Automating IPAM In Cloud

Ansible + Netbox

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What is *IPAM*?

IP Address Management *(IPAM)* is the critical component that organizes your IP Addresses and Networks in one place. Responsible management of IP Addressing drives efficient, repeatable, and reliable network automation.

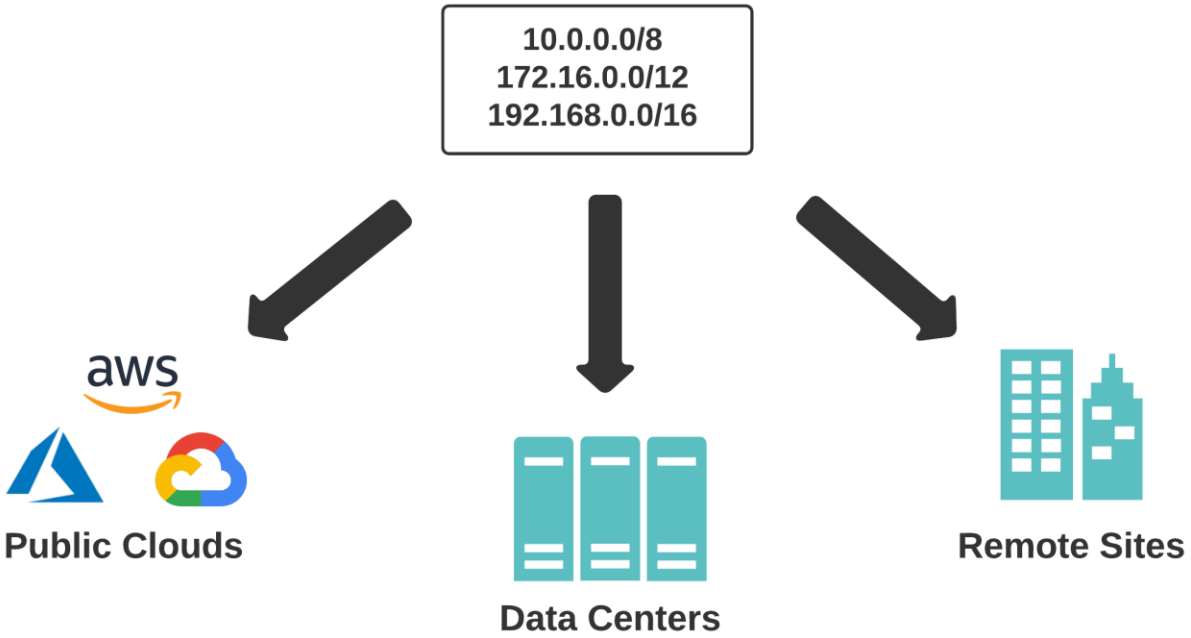
IP Address	Network Prefix	SuperNet
Single device on a network	Aggregation of IP Addresses	Multiple networks combined into a bigger network
Virtual Machine	**Virtual Network**	**Cloud Region**

The Problem

As Hybrid Multi-Cloud becomes reality, private IP space becomes shared across cloud(s) and on-premises

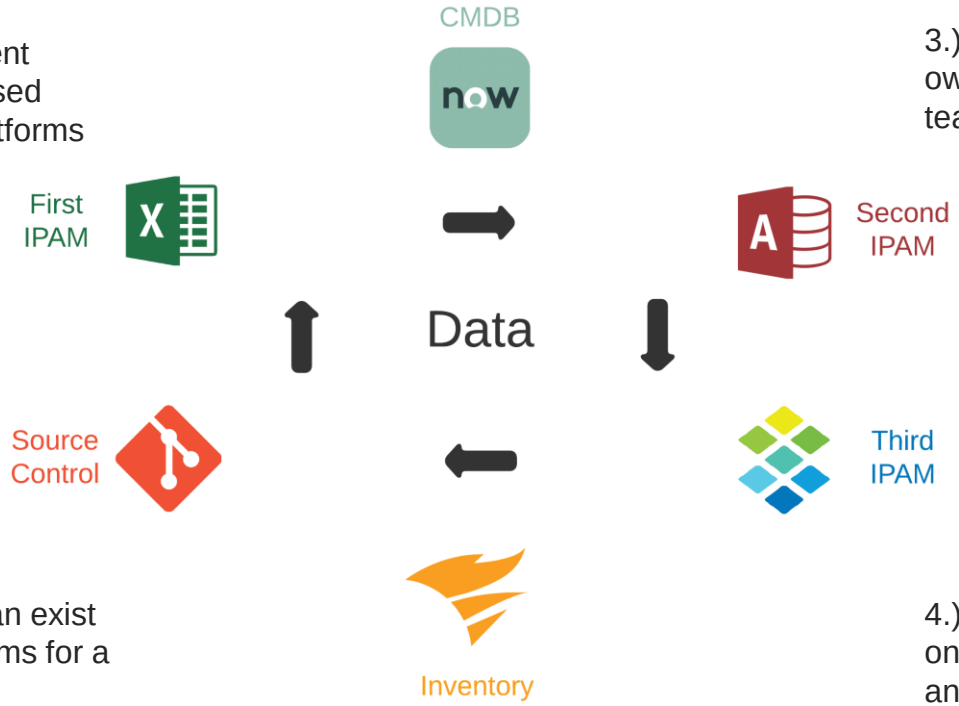
Developers leverage CI/CD as they deploy, migrate, and maintain applications in the cloud; network can't keep up

Some developers also do not have a good understanding of how IP Addressing works and how to responsibility consume it



The Problem (cont.)

1.) Data required for efficient automation is often dispersed across many tools and platforms



3.) Tools and platforms may be owned and managed by different teams with different directions

2.) Oftentimes, overlap can exist between tools and platforms for a given domain of data

4.) Good automation is dependent on data accuracy, consistency, and ability to be consumed

What Do We Want?

Automated IP Address Management

- Minimal human intervention
- Repeatable with other cloud providers
- Compatible across traditional + cloud networking
- Reliable but flexible agility (Go fast but responsible)

Outcome = **Good User Experience** for those that design, consume, maintain, and support cloud networking!

The Technology

Automating the network at scale means, automating across multiple vendors and environments

Tools

Ansible Tower

Acts as the central orchestration layer for network automation tasks

Netbox

Serves as a Source of Truth for desired network state; many use cases beyond IPAM

Environments

Colocation DCs

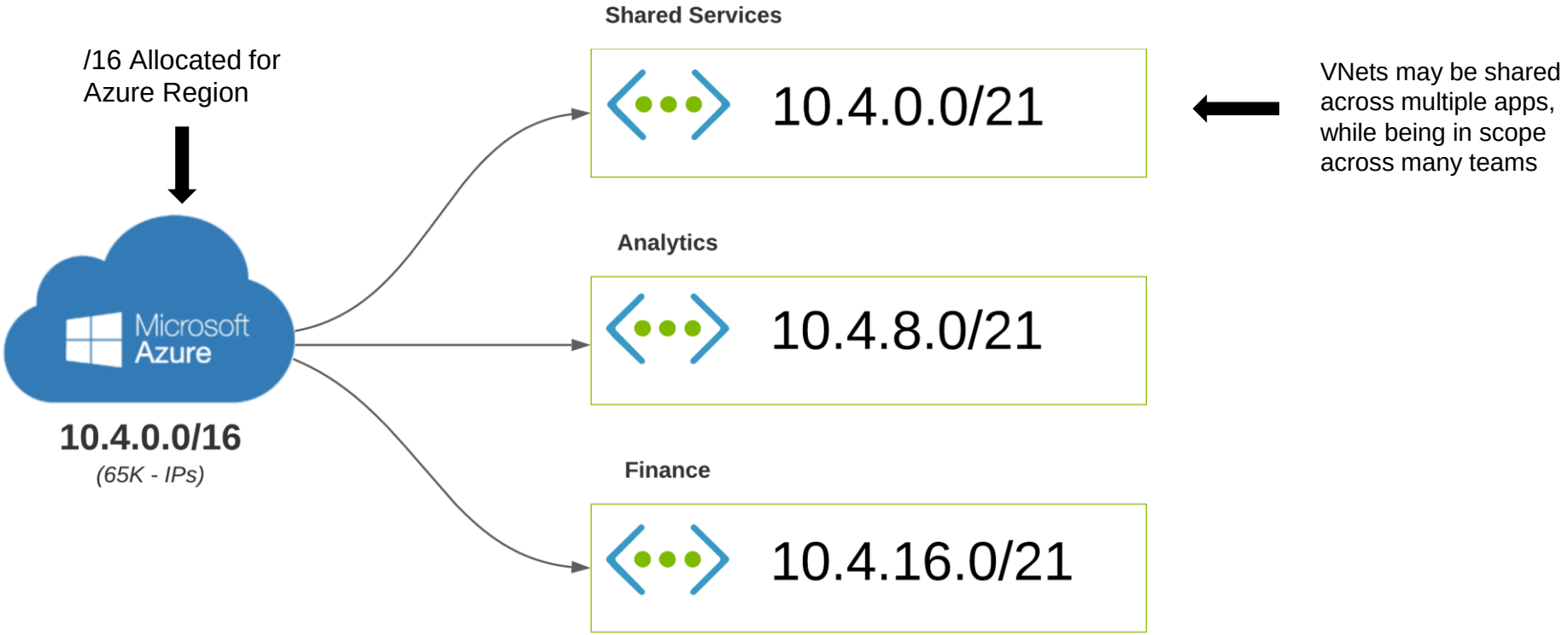
Provides fast on-ramps to cloud providers; contains bare metal network gear

Public Cloud

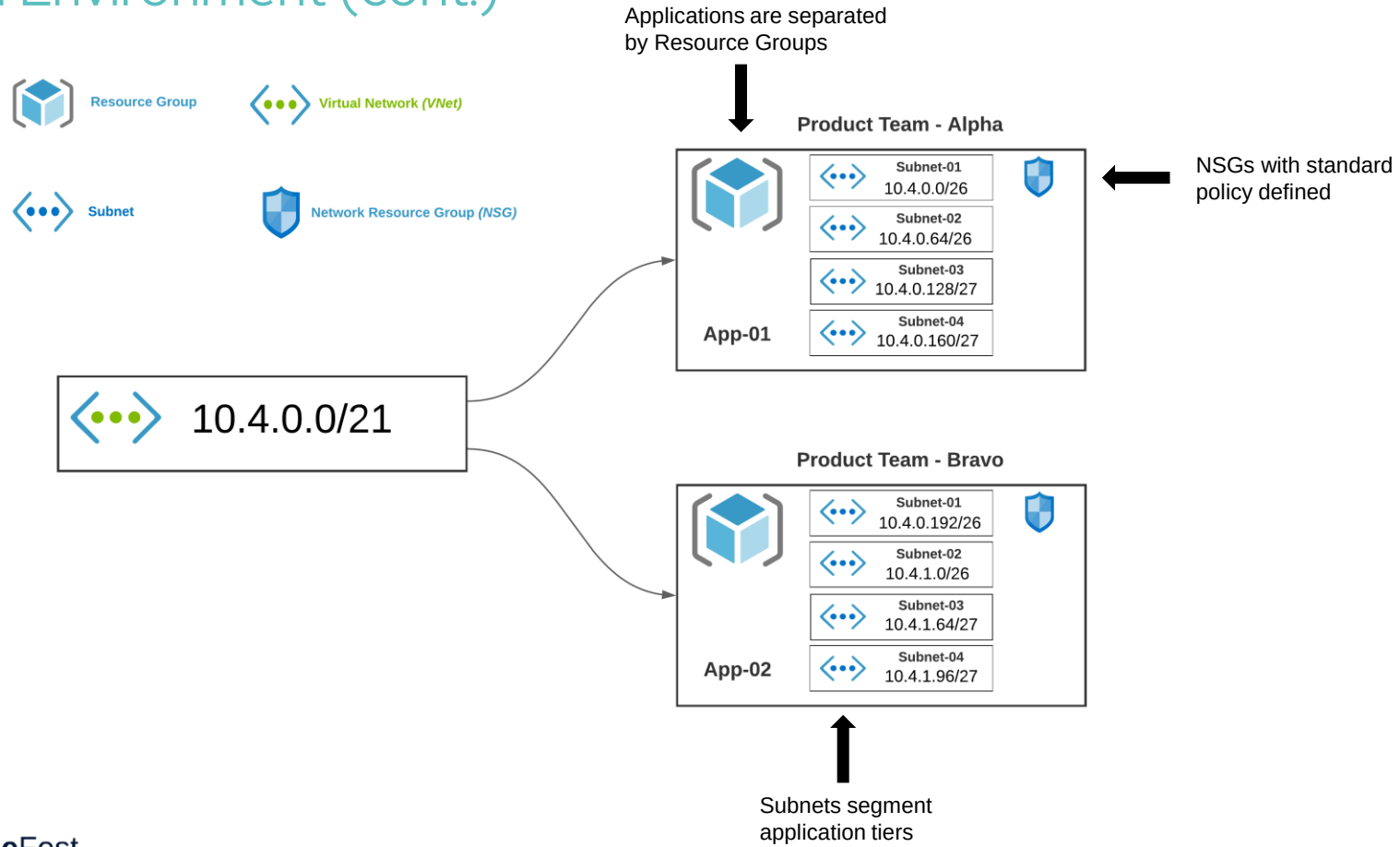
Cloud services owned and operated by a third-party and delivered over the internet

What Are We Automating?

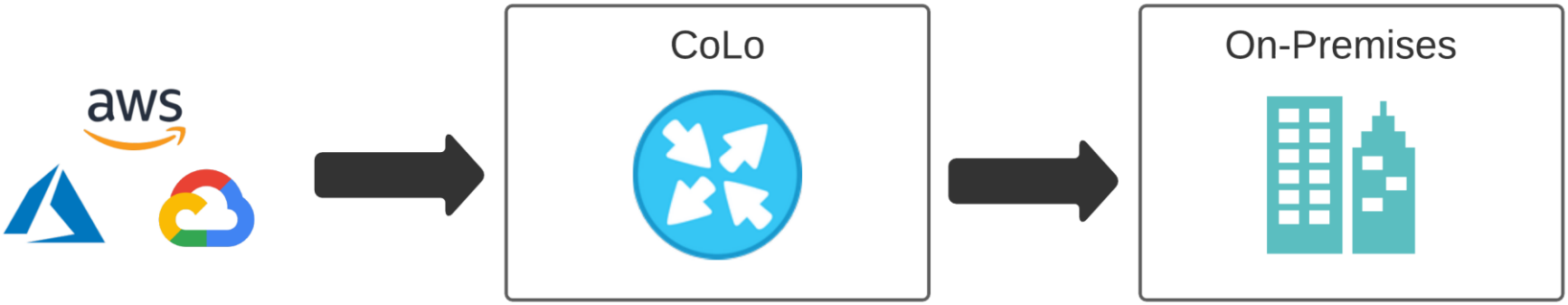
Cloud Environment



Cloud Environment (cont.)



CoLo Environment



Inbound route-map filters traffic; prefix-list appended as new cloud environments are setup

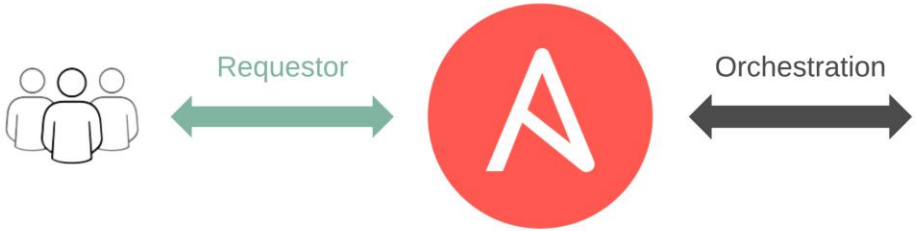
Only specific traffic is allowed to route back on-prem. Let's keep this optimized and least-privilege!

Touchpoints

1.) Source Of Truth

2.) Cloud Infrastructure

2.) Network Gear



Reserve next available prefix in Netbox

Create new Azure Resource Group

Create new Azure VNet and Subnets with reserved prefix

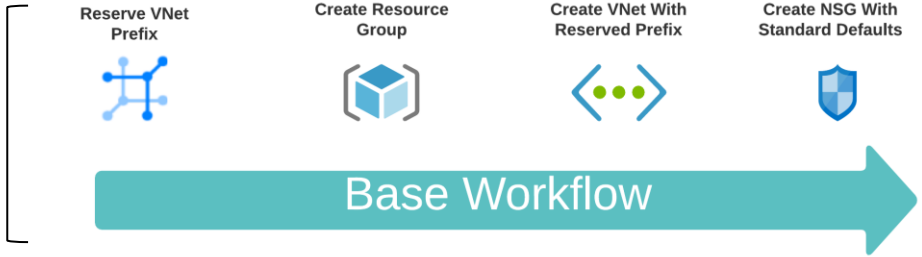
Create NSG and associate it with newly created Subnets

Append subnet to prefix-list on physical network gear

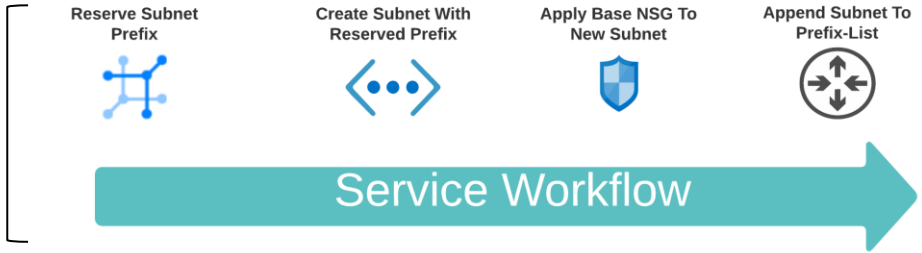
Design Drives Automation

Thinking through a given design is a key element for how you approach the automation. For this demo, we will leverage two different workflows for automating IPAM and building cloud infrastructure.

Builds ***foundational*** components that can be shared across business units, teams, applications, and tools.



Builds ***service*** oriented components specific to a given team, service, and application environment.

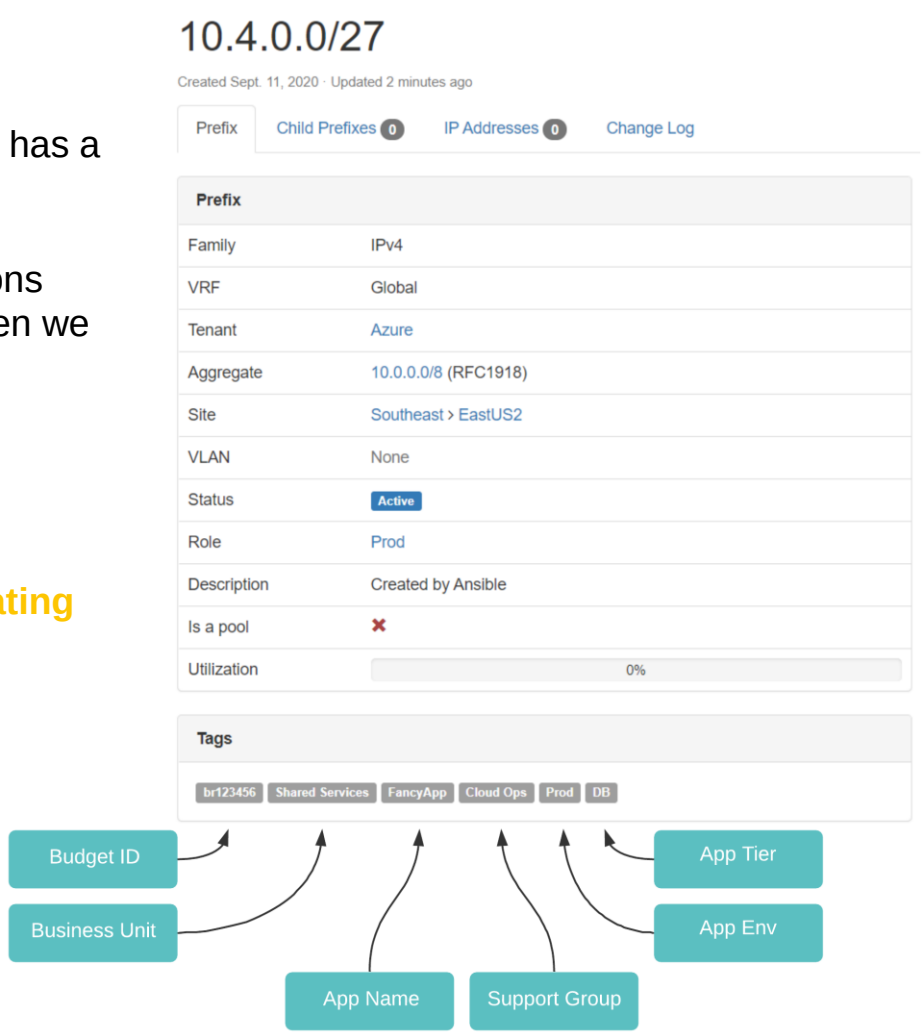


Tagging All The Things!

Applying tags to resources in cloud has a lot of benefits.

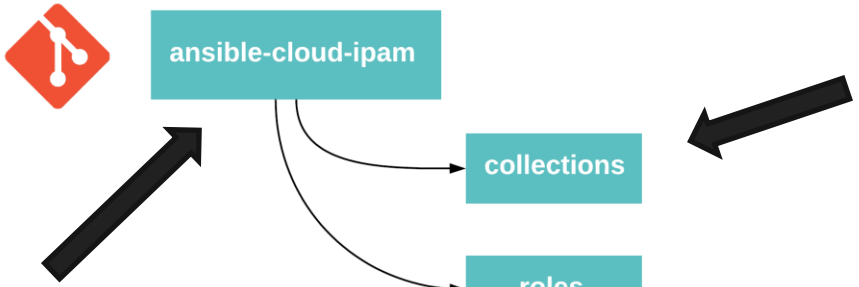
What if we tagged our IP reservations with the same tags that we use when we deploy new cloud infrastructure?

Now we can start treating our pets like cattle!



Breaking Down The Logic

Project Structure



ansible-cloud-ipam / collections / requirements.yml

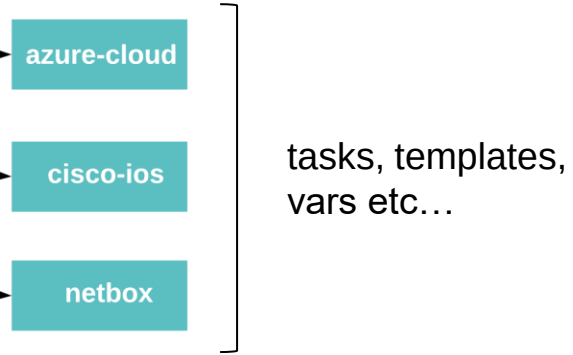
```
collections:
  - name: netbox.netbox
    version: 1.0.0
    source: https://galaxy.ansible.com
```

Project Root

Contains folders for both collections and roles; stores playbooks

Roles

Broken down by functional technology or vendor OS type



tasks, templates, vars etc…

The Logic – High Level Plays

Playbooks sitting in our root project folder are simple. They are primarily used as the entry point for Ansible and execute based on a specific condition.

ansible-cloud-ipam / play.netbox_reserve_prefix_snet.yml

```
---

- hosts: all
  connection: local
  hosts: localhost
  gather_facts: False
  vars:
    play_action: netbox_reserve_prefix_snet

  roles:
    - netbox

...
```

Let's define our Play Action folks!

Include the netbox role

The Logic – Functional Roles

Roles are organized by either a given platform or OS type. Each role's main file will include specific tasks to use based on the condition defined in the root level play.

ansible-cloud-ipam / roles / netbox / tasks / main.yml

```
---

- include_tasks: task.netbox_reserve_prefix_vnet.yml
  when: play_action == 'netbox_reserve_prefix_vnet'

- include_tasks: task.netbox_reserve_prefix_snet.yml
  when: play_action == 'netbox_reserve_prefix_snet'

...
```

Only include this task when…
Play Action is exactly this!

The Logic – Purpose Built Tasks

The real logic is handled inside a given role's tasks. Each task is built to do a very specific thing. The idea is to keep things DRY *(Don't Repeat Yourself)* to maximize reuse.

In using Workflows with Ansible Tower, we generally want to perform some action, retrieve some data, and then provide as an artifact to be used in forthcoming tasks in the Workflow.

set_stats == AWESOME

ansible-cloud-ipam / roles / netbox / tasks / task.netbox_reserve_prefix_snet.yml

```
- name: Add next prefix in Netbox
  netbox.netbox.netbox_prefix:
    netbox_url: "{{ netbox_url }}"
    netbox_token: "{{ netbox_token }}"
    data:

      # Define criteria for prefix
      parent: "{{ prefix_parent }}"
      prefix_length: "{{ prefix_length }}"

      # Define criteria for site
      tenant: "{{ tenant_name }}"
      site: "{{ azure_location }}"

      # Metadata
      prefix_role: "{{ prefix_role }}"
      description: "{{ prefix_desc }}"

      # Tags
      tags:
        - "{{ app_name }}"
        - "{{ app_tier }}"
        - "{{ app_env }}"
        - "{{ billing_id }}"
        - "{{ business_unit }}"
        - "{{ support_group }}"

    # State
    state: present
    first_available: yes

  # Register output
  register: first_available

  # Set stat for prefix string
- name: Set stats
  set_stats:
    data:
      net_prefix: "{{ first_available.prefix.prefix }}"
```

Enforced Tagging!
Let's keep track of stuff

The Logic – Physical Network

For the physical Cisco ASR, we will leverage Ansible's *network_cli* for communication and the *ios_config* module to push the configuration.

Each time the Service Workflow is run, each subnet reservation will be appended to a prefix-list living on the ASR.

The configuration is rendered with Jinja2 with the variables being passed in from Ansible Tower.

ansible-cloud-ipam / roles / cisco-ios / templates / prefix_list_append.j2

```
ip prefix-list {{ list_name }} {{ list_action }} {{ net_prefix }}
```

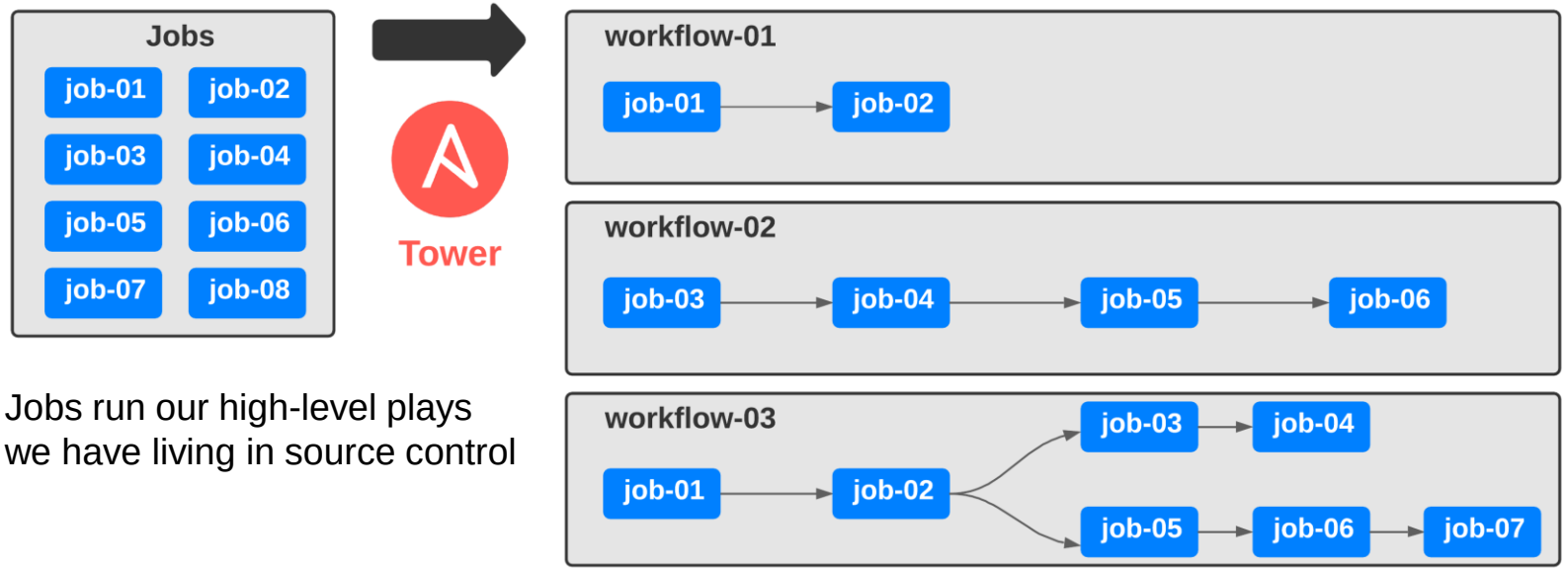
ansible-cloud-ipam / roles / cisco-ios / tasks / task.ios_prefix_list_append.yml

```
---

# Block - Append prefix-list on IOS
- name: Append prefix-list on IOS
  block:

  # Create temp staging directory
  - name: Stage config directory
    file:
      path: "staging/{{ inventory_hostname }}"
      state: directory
      mode: '0777'

  # Stage configuration for IOS prefix-list
  - name: Stage configuration for IOS prefix-list
    template:
      src: prefix_list_append.j2
      dest: "staging/{{ inventory_hostname }}/prefix_list_append.cfg"

  # Push configuration to IOS
  - name: Push configuration to IOS
    ios_config:
      src: "staging/{{ inventory_hostname }}/prefix_list_append.cfg"

  # Clean up temp staging directory
  - name: Clean staging directory
    file:
      path: "staging/{{ inventory_hostname }}"
      state: absent

...
```

Bringing It All Together

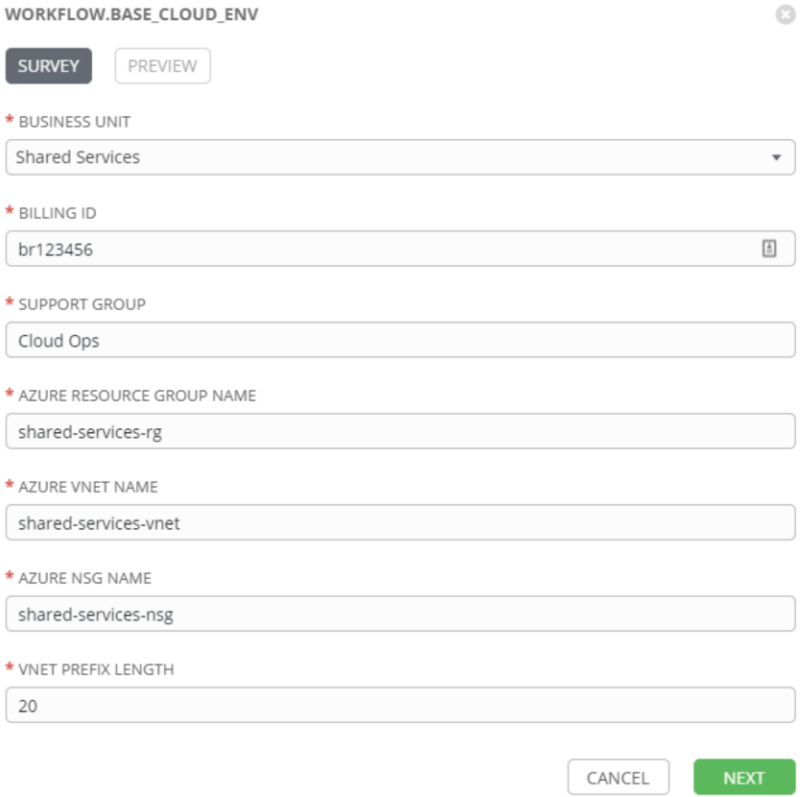
Jobs And Workflows

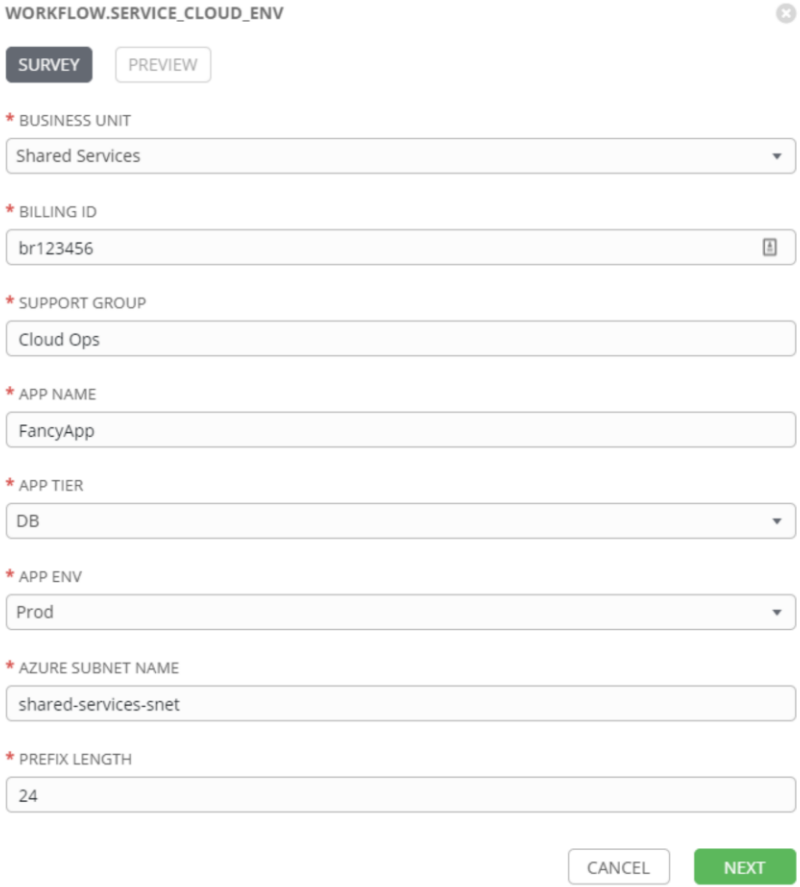
Workflows group our job templates together
to enable different combinations / outcomes



Jobs run our high-level plays
we have living in source control

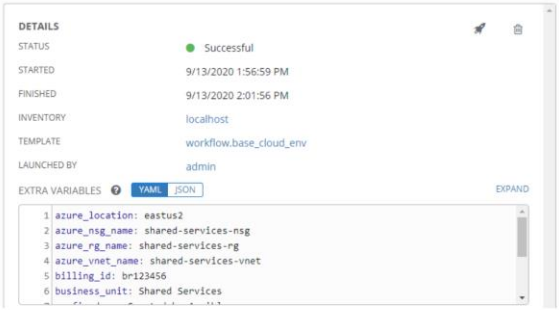
Surveys And Data

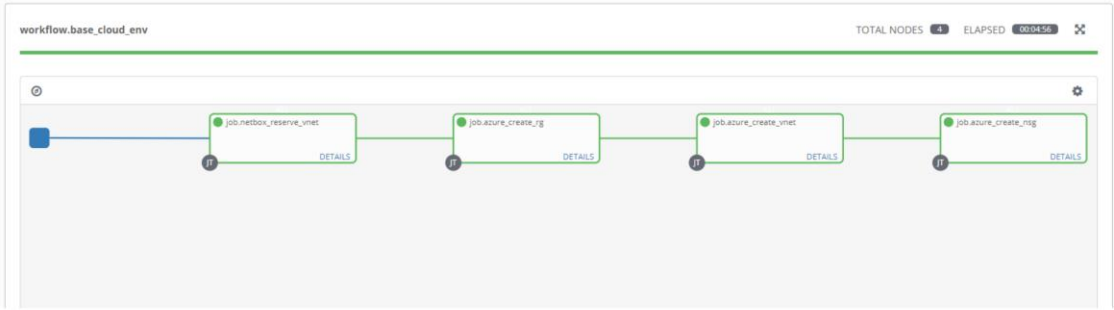


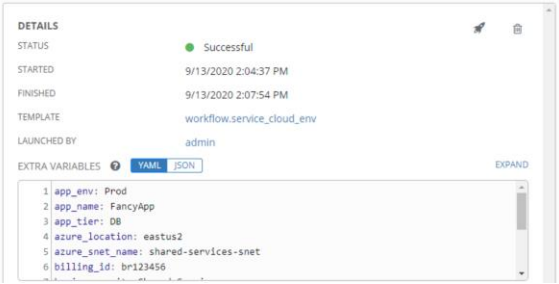


Workflows In Action

The infrastructure's build + release pipeline!







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