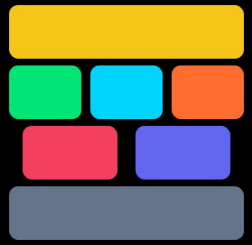


The Network Automation Map

Navigate Your Journey with the NAF Automation Framework

Pete Crocker
OpsMill

ESNOG 35

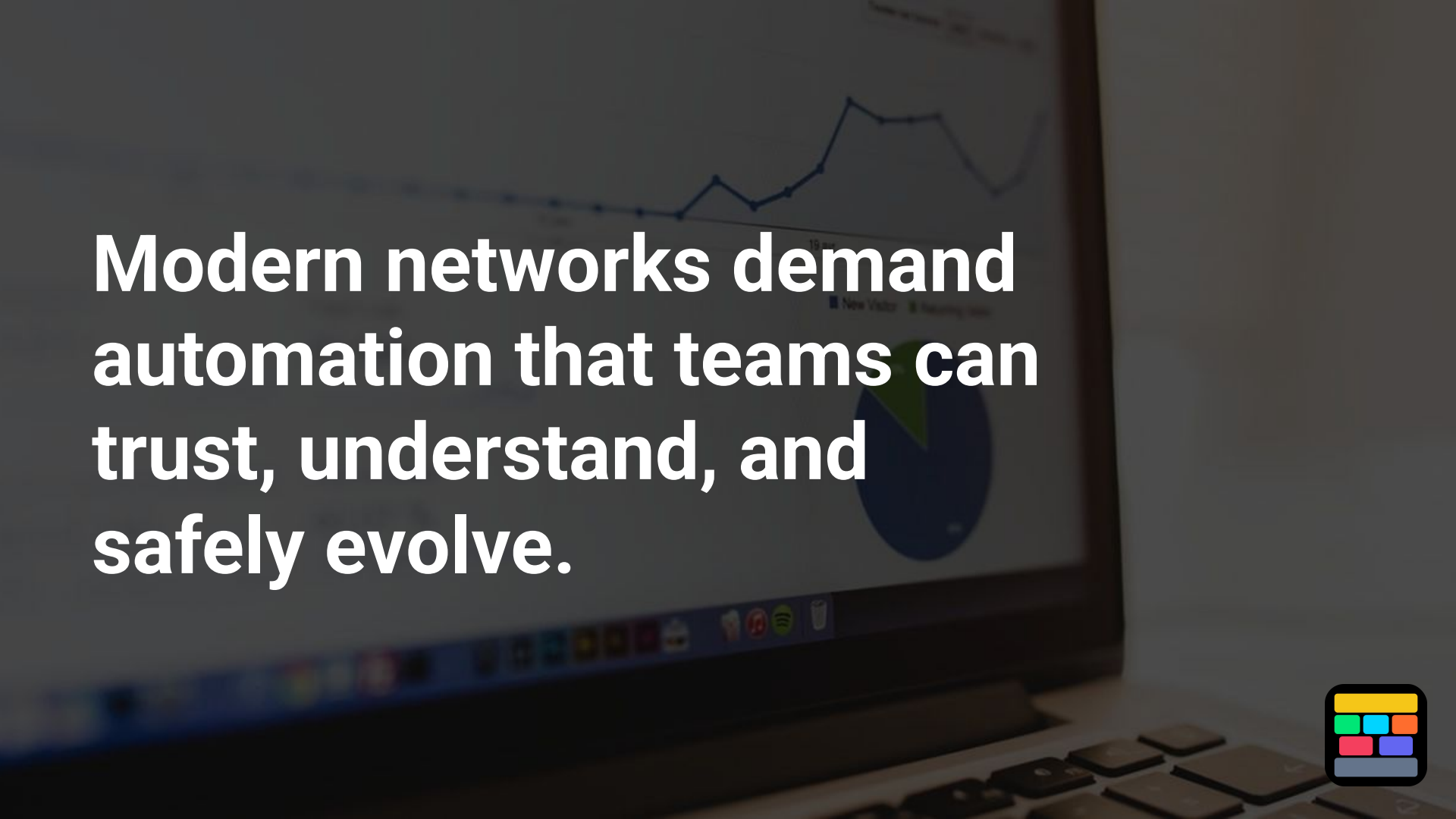
About Me

Pete Crocker

Director of Solution Architecture

OpsMill

Introduction


Modern networks demand automation that teams can trust, understand, and safely evolve.

Yet, it’s still overly complicated for most organizations

Building it is hard, maintaining it is almost impossible

The pattern we keep seeing

Rebuild from scratch

Teams keep recreating the same building blocks—data models, pipelines, integrations

Learn the hard way

Most “best practices” are discovered through outages, drift, and painful rewrites instead of repeatable patterns.

No shared blueprint for what ‘good’ looks like

Without a common map, it’s hard to assess maturity, compare architectures, or even agree on what problem to solve first.

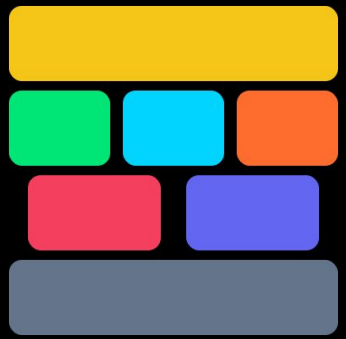
Multiple people from the NAF community got together to find a solution

It quickly turned into a working group with weekly meetings

It was hard at first
Everyone was biased by their own tools and habits
Ironically, we were missing a shared lexicon

The solution was to stop focusing on tools and focus on functional building blocks

Quickly, everyone started talking the same language



NAF Automation Framework

Simple building blocks that underpin any network automation framework

Not a reference architecture — it’s a shared vocabulary + responsibilities.

Ryan Shaw

Dinesh Dutt

Christian Adell

Claudia de Luna

Srividya Iyer

Wim Henderickx

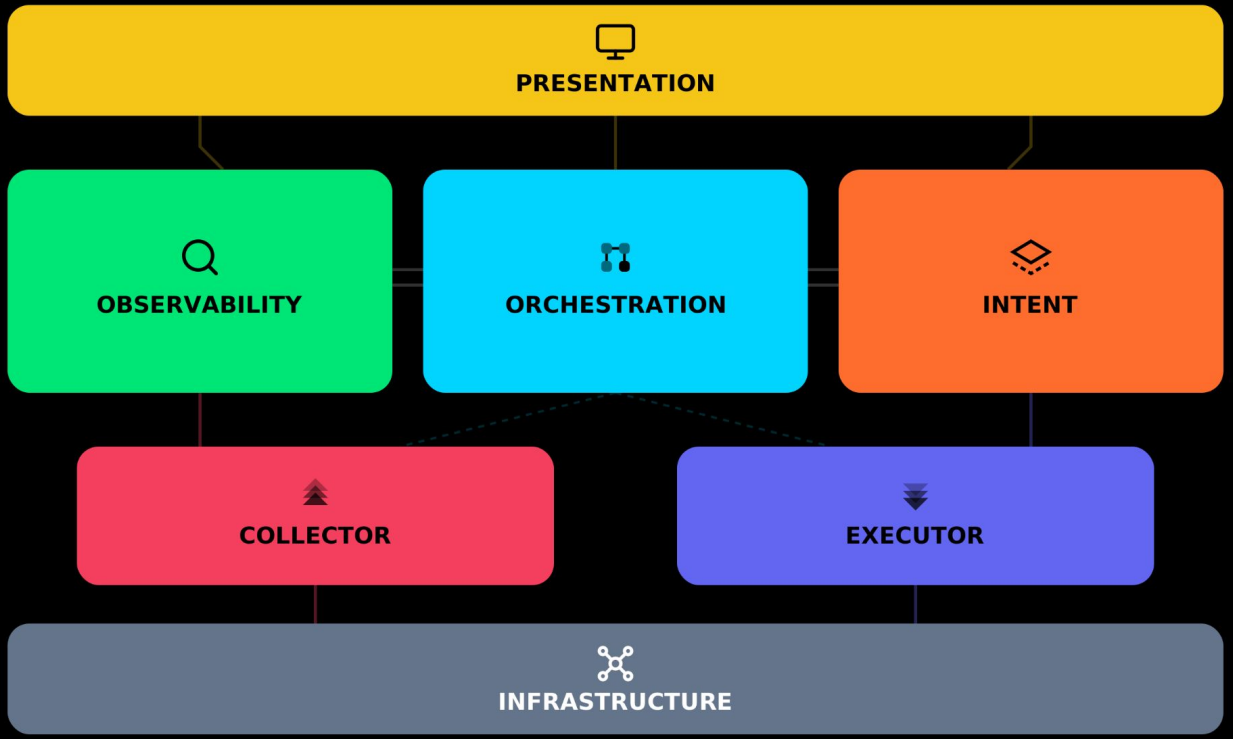
Damien Garros

The NAF Community

NAF

The Team behind the Working Group

NAF Automation Framework



NAF Automation Framework Fundamentals

Functional Building Blocks

The NAF automation framework is meant to be tool agnostic to avoid comparing apple and orange.

Each functional building block can be mapped to one or more tools and each tool can map to multiple functional blocks.

Living Document Not a Protocol

The NAF automation framework is meant to evolve over time.

It’s not a strict implementation that imposes a specific way of doing things and in many cases, not all components are required to get started.

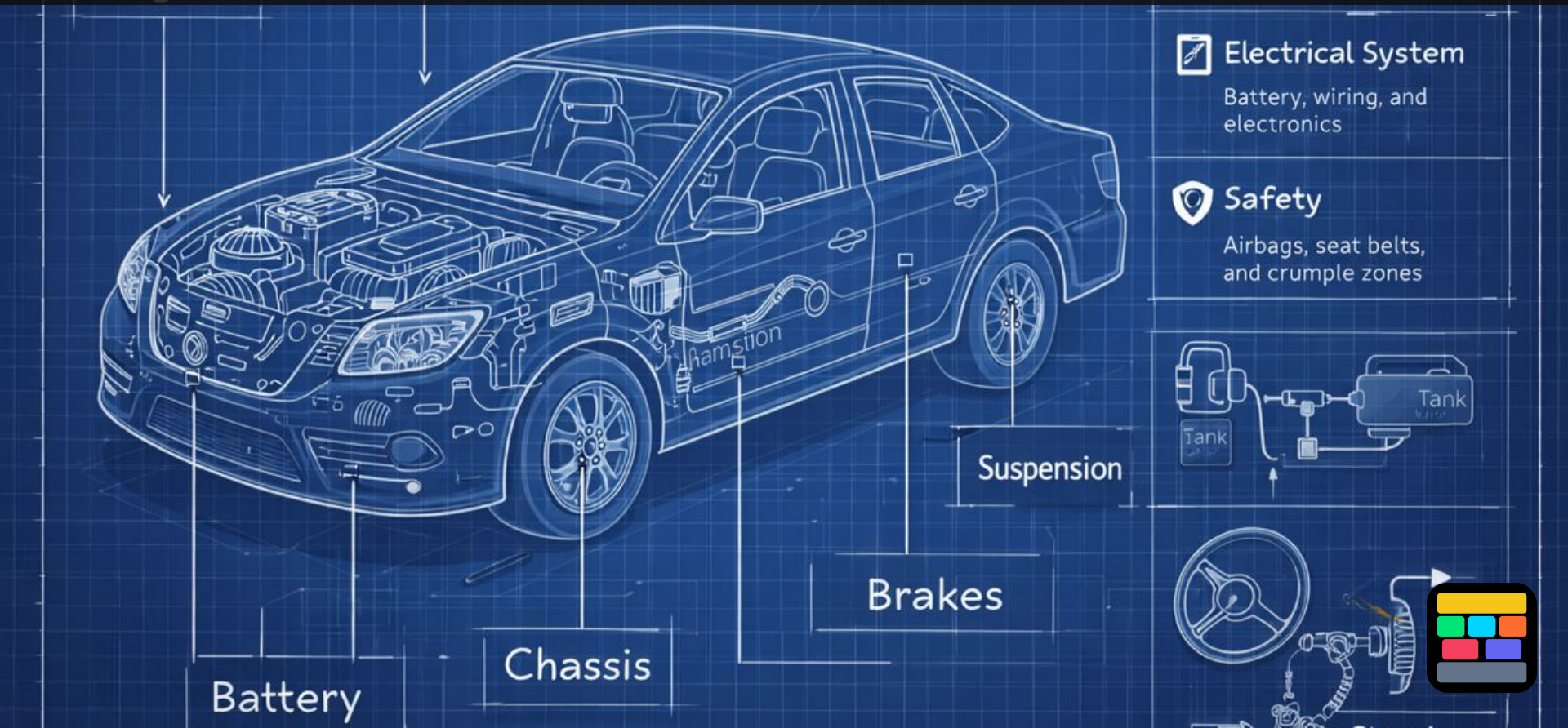
Both for Beginners and Experts

The NAF automation framework initiative is focusing initially on laying out the main building blocks to lay the foundation.

In the future the goal is to go deeper into each block.

A map to help navigate the terminology and understand how things are related to each other

A functional blueprint to help everyone understand and build Network Automation Stack (system thinking)



Target Audience

Builders

Network Automation Engineer

Automation Architect

Software Engineer

Network Reliability Engineer

Users

Network Engineer

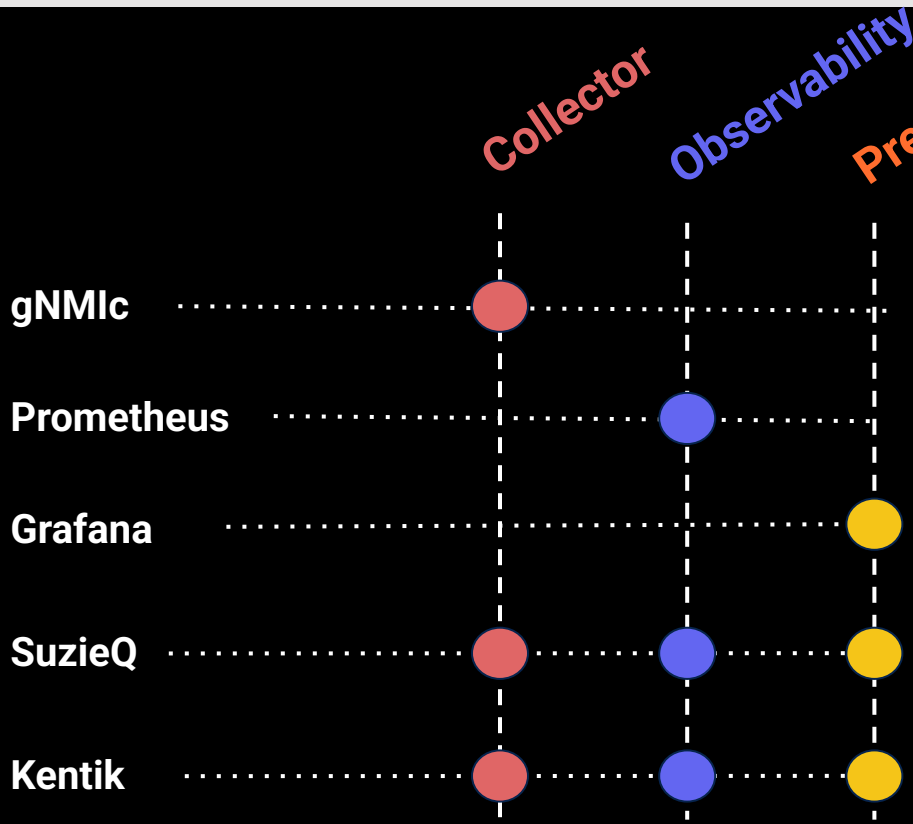
Network Ops

Network Architect

Engineering Manager


Wait, what about my tools ? Are they gone ?

Mapping between functional blocks and tools



Each tool / product / project
can map
Completely or Partially
to
One or Multiple blocks

Where do I start?

Do I need to implement all blocks to get started?

No, you should only implement what is required for your use case(s)

Is there a specific order to get started?

No, it really depends on your use case(s).

Main functional Building blocks

What defines a functional building block

A **tool-agnostic function** in the automation system —
A **chunk of responsibilities** with clear goals, inputs/outputs, and capabilities

Purpose / Goals

what outcome it exists to deliver

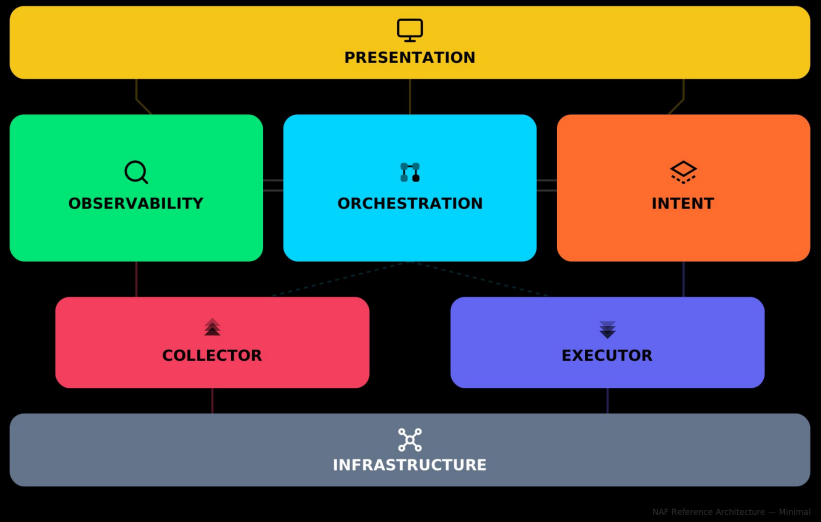
Capabilities

expressed as MUST / SHOULD / MAY (requirements, not products)

Boundaries

what it does and what it does not do (inputs → outputs)

Intent


PRESENTATION
OBSERVABILITY
ORCHESTRATION
INTENT
COLLECTOR
EXECUTOR
INFRASTRUCTURE
NAF Reference Architecture — Minimal

Intent

Defines the logic to handle and the persistence layer to store the desired state of the network, including both configuration and operational expectations.

Source of Truth ✗

Source of Truth has been the root cause of many misunderstandings within our industry.

Intent ✔

Intent is meant to provide a more accurate definition

Intent - Introduction

Inventory	Cabling / Topology	DCIM
Circuit	IPAM	Roles/Statuses
Configuration Templates	Routing Information	Services

What do you need to rebuild it
if the network was completely lost?

Why do we need the Intent

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.

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

Declarative - WHAT

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

Differences between Cloud and Networking

	Cloud	Networking
Declarative	Git	Git, Netbox, Nautobot, Infrahub
Imperative	Optional	Optional

Intent - Requirements

MUST be capable of representing, in a structured form, any network-related aspect.

MUST support create, read, update, and delete operations

MUST be exposed through a standardized, well-documented API

SHOULD provide a consistent and unified view of the desired state

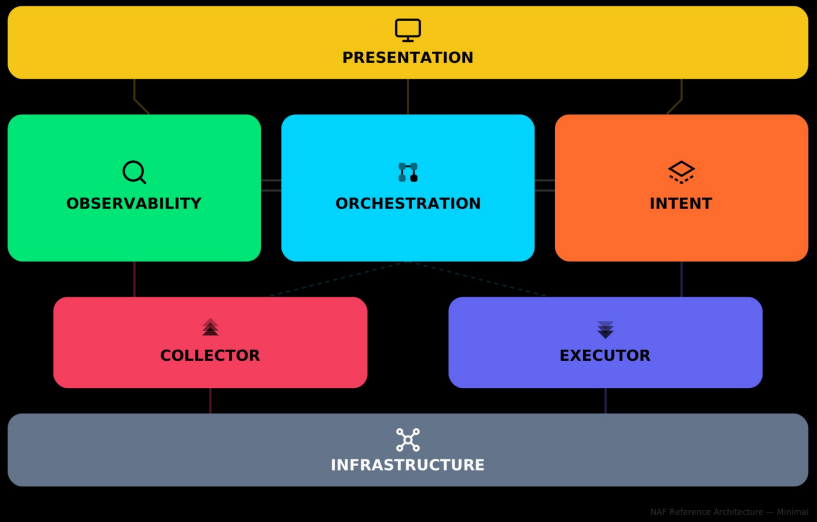
SHOULD use a neutral representation that will be derived into vendor-specific configuration artifacts

SHOULD include metadata that supports effective data governance

SHOULD be transactional, and provide a versioned access to data.

MAY include all the logic related to intended state management

Executor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Executor

Encompasses the actual tasks applied to the network to drive changes (e.g., updating configuration) as guided by the intended state.

Executor - Requirements

MUST be capable of interacting with any of the supported network write interfaces

SHOULD provide a dry-run operation to check the expected result of the execution

SHOULD come from the intended state or be derived from it

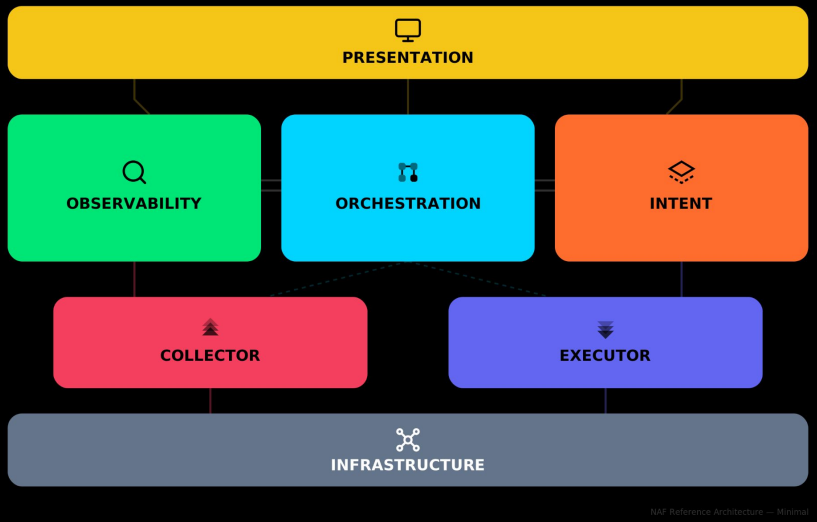
SHOULD support transactional execution of the changes

SHOULD support any network operation that alters the network state

MAY support both imperative and declarative approaches

Observability

Collector



Observability

Stores the actual network state, and defines the logic to process the observed data.

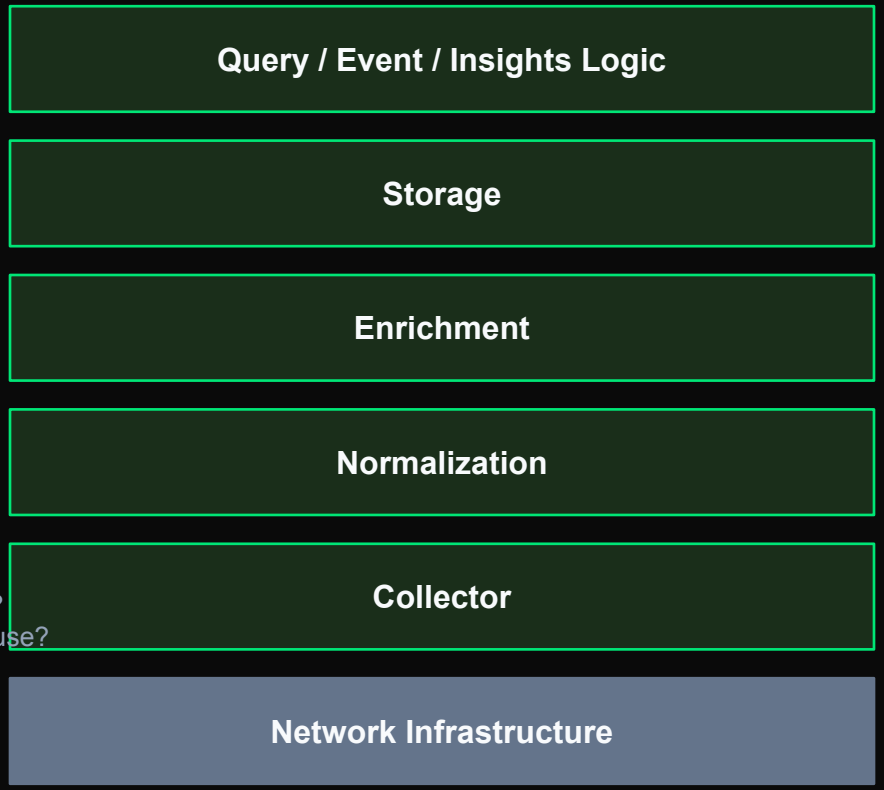
Collector

Focuses on retrieving (i.e., reading) the actual state of the network.

Observability Sources

Logs	Metrics	Traces	Flows
Packet Captures	State	Config	Probes

Observability Stack: some questions to ask



Which Data retention Policy?

Provide Context to the data

Make the data vendor neutral (Optional)

What to collect? Static or dynamic?

Push, Pull or both?
Which protocol to use?

Observability - Requirements

MUST support historical data persistence

MUST offer programmatic access to this data

SHOULD offer a capable query language to extract the data.

SHOULD expose relevant insights into the current network state

SHOULD automatically generate events when discrepancies are detected

data SHOULD be normalized into vendor agnostic data model

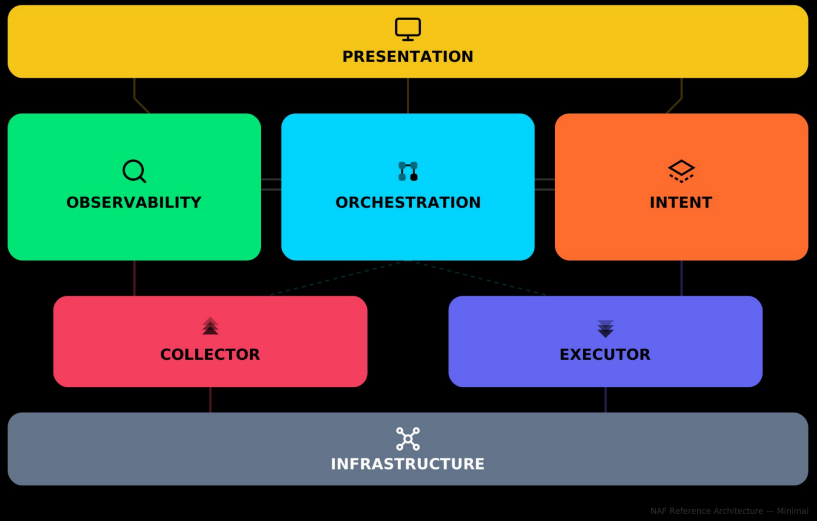
events MAY be processed by humans or connected to the Orchestration

MAY be enriched with contextual information from the intended state

Collector - Requirements

MUST include capabilities for retrieving live data from the network using read interfaces (push, pull)

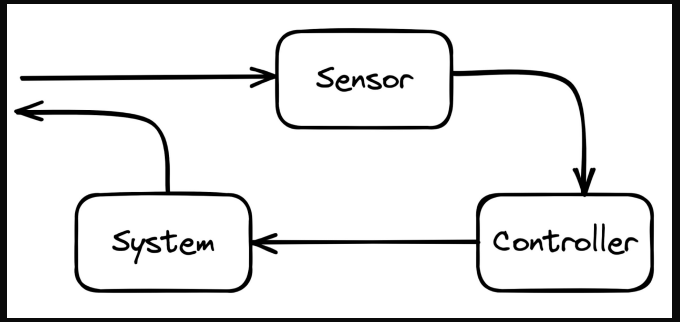
Orchestrator

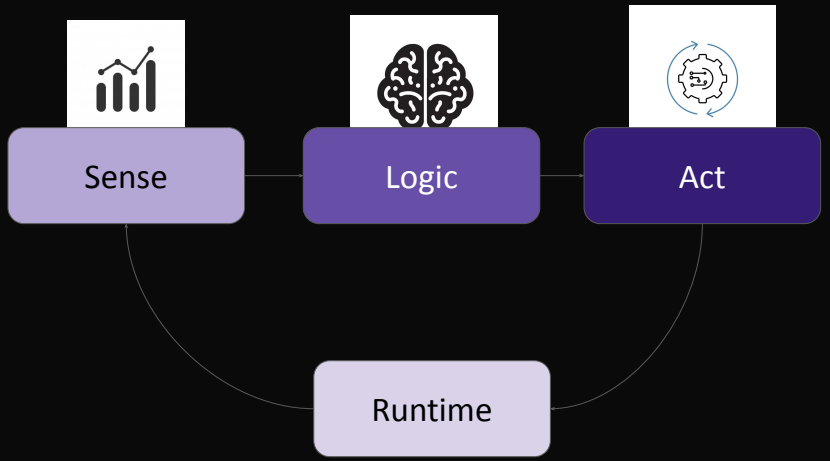


Orchestrator

Coordinates activities across various building blocks

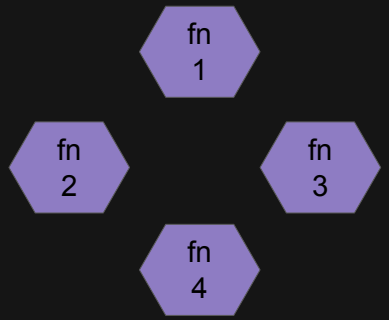
Event Driven Control Loop: Sense - Logic (Reason) - Act





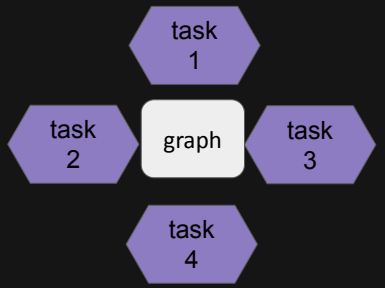
Orchestration implementation approaches

Monolith



E.g. a python program

Workflow



Ansible (predefined workflow)

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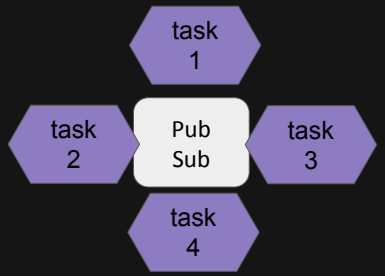
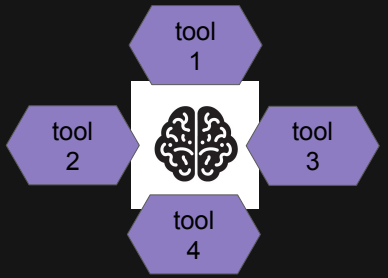


Event driven and distributed

Agentic



Agentic

Orchestration: Trust

TRUSTED

- controller style

NOT TRUSTED

- change log/approval style
- Dry-run
- Diff (before/after)
- Rollback

Gaining Trust: Dry Run - Rollback - Diff

Diff:
- What changed?
- Review the changes before applying to the network

DRY-RUN

Try the workflow without applying it to the network

BEFORE

Rollback:
- Something bad happened, move back to a well known good state

AFTER

Orchestrator - Requirements

MUST enable to coordinate processes across the various building blocks

Process execution SHOULD follow an event-driven approach

Execution logic SHOULD allow for reverse/compensating actions

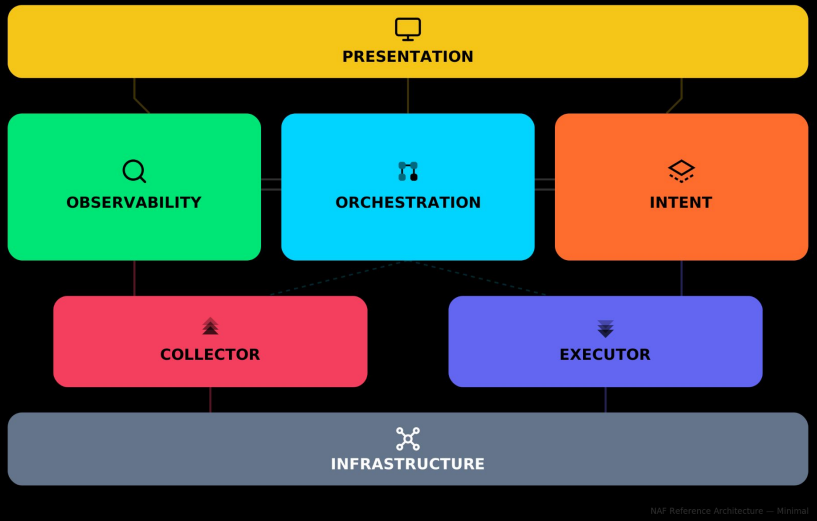
SHOULD provide the ability to schedule the execution of a workflow

SHOULD provide a dry-run operation to check the expected result of the workflow

SHOULD provide logging and traceability of past and current workflows

MAY include logic to correlate multiple events, infer relationships

Presentation



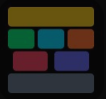
Presentation

Provides the interfaces through which users interact with the system, including dashboards, graphical user interfaces

Presentation

It's important to separate the presentation layer to avoid building workflows that are specific to one tool / interface

It is designed to interface with any of the other building blocks as required, serving as the primary point of contact between humans and the automation system, but this does not imply the need for a single pane of glass.



Presentation - Requirements

MUST provide robust authentication and authorization capabilities.

MAY take various forms depending on the needs of the end user

MAY support both read and write interactions

Practical Example

Example

Roll Out a New Subnet Across 50 Sites

A practical example showing how the NAF building blocks work together to deploy, validate, and remediate a network change at scale.

THE PROBLEM

Deploy a new subnet **(10.100.0.0/24)** across 50 branch sites, validate that it's working on every device, and automatically alert and remediate if any site falls out of compliance.

HIGH-LEVEL WORKFLOW

Example - Step-by-Step Workflow

1

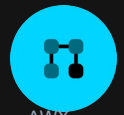
INTENT — SOURCE OF TRUTH

Engineer enters the desired config: subnet, VLAN, routing. This is stored as the Desired State.

2

ORCHESTRATOR — TRIGGER

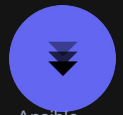
Receives a webhook about the change and triggers the Executor to begin deployment.



3

EXECUTOR — DEPLOY

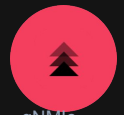
Reads from the Intent API, generates device-specific configs, and pushes them via NETCONF to all 50 routers.



4

COLLECTOR — GATHER STATE

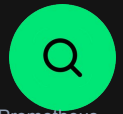
Connects to each device and retrieves actual interface configs, IP addresses, and routing tables.



5

OBSERVABILITY — VALIDATE

Compares Desired State against Actual State. Mismatches are exposed as metrics and trigger alerts.

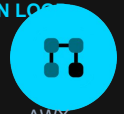


6

ORCHESTRATOR — REMEDIATE

↻ REMEDIATION LO

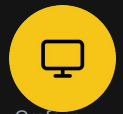
When an alert fires, automatically re-runs the Executor on the failing site, re-collects, and validates.



7

PRESENTATION — VISIBILITY

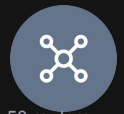
Dashboard shows all 50 sites: compliant ✓ or drifted ✗. Non-technical users can trigger manual remediations.



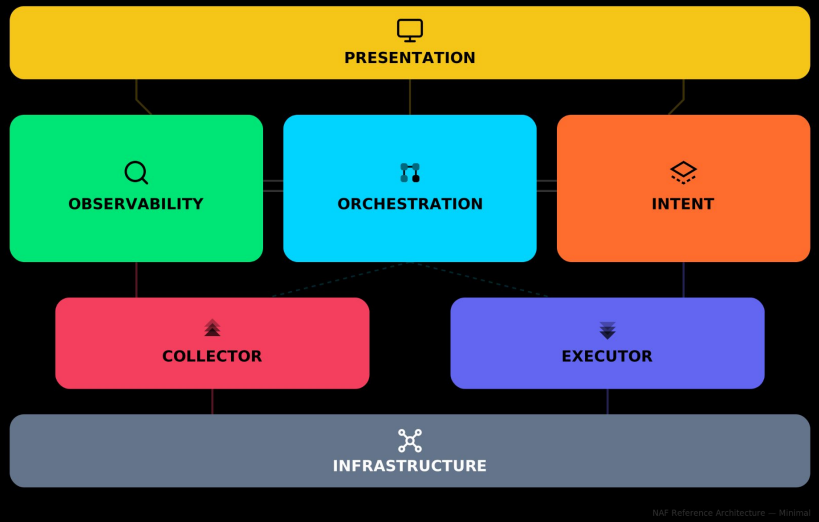
8

NETWORK — FOUNDATION

Success depends on device capabilities (e.g. NETCONF support). Limitations here affect the entire flow.



Example - Mapping to the Framework



STEP 1 → INTENT · INFRAHUB

Engineer defines desired config — the single source of truth for what the network should look like.

STEPS 2, 6 → ORCHESTRATION · AWX

Coordinates the workflow: triggers deployment, handles alerts, and runs remediation loops.

STEP 3 → EXECUTOR · ANSIBLE

Generates and pushes device configs via NETCONF to all 50 sites.

STEP 4 → COLLECTOR · GNMIC

Reads the actual state from each device after deployment.

STEP 5 → OBSERVABILITY · PROMETHEUS

Compares desired vs. actual, exposes drift as metrics, triggers alerts.

STEP 7 → PRESENTATION · GRAFANA

Dashboard shows compliance status per site with drill-down.

Additional Resources

Additional Resources

Designing Network Automation at Scale

A comprehensive guide to designing scalable, reliable, and maintainable network automation systems

https://designingnetworkautomation.com/
By Christian Adell

NAF Network Automation Solution Wizard

This application helps you apply the Network Automation Forum's NAF to your automation projects.

https://naf-naf-wizard.streamlit.app/
By Claudia de Luna

Summary

- Not a standard, it’s a guide
- You don’t need everything to get started
- Think Automation as a system
- Focus on functional first, tools later
- Each tool can map to multiple building blocks
- Don’t reinvent the wheel
- Map your existing workflow toward the framework
- Give us some honest feedback good and bad

How can you help

Use case document Github:

https://github.com/Network-Automation-Forum/reference/blob/main/docs/Framework/Framework.md

Tool mapping

Expand details per building block

NAF Slack channel:

https://networkautomationfrm.slack.com/archives/C082G6VGZHP

Observability

Collector

Observability

Stores the actual network state, and defines the logic to process the observed data.

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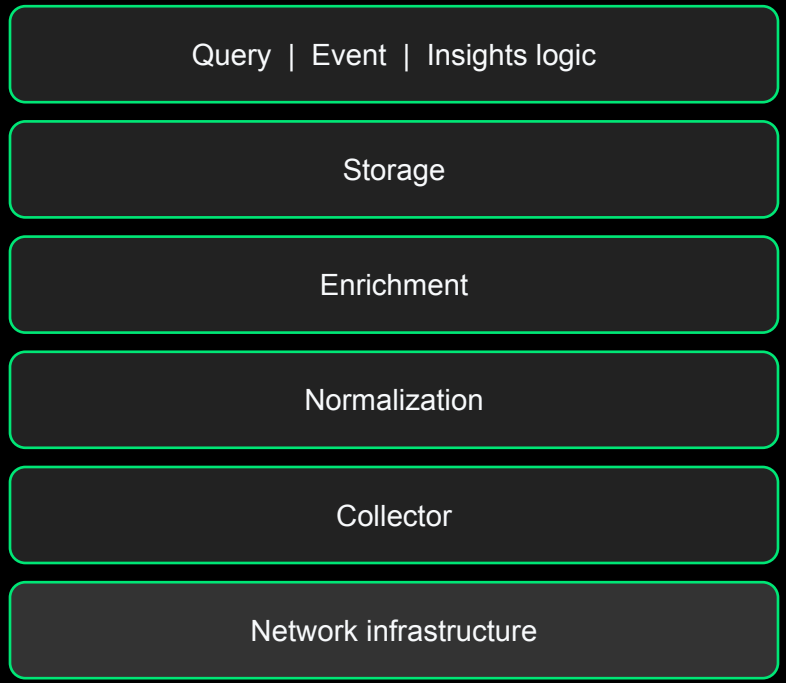
Focuses on retrieving (i.e., reading) the actual state of the network.

Observability Sources

- Logs
- Metrics
- Traces
- Flows
- Packet Captures
- State
- Config
- Probes

Observability Stack: some questions to ask



Which Data retention Policy?

Provide Context to the data

Make the data vendor neutral (Optional)

What to collect?

- Push, Pull or both?
- Which protocol to use and what is supported by the vendor?

Observability - Requirements

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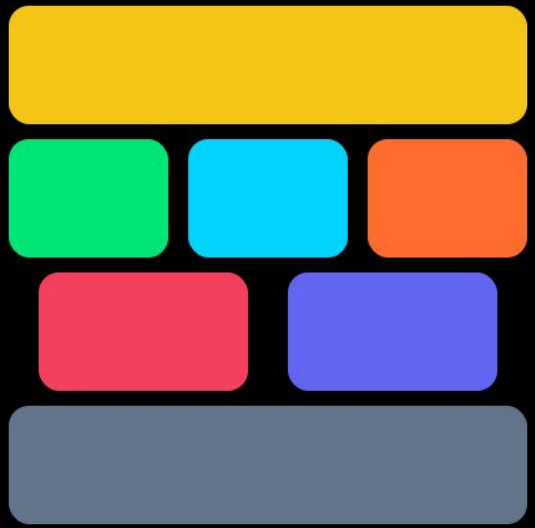
Orchestrator



Orchestrator

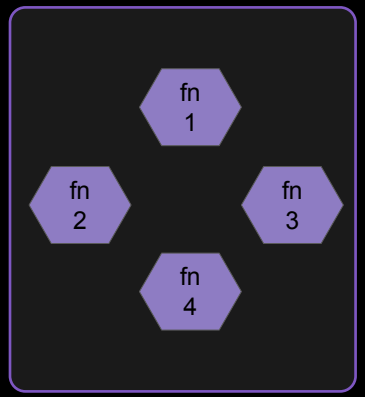
Coordinates activities across various building blocks

Event Driven Control Loop: Sense - Logic (Reason) - Act

Sensor → Controller → System (feedback loop)

Orchestration implementation approaches

Monolith



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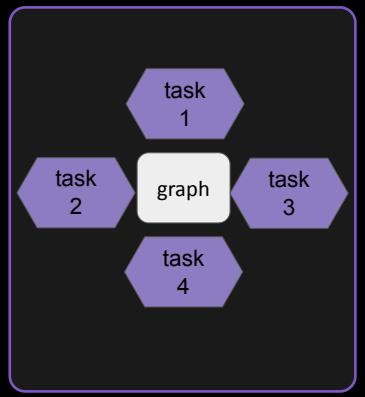

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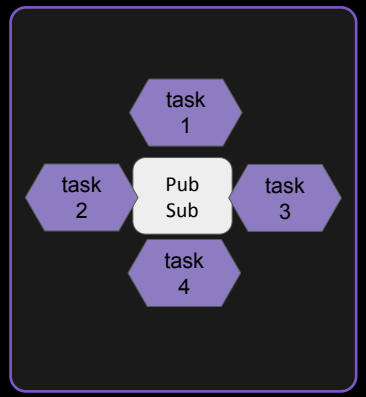

Event driven and distributed

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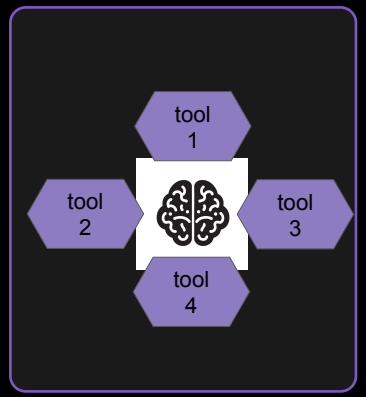

Agentic

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