Building Trustworthy Network Automation, From Principles to Practice

Damien Garros - CHINOG 12 - May 2025

About me : Damien Garros

Co-Founder and CEO of OpsMill
Creator of Infrahub, a next generation Infrastructure data management platform (Source of Truth)

Focused on Infrastructure as Code, Automation & Observability for 12+ years

Previously leading Technical Architecture at Network to Code

OpsMill
Simplifying Complexity, Enabling Agility

INFRAHUB

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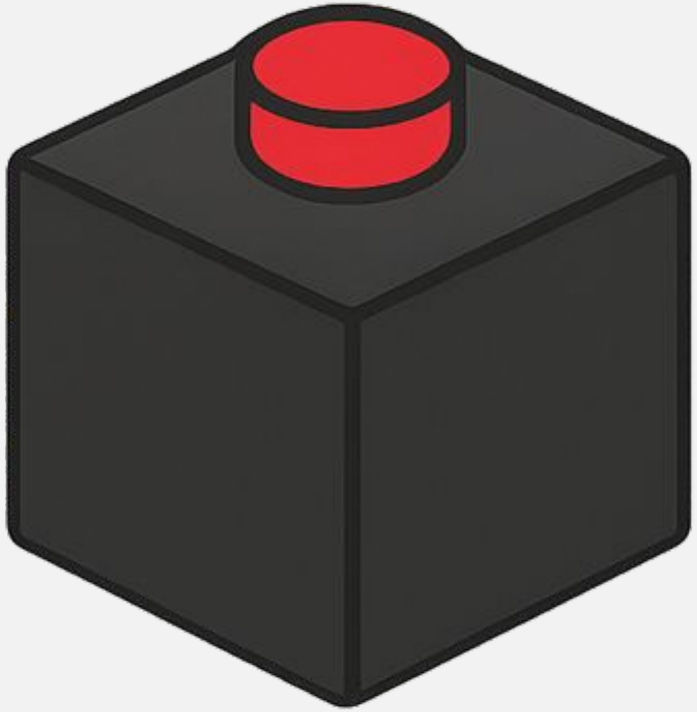
Introduction

Trust
is essential for successful network automation adoption.

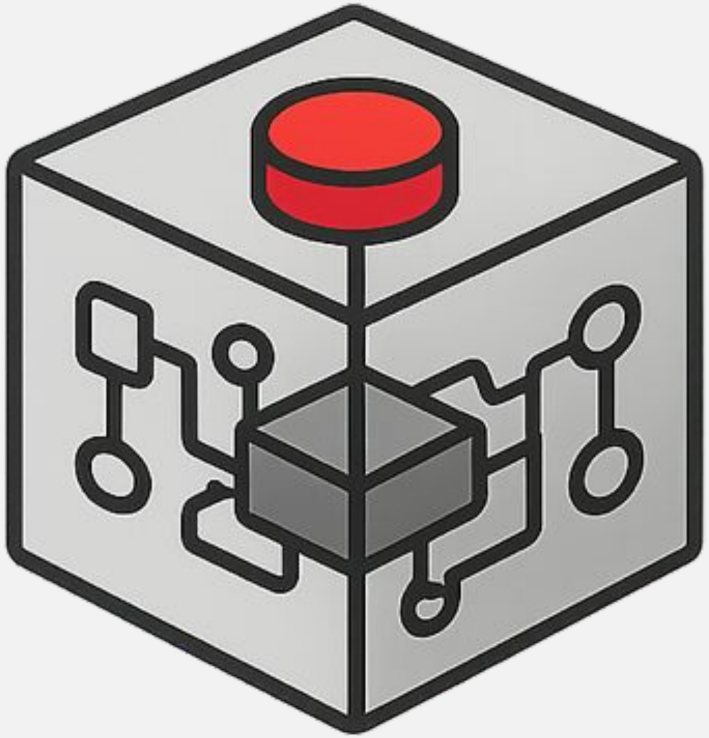
Press the button to upgrade your network



Software Upgrade

Automation User

The person who developed it probably has a completely different perspective on it

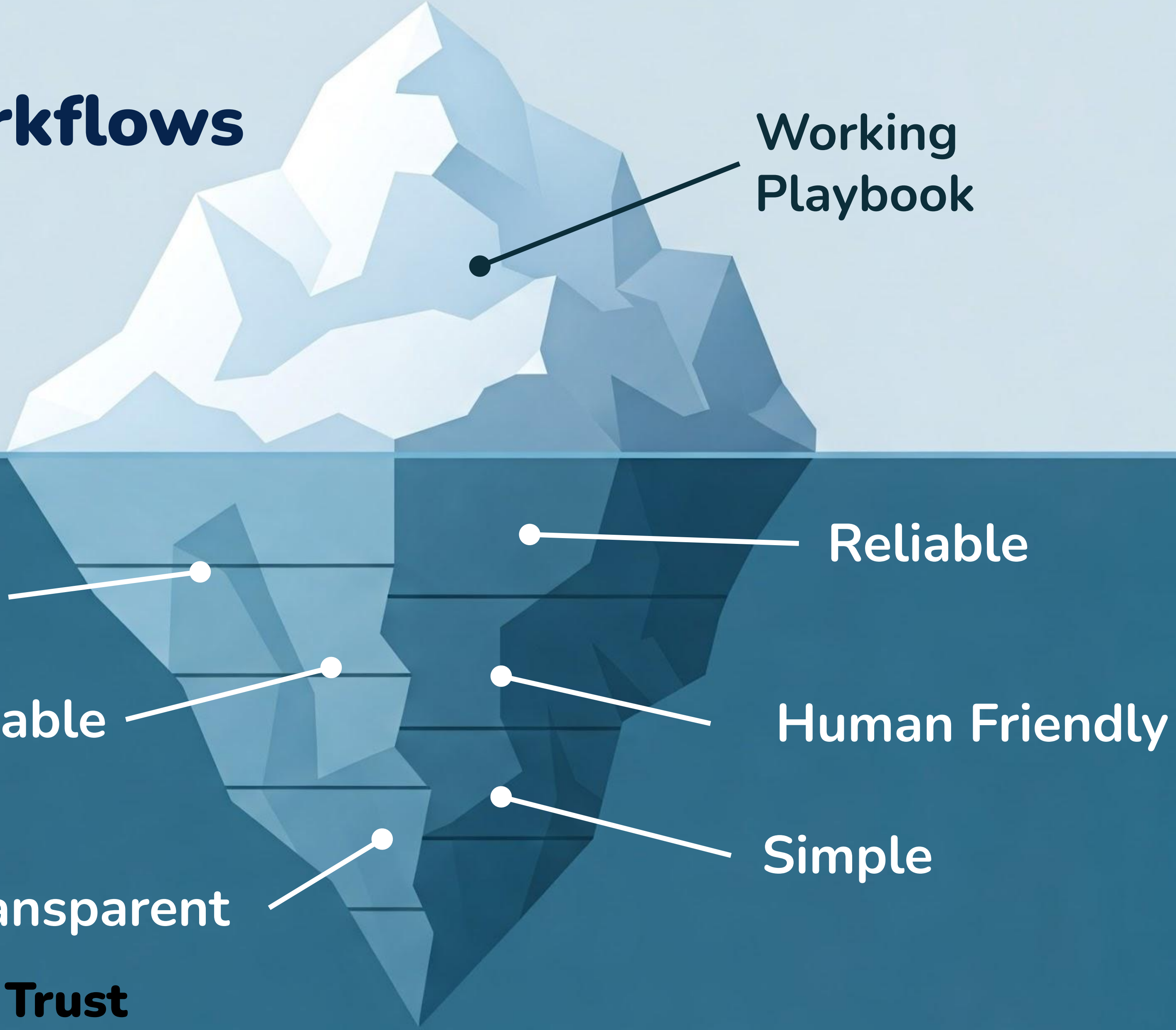


Software Upgrade

Automation Developer

Effort to build automation workflows

What we often focus on



What is required to build Trust

Which cars do you trust the most ?

Another perspective on this topic

Reliable

Manageable

Human Friendly

Predictable

Main Principles to build Trust

Predictable

Automation should produce consistent and repeatable outcomes every time it runs.

Manageable

Systems and workflows should be easy to configure, control, and update without hidden complexity.

Transparent

Automation should clearly show what it will do and what it has done — no surprises.

Simple

Solutions should avoid unnecessary complexity, making them easier to understand, audit, and maintain.

Reliable

Automation must handle failures gracefully and ensure that critical operations complete successfully.

Human Friendly

Interfaces and experiences should be designed with people in mind — intuitive, safe, and supportive of decision-making.

Trust comes from visibility, control, and graceful failure handling — not just from correct execution.

Built on Mistakes. Refined by Experience.

This presentation present some hard-earned knowledge based on years of trying and making mistakes.

Building automation that’s predictable, manageable, transparent, and reliable isn’t easy.
It takes time, and it takes care — but every step forward matters.

Design Principles of Trustworthy Automation

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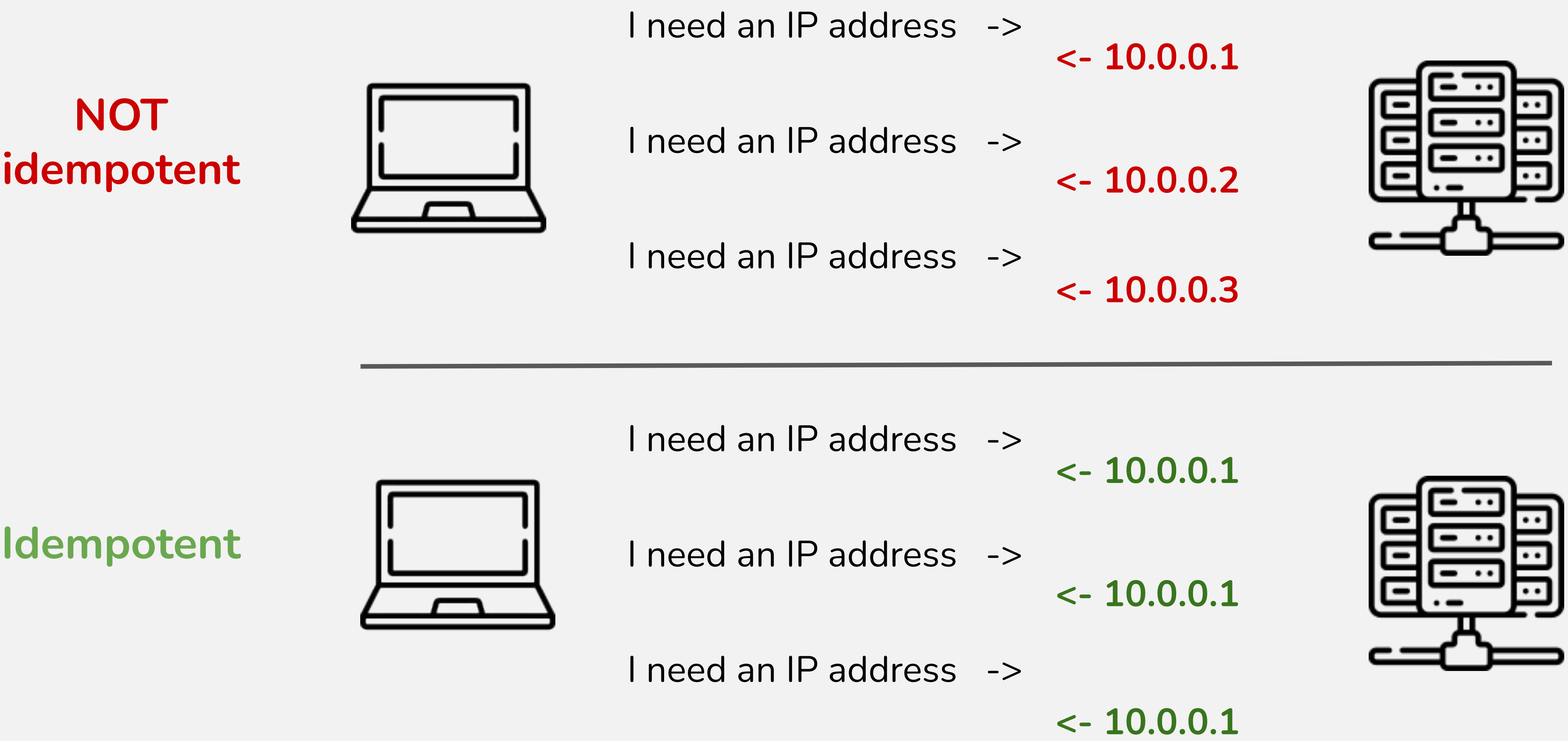
Idempotency

Definition

running the same operation multiple times has the same effect as running it once.

Idempotency is one of the cornerstone of reliability and simplicity in automation systems.

Example of Idempotency in networking



NOT idempotent

I need an IP address ->

<- 10.0.0.1

I need an IP address ->

<- 10.0.0.2

I need an IP address ->

<- 10.0.0.3

Idempotent

I need an IP address ->

<- 10.0.0.1

I need an IP address ->

<- 10.0.0.1

I need an IP address ->

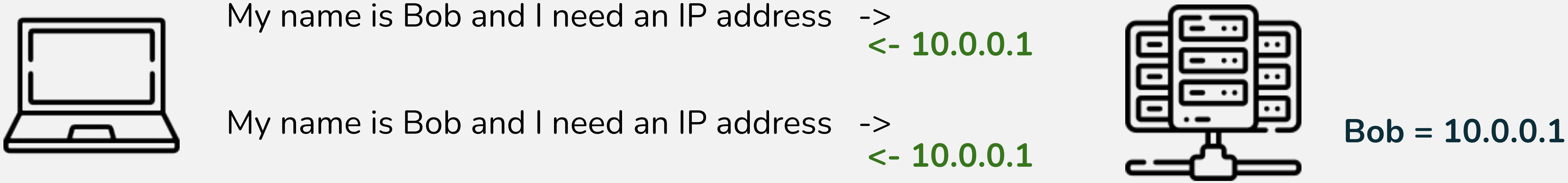
<- 10.0.0.1

Example of Idempotency in networking

Idempotency uses a declarative approach to move the complexity of managing the state from the client .. to the server

The example below works because the server is keeping the information that Bob was previously allocated the IP address 10.0.0.1

The laptop doesn't need to know the current state of the system.
The complexity is managed within the server to understand what needs to be done.



My name is Bob and I need an IP address ->
<- 10.0.0.1

My name is Bob and I need an IP address ->
<- 10.0.0.1

Bob = 10.0.0.1

Dry Runs

Definition

Show users exactly what will change before anything is executed

Builds confidence and reduces fear of unintended consequences.

Dry Run mode (AKA check mode)

Before executing any changes, the automation shows exactly what it would do, without actually doing it.

This gives the operator a chance to review, approve, and catch mistakes early.

“Here’s the diff - do you want to proceed?”

Dry Run mode - examples

ANSIBLE

Ansible includes 2 options
--diff & --check

Check each modules for support

```
@@ -7,7 +7,7 @@

 access-list 101 permit tcp any host 192.168.1.1 eq 80
 access-list 101 permit tcp any host 192.168.1.1 eq 443
-access-list 101 permit ip any any
+access-list 101 deny ip any any
 access-list 101 remark End of ACL
```

HashiCorp
Terraform

Terrarform plan, a built-in feature that is supported on all providers

```
# aws_instance.example will be created

+ ami           = "ami-abc123"
+ instance_type = "t3.micro"
```

kubernetes

kubectl diff or ArgoCD show diffs between current cluster state and the desired YAML.

```
spec:
  replicas: 2 -> 3
```

Transactional

Definition

Group changes so they either all succeed or can be rolled back cleanly if something fails.

Prevents partial or broken changes

Transactional

Transactional automation means grouping a set of changes so they either:

All succeed (commit) → and the system moves to the new desired state
Or none are applied (rollback) → leaving the system unchanged if something fails

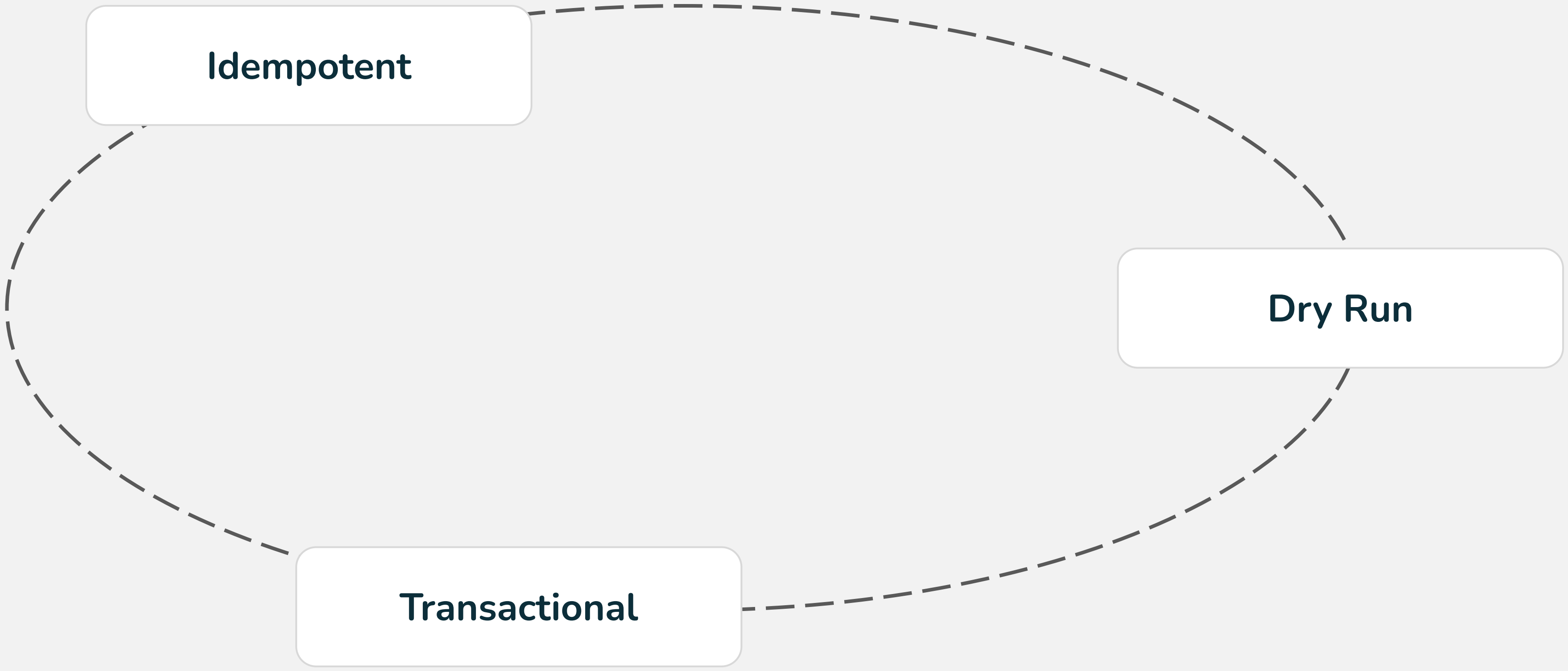
If failure occurs partway through,
the automation ensures no “half-applied” or “broken” states remain.

Rollback capabilities extend this by allowing the system to revert changes after they have been committed if issues are detected later.

Design Principles to build Trust

Main Principles	Predictable	Manageable	Transparent
	Simple	Reliable	Human Friendly
Design Principles	Idempotent	Dry Run	Transactional

Virtuous circle of Design Principles



Idempotent

Dry Run

Transactional

Tools and Technologies that enable Trustworthy Automation

Tools and Technologies to build Trust

Main Principles	Predictable	Manageable	Transparent
	Simple	Reliable	Human Friendly
Design Principles	Idempotent	Dry Run	Transactional
Tools and Technologies	Declarative Vs Imperative	Version Control	Testing

Declarative Vs Imperative

Imperative

HOW

Focuses on actions

Declarative

WHAT

Focuses on outcomes

Declarative Vs Imperative

```
configure terminal
interface GigabitEthernet0/1
switchport access vlan 10
exit
Exit
write memory
```

Imperative - HOW

- Manually describe the step-by-step recipe.
- If something goes wrong halfway, state may be inconsistent.

Focuses on actions

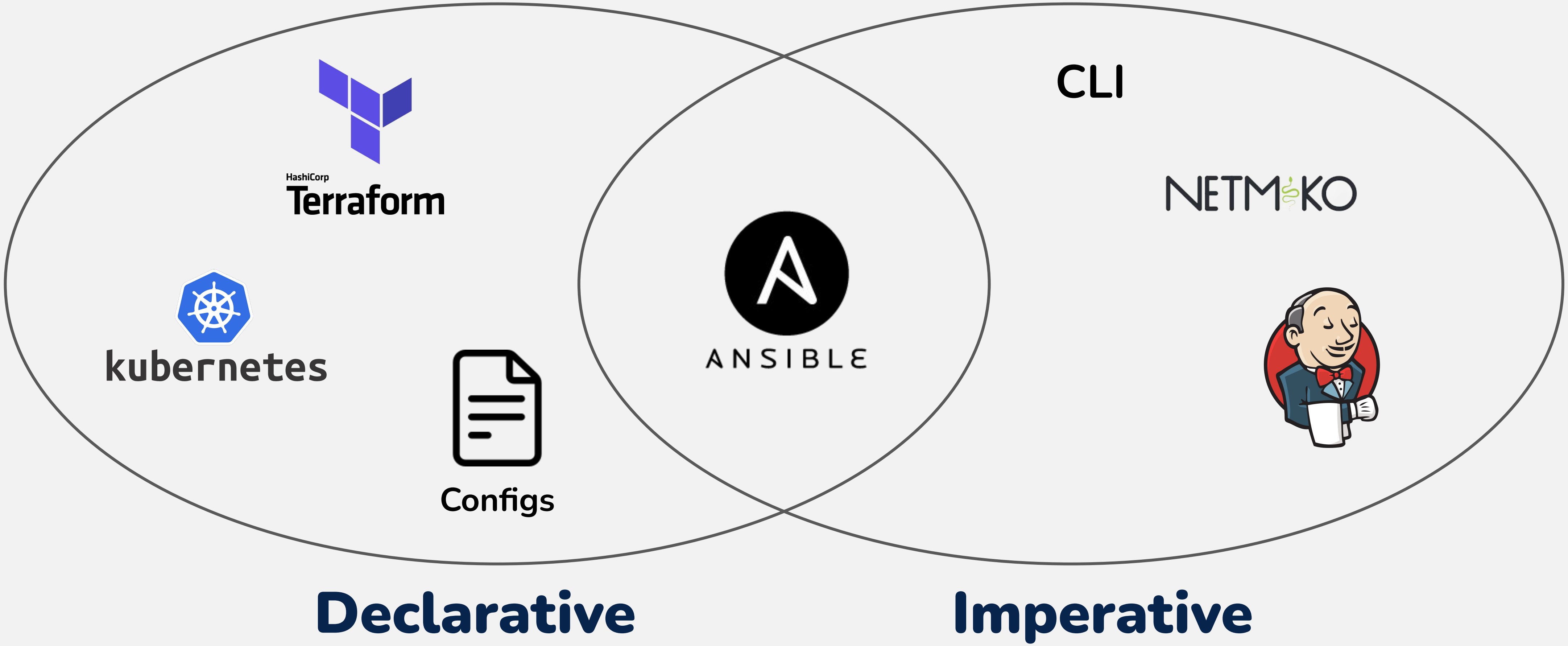
```
interface:
  name: GigabitEthernet0/1
  vlan: 10
```

Declarative - WHAT

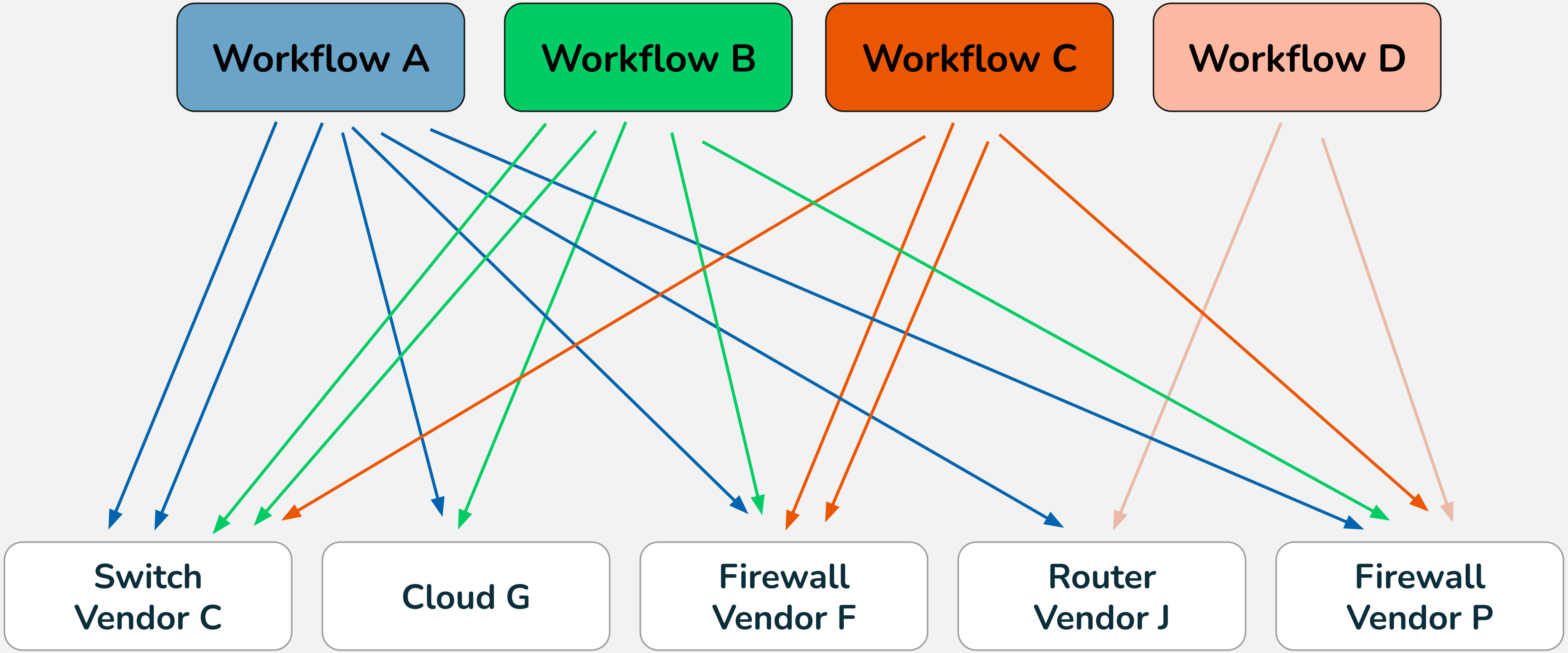
- You describe the desired end state, not how to get there.
- Easier to make idempotent and retry safely.

Focuses on outcomes

Declarative Vs Imperative

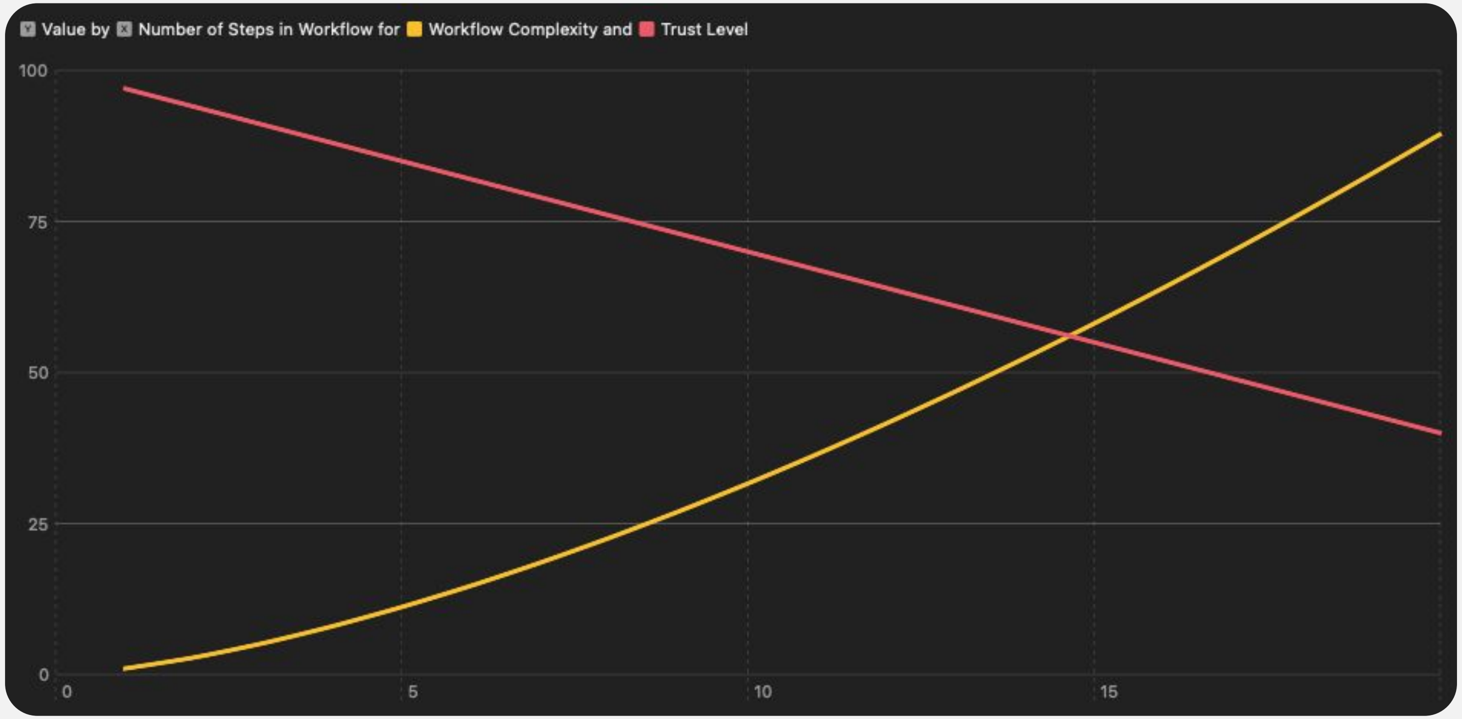


Imperative Method

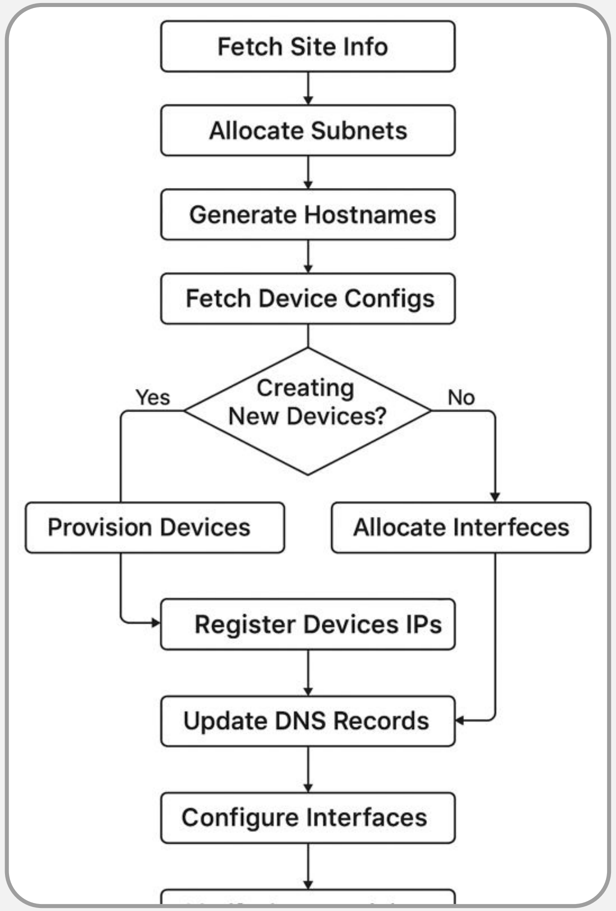


Declarative Vs Imperative

Imperative workflows are composed of multiple steps, the more steps, the higher the complexity



Number of steps in a workflow


Fetch Site Info

Allocate Subnets

Generate Hostnames

Fetch Device Configs

Creating New Devices?

Yes

No

Provision Devices

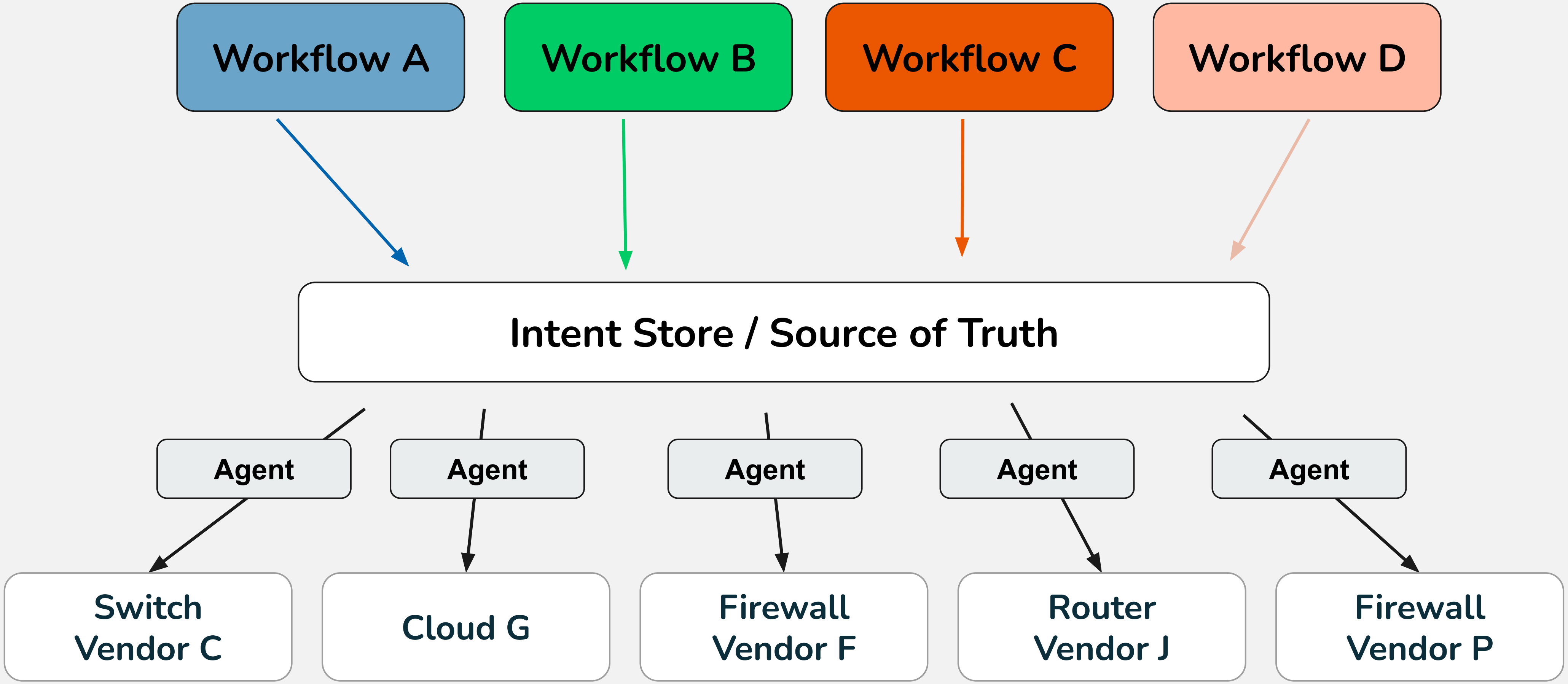
Allocate Interfeces

Register Devices IPs

Update DNS Records

Configure Interfaces

Declarative Method



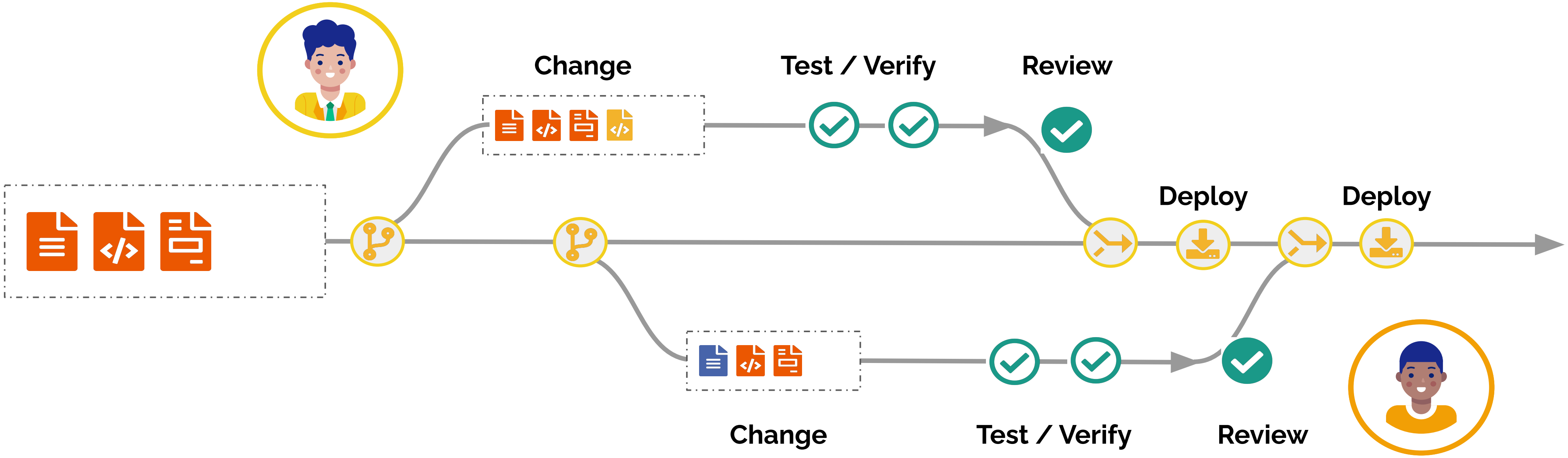
Version Control

Version control allows changes to be:

- Prepared in isolation
- Safely validated
- Reviewed

and only then integrated into the main automation environment.

Changes are done in a branch



Main benefits of Version Control

Auditability and Traceability

- See who changed what, when, and why.
- Essential for post-mortems and compliance
- Makes operations more transparent and safe

Collaboration and Review (Change Management)

- Team members can propose changes via PR
- Prevents risky or unreviewed changes from being pushed directly into production.

CI/CD Pipelines

- Automation workflows can be triggered automatically
- Changes can be tested and validated automatically before being deployed

Atomic changes

- Changes are grouped and committed as a single unit.
- There is no “partial change” state

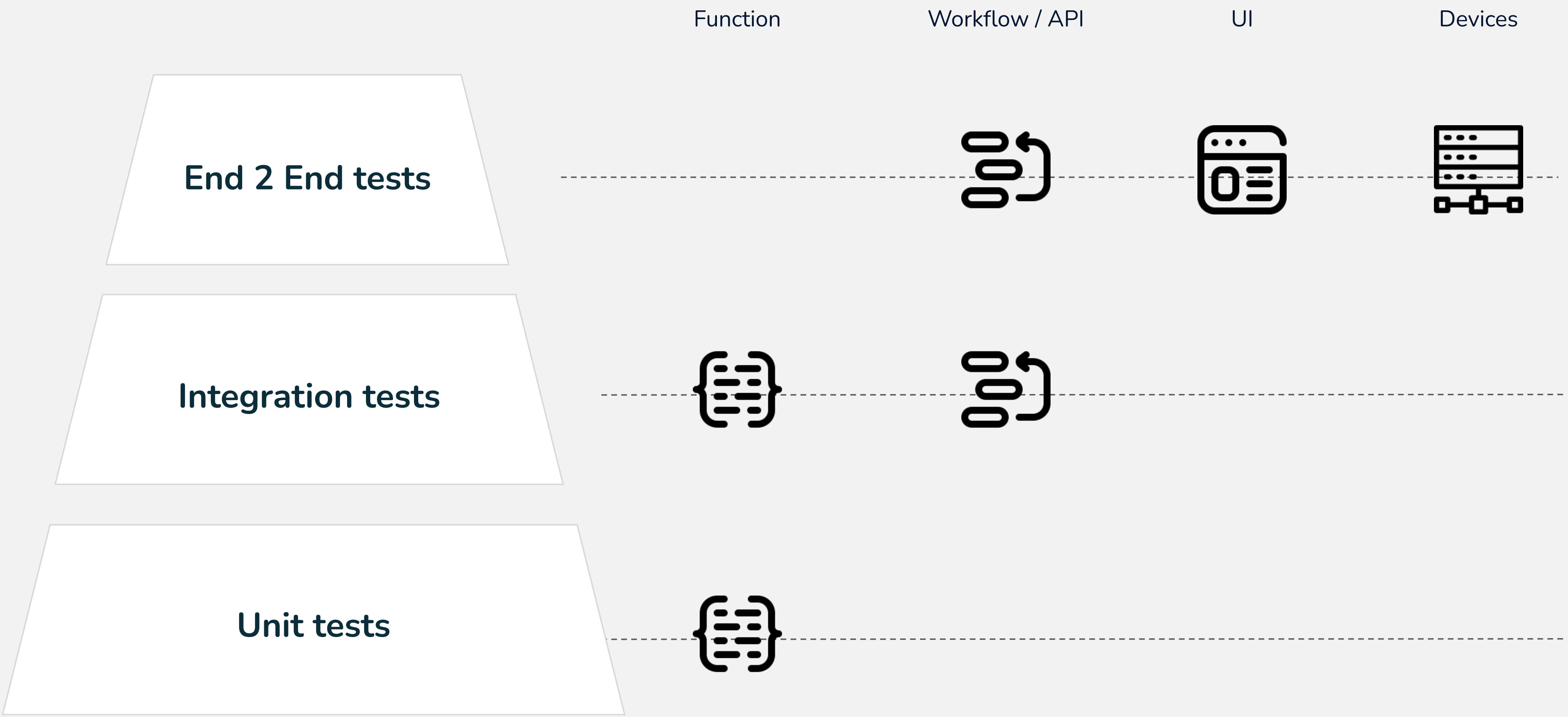
Testing

Testing pushes you to design applications and workflows that are modular, observable, and deterministic.

It encourages clear boundaries, clean inputs and outputs, and repeatable behaviors.

Testable systems are a design choice

Testing



Function

Workflow / API

UI

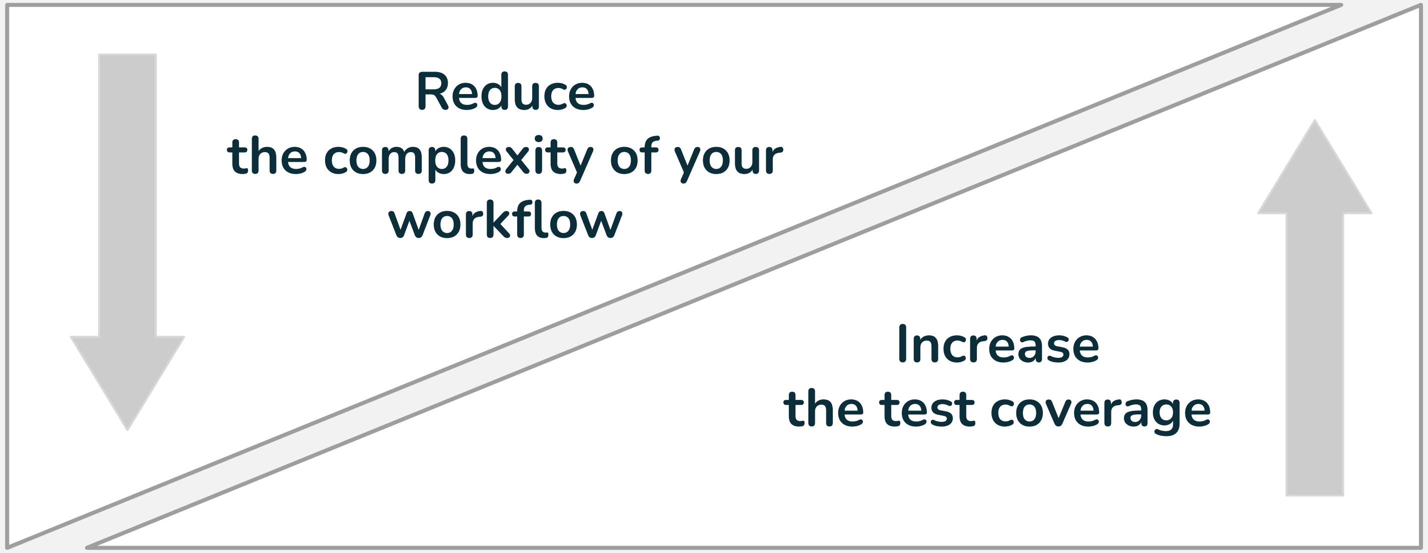
Devices

End 2 End tests

Integration tests

Unit tests

Automation workflow testing

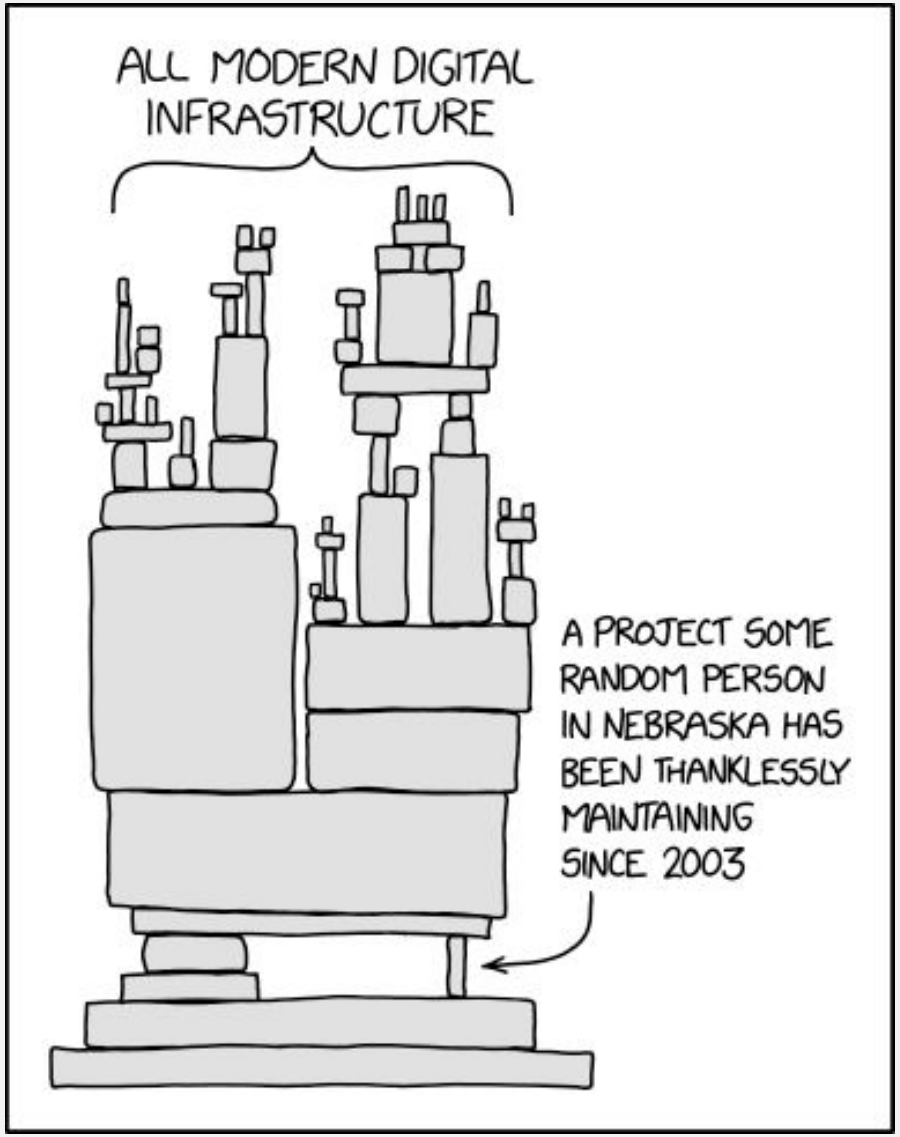


Reduce
the complexity of your
workflow

Increase
the test coverage

Write integration tests
Spend hours manually testing my workflow and still missing stupid bugs
imgflip.com

Practical Patterns for Building Trust


ALL MODERN DIGITAL INFRASTRUCTURE
A PROJECT SOME RANDOM PERSON IN NEBRASKA HAS BEEN THANKLESSLY MAINTAINING SINCE 2003

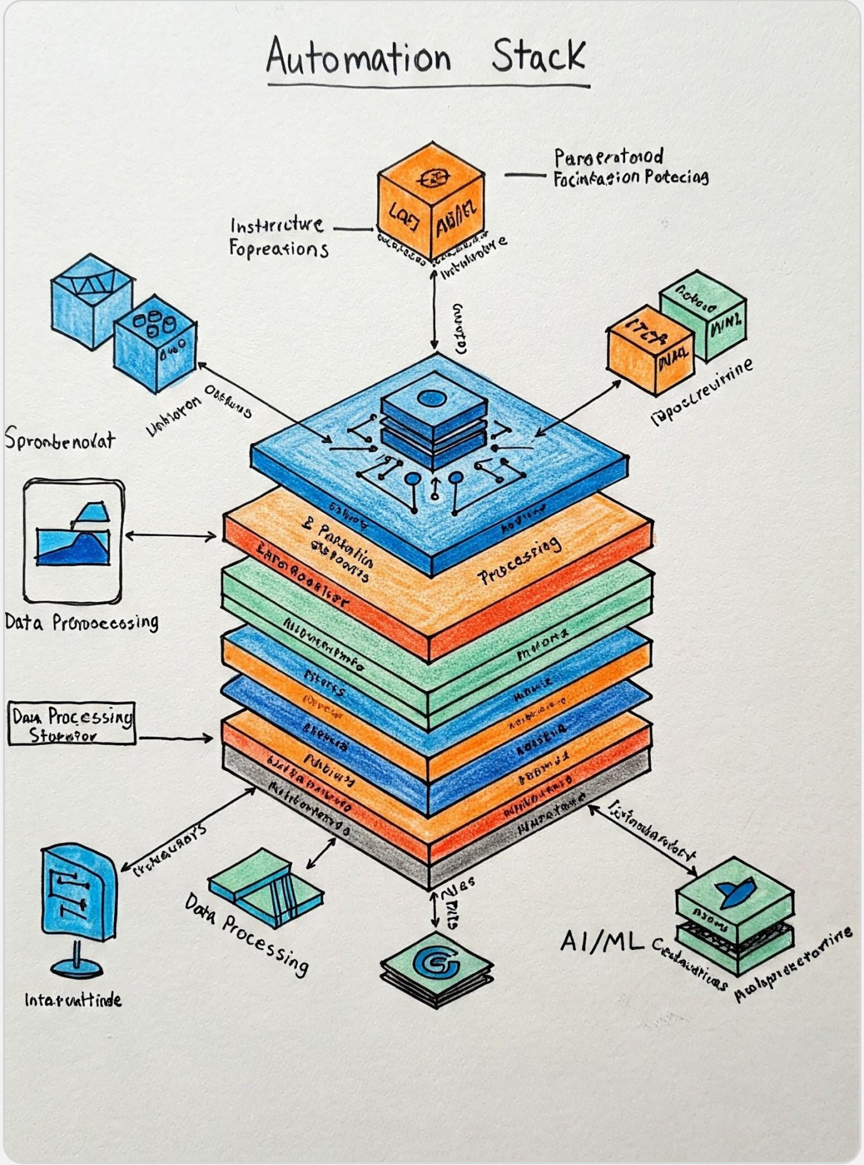
Integrate what you CAN

Build what you MUST

Select the right stack

Ensure the libraries / tools you are dependent on provides

- Programmable interfaces
- Declarative behavior
- Idempotency
- Test friendly interfaces
- Developer Experience
- Traceability & Logging



The 3 primary attributes, classify your data

Role	Capture the primary function of an object
Status	Capture all the stages of the lifecycle of an object
Kind	Capture the nature of an object

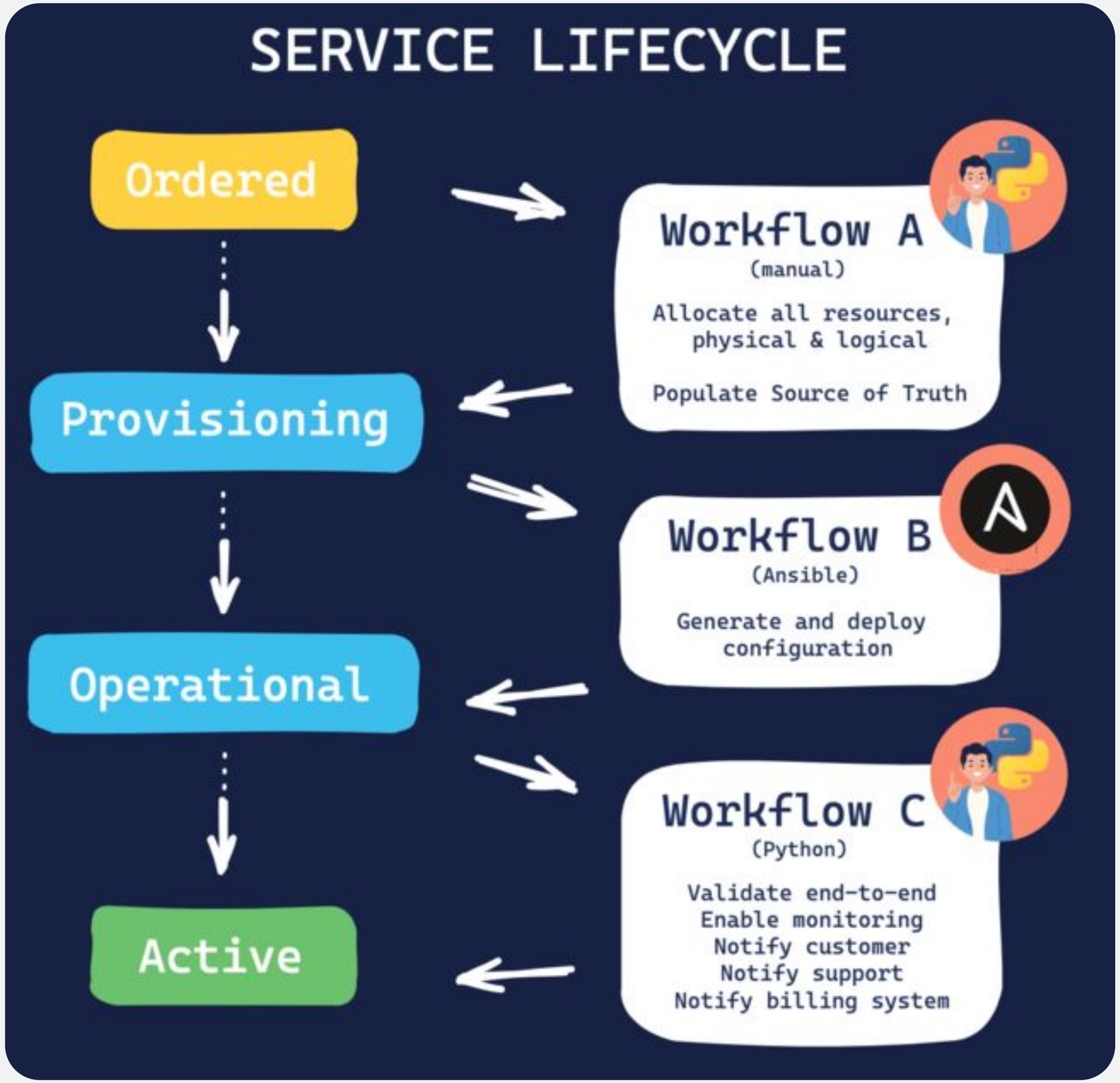
Enforce business processes as part of your automation workflows

Maintenance windows are designed to ensure that no disruptive actions will be applied during business hours.

Similar rules should be embedded directly within your playbook

Ideally filter the valid target devices at the inventory level

- Only arista devices
- that are in maintenance mode



Enforce business processes as part of your automation workflows

Option 1 - Limited Inventory

```yaml
---
- name: "Upgrade Software image on Arista Devices"
  hosts: platform_arista:&status_maintenance
  gather_facts: false
  tasks:
    - name: "Upgrade Software image"
      ...
```

Option 2 - Inline Validation

```yaml
---
- name: "Upgrade Software image on Arista Devices"
  hosts: platform_arista
  gather_facts: false
  tasks:
   - name: "Validate if the device is in maintenance mode"
     meta: "end_play"
     run_once: true
     when:
       - "device.status != 'maintenance'"
```

Provide safe default options

Create different playbook for the same workflow but with different outcome.

- Call out safe playbooks explicitly
- Ensure default values are always Safe
- Activate diff mode by default

Prepare the change

```
ansible-playbook pb.policies.yml --check --diff
```

Apply the change

```
ansible-playbook pb.policies.yml
```

```
– fortinet
  ├── pb.policies.apply.yml
  ├── pb.policies.check.yml

– load_balancers_external
  ├── pb.config.vips.apply.yml
  ├── pb.config.vips.check.yml
```

Thank You

Abstract

Building Trustworthy Network Automation, From Principles to Practice

Trust is essential for successful network automation adoption.

When automation platforms exhibit predictable behaviors and transparent processes, teams can confidently delegate critical network operations. Building trustworthy automation doesn't happen by itself, it needs to be baked into the design of every workflows. This technical session examines core principles that build trust, including idempotency, declarative workflows, and robust version control. Using practical examples from production environments, we'll analyze how specific technical decisions affect automation reliability and team confidence. The presentation covers key implementation patterns like state verification, diff-based changes, and failure handling. Attendees will learn concrete approaches for building automation platforms that network teams can trust and rely on daily.