ATS GROUP
ADVANCED TECHNOLOGY SERVICES

Monitoring Kubernetes Using Zabbix

Michaela DeForest
Platform Engineer

Smart Solutions from The ATS Group

INFRASTRUCTURE SOLUTIONS

Supporting the configuration of the most popular on-prem or cloud hardware platforms and operating systems

CLOUD ENABLEMENT

End-to-end consulting services to help customers optimize the benefits of hybrid and public cloud

DATA PROTECTION

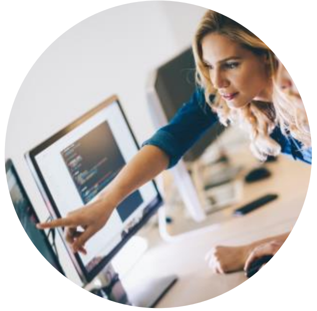
Leading the way with business continuity and data protection, recovery, and reuse for maximum value

INFRASTRUCTURE INTELLIGENCE

Optimizing customer resources through data visualization, proactive insights, and technical advocacy

EXPERTLY MANAGED SERVICES

Proactive management for customer infrastructure, on-prem or in the cloud



DEVOPS & AUTOMATION

Strategic services to guide customers through their DevOps lifecycle journey

Agenda

01

Installation of Kubernetes Monitoring in Zabbix

High level overview of the required components to monitor Kubernetes in Zabbix and how to set them up.

02

Integration Features

Metrics included in the base Kubernetes templates including performance metrics, discovered hosts, and various Kubernetes object statuses.

03

Prometheus Metrics

How existing components generating “Prometheus Data Model” data can be processed in Zabbix.

Kubernetes Integration Installation

ATS GROUP
ADVANCED TECHNOLOGY SERVICES

Background and Prerequisites

ZABBIX
6.0

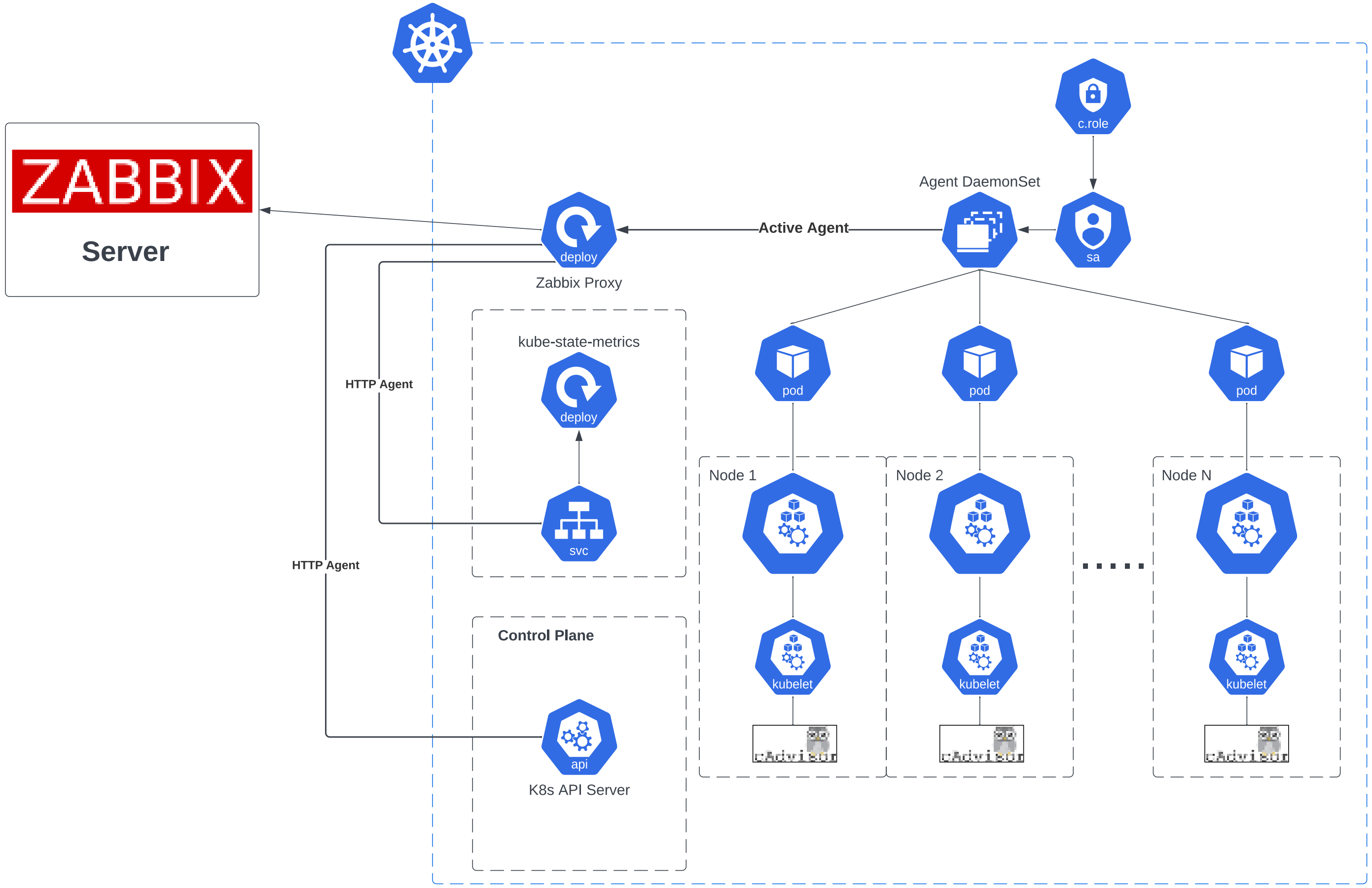
- Introduced in Zabbix 6.0
- Zabbix provides custom Zabbix templates and a helm chart
- Prerequisites
    - Kubernetes Cluster to be monitored 1.19+
    - Helm 3.0+
    - Zabbix Server 6.0+
    - kube-state-metrics 2.13.2+

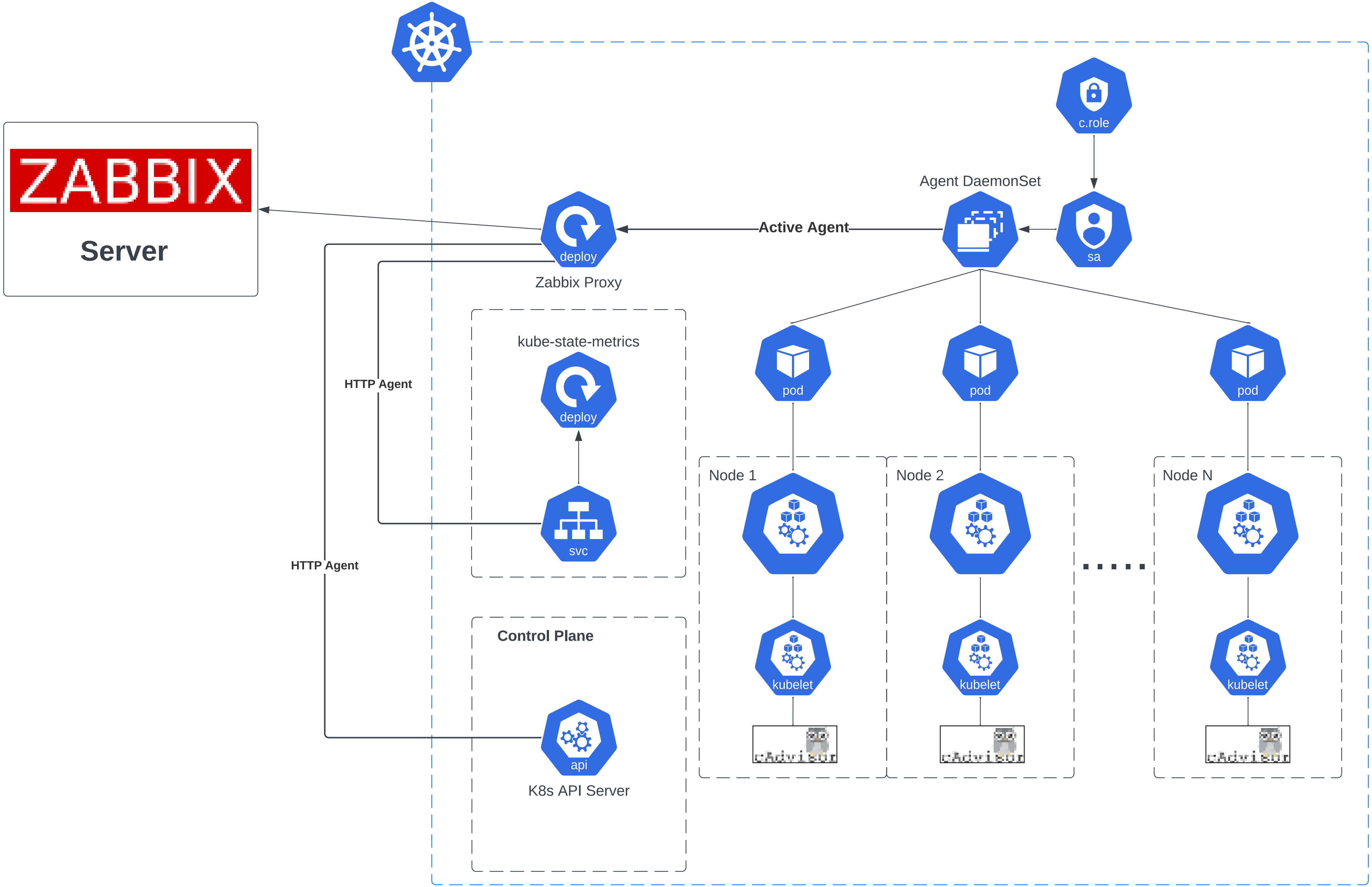
Components

Integration components provided by Zabbix

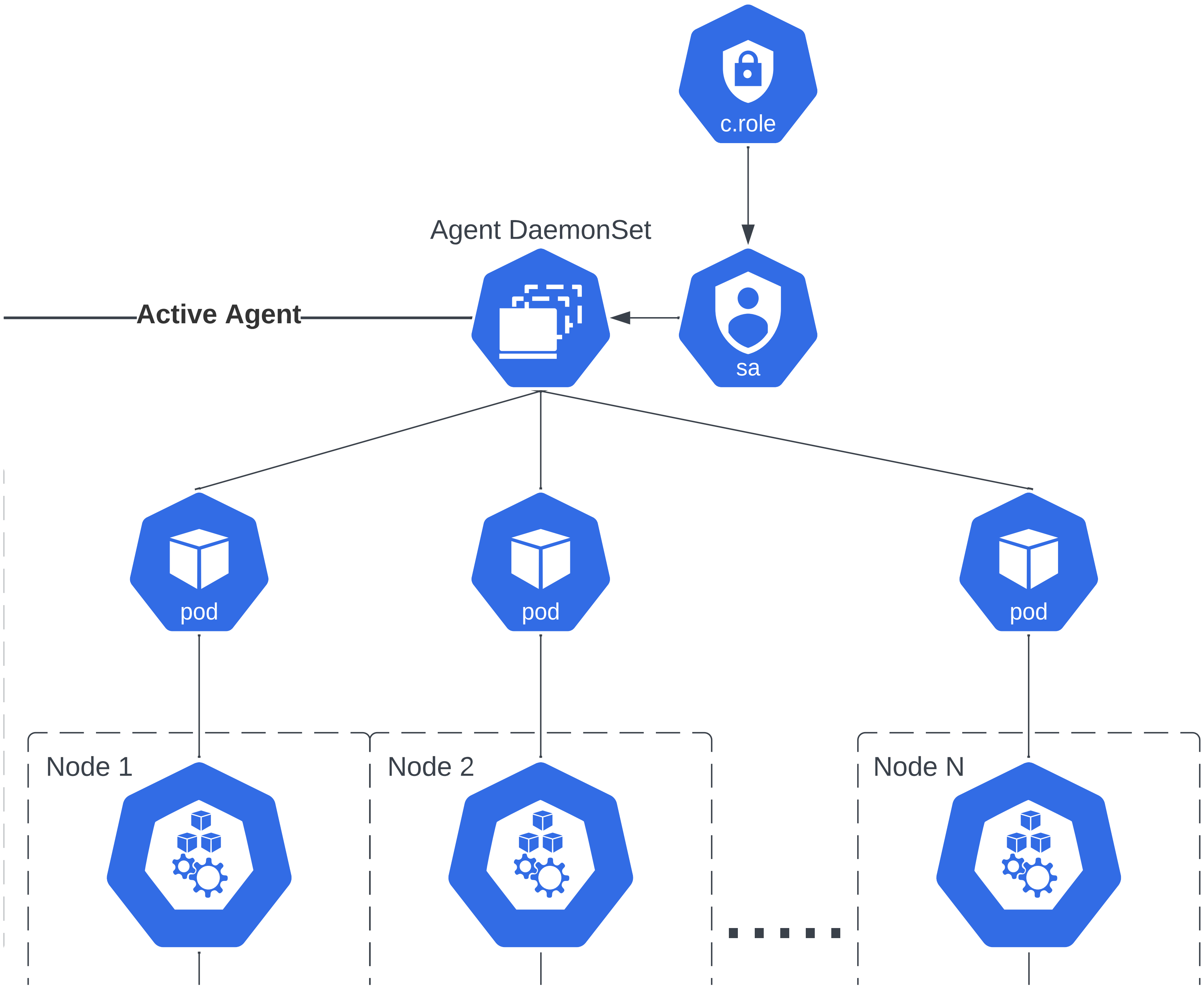
- *Official Zabbix Templates*
    - **Kubernetes nodes by HTTP**
    - **Kubernetes cluster state by HTTP**
    - Kubernetes API server by HTTP
    - Kubernetes Controller manager by HTTP
    - Kubernetes Scheduler by HTTP
    - Kubernetes kubelet by HTTP
- *Helm Chart*

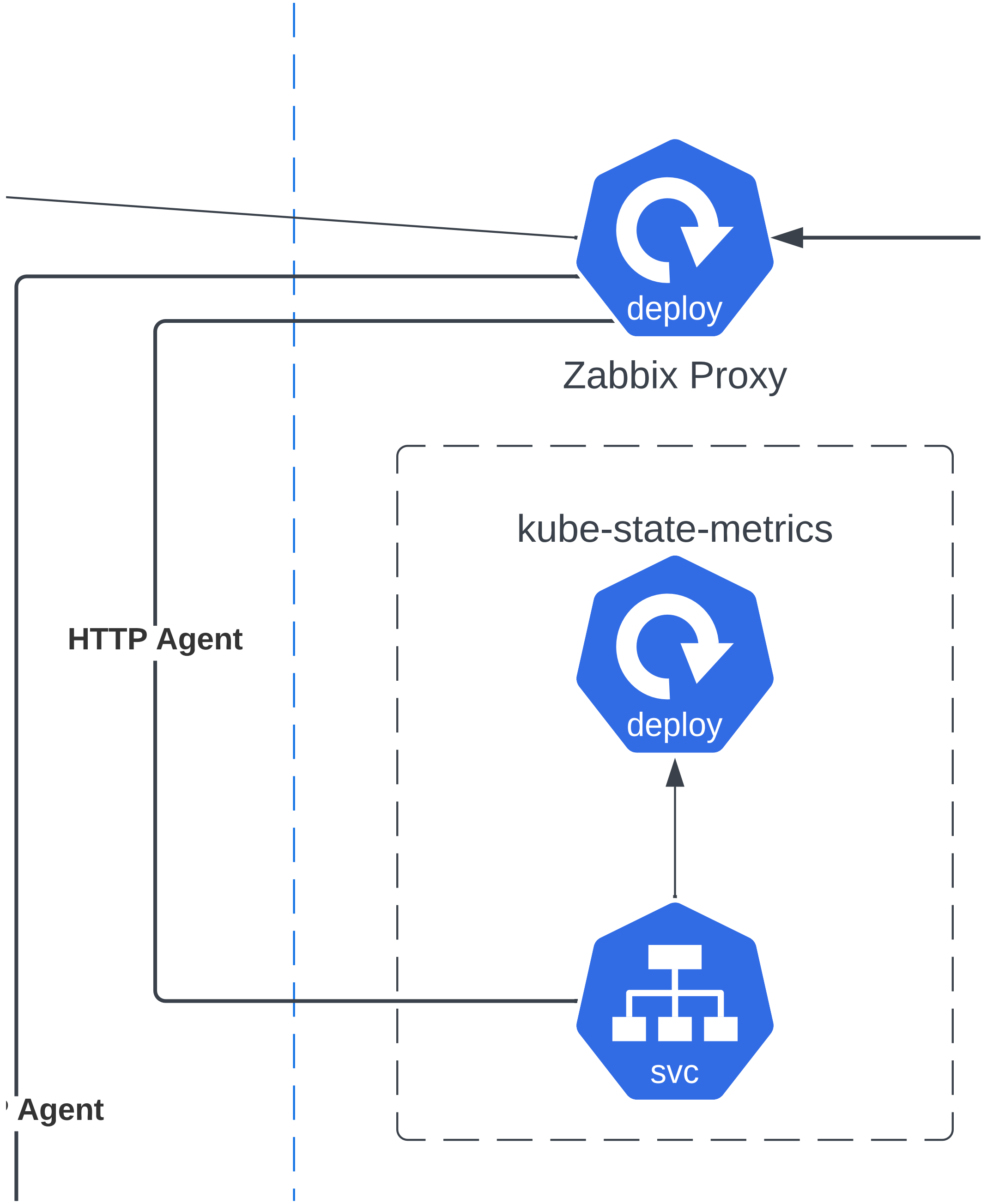
Integration Architecture

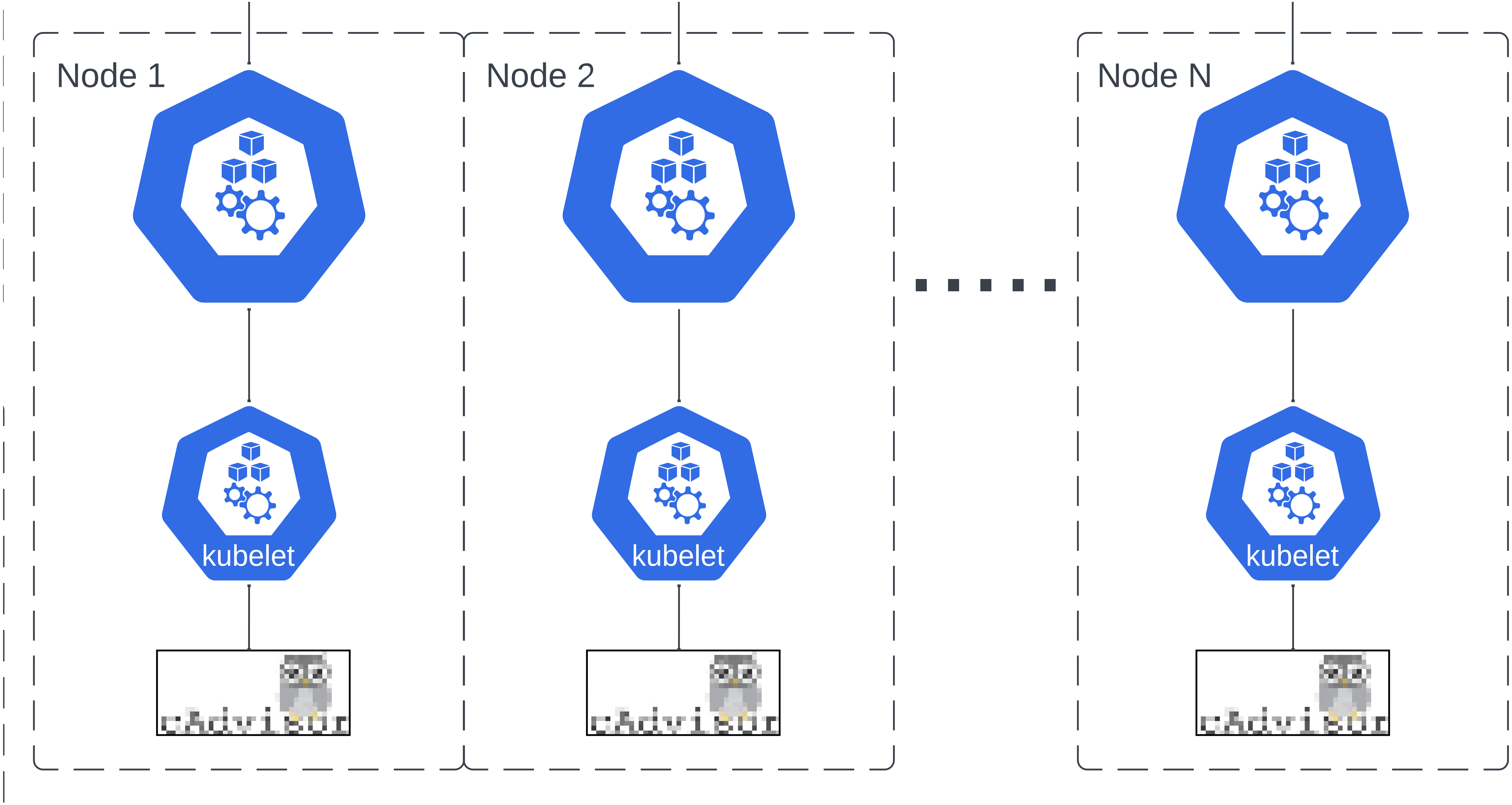


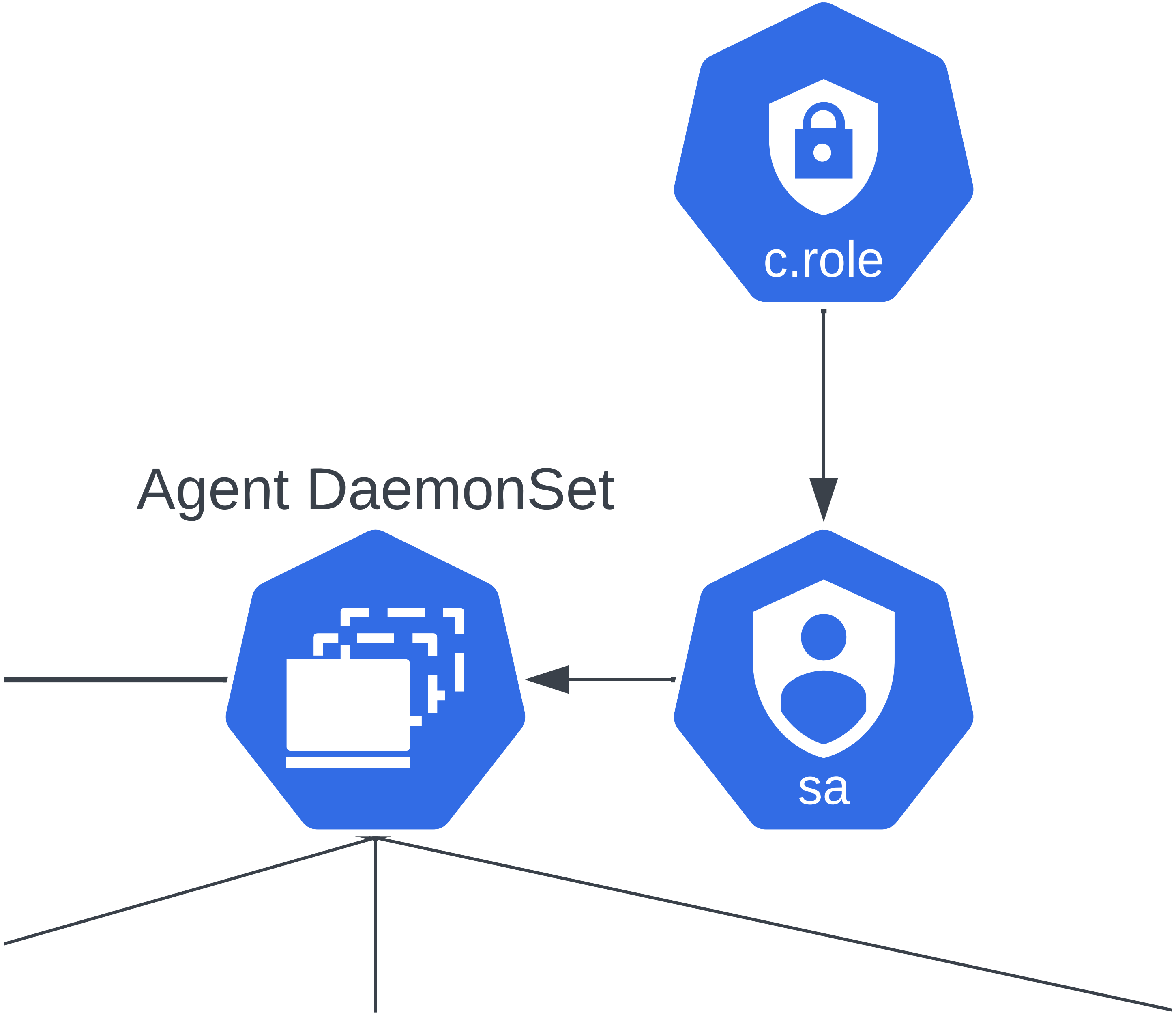

ZABBIX
Server
c.role
Agent DaemonSet
Active Agent
deploy
Zabbix Proxy
sa
HTTP Agent
kube-state-metrics
deploy
svc
HTTP Agent
pod
pod
pod
Node 1
Node 2
Node N
kubelet
kubelet
kubelet
cAdvisor
cAdvisor
cAdvisor
Control Plane
api
K8s API Server

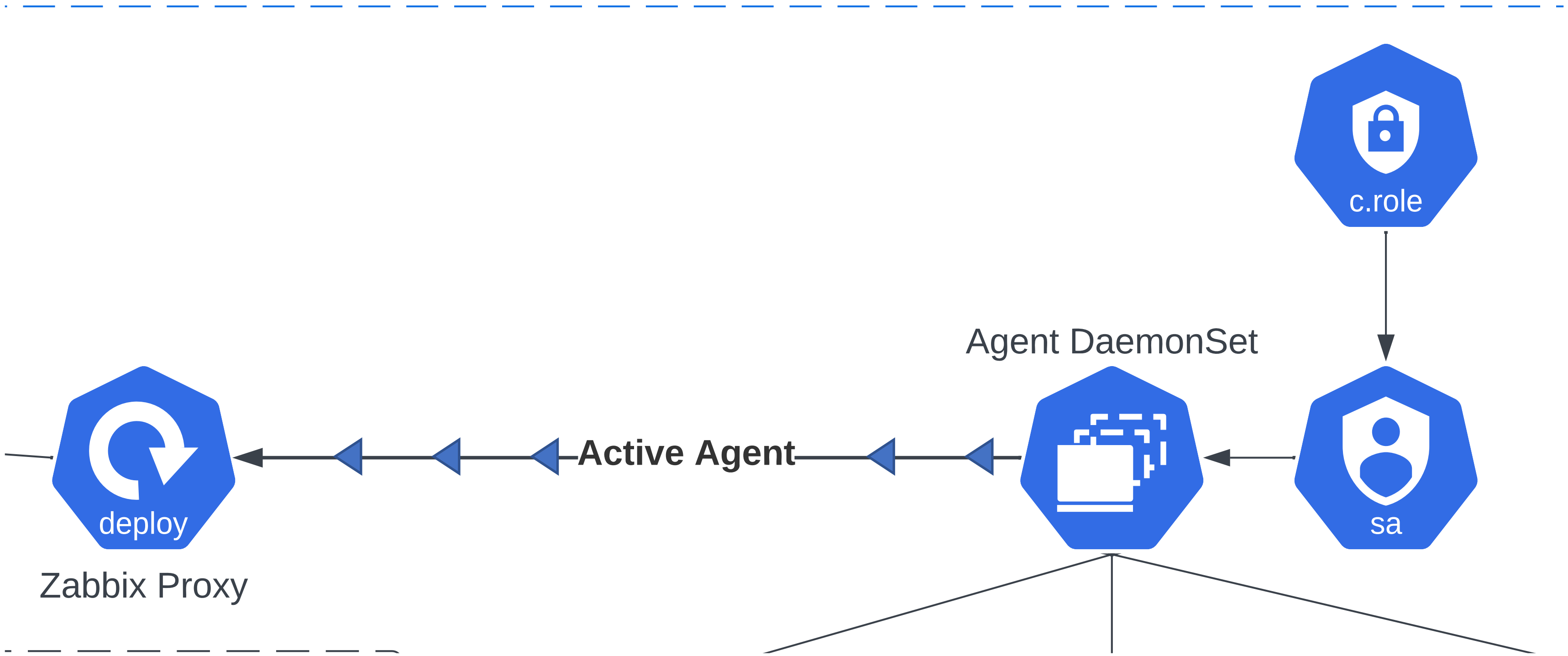
Server

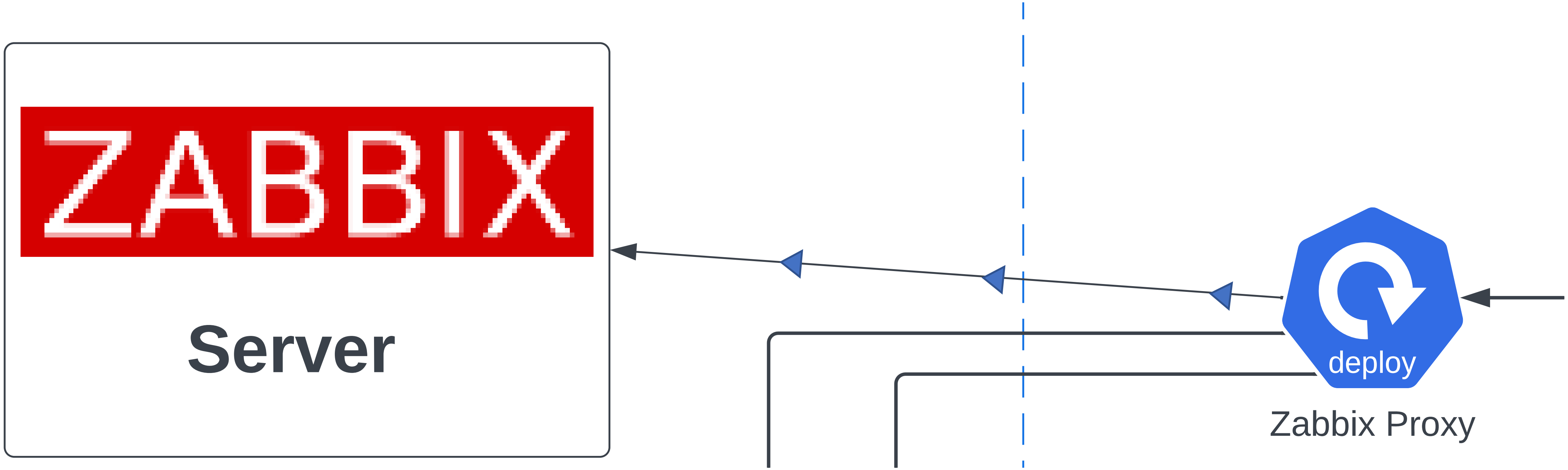

c.role
Agent DaemonSet
Active Agent
sa
pod
pod
pod
Node 1
Node 2
Node N


deploy
Zabbix Proxy
kube-state-metrics
deploy
svc
HTTP Agent
Agent


Node 1
Node 2
Node N
kubelet
kubelet
kubelet
cAdvisor
cAdvisor
cAdvisor

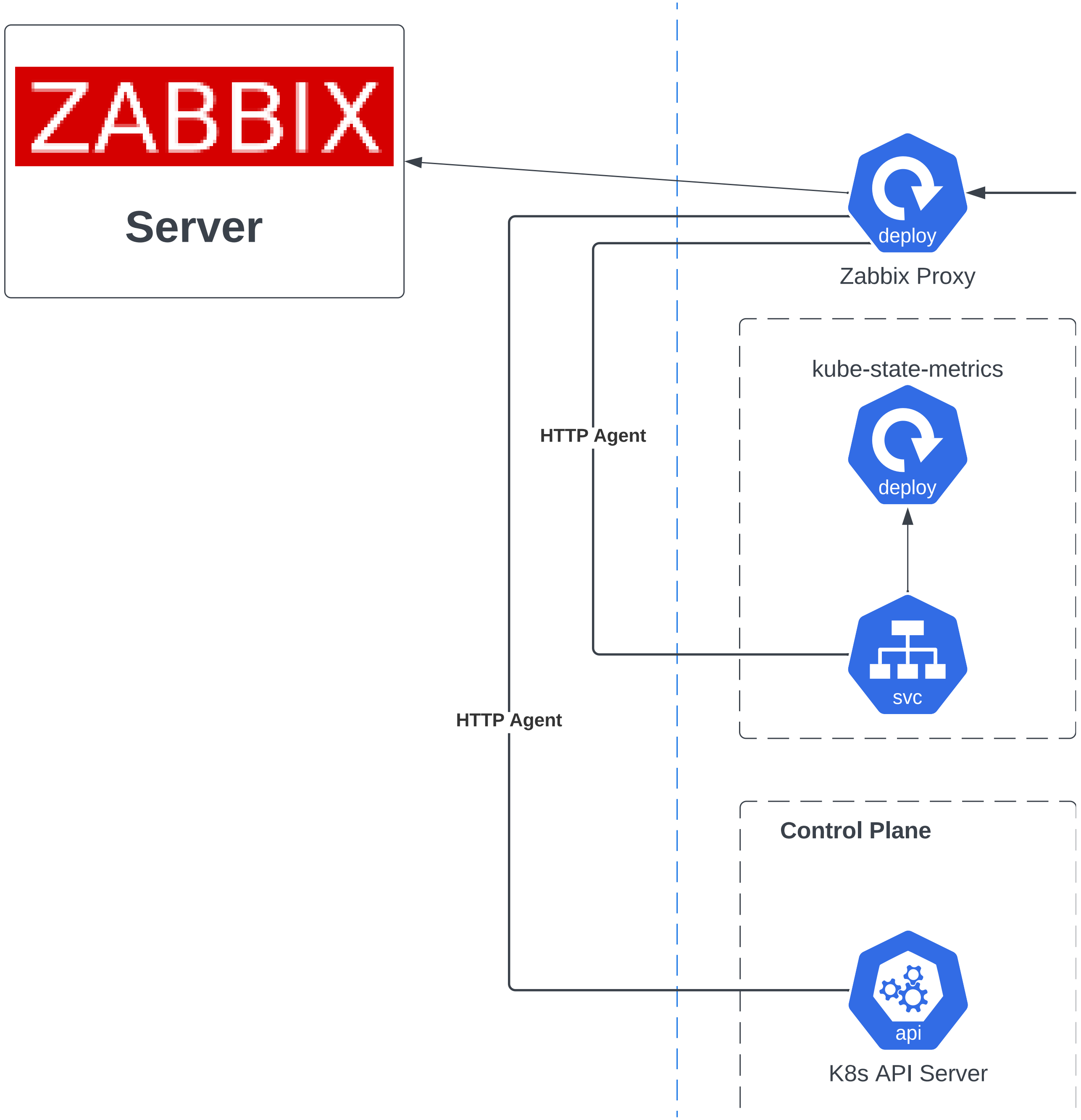

c.role
Agent DaemonSet
sa


c.role
Agent DaemonSet
Active Agent
deploy
sa
Zabbix Proxy



Server

Zabbix Proxy


ZABBIX
Server
deploy
Zabbix Proxy
HTTP Agent
kube-state-metrics
deploy
svc
HTTP Agent
Control Plane
api
K8s API Server

Cluster Role

*** Get and list permissions unless otherwise marked**

API Group

Non-Resource URLS	core	Batch	Extensions	Apps
/metrics **(get)**	nodes/metrics **(get)**	jobs	deployments	statefulsets
/metrics/cadvisor **(get)**	nodes/spec **(get)**	cronjobs	daemonsets	deployments
/version **(get)**	nodes/proxy **(get)**			daemonsets
/healthz **(get)**	nodes/stats **(get)**			
/readyz **(get)**	namespace			
	pods			
	services			
	componentstatuses			
	nodes			
	endpoints			
	events			

Installation

Install Helm Chart

Installs the Zabbix Agent on all Nodes, Zabbix Proxy, and optionally kube-state-metrics.

Connect Proxy

Connect proxy from within the monitored cluster to your Zabbix Server via Zabbix frontend.

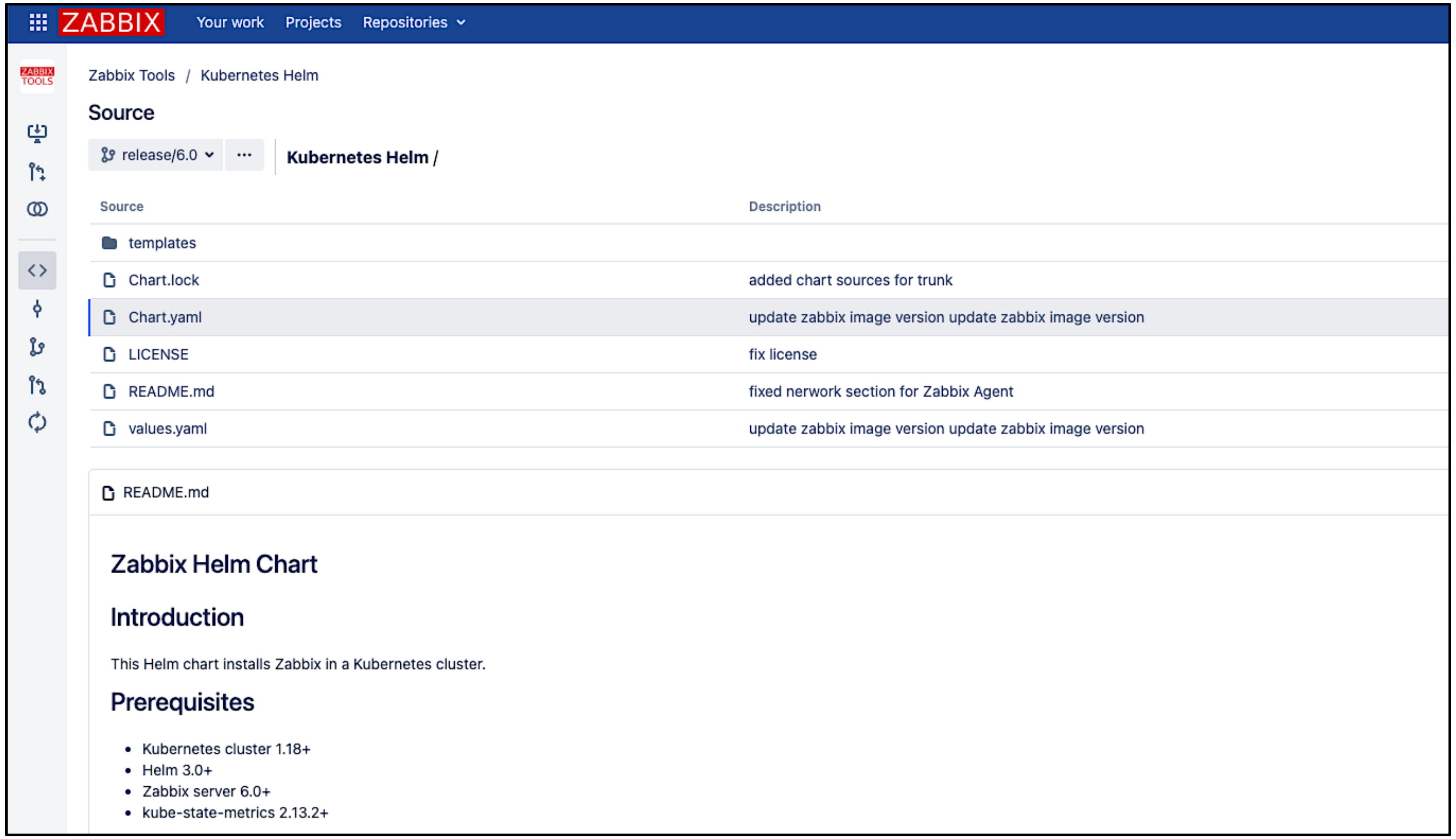
Attach Templates

Create initial hosts and attach two main Kubernetes templates included in Zabbix 6.0.

https://www.zabbix.com/integrations/kubernetes

Install Helm Chart

https://git.zabbix.com/projects/ZT/repos/kubernetes-helm/



Zabbix Tools / Kubernetes Helm

Source

release/6.0 ··· **Kubernetes Helm /**

Source	Description
templates	
Chart.lock	added chart sources for trunk
Chart.yaml	update zabbix image version update zabbix image version
LICENSE	fix license
README.md	fixed nerwork section for Zabbix Agent
values.yaml	update zabbix image version update zabbix image version

README.md

Zabbix Helm Chart

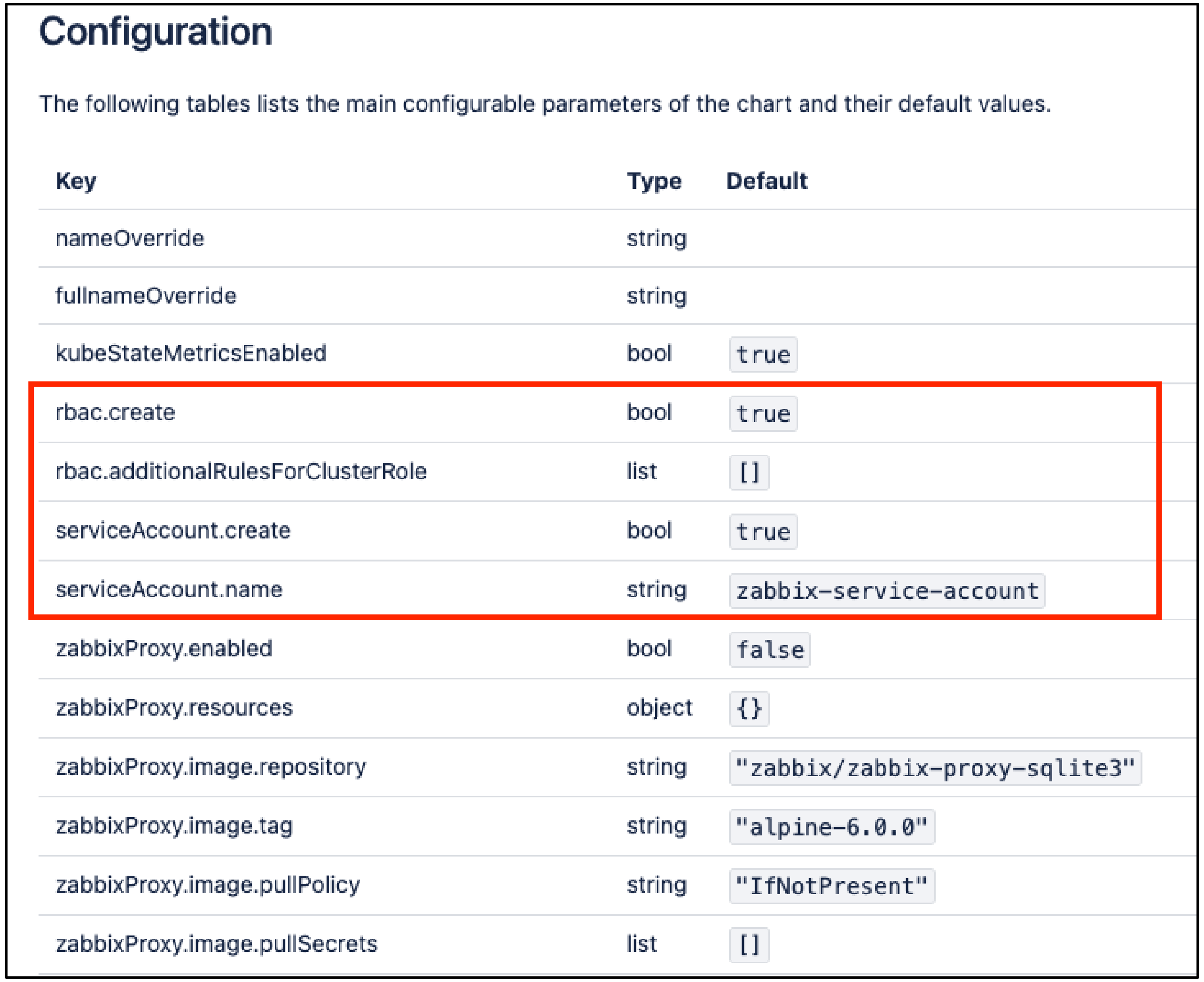
Introduction

This Helm chart installs Zabbix in a Kubernetes cluster.

Prerequisites

- Kubernetes cluster 1.18+
- Helm 3.0+
- Zabbix server 6.0+
- kube-state-metrics 2.13.2+

Install Helm Chart



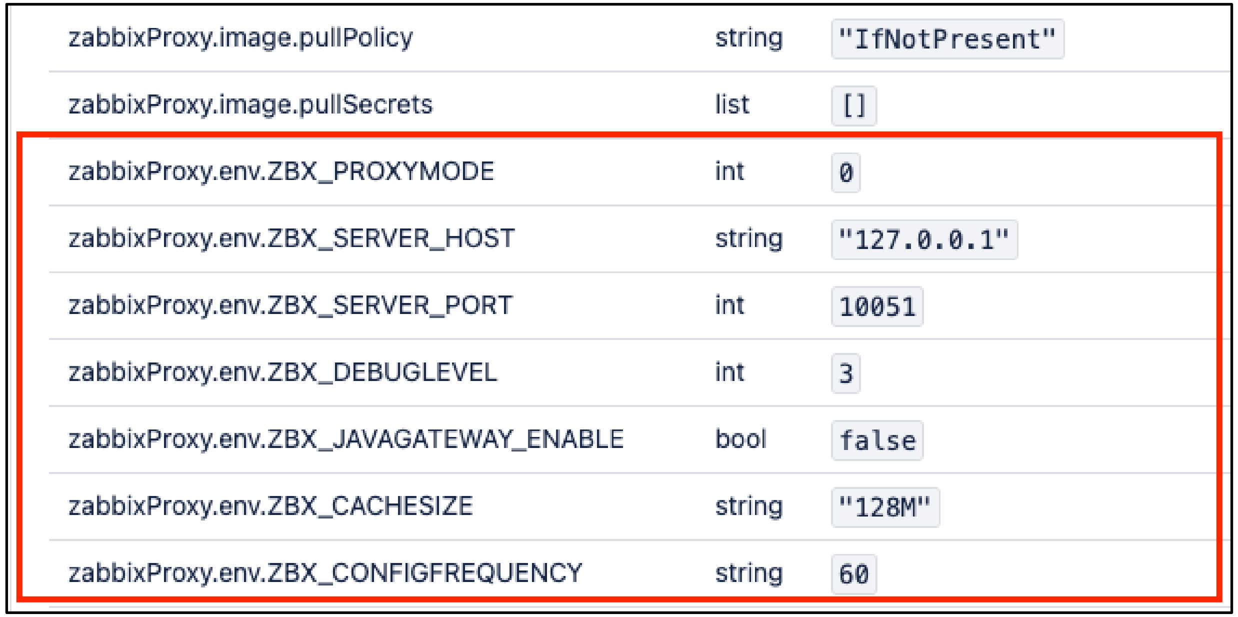
Configuration

The following tables lists the main configurable parameters of the chart and their default values.

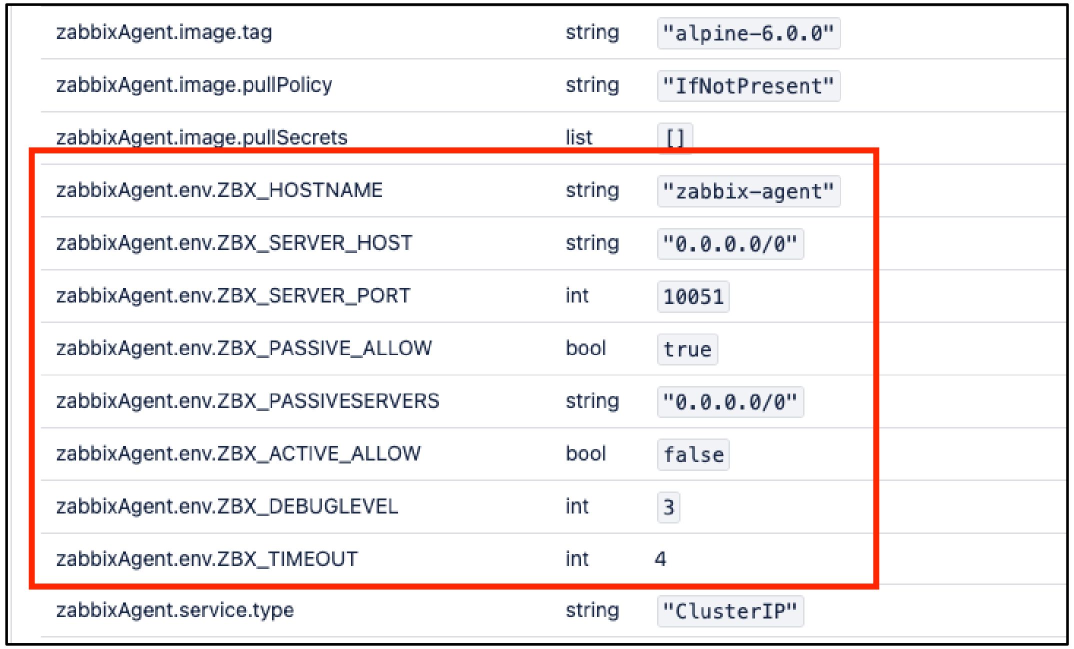
Key	Type	Default
nameOverride	string	
fullnameOverride	string	
kubeStateMetricsEnabled	bool	`true`
rbac.create	bool	`true`
rbac.additionalRulesForClusterRole	list	`[]`
serviceAccount.create	bool	`true`
serviceAccount.name	string	`zabbix-service-account`
zabbixProxy.enabled	bool	`false`
zabbixProxy.resources	object	`{}`
zabbixProxy.image.repository	string	`"zabbix/zabbix-proxy-sqlite3"`
zabbixProxy.image.tag	string	`"alpine-6.0.0"`
zabbixProxy.image.pullPolicy	string	`"IfNotPresent"`
zabbixProxy.image.pullSecrets	list	`[]`

https://git.zabbix.com/projects/ZT/repos/kubernetes-helm/

Install Helm Chart



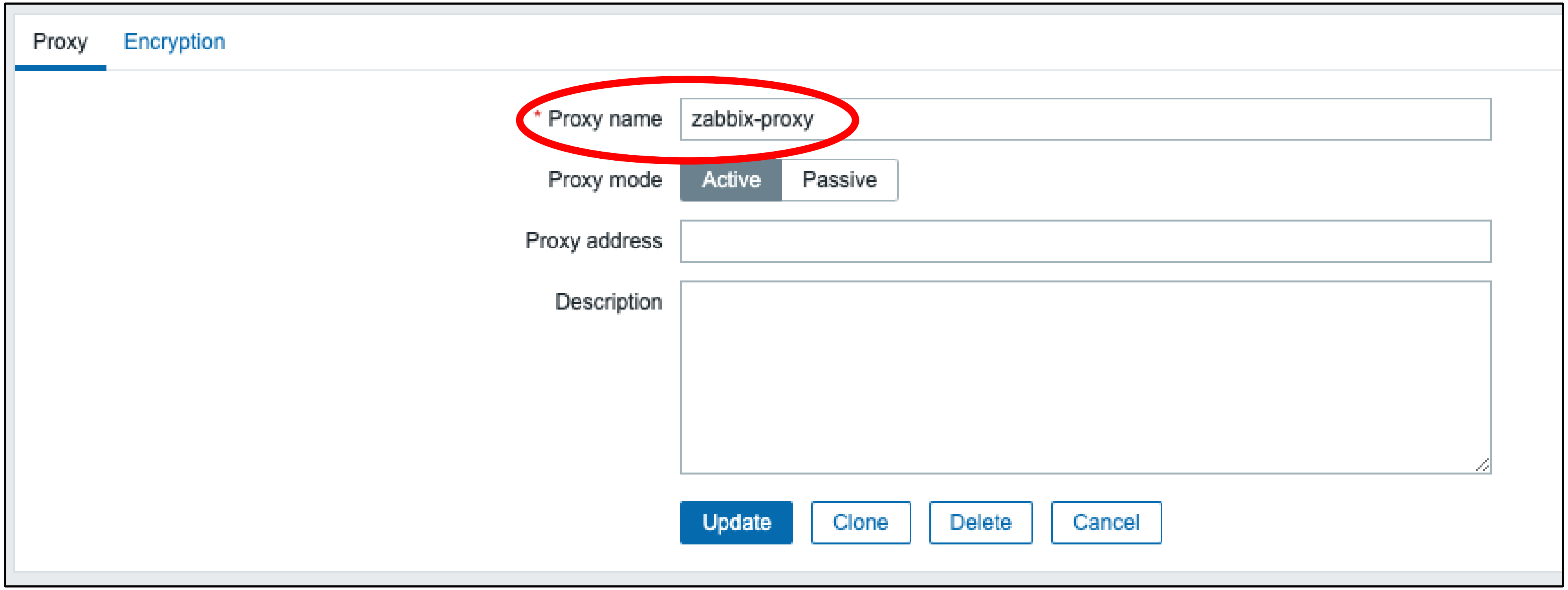
zabbixProxy.image.pullPolicy	string	"IfNotPresent"
zabbixProxy.image.pullSecrets	list	[]
zabbixProxy.env.ZBX_PROXYMODE	int	0
zabbixProxy.env.ZBX_SERVER_HOST	string	"127.0.0.1"
zabbixProxy.env.ZBX_SERVER_PORT	int	10051
zabbixProxy.env.ZBX_DEBUGLEVEL	int	3
zabbixProxy.env.ZBX_JAVAGATEWAY_ENABLE	bool	false
zabbixProxy.env.ZBX_CACHESIZE	string	"128M"
zabbixProxy.env.ZBX_CONFIGFREQUENCY	string	60



zabbixAgent.image.tag	string	"alpine-6.0.0"
zabbixAgent.image.pullPolicy	string	"IfNotPresent"
zabbixAgent.image.pullSecrets	list	[]
zabbixAgent.env.ZBX_HOSTNAME	string	"zabbix-agent"
zabbixAgent.env.ZBX_SERVER_HOST	string	"0.0.0.0/0"
zabbixAgent.env.ZBX_SERVER_PORT	int	10051
zabbixAgent.env.ZBX_PASSIVE_ALLOW	bool	true
zabbixAgent.env.ZBX_PASSIVESERVERS	string	"0.0.0.0/0"
zabbixAgent.env.ZBX_ACTIVE_ALLOW	bool	false
zabbixAgent.env.ZBX_DEBUGLEVEL	int	3
zabbixAgent.env.ZBX_TIMEOUT	int	4
zabbixAgent.service.type	string	"ClusterIP"

https://git.zabbix.com/projects/ZT/repos/kubernetes-helm/

Connect Proxy



* Proxy name: zabbix-proxy

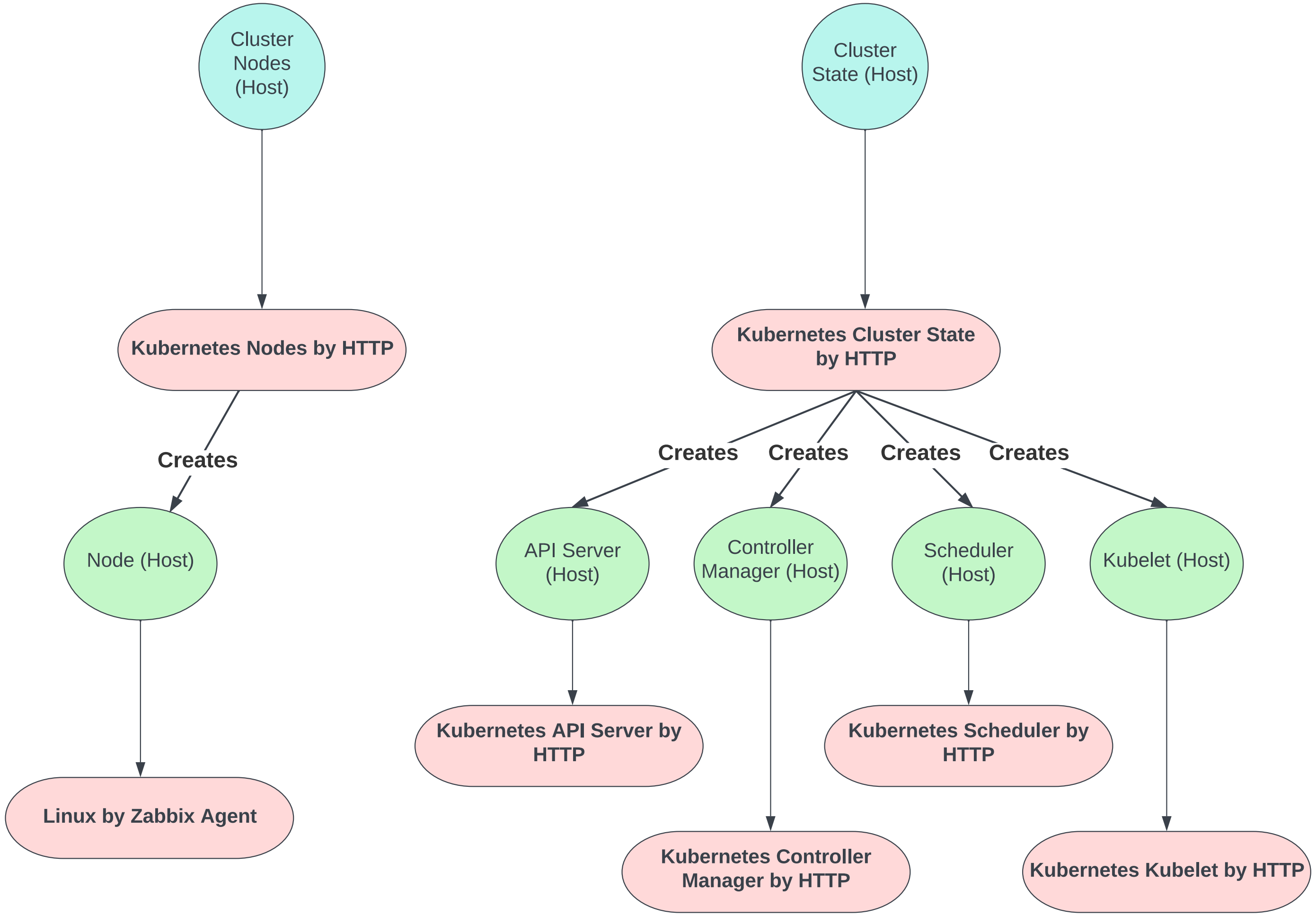
Proxy mode: Active Passive

Proxy address:

Description:

***name must match environment variable: ZBX_HOSTNAME in proxy pod**

Template Structure


Cluster Nodes (Host)

Kubernetes Nodes by HTTP

Creates

Node (Host)

Linux by Zabbix Agent

Cluster State (Host)

Kubernetes Cluster State by HTTP

Creates

Creates

Creates

Creates

API Server (Host)

Controller Manager (Host)

Scheduler (Host)

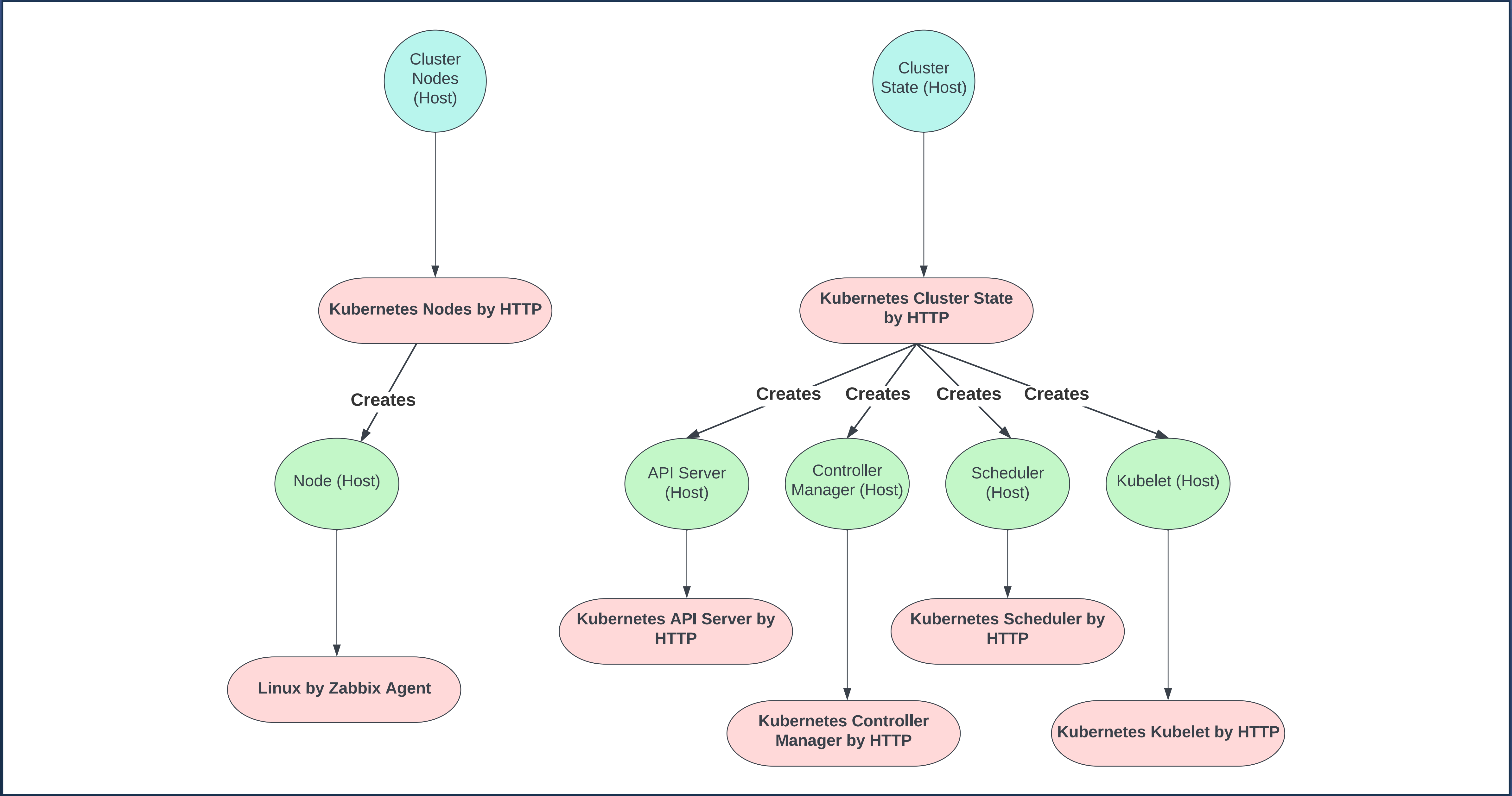
Kubelet (Host)

Kubernetes API Server by HTTP

Kubernetes Controller Manager by HTTP

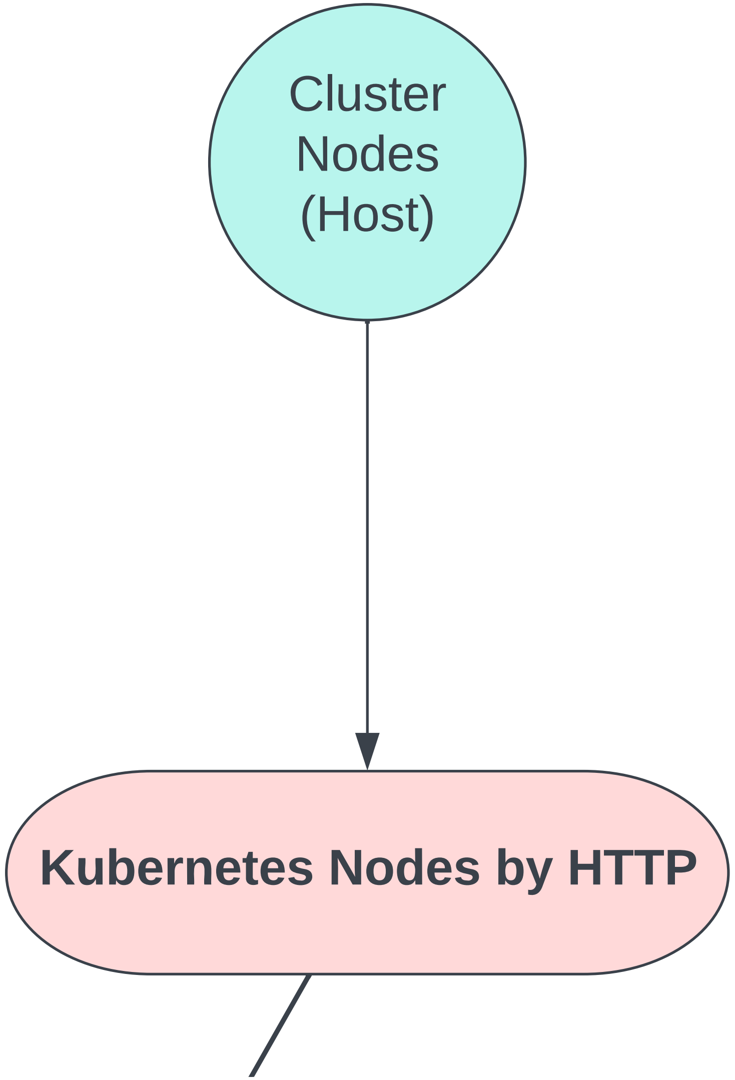
Kubernetes Scheduler by HTTP

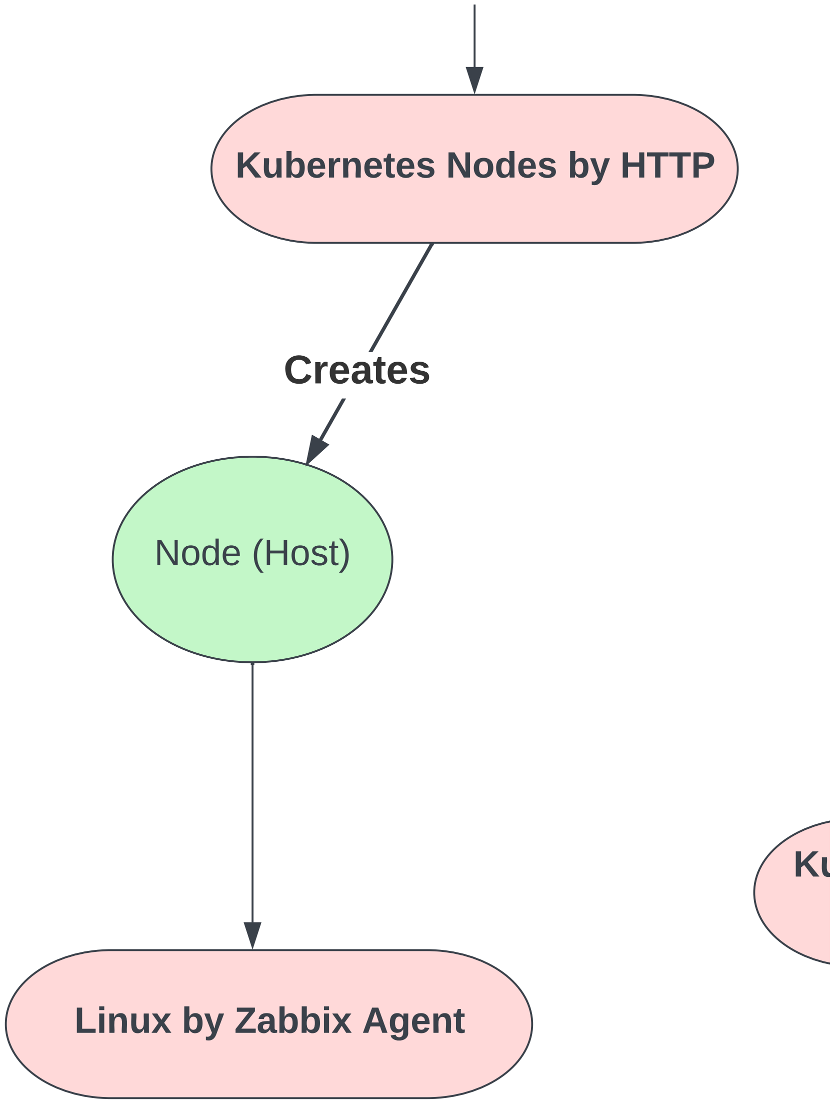
Kubernetes Kubelet by HTTP

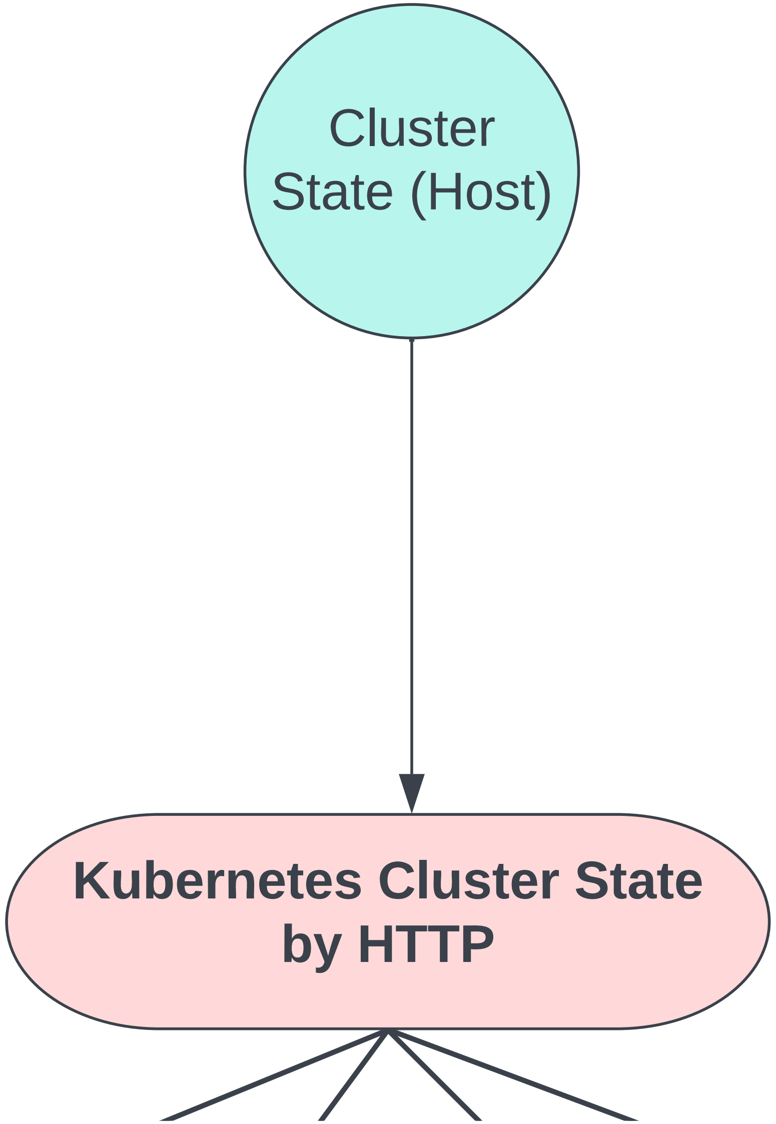

Cluster Nodes (Host)
Cluster State (Host)
Kubernetes Nodes by HTTP
Kubernetes Cluster State by HTTP
Creates
Creates
Creates
Creates
Creates
Node (Host)
API Server (Host)
Controller Manager (Host)
Scheduler (Host)
Kubelet (Host)
Linux by Zabbix Agent
Kubernetes API Server by HTTP
Kubernetes Scheduler by HTTP
Kubernetes Controller Manager by HTTP
Kubernetes Kubelet by HTTP

Kubernetes Nodes by HTTP

Kubernetes Cluster State by HTTP

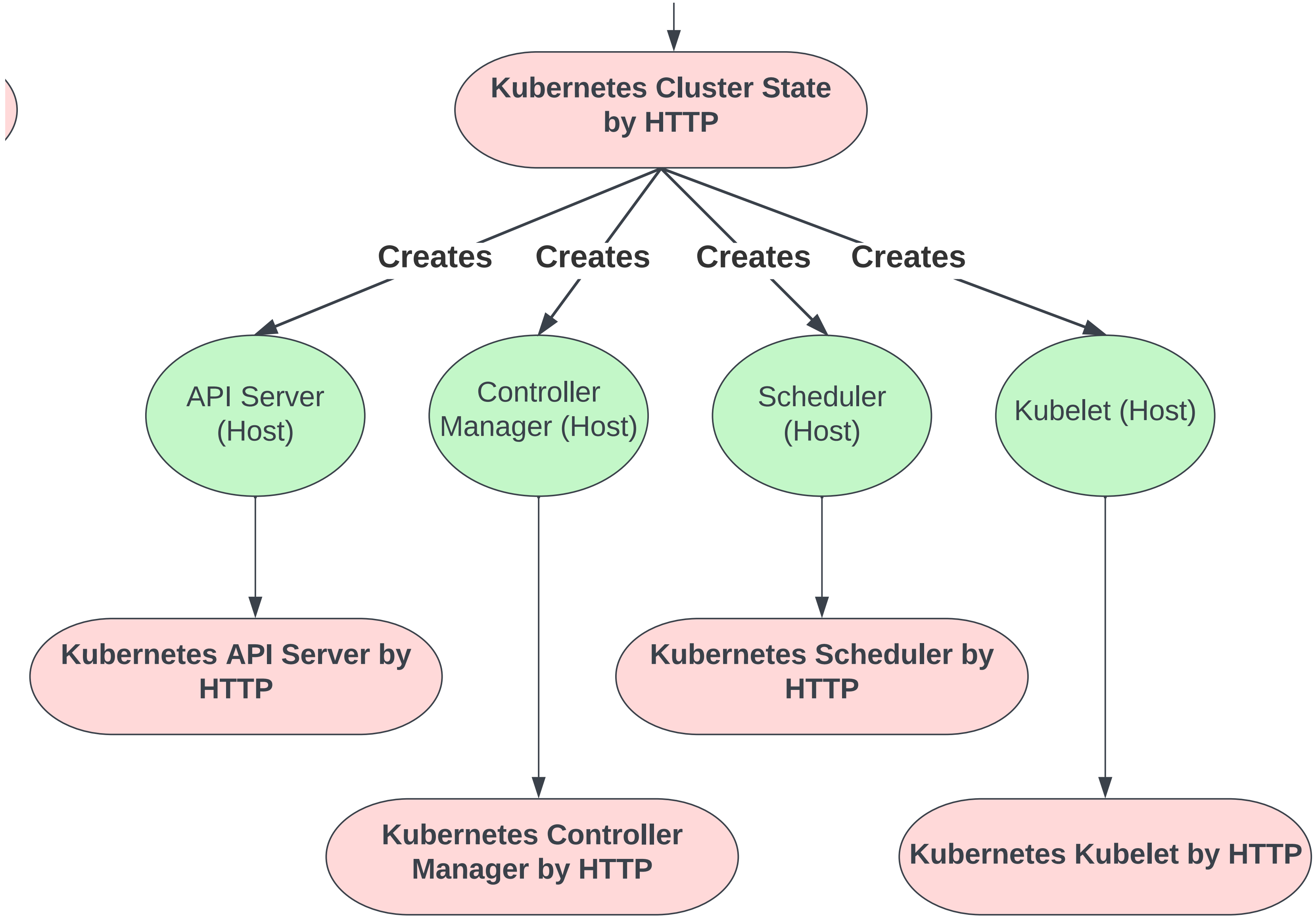

Cluster Nodes (Host)
Kubernetes Nodes by HTTP

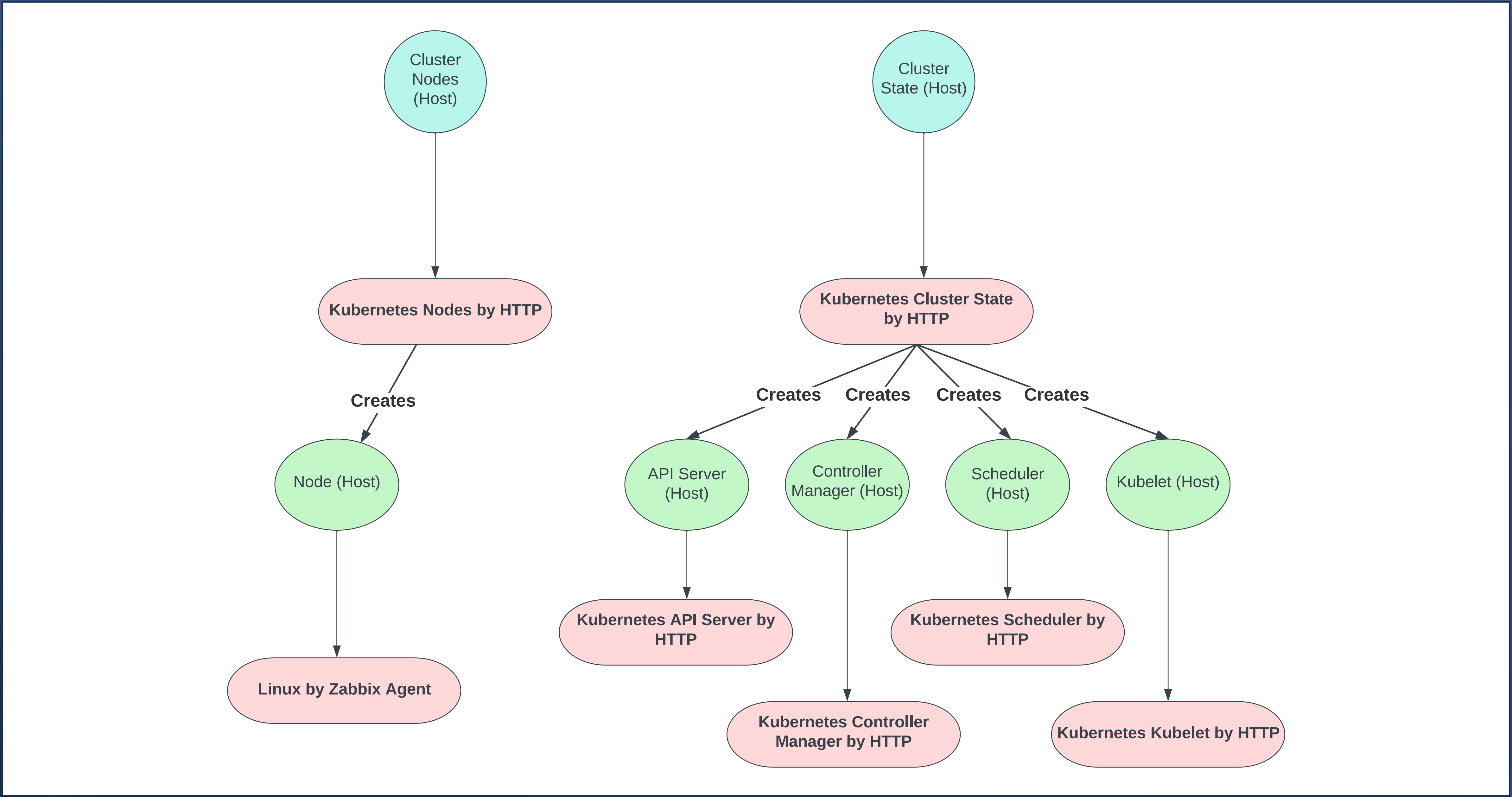

Kubernetes Nodes by HTTP
Creates
Node (Host)
Linux by Zabbix Agent
Ku



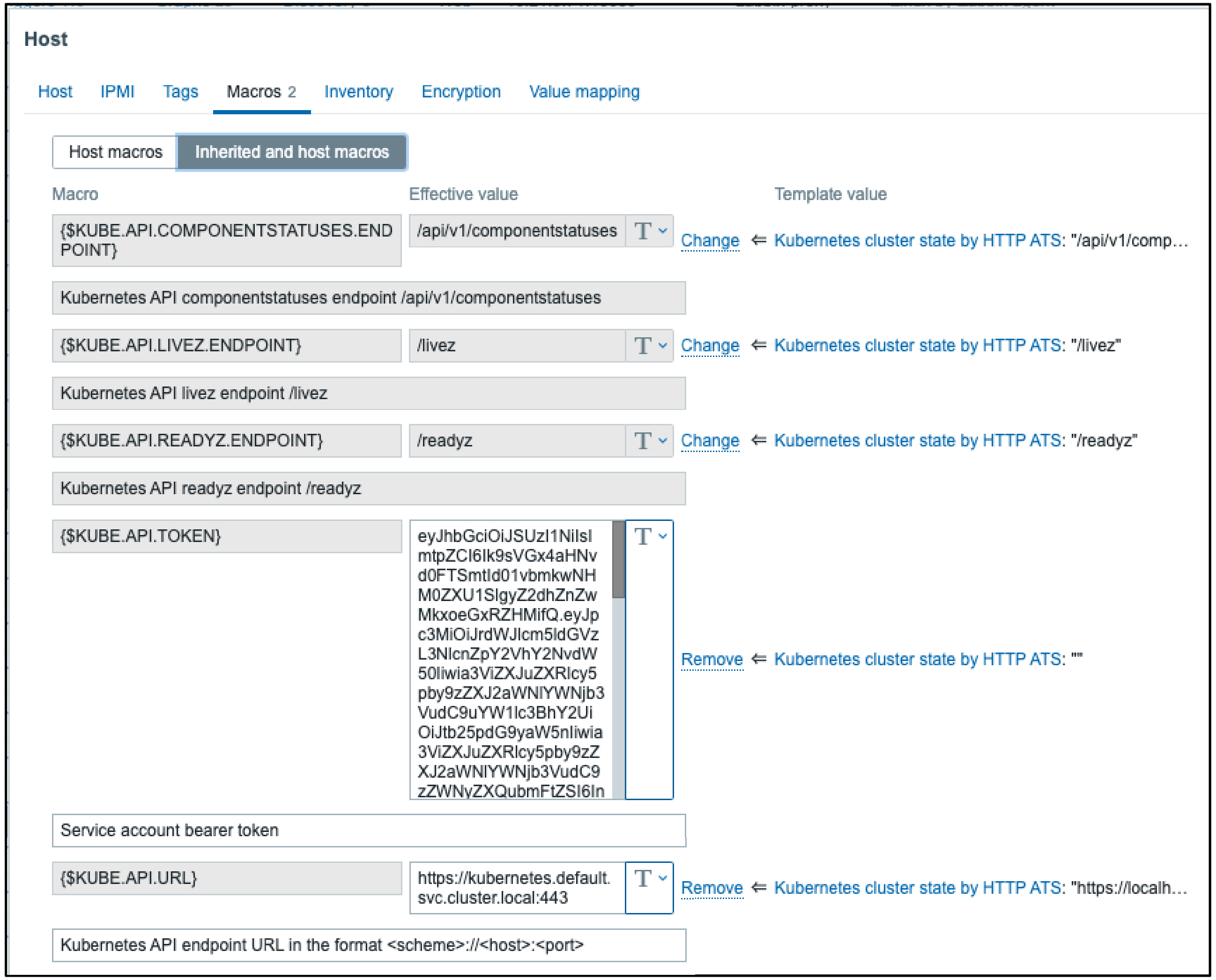
Cluster State (Host)

Kubernetes Cluster State by HTTP


Kubernetes Cluster State by HTTP
Creates
Creates
Creates
Creates
API Server (Host)
Controller Manager (Host)
Scheduler (Host)
Kubelet (Host)
Kubernetes API Server by HTTP
Kubernetes Controller Manager by HTTP
Kubernetes Scheduler by HTTP
Kubernetes Kubelet by HTTP


Cluster Nodes (Host)
Kubernetes Nodes by HTTP
Creates
Node (Host)
Linux by Zabbix Agent
Cluster State (Host)
Kubernetes Cluster State by HTTP
Creates
Creates
Creates
Creates
API Server (Host)
Controller Manager (Host)
Scheduler (Host)
Kubelet (Host)
Kubernetes API Server by HTTP
Kubernetes Controller Manager by HTTP
Kubernetes Scheduler by HTTP
Kubernetes Kubelet by HTTP

Macros

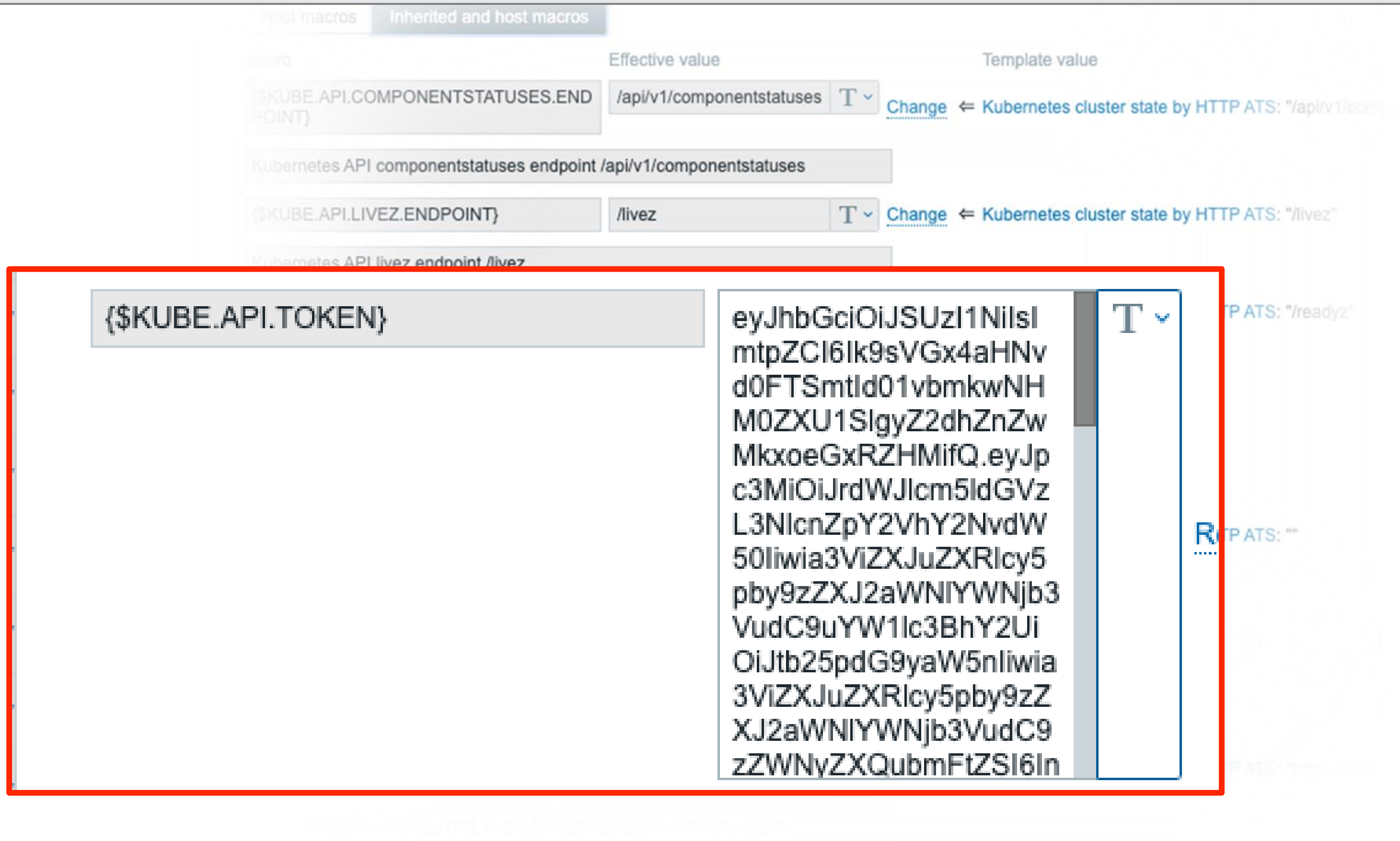


Host

Macro	Effective value		Template value
{$KUBE.API.COMPONENTSTATUSES.ENDPOINT}	/api/v1/componentstatuses	Change ⇐	Kubernetes cluster state by HTTP ATS: "/api/v1/comp…
Kubernetes API componentstatuses endpoint /api/v1/componentstatuses			
{$KUBE.API.LIVEZ.ENDPOINT}	/livez	Change ⇐	Kubernetes cluster state by HTTP ATS: "/livez"
Kubernetes API livez endpoint /livez			
{$KUBE.API.READYZ.ENDPOINT}	/readyz	Change ⇐	Kubernetes cluster state by HTTP ATS: "/readyz"
Kubernetes API readyz endpoint /readyz			
{$KUBE.API.TOKEN}	eyJhbGciOiJSUzI1NiIsI mtpZCI6Ik9sVGx4aHNv d0FTSmtId01vbmkwNH M0ZXU1SIgyZ2dhZnZw MkxoeGxRZHMifQ.eyJp c3MiOiJrdWJlcm5ldGVz L3NlcnZpY2VhY2NvdW 50Iiwia3ViZXJuZXRlcy5 pby9zZXJ2aWNlYWNjb3 VudC9uYW1lc3BhY2Ui OiJtb25pdG9yaW5nIiwia 3ViZXJuZXRlcy5pby9zZ XJ2aWNlYWNjb3VudC9 zZWNyZXQubmFtZSI6In	Remove ⇐	Kubernetes cluster state by HTTP ATS: ""
Service account bearer token			
{$KUBE.API.URL}	https://kubernetes.default.svc.cluster.local:443	Remove ⇐	Kubernetes cluster state by HTTP ATS: "https://localh…
Kubernetes API endpoint URL in the format <scheme>://<host>:<port>			

Macros

```
kubectl get secret zabbix-service-account -n monitoring -o jsonpath={.data.token} | base64 -d
```



Macro | Effective value | Template value

{$KUBE.API.COMPONENTSTATUSES.ENDPOINT} /api/v1/componentstatuses T Change ⇐ Kubernetes cluster state by HTTP ATS: "/api/v1/com

Kubernetes API componentstatuses endpoint /api/v1/componentstatuses

{$KUBE.API.LIVEZ.ENDPOINT} /livez T Change ⇐ Kubernetes cluster state by HTTP ATS: "/livez"

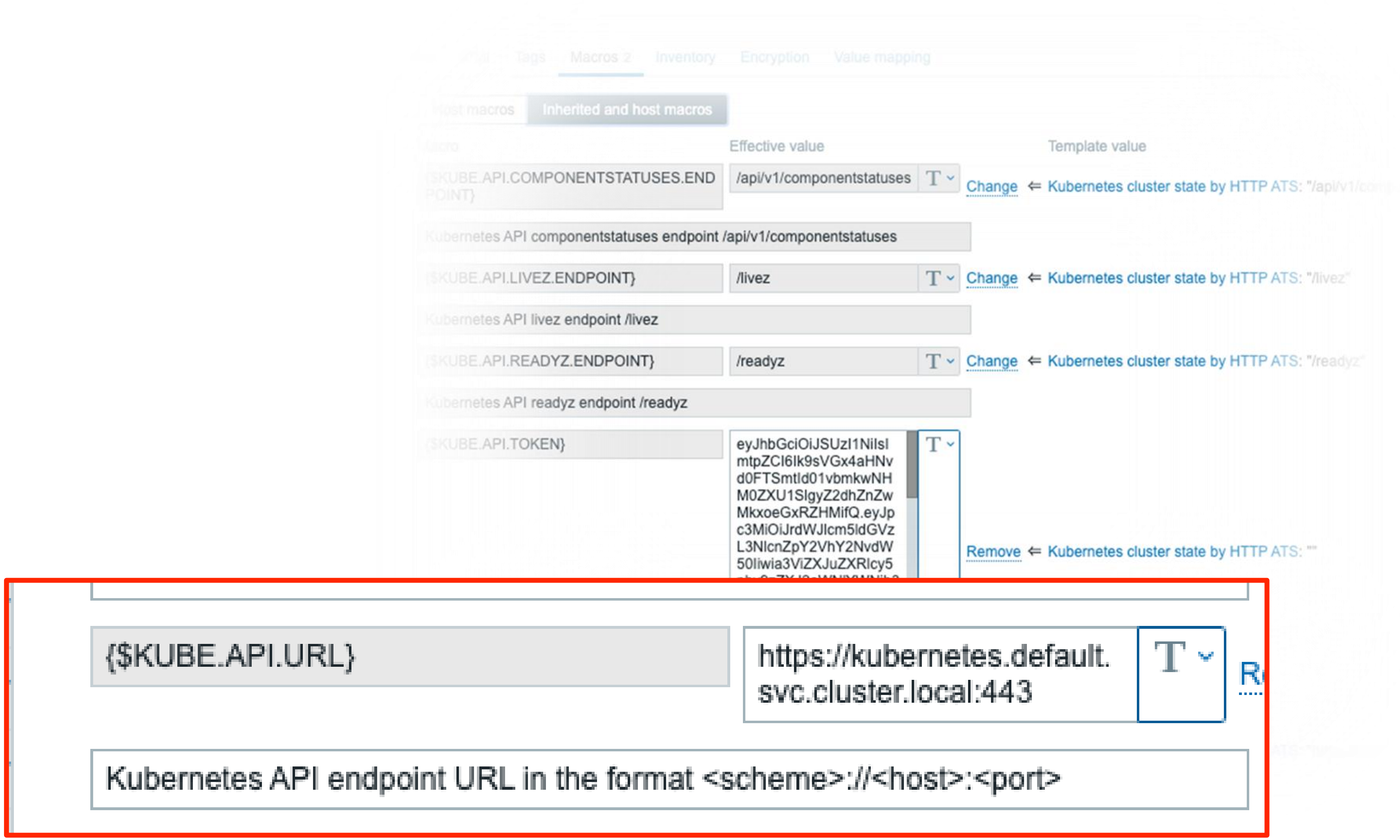
Kubernetes API livez endpoint /livez

TP ATS: "/readyz"

{$KUBE.API.TOKEN}

```
eyJhbGciOiJSUzI1NiIsI
mtpZCI6Ik9sVGx4aHNv
d0FTSmtId01vbmkwNH
M0ZXU1SIgyZ2dhZnZw
MkxoeGxRZHMifQ.eyJp
c3MiOiJrdWJlcm5ldGVz
L3NlcnZpY2VhY2NvdW
50Iiwia3ViZXJuZXRlcy5
pby9zZXJ2aWNlYWNjb3
VudC9uYW1lc3BhY2Ui
OiJtb25pdG9yaW5nIiwia
3ViZXJuZXRlcy5pby9zZ
XJ2aWNlYWNjb3VudC9
zZWNyZXQubmFtZSI6In
```

Macros



Macro | Effective value | Template value

{$KUBE.API.COMPONENTSTATUSES.ENDPOINT} /api/v1/componentstatuses T Change ⇐ Kubernetes cluster state by HTTP ATS: "/api/v1/com

Kubernetes API componentstatuses endpoint /api/v1/componentstatuses

{$KUBE.API.LIVEZ.ENDPOINT} /livez T Change ⇐ Kubernetes cluster state by HTTP ATS: "/livez"

Kubernetes API livez endpoint /livez

{$KUBE.API.READYZ.ENDPOINT} /readyz T Change ⇐ Kubernetes cluster state by HTTP ATS: "/readyz"

Kubernetes API readyz endpoint /readyz

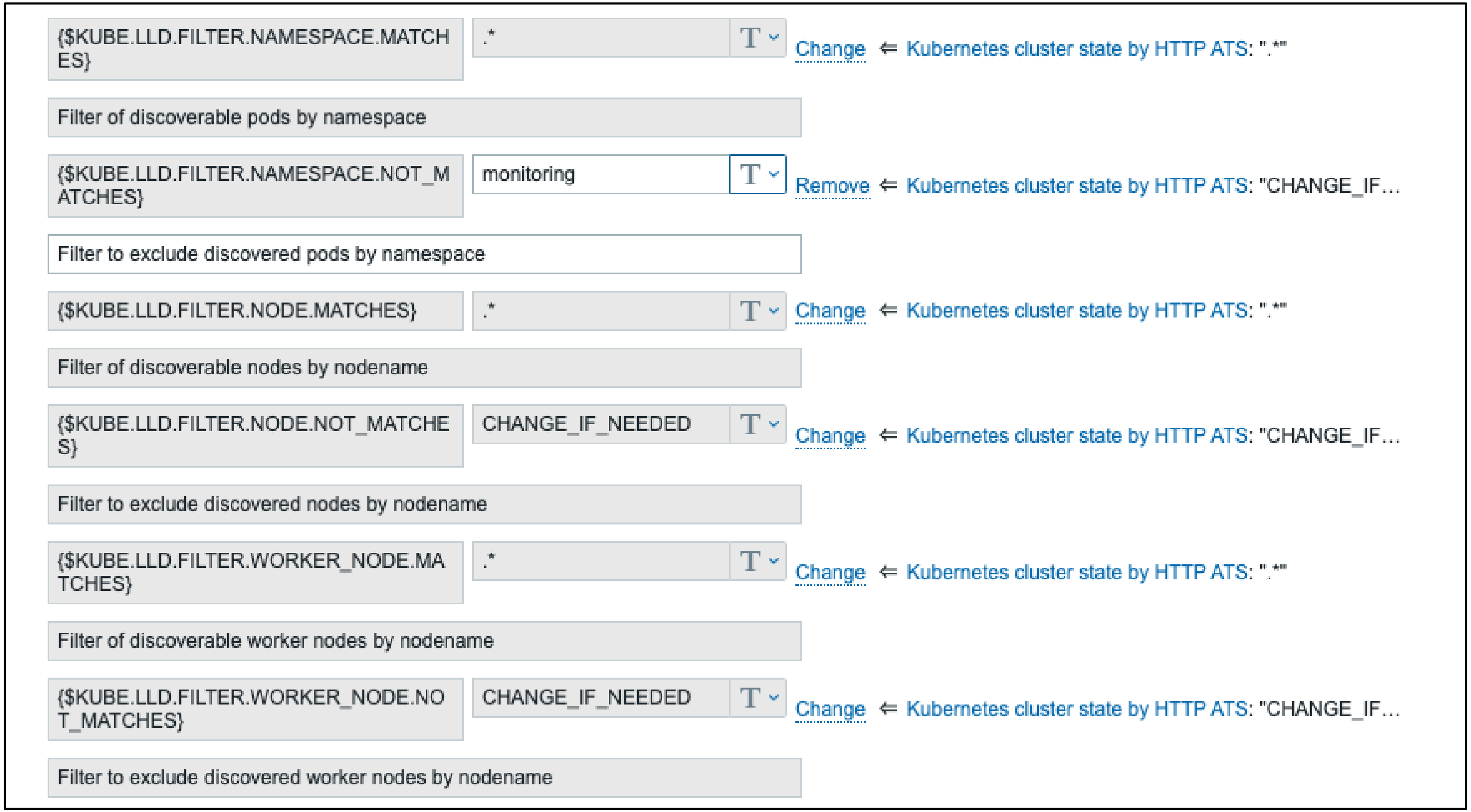
{$KUBE.API.TOKEN} T Remove ⇐ Kubernetes cluster state by HTTP ATS: ""

```
eyJhbGciOiJSUzI1NiIsI
mtpZCI6Ik9sVGx4aHNv
d0FTSmtld01vbmkwNH
M0ZXU1SlgyZ2dhZnZw
MkxoeGxRZHMifQ.eyJp
c3MiOiJrdWJlcm5ldGVz
L3NlcnZpY2VhY2NvdW
50Iiwia3ViZXJuZXRlcy5
```

{$KUBE.API.URL} https://kubernetes.default.svc.cluster.local:443 T R

Kubernetes API endpoint URL in the format <scheme>://<host>:<port>

Macros



{$KUBE.LLD.FILTER.NAMESPACE.MATCHES}	.*	Change ⇐ Kubernetes cluster state by HTTP ATS: ".*"
Filter of discoverable pods by namespace		
{$KUBE.LLD.FILTER.NAMESPACE.NOT_MATCHES}	monitoring	Remove ⇐ Kubernetes cluster state by HTTP ATS: "CHANGE_IF…
Filter to exclude discovered pods by namespace		
{$KUBE.LLD.FILTER.NODE.MATCHES}	.*	Change ⇐ Kubernetes cluster state by HTTP ATS: ".*"
Filter of discoverable nodes by nodename		
{$KUBE.LLD.FILTER.NODE.NOT_MATCHES}	CHANGE_IF_NEEDED	Change ⇐ Kubernetes cluster state by HTTP ATS: "CHANGE_IF…
Filter to exclude discovered nodes by nodename		
{$KUBE.LLD.FILTER.WORKER_NODE.MATCHES}	.*	Change ⇐ Kubernetes cluster state by HTTP ATS: ".*"
Filter of discoverable worker nodes by nodename		
{$KUBE.LLD.FILTER.WORKER_NODE.NOT_MATCHES}	CHANGE_IF_NEEDED	Change ⇐ Kubernetes cluster state by HTTP ATS: "CHANGE_IF…
Filter to exclude discovered worker nodes by nodename		

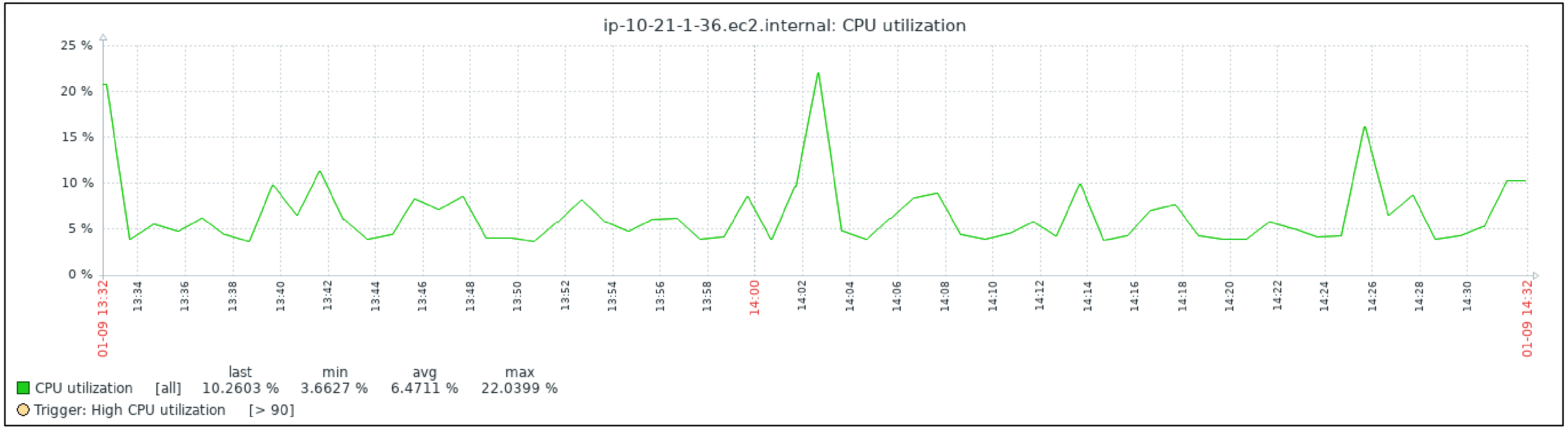
Monitoring Cluster in Zabbix

ATS GROUP
ADVANCED TECHNOLOGY SERVICES

Performance and Resource Usage Metric Items

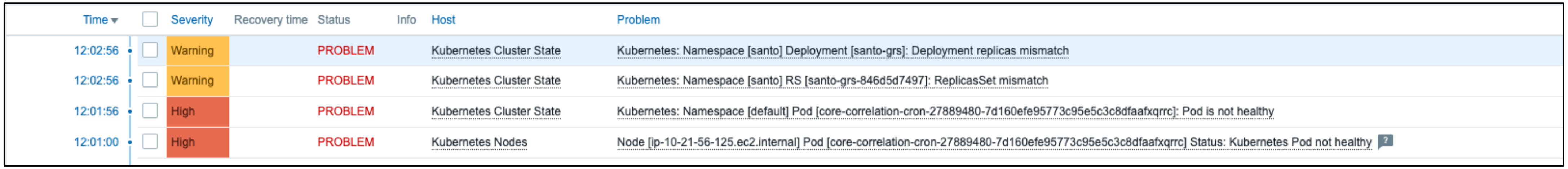
- Standard items from “Linux by Zabbix Agent” template on each node
- Additional per-node items
  - CPU/Memory on node available to cluster
- CPU/Memory per pod (requires cAdvisor)

https://git.zabbix.com/projects/ZBX/repos/zabbix/browse/templates/app/kubernetes_http



Object Status Items

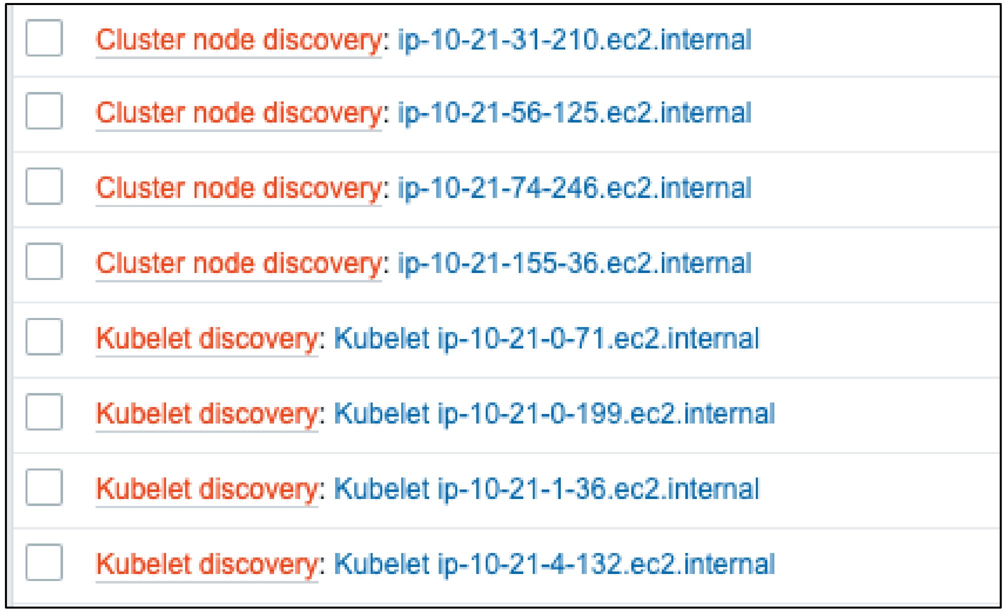
- State info for pods
  - CPU/Memory limits/requests
  - Number of containers in each state (ready, running, terminated, waiting)
  - Number of container restarts
  - Pod State (failed, pending, running, succeeded, unknown)
- Triggers
  - Replica mismatch
  - Crash Looping Pod
  - Unhealthy pod



Time ▾	□	Severity	Recovery time	Status	Info	Host	Problem
12:02:56	□	Warning		PROBLEM		Kubernetes Cluster State	Kubernetes: Namespace [santo] Deployment [santo-grs]: Deployment replicas mismatch
12:02:56	□	Warning		PROBLEM		Kubernetes Cluster State	Kubernetes: Namespace [santo] RS [santo-grs-846d5d7497]: ReplicasSet mismatch
12:01:56	□	High		PROBLEM		Kubernetes Cluster State	Kubernetes: Namespace [default] Pod [core-correlation-cron-27889480-7d160efe95773c95e5c3c8dfaafxqrrc]: Pod is not healthy
12:01:00	□	High		PROBLEM		Kubernetes Nodes	Node [ip-10-21-56-125.ec2.internal] Pod [core-correlation-cron-27889480-7d160efe95773c95e5c3c8dfaafxqrrc] Status: Kubernetes Pod not healthy ?

Discovered Hosts and Items

- Templates discover nodes -> represented by two hosts
  - Generic Linux Host
  - Kubelet
- Objects such as pods, daemonsets, cronjobs, jobs, etc.
- Control Plane components represented as hosts
  - API Server
  - Controller Manager
  - Scheduler



□ Cluster node discovery: ip-10-21-31-210.ec2.internal

□ Cluster node discovery: ip-10-21-56-125.ec2.internal

□ Cluster node discovery: ip-10-21-74-246.ec2.internal

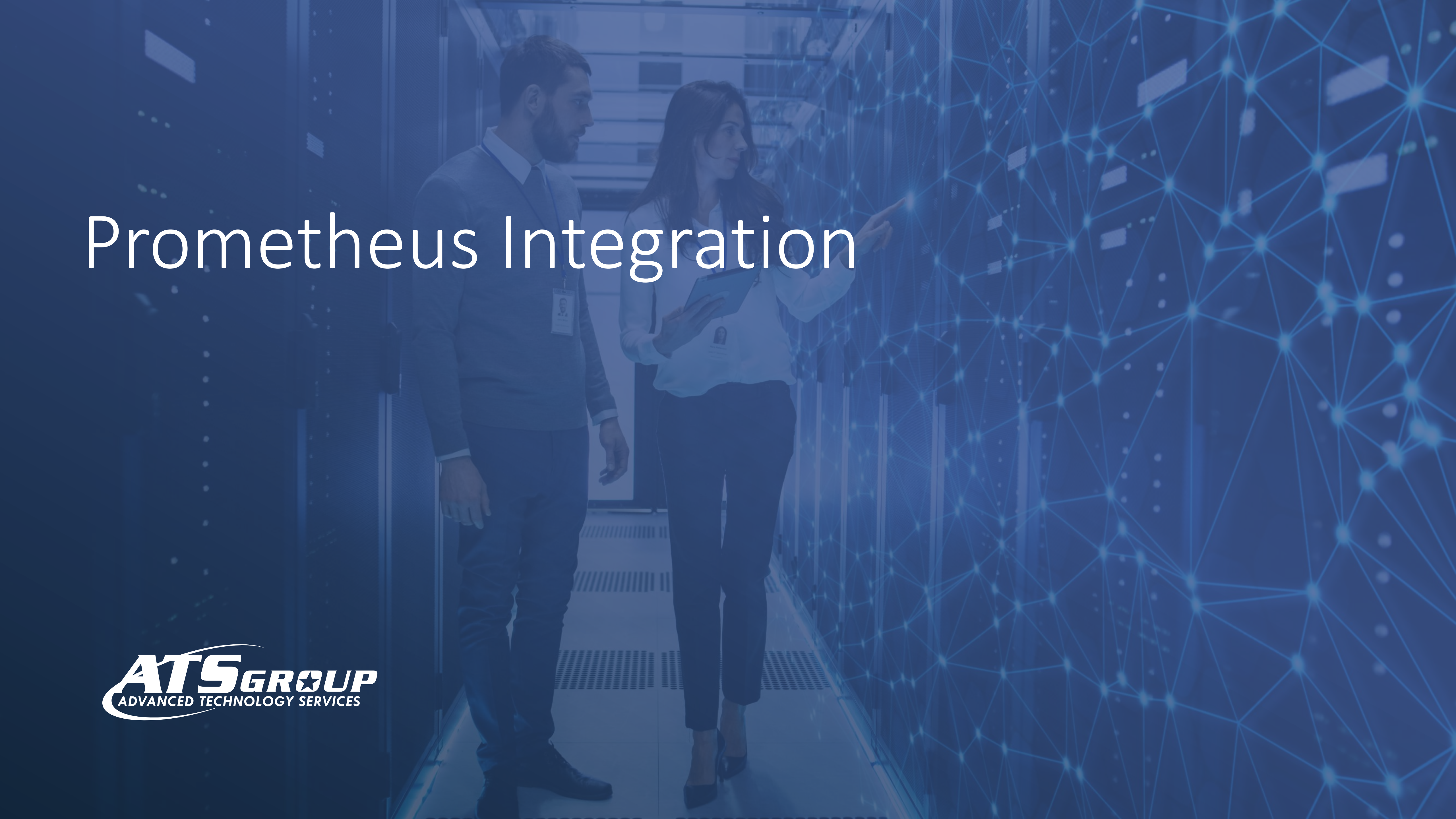
□ Cluster node discovery: ip-10-21-155-36.ec2.internal

□ Kubelet discovery: Kubelet ip-10-21-0-71.ec2.internal

□ Kubelet discovery: Kubelet ip-10-21-0-199.ec2.internal

□ Kubelet discovery: Kubelet ip-10-21-1-36.ec2.internal

□ Kubelet discovery: Kubelet ip-10-21-4-132.ec2.internal

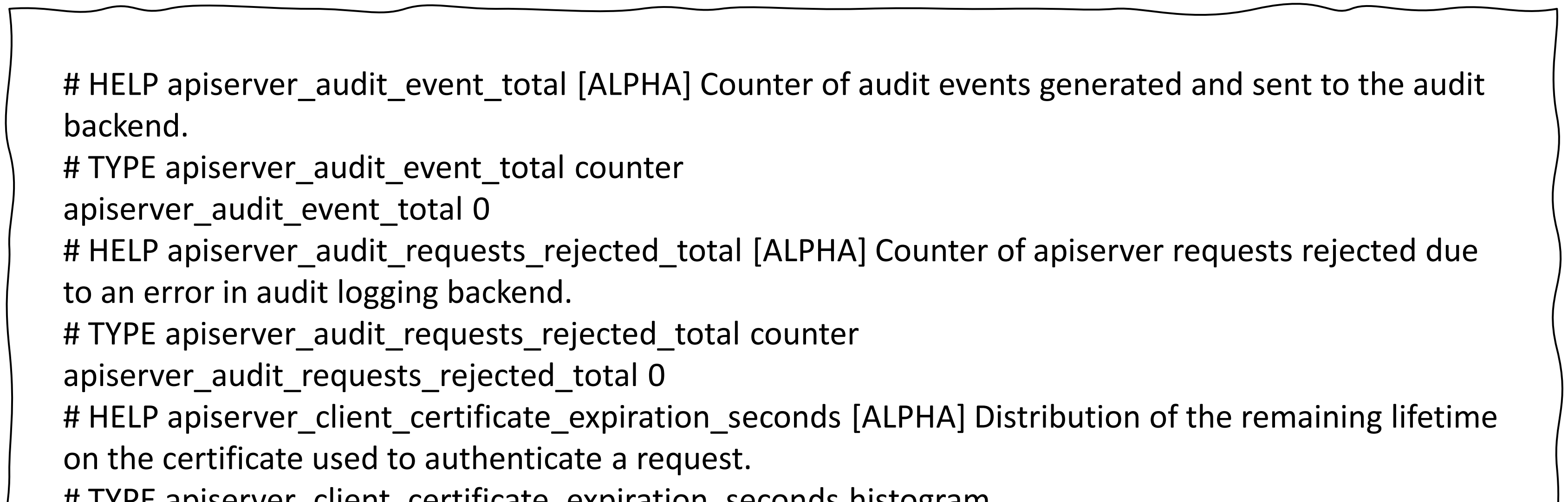


Prometheus Integration

ATS GROUP
ADVANCED TECHNOLOGY SERVICES

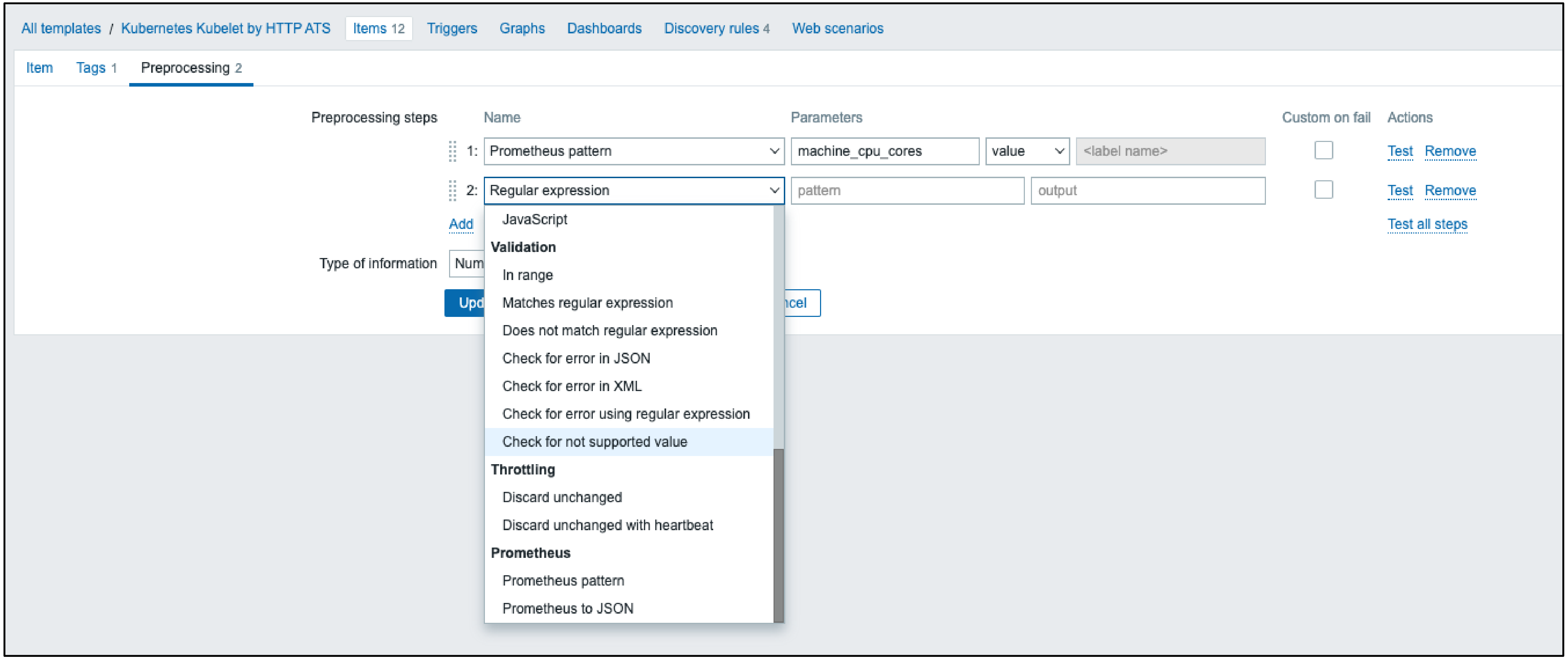
Prometheus Integration

- Available since Zabbix 4.0
- Used in Kubernetes Integration
  - cAdvisor
  - kube-state-metrics
- Zabbix supports most use cases of Prometheus and its data model
  - Node Exporter
  - Applications exposing “/metrics” endpoint



```
# HELP apiserver_audit_event_total [ALPHA] Counter of audit events generated and sent to the audit
backend.
# TYPE apiserver_audit_event_total counter
apiserver_audit_event_total 0
# HELP apiserver_audit_requests_rejected_total [ALPHA] Counter of apiserver requests rejected due
to an error in audit logging backend.
# TYPE apiserver_audit_requests_rejected_total counter
apiserver_audit_requests_rejected_total 0
# HELP apiserver_client_certificate_expiration_seconds [ALPHA] Distribution of the remaining lifetime
on the certificate used to authenticate a request.
# TYPE apiserver_client_certificate_expiration_seconds histogram
```

Prometheus Preprocessing

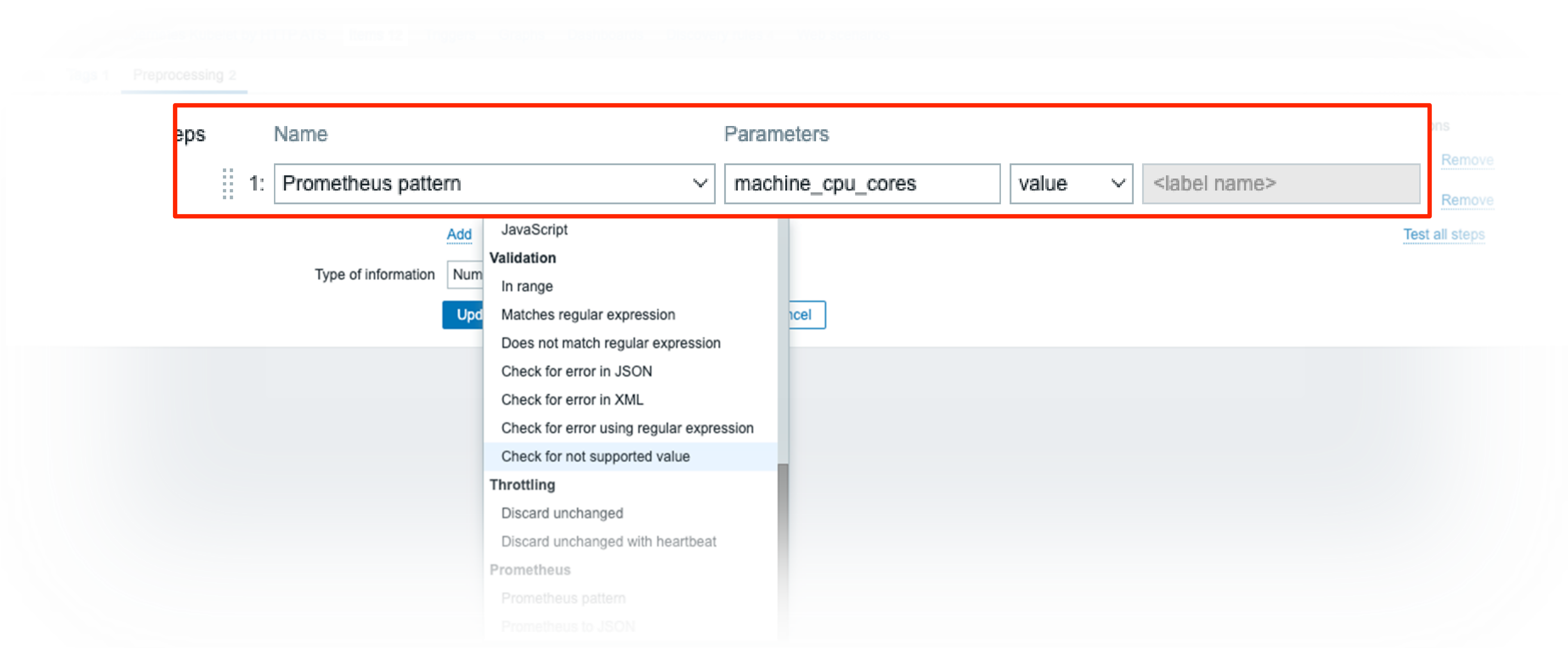


Preprocessing steps	Name	Parameters			Custom on fail	Actions
1:	Prometheus pattern	machine_cpu_cores	value	<label name>	□	Test Remove
2:	Regular expression	pattern	output		□	Test Remove
Add						Test all steps

Type of information Num

JavaScript
Validation
In range
Matches regular expression
Does not match regular expression
Check for error in JSON
Check for error in XML
Check for error using regular expression
Check for not supported value
Throttling
Discard unchanged
Discard unchanged with heartbeat
Prometheus
Prometheus pattern
Prometheus to JSON
Upd
ncel

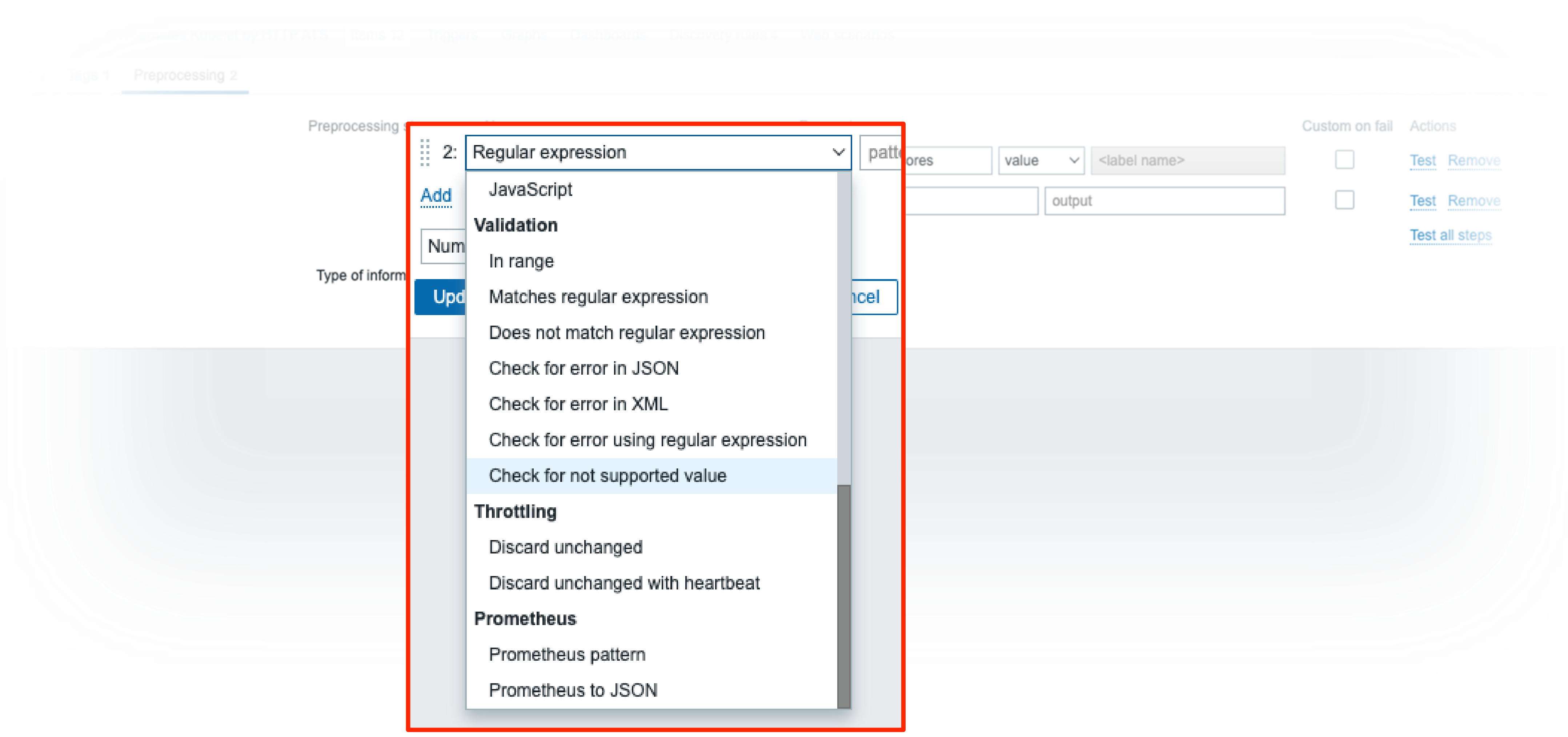
Prometheus Preprocessing



eps Name Parameters

1: Prometheus pattern machine_cpu_cores value <label name>

Prometheus Preprocessing



Prometheus Integration

- Available since Zabbix 4.0
- Used in Kubernetes Integration
  - cAdvisor
  - kube-state-metrics
- Zabbix supports most use cases of Prometheus and its data model
  - Node Exporter
  - Applications exposing “/metrics” endpoint

```
# HELP apiserver_audit_event_total [ALPHA] Counter of audit events generated and sent to the audit
backend.
# TYPE apiserver_audit_event_total counter
apiserver_audit_event_total 0
# HELP apiserver_audit_requests_rejected_total [ALPHA] Counter of apiserver requests rejected due
to an error in audit logging backend.
# TYPE apiserver_audit_requests_rejected_total counter
apiserver_audit_requests_rejected_total 0
# HELP apiserver_client_certificate_expiration_seconds [ALPHA] Distribution of the remaining lifetime
on the certificate used to authenticate a request.
# TYPE apiserver_client_certificate_expiration_seconds histogram
```

ATS GROUP
ADVANCED TECHNOLOGY SERVICES

TheATSGroup.com

Thank You!

Michaela DeForest
mdeforest@TheATSGroup.com