To CRD, or Not to CRD, *That* Is the Question

KubeCon | CloudNativeCon

OPEN SOURCE SUMMIT

China 2019

Intros

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@edking2

This Talk

- Motivations
- Where we’ve come from:
  - The k8s API, CRDs & Operators
- Where we **may** be heading:
  - Building on top of the k8s API
  - Pros, cons and considerations
- Closing remarks and Questions

Motivations

K8s is API-centric

The k8s API

Declarative

- What vs How
- World can be built from a set of config
- Easy to record changes

State separation

- Desired state
- Observed state

Level-based

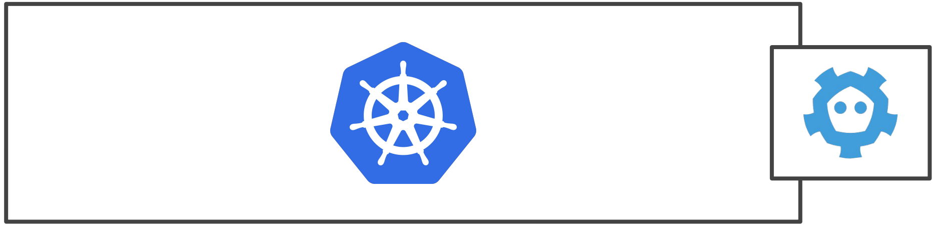
- Does not rely on individual changes
- Less prone to error

Transparent

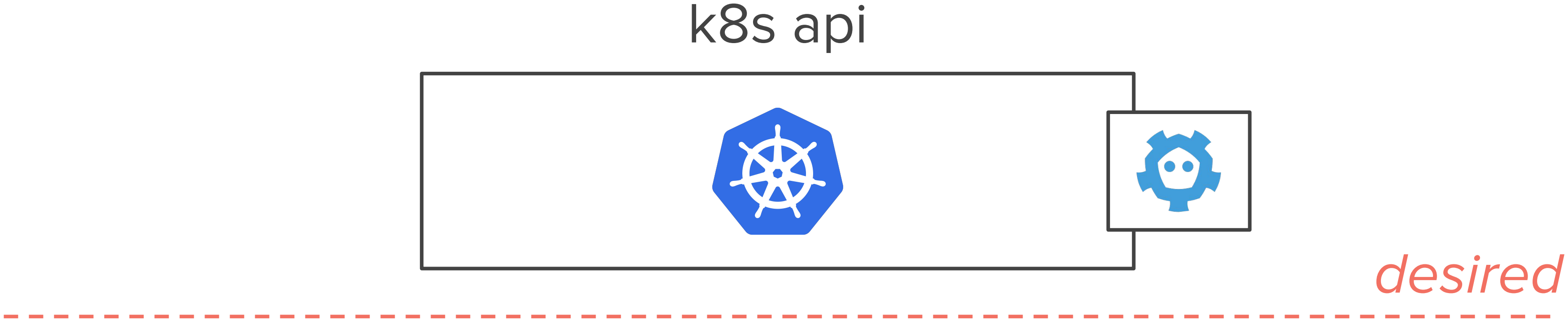
- One control plane
- Facilities composability

Example

k8s api



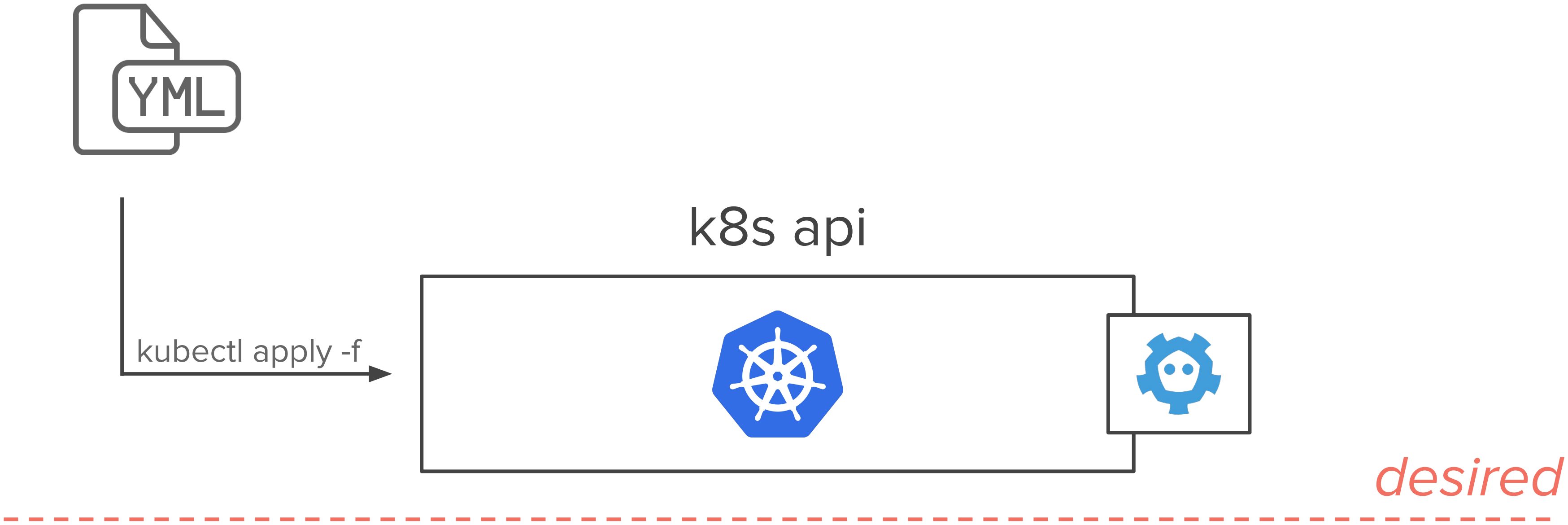
“I want 1 pod to be running”

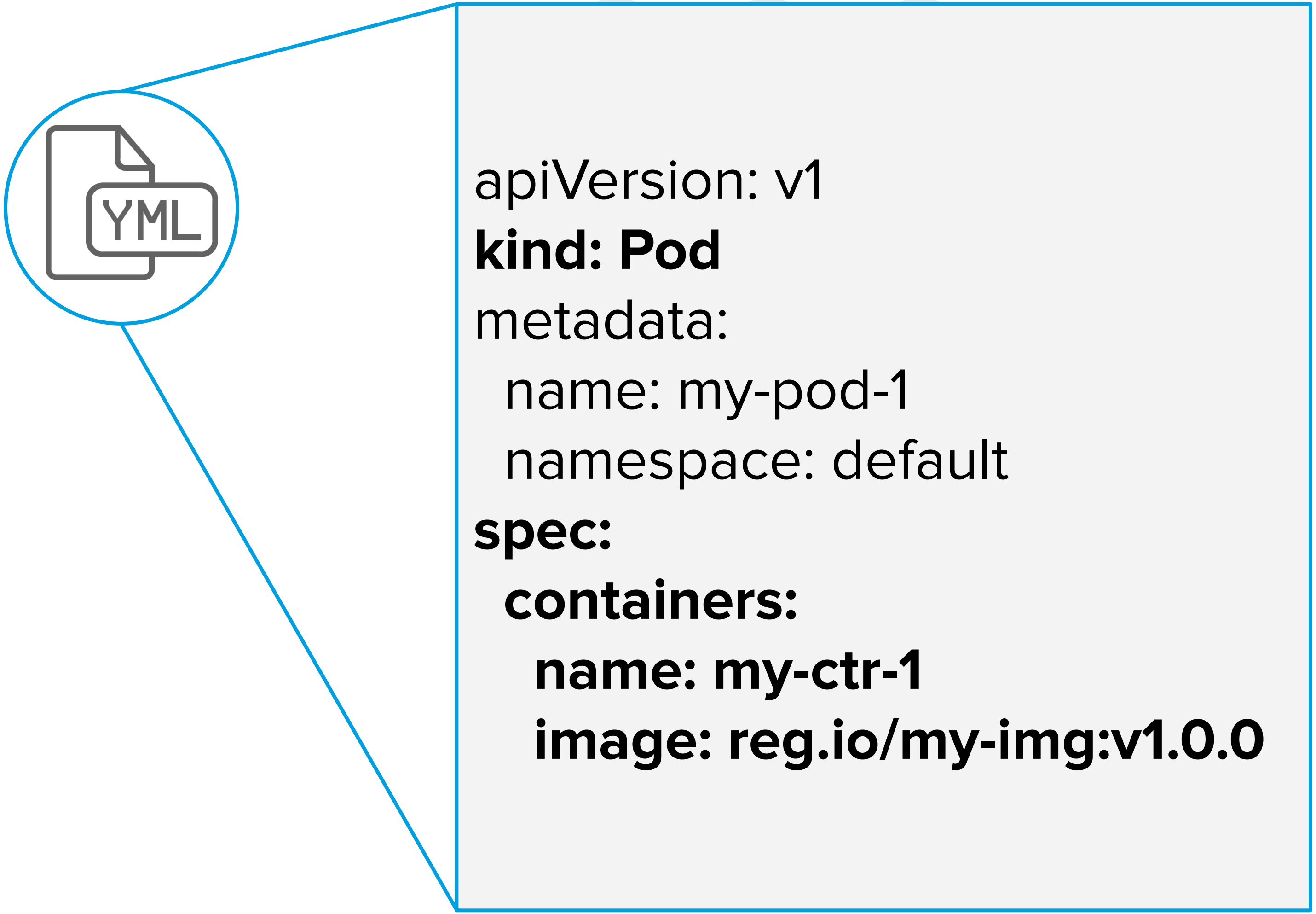


k8s api

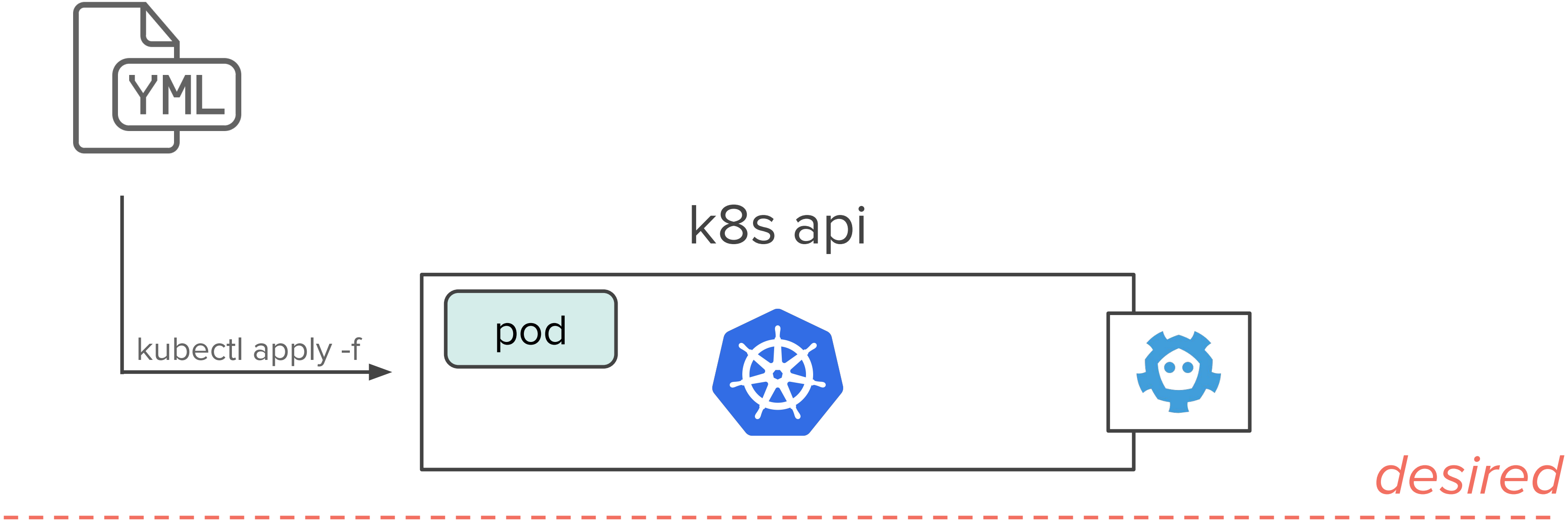
desired

“I want 1 pod to be running”





```yaml
apiVersion: v1
kind: Pod
metadata:
  name: my-pod-1
  namespace: default
spec:
  containers:
    name: my-ctr-1
    image: reg.io/my-img:v1.0.0
```

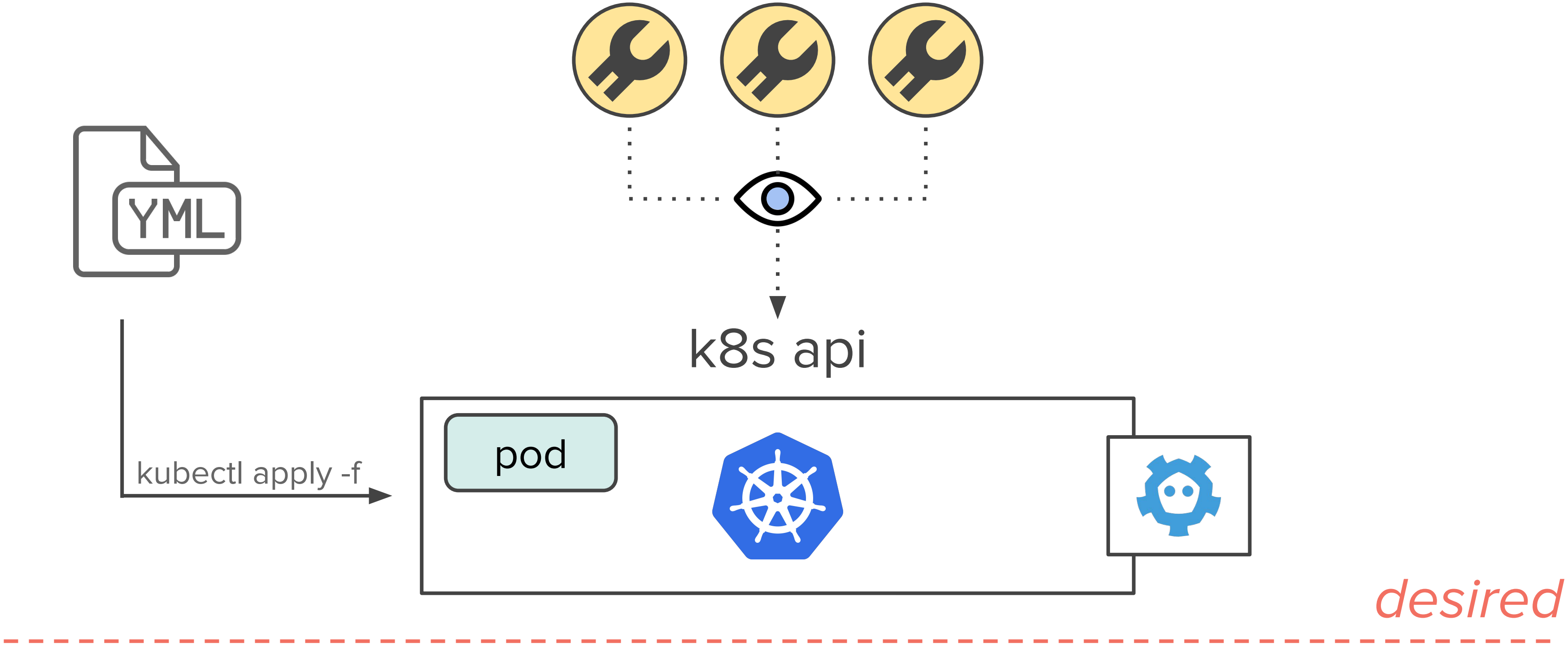


k8s api

kubectl apply -f

pod

desired



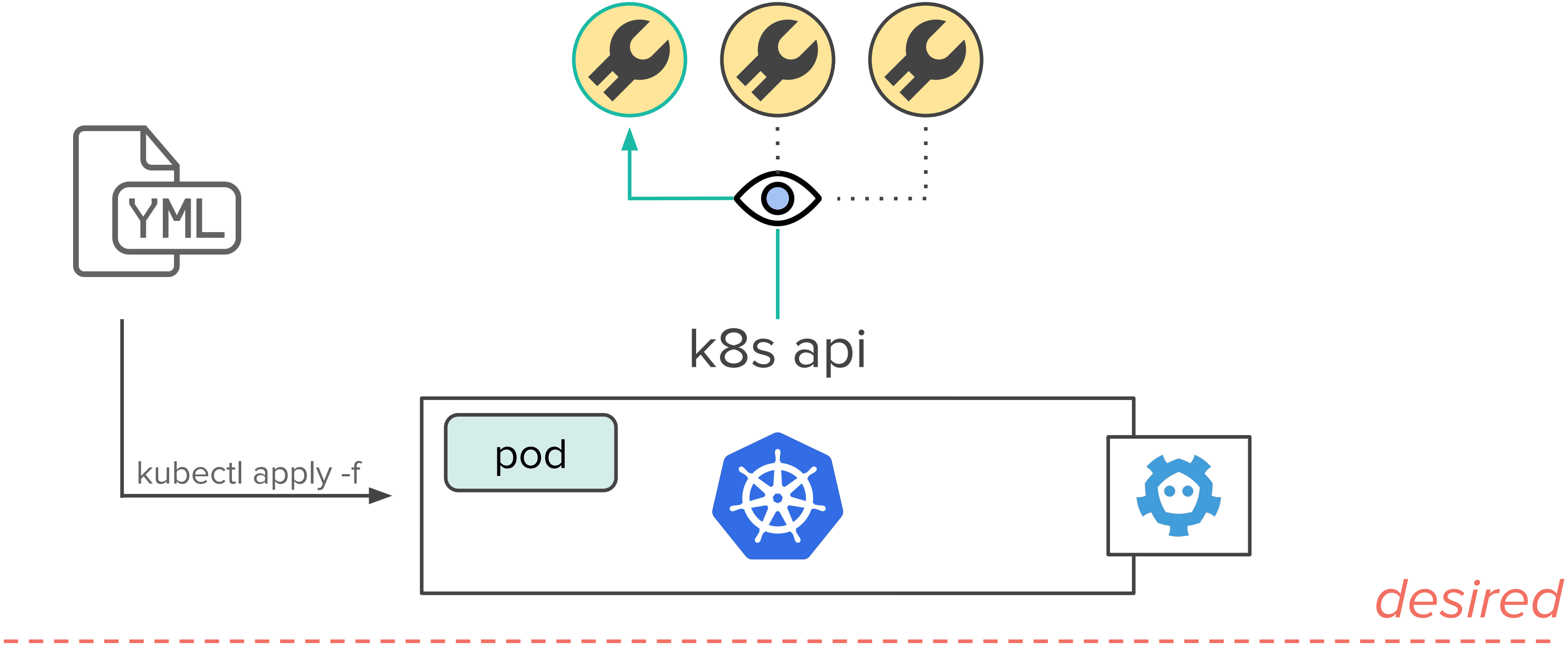
YML

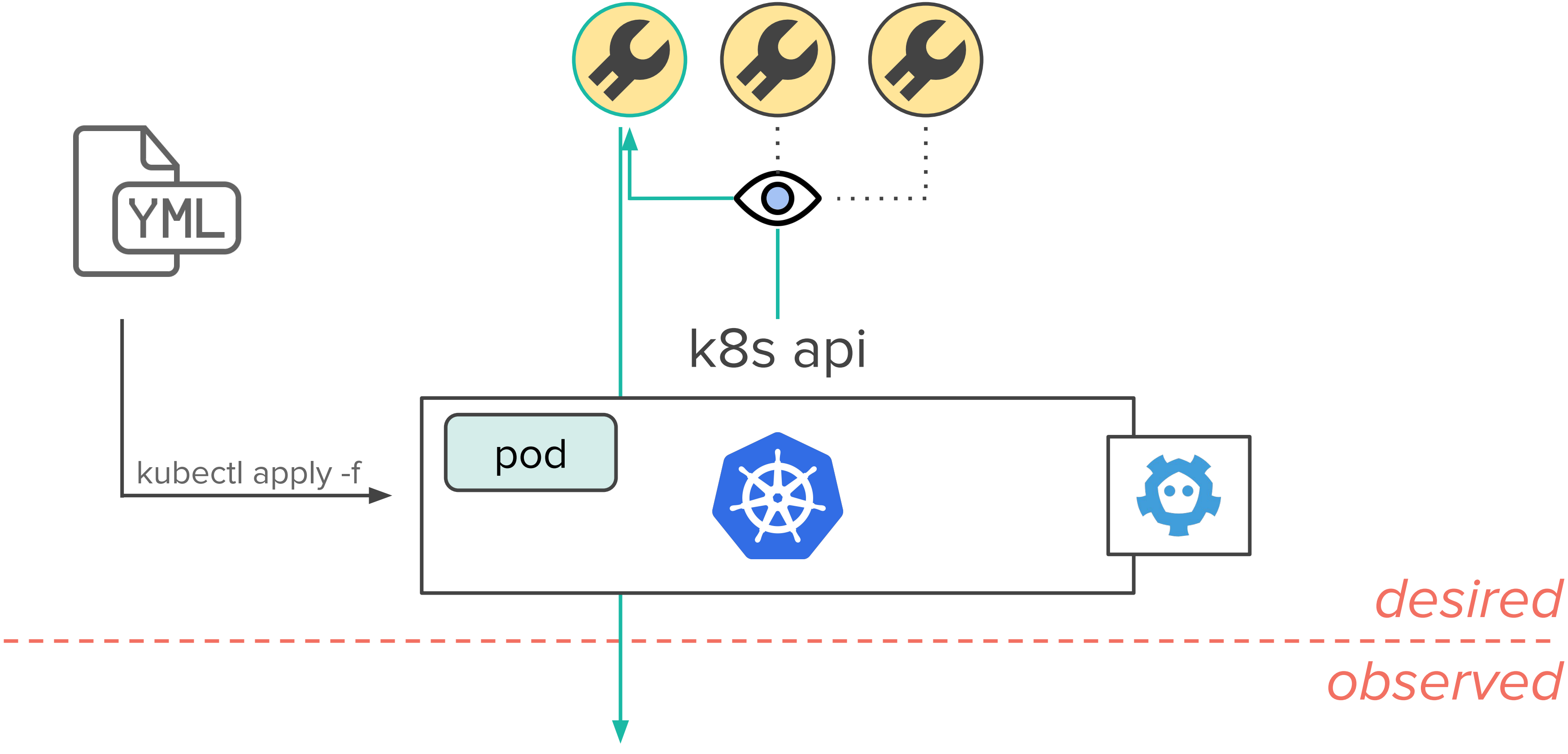
k8s api

pod

kubectl apply -f

desired


YML
kubectl apply -f
k8s api
pod
desired



kubectl apply -f

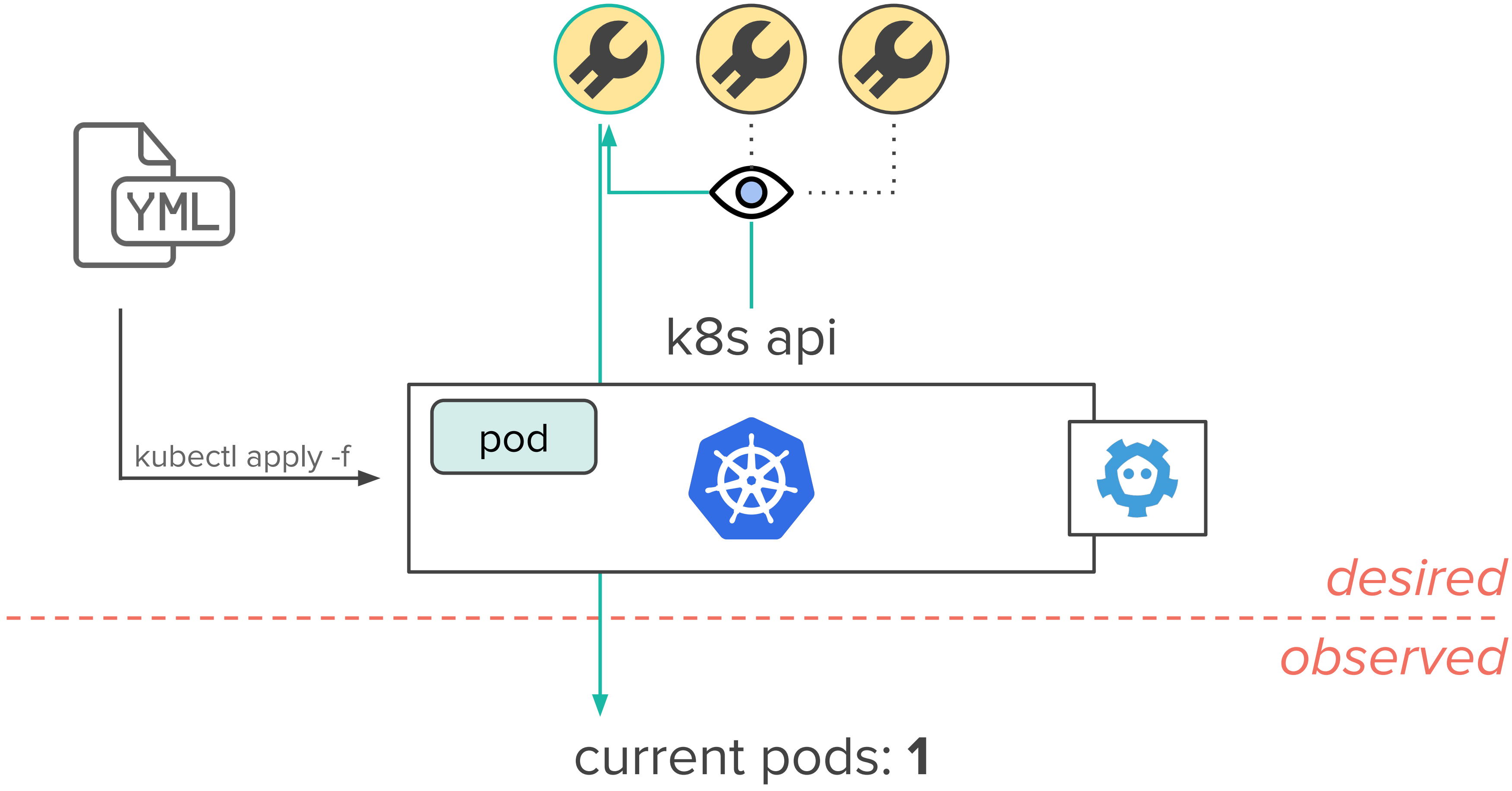
k8s api

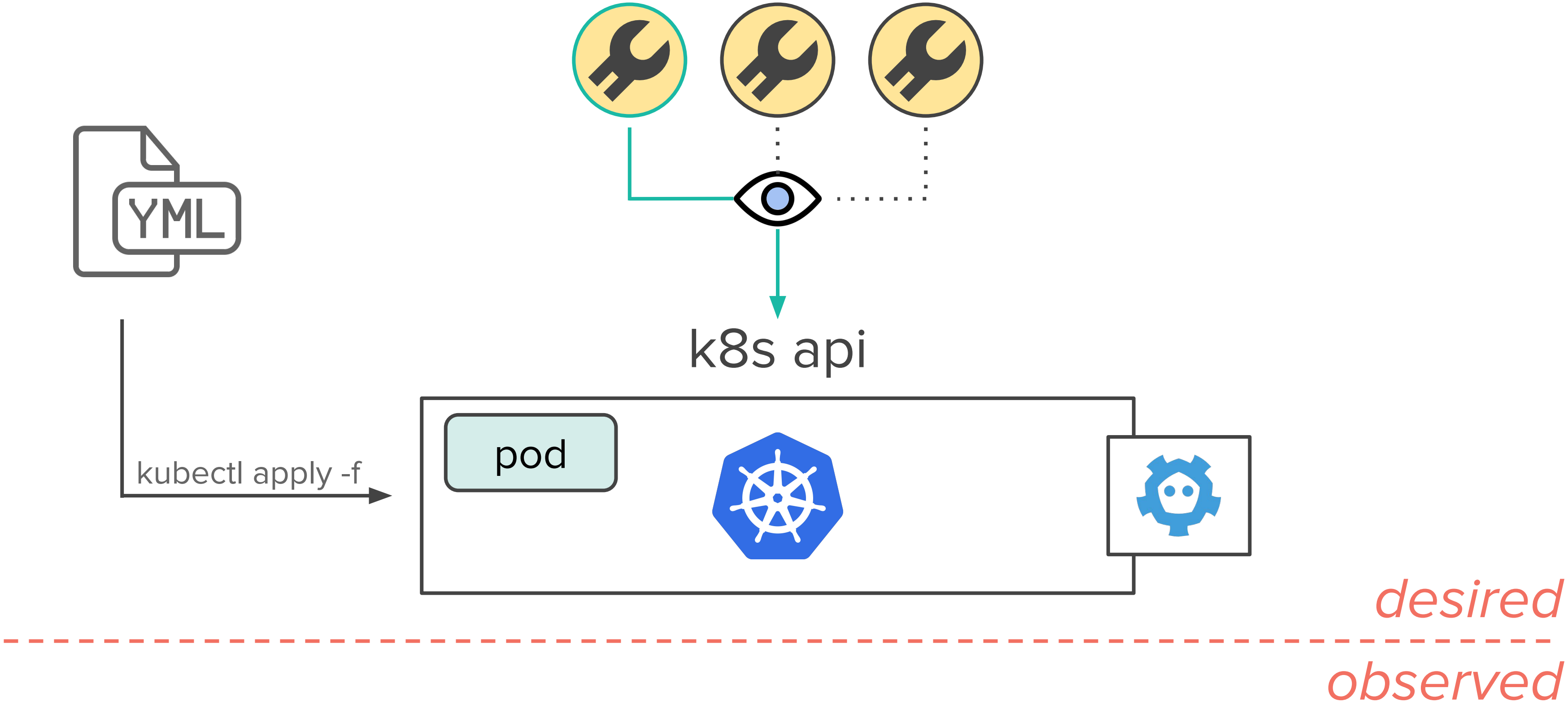
pod

desired

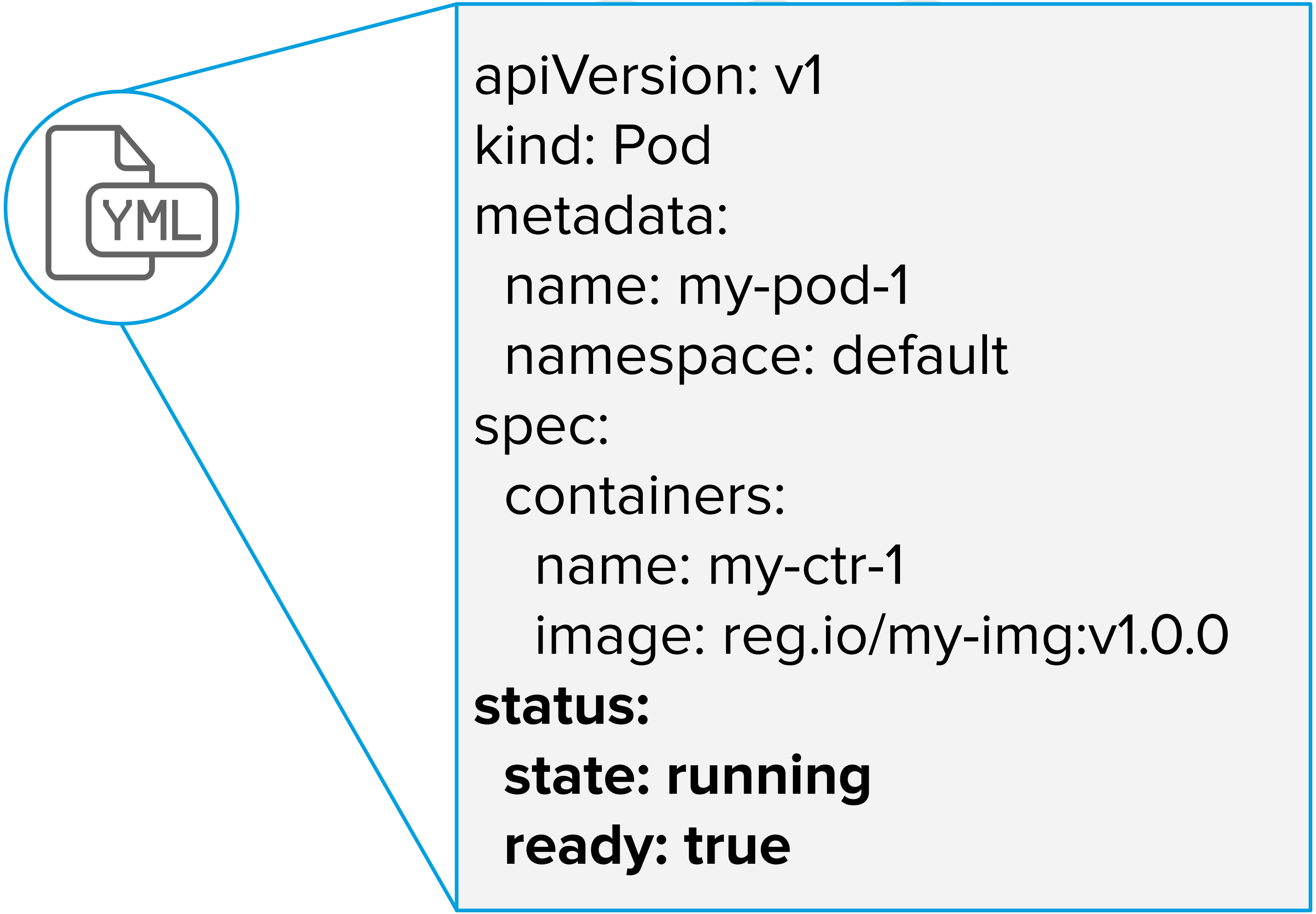
observed

current pods: **0**

YML
kubectl apply -f
k8s api
pod
desired
observed
current pods: **1**

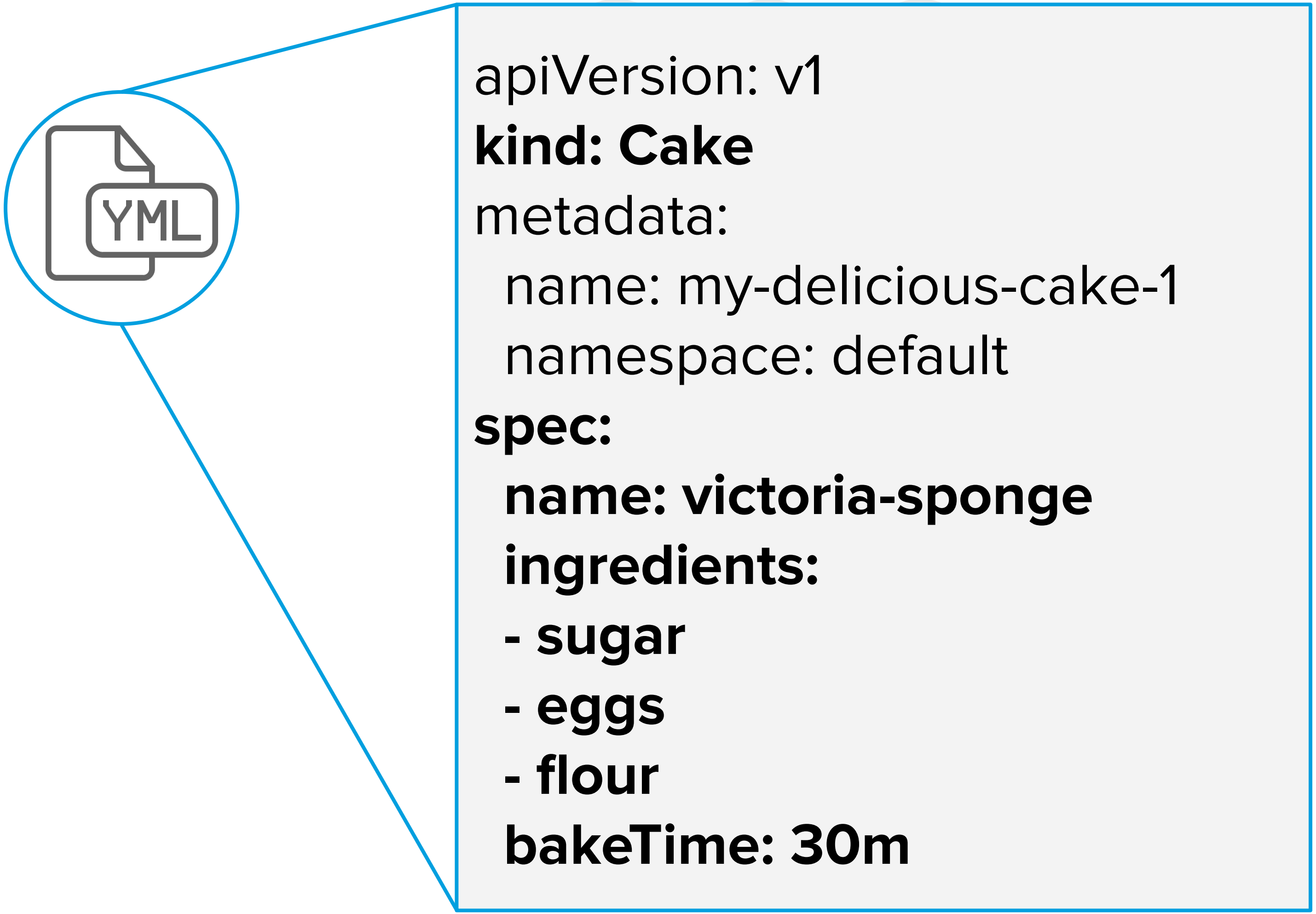


current pods: **1**

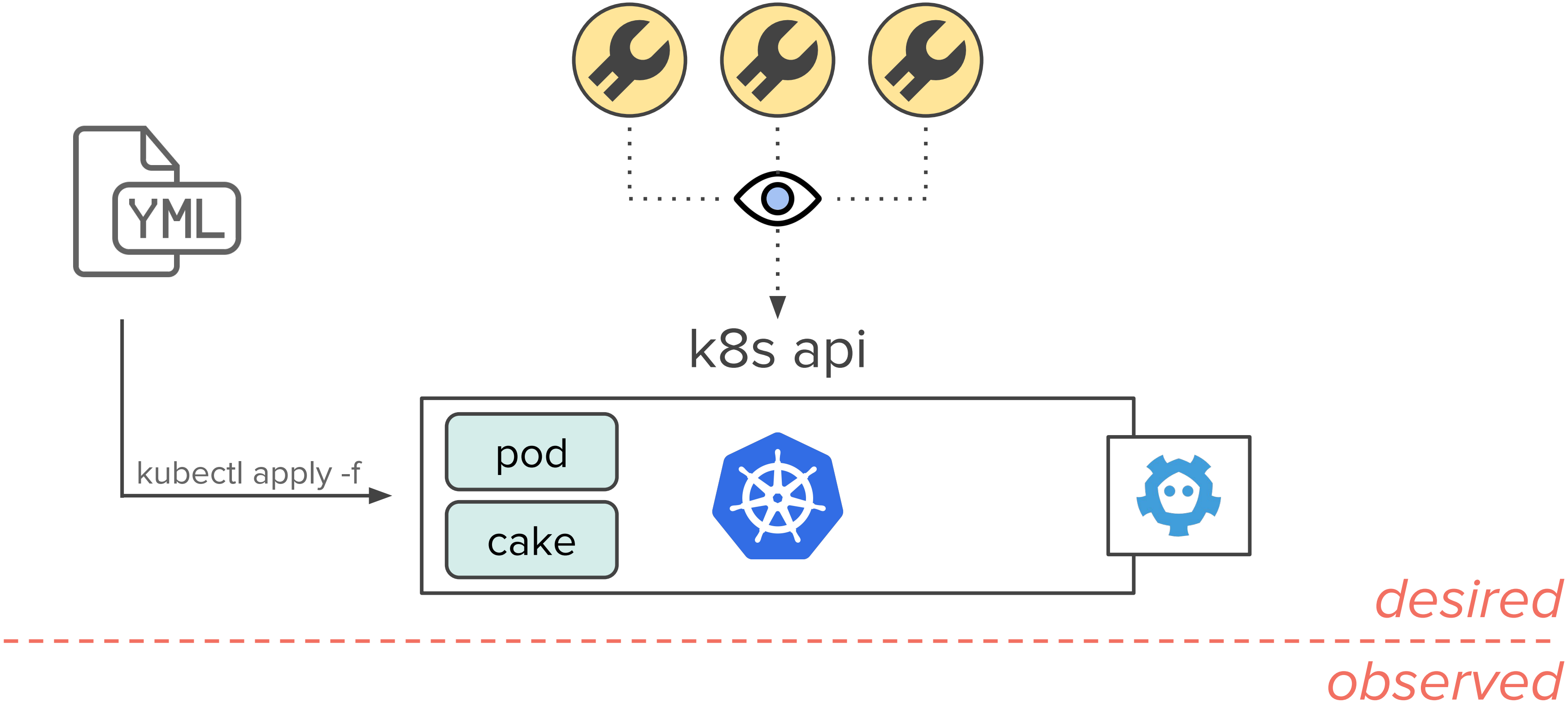


```
apiVersion: v1
kind: Pod
metadata:
  name: my-pod-1
  namespace: default
spec:
  containers:
    name: my-ctr-1
    image: reg.io/my-img:v1.0.0
status:
  state: running
  ready: true
```

Custom Resource Definitions



```yaml
apiVersion: v1
kind: Cake
metadata:
  name: my-delicious-cake-1
  namespace: default
spec:
  name: victoria-sponge
  ingredients:
  - sugar
  - eggs
  - flour
  bakeTime: 30m
```



YML

kubectl apply -f

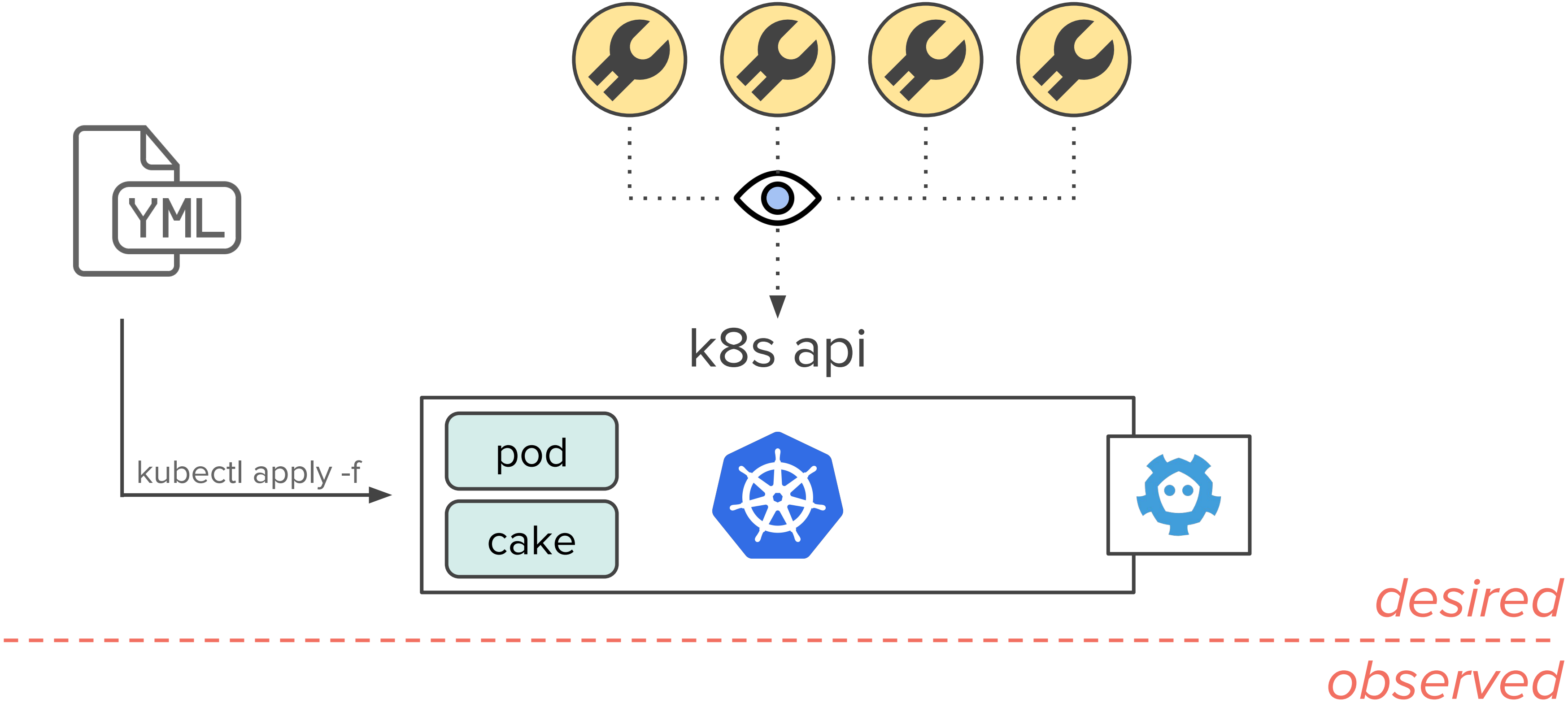
k8s api

pod

cake

desired

observed



YML

k8s api

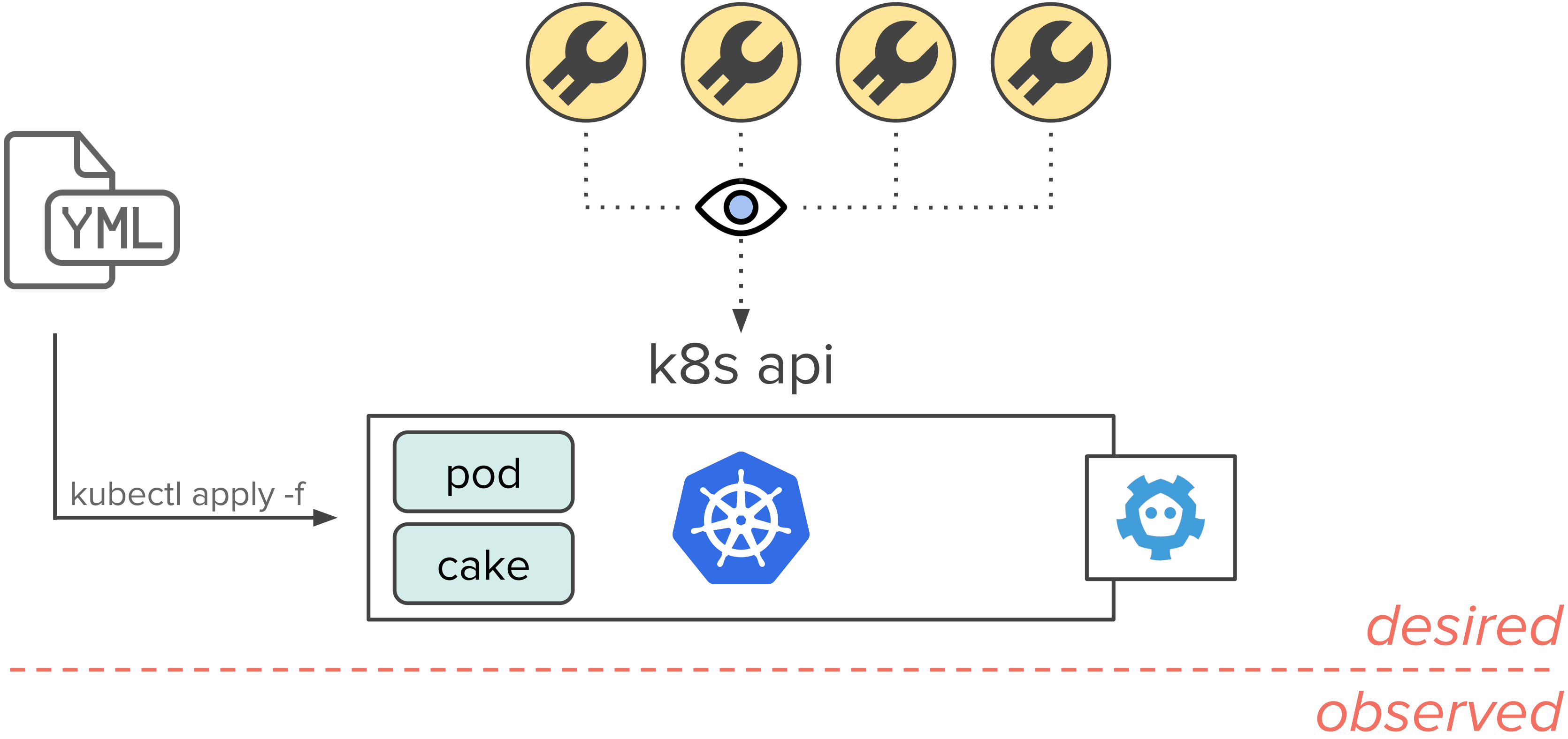
kubectl apply -f

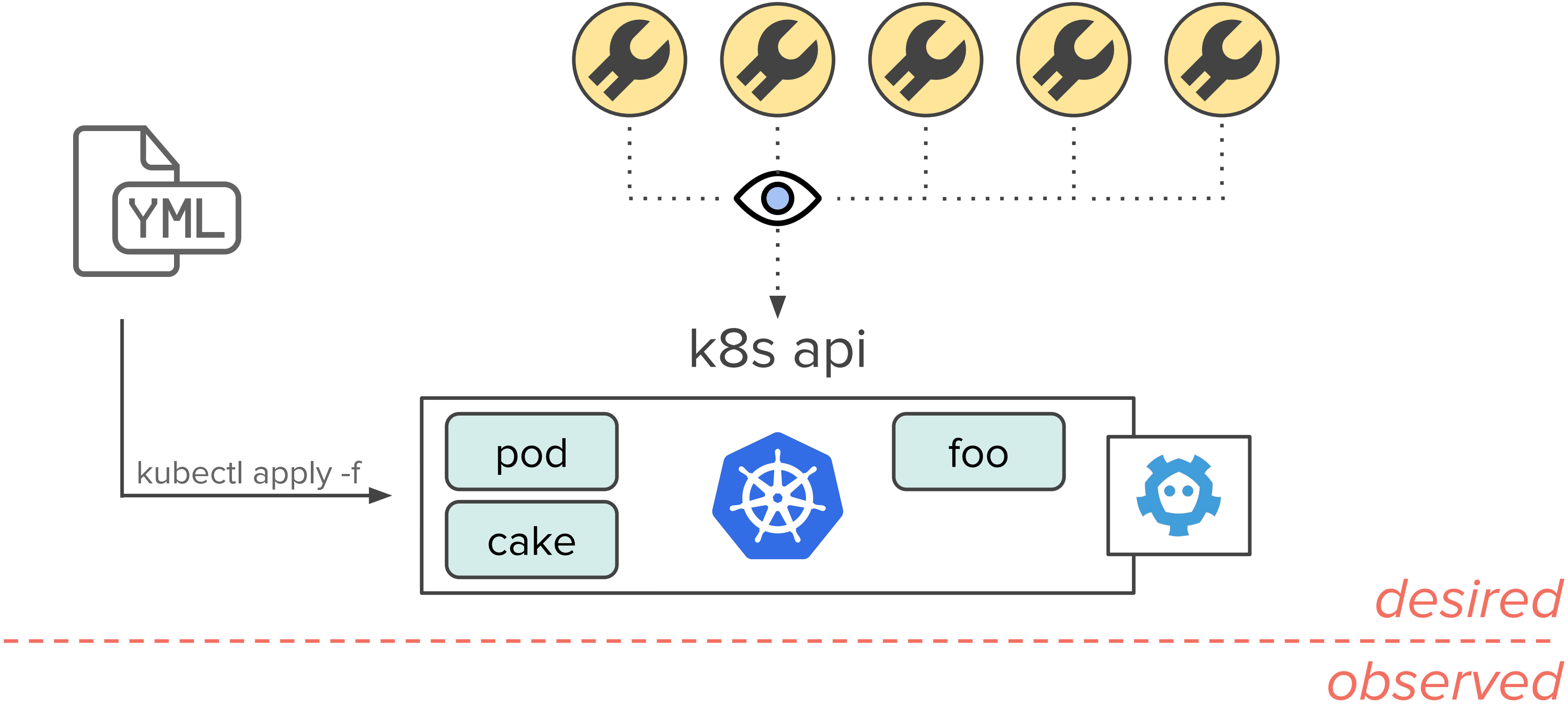
pod

cake

desired

observed


YML
kubectl apply -f
k8s api
pod
cake
desired
observed



YML

kubectl apply -f

k8s api

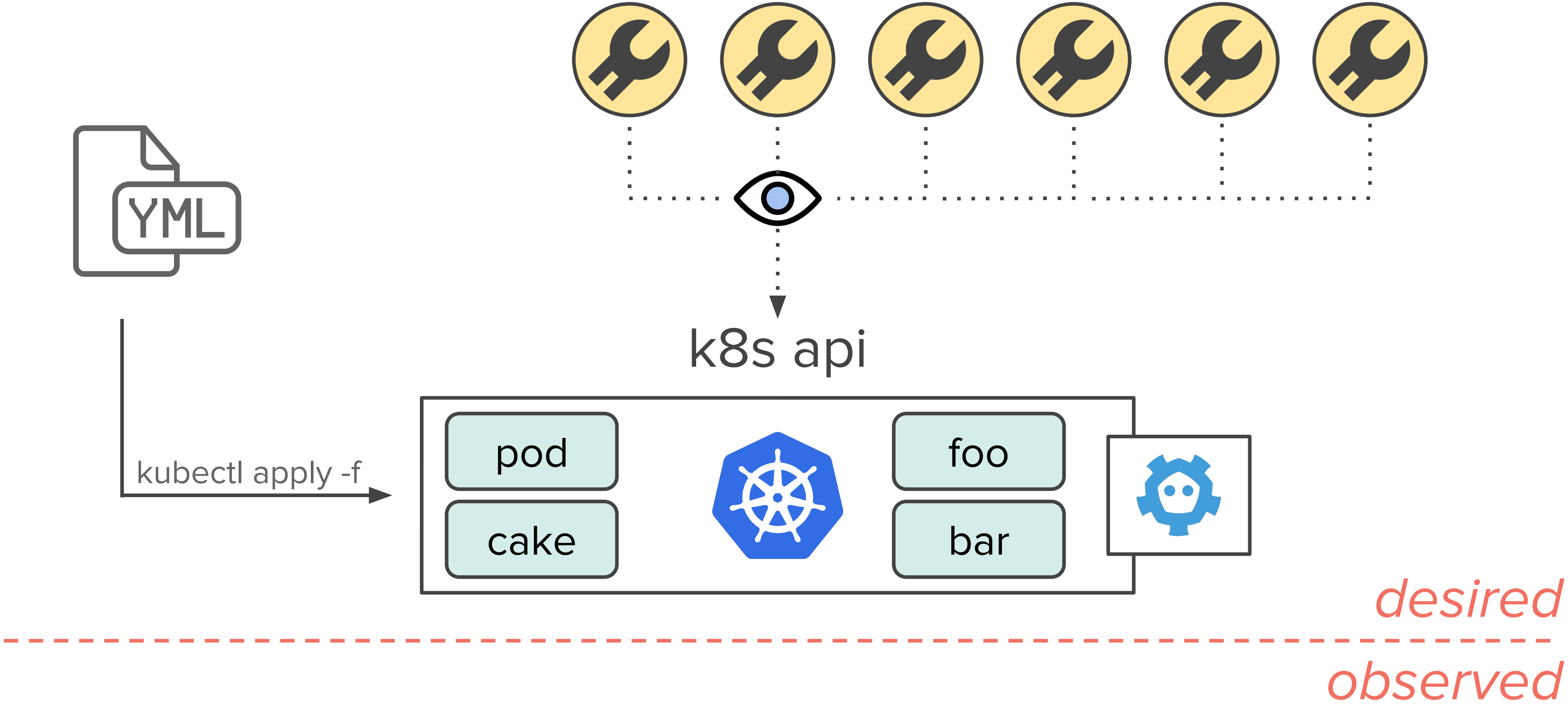
pod

cake

foo

desired

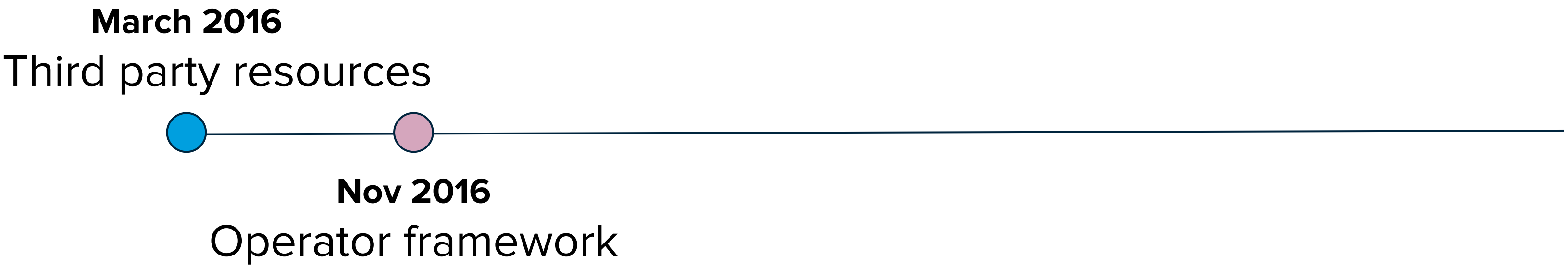
observed


YML
kubectl apply -f
k8s api
pod
cake
foo
bar
desired
observed

Timeline

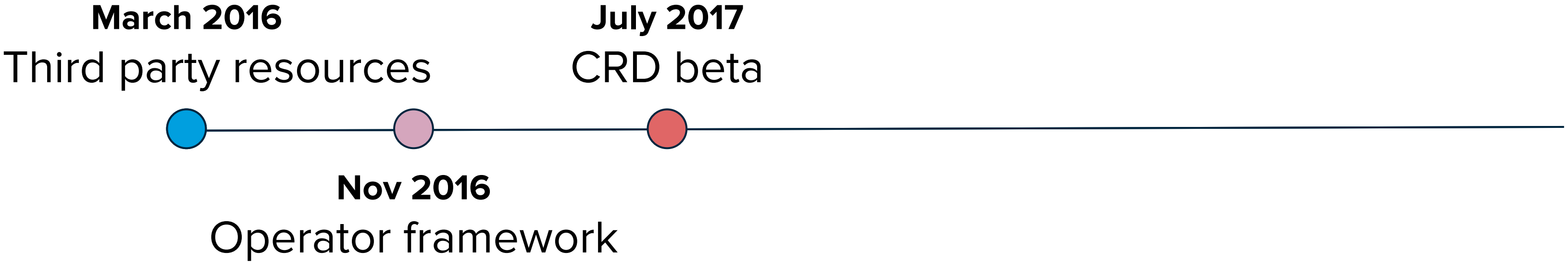
March 2016

Third party resources



March 2016
Third party resources

Nov 2016
Operator framework



March 2016
Third party resources

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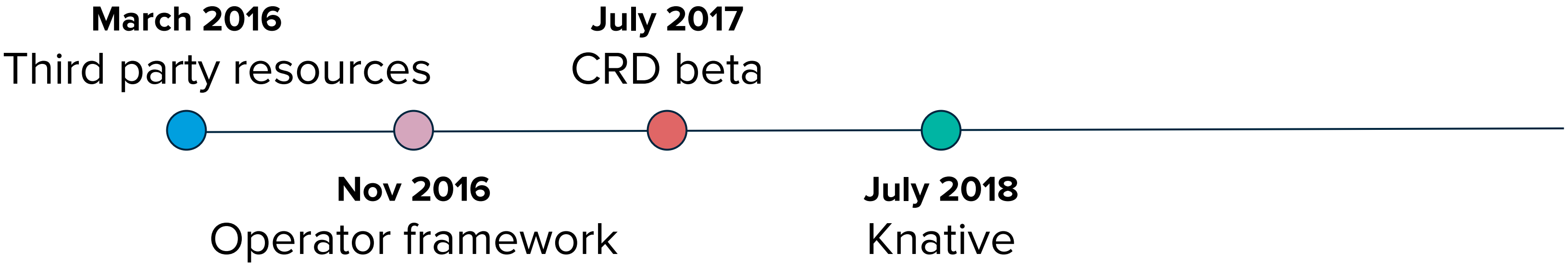
Operator framework

July 2017
CRD beta



March 2016
Third party resources

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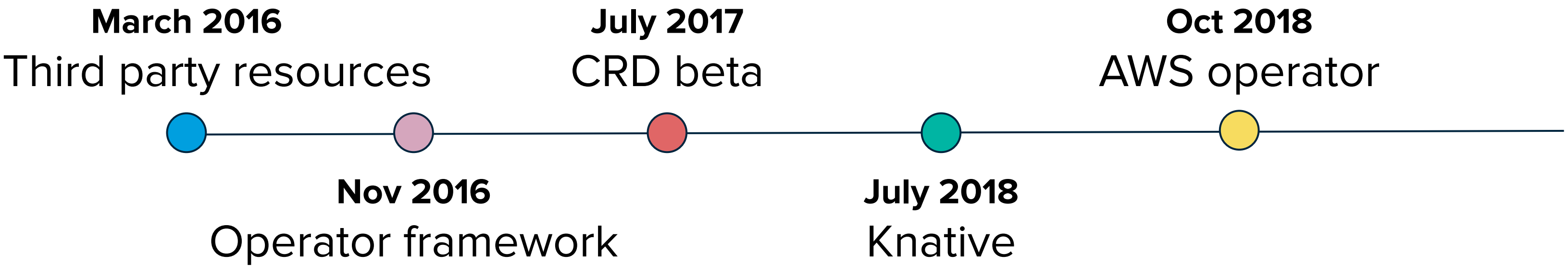
July 2017
CRD beta

July 2018
Knative



March 2016
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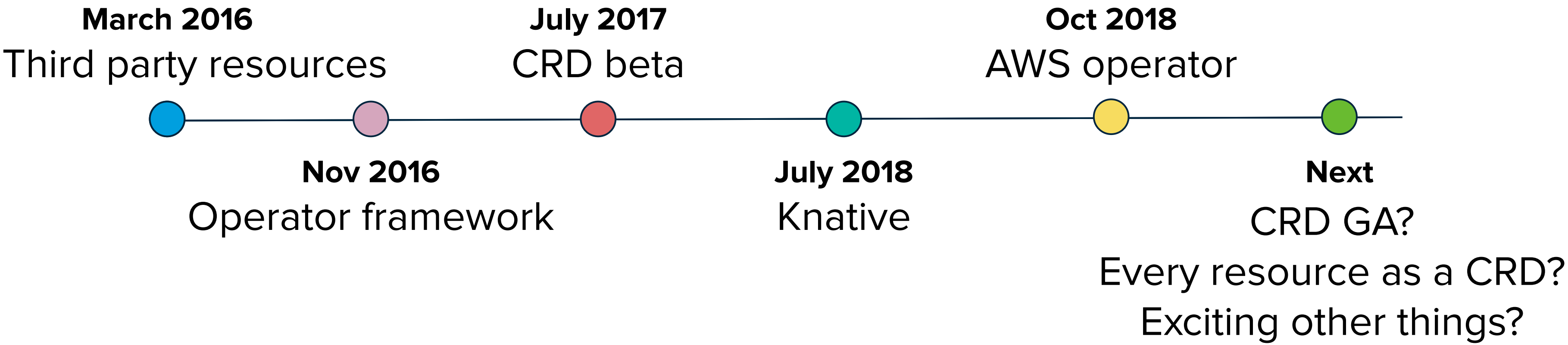
July 2017
CRD beta

July 2018
Knative

Oct 2018
AWS operator



March 2016
Third party resources

Nov 2016
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July 2017
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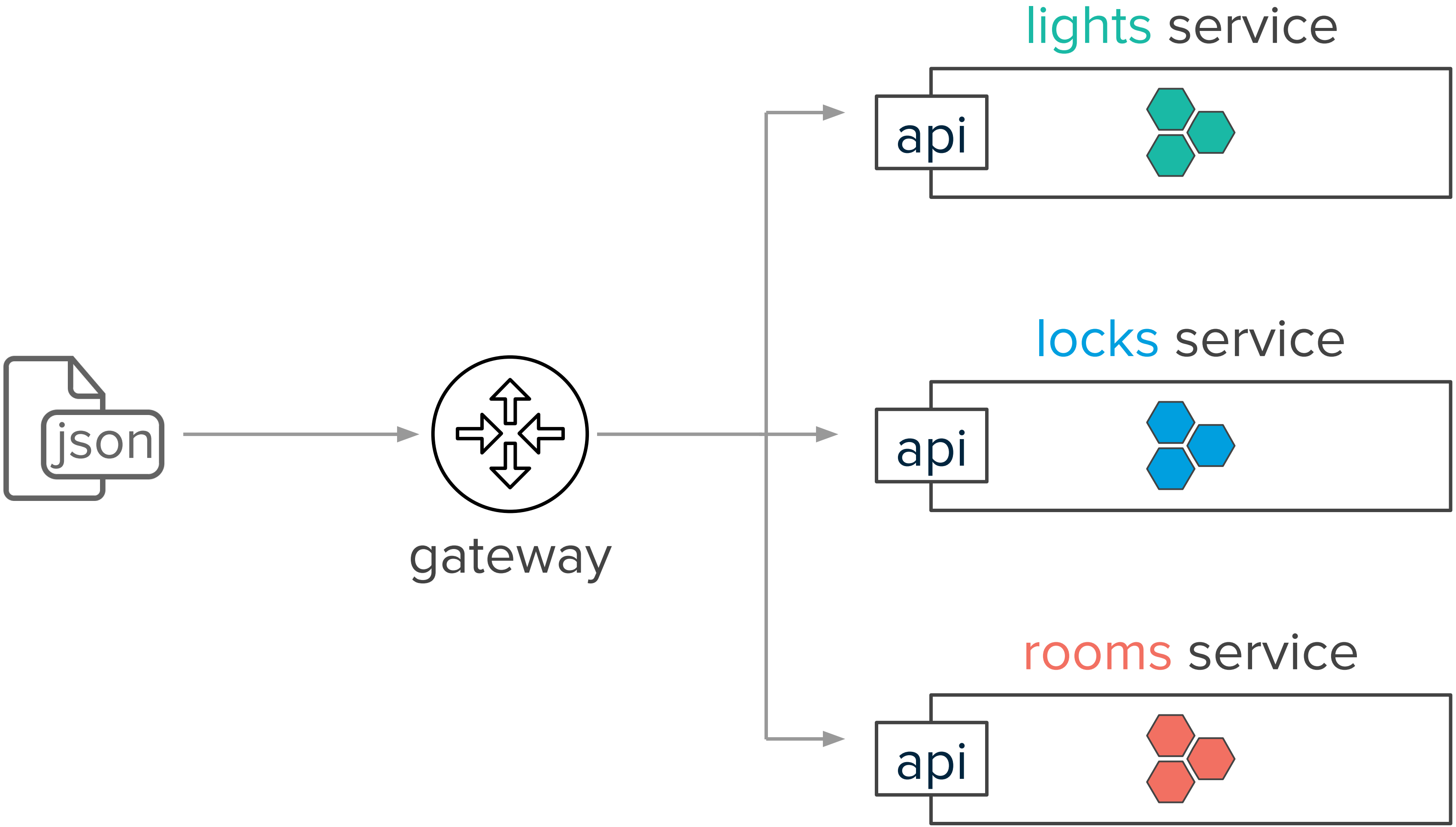
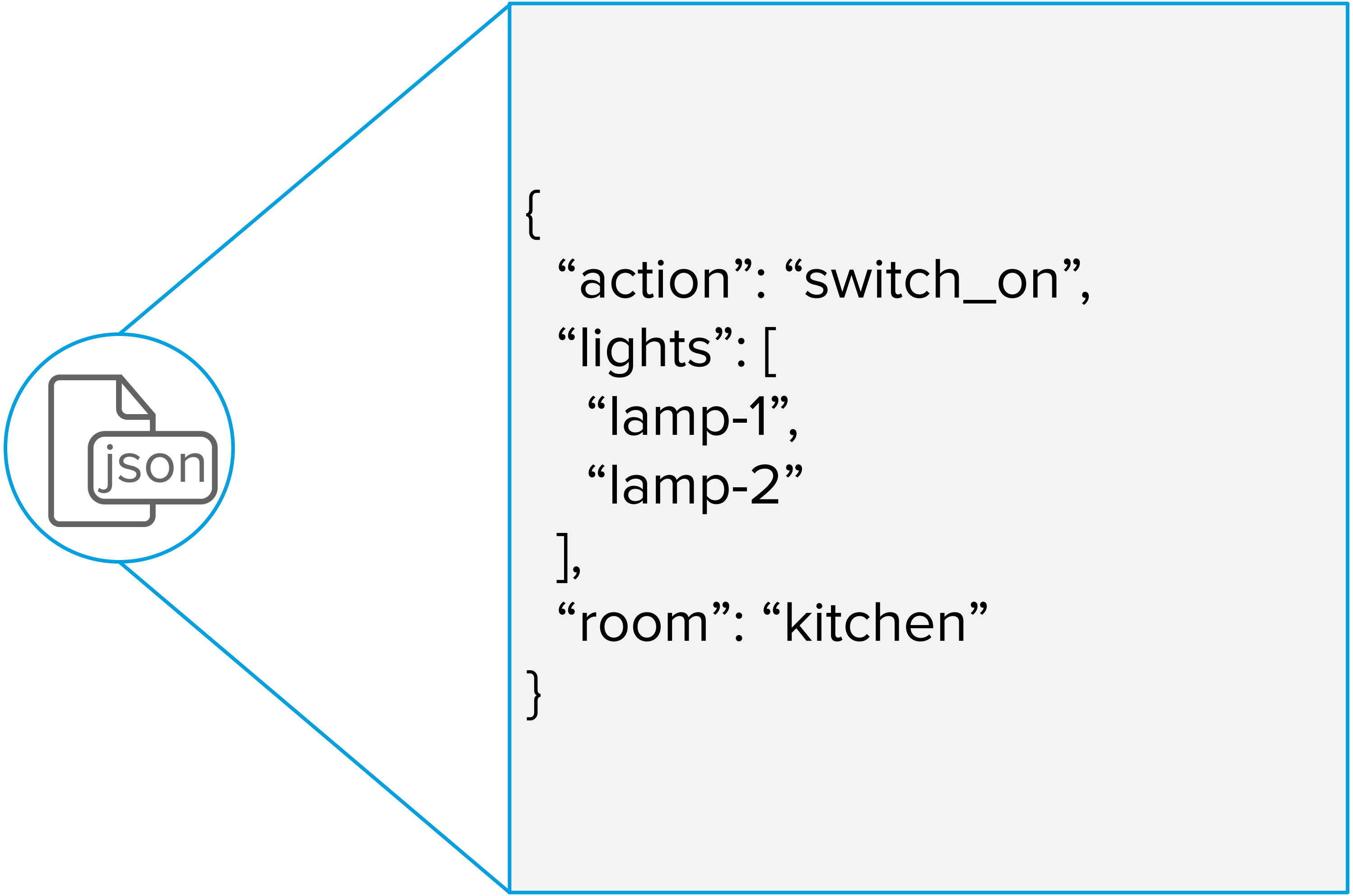
July 2018
Knative

Oct 2018
AWS operator

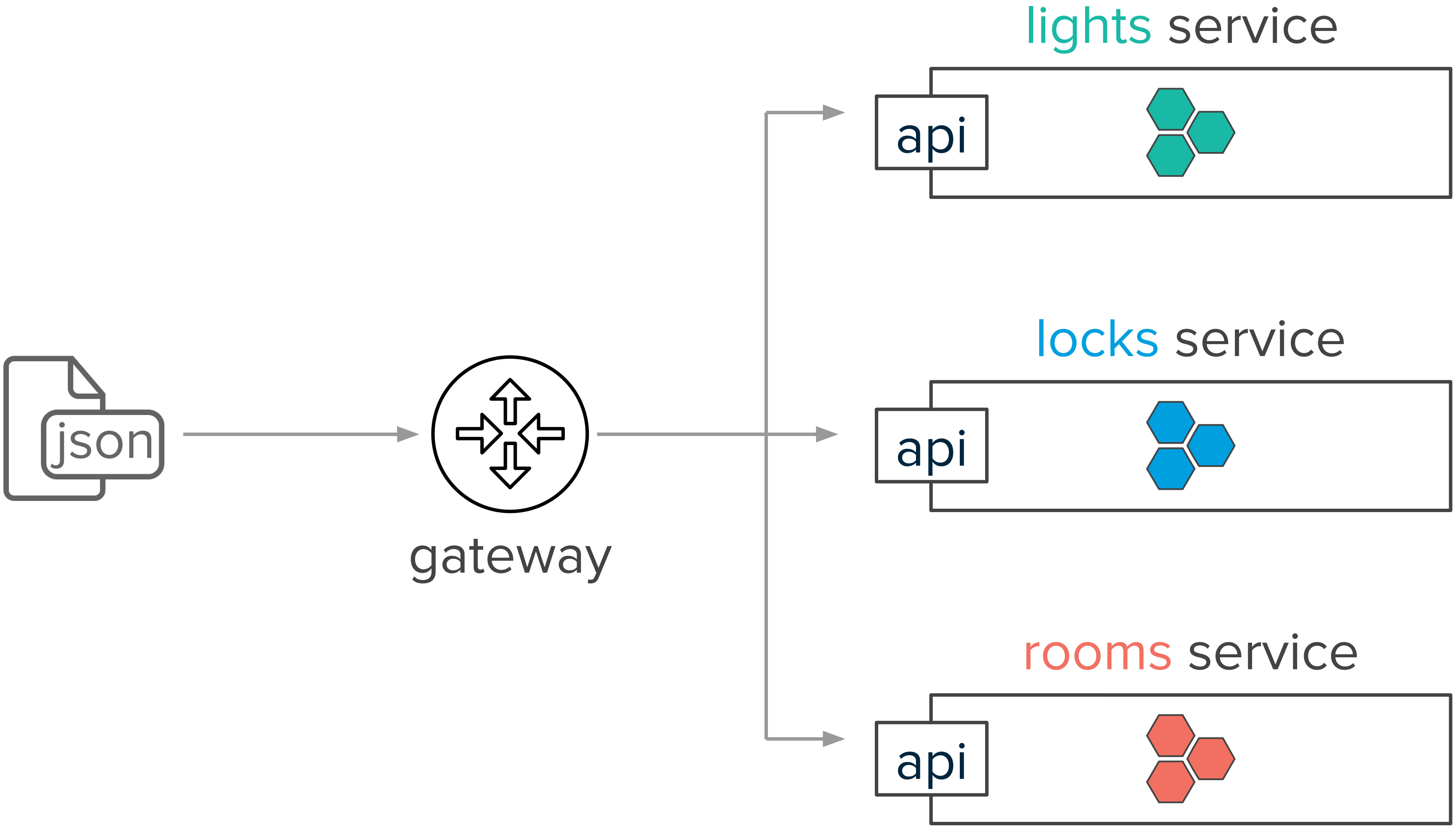
Next
CRD GA?
Every resource as a CRD?
Exciting other things?

Let me paint you a picture


lights service
locks service
rooms service
json
gateway
api
api
api



```
{
  “action”: “switch_on”,
  “lights”: [
    “lamp-1”,
    “lamp-2”
  ],
  “room”: “kitchen”
}
```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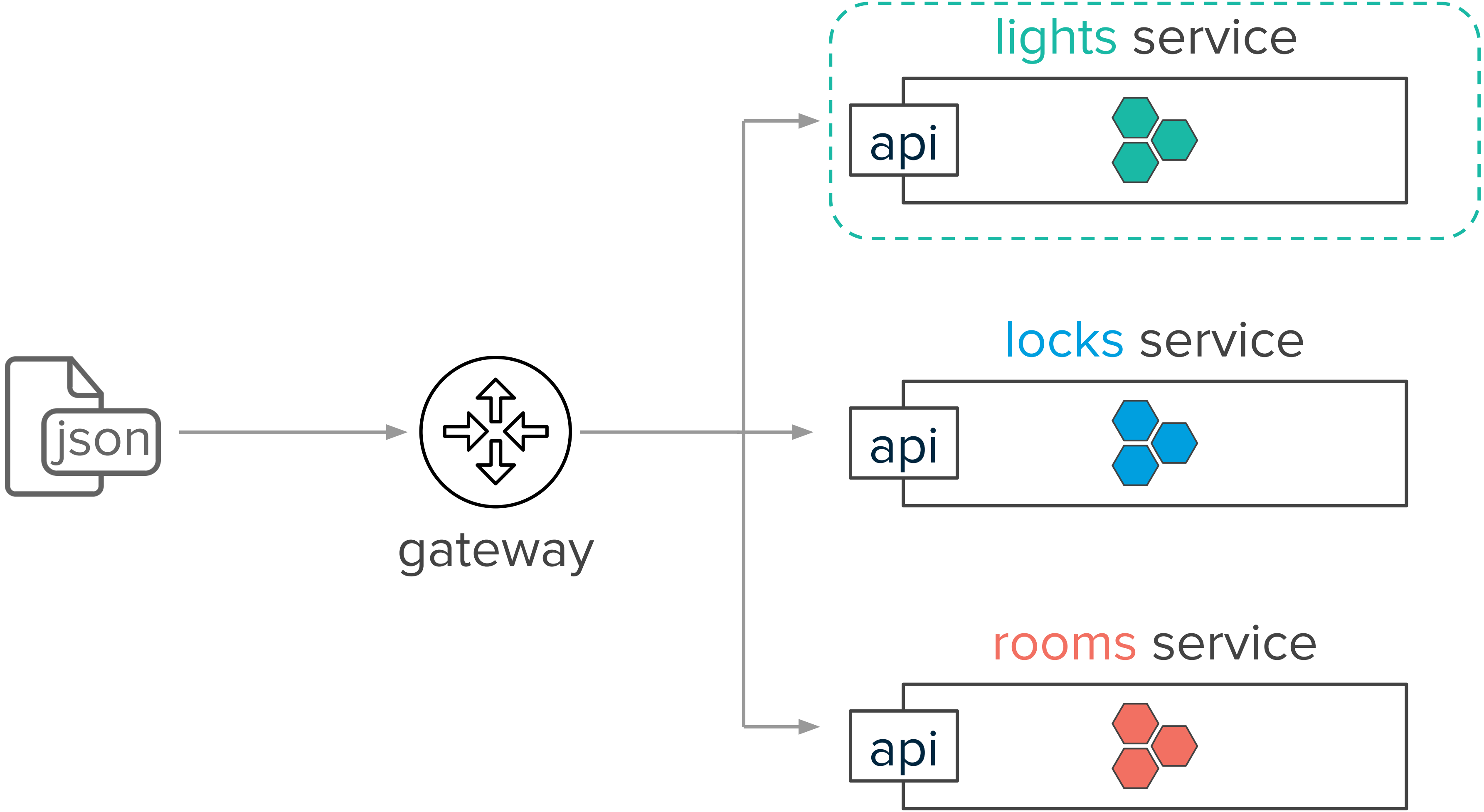
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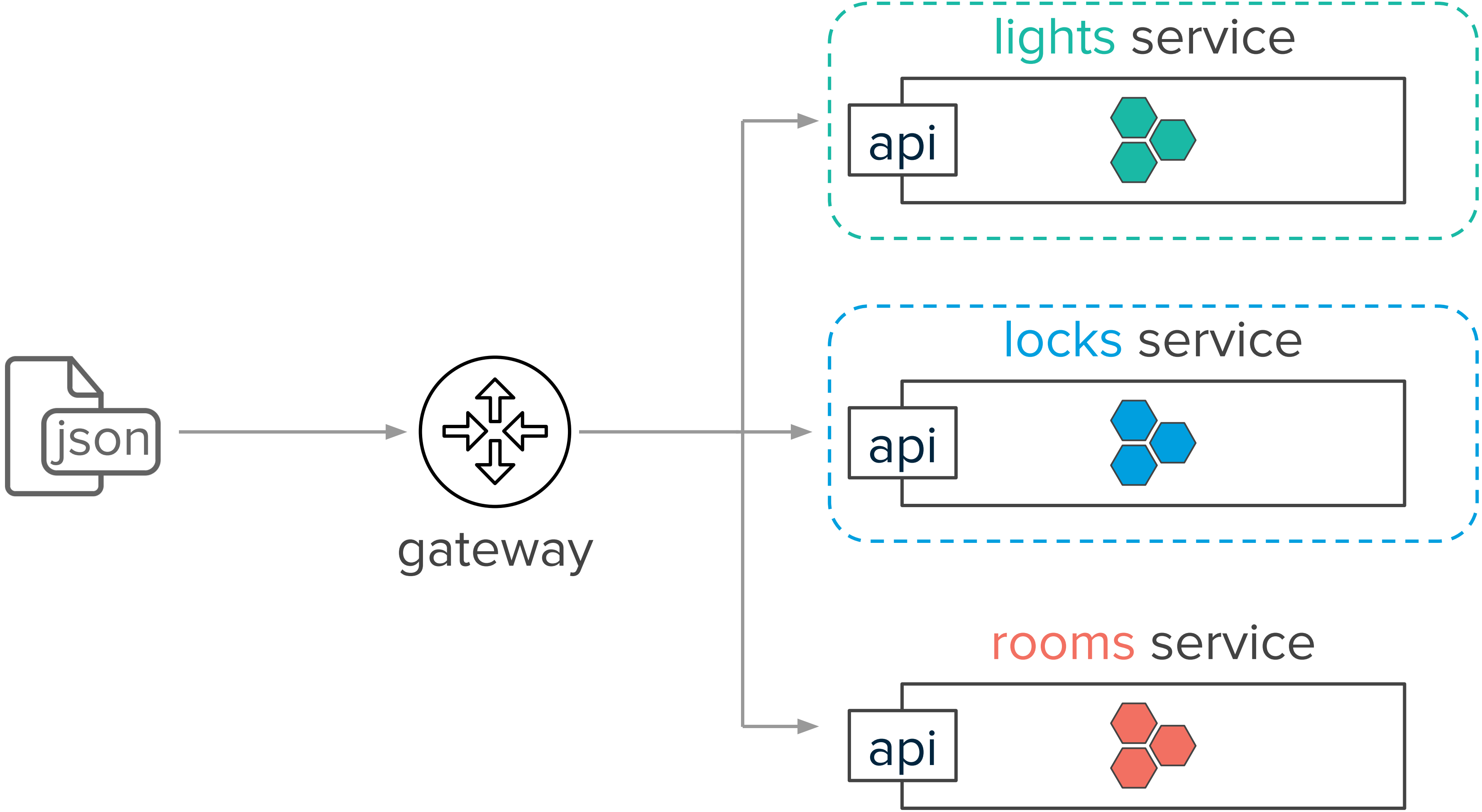
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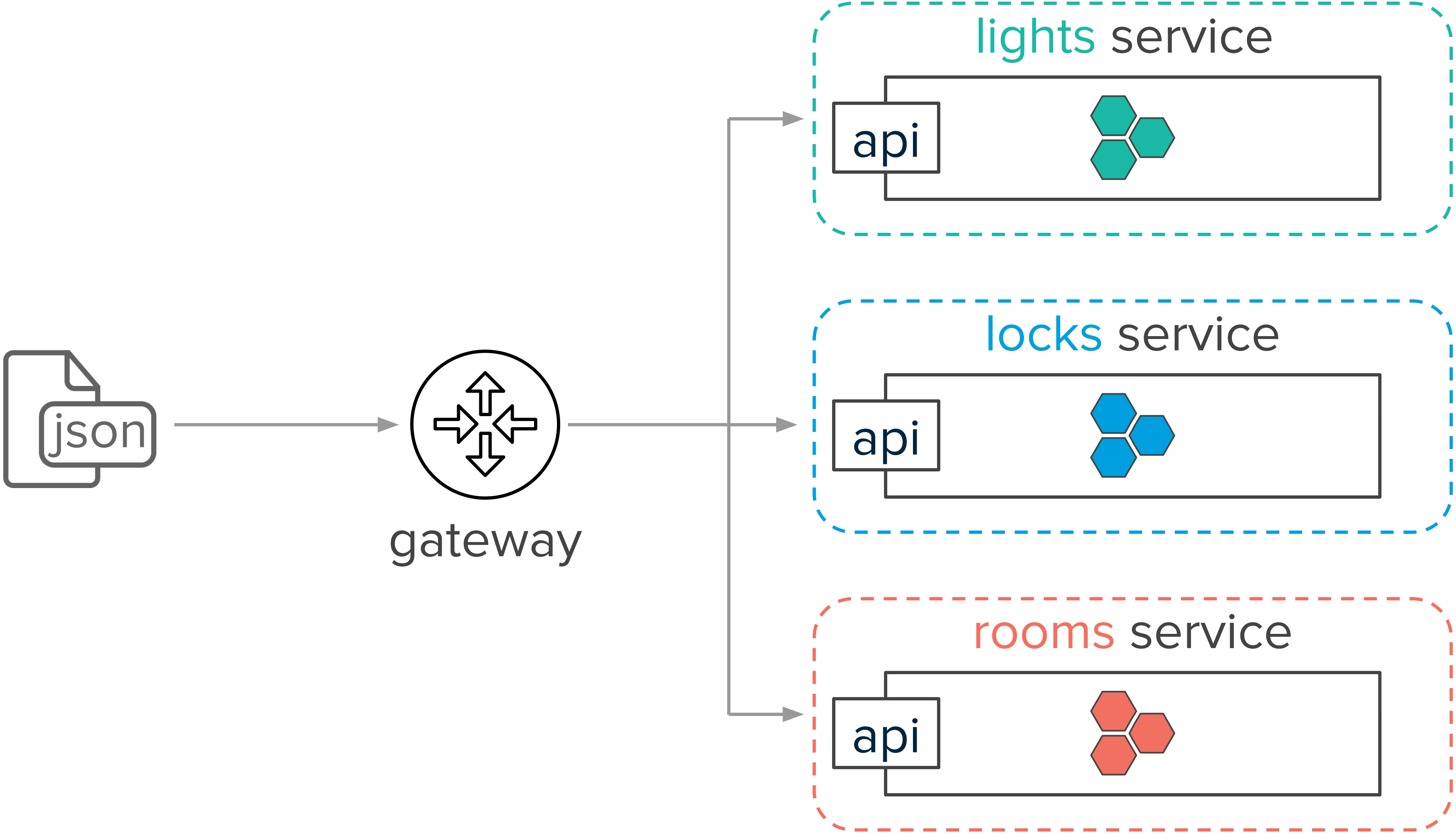
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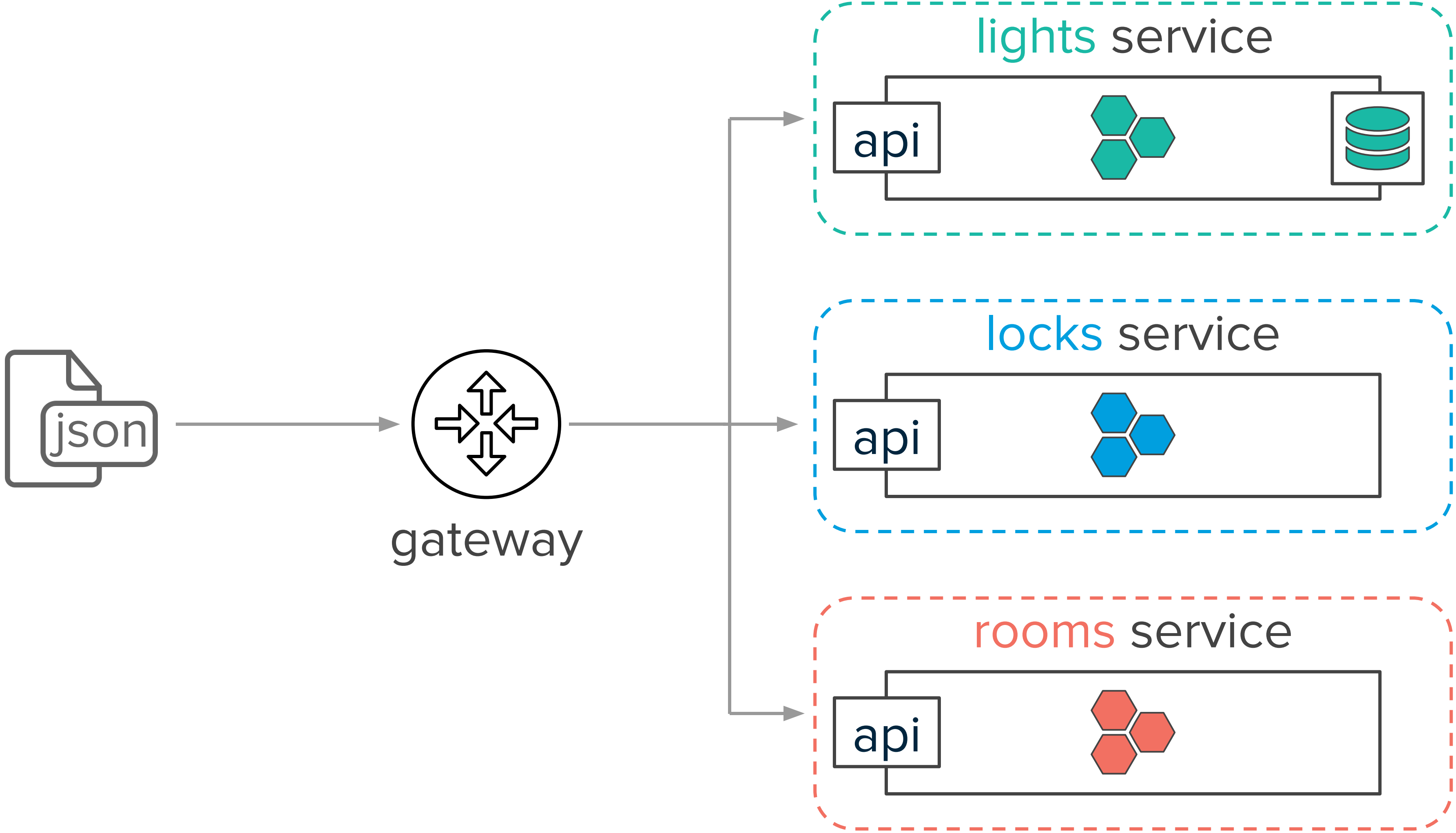
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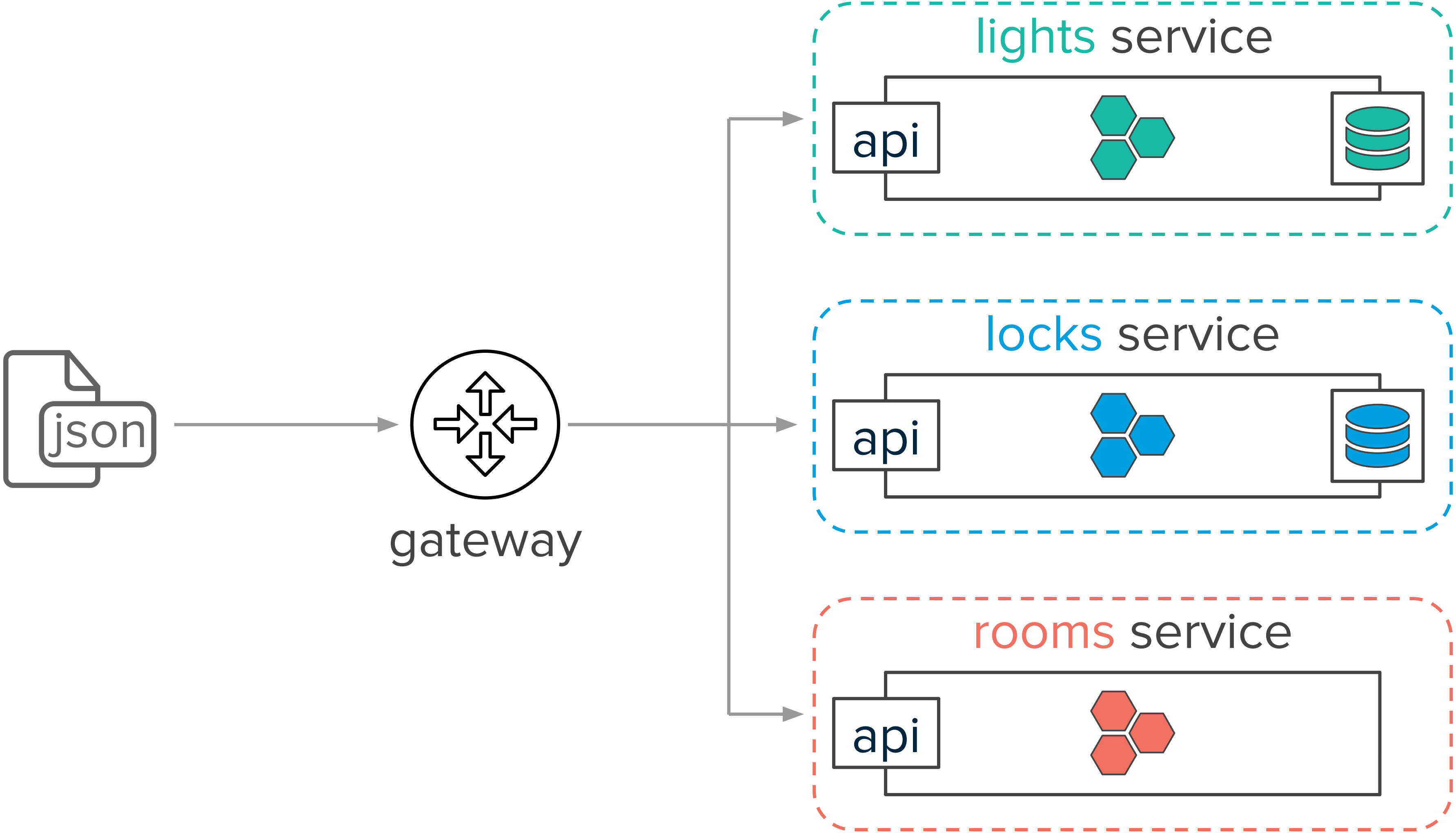

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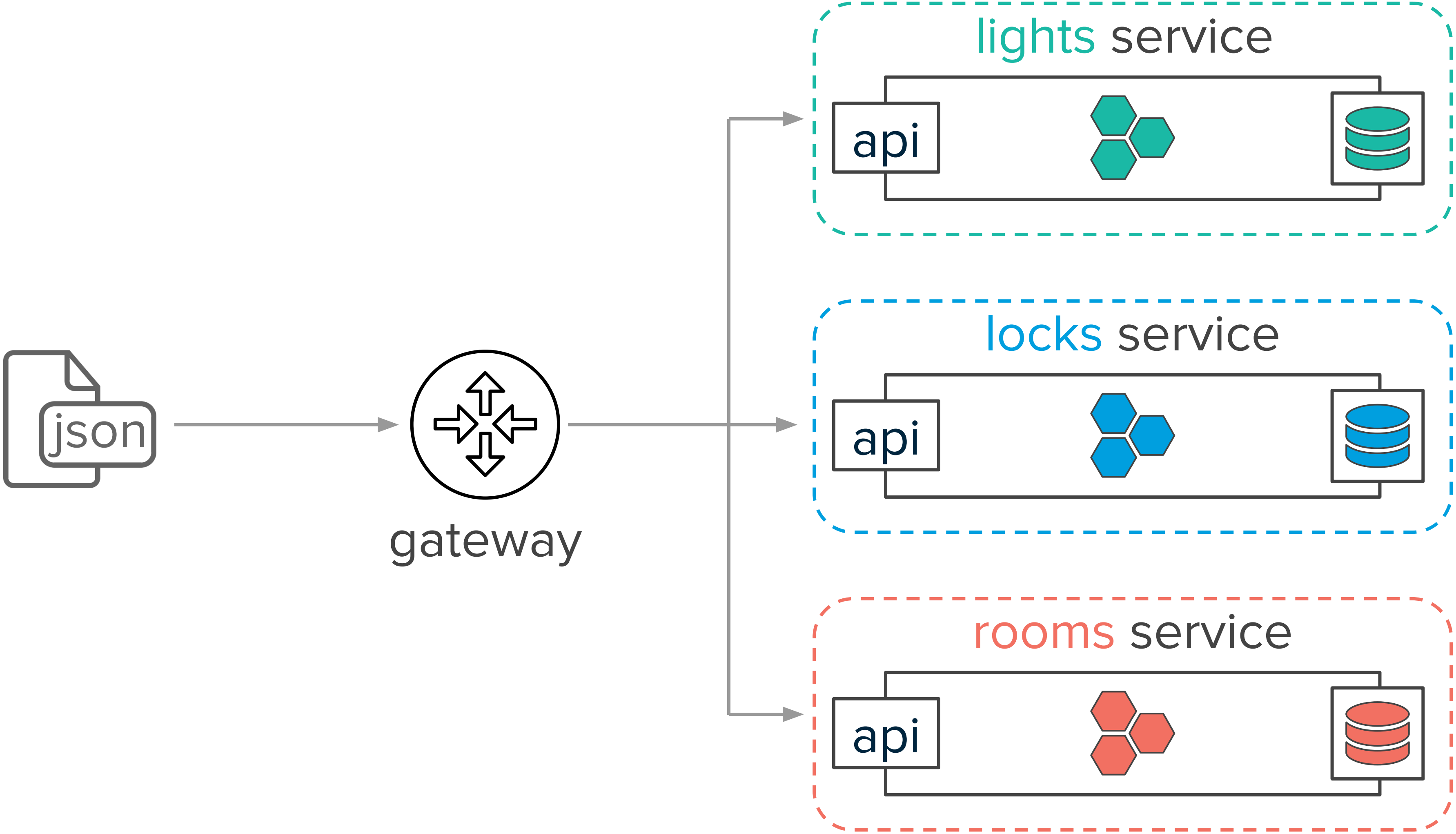
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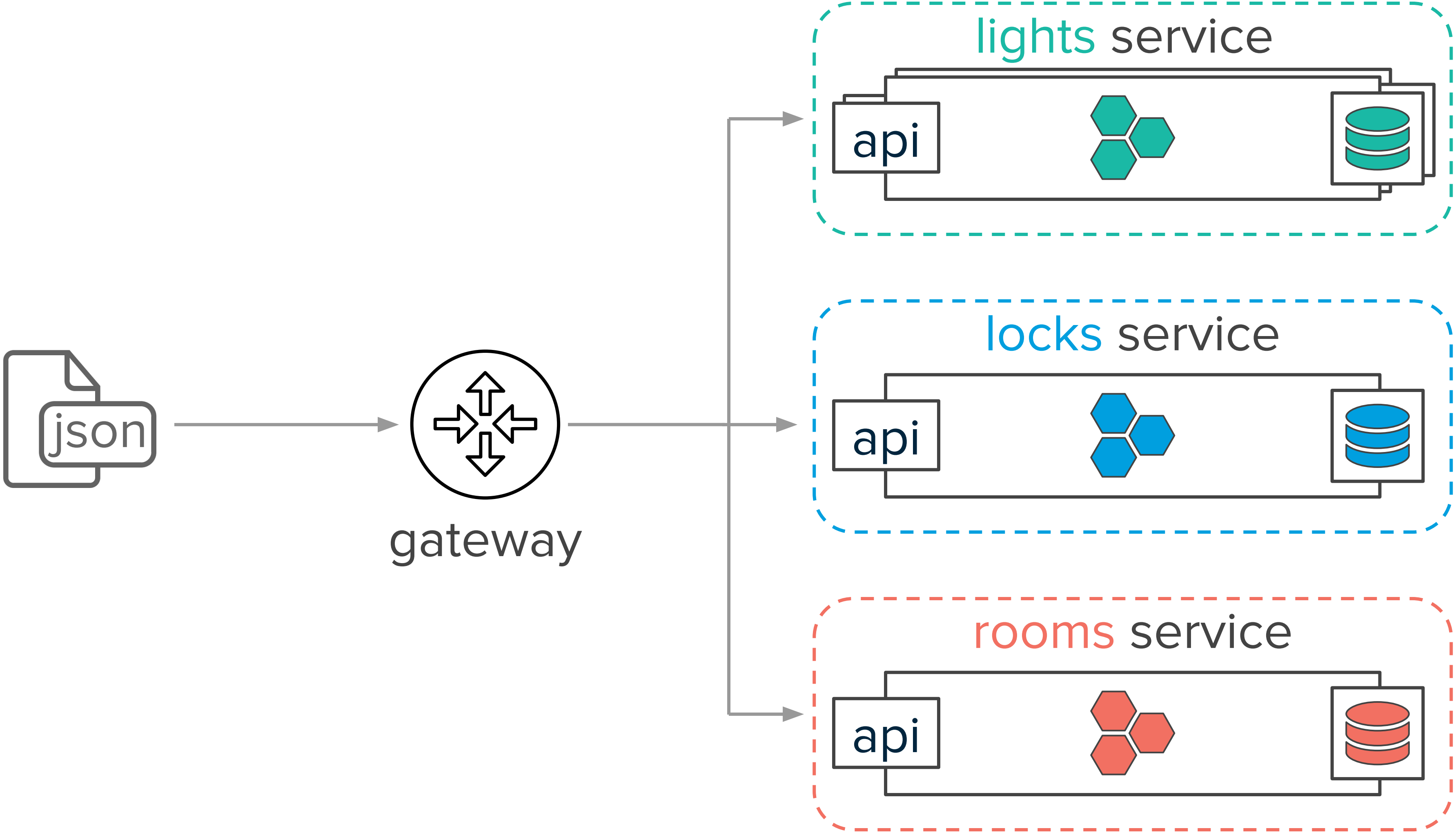
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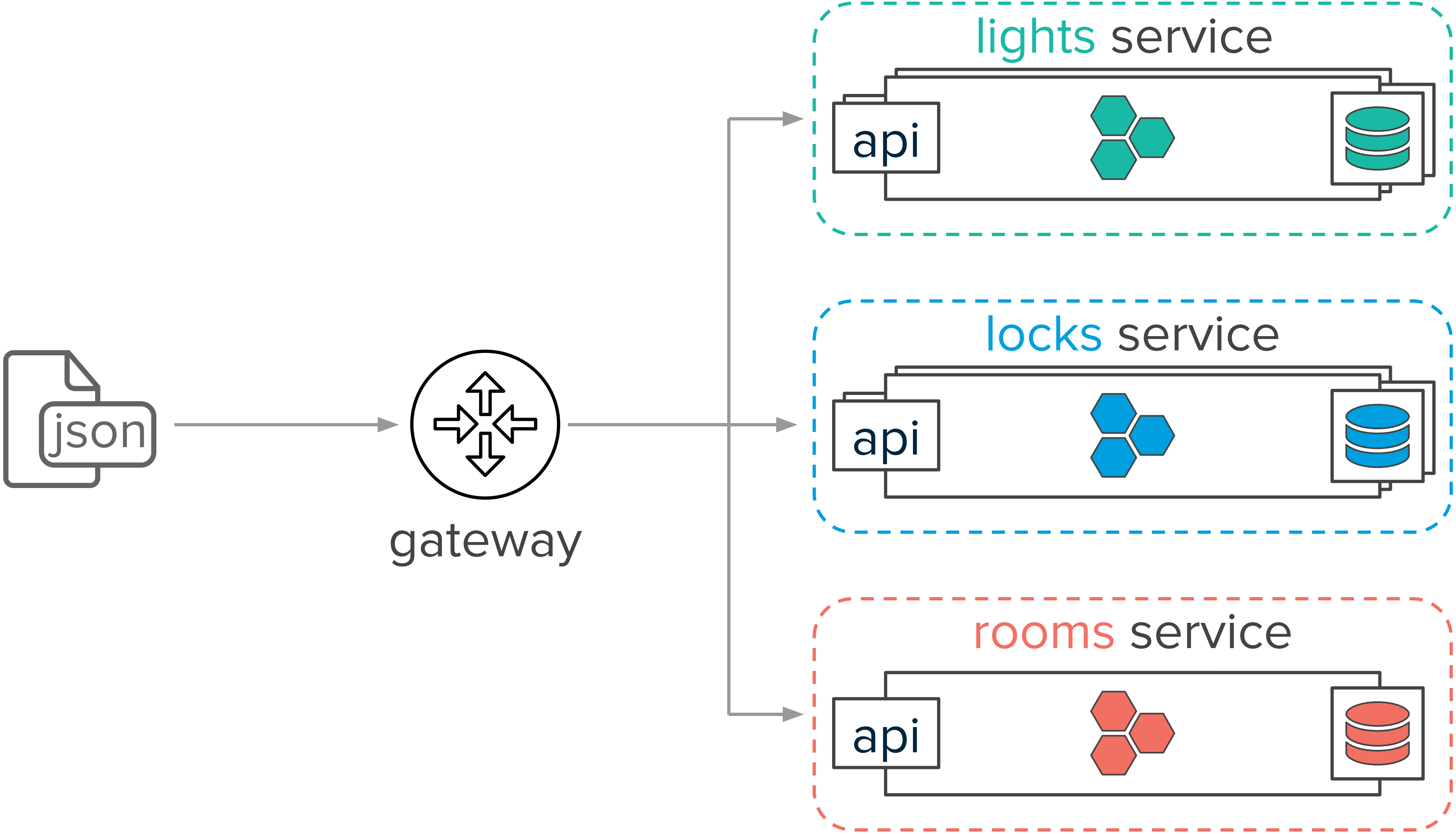
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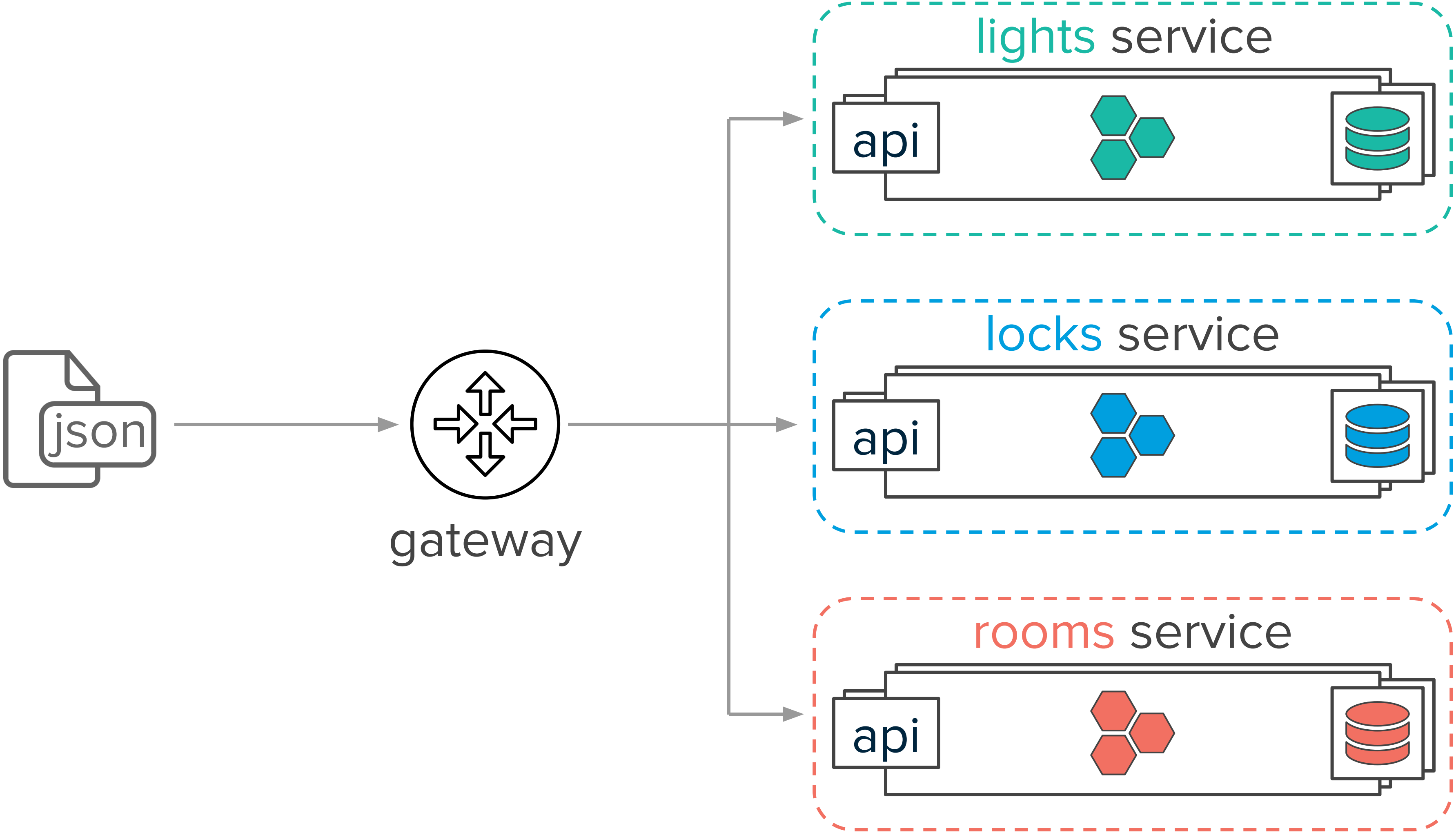
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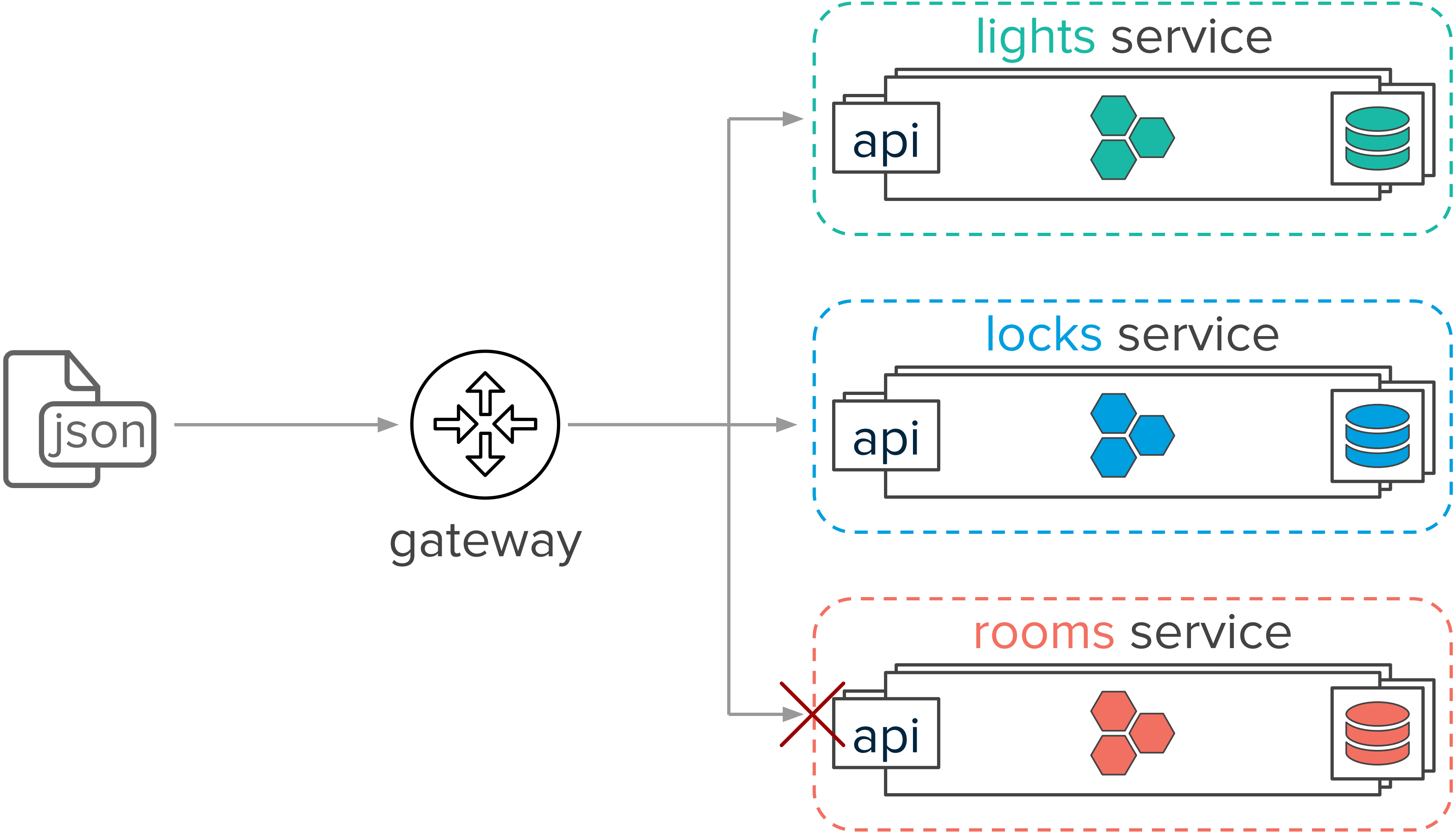
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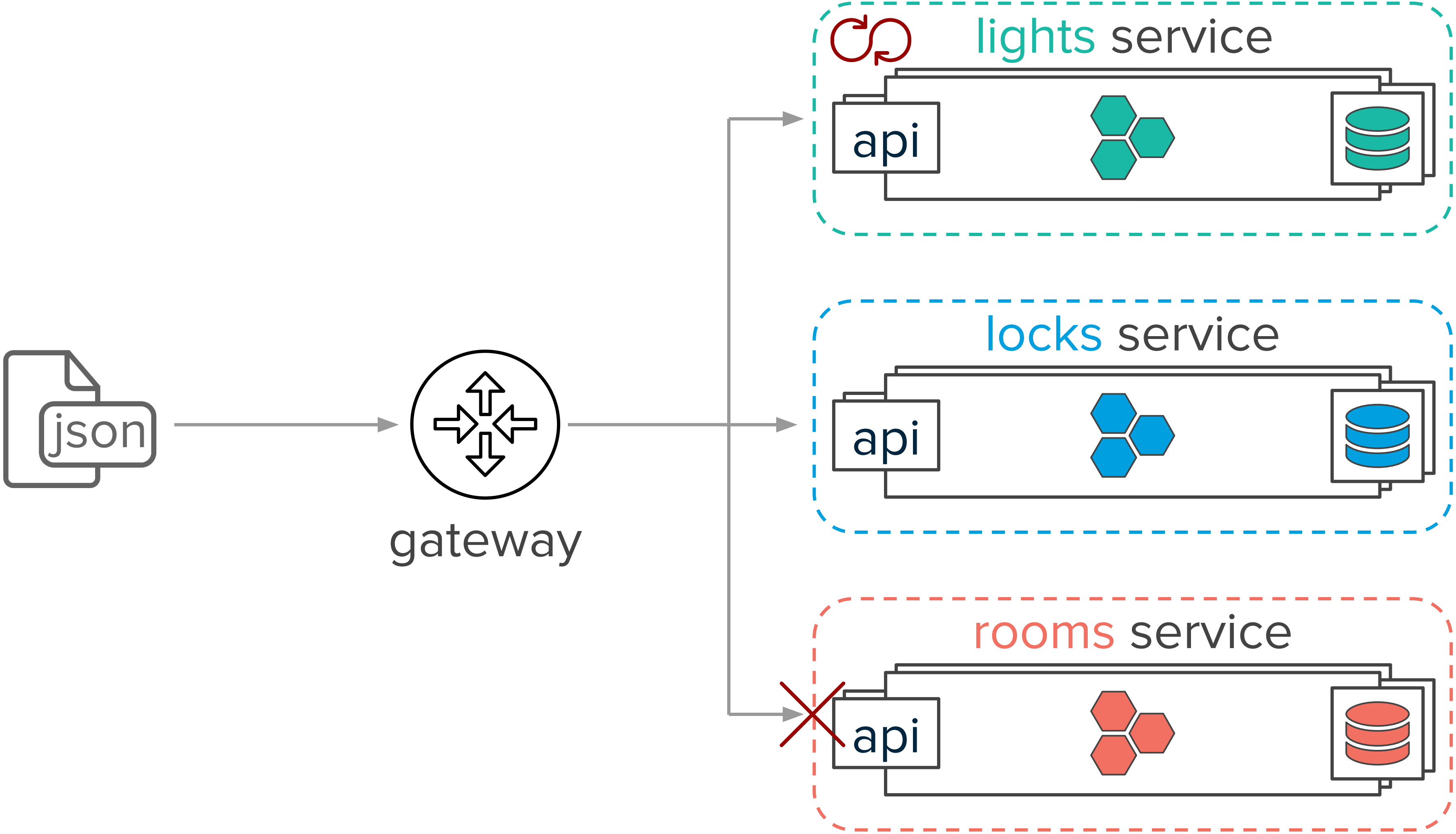
gateway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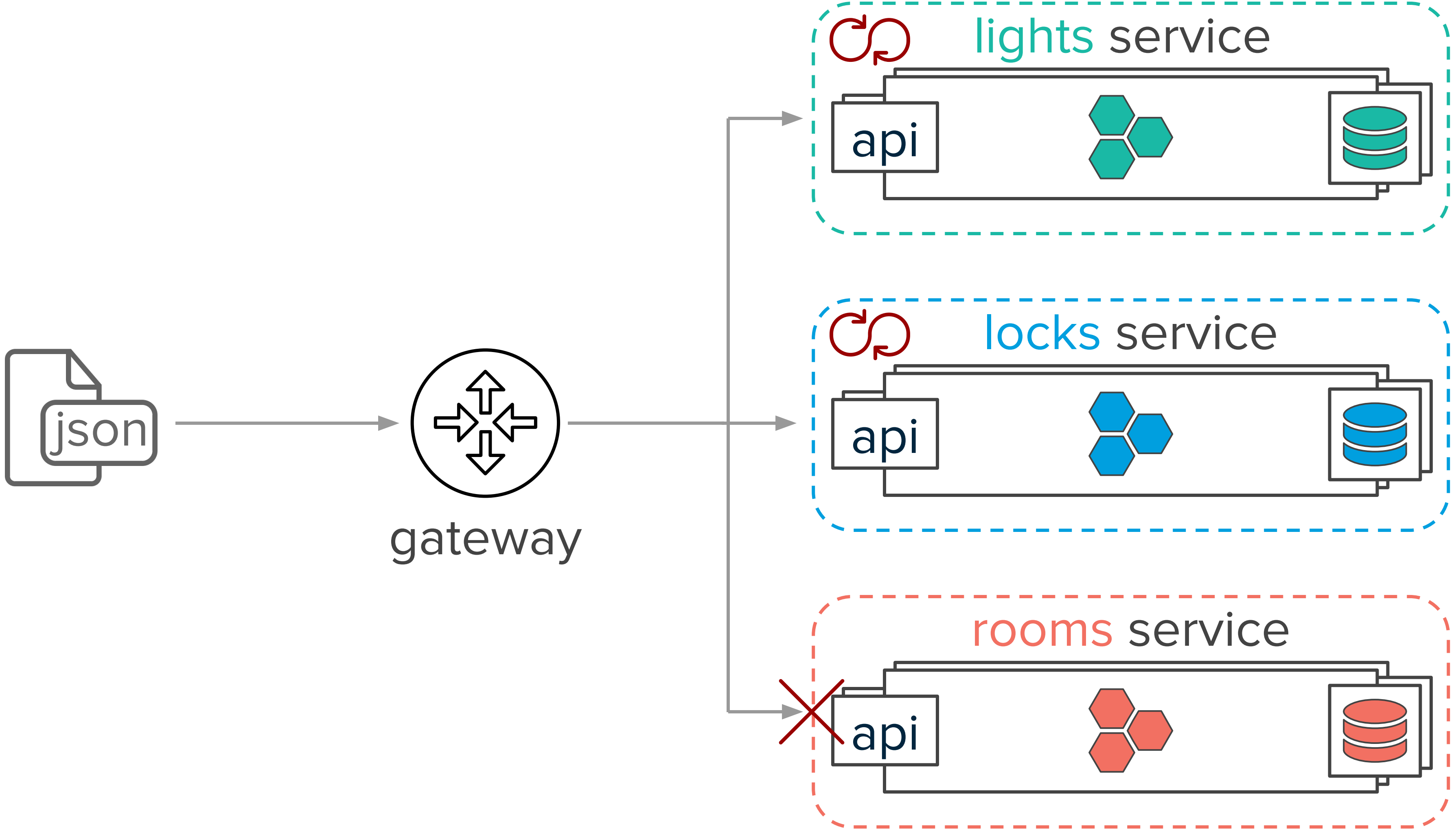
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api
locks service
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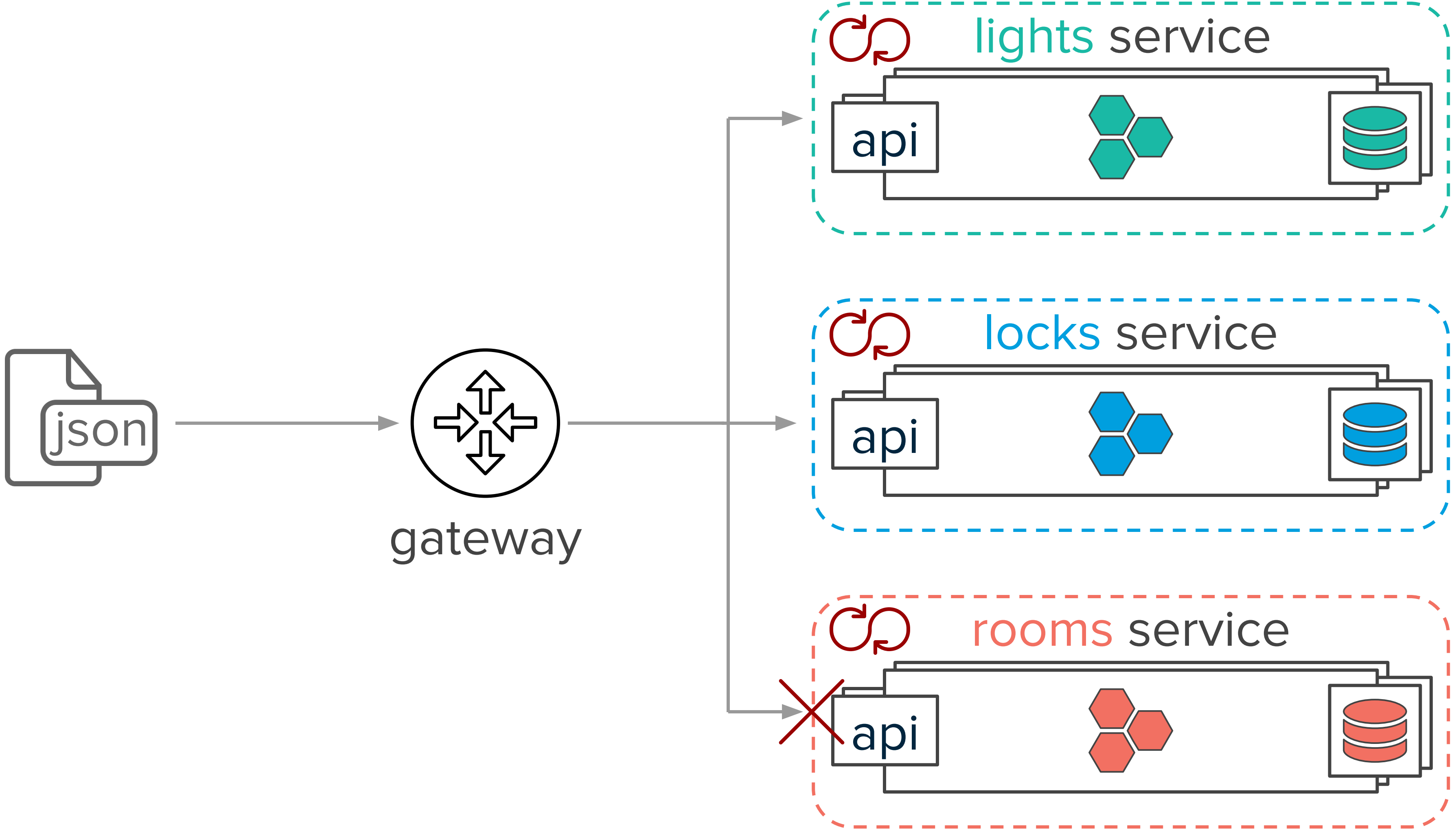
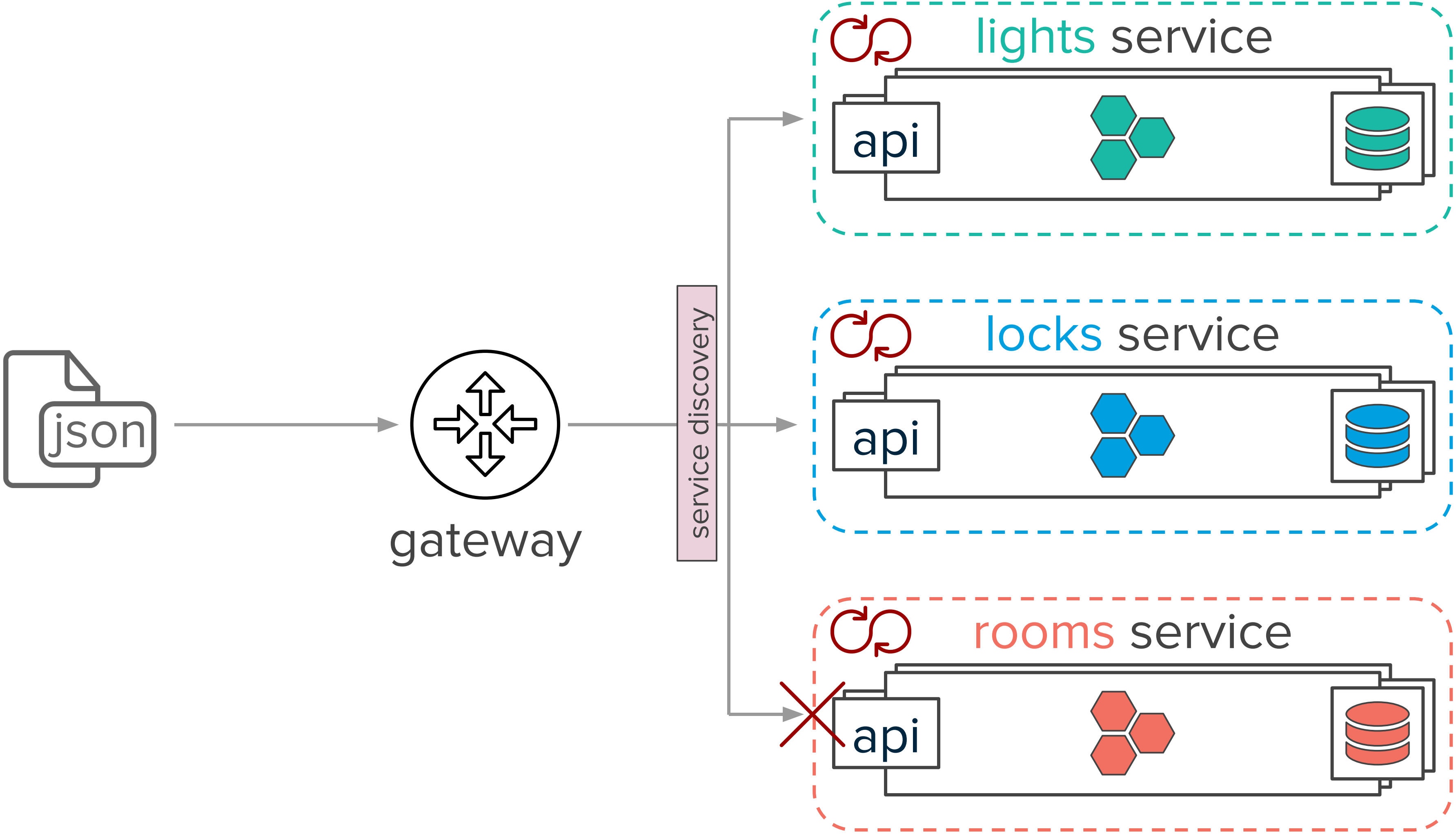
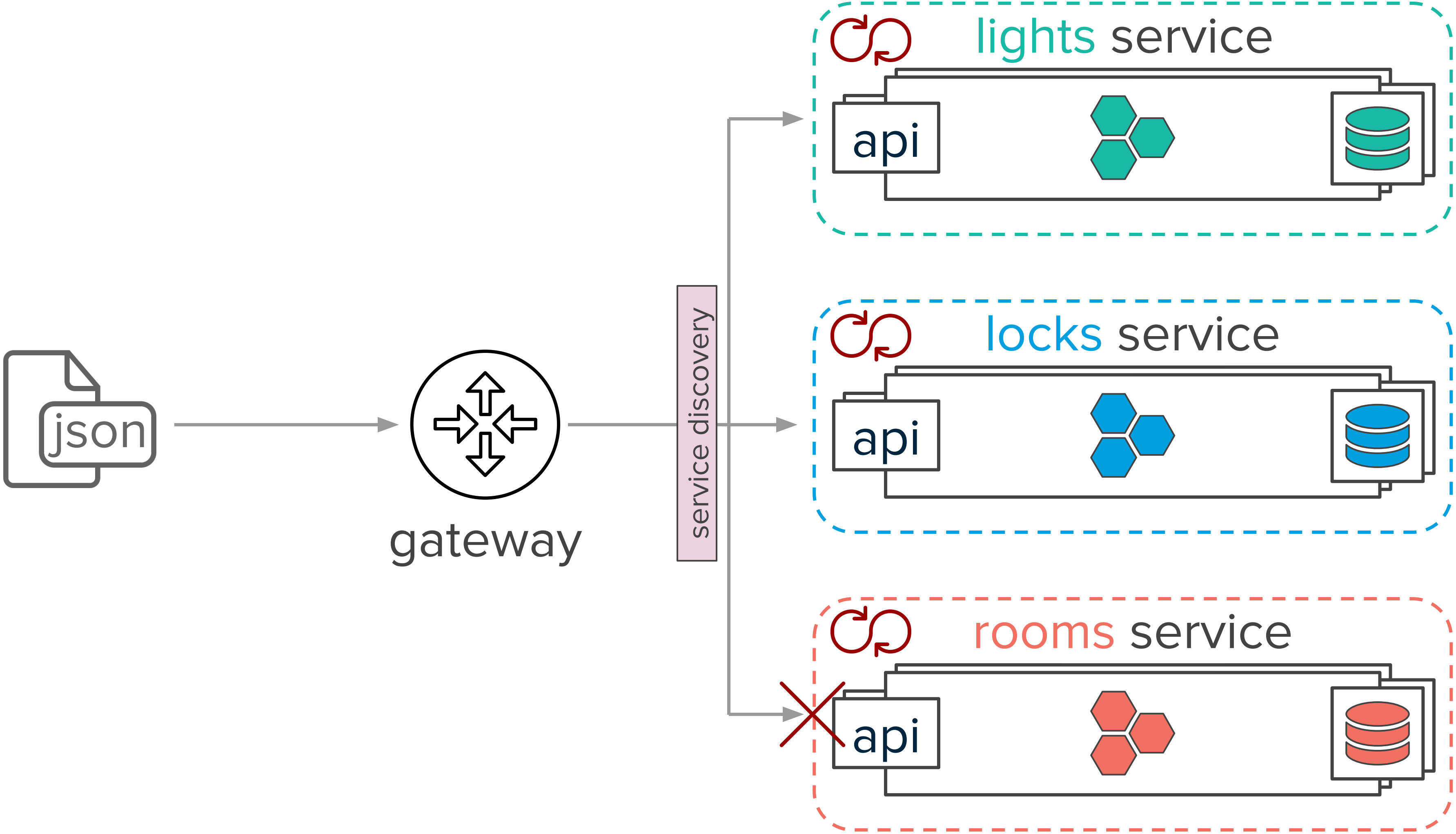

lights service
api
locks service
api
rooms service
api
json
gateway


json
gateway
service discovery
lights service
api
locks service
api
rooms service
api

Distractions ...

- Storage
- High Availability
- Reliability
- The API contracts of each service (e.g. company standards)
- Team collaboration over APIs

These all take time and effort away from the main focus of each team, which is to provide the best service they can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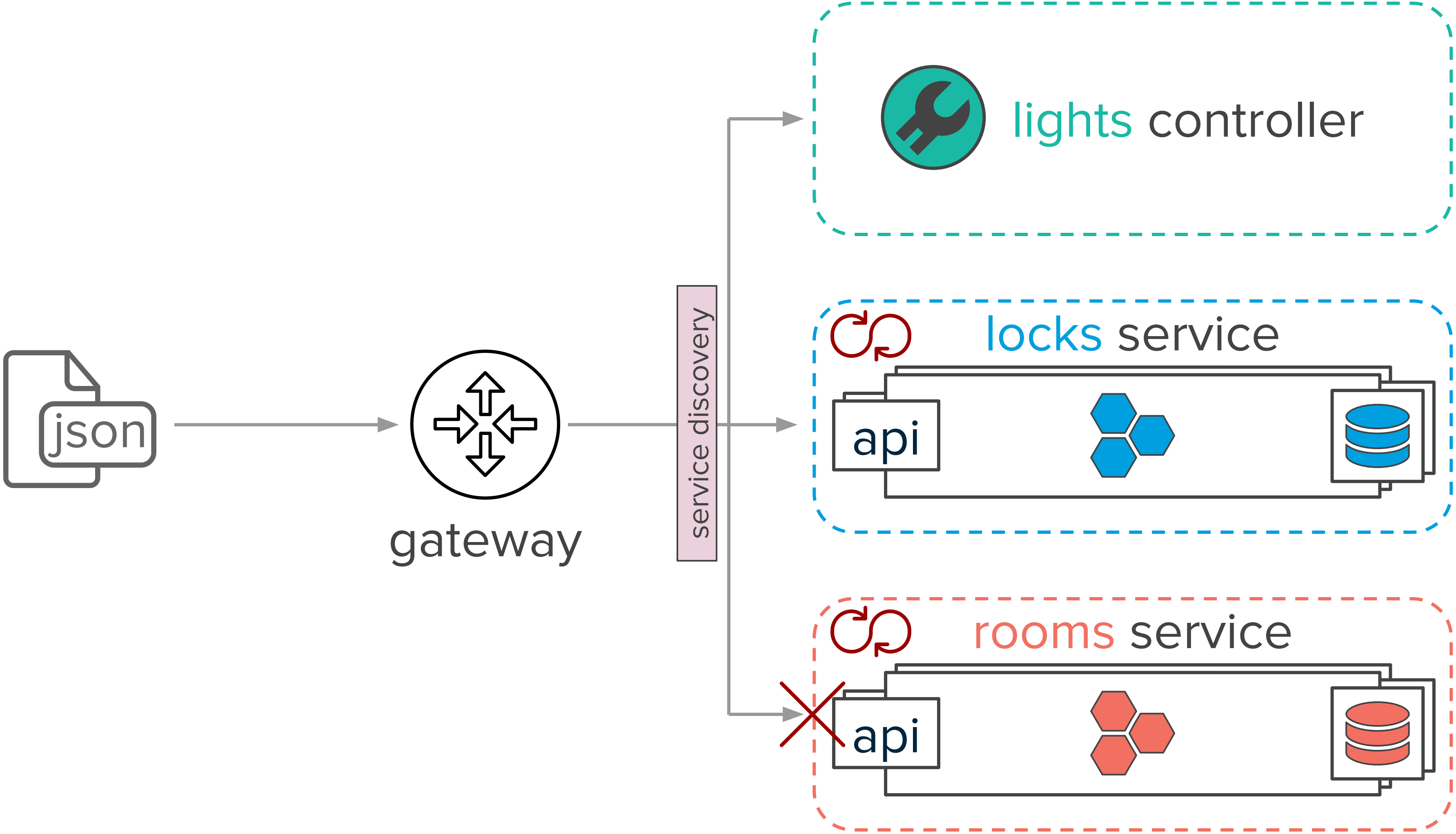
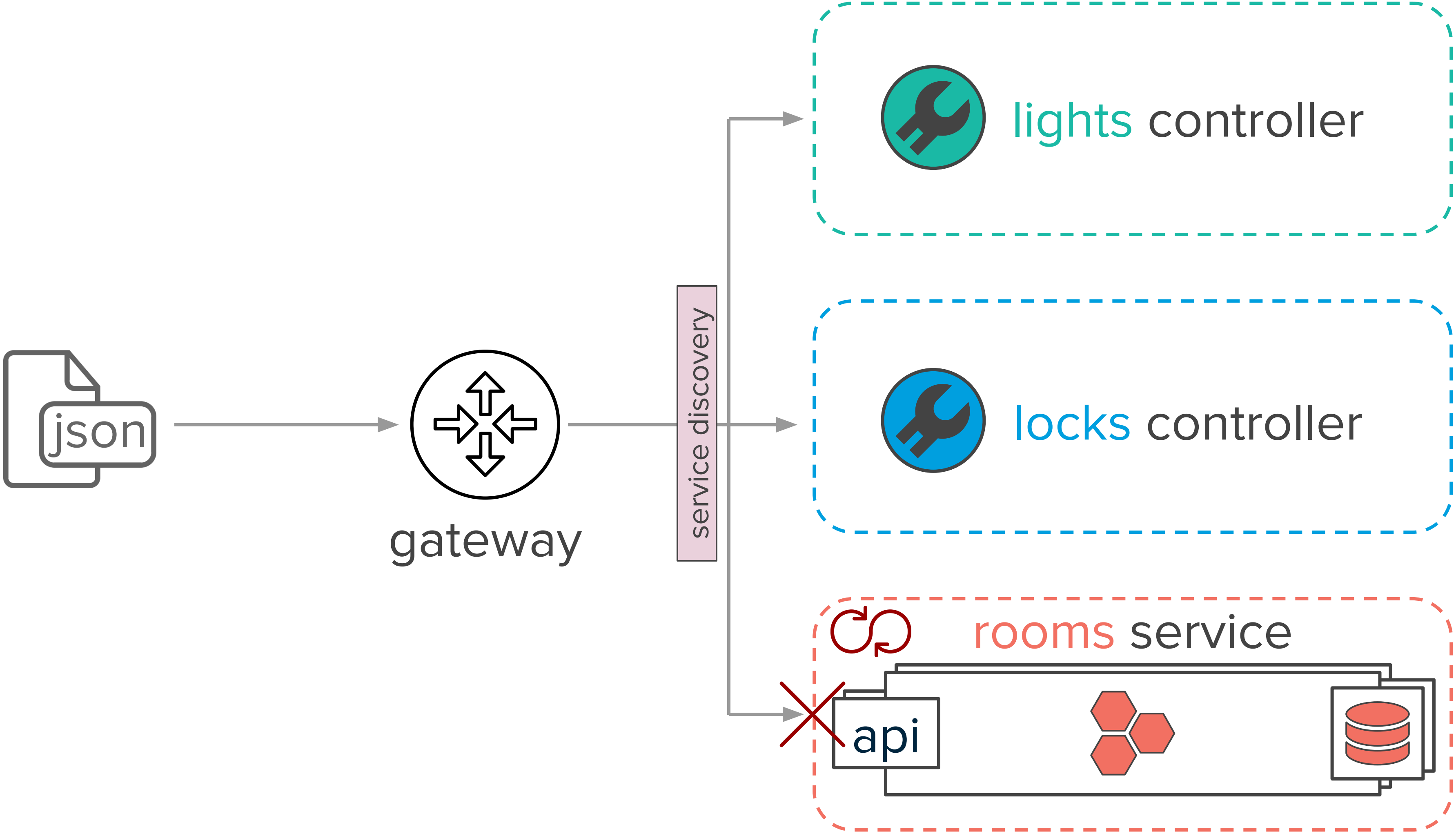
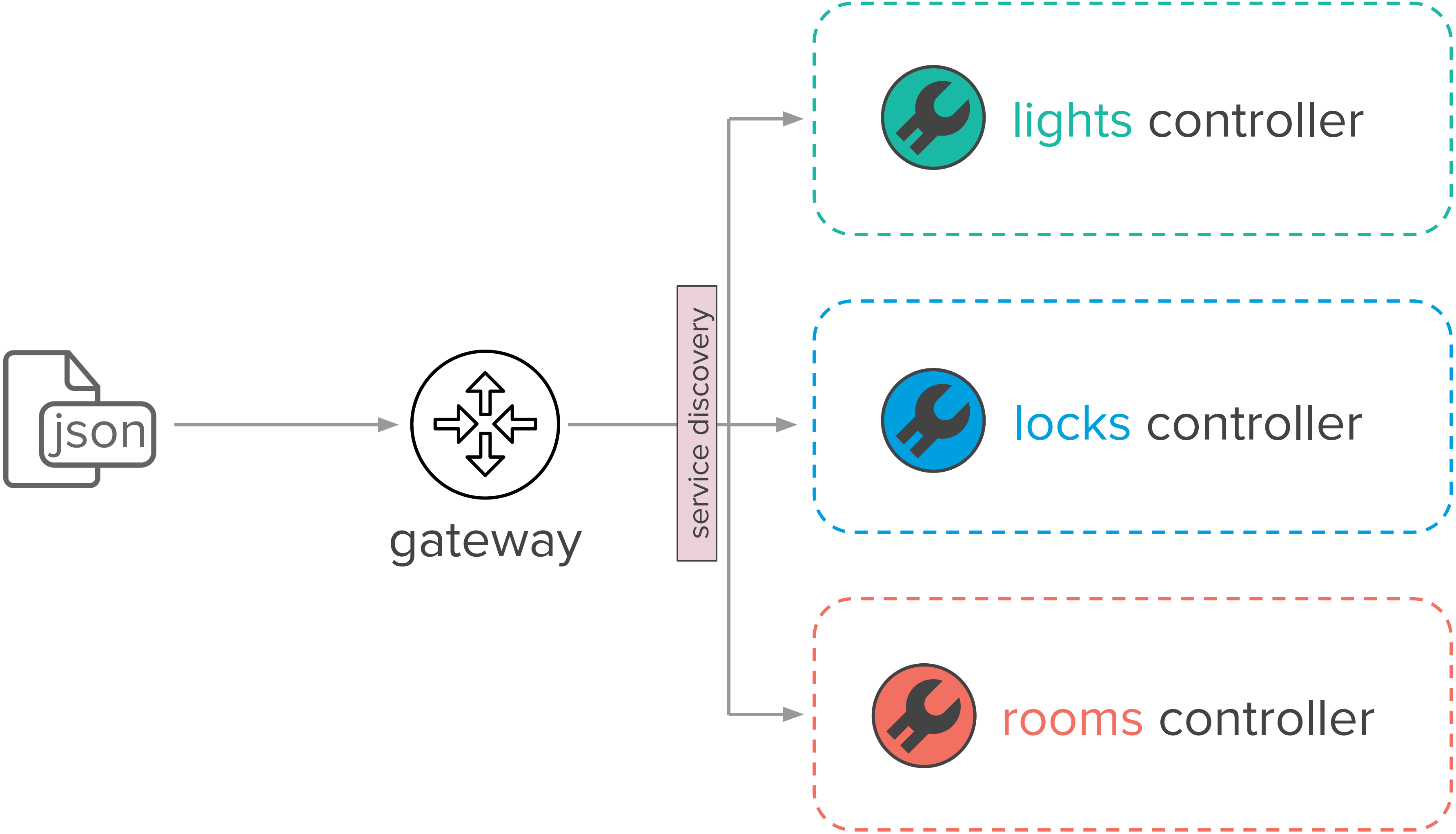

json
gateway
service discovery
lights controller
locks service
api
rooms service
api


json
gateway
service discovery
lights controller
locks controller
rooms service
api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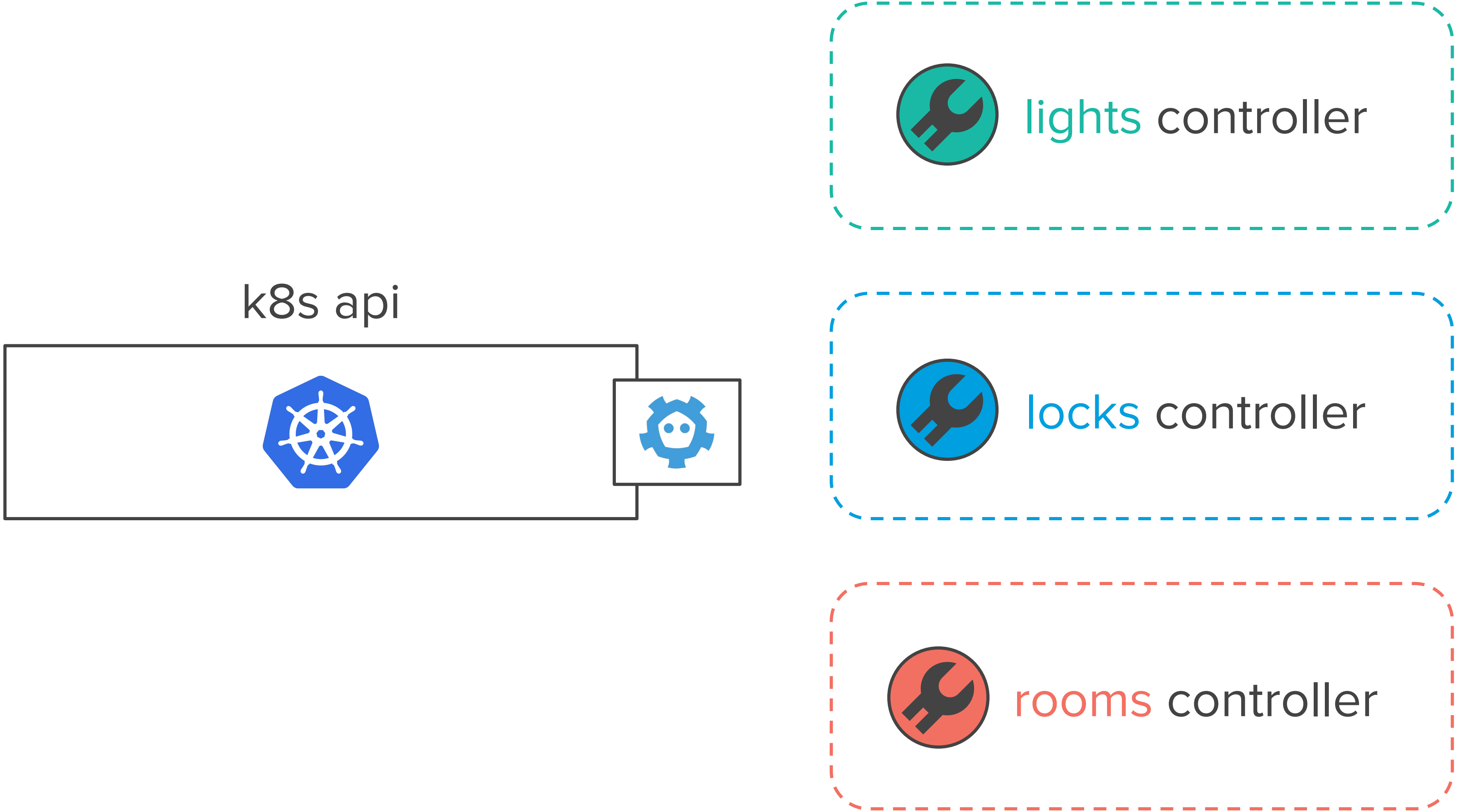
gateway
service discovery
lights controller
locks controller
rooms controller



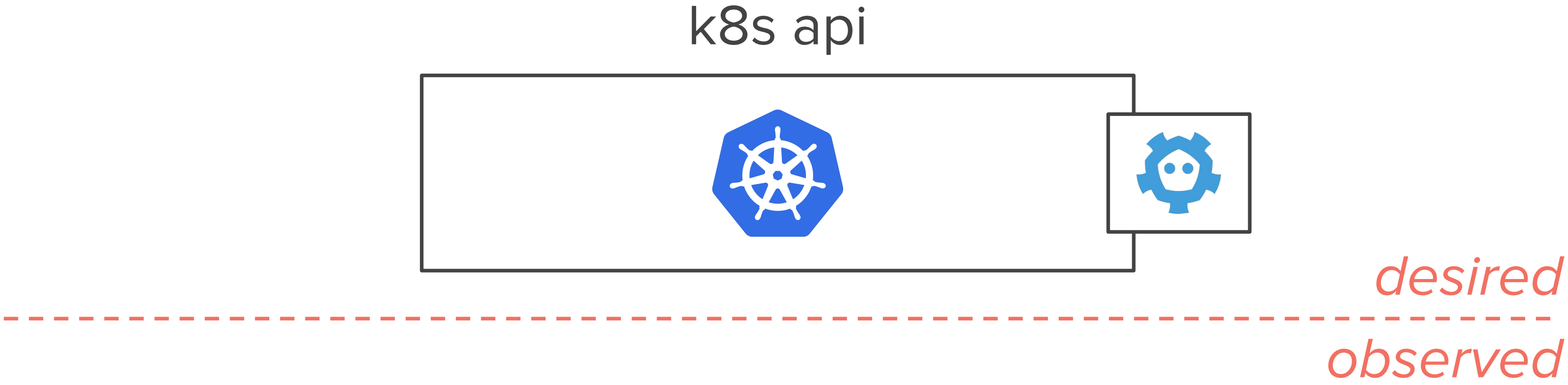
k8s api

lights controller

locks controller

rooms controller

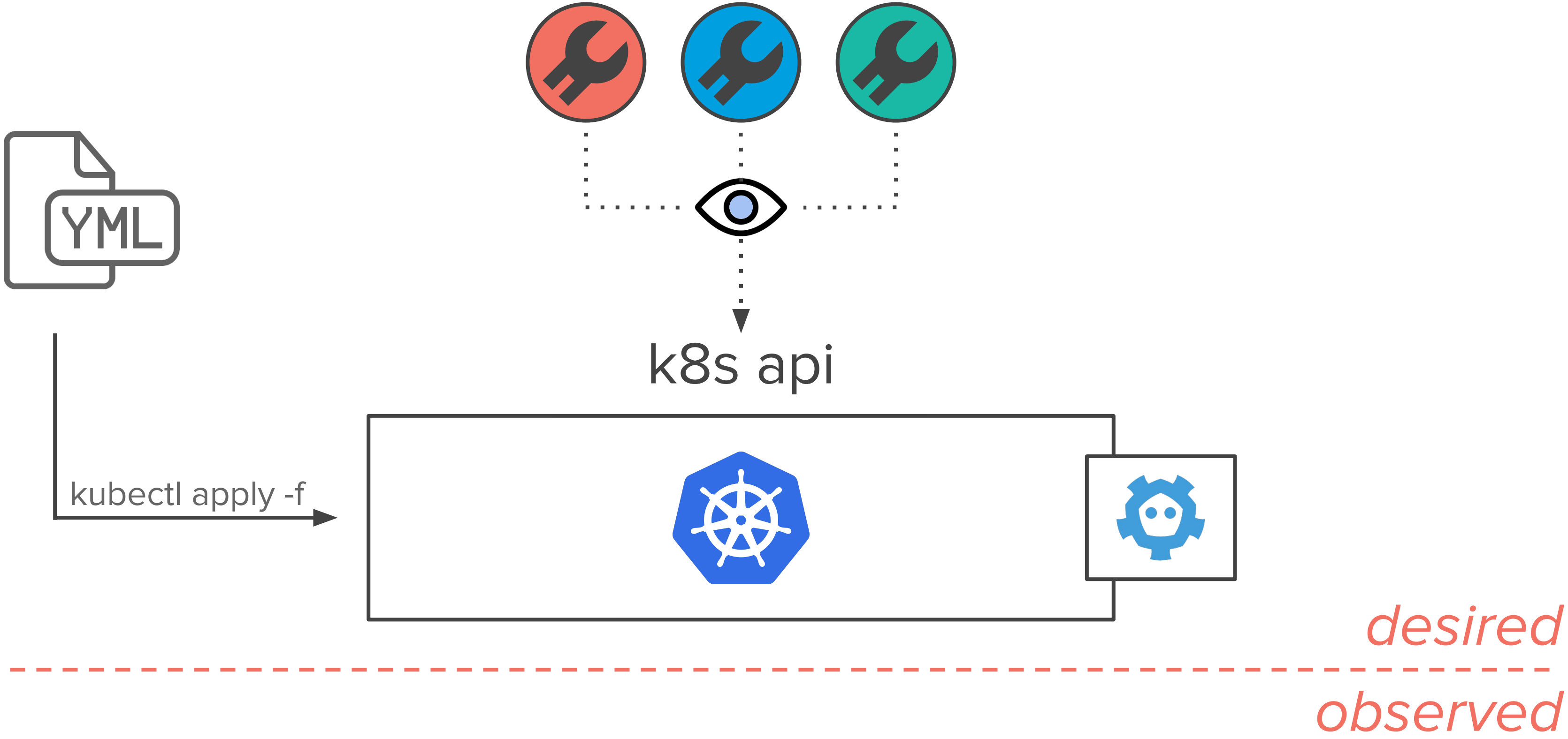
“I want the kitchen lights to be on”

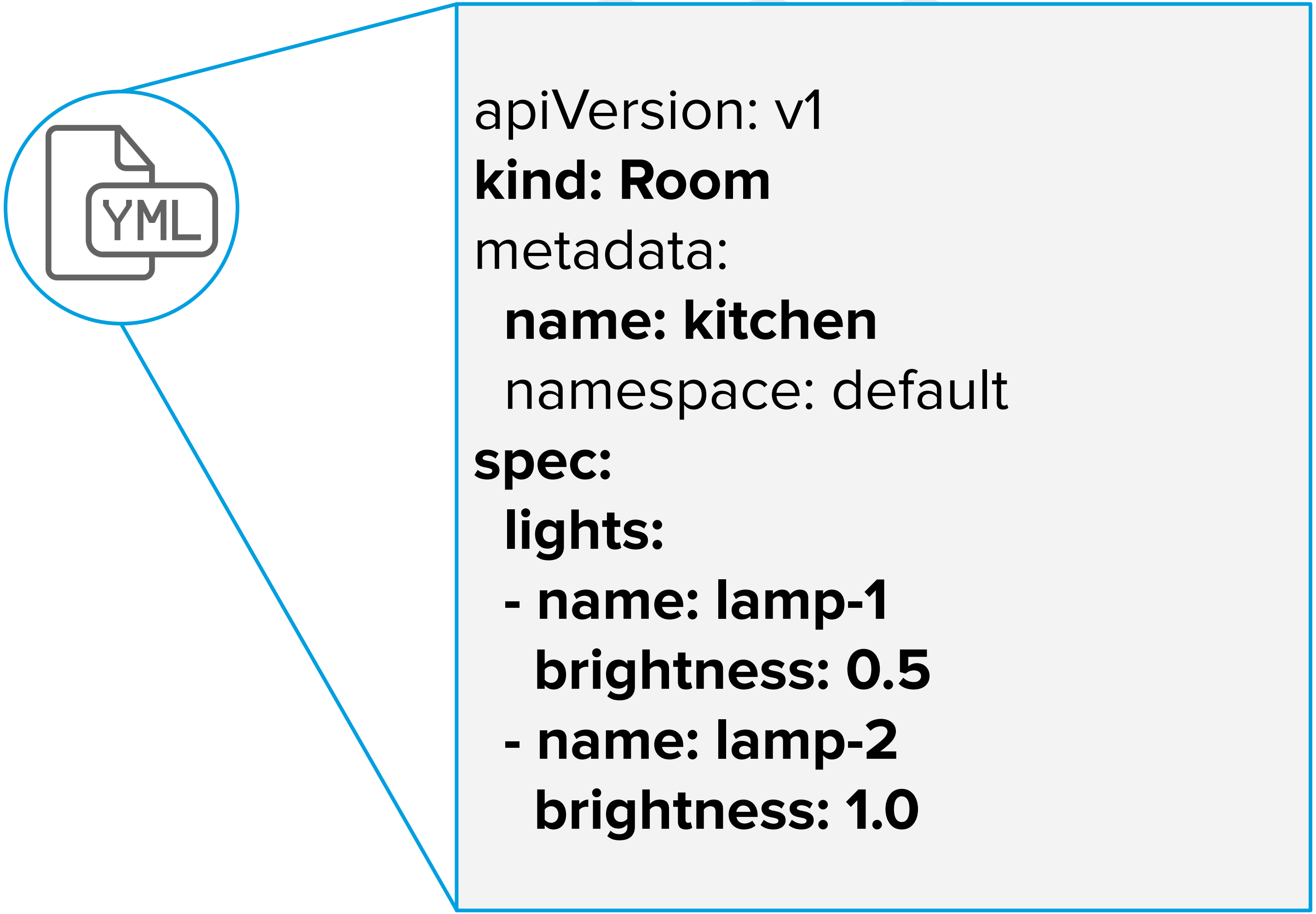


k8s api

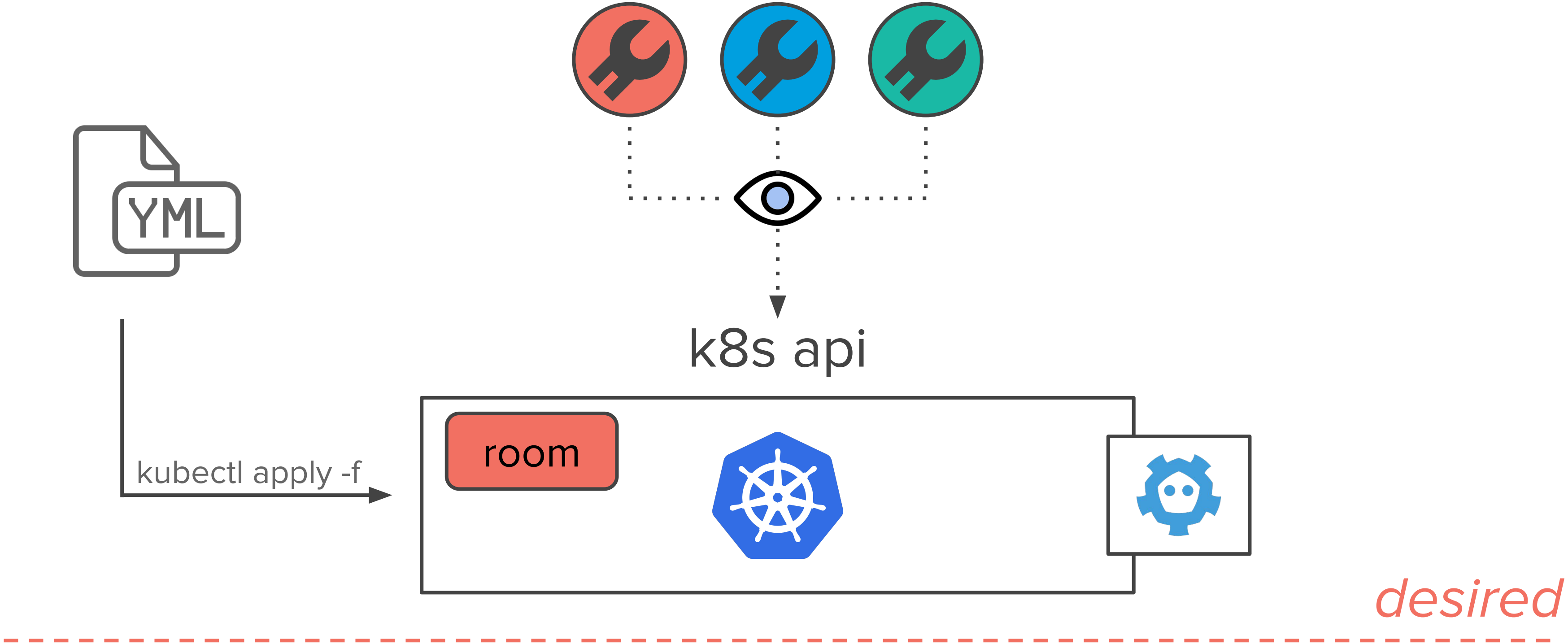
desired

observed


YML
kubectl apply -f
k8s api
desired
observed



```yaml
apiVersion: v1
kind: Room
metadata:
  name: kitchen
  namespace: default
spec:
  lights:
  - name: lamp-1
    brightness: 0.5
  - name: lamp-2
    brightness: 1.0
```

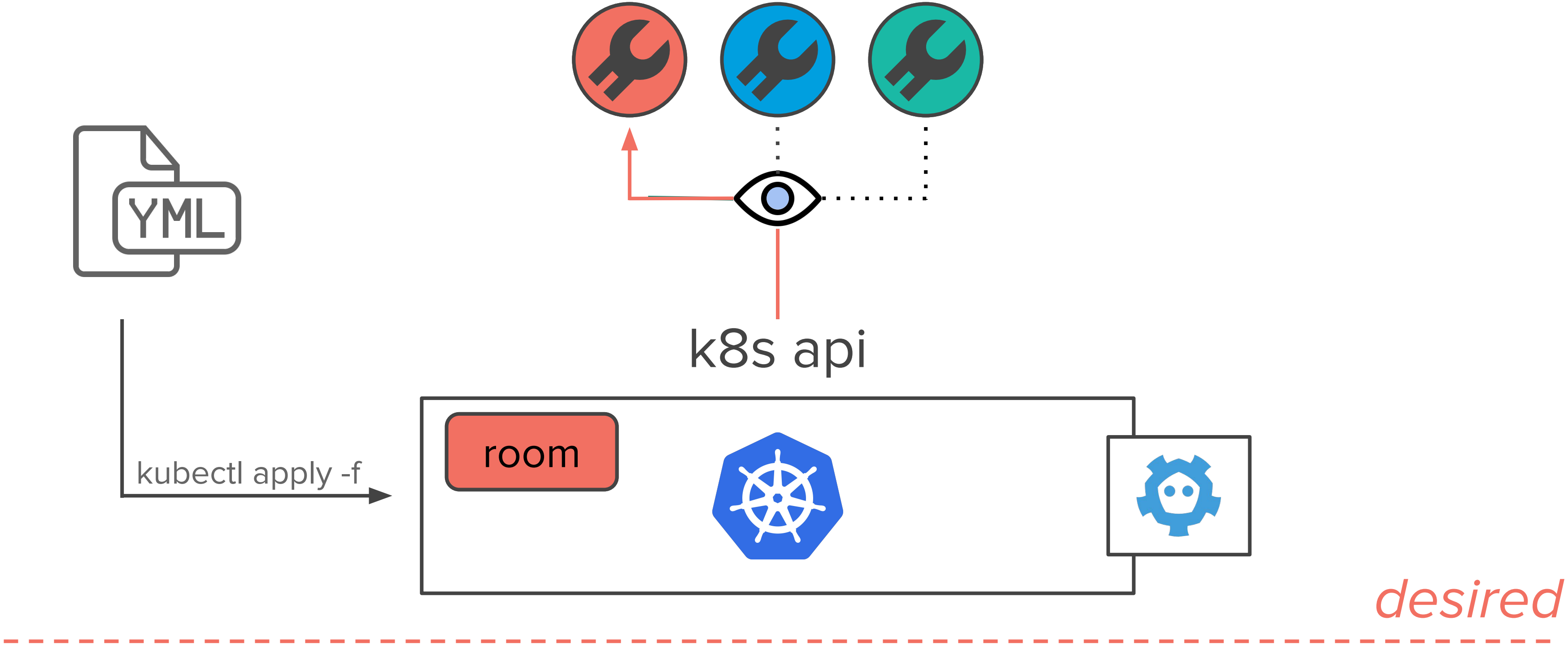


k8s api

room

kubectl apply -f

desired



YML

kubectl apply -f

k8s api

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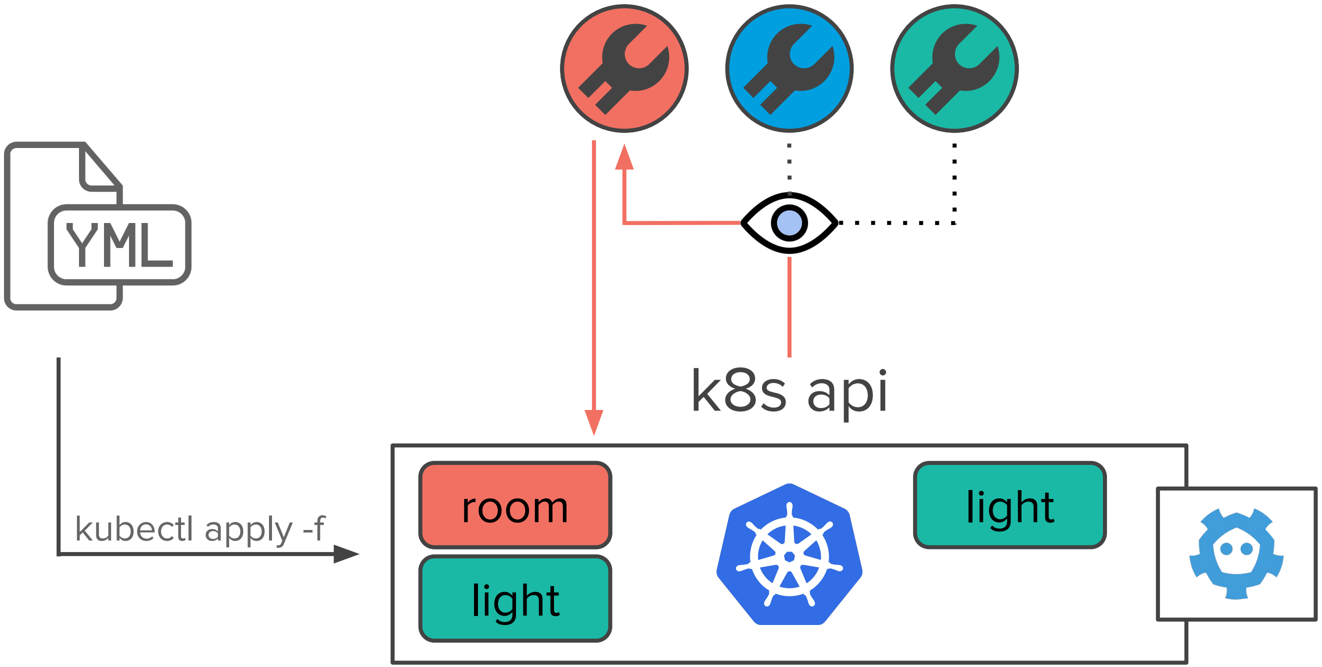
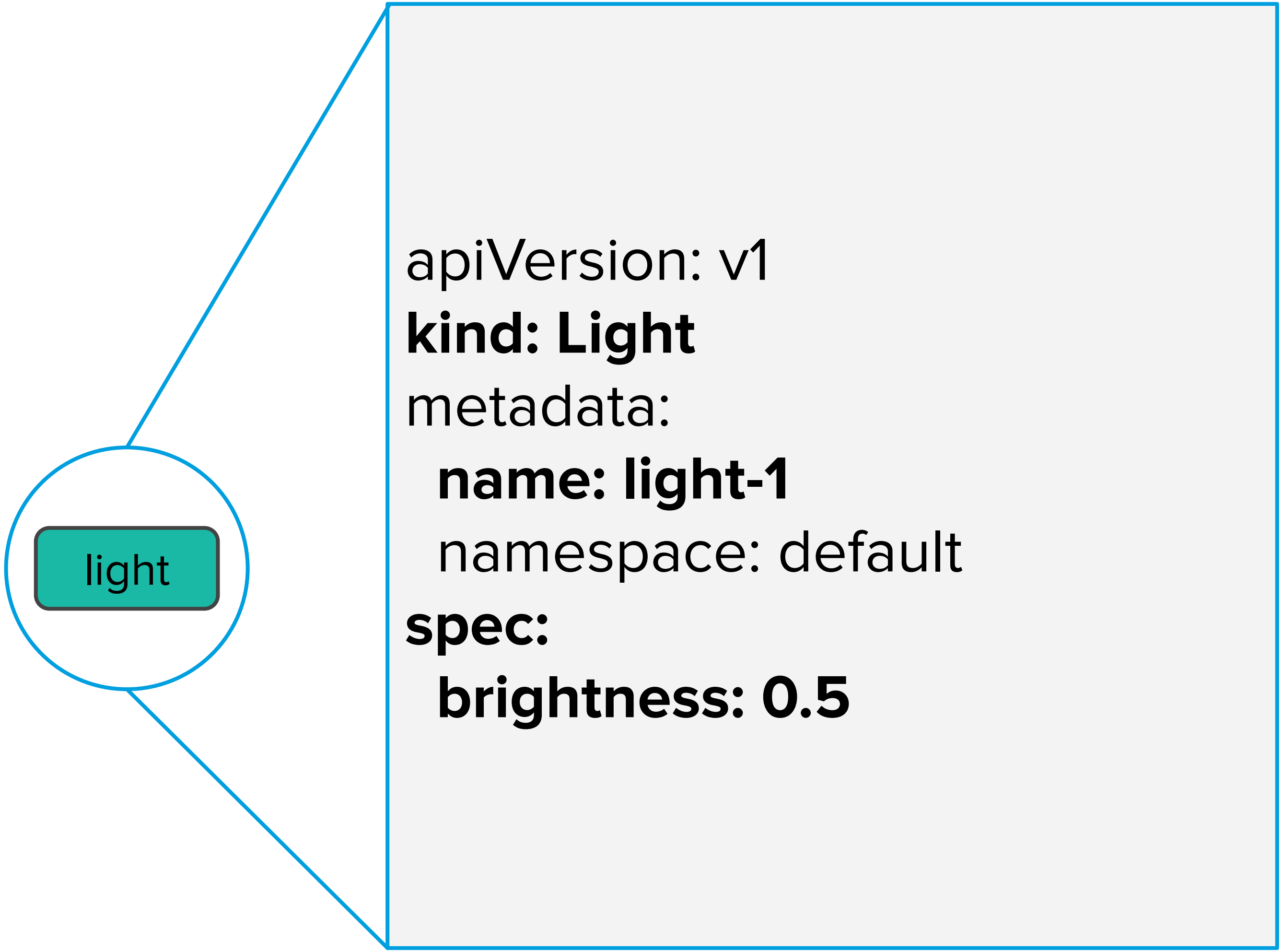
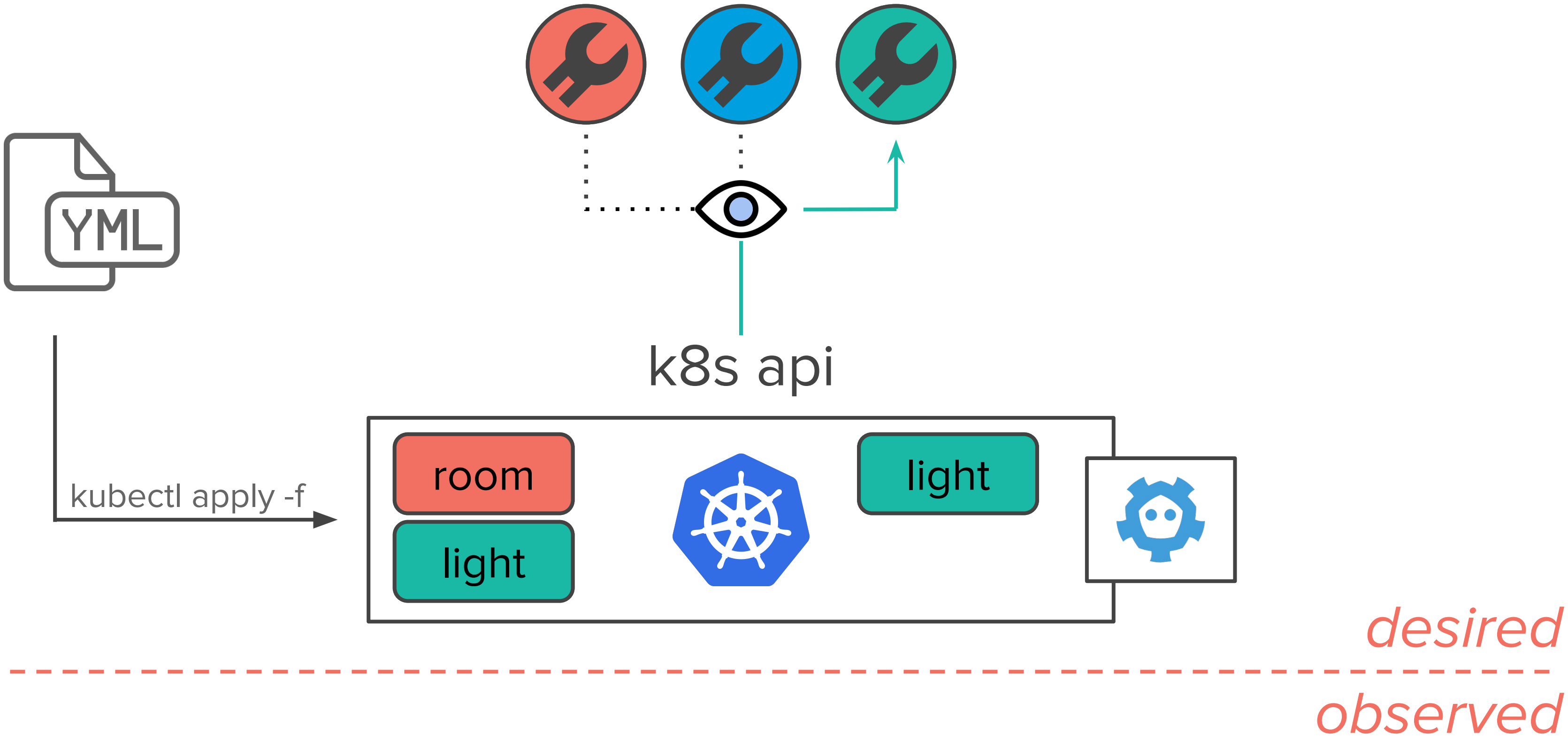
desired

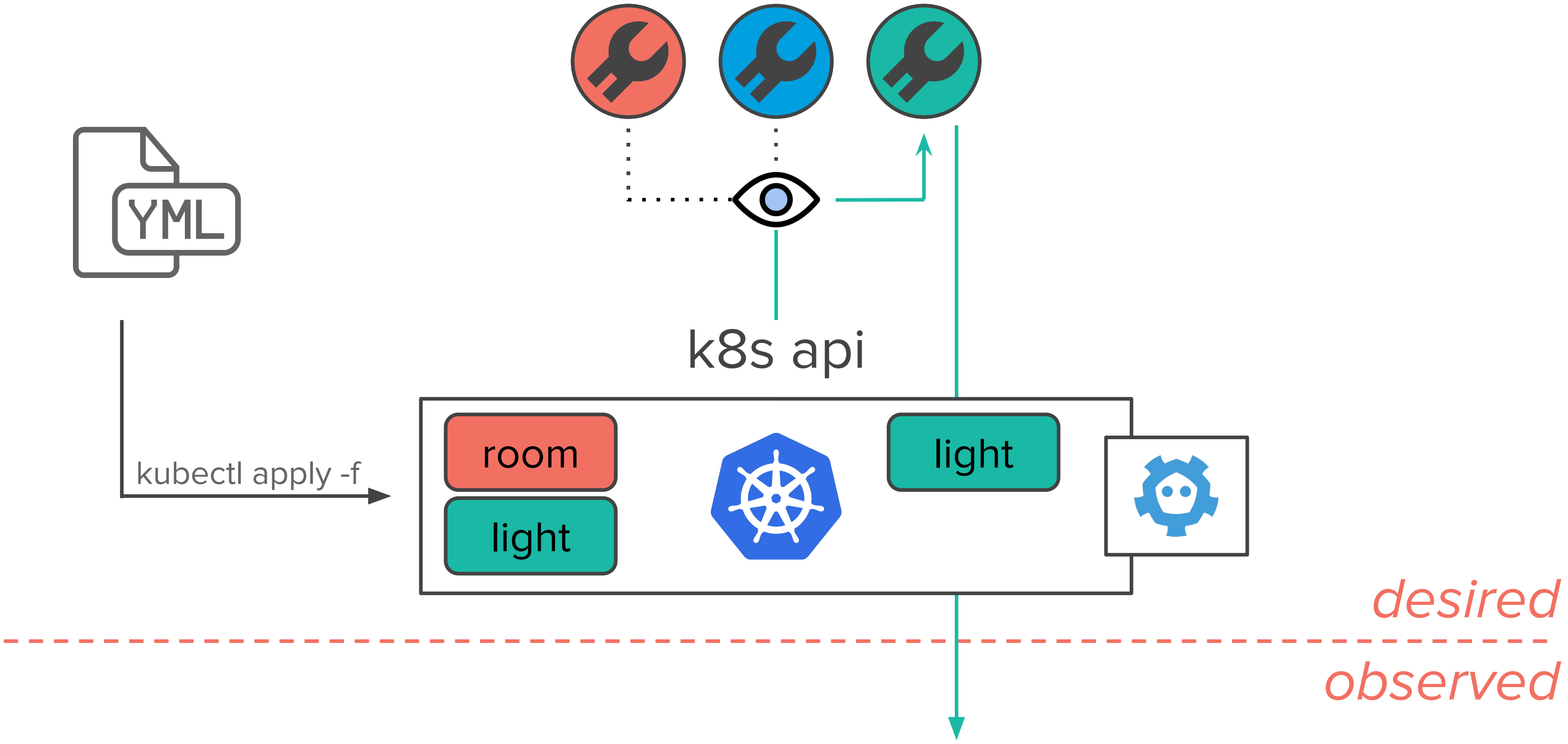


desired



```
apiVersion: v1
kind: Light
metadata:
  name: light-1
  namespace: default
spec:
  brightness: 0.5
```


YML
kubectl apply -f
k8s api
room
light
light
desired
observed



YML

kubectl apply -f

k8s api

room

light

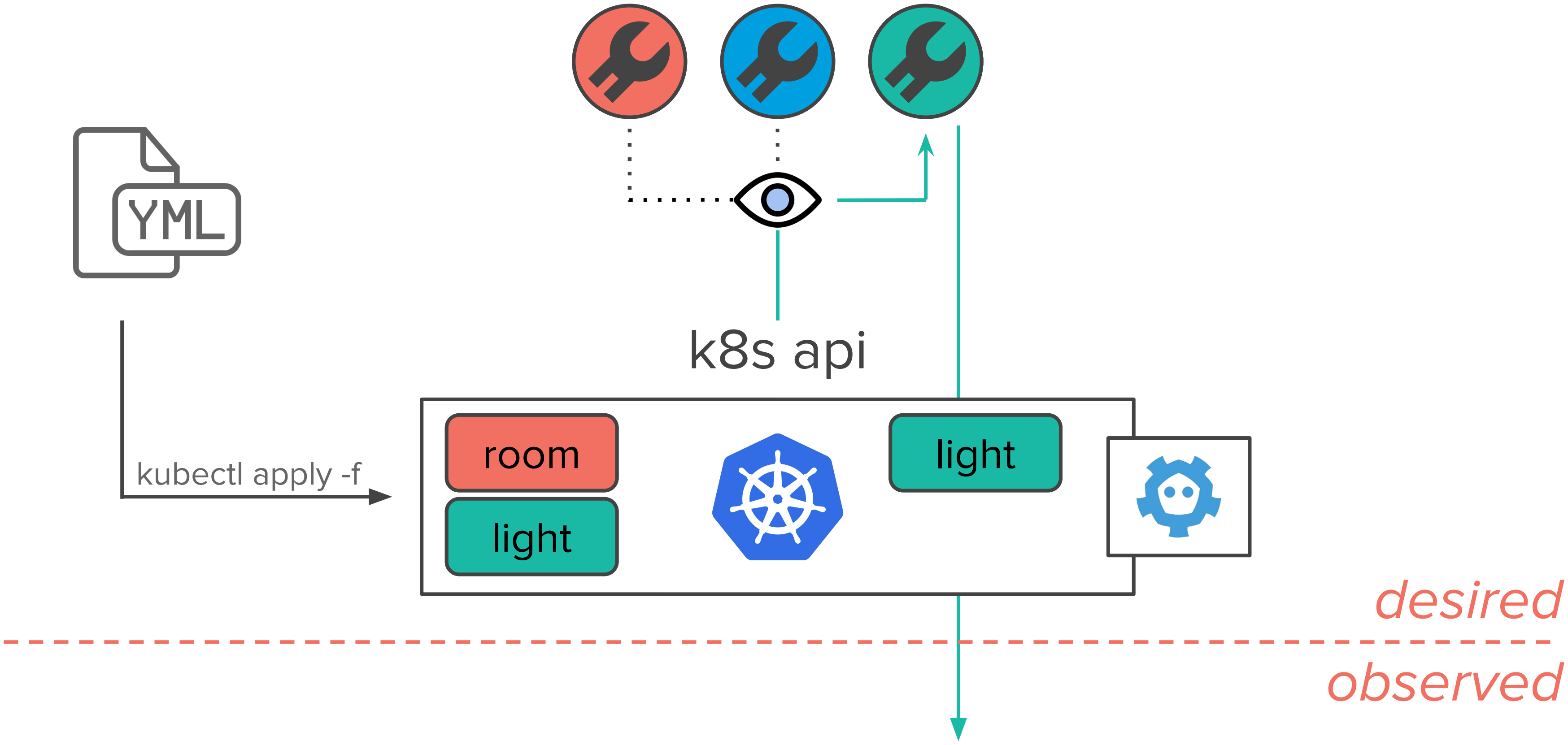
light

desired

observed

‘lamp-1’ brightness: **0.0**

‘lamp-2’ brightness: **0.0**



YML

kubectl apply -f

k8s api

room

light

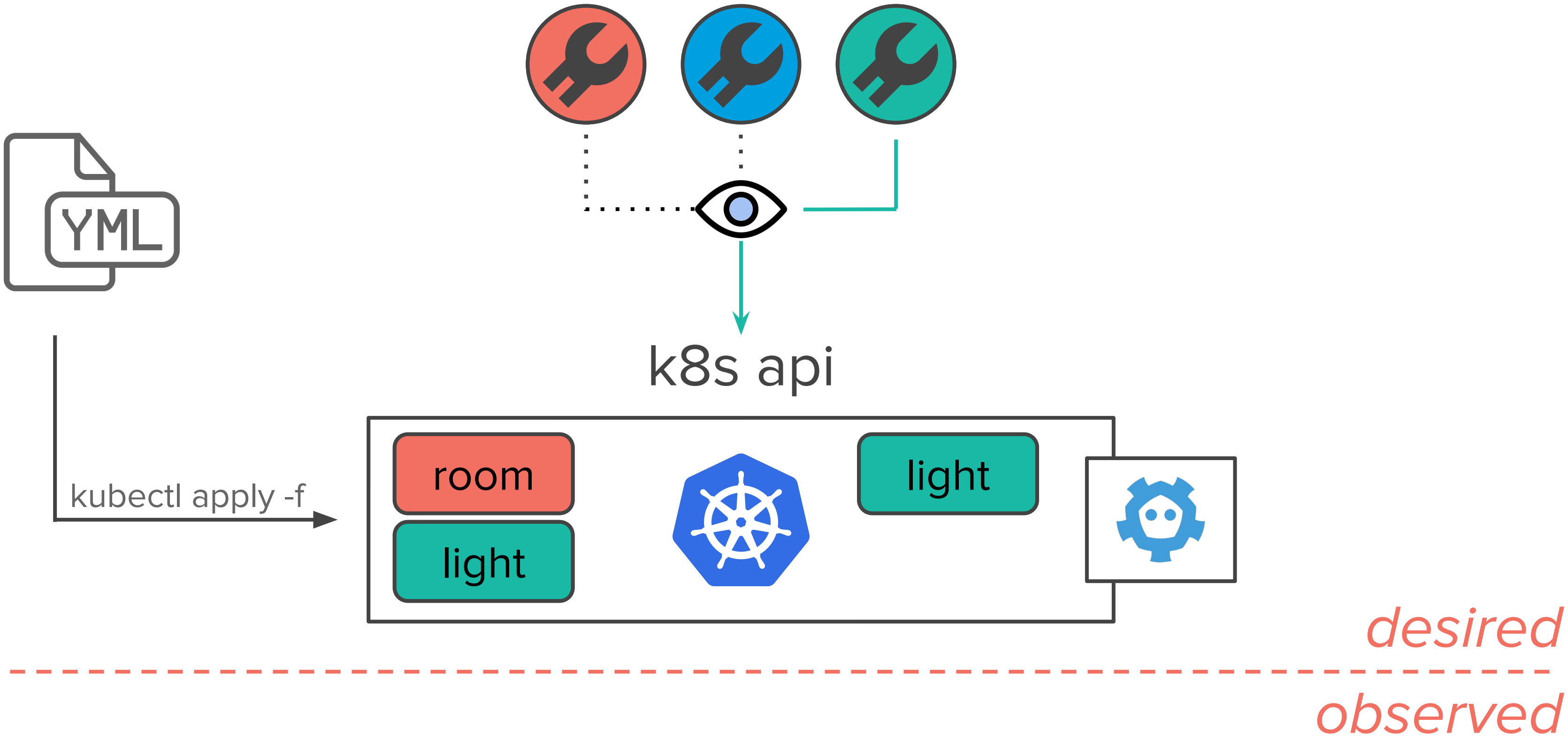
light

desired

observed

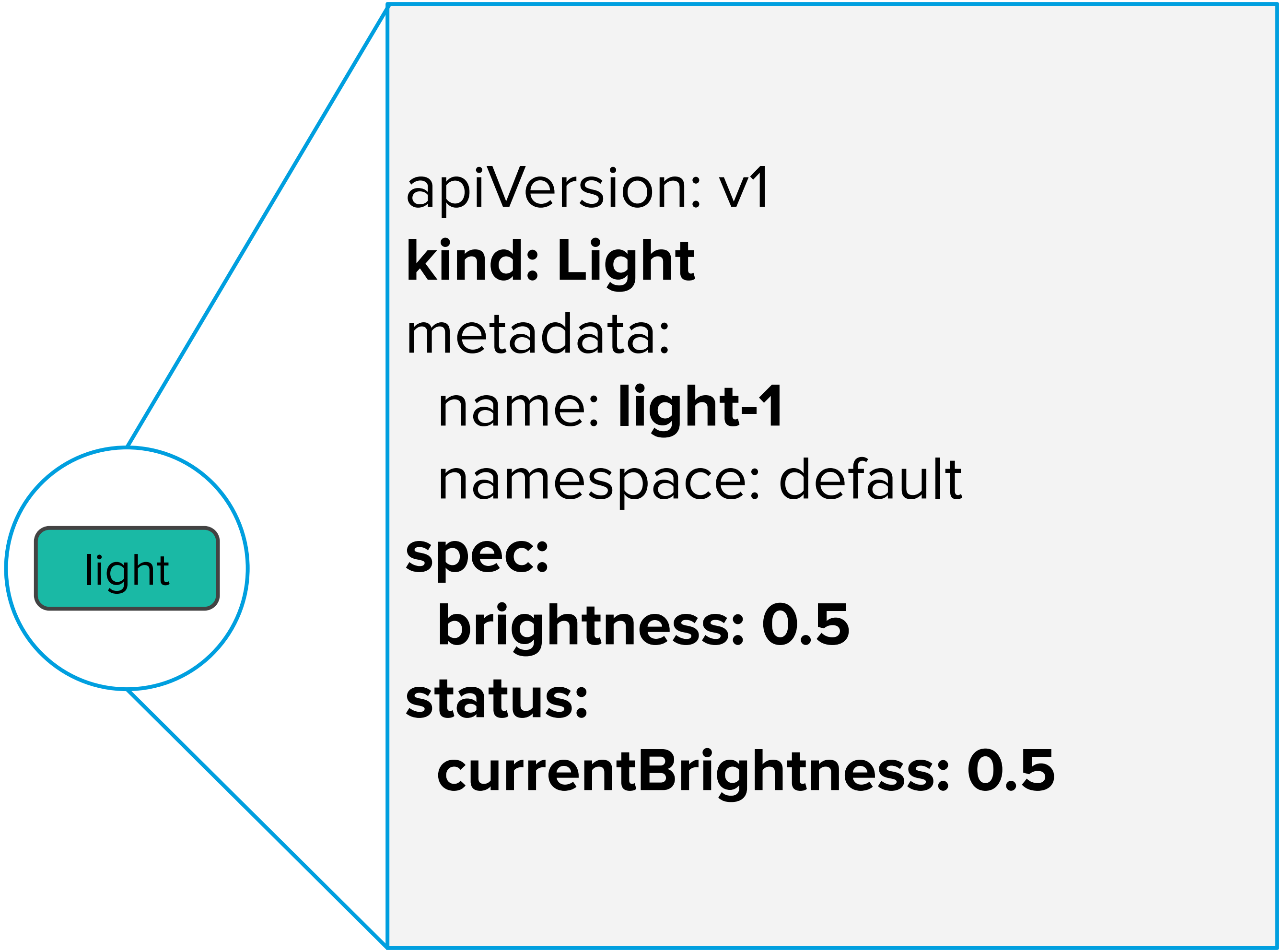
‘lamp-1’ brightness: **0.5**

‘lamp-2’ brightness: **1.0**

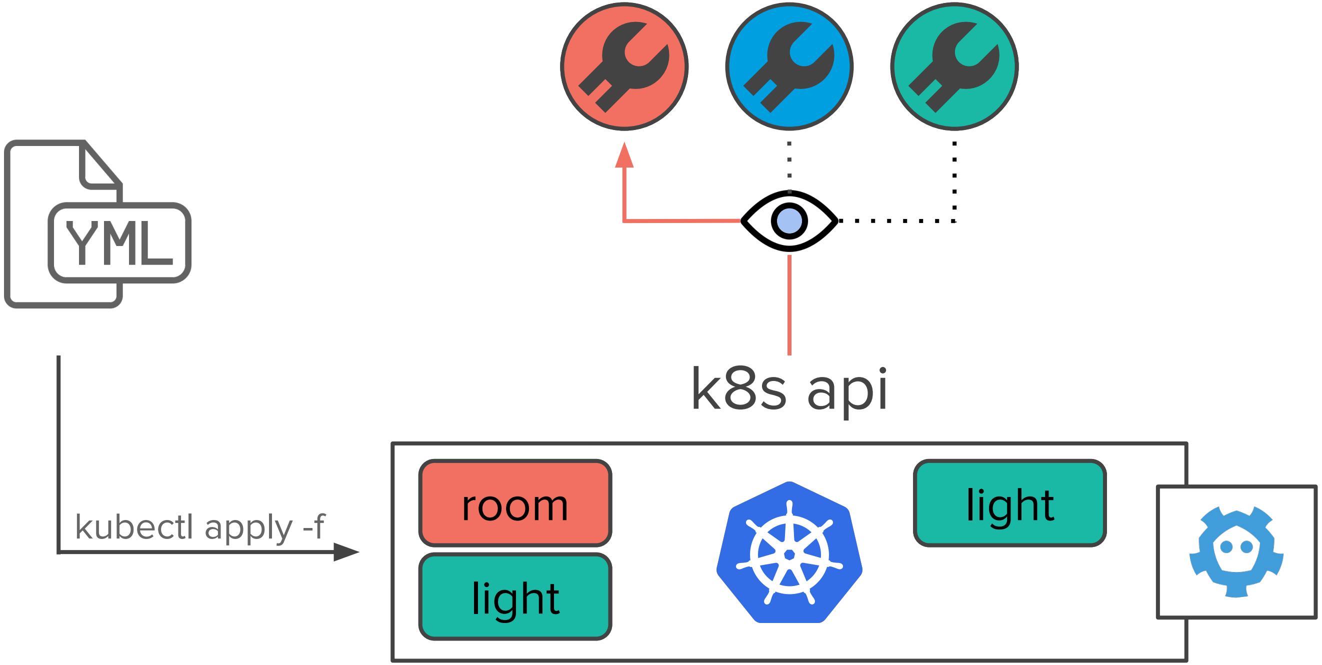


‘lamp-1’ brightness: **0.5**

‘lamp-2’ brightness: **1.0**



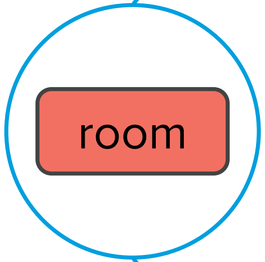
```yaml
apiVersion: v1
kind: Light
metadata:
  name: light-1
  namespace: default
spec:
  brightness: 0.5
status:
  currentBrightness: 0.5
```



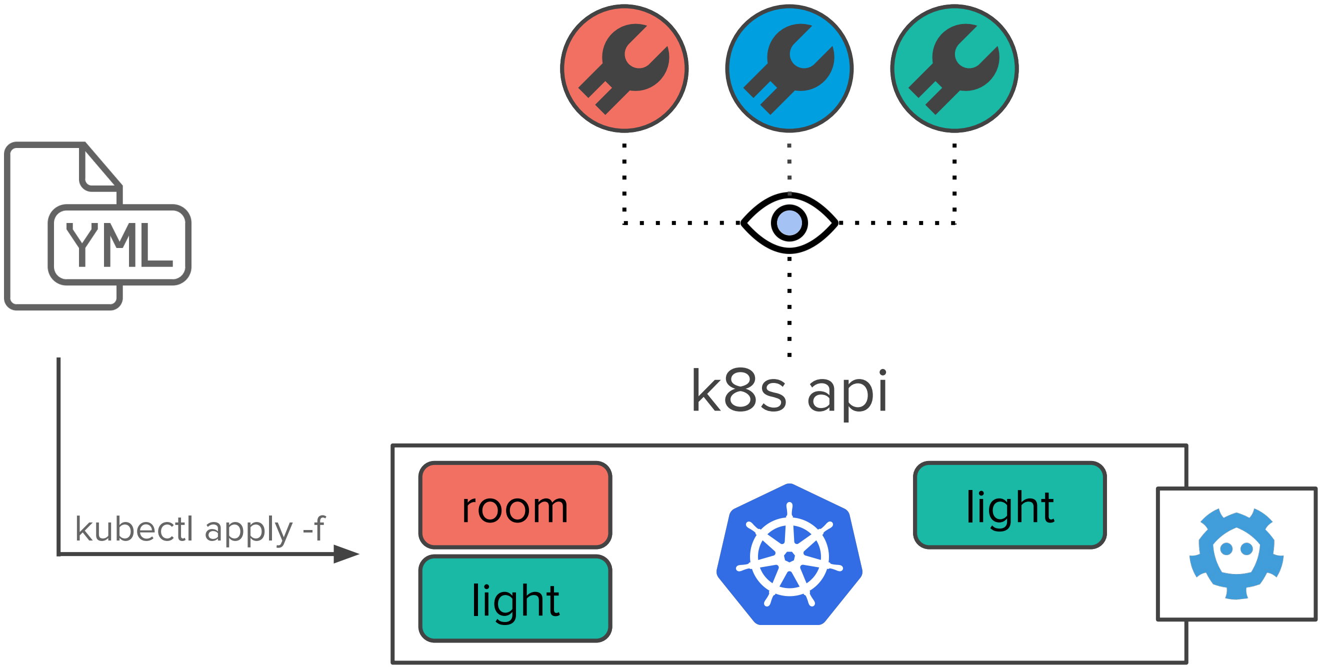
desired

observed

‘lamp-1’ brightness: **0.5**
‘lamp-2’ brightness: **1.0**



```yaml
apiVersion: v1
kind: Room
metadata:
  name: kitchen
  namespace: default
spec:
  lights:
  - name: lamp-1
    brightness: 0.5
  - name: lamp-2
    brightness: 1.0
status:
  numLightsOn: 2
```



desired

observed

‘lamp-1’ brightness: **0.5**
‘lamp-2’ brightness: **1.0**

Pros, Cons & Considerations

Storage

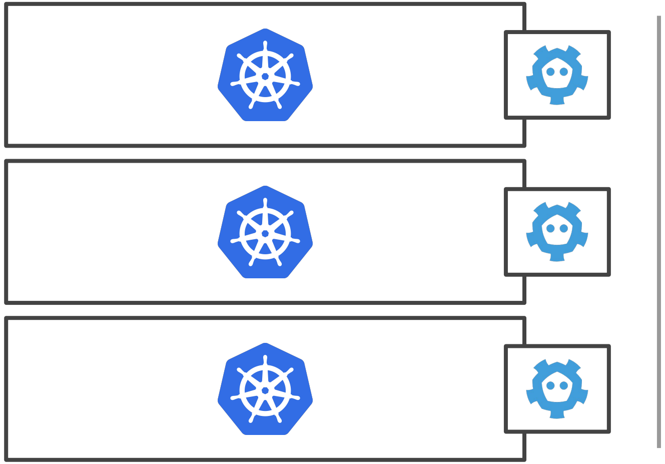
Access to an etcd datastore for “free”!

- Developers do not need to worry about operational overheads
- … But etcd is not a relational database

High Availability

API is highly available for “free”!

- When deployed in a multi-master configuration, the k8s API is Highly Available
- Developers do not need to worry about operational overheads!



multi-master

Performance

Performance is largely dependent on etcd

- “Noisy” services could have a negative impact on performance
- 1 huge k8s cluster vs lots of little ones
  - Perhaps not so much of an issue in smaller clusters
- API machinery are thinking about scaling targets
  - Fill in the survey!

Programming Model

Declarative vs Imperative

- The k8s API is entirely declarative and eventually consistent
- Great for stability and reliability of the system!
- Writing reconciliation
- Not everything fits!

Team Collaboration

CRDs as the standard interface between teams

- Teams ship controllers and CRDs
- Team A’s controller could watch for changes to Team B’s Custom Resources
- Part of what it means to be “kubernetes-native”

Other API Features

What other API features should you consider?

- AuthN/Z
- Pagination
- Querying
- Binary Data

- Resource relationship
- Versioning
- Quotas
- Tooling (kubectl/UIs etc)

To CRD, or Not to CRD?

Kelsey Hightower
@kelseyhightower

To the entire Kubernetes community:

> Abby Fuller @abbyfuller · Jun 18
>
> I don't know who needs to hear this but not everything needs to be a Kubernetes CRD

3:12 AM · Jun 18, 2019 · Twitter for iPhone

86 Retweets **398** Likes

Thank You!