
# All Things You Should Know after Kubernetes 1.8

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# Contents

- 1.8之后Kubernetes以及容器社区的现状
- 我们（社区参与者）应该着重关注的主线在哪?
- 这些关注点的设计与实现又是怎样的?

# Kubernetes渐成主流

RANCHER 2.0 TECH PREVIEW

In the last year, however, the growth of Kubernetes has far outpaced other orchestrators. Rancher users are increasingly demanding a better user experience and more functionality on top of Kubernetes. We have, therefore, decided to reengineer Rancher 2.0 to take advantage of the power of Kubernetes by rebasing the popular Rancher experience (known as Cattle) on Kubernetes. With Rancher 2.0:

中国工商银行股份有限公司云计算技术支持服务项目(PaaS)国内公开招标评标结果公示

招标编号：0747-1660SITCD139

招标内容：云计算技术支持服务项目(PaaS)

经过评标委员会评定，推荐中标候选人及非序公示如下：

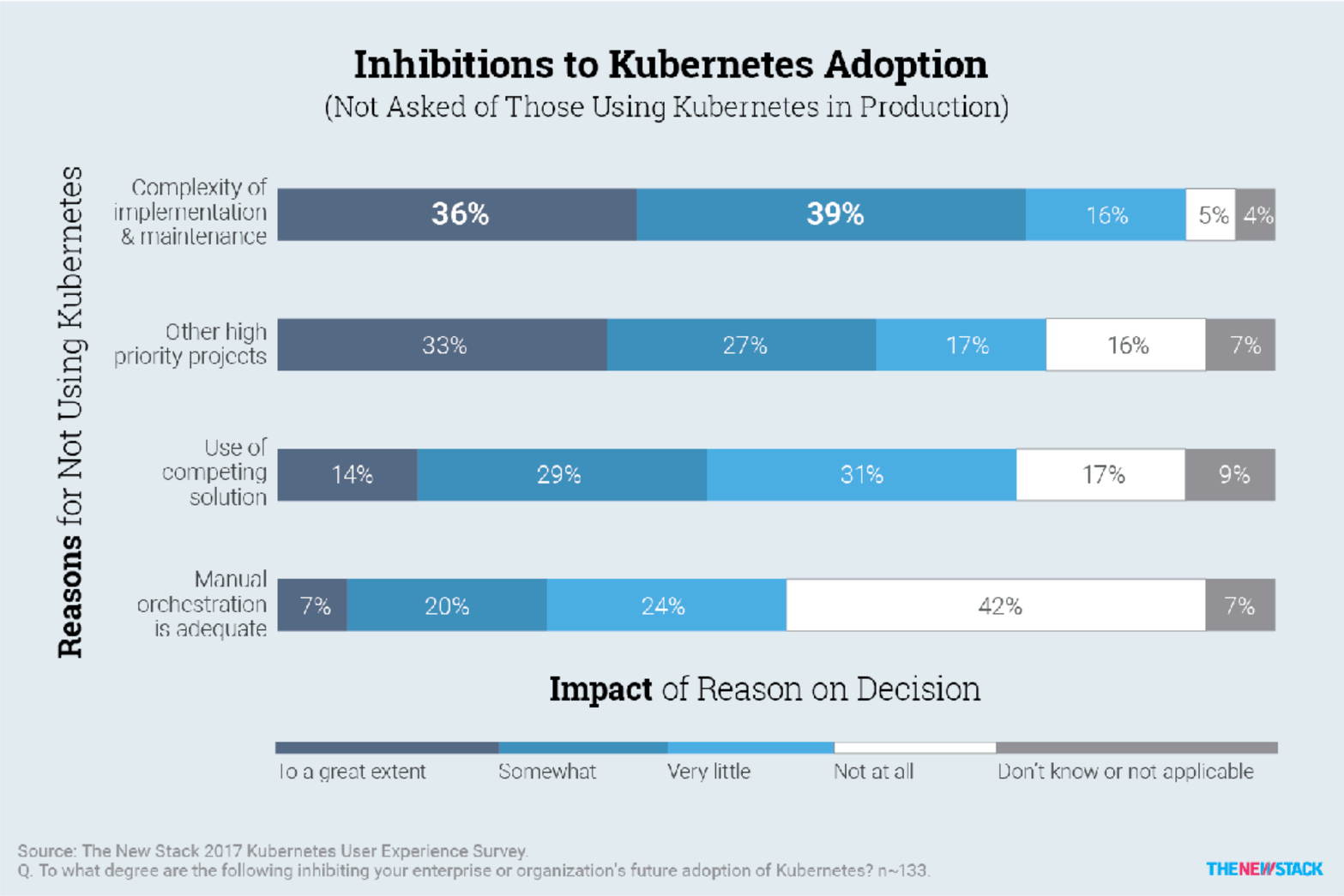
第一中标候选人：国际商业机器（中国）有限公司
第二中标候选人：红帽软件（北京）有限公司
第三中标候选人：华为技术有限公司

中化国际招标有限责任公司

2017年4月17日

ICBC

# Kubernetes任重道远




Source: https://thenewstack.io/week-numbers-kubernetes-implementations-good-bad-ugly/

# 曾经的两个核心问题

(build once, run everywhere)

- **代码/二进制 -> 最小可运行单元**
  - App Engine:
    - Intrusive plugin/library (侵入性插件)
  - 经典PaaS:
    - buildpack: war + tomcat
  - Docker: 胜出
    - 王炸：Docker Image
      - war + tomcat + OS libs/bins/deps
- **最小可运行单元 -> 最终用户服务**
  - Others: 得了，咱们也学Kubernetes吧
    - DEA，docker run，IaaS etc.
    - 其实并不知道该咋整 …
  - Kubernetes: 胜出
    - 王炸：抄Borg！
    - Pod, Deployment (replica), StatefulSet, Job, CronJob, DaemonSet, Service, Controller
    - CRI, CNI, CSI, DevicePlugin …

# 1.8之后的发展主线

- 主线：受到社区重点关注，具有技术和战略价值

  1. Runtime逐渐趋于稳定，直面用户的sig-app将体现出强大的吸引力

  2. 生态地位逐步确立，“可扩展性”便成为社区的主战场

- 这两点将是Kubernetes 1.8之后主旋律

# 1. Control Panel

# Pod! Pod! Pod!

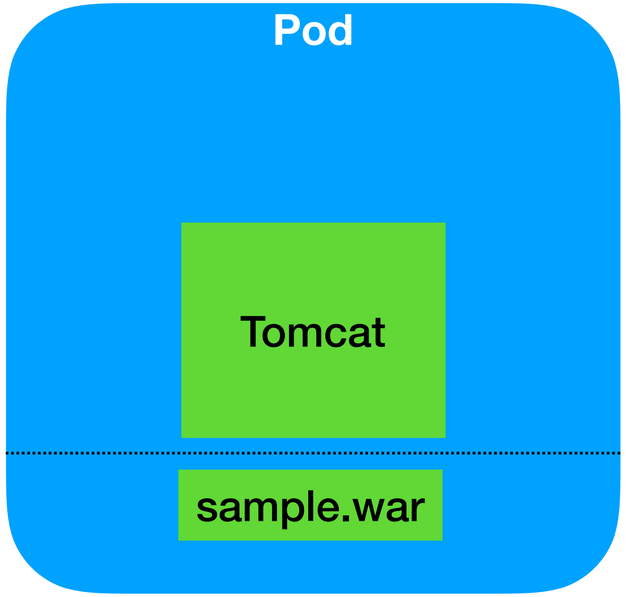
- **解耦**容器关系
- 原子**调度**单位
- Shared namespace
  - network, IPC etc
- Shared volume

**Process group** in container cloud

# Pod: stop creating fat container

抑制制作“胖”容器的冲动

# Best Practice: Tomcat + war




而不是一个容器，强迫解耦容器

- 两个容器组成一个Pod：
  - war容器
  - Tomcat容器

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: javaweb-2
spec:
  initContainers:
  - name: war
    image: resouer/sample:v2
    command: ["cp", "/sample.war", "/app"]
    volumeMounts:
    - mountPath: /app
      name: app-volume
  containers:
  - name: tomcat
    image: resouer/mytomcat:7.0
    command: ["sh","-c","/root/apache-tomcat-7.0.42-v2/bin/start.sh"]
    volumeMounts:
    - mountPath: /root/apache-tomcat-7.0.42-v2/webapps
      name: app-volume
    ports:
    - containerPort: 8080
      hostPort: 8001
  volumes:
  - name: app-volume
    emptyDir: {}
```

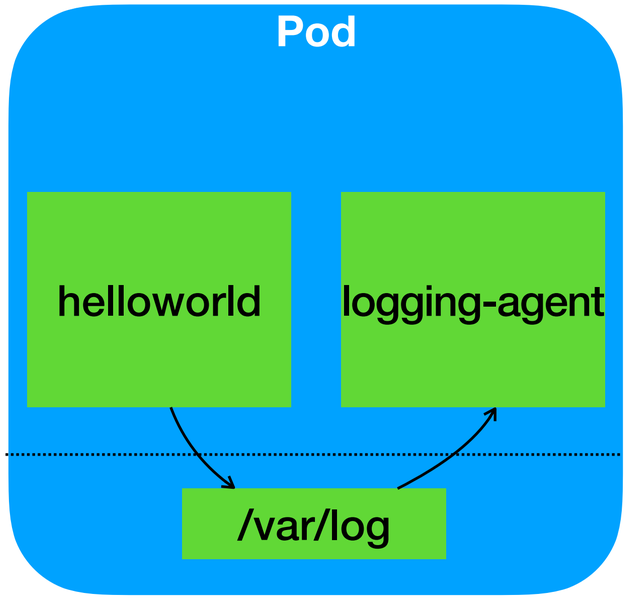
# Pod: container design pattern

“容器设计模式”

# 入门级：sidecar

```
apiVersion: apps/v1beta1
kind: Deployment
metadata:
  name: helloworld
spec:
  replicas: 1
  template:
    metadata:
      name: helloworld
    spec:
      containers:
        - name: helloworld
          image: gcr.io/resouer/helloworld:0.0.1
          volumeMounts:
          - name: varlog
            mountPath: /var/log
        - name: logging-agent
          image: gcr.io/google_containers/fluentd:1.30
          volumeMounts:
          - name: varlog
            mountPath: /var/log
        volumes:
        - name: varlog
          emptyDir: {}
```

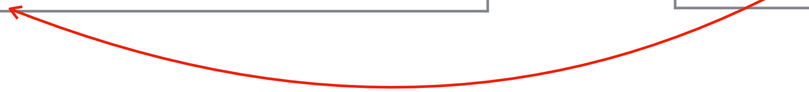
共享 / var / log



# 进阶级： initializer

```yaml
apiVersion: apps/v1beta1
kind: Deployment
metadata:
  annotations:
    "initializer.kubernetes.io/logging-agent": "true"
  name: helloworld-with-annotation
spec:
  replicas: 1
  template:
    metadata:
      name: helloworld-with-annotation
    spec:
      containers:
        - name: helloworld
          image: gcr.io/resouer/helloworld:0.0.1
```

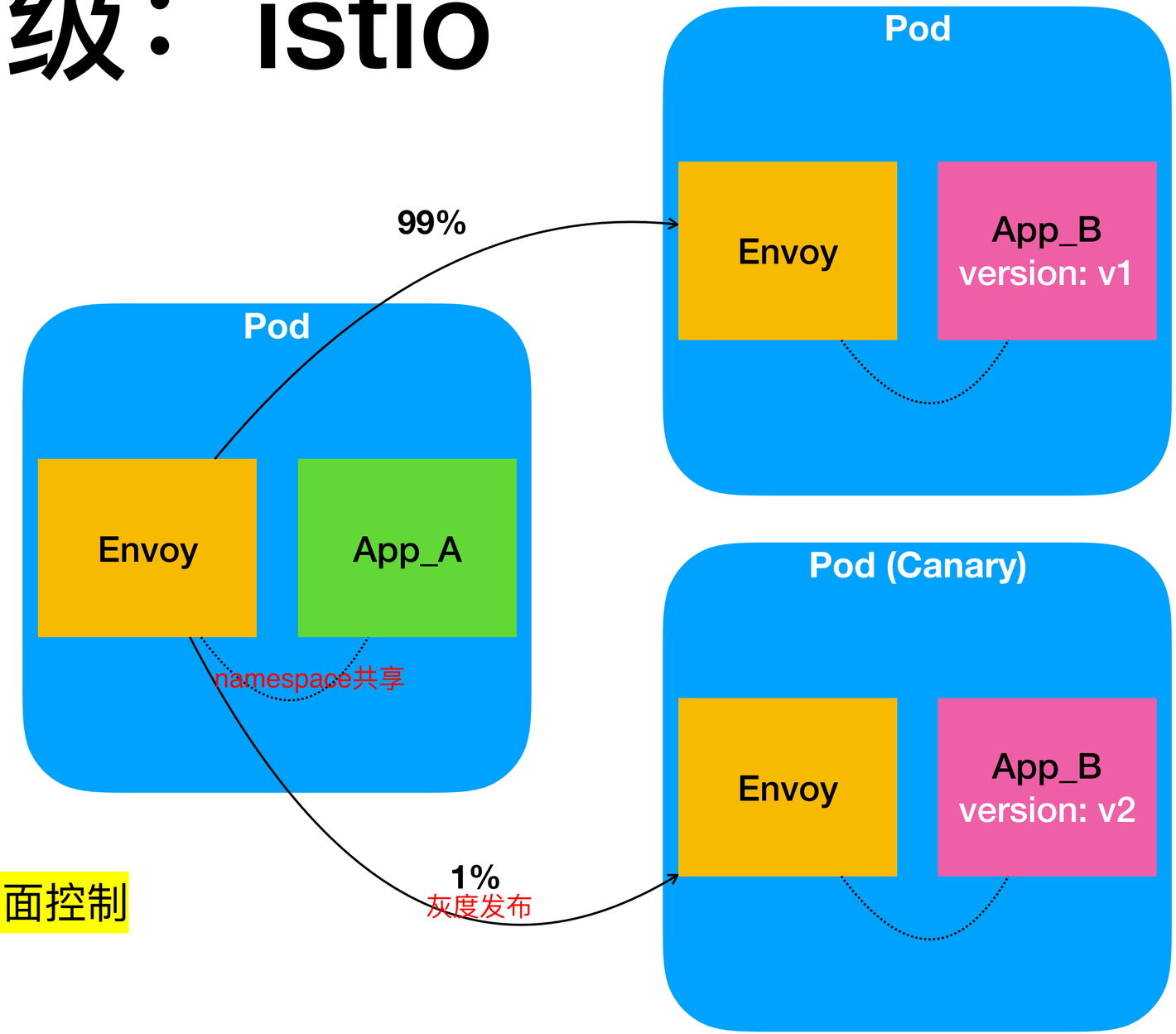
```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: logging-agent-initializer
data:
  config: |
    - name: logging-agent
    image: gcr.io/google_containers/fluentd:1.30
    volumeMounts:
    - name: varlog
      mountPath: /var/log
  volumes:
  - name: varlog
    emptyDir: {}
```



**Automatically Inject**

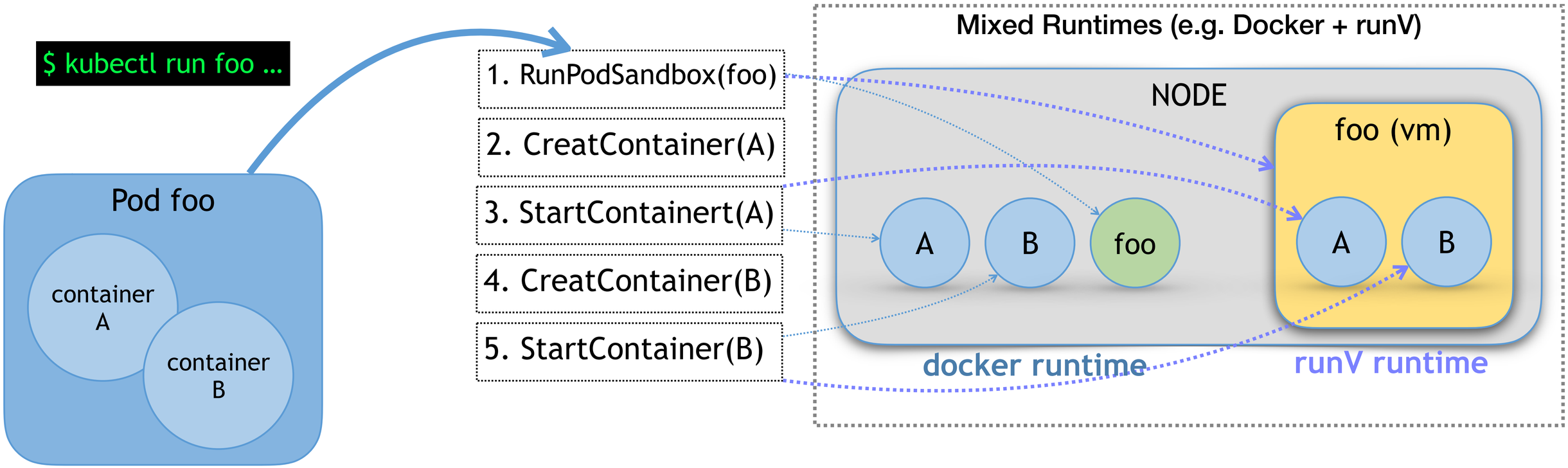
# 大师级：istio

- **面向容器的非侵入式微服务框架**
  - 服务拆分（Pod）
  - 流量控制（Routing & LB）
  - 访问授权（Auth）
  - 策略控制（切面/Aspect）
- **实现原理：**
  - 向每个Pod注入Envoy容器来负责流量切面控制



# Pod的实现：CRI

**Leads: Google, Hyper, CoreOS, RedHat**



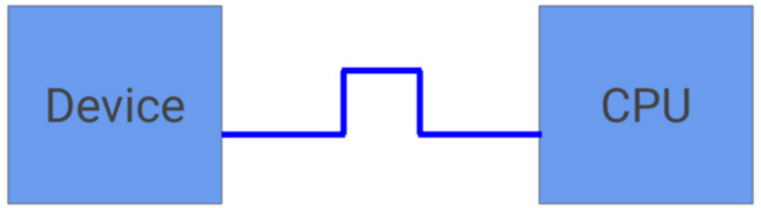
# Controller: Kubernetes的心脏

1.“Watch” object change　　reconcile

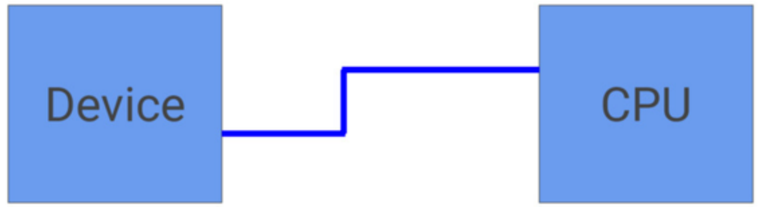
2.Decide next step based on state change

- not edge driven (event)
- level driven (state)

- **Goals**
  - loose coupling
  - high performance　　瓶颈一般在etcd？ ectd 2–>3
  - customization and extensibility




**edge**




**level**

状态驱动

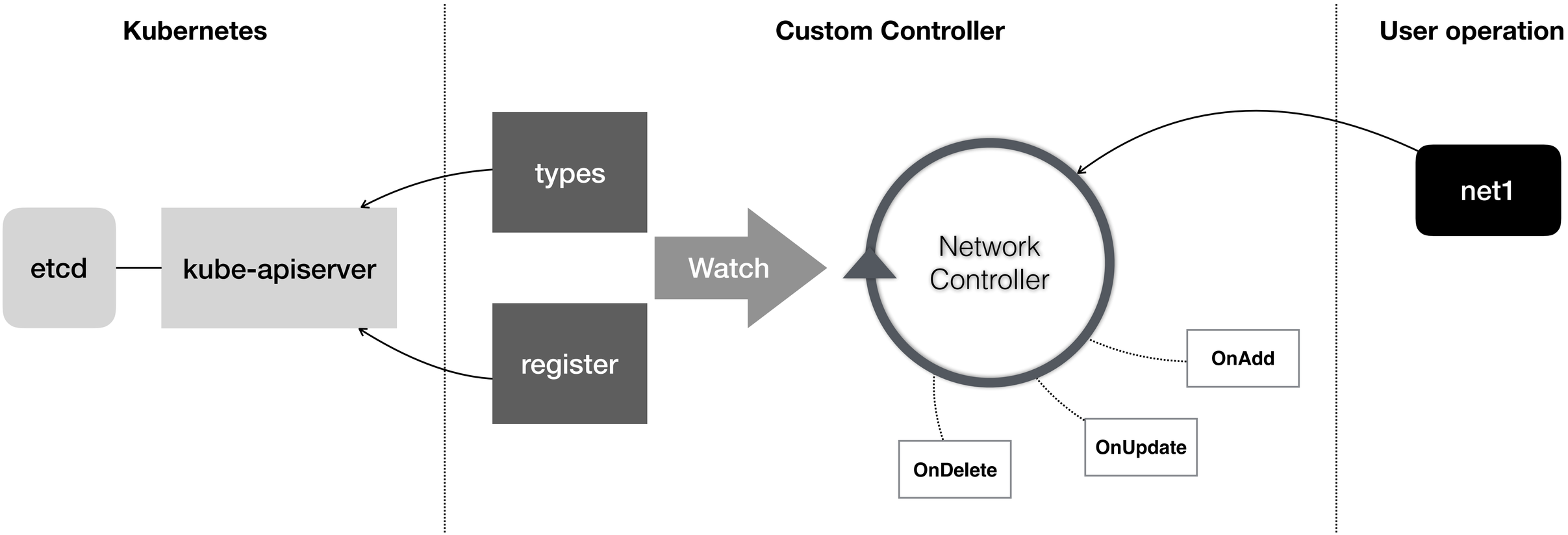
# Write Your Own API Object!

- I want to have a **Network** object into k8s API
- I want a **Network Controller** to handle **add/update/delete** of all Network instances

```
$ kubectl get network

NAME        KIND
net1   network.v1.cr.client-go.k8s.io
```

# My Network CRD & Controller

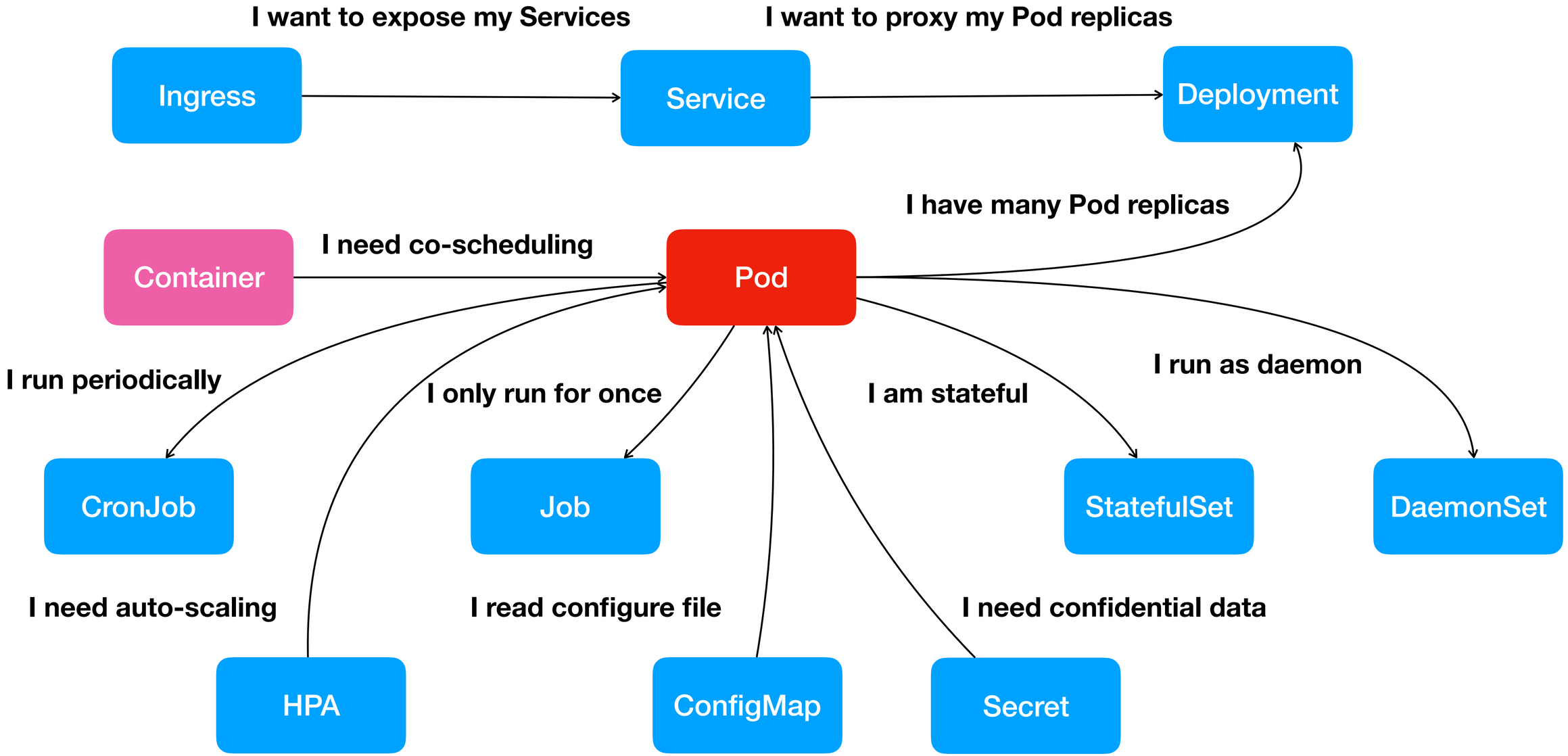


# A Real World Example

```
70  func NewNetworkController(kubeClient kubernetes.Interface, osClient openstack.I
71          // initialize CRD if it does not exist
72          _, err := kubecrd.CreateNetworkCRD(kubeExtClient)
73          if err != nil && !apierrors.IsAlreadyExists(err) {
74                  return nil, fmt.Errorf("failed to create CRD to kube-apiserver:
75          }
76
77          source := cache.NewListWatchFromClient(
78                  osClient.GetCRDClient().Client(),
79                  crv1.NetworkResourcePlural,
80                  apiv1.NamespaceAll,
81                  fields.Everything())
82
83  https://github.com/openstack/stackube/blob/master/pkg/network-controller/
84  network_controller.go                                                ent(),
85
86          }
87          _, networkInformer := cache.NewInformer(
88                  source,
89                  &crv1.Network{},
90                  0,
91                  cache.ResourceEventHandlerFuncs{
92                          AddFunc:    networkController.onAdd,
93                          UpdateFunc: networkController.onUpdate,
94                          DeleteFunc: networkController.onDelete,
95                  })
96          networkController.networkInformer = networkInformer
97
98          return networkController, nil
99  }
```

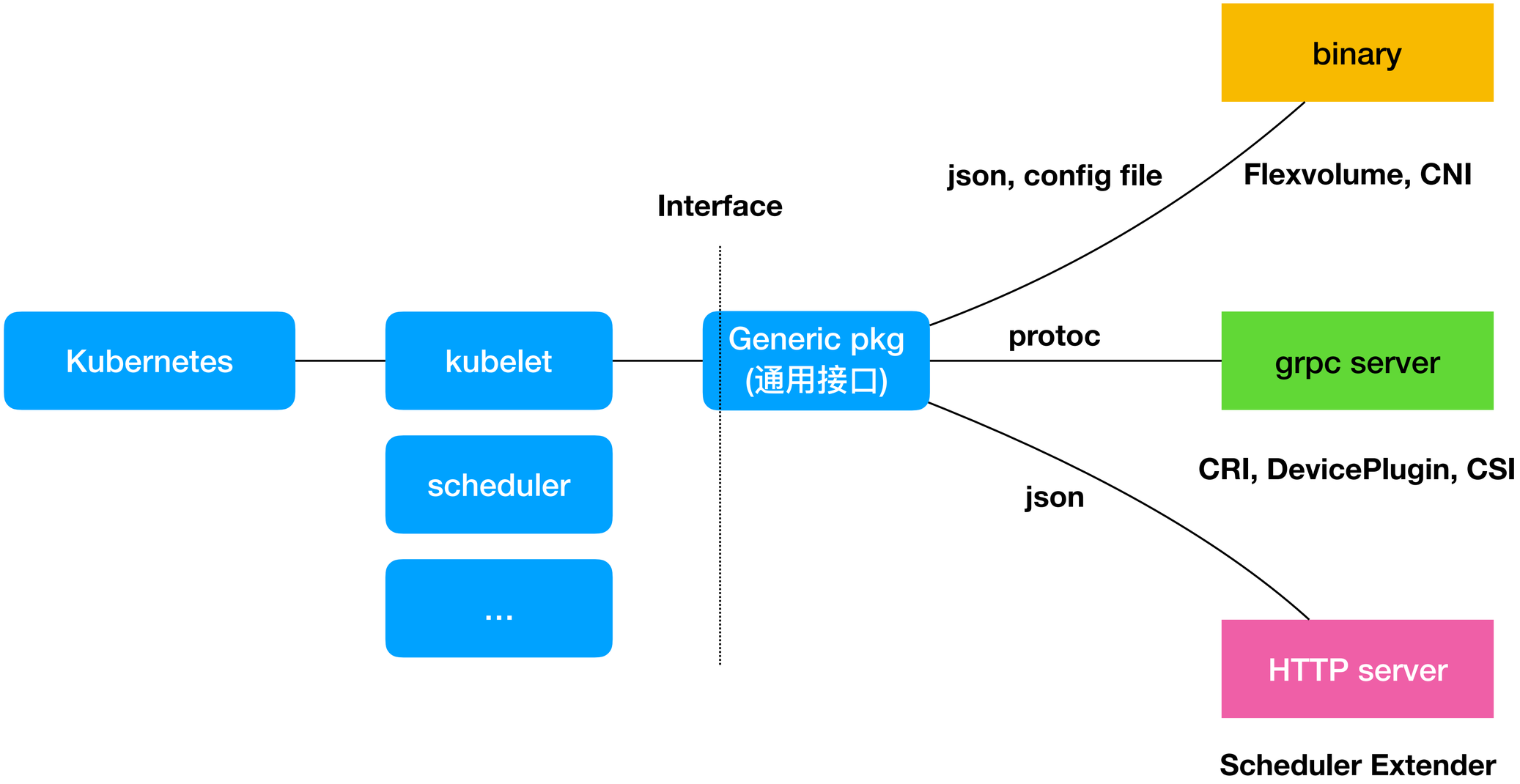
```
101 func (c *NetworkController) onAdd(obj interface{}) {
102         network := obj.(*crv1.Network)
103         // glog.Infof("[NETWORK CONTROLLER] OnAdd %\n", network.ObjectMeta.SelfLink)
104         glog.Infof("[NETWORK CONTROLLER] OnAdd %#v\n", network)
105
106         // NEVER modify objects from the store. It's a read-only, local cache.
107         // You can use networkScheme.Copy() to make a deep copy of original object and modify this copy
108         // Or create a copy manually for better performance
109         copyObj, err := c.kubeCRDClient.Scheme().Copy(network)
110         if err != nil {
111                 glog.Errorf("ERROR creating a deep copy of network object: %v\n", err)
112                 return
113         }
114
118         // 1. Create Network in Neutron
119         // 2. Update Network CRD object status to Active or Failed
120         err = c.addNetworkToDriver(networkCopy)
121         if err != nil {
122                 glog.Errorf("Add network to driver failed: %v", err)
123                 return
124         }
125
126         // create kube-dns in this namespace.
127         namespace := networkCopy.Namespace
128         if err := c.createKubeDNSDeployment(namespace); err != nil {
129                 glog.Errorf("Create kube-dns deployment failed: %v", err)
130                 return
131         }
132
133         if err := c.createKubeDNSService(namespace); err != nil {
134                 glog.Errorf("Create kube-dns service failed: %v", err)
135                 return
136         }
137 }
```

# Control Panel



# 3. Extensibility

# Kubernetes扩展通用模型



# CNI

**Leads: CoreOS, Tigera**

1. 通用接口:
    1. ADD: e.g. networkPlugin.addToNetwork(…)
    2. DELETE: e.g. networkPlugin.deleteFromNetwork(…)
2. 实际操作：
    1. kubelet创建network namespace (i.e. infra container的net ns)
    2. kubelet调用CNI插件配置该network namespace
        - e.g. ADD：
            1. 将network interface（e.g. veth的一端）插入到ns
            2. 配置宿主机（e.g. veth的另一端加入到bridge）
            3. 配置net ns中的IP（e.g. 调用IPAM）、路由等信息
    3. 其他同Pod的容器共享这个network namespace

# Flexvolume

**Leads: Google, RedHat**

1. 通用接口:
    1. volume controller: `reconcile(actuallWorld, desireWorld)`
        1. attach(): volume provider -> host machine path
        2. mount(): host machine path -> container path (bind mount)
2. 实际操作（e.g. my_driver是二进制文件）：
    1. ./my_driver attach <json options> <node name>
    2. ./my_driver isattached <json options> <node name>
    3. ./my_driver mount <mount dir> <json options>

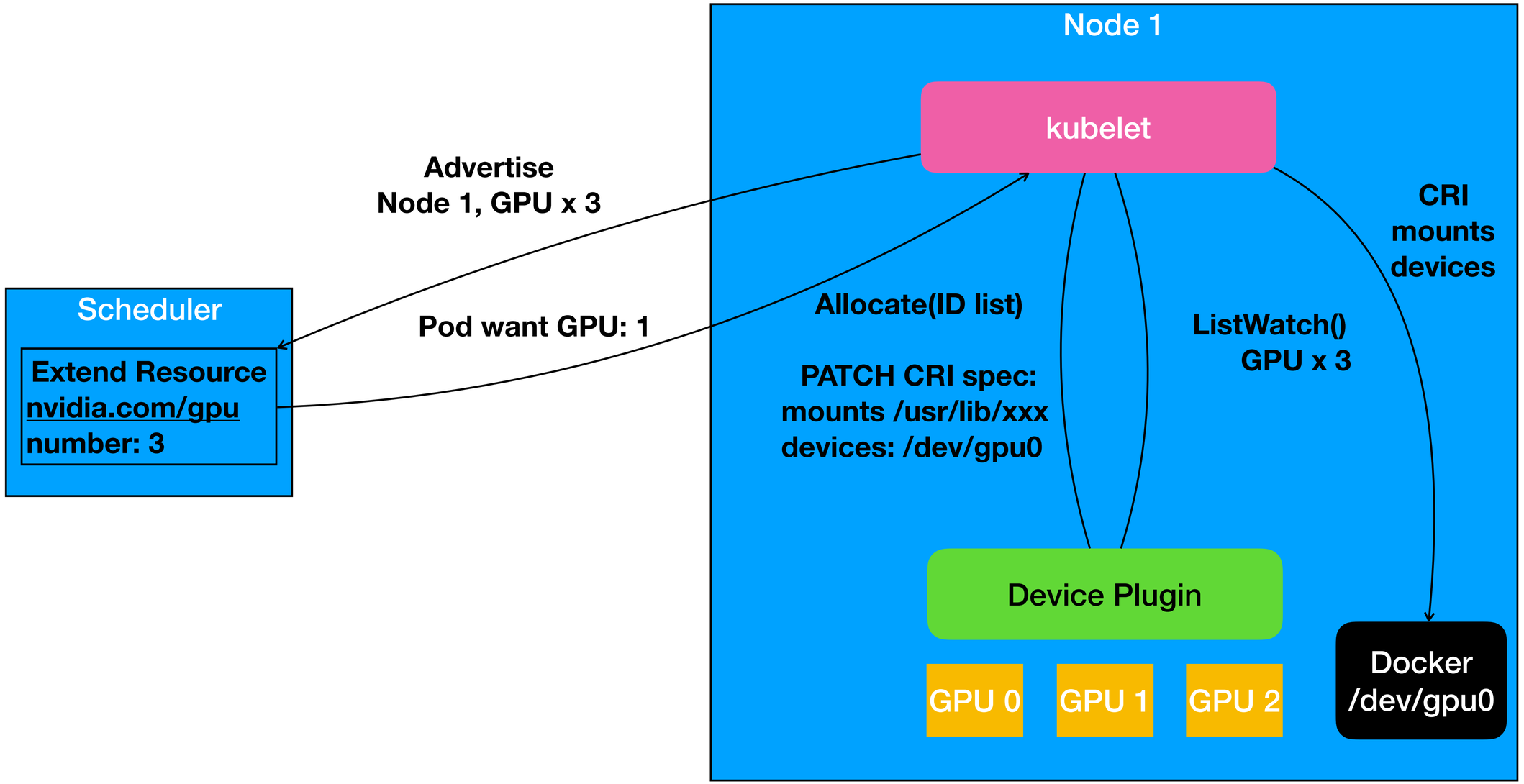
```
volumes:
  - name: my-volume
    flexVolume:
      driver: "cinder/flexvolume_driver"
      fsType: ext4
      options: # data will be passed to binary as json
        cinderConfig: /etc/kubernetes/cinder.conf
        volumeID: daa7b4e6-1792-462d-ad47-78e900fed429
```

# Device Plugin

**Leads: NVIDIA, Intel, Google, RedHat**

- 划重点:
  - Deprecate:
    - GPU support based on dockertools (coupled with Docker)
  - Prefer:
    - CRI + Device Plugin
  - Goals:
    - GPUs, High-performance NICs, FPGAs, InfiniBand, Storage devices etc

# Device Plugin



# Write Your

```
// Implements DevicePlugin service functions
func (ngm *nvidiaGPUManager) ListAndWatch(emtpy *pluginapi.Empty, stream plugi
        fmt.Printf("device-plugin: ListAndWatch start\n")
        changed := true
        for {
                for id, dev := range ngm.devices {
                        state := ngm.GetDeviceState(id)
                        if dev.Health != state {
                                changed = true
                                dev.Health = state
                                ngm.devices[id] = dev
                        }
                }
                if changed {
                        }
                        fmt.Printf("ListAndWatch: send devices %v", resp)
                        if err := stream.Send(resp); err != nil {
                                fmt.Printf("device-plugin: cannot update devic
                                ngm.grpcServer.Stop()
                                return err
                        }
                }
                changed = false
                time.Sleep(5 * time.Second)
        }
}
```

Maintain devic

```
func (ngm *nvidiaGPUManager) Allocate(ctx context.Context, rqt *pluginapi.AllocateRequest) (*pl
        resp := new(pluginapi.AllocateResponse)
        for _, id := range rqt.DevicesIDs {
                dev, ok := ngm.devices[id]
                if !ok {
                        return nil, fmt.Errorf("Invalid allocation request with non-existing de
                }
                if dev.Health != pluginapi.Healthy {
                        return nil, fmt.Errorf("Invalid allocation request with unhealthy devic
                }
                devRuntime := new(pluginapi.DeviceRuntimeSpec)
                devRuntime.Devices = append(devRuntime.Devices, &pluginapi.DeviceSpec{
                        HostPath:      "/dev/" + id,
                        ContainerPath: "/dev/" + id,
                        Permissions:   "mrw",
                })
                for _, d := range ngm.defaultDevices {
                        devRuntime.Devices = append(devRuntime.Devices, &pluginapi.DeviceSpec{
                                HostPath:      d,
                        })
                }
                devRuntime.Mounts = append(devRuntime.Mounts, &pluginapi.Mount{
                        ContainerPath: path.Join(ContainerPathPrefix, "lib64"),
                        HostPath:      path.Join(HostPathPrefix, "lib"),
                        ReadOnly:      true,
                })
                devRuntime.Mounts = append(devRuntime.Mounts, &pluginapi.Mount{
                        ContainerPath: path.Join(ContainerPathPrefix, "bin"),
                        HostPath:      path.Join(HostPathPrefix, "bin"),
                        ReadOnly:      true,
                })
                resp.Spec = append(resp.Spec, devRuntime)
        }
        return resp, nil
}
```

Allocate devices

Allocate mounts

https://github.com/GoogleCloudPlatform/container-engine-accelerators

# Tips

- Next goal: generic API for heterogeneous environment
  - GPU memory, NVLink etc in Device description (instead of qValue).
  - More device types are coming.
- 拥抱变化，但不要走偏！

# Summary

1. Control Panel
    - How k8s describe my workloads in container way?
    - Pod, 容器设计模式, Control Panel (sig-app)
    - **Use!**
2. Plugins & extensibility
    - How to make k8s works in my way?
    - 扩展性设计：Controller, CNI, CRI, CSI, Device Plugin
    - **Hack!**

- Enjoy!


# Thanks!

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