

Open Source  
**MANO**  
*by ETSI*

# Overview of the Service Assurance architecture

Gerardo García (Telefónica, OSM TSC Chair)

OSM Training Seminar - SLICES

13/02/2024

# Release FOURTEEN comes with the new Service Assurance architecture enabled by default

---

- MON and POL functionality has been transferred to the new architecture
  - Metric acquisition (VM resource consumption)
  - Closed-loop for auto-healing
  - Closed-loop for auto-scaling
  - VNF alarms
- Airflow, Prometheus AlertManager and PushGateway are deployed
  - Airflow provide a mechanism to run scheduled workflows, as well as workflows on demand from an alert
- Webhook Translator is a new component that has been added to translate webhooks

# The new SA architecture is installed by default

## ./install\_osm.sh

```
$ helm -n osm ls
```

NAME	NAMESPACE	REVISION	UPDATED	STATUS	CHART	APP VERSION
airflow	osm	1	2023-06-07 15:08:48.613039036 +0000 UTC	deployed	airflow-1.9.0	2.5.3
alertmanager	osm	1	2023-06-07 15:10:23.448079581 +0000 UTC	deployed	alertmanager-0.22.0	v0.24.0
osm	osm	1	2023-06-07 15:08:43.421836769 +0000 UTC	deployed	osm-0.0.1	14
pushgateway	osm	1	2023-06-07 15:10:19.507304535 +0000 UTC	deployed	prometheus-pushgateway-1.18.2	1.4.2

```
$ kubectl -n osm get pods
```

NAME	READY	STATUS	RESTARTS	AGE
airflow-postgresql-0	1/1	Running	2 (2d20h ago)	5d22h
airflow-redis-0	1/1	Running	1 (2d20h ago)	5d22h
airflow-scheduler-5f7dbdc4f5-54x9c	2/2	Running	4 (2d20h ago)	5d22h
airflow-statsd-d8c8f886c-vt7xq	1/1	Running	4 (2d20h ago)	5d22h
airflow-triggerer-6668bd965c-n6snh	2/2	Running	3 (2d20h ago)	5d22h
airflow-webserver-5fb957dcf7-bcgzw	1/1	Running	1 (2d20h ago)	5d22h
airflow-worker-0	2/2	Running	2 (2d20h ago)	5d22h
alertmanager-0	1/1	Running	6 (2d20h ago)	5d22h
grafana-69c9c55dfb-jtwf1	2/2	Running	2 (2d20h ago)	5d22h
kafka-0	1/1	Running	1 (2d20h ago)	5d22h
keystone-7dbf4b7796-rqwg4	1/1	Running	1 (2d20h ago)	5d22h
lcm-6d97b88675-4m77j	1/1	Running	2 (2d20h ago)	5d22h
modeloperator-7dd8bf6c79-wx49m	1/1	Running	1 (2d20h ago)	5d22h
mon-ccb965d54-drvmr	1/1	Running	1 (2d20h ago)	5d22h
mongodb-k8s-0	1/1	Running	3 (2d20h ago)	5d22h
mongodb-k8s-operator-0	1/1	Running	1 (2d20h ago)	3d11h
mysql-0	1/1	Running	1 (2d20h ago)	5d22h
nbi-64b4f6ffd9-jtbf5	1/1	Running	5 (2d20h ago)	5d22h
ngui-78d9bd66dc-xbff6	1/1	Running	3 (2d19h ago)	5d22h
prometheus-0	2/2	Running	4 (2d20h ago)	5d22h
pushgateway-prometheus-pushgateway-6f9dc6cb4d-4sp4x	1/1	Running	1 (2d20h ago)	5d22h
ro-86cf9d4b55-z6ls7	1/1	Running	5 (2d20h ago)	5d22h
webhook-translator-57b75fc797-j9s7w	1/1	Running	1 (2d20h ago)	5d22h
zookeeper-0	1/1	Running	1 (2d20h ago)	5d22h

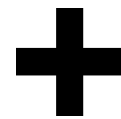
# Building blocks

# Building blocks of the new SA architecture

---



Apache  
**Airflow**

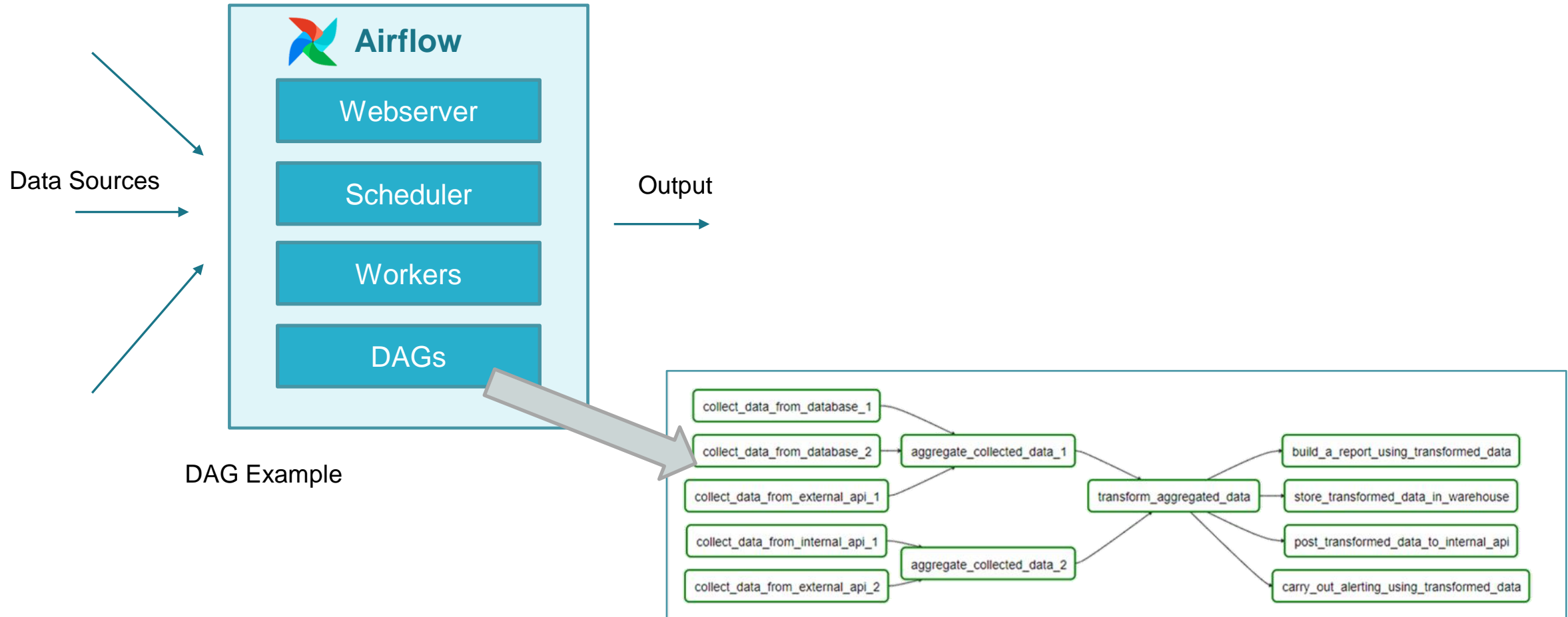


**Prometheus**

Prometheus  
Stack

# Building blocks of the new SA architecture

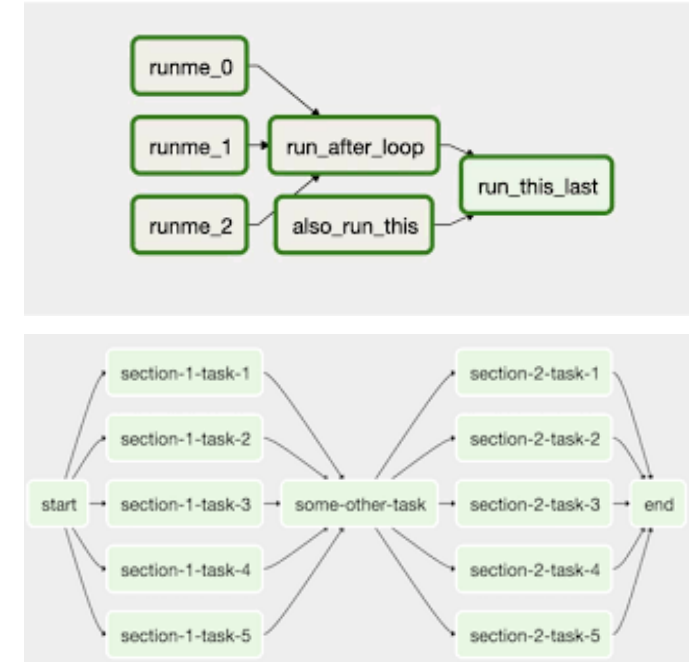
## Apache Airflow



# Building blocks of the new SA architecture

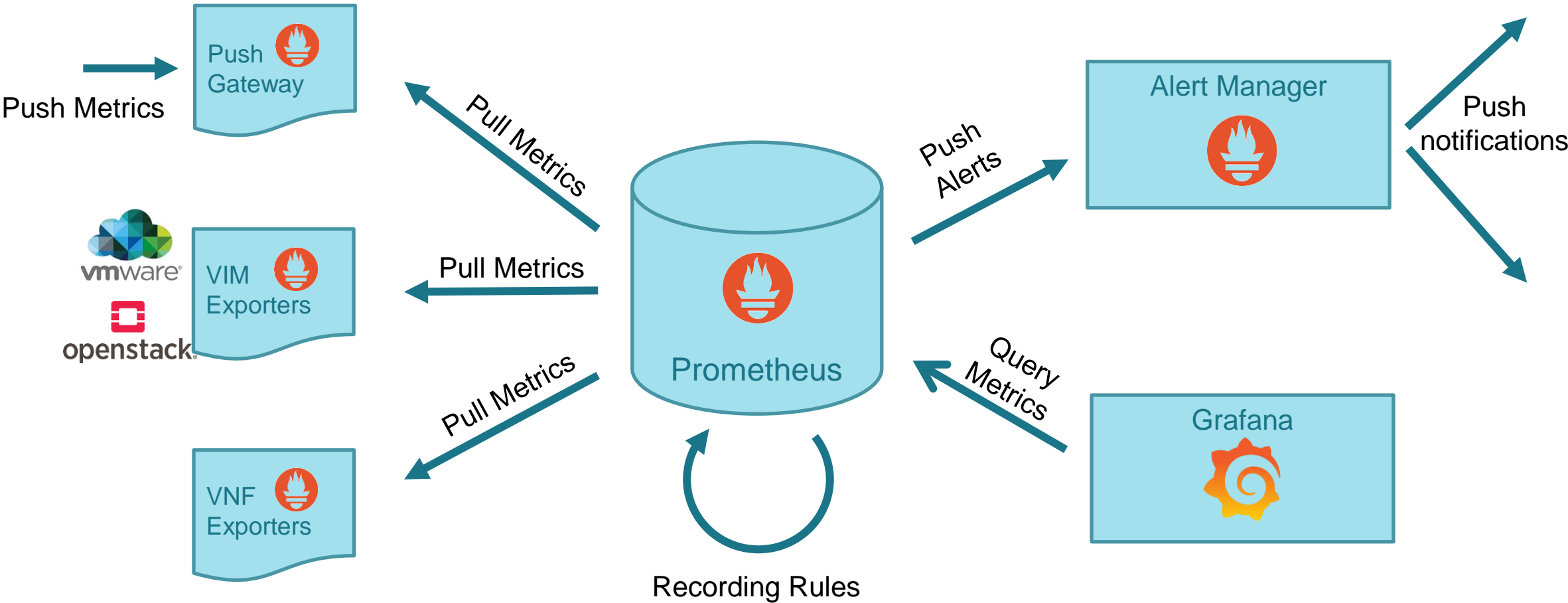
## Airflow DAGs

- DAG (Directed Acyclic Graph):
  - Collection of tasks
    - A lot of flexibility to create dependencies between tasks
  - Defined in Python
  - DAGs can be dynamically created, for instance:
    - One per VIM
    - One per NS
  - Tasks can be dynamically created inside a DAG, for instance:
    - One per VM
  - Designed to scale
    - Airflow workers run tasks in parallel
  - Scheduled independently



# Building blocks of the new SA architecture

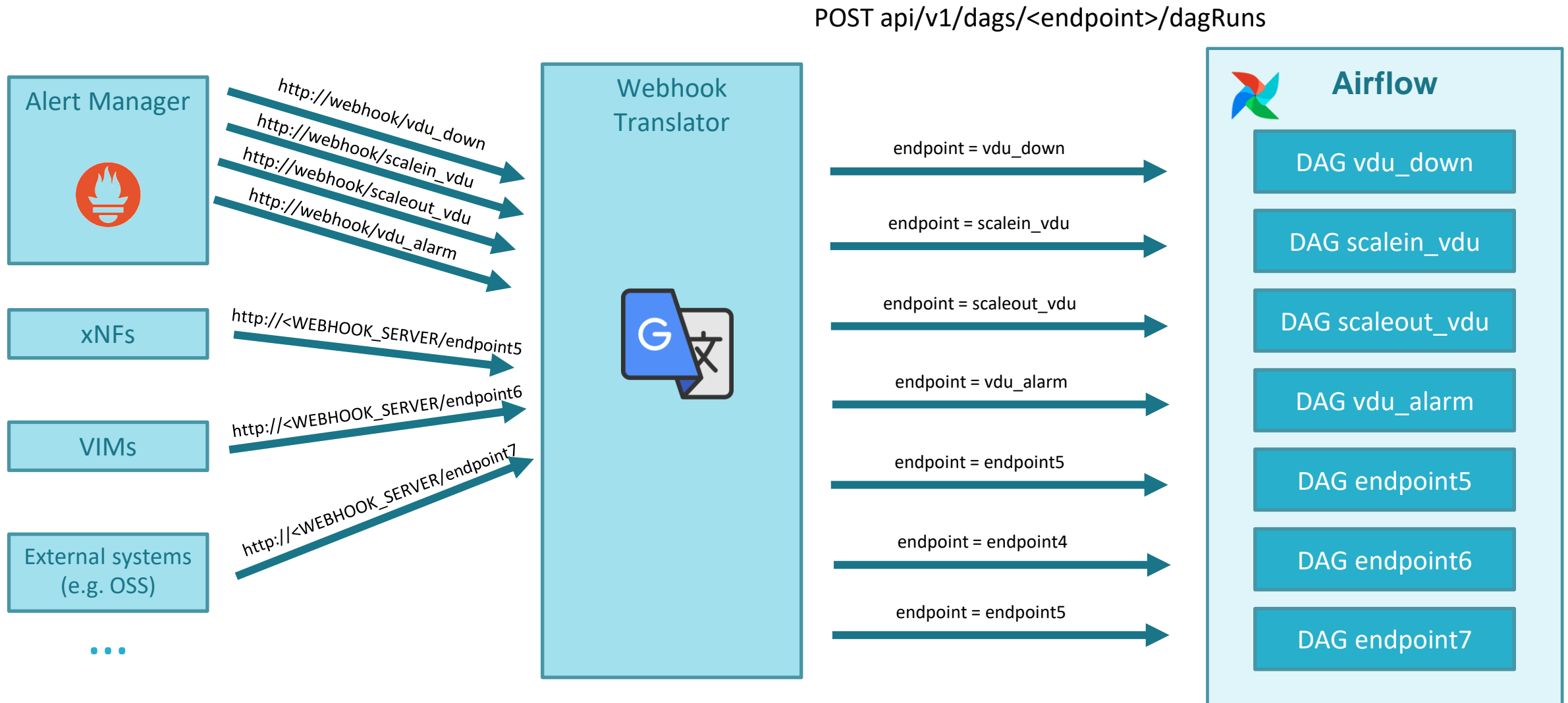
## Prometheus Stack





# Building blocks

## Webhook translator



# Building blocks

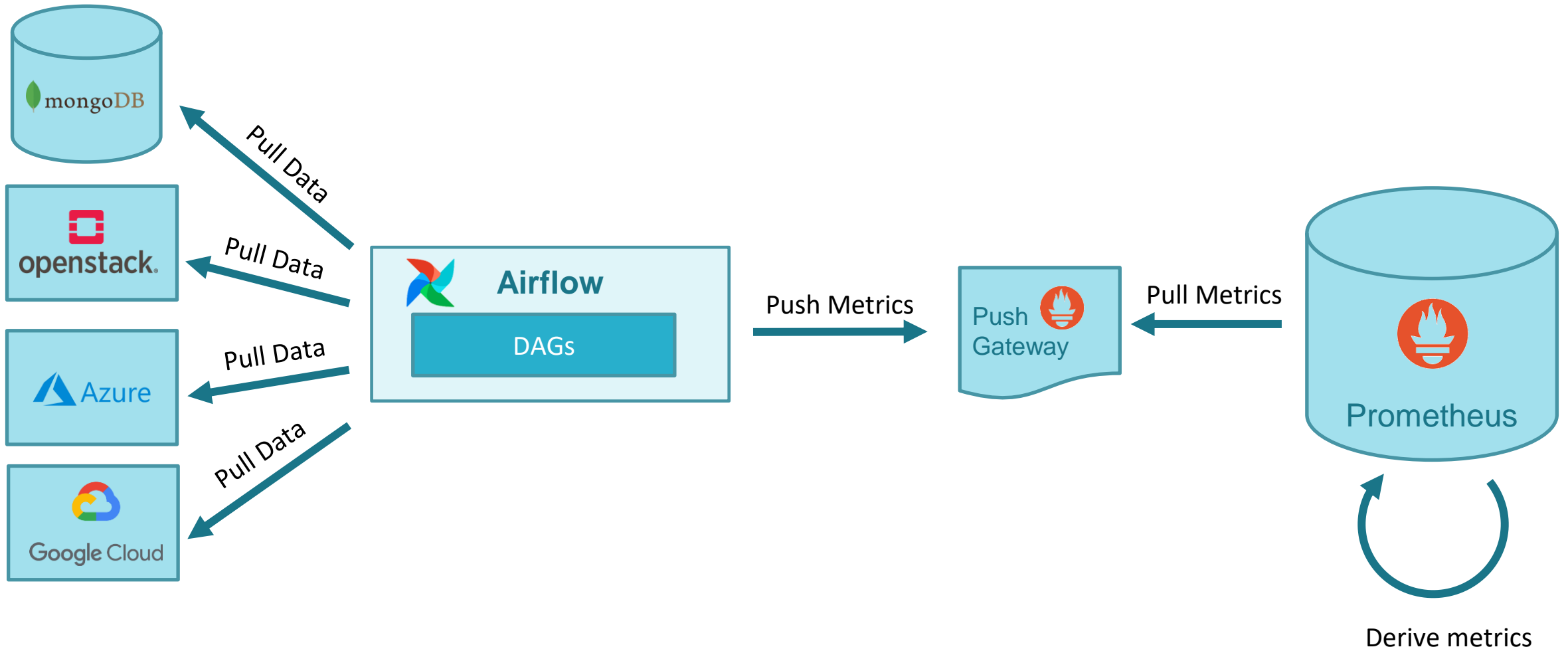
## Webhook translator

---

- Principles:
  - Lightweight: a very small number of lines of code will do the work.
  - Stateless. It only translates HTTP requests. No state for those translations
    - When running as a deployment, native scaling is achieved by means of Kubernetes services
  - Simple. Based on FastAPI (<https://fastapi.tiangolo.com/>)
    - Simple and fast framework for developing an HTTP REST API in Python.
  - Independent from the source of the alert
    - No maintenance

# Workflows

# Workflow for metric acquisition and derivation



# Metric acquisition

- NS topology:
  - From Mongo DB to Prometheus
  - SW used: Airflow DAG + Prometheus PushGateway
- VM status:
  - From MongoDB and VIM to Prometheus
  - SW used: Airflow DAG per VIM + Prometheus PushGateway
- VIM status
  - From MongoDB and VIM to Prometheus
  - SW used: Airflow DAG per VIM + Prometheus PushGateway
- VM metrics (resource consumption)
  - From MongoDB and VIM to Prometheus
  - SW used: Airflow DAG per VIM + Prometheus PushGateway










































# Screenshot of Airflow DAGs

Airflow DAGs Security Browse Admin Docs 21:51 UTC AU

## DAGs

All 7 Active 7 Paused 0

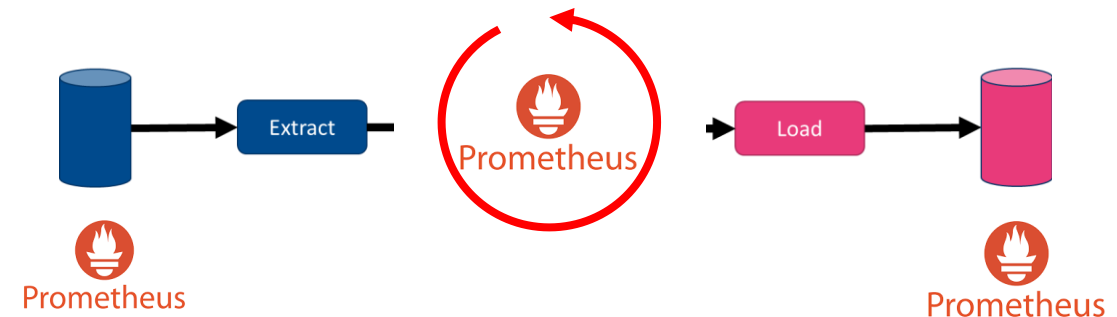
Filter DAGs by tag Search DAGs

DAG	Owner	Runs	Schedule	Last Run	Next Run	Recent Tasks	Actions	Links
 ns_topology osm topology	airflow	 33683  88	*/* * * * *	2022-11-28, 21:48:00	2022-11-28, 21:50:00		 	...
 vim_status_48f5d90d-fc3d-4239-afcd-0015f007978f osm vim	airflow	 34115	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...
 vim_status_a634ffa8-182a-4583-9fee-f37fcb4b78a8 osm vim	airflow	 34117	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...
 vim_status_c341ebab-ef51-468a-8435-7c2ab1057e61 osm vim	airflow	 34117	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...
 vm_status_vim_48f5d90d-fc3d-4239-afcd-0015f007978f osm vim	airflow	 33209  34	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...
 vm_status_vim_a634ffa8-182a-4583-9fee-f37fcb4b78a8 osm vim	airflow	 35209  182	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...
 vm_status_vim_c341ebab-ef51-468a-8435-7c2ab1057e61 osm vim	airflow	 30849  16	*/* * * * *	2022-11-28, 21:50:00	2022-11-28, 21:51:00		 	...

Showing 1-7 of 7 DAGs

# Metric derivation

- Extended VM status:
  - From Prometheus (NS topology, VM status) to Prometheus
  - SW used: Prometheus Recording Rules
- VNF status:
  - From Prometheus (Extended VM status) to Prometheus
  - SW used: Prometheus Recording Rules
- NS status:
  - From Prometheus (Extended VM status) to Prometheus
  - SW used: Prometheus Recording Rules



# Screenshot of the derived metrics in Prometheus

Prometheus Alerts Graph Status Help Classic UI

Use local time  Enable query history  Enable autocomplete  Use experimental editor  Enable highlighting  Enable linter

vm\_status\_extended Execute

Table Graph Load time: 105ms Resolution: 14s Result series: 1

< Evaluation time >

vm_status_extended {job="osm_prometheus", ns_id="8cfca048-82ea-4963-8425-c478c7bf8b56", project_id="7762bceb-c57c-49b3-a4e0-861d54d9f64f", vdu_id="5fb38ca2-0a85-4e62-b6cd-a138b7253e43", vdu_name="hfbasic_metrics-vnf-hackfest_basic_metrics-VM-0", vim_id="a634ffa8-182a-4583-9fee-f37fcb4b78a8", vm_id="ab9d47f6-6dca-4ba6-a374-c35fc5f709ed", vnf_id="7fa8efe5-9cdf-488d-92f2-60aa45d8b945", vnf_member_index="vnf"}	1
---	---

Prometheus Alerts Graph Status Help Classic UI

Use local time  Enable query history  Enable autocomplete  Use experimental editor  Enable highlighting  Enable linter

vnf\_status Execute

Table Graph Load time: 95ms Resolution: 14s Result series: 1

< Evaluation time >

vnf_status {job="osm_prometheus", ns_id="8cfca048-82ea-4963-8425-c478c7bf8b56", vnf_id="7fa8efe5-9cdf-488d-92f2-60aa45d8b945"}	1
--	---

Prometheus Alerts Graph Status Help Classic UI

Use local time  Enable query history  Enable autocomplete  Use experimental editor  Enable highlighting  Enable linter

ns\_status Execute

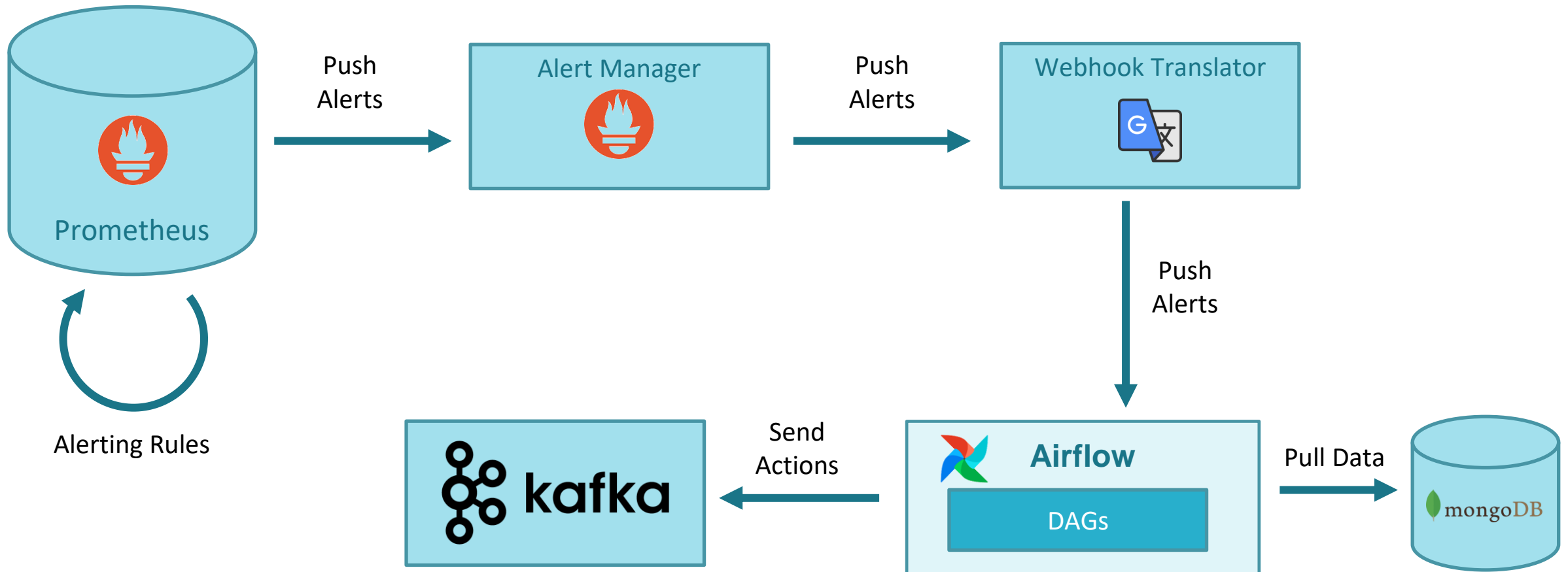
Table Graph Load time: 112ms Resolution: 14s Result series: 1

< Evaluation time >

ns_status {job="osm_prometheus", ns_id="8cfca048-82ea-4963-8425-c478c7bf8b56"}	1
--	---



# Closed loops with new SA architecture



# Closed loops with new SA architecture

---

- Prometheus alerts
  - [https://prometheus.io/docs/prometheus/latest/configuration/alerting\\_rules/](https://prometheus.io/docs/prometheus/latest/configuration/alerting_rules/)
  - Alerts are automatically triggered and stopped by Prometheus depending on their defining rule
- AlertManager
  - <https://prometheus.io/docs/alerting/latest/alertmanager/>
  - Provides a mechanism to send alerts to webhooks
  - In addition, it includes mechanisms for silencing, inhibition, aggregation, etc.
- Webhook Translator.
  - Rationale: AlertManager send alerts with a format that cannot be consumed directly by Airflow DAGs
  - It receives HTTP POST messages from AlertManager and forwards it to an Airflow webhook

# Closed loops with new SA architecture

---

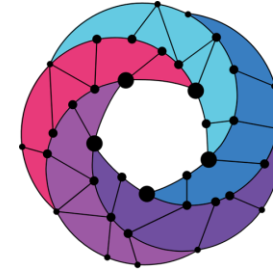
- Airflow
  - Runs DAGs driven by webhooks
  - Fed with the information in MongoDB
  - Behaves as Policy Manager (POL). It translates the alert to an action:
    - A Kafka message to be consumed by LCM (heal, scale)
    - Or potentially other actions in the future
- MongoDB
  - Keeps persistence of closed-loop actions
  - Previously managed by MON, now managed by LCM

# Future work

# Future work

---

- Run vulnerability scan on NG-SA
- Remove installation of old SA from the installer
  - Currently it is an option (--old-sa)
- Move MON functionality (grafana-dashboarder) somewhere else
- Refactor DAG code to re-use as much as possible
- Independent time period for different VIMs, probably as a VIM parameter passed during VIM registration

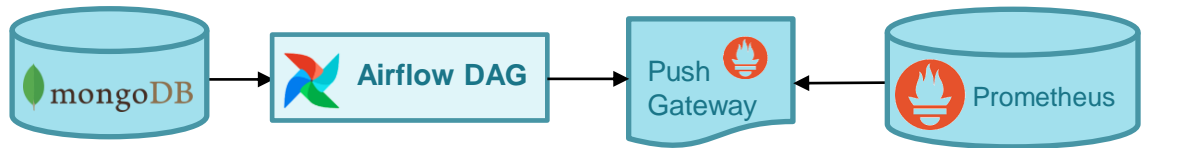


Open Source  
**MANO**  
*by ETSI*

**Thank You!**

# Workflows

## Metric acquisition (ns\_topology)

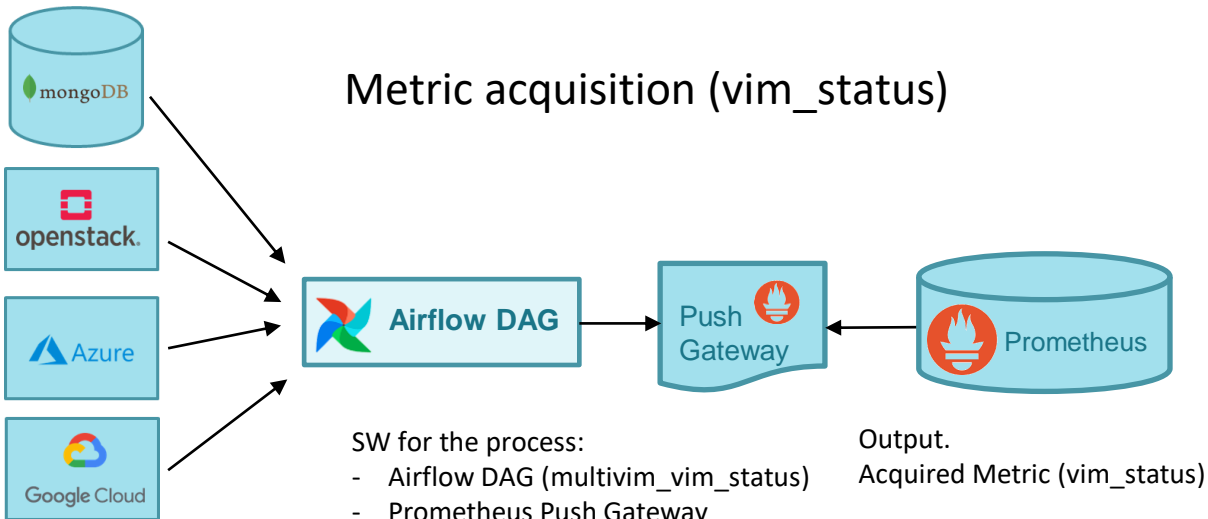


Input:  
Data Source: NS Record

SW for the process:  
- Airflow DAG (ns\_topology)  
- Prometheus Push Gateway

Output:  
Acquired Metric (ns\_topology)

## Metric acquisition (vim\_status)

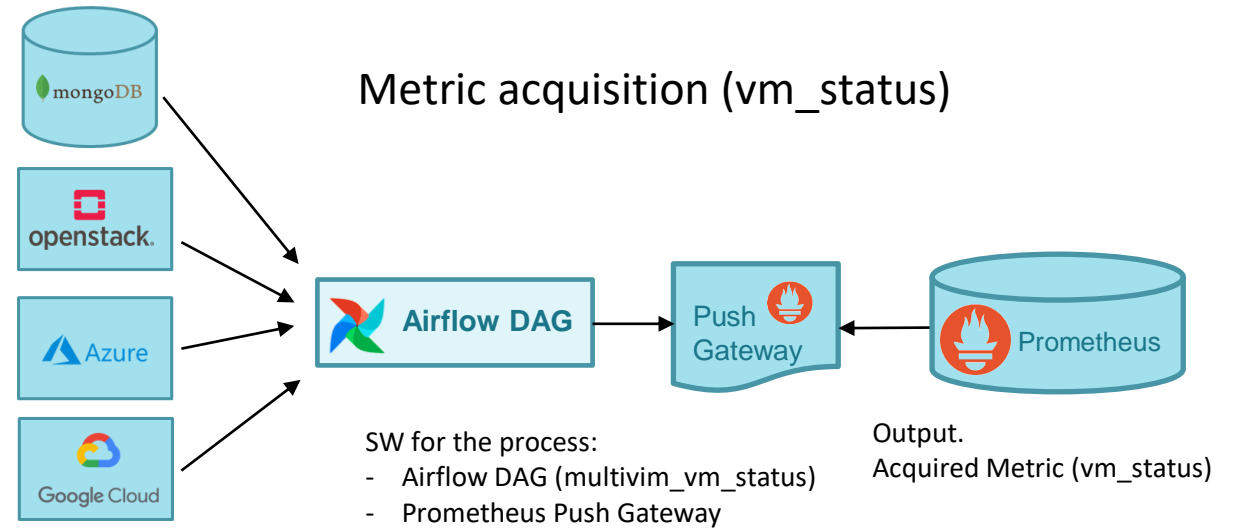


SW for the process:  
- Airflow DAG (multivim\_vim\_status)  
- Prometheus Push Gateway

Output:  
Acquired Metric (vim\_status)

Input. Data Sources:  
- VIM Record  
- VIMs

## Metric acquisition (vm\_status)

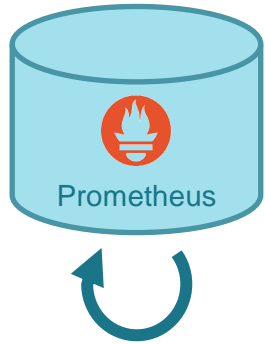


SW for the process:  
- Airflow DAG (multivim\_vm\_status)  
- Prometheus Push Gateway

Output.  
Acquired Metric (vm\_status)

Input. Data Sources:  
- VIM Record  
- VIMs

## Metric derivation (vm\_status\_extended)



### Recording Rules

Input. Acquired metrics:

- vm\_status
- ns\_topology

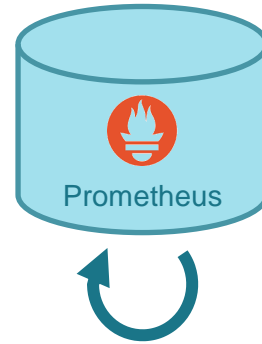
SW for the process:

- Prometheus recording rule

Output. Derived metric:

- vm\_status\_extended

## Metric derivation (vnf\_status)



### Recording Rules

Input. Acquired metrics:

- vm\_status\_extended

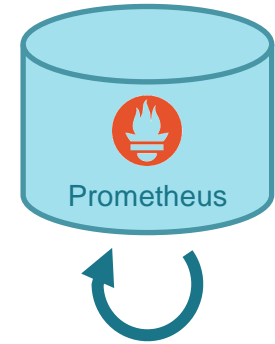
SW for the process:

- Prometheus recording rule

Output. Derived metric:

- vnf\_status

## Metric derivation (ns\_status)



### Recording Rules

Input. Acquired metrics:

- vm\_status\_extended

SW for the process:

- Prometheus recording rule

Output. Derived metric:

- ns\_status