Rancher 2.0
Technical Deep Dive

LINE Corporation
IT Service Center Verda 2
Yuki Nishiwaki

Who Are You: Yuki Nishiwaki

Current Role

- Develop/Operate OpenStack based Private Cloud
- Plan/Develop/Operate Kubernetes as a Service

Recent Talk

- Excitingly simple multi-path OpenStack Networking (May 2018, OpenStack Summit)

Brief introduction of ourselves(Verda)

The position against k8s from me

OpenStack based Private Cloud

Server | Network | Database | .....

New Resource Type

Verda

Operator/Developer for Private Cloud

Verda Kubernetes as a Service - Background

- We’ve seen about 600 k8s node users deployed/used on our Private Cloud
- Many teams find easy way/struggle to use/operate k8s

Problem description

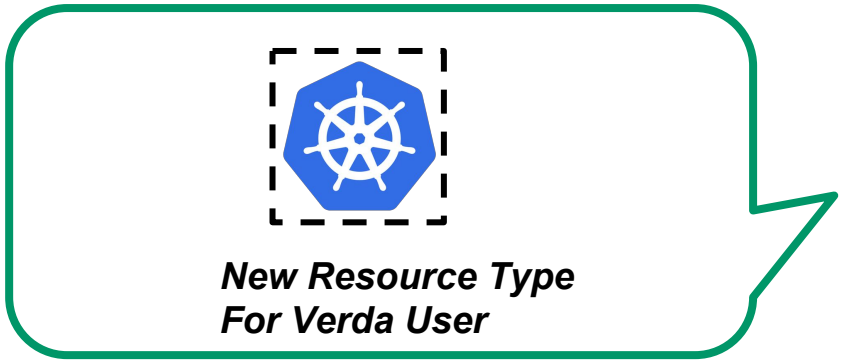
- Operating k8s is not such a small burden every developer can handle in spare time
- Knowledge of k8s operation is fragmented

New Resource Type
For Verda User

Verda

Verda Kubernetes as a Service - Target

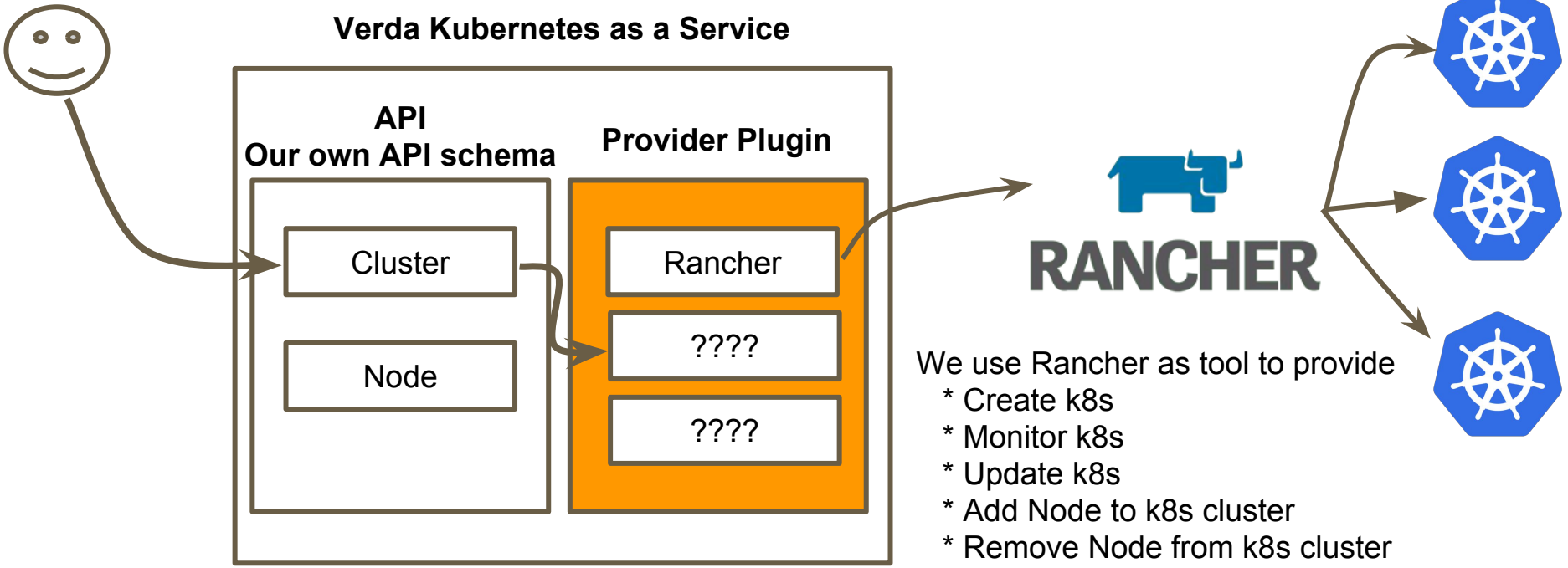
- Provide stable Kubernetes Cluster to Verd User
  - Don’t have to automate everything but we will take responsibility to operate
- Provide API to Verda User
  - CREATE/DELETE Kubernetes Cluster (UPGRADE is not the target at the moment)
  - ADD/REMOVE Node
- Provide “Service Desk”
  - To advise/consider how to use with Verda User(Application developer)



Verda Kubernetes as a Service - Status of Project

- Start Project since May 2018
  - Pretty late, relatively
- Decided to utilize existing software(OSS)
  - Reduce lead time as much as possible
  - Rancher 2.0 is one of the candidates we will use
    - We are thinking to use Rancher 2.0 for Phase 1
- Still deciding which is good to use for managing k8s part
  - Or Will we have to develop from scratch?

Less dependent design - Still considering



We use Rancher as tool to provide
* Create k8s
* Monitor k8s
* Update k8s
* Add Node to k8s cluster
* Remove Node from k8s cluster

Roadmap

Phase 1

Phase1 (2018/09/01)
* This is First release
* No change for Kubernetes/Rancher
* Support only basic k8s cluster
* Support Limited Number of Cluster
* Train ourselves
  * For Rancher (because we depended)

Phase 2

Phase2 (Planning)
* Enhance VKS control plane(Tune Rancher)
  * Support More Clusters
  * Enhance monitoring item
  * Enhance GUI
* Enhance k8s support
  * Support Type Loadbalancer for in-house LB
  * Support Persistent Volume
  * Optimizing Container Networking
* Train ourselves
  * For Kubernetes, Etcd

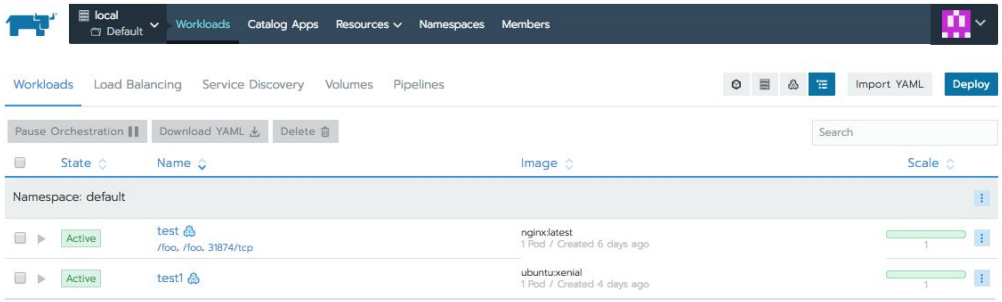
Phase 3

Phase3 (Planning)
* Enhance k8s support
  * CRD/Controller for in-house Component
  * Prepare skeleton template to make it easy to start development
  * Consider solution about how k8s cover whole system including VM (kubevirt)

About Rancher 2.0

What's Rancher?

- Container Management Tool
- Support to deploy Container Orchestration Tool itself like Kubernetes
- Make "Container Orchestration itself" abstract and Provide rich UI
- UI allow you to deploy your container workload easier than native console
- UI allow you to use well-tested catalog



Rancher 2.0 Released (May 1 2018)

- Focus on using Kubernetes as a Container Orchestration Platform
- Re-design to work on Kubernetes from scratch
- Re-Implement from scratch
- Introduce Rancher Kubernetes Engine (RKE)
- Unified Cluster Management including GKE, EKS... as well as RKE
- Application Workload Management

Rancher 2.0

Our Interest as a backend
For our “k8s as a service“

- Focus on using Kubernetes as a Container Orchestration Platform
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Rancher 2.0

Our Interest as a backend For our “k8s as a service“

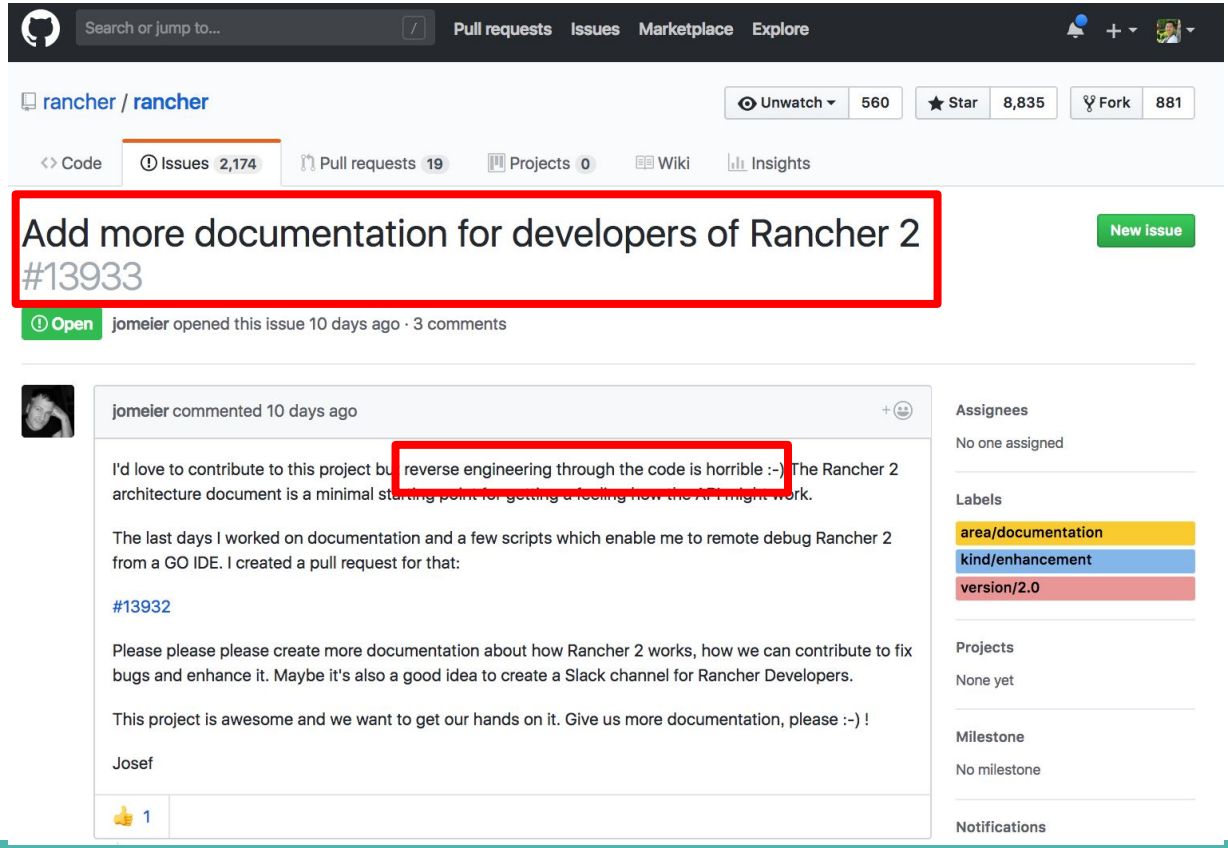
- Focus on using Kubernetes as a Container Orchestration Platform
- Re-design to work on Kubernetes from scratch
  - Don’t have to understand multiple container orchestrators
- Re-Implement from scratch
  - Readable amount of code (about 50,000~80,000 lines except for vendoring)
- Introduce Rancher Kubernetes Engine (RKE)
  - Support Deploy/Upgrade/Monitor Kubernetes cluster
  - Less requirements for the environment to build k8s
- Unified Cluster Management including GKE, EKS... as well as RKE
- Application Workload Management

As a context: backend for Verda K8s as a Service

- In our use case, User/Operator for Rancher is different
  - Operator: Cloud Operator (us)
  - User: Application Developers for LINE Service
- Down time of Rancher affect to many users

Need to know well about How Rancher works

But Documentation....



Only High-level Architecture is available

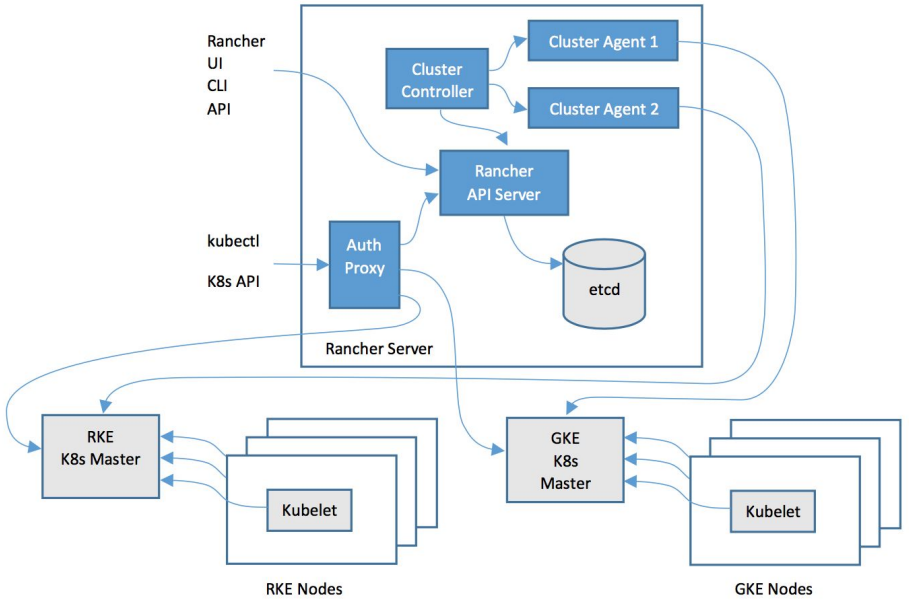
To be honest,
It's difficult to operate Rancher 2.0 with just official documents

¯_(ツ)_/¯

High-level Architecture

Like Rancher 1.0, majority of Rancher 2.0 software runs on the Rancher server. Rancher server includes all the software components used to manage the entire Rancher deployment.

Figure 2 illustrates the high-level architecture of Rancher 2.0. The figure depicts a Rancher server installation that manages two Kubernetes clusters: one Kubernetes cluster created by RKE and another Kubernetes cluster created by GKE.



Let’s unbox Rancher 2.0
<v2.0.0>

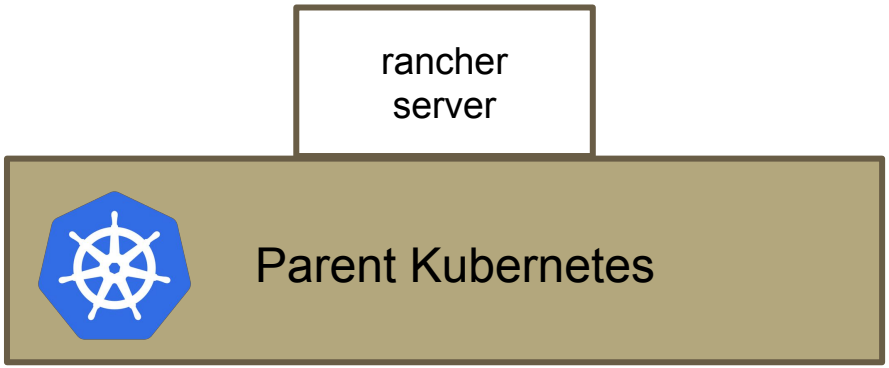
本資料は、調査資料を一部抜粋して作成しています。
フルバージョンをご覧になりたい方は、後日slideshareでご確認をお願いします。

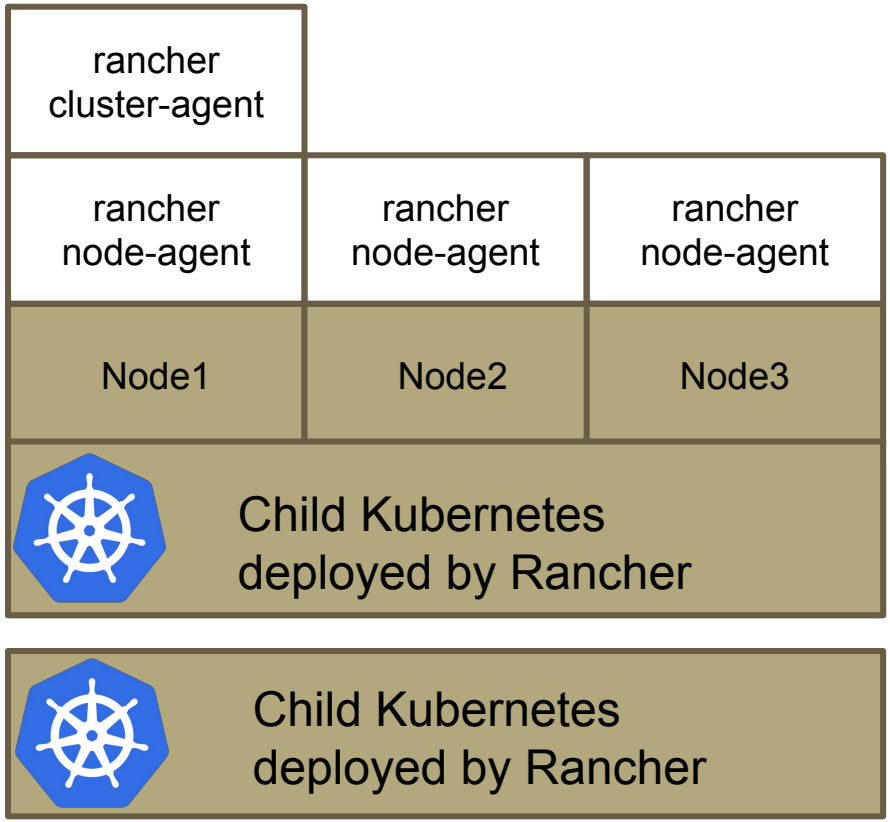
1. Rancher Overview

Parent k8s: k8s working with rancher
Child k8s: k8s deployed by rancher

1.1. Casts in Rancher 2.0

- Rancher Server
- Rancher Cluster Agent
- Rancher Node Agent

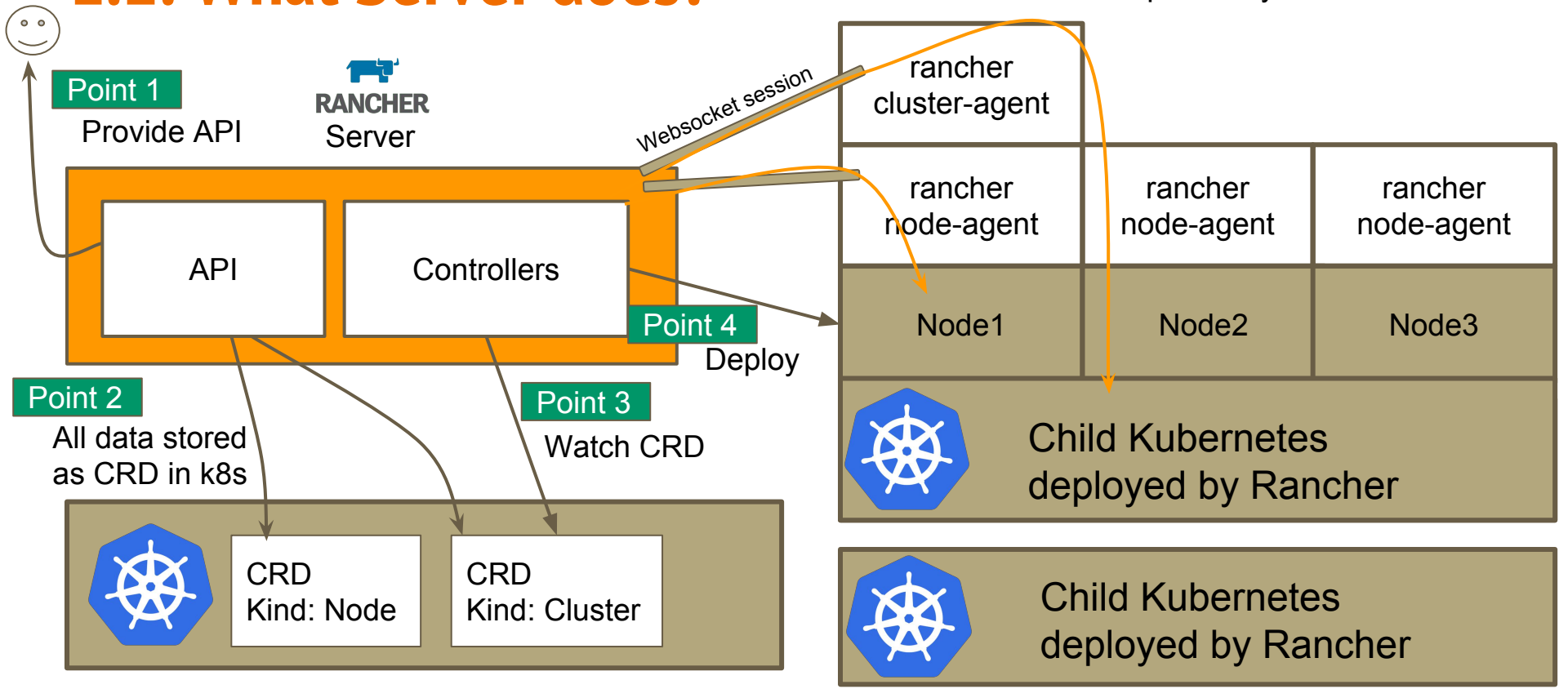




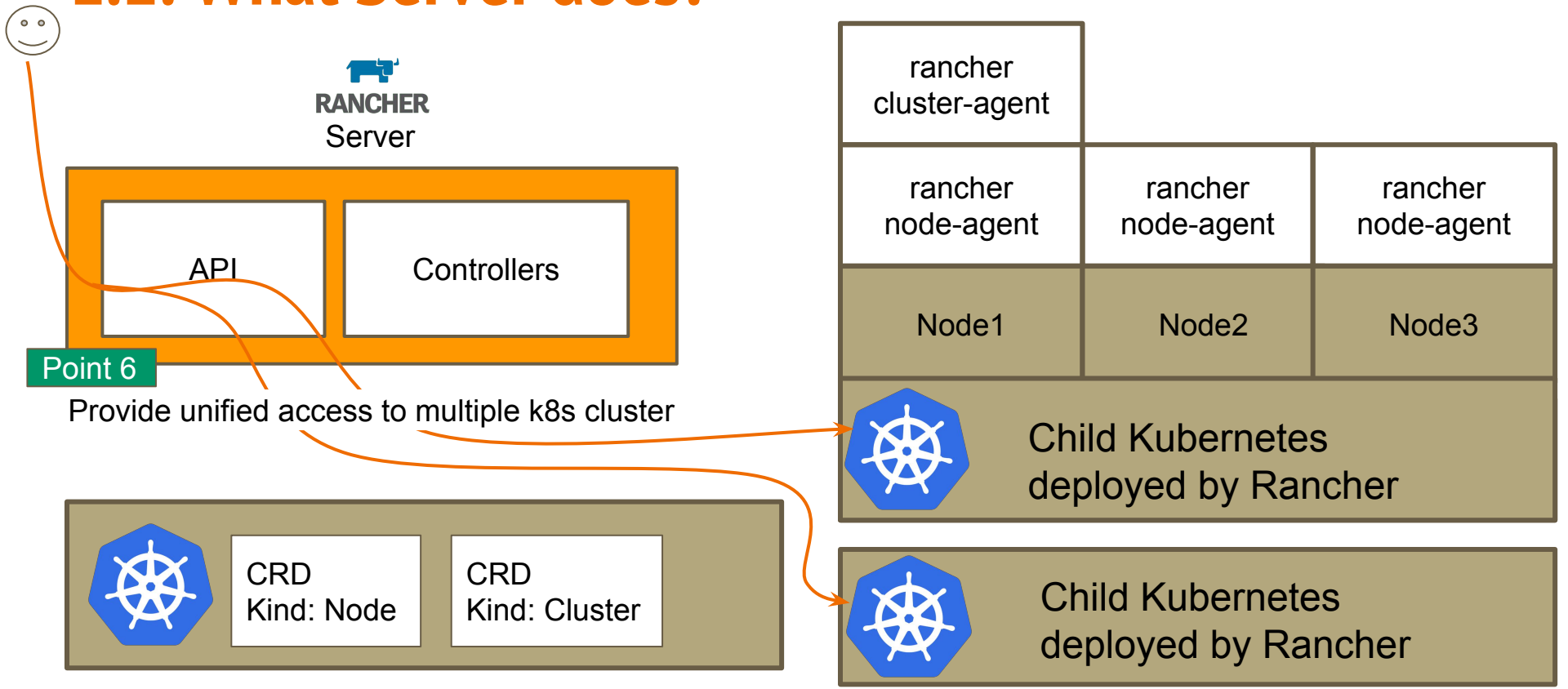
1.2. What Server does?

Point 5

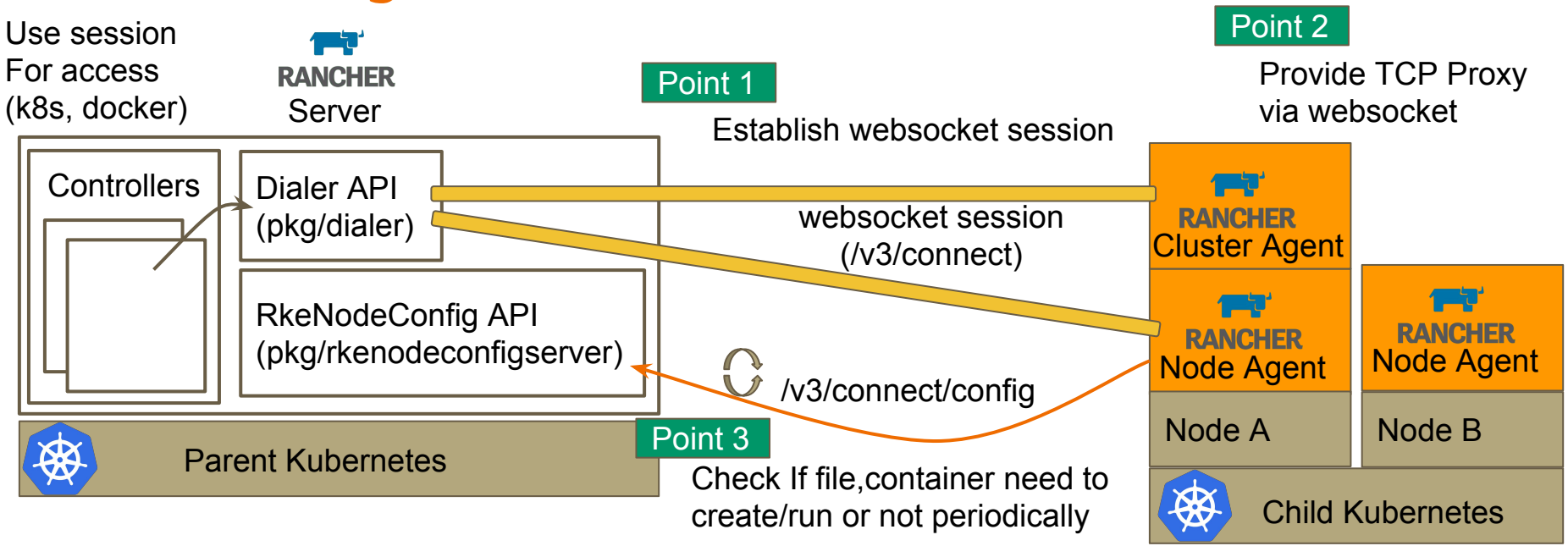
Monitor Cluster/Sync Data
Call docker/k8s API via websocket, If need.
Don't access to docker/k8s api directly from rancher server



1.2. What Server does?



1.3. What Agent does?



Rancher Agent basically establishes websocket to provide TCP Proxy and just checks NodeConfig periodically. Almost all configurations will be done/triggered by controllers through websocket

Parent k8s: k8s working with rancher
Child k8s: k8s deployed by rancher

1.4. Rancher 2.0 overview summary

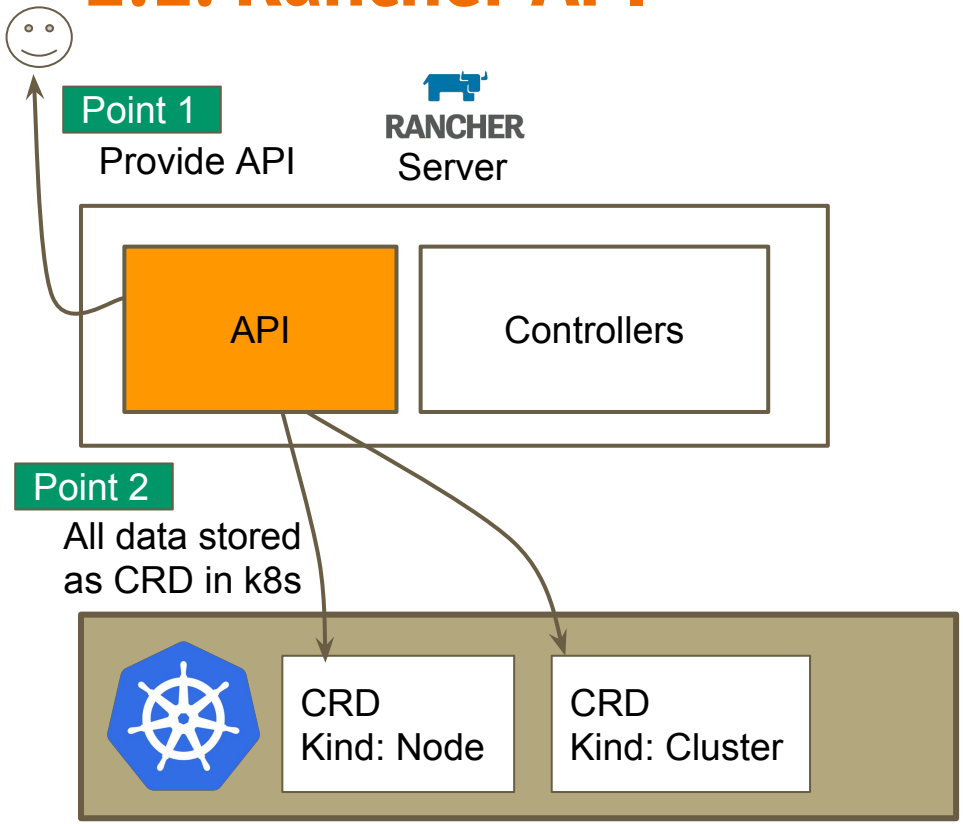
Almost all logics are in Rancher Server and Agent is just sitting as a TCP Proxy

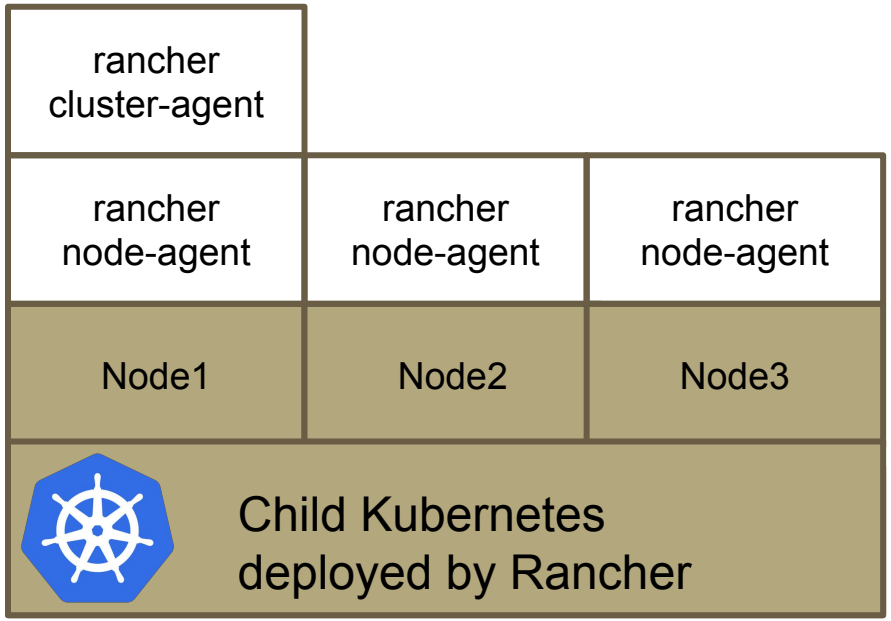
If we want to know more about How Rancher maintain Kubernetes Cluster, It's enough to see just Rancher Server. Because Agent is just to provide proxy.

b. Check periodically if node need to create something file or run something container

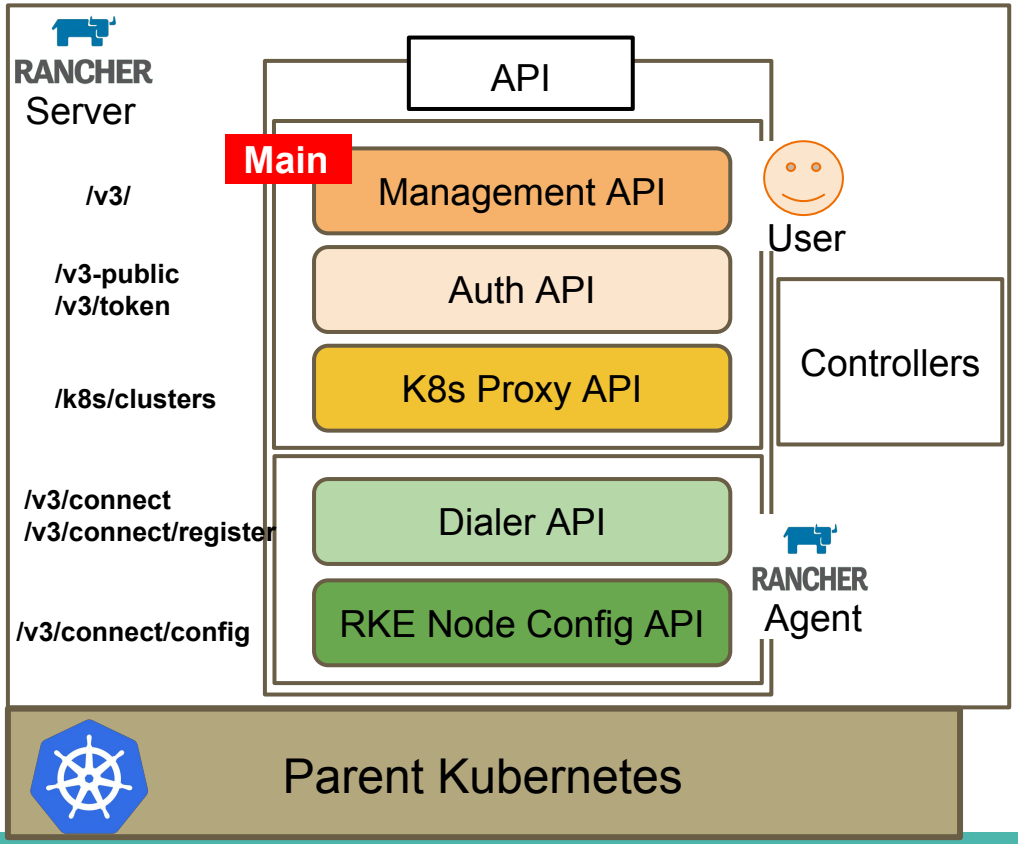
2. Rancher Server Internal

2.1. Rancher API



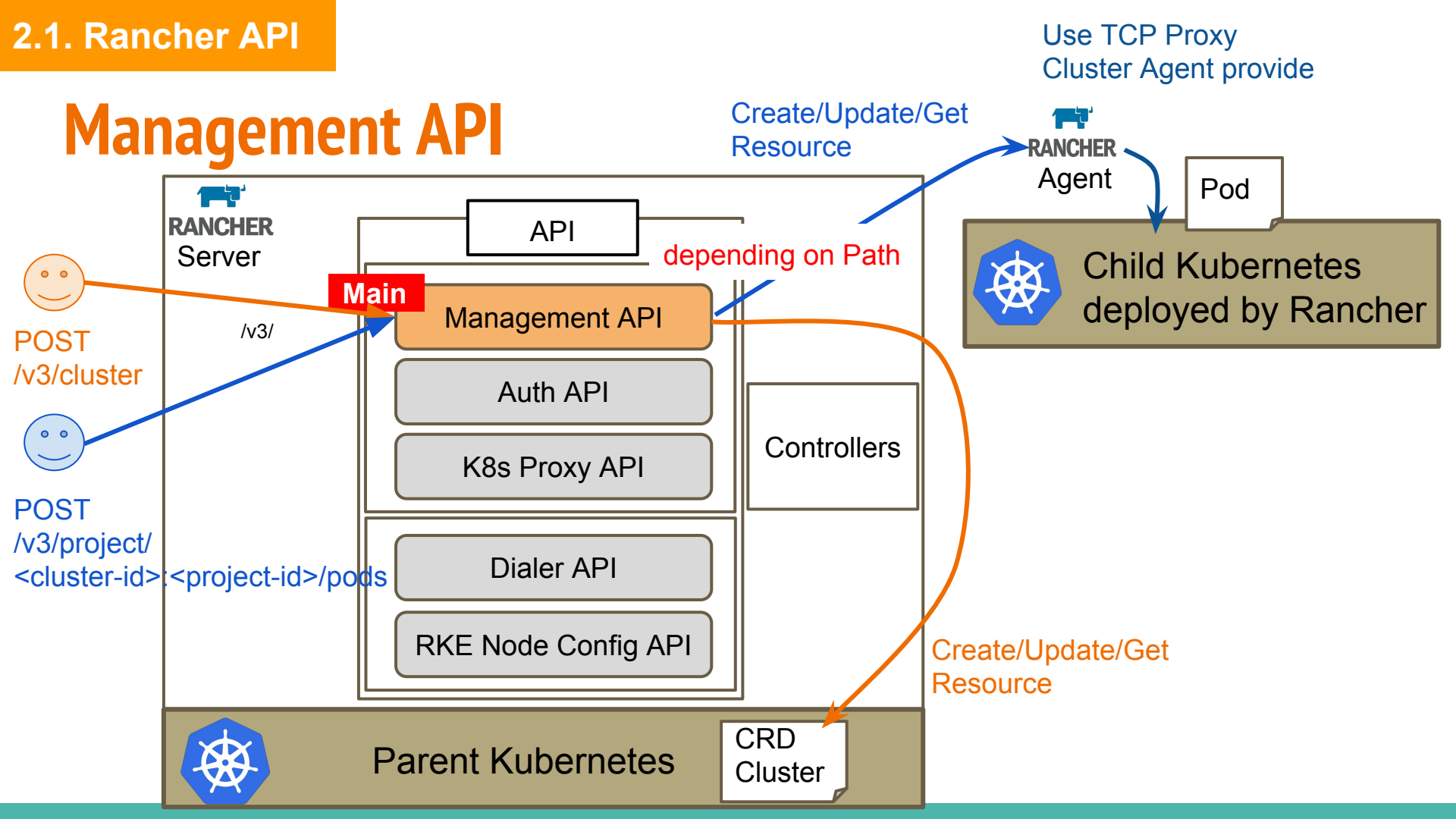


5 types of API



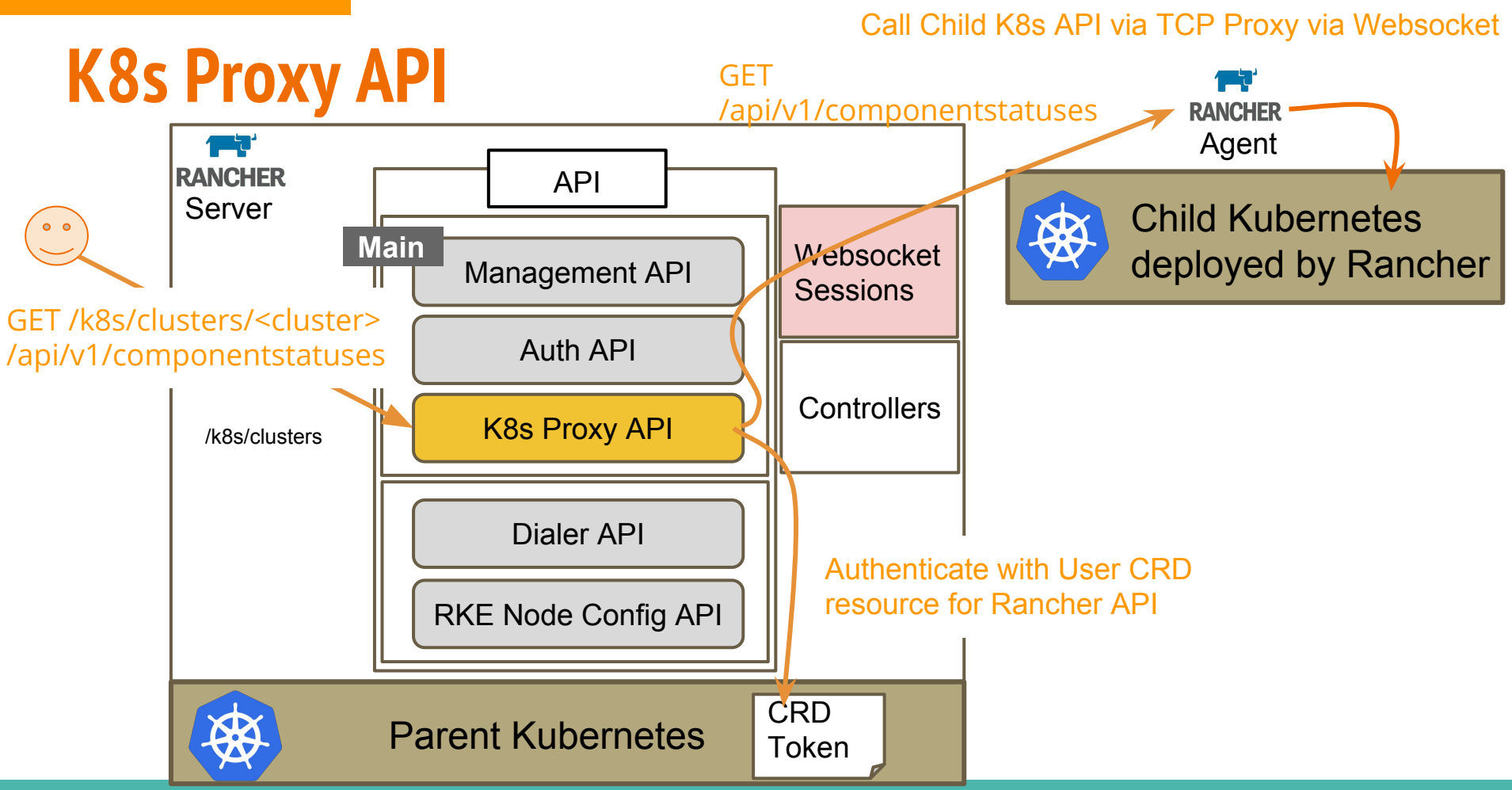
- API can be classified into 5 types
- Some API is for only Agent
  - API for user
    - Management
    - Auth
    - K8s Proxy
  - API for agent
    - Dialer
    - RKE Node Config

2.1. Rancher API

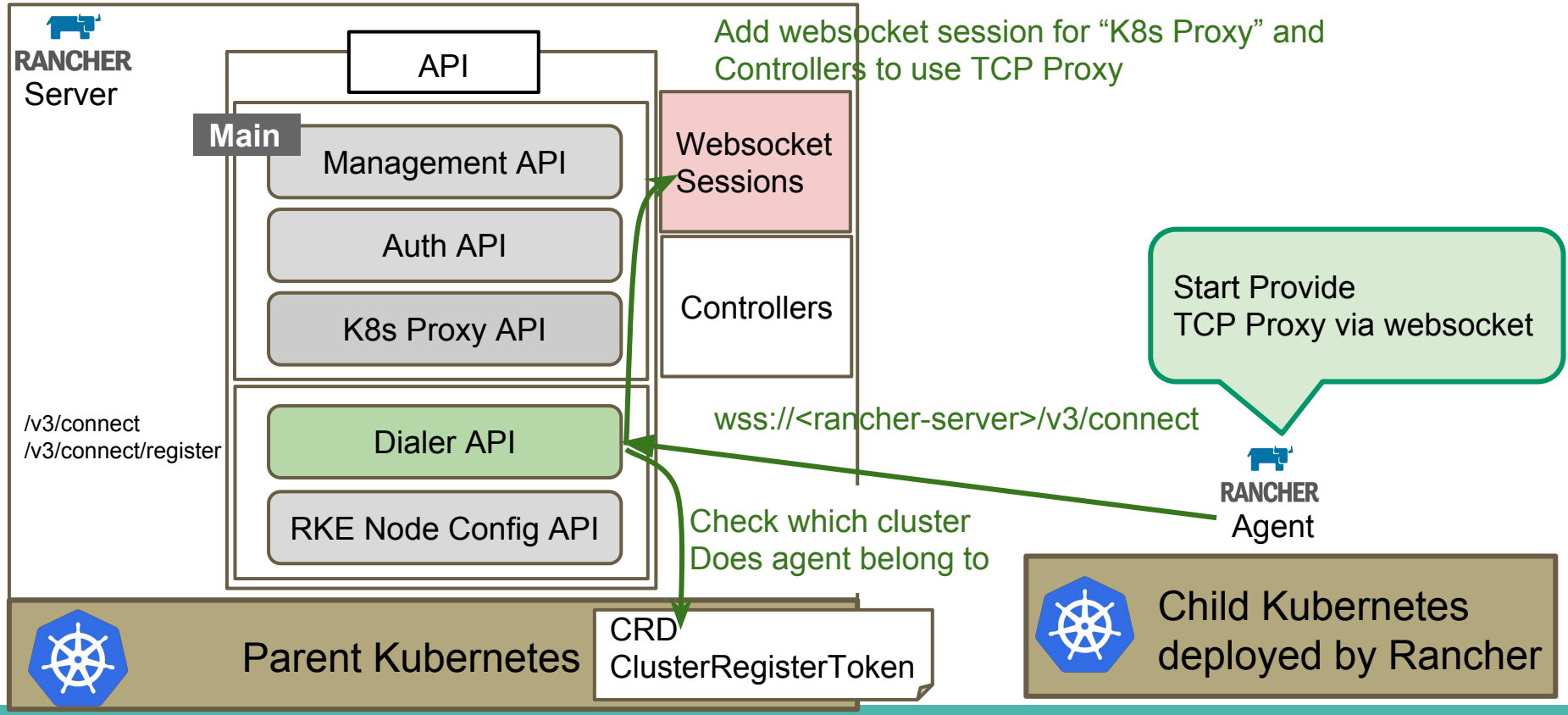


2.1. Rancher API

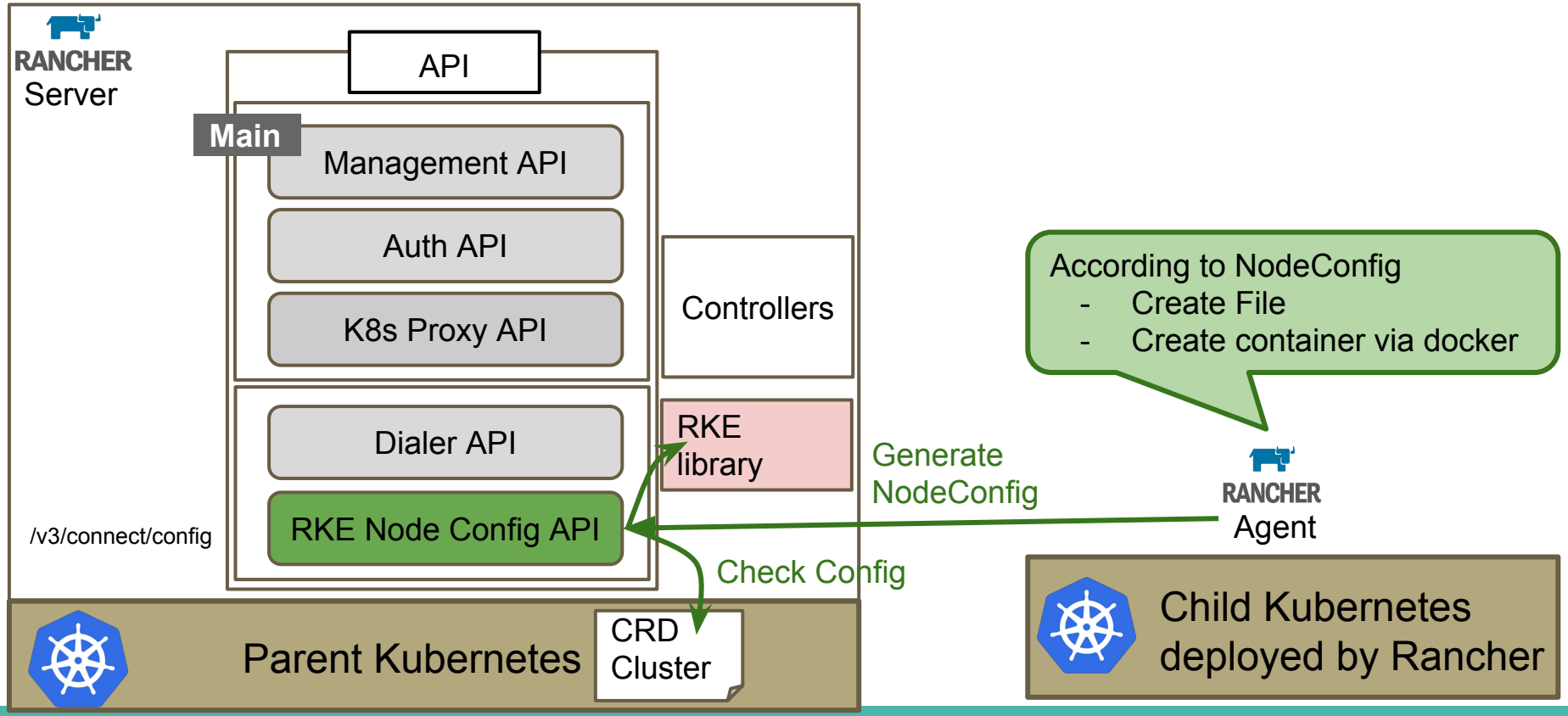
K8s Proxy API



Dialer API


RANCHER
Server
API
Main
Management API
Auth API
K8s Proxy API
Dialer API
RKE Node Config API
/v3/connect
/v3/connect/register
Websocket Sessions
Controllers
Add websocket session for “K8s Proxy” and Controllers to use TCP Proxy
Start Provide TCP Proxy via websocket
wss://<rancher-server>/v3/connect
RANCHER
Agent
Check which cluster Does agent belong to
Parent Kubernetes
CRD ClusterRegisterToken
Child Kubernetes deployed by Rancher

RKE Node Config API



2.2. Rancher Controllers

Point 5

Monitor Cluster/Sync Data
Call docker/k8s API via websocket, If need.
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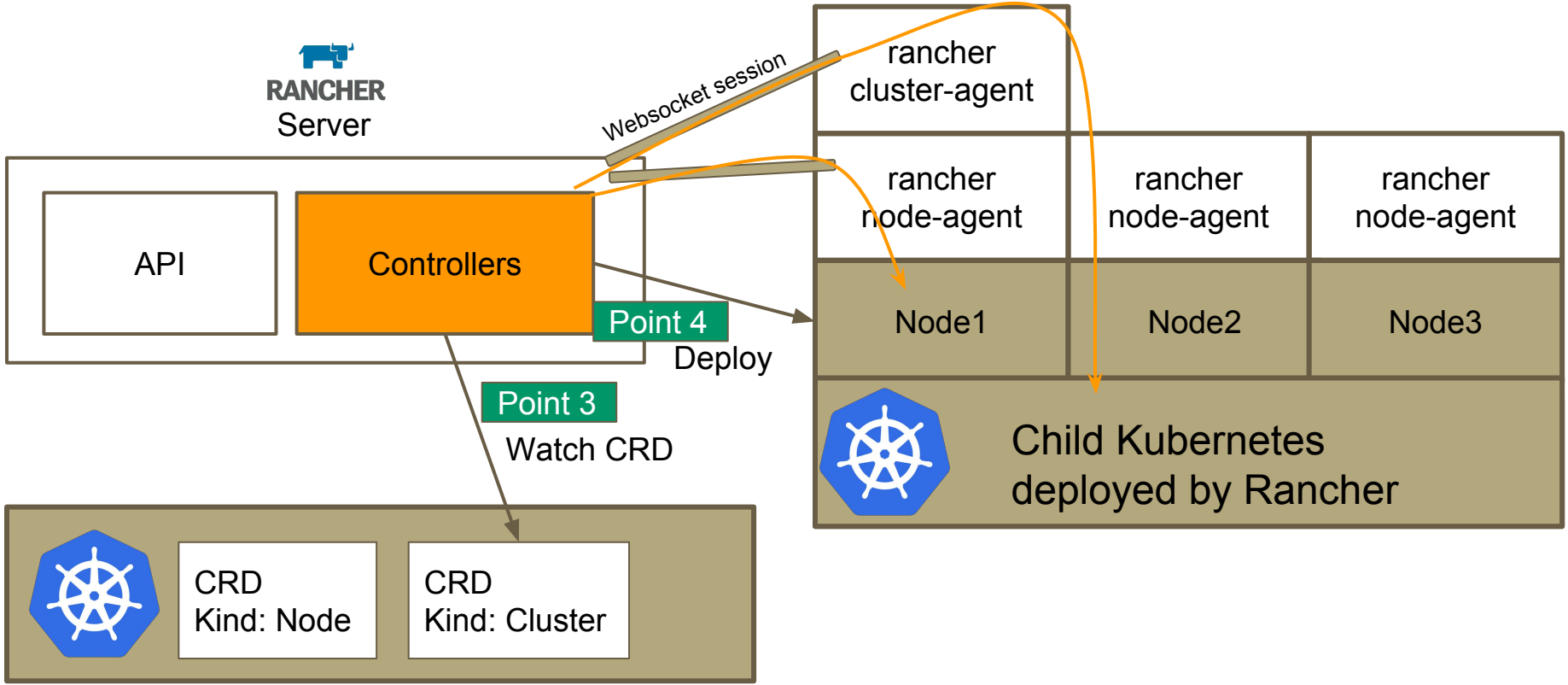
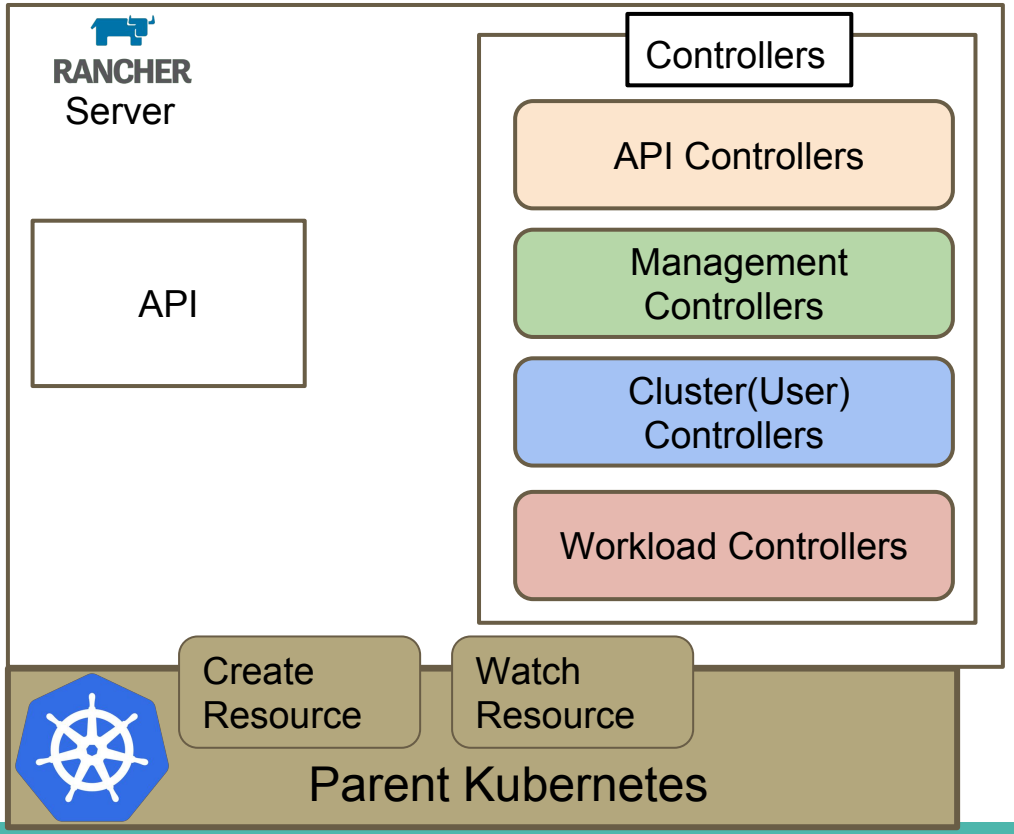
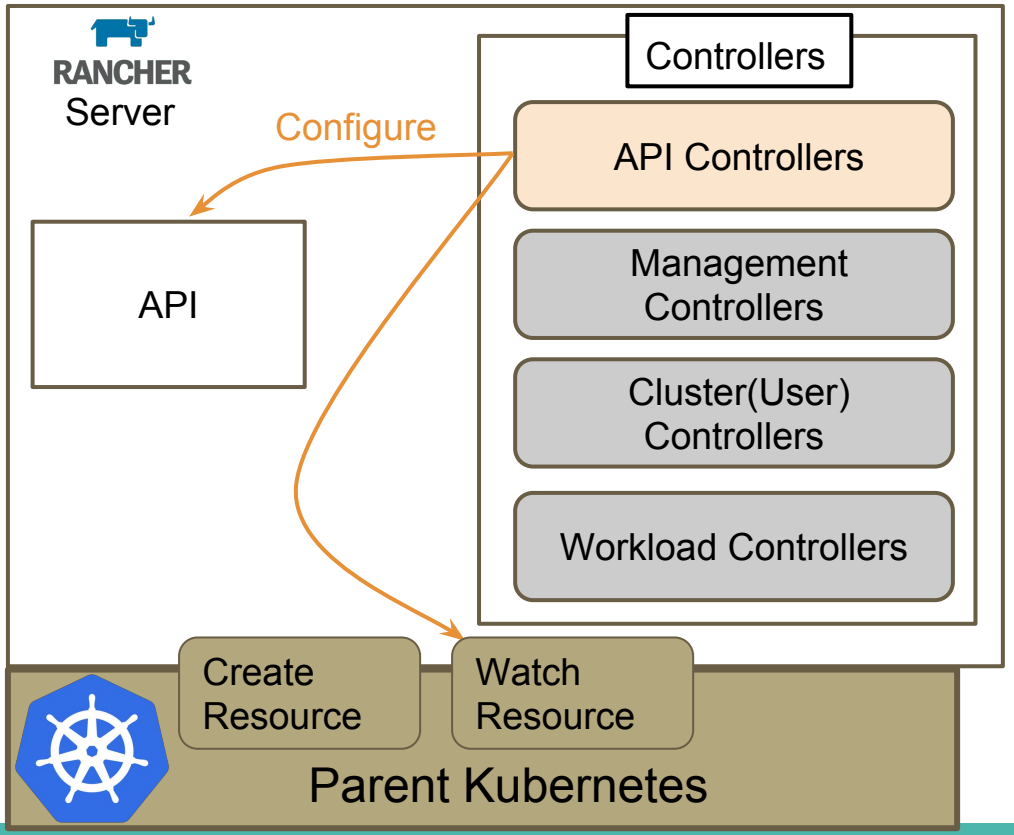


4 types of Controllers



- Rancher Controllers can be classified into 4 types of group
- Each group have own trigger to start
- Triggered when Server start
  - API Controllers
  - Management Controllers
- Triggered when new Cluster detected
  - Cluster(User) Controllers
  - Workload Controllers

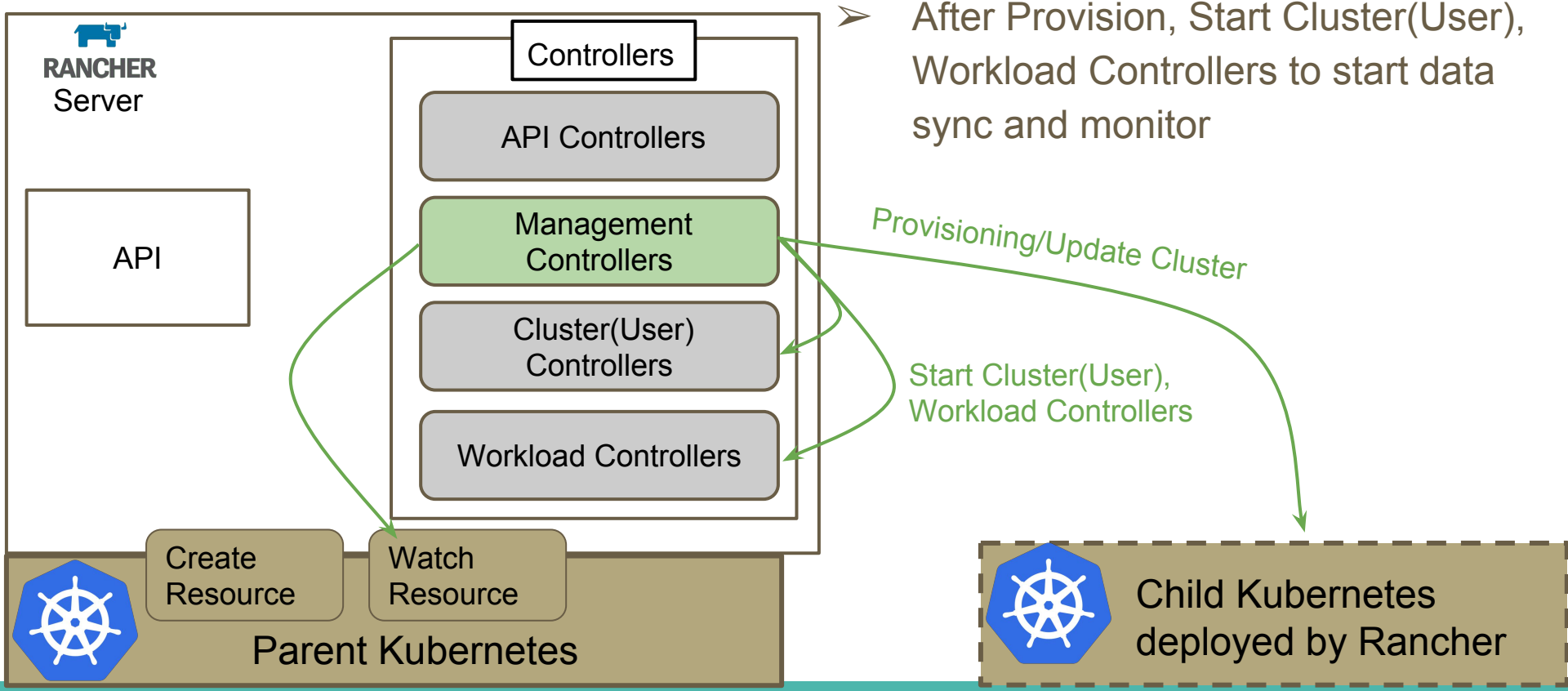
API Controllers



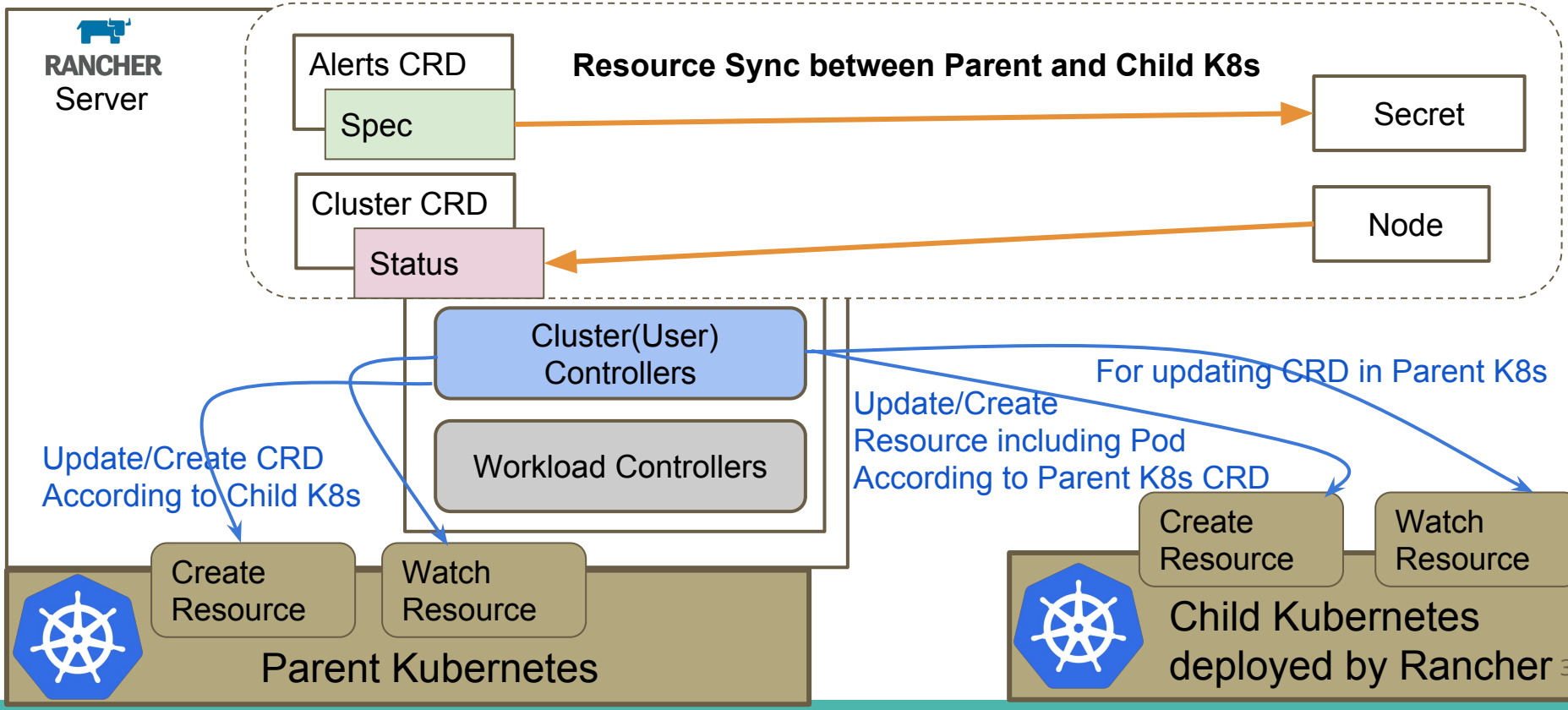
- Watch CRD resource related to API Server Configuration
  - settings
  - dynamicschemas
  - nodedrivers
- Configure API server according to the change of resource

Management Controllers

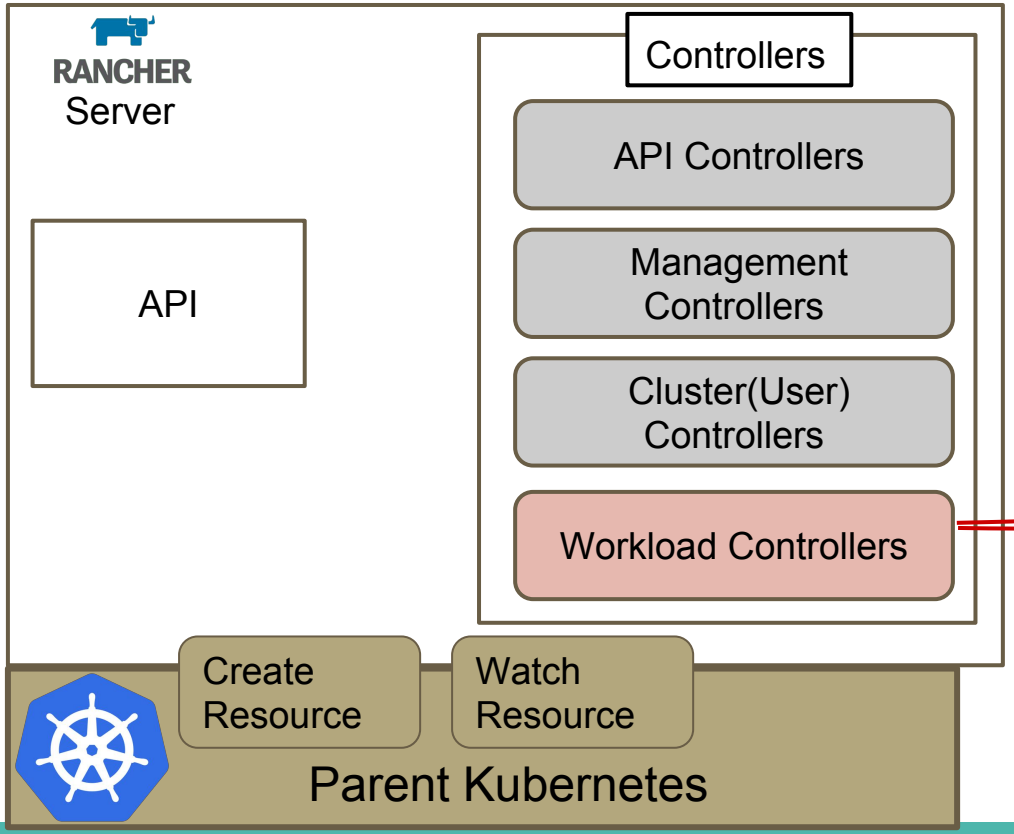
- Watch Cluster/Node related CRD
- Provision/Update Cluster according to the change of resource
- After Provision, Start Cluster(User), Workload Controllers to start data sync and monitor



Cluster(User) Controllers

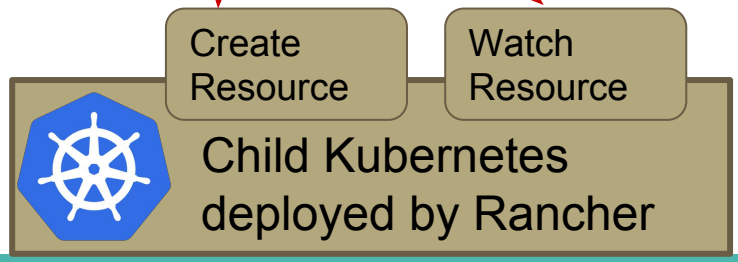


Workload Controllers



- Watch only resource@Child K8s
- Create/Update additional resource
- These Controller are more like enhancing K8s feature itself

The Simple Custom Controller to extend K8s



2.3. Examples: Controllers

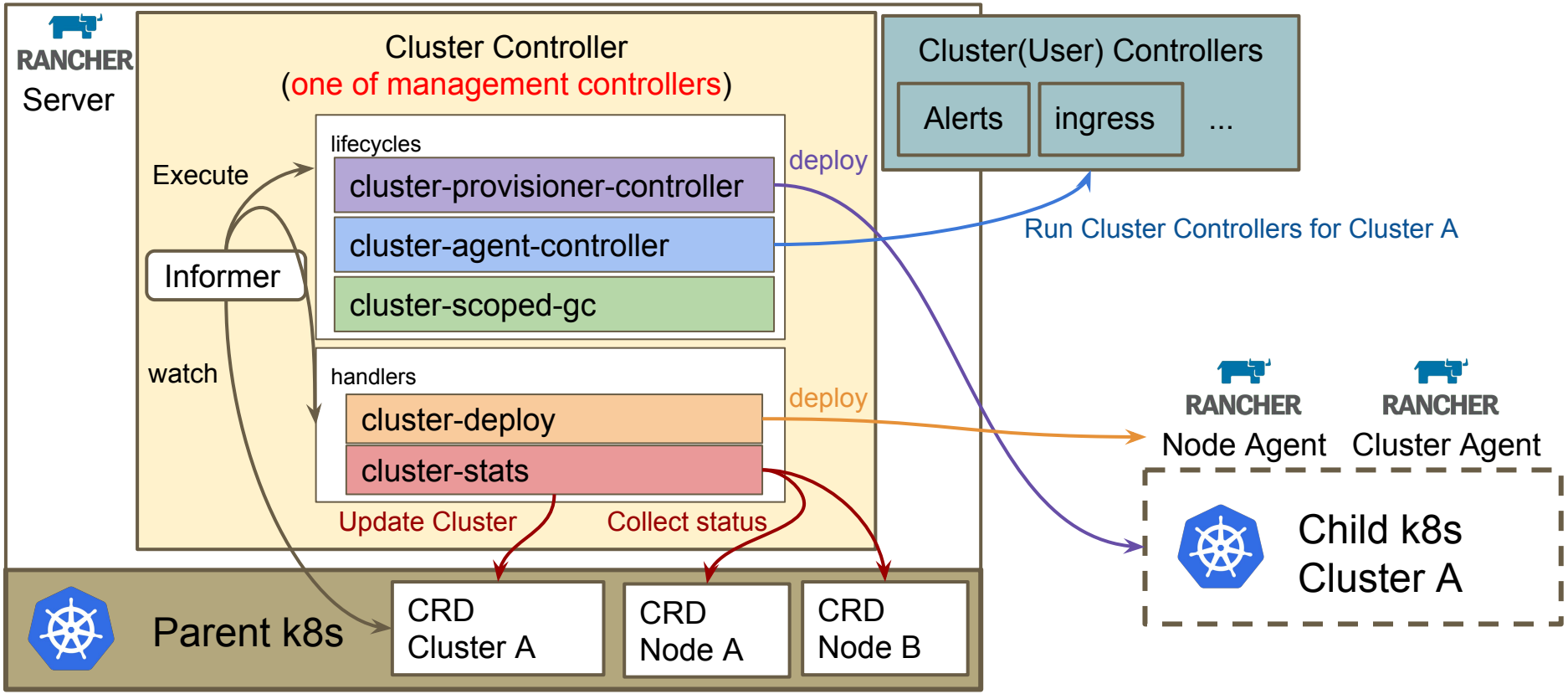
Management Controllers

- Cluster Controller
- Node Controller

Cluster(User) Controllers

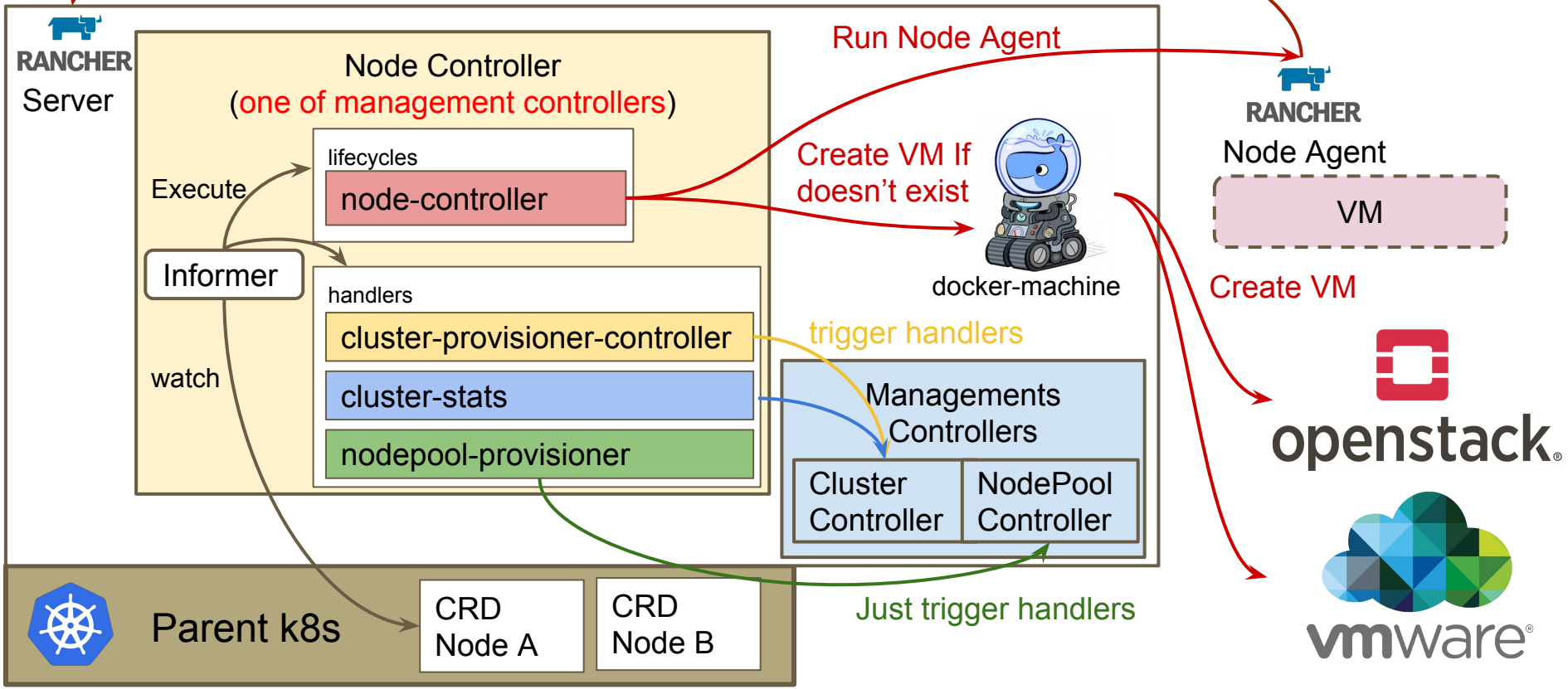
- ClusterLogging Controller

Cluster Controller Implement (pkg/controllers/management)



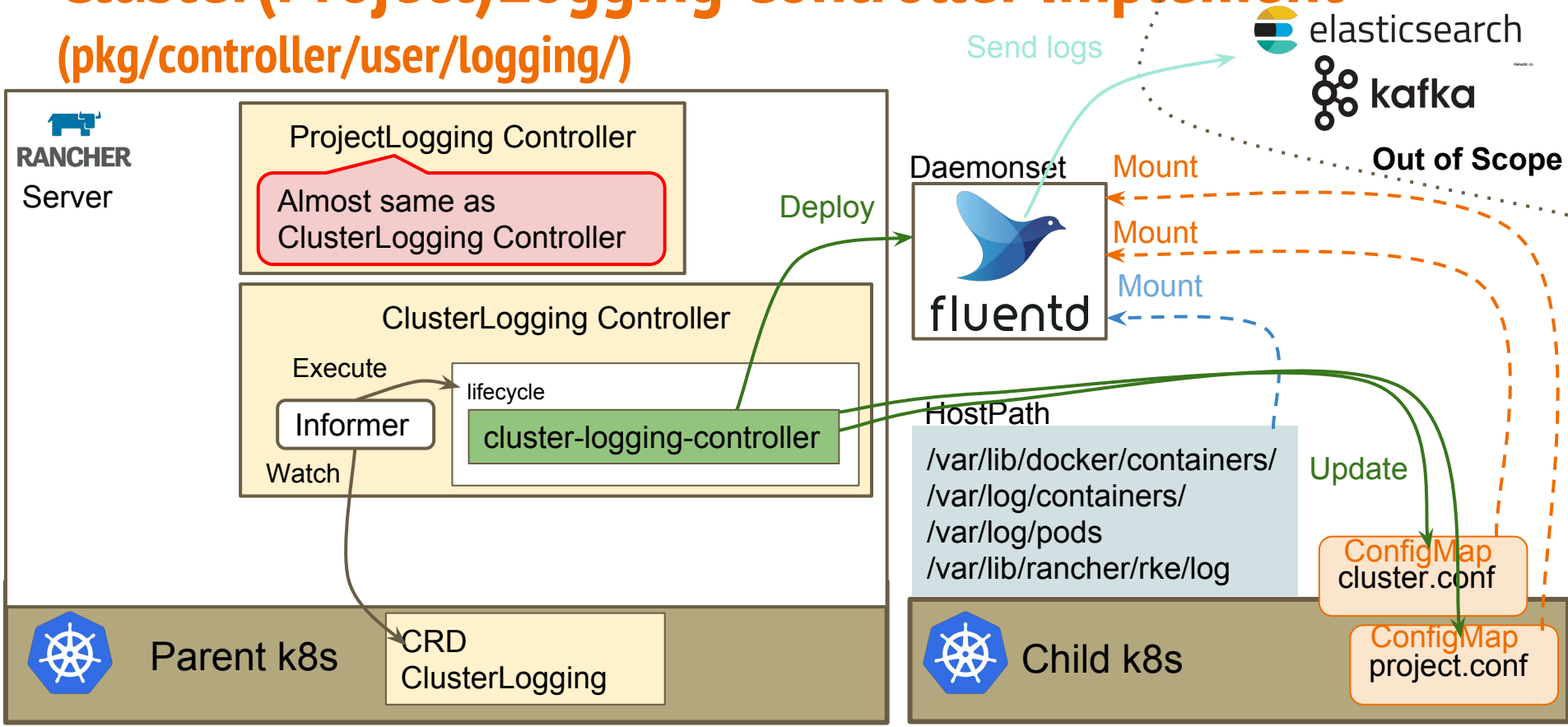
Call wss://<server>/v3/connect/register
To register node into specific cluster

Node Controller Implement (pkg/controllers/management)



Cluster(Project)Logging Controller Implement

(pkg/controller/user/logging/)



How I look Rancher 2.0
In the context of backend for Verda k8s as a Service

Good thing: we are thinking to utilize

- Less requirement for environment to run
  - but this cause some scalability limitation at the same time though...
- There are some interesting Controllers like alert, logging, eventsync ...
  - We can utilize these feature to manage K8s Cluster
- Easy to modify/add Rancher behaviour thanks to Norman Framework
  - We will utilize this framework to extend even for k8s

Not good thing: we are thinking to improve

- Poor Document (Currently reading code is only way to know)
  - Norman Framework that Rancher actively used is also less document
- Doesn’t support Active-Active HA
  - Scalability limitation cannot be avoided
- 1 binary that have ton of features make it difficult to do performance tuning
- Even for K8s Proxy API, we can not deploy multiple process because that feature depend on websocket session to cluster-agent
- Poor monitoring relying on kubelet and componentstatus
- Upgrading Strategy is just to replace old container with new one. Is it enough?

https://github.com/rancher/rke/blob/master/services/kubeapi.go#L15 , https://github.com/rancher/rke/blob/master/docker/docker.go#L72

Future Work
Verda Kubernetes as a Service

Future Works

- Use Rancher 2.0 as a backend to manage k8s without any change at Phase 1
  - Modify Rancher and Give feedback to community in the long run after Phase 1 release
    - Enhance scalability
    - Enhance monitoring
    - Cut(or Disable) many unneeded features to us
- Enrich Kubernetes deployed by RKE
  - Support Type Loadbalancer for our XDP based Loadbalancer
  - Support Persistent Volume
  - Add CRD/Controller to support our In-house Component like Kafka, Database as a Service
    - We want Kubernetes to be orchestration tool for System not for Container
- Need more k8s/etcd itself knowledge
  - !!!!Read Code!!!! Not only just books/documents!!
    - Kubernetes
    - Etcd

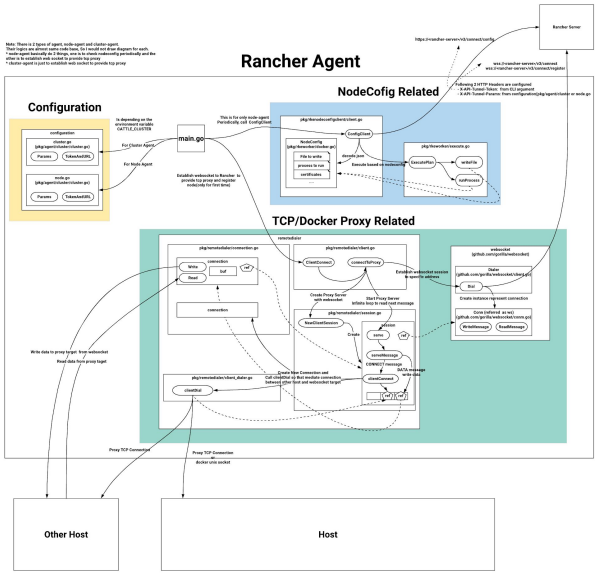
We are hiring people!!!

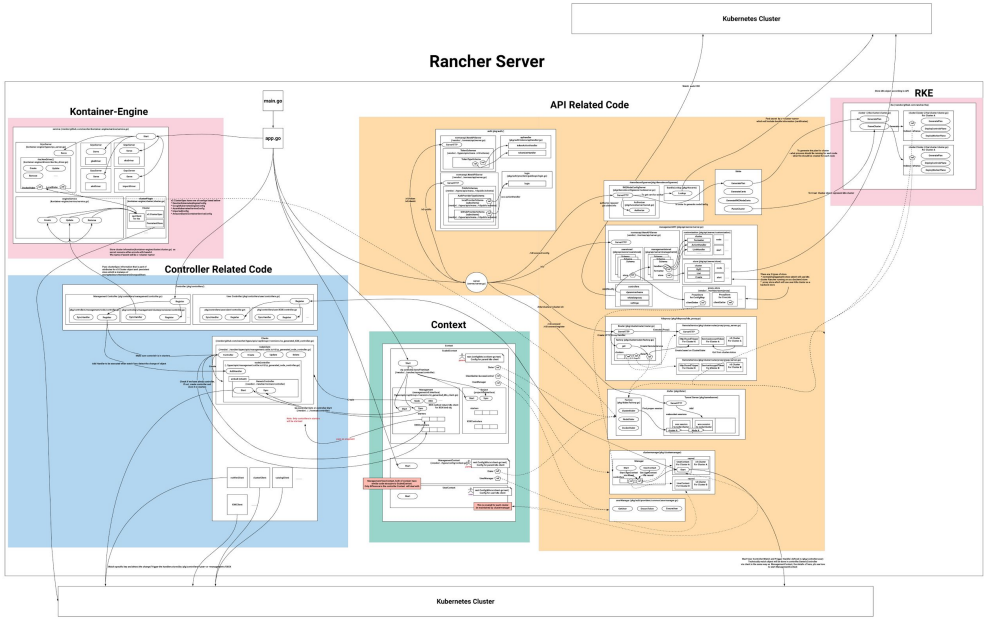
- Love to understand/customize OSS at source code level
  - Kubernetes
  - Etcd
  - OpenStack
  - Rancher
  - Ceph...

https://linecorp.com/ja/career/position/827
https://linecorp.com/ja/career/position/564

Appendix

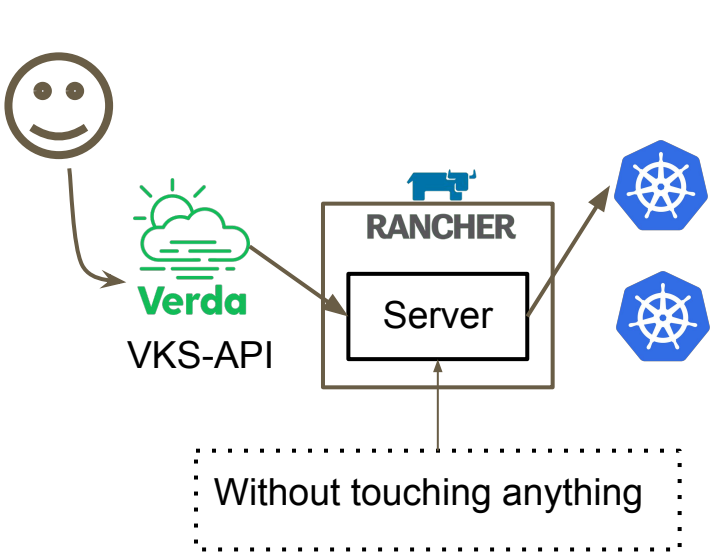
I straighten my understandings as a diagram.
It's available in (https://github.com/ukinau/rancher-analyse)



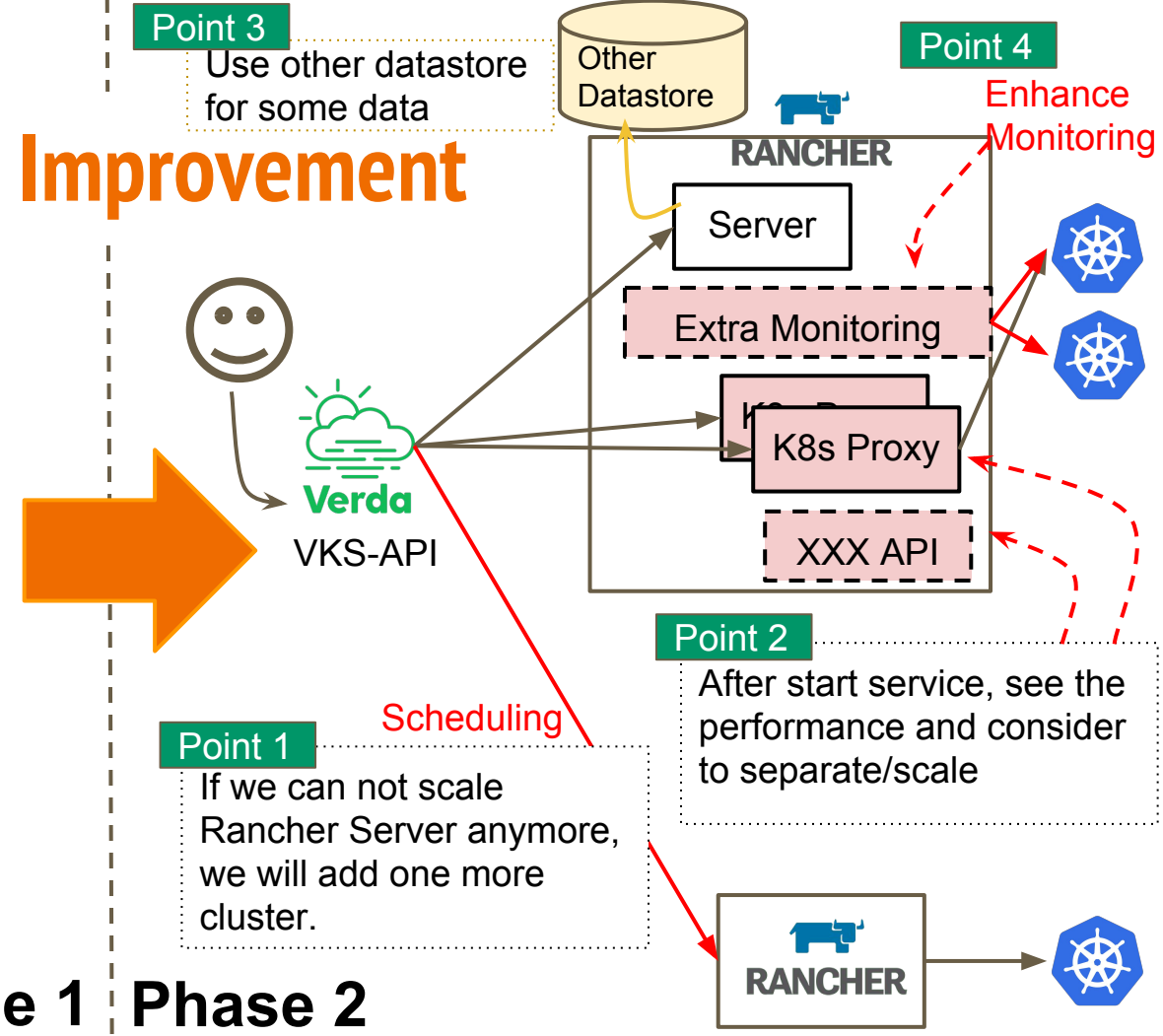


Appendix

Rancher Scalability Improvement

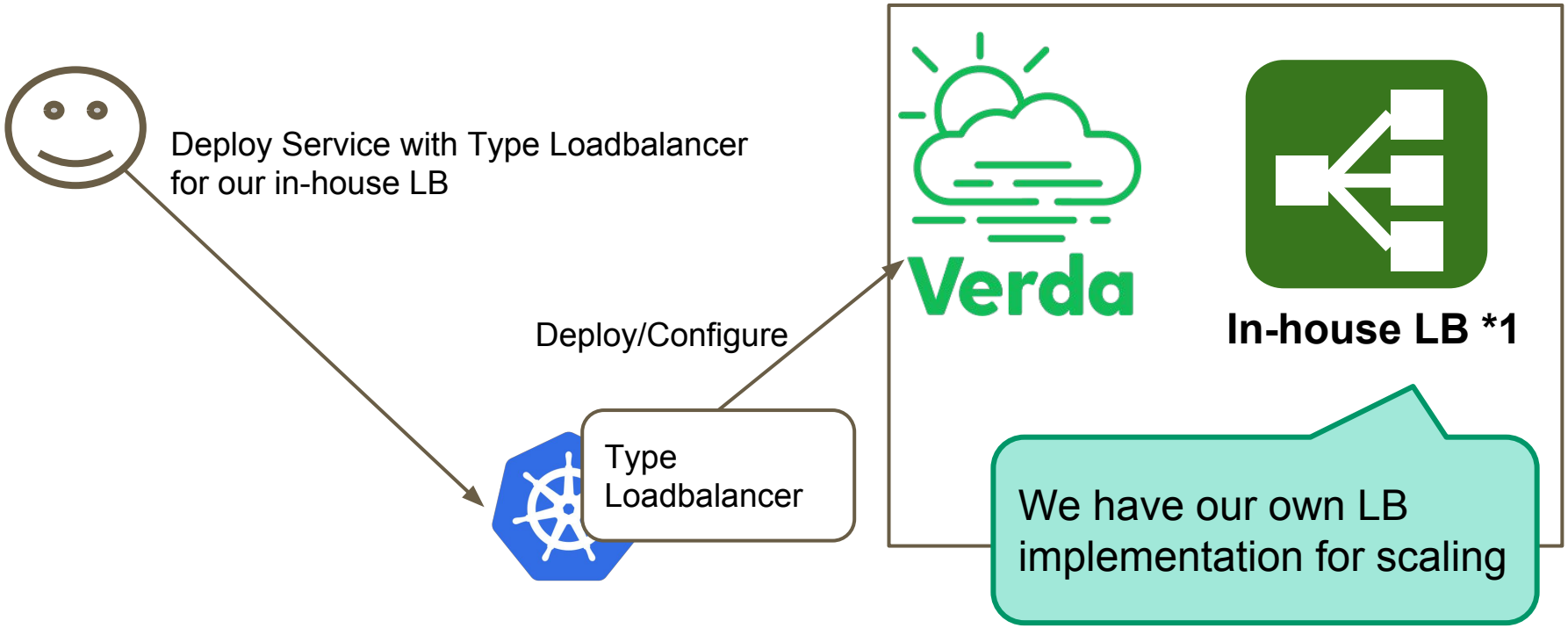


Phase 1



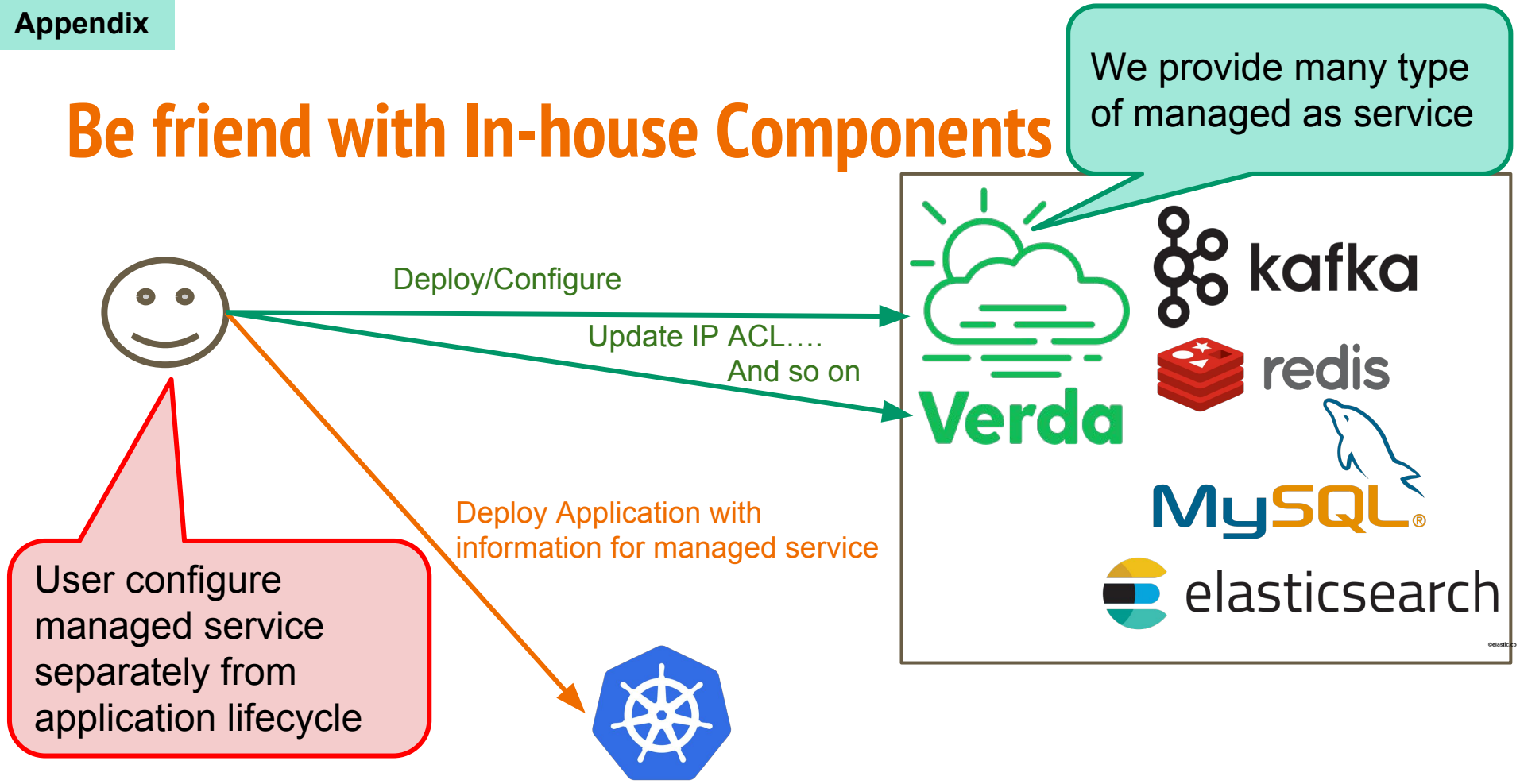
Phase 2

Support Type Loadbalancer for in-house LB



*1 https://www.janog.gr.jp/meeting/janog40/application/files/6115/0105/4928/janog40_sp6lb.pdf

Be friend with In-house Components



Be friend with In-house Components