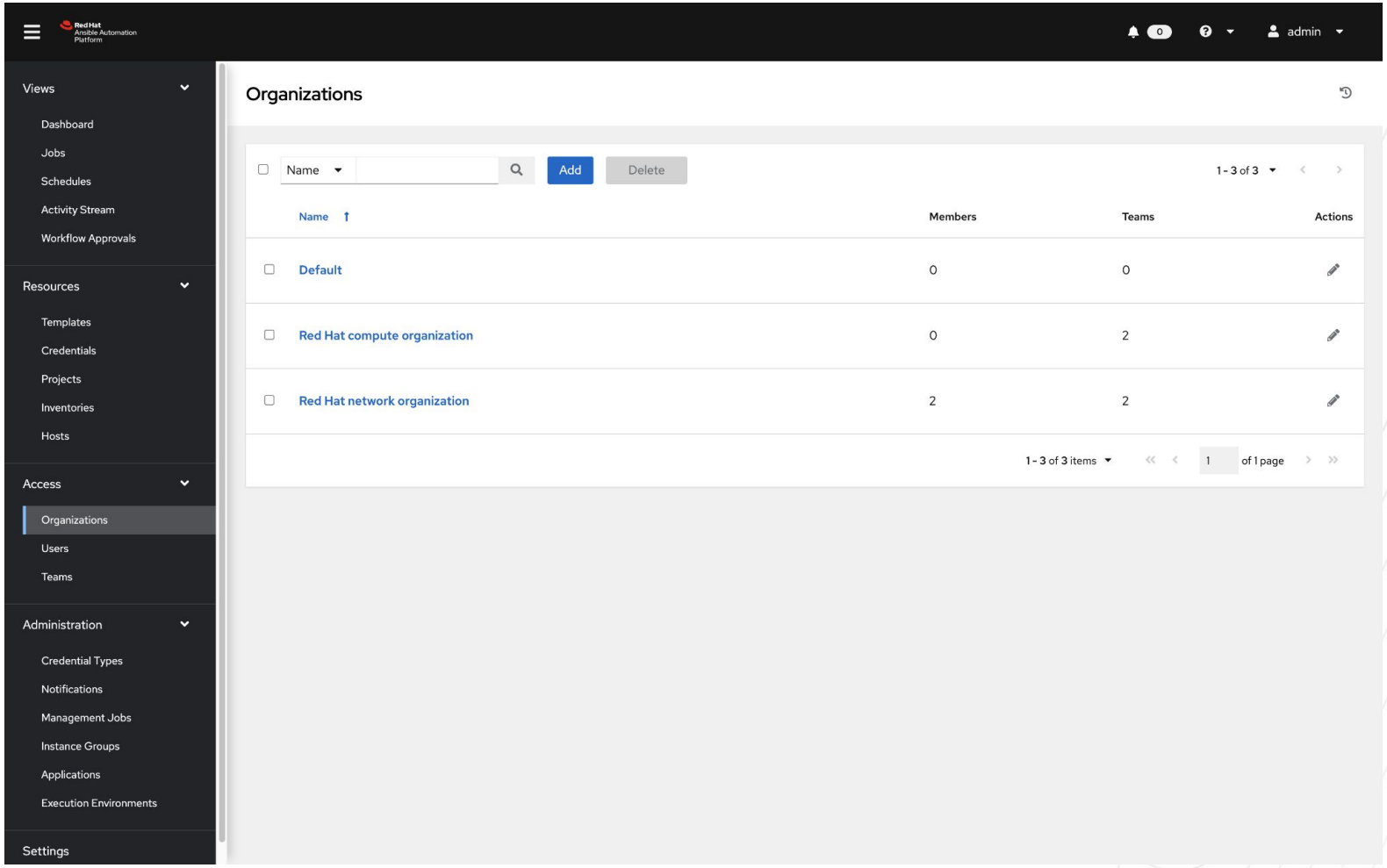
- A **user** is an account to access Ansible Automation Controller and its services given the permissions granted to it.

- **Teams** provide a means to implement role-based access control schemes and delegate responsibilities across organizations.



Viewing Organizations

Clicking on the **Organizations** button in the left menu will open up the Organizations window



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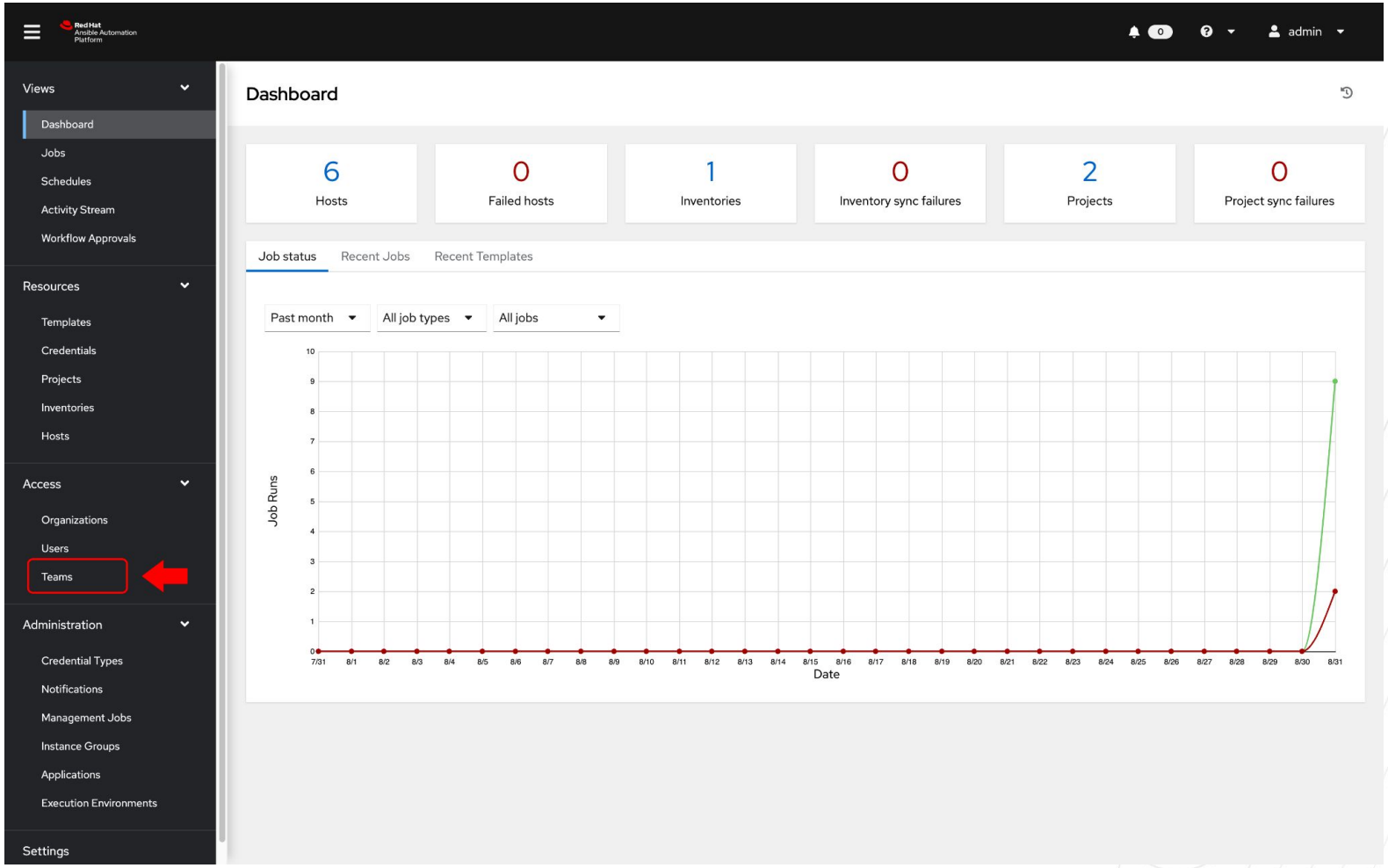
Viewing Teams

Clicking on the **Teams** buttons in the left menu will open up the Teams window



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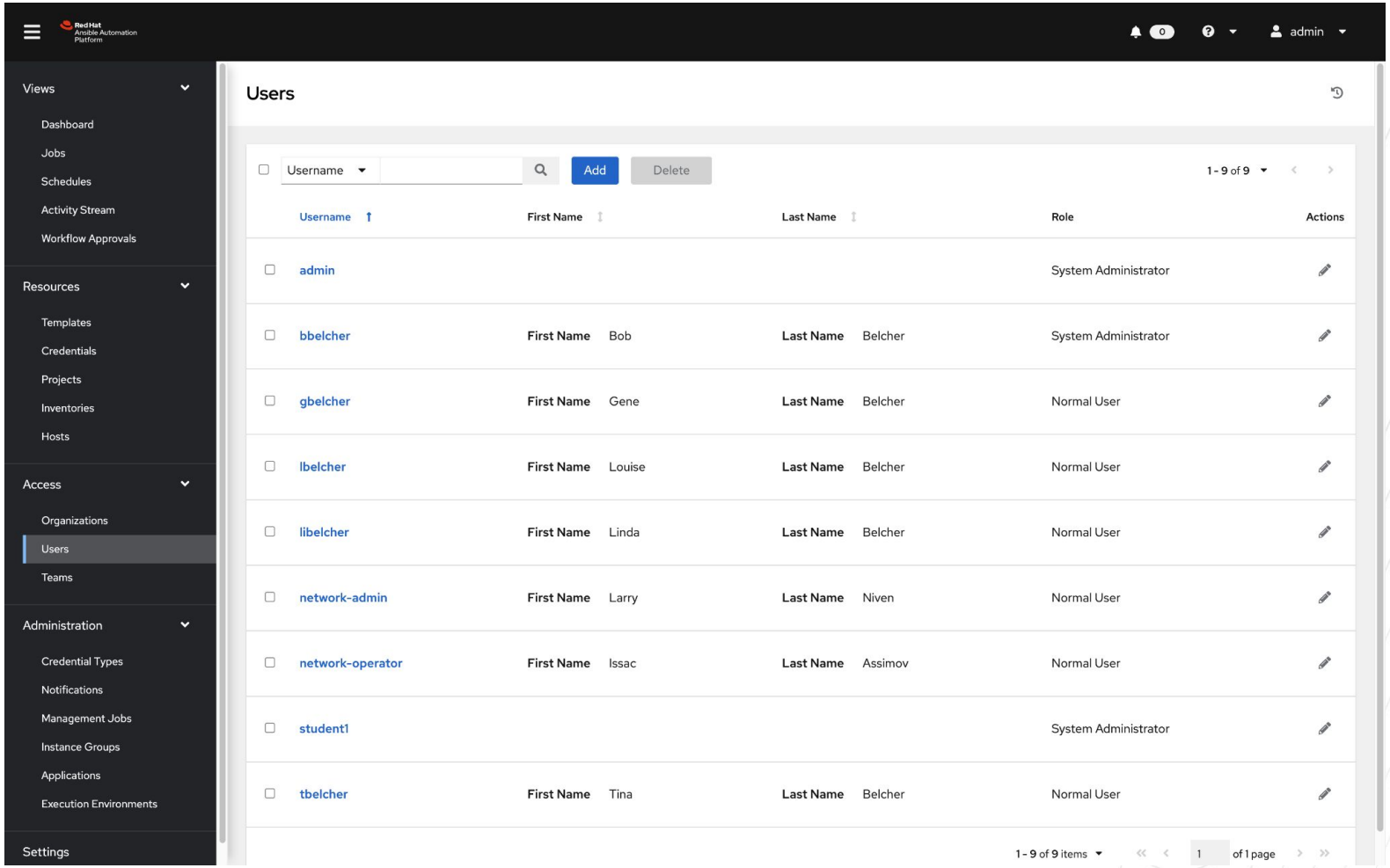
Viewing Users

Clicking on the **Users** button in the left menu will open up the Users window



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Lab Time

Exercise 8: Understanding RBAC in Automation controller

red.ht/network-workshop-8

Demonstrate the use of role based access control on Automation controller.

Approximate time: 15 mins

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Section 9 Workflows

Topics Covered:

- Understanding Workflows
- Branching
- Convergence / Joins
- Conditional Logic

Lab Time

Exercise 9: Creating a Workflow

red.ht/network-workshop-9

Demonstrate the use of Automation Controller workflow. Workflows allow you to configure a sequence of disparate job templates (or workflow templates) that may or may not share inventory, playbooks, or permissions.

Approximate time: 15 mins

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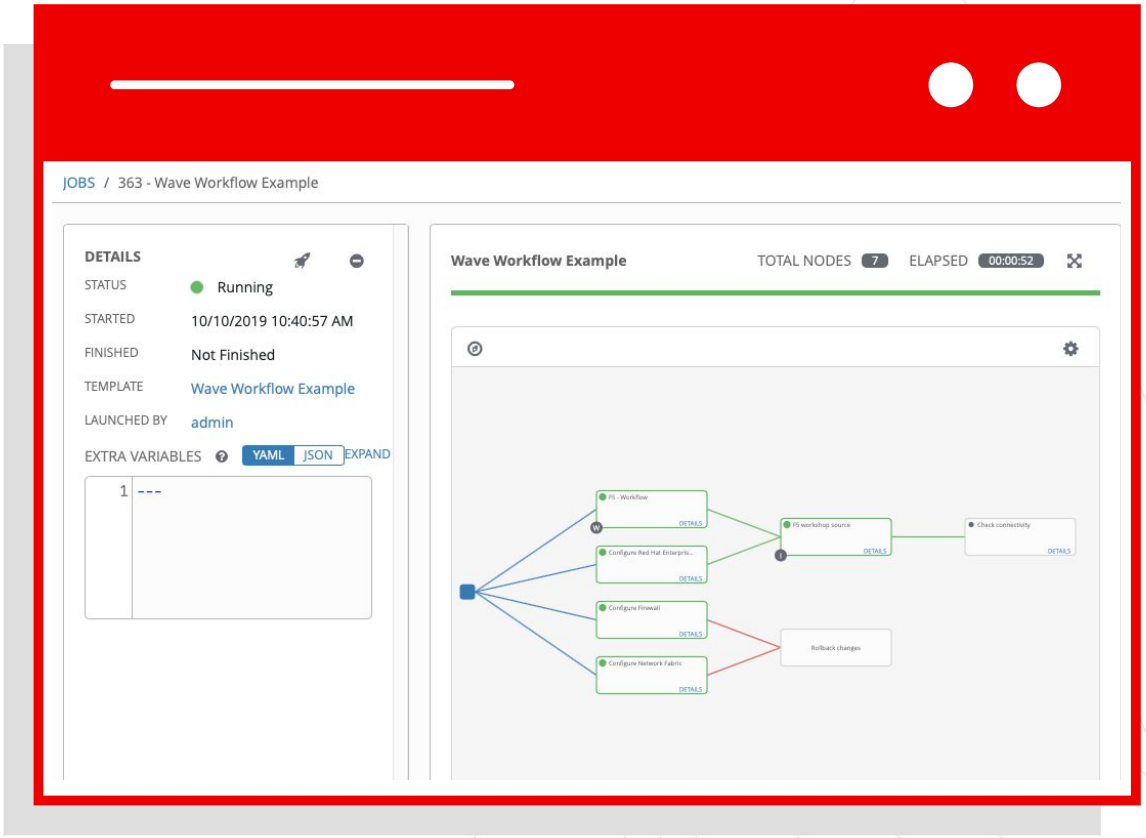
Workflows

Combine automation to create something bigger

- Workflows enable the creation of powerful holistic automation, chaining together multiple pieces of automation and events.
- Simple logic inside these workflows can trigger automation depending on the success or failure of previous steps.



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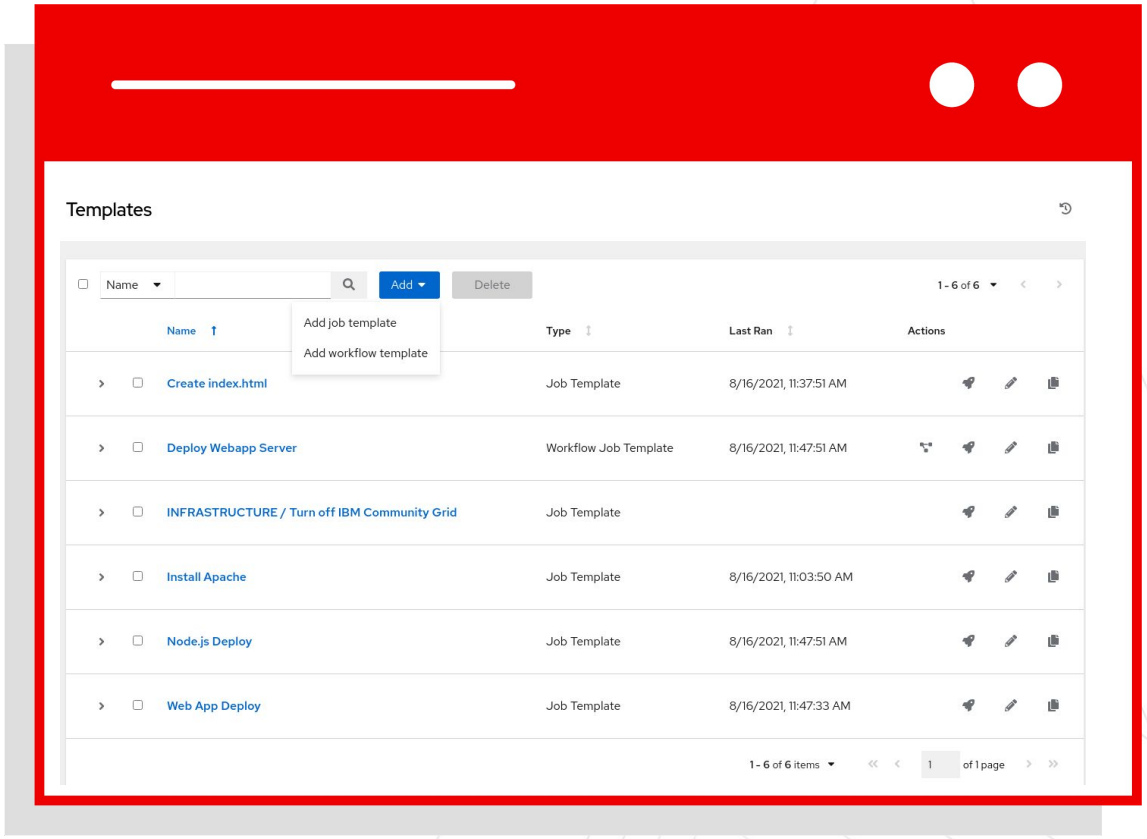
Adding a New Template

- To add a new **Workflow** click on the **Add** button.

  This time select the **Add workflow template**



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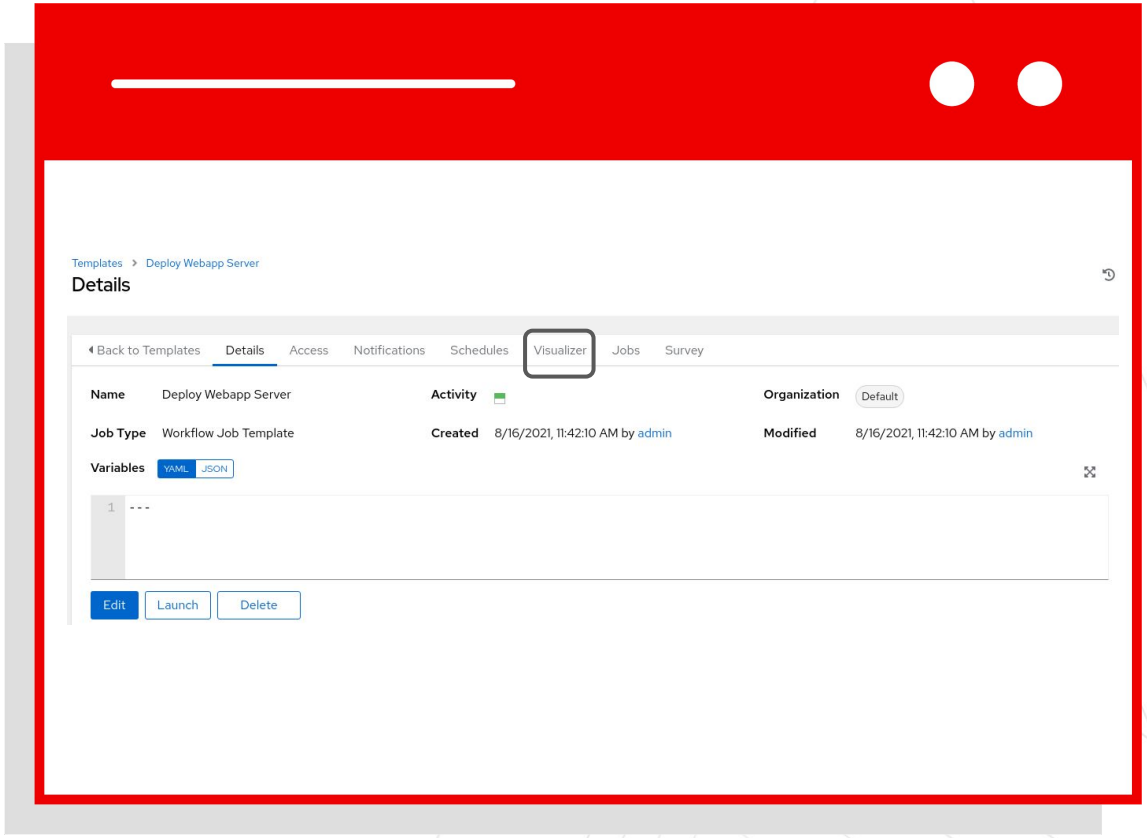
Creating the Workflow

- Fill out the required parameters and click **Save.**
  As soon as the Workflow Template is saved the Workflow Visualizer will open.



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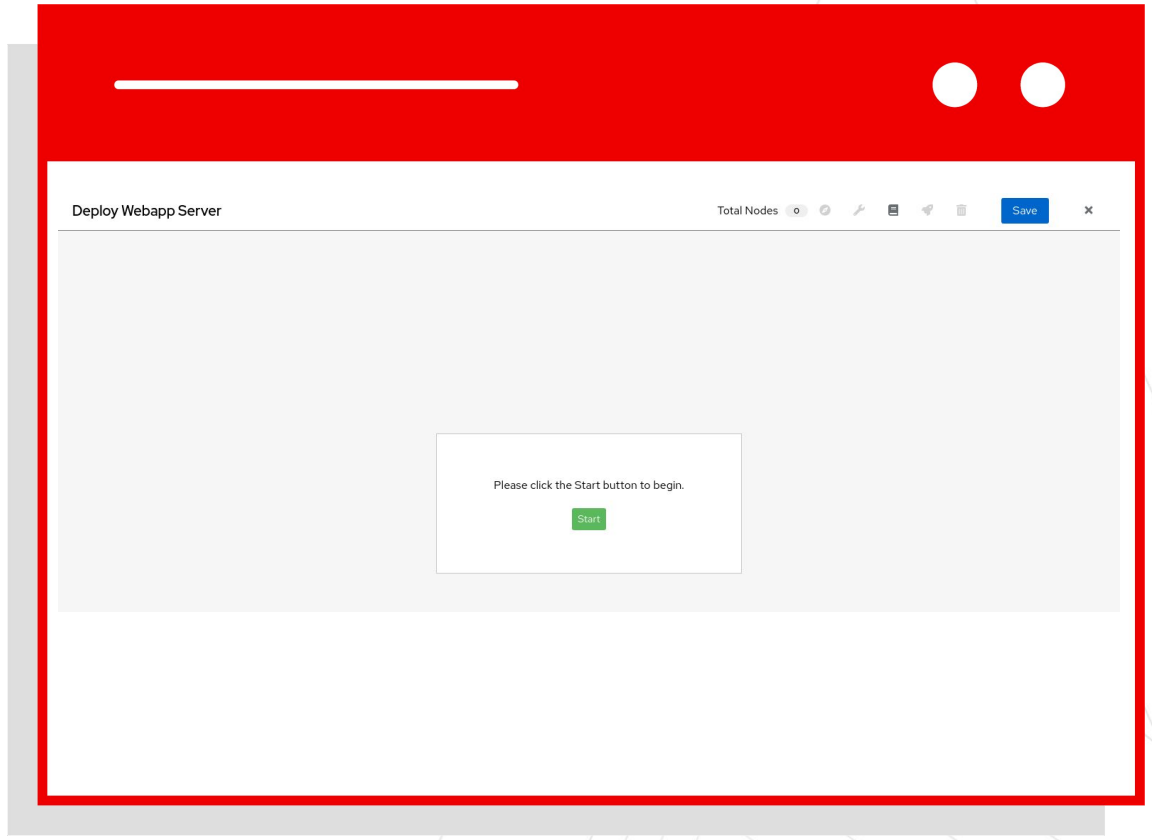
Workflow Visualizer

- The Workflow Visualizer will start as a blank canvas.
- Click the green Start button to start building the workflow.



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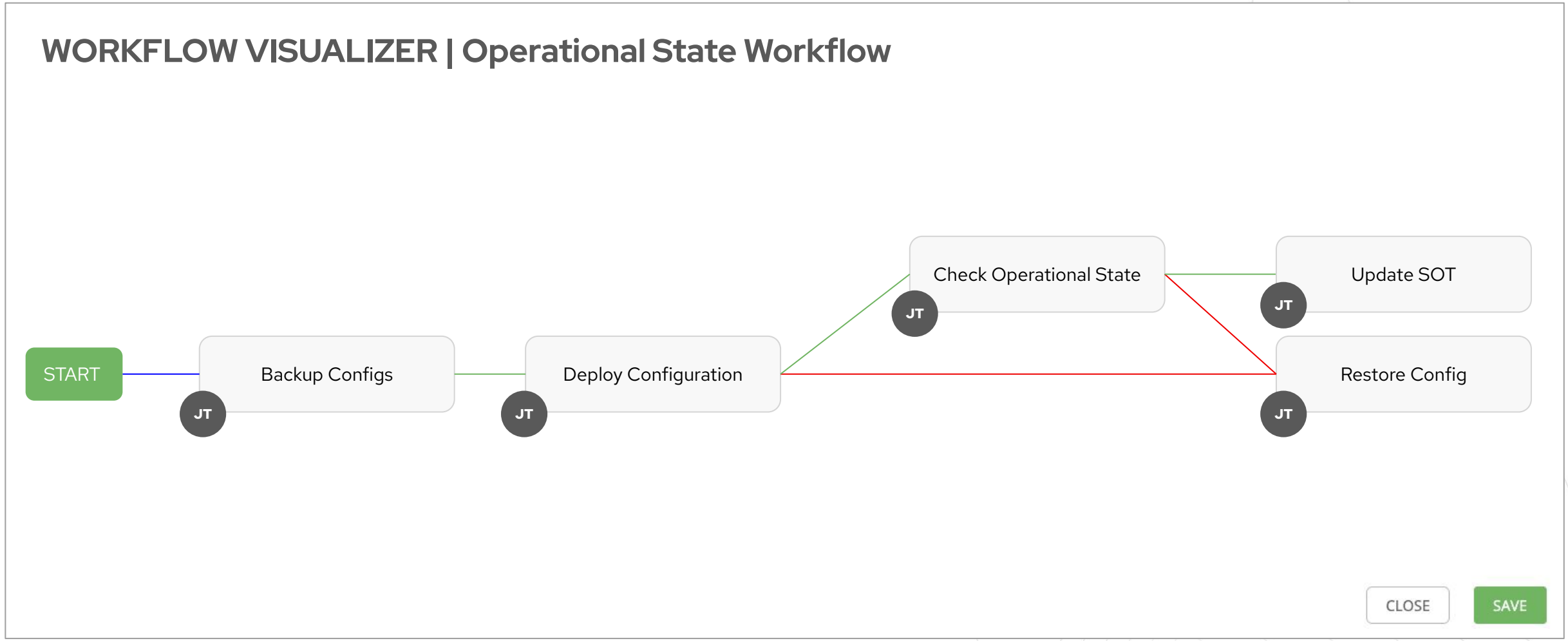
Using workflows to enhance your automation



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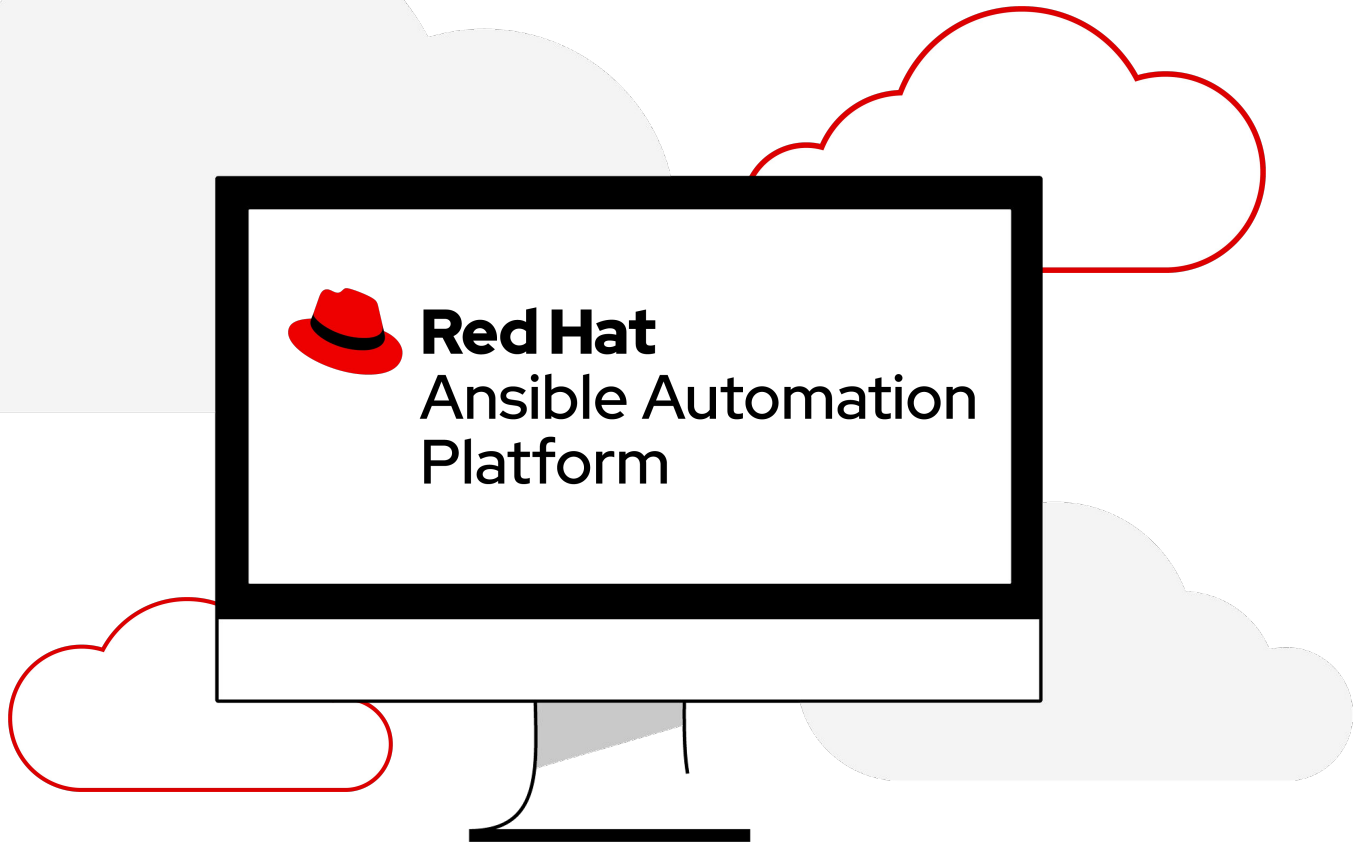
Wrapping up

Topics Covered:

- Next Steps
- Chat with us
- Consulting Services



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- Red Hat Automation Adoption Journey
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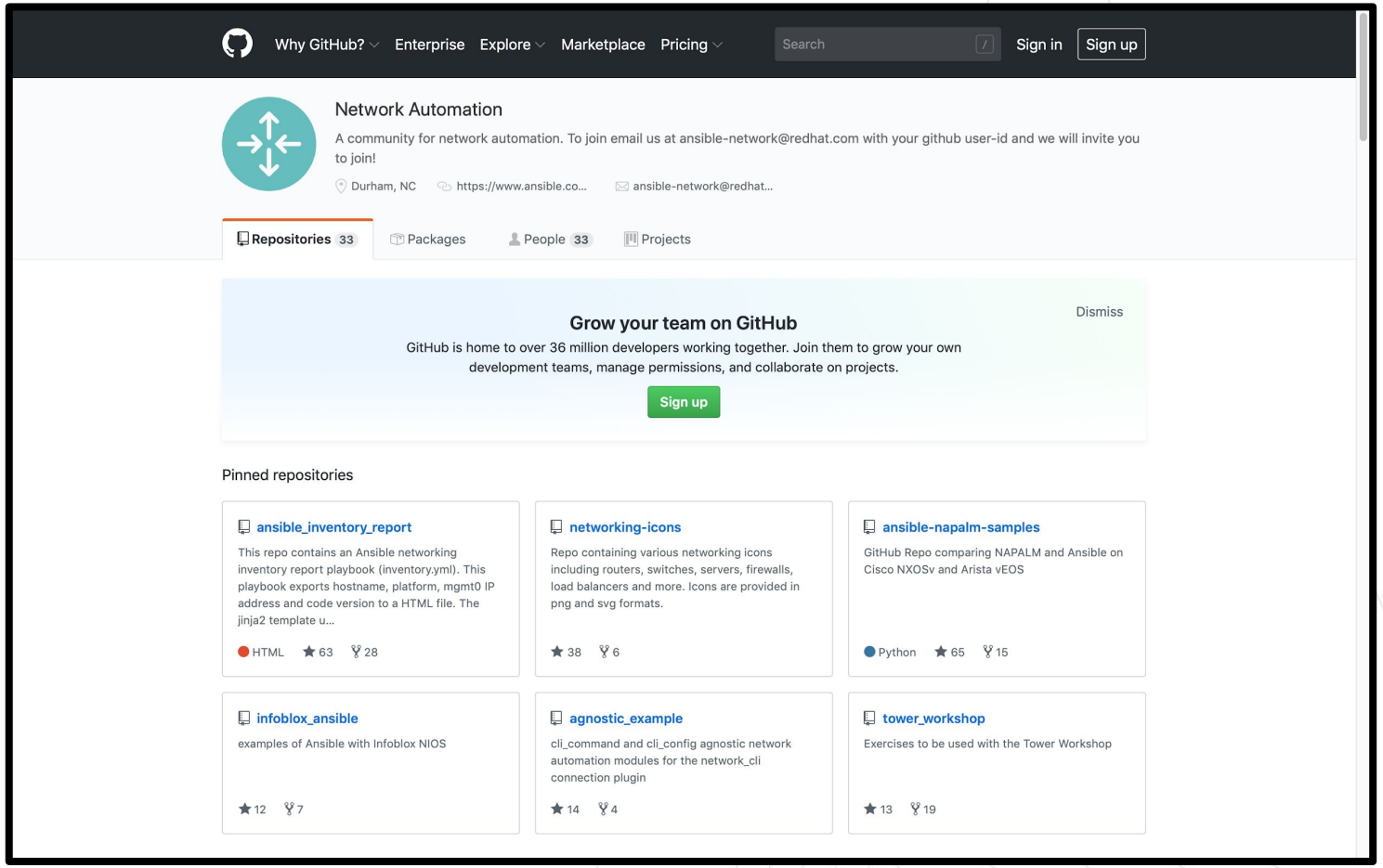
Bookmark the Github organization

- Examples, samples and demos
- Run network topologies right on your laptop



Red Hat
Ansible Automation Platform

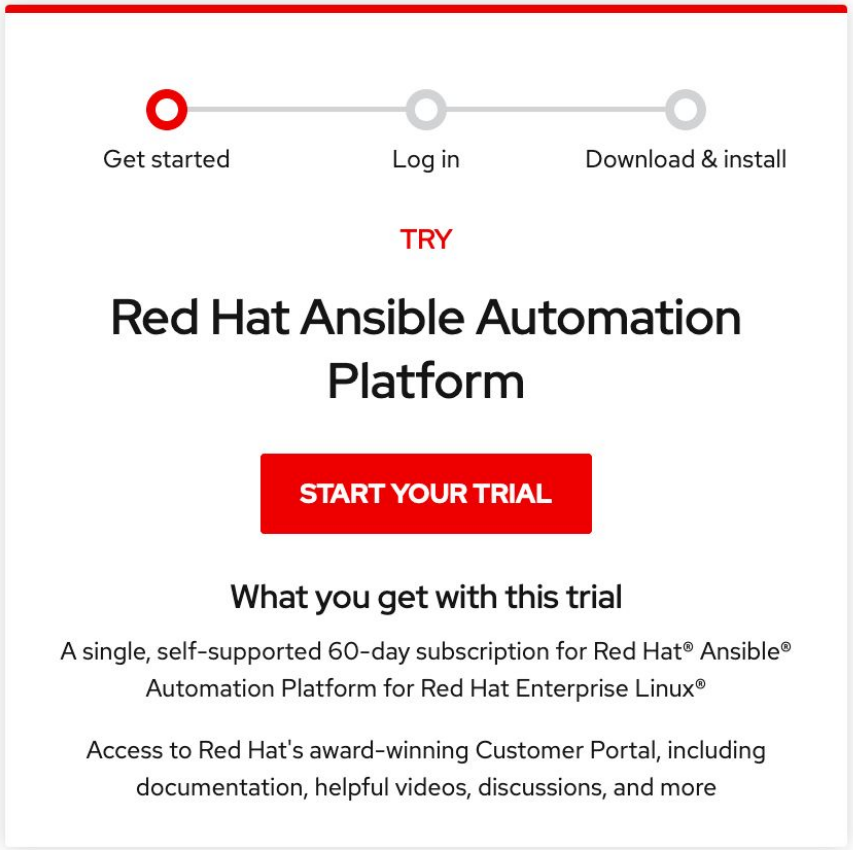
Red Hat Services

Accelerate standardization and automation of network configuration

Challenge	Approach	Benefits
Slow Time consuming, labor intensive procedures to propagate network changes	**Automate** Encode and execute procedures with human-readable Ansible playbooks	**Speed** Reduce changes from days to hours and drive simultaneous config across 100s of endpoints
Chaos Rising number of devices, environments, and vendor-specific tooling create sprawl and skills gaps	**Standardize** Automate common tasks using Ansible modules to abstract vendor-specific details	**Efficiency** Easily combine and execute complex configuration procedures across environments
Errors Over time, vulnerabilities, patches, and mistakes undermine known-good configurations.	**Test** Iteratively refine and validate provisioning and configuration pre-PROD	**Reliability** Eliminate human error in production changes
Mystery No living source of truth for which patches, packages, or configurations are deployed where	**Catalog** Automate configuration reporting, inventory, and change tracking across all environments	**Manageability** Centrally track and manage configuration rollout, drift, patching, and compliance

Resources

- Network automation for everyone (Overview)
- Automate your network with Red Hat (Technical)
- Online training: Red Hat Ansible for Network Automation
- Network Automation web page
- Red Hat Ansible Automation Platform blog



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Supplemental

Topics Covered:

- Understand group variables
- Understand Jinja2
- cli_config module

Group variables

Group variables are variables that are common between two or more devices. Group variables can be associated with an individual group (e.g. “cisco”) or a nested group (e.g. routers).

Examples include

- NTP servers
- DNS servers
- SNMP information

Basically network information that is common for that group

Inventory versus group_vars directory

Group variables can be stored in a directory called **group_vars** in YAML syntax. In exercise one we covered **host_vars** and **group_vars** with relationship to inventory. What is the difference?

inventory

Can be used to set variables to connect and authenticate **to the device**.

Examples include:

- Connection plugins (e.g. network_cli)
- Usernames
- Platform types (**ansible_network_os**)

group_vars

Can be used to set variables to configure **on the device**.

Examples include:

- VLANs
- Routing configuration
- System services (NTP, DNS, etc)

Examining a group_vars file

At the same directory level as the Ansible Playbook create a folder named **group_vars.**
Group variable files can simply be named the group name (in this case **all.yml**)

```
$ cat group_vars/all.yml

nodes:
  rtr1:
    Loopback100: "192.168.100.1"
  rtr2:
    Loopback100: "192.168.100.2"
  rtr3:
    Loopback100: "192.168.100.3"
  rtr4:
    Loopback100: "192.168.100.4"
```

Jinja2

- Ansible has native integration with the Jinja2 templating engine
- Render data models into device configurations
- Render device output into dynamic documentation

Jinja2 enables the user to manipulate variables, apply conditional logic and extend programmability for network automation.

Network Automation config modules

cli_config (agnostic)

ios_config:

nxos_config:

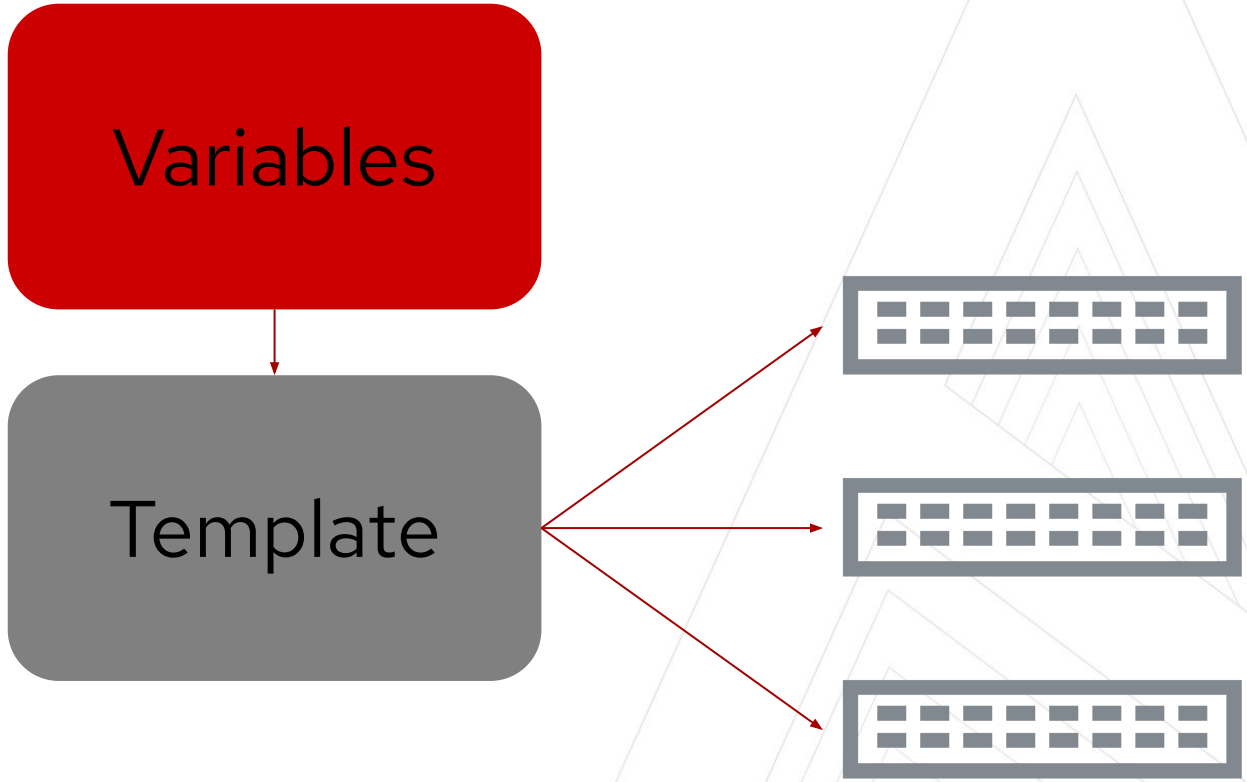
iosxr_config:

eos_config

.

.

*os_config:



Jinja2 Templating Example (1/2)

Variables

```
ntp_server: 192.168.0.250
name_server: 192.168.0.251
```

Jinja2 Template

```
!
ntp server {{ntp_server}}
!
ip name-server {{name_server}}
!
```

Generated Network Configuration

rtr1

```
!
ip name-server 192.168.0.251
!
ntp server 192.168.0.250
!
```

rtrX

```
!
ip name-server 192.168.0.251
!
ntp server 192.168.0.250
!
```

Jinja2 Templating Example (2/2)

Variables

```
nodes:
  rtr1:
    Loopback100: "192.168.100.1"
  rtr2:
    Loopback100: "192.168.100.2"
  rtr3:
    Loopback100: "192.168.100.3"
  rtr4:
    Loopback100: "192.168.100.4"
```

Jinja2 Template

```
{% for interface,ip in nodes[inventory_hostname].items() %}
interface {{interface}}
  ip address {{ip}} 255.255.255.255
{% endfor %}
```

Generated Network Configuration

rtr1

```
interface Loopback100
  ip address 192.168.100.1
!
```

rtr2

```
interface Loopback100
  ip address 192.168.100.2
!
```

rtrX

```
interface Loopback100
  ip address X
!
```

The cli_config module

Agnostic module for network devices that uses the network_cli connection plugin.

```
---
- name: configure network devices
  hosts: rtr1,rtr2
  gather_facts: false
  tasks:
    - name: configure device with config
       cli_config:
         config: "{{ lookup('template', 'template.j2') }}"
```