A Vision for API Machinery

Coming to terms with the platform we built

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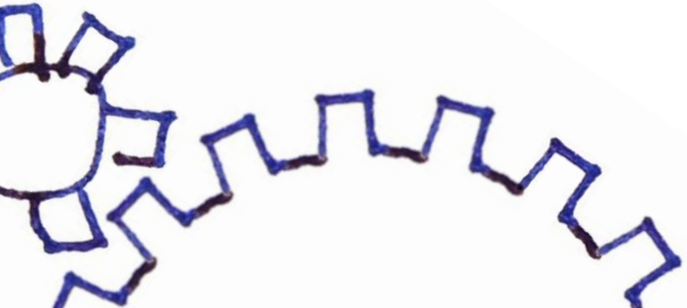
originalavalamp@ twitter

A VISION FOR API MACHINERY



ME

DANIEL SMITH

SIG API MACHINERY
CO-CHAIR, CO-TL

STAFF SOFTWARE ENGINEER @ GOOGLE

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lavalamp@github
originalavalamp@twitter

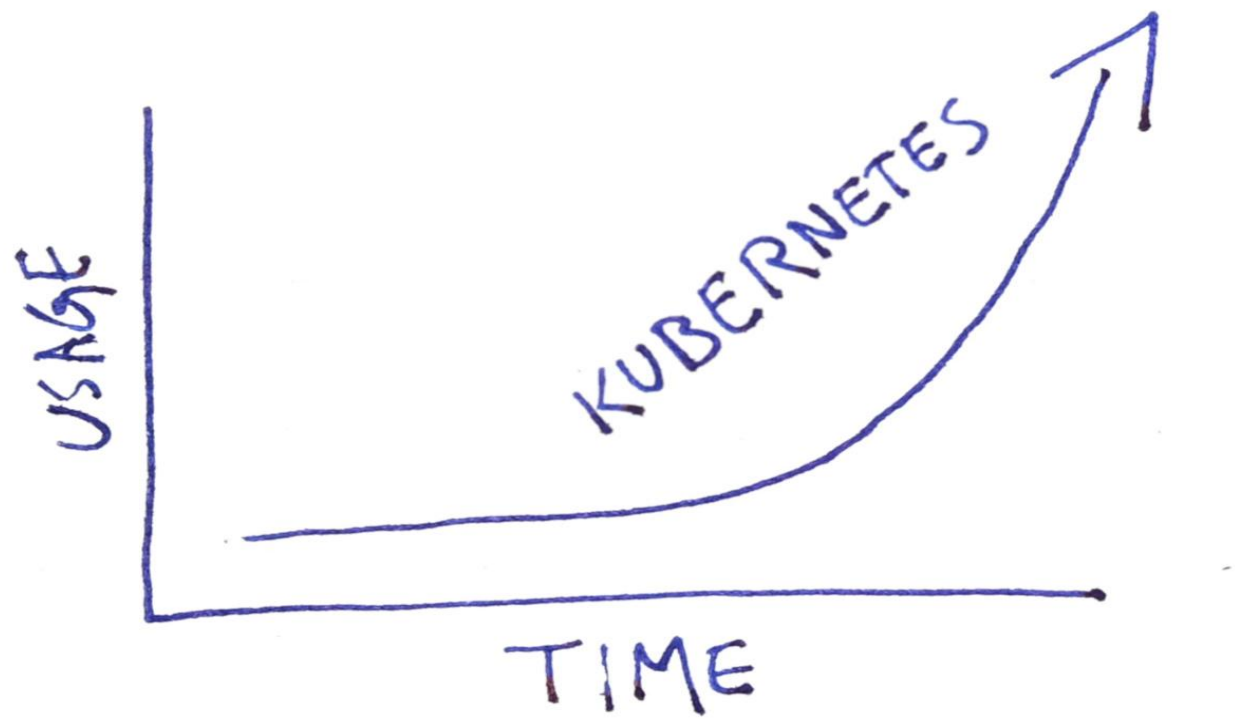
1. WHERE WE CAME FROM

2. WHERE WE ARE

3. WHERE WE SHOULD GO

WHERE WE CAME FROM

KUBERNETES:
UP AND TO THE RIGHT




CODE

```
// Defines the endpoints that implement the actual service, for example:
// Name: "mysql", Endpoints: ["10.10.1.1:1909", "10.10.2.2:8834"]
type Endpoints struct {
    Name      string
    Endpoints []string
}

...

func ParseEndpoints(jsonString string) (api.Endpoints, error) {
    var e api.Endpoints
    err := json.Unmarshal([]byte(jsonString), &e)
    return e, err
}
```

June 5th, 2014

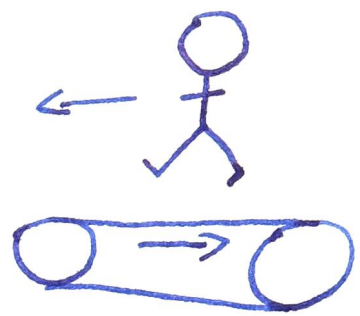
```
// JSONBase is shared by all objects sent to, or returned from the client
type JSONBase struct {
    Kind              string `json:"kind,omitempty" yaml:"kind,omitempty"`
    ID                string `json:"id,omitempty" yaml:"id,omitempty"`
    CreationTimestamp string `json:"creationTimestamp,omitempty"
yaml:"creationTimestamp,omitempty"`
    SelfLink          string `json:"selfLink,omitempty" yaml:"selfLink,omitempty"`
}
```

```go
// TypeMeta is shared by all objects sent to, or returned from the client.
type TypeMeta struct {
    Kind              string    `json:"kind,omitempty" yaml:"kind,omitempty"`
    ID                string    `json:"id,omitempty" yaml:"id,omitempty"`
    CreationTimestamp util.Time `json:"creationTimestamp,omitempty" yaml:"creationTimestamp,omitempty"`
    SelfLink          string    `json:"selfLink,omitempty" yaml:"selfLink,omitempty"`
    ResourceVersion   string    `json:"resourceVersion,omitempty" yaml:"resourceVersion,omitempty"`
    APIVersion        string    `json:"apiVersion,omitempty" yaml:"apiVersion,omitempty"`
    Namespace         string    `json:"namespace,omitempty" yaml:"namespace,omitempty"`
    UID               string    `json:"uid,omitempty" yaml:"uid,omitempty"`


    // Annotations are unstructured key value data stored with a resource that may be set by
    // external tooling. They are not queryable and should be preserved when modifying
    // objects.
    Annotations map[string]string `json:"annotations,omitempty" yaml:"annotations,omitempty"`
}
```

```
// TypeMeta describes an individual object in an API response or request
// with strings representing the type of the object and its API schema version.
// Structures that are versioned or persisted should inline TypeMeta.
type TypeMeta struct {
	// Kind is a string value representing the REST resource this object represents.
	// Servers may infer this from the endpoint the client submits requests to.
	Kind string `json:"kind,omitempty"`

	// APIVersion defines the versioned schema of this representation of an object.
	// Servers should convert recognized schemas to the latest internal value, and
	// may reject unrecognized values.
	APIVersion string `json:"apiVersion,omitempty"`
}

// ObjectMeta is metadata that all persisted resources must have, which includes all objects
// users must create. A resource may have only one of {ObjectMeta, ListMeta}.
type ObjectMeta struct {
	// Name is unique within a namespace.  Name is required when creating resources, although
	// some resources may allow a client to request the generation of an appropriate name
	// automatically. Name is primarily intended for creation idempotence and configuration
	// definition.
	Name string `json:"name,omitempty"`

	// Namespace defines the space within which name must be unique. An empty namespace is
	// equivalent to the "default" namespace, but "default" is the canonical representation.
	// Not all objects are required to be scoped to a namespace - the value of this field for
	// those objects will be empty.
	Namespace string `json:"namespace,omitempty"`

	// SelfLink is a URL representing this object.
	SelfLink string `json:"selfLink,omitempty"`

	// UID is the unique in time and space value for this object. It is typically generated by
	// the server on successful creation of a resource and is not allowed to change on PUT
	// operations.
	UID types.UID `json:"uid,omitempty"`

	// An opaque value that represents the version of this resource. May be used for optimistic
	// concurrency, change detection, and the watch operation on a resource or set of resources.
	// Clients must treat these values as opaque and values may only be valid for a particular
	// resource or set of resources. Only servers will generate resource versions.
	ResourceVersion string `json:"resourceVersion,omitempty"`

	// CreationTimestamp is a timestamp representing the server time when this object was
	// created. It is not guaranteed to be set in happens-before order across separate operations.
	// Clients may not set this value. It is represented in RFC3339 form and is in UTC.
	CreationTimestamp util.Time `json:"creationTimestamp,omitempty"`

	// Labels are key value pairs that may be used to scope and select individual resources.
```

January 20, 2015

THE ABSTRACTION TREADMILL



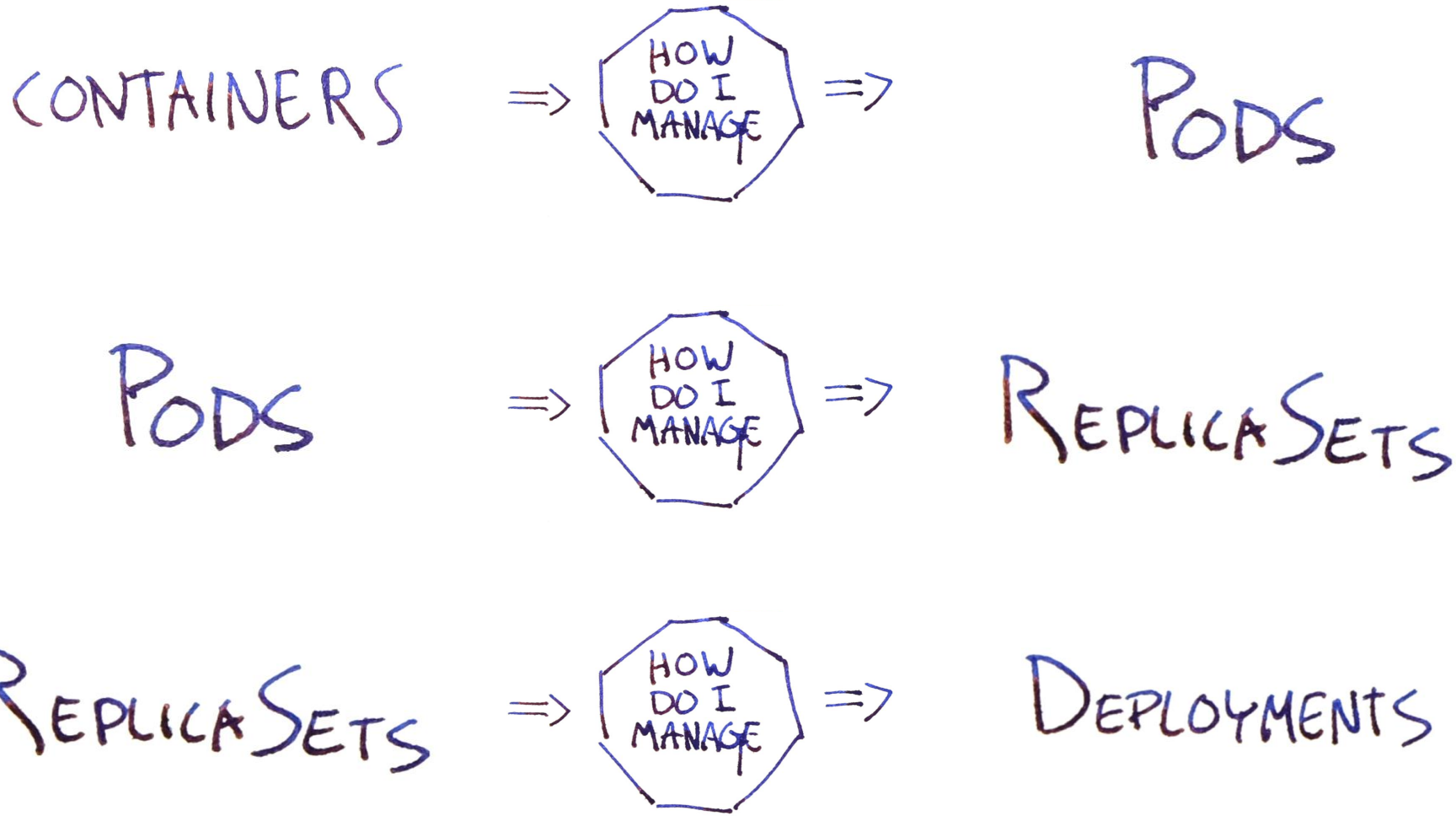

HOW
DO I
MANAGE

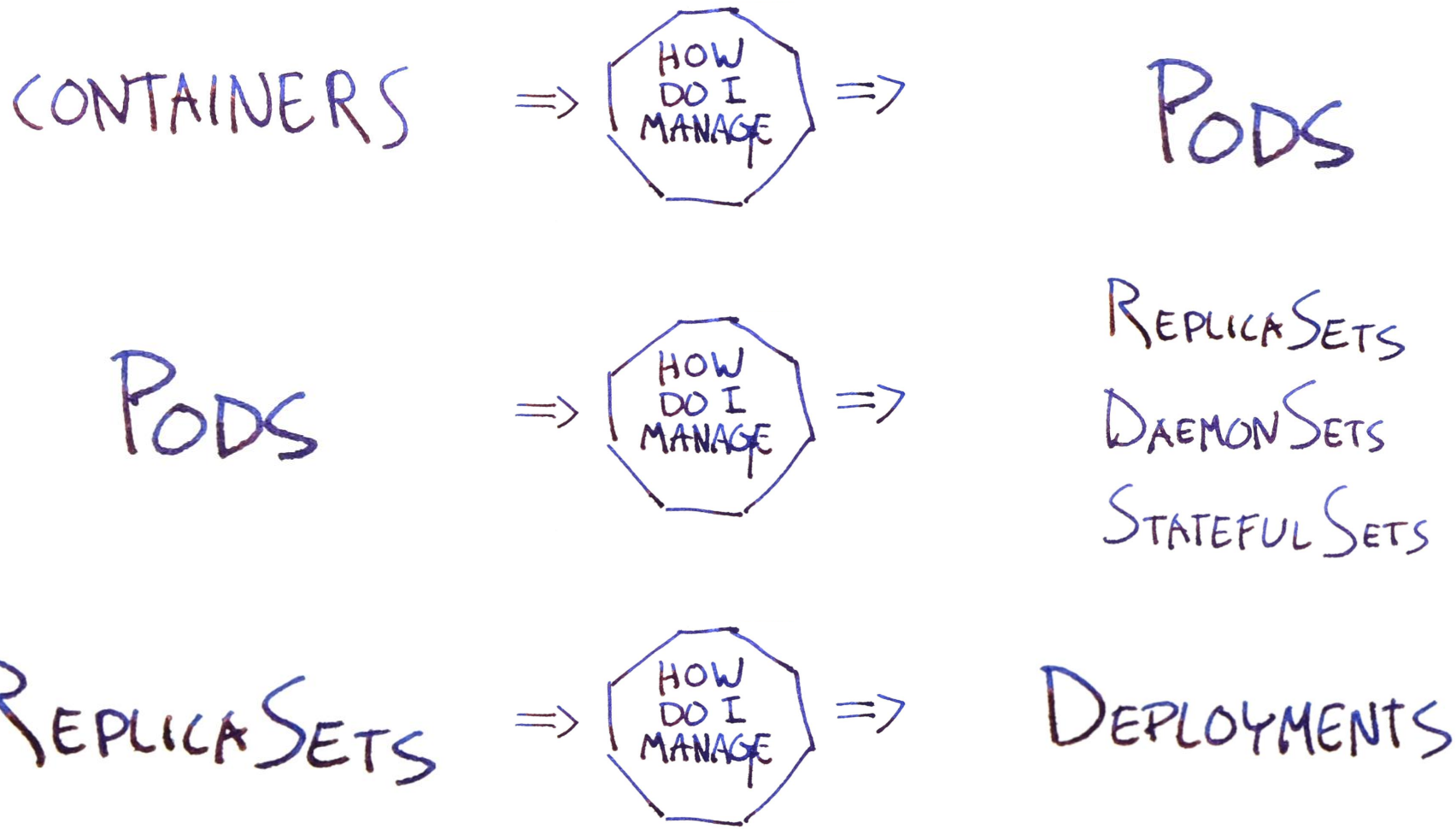
COMPUTERS ⇒ 

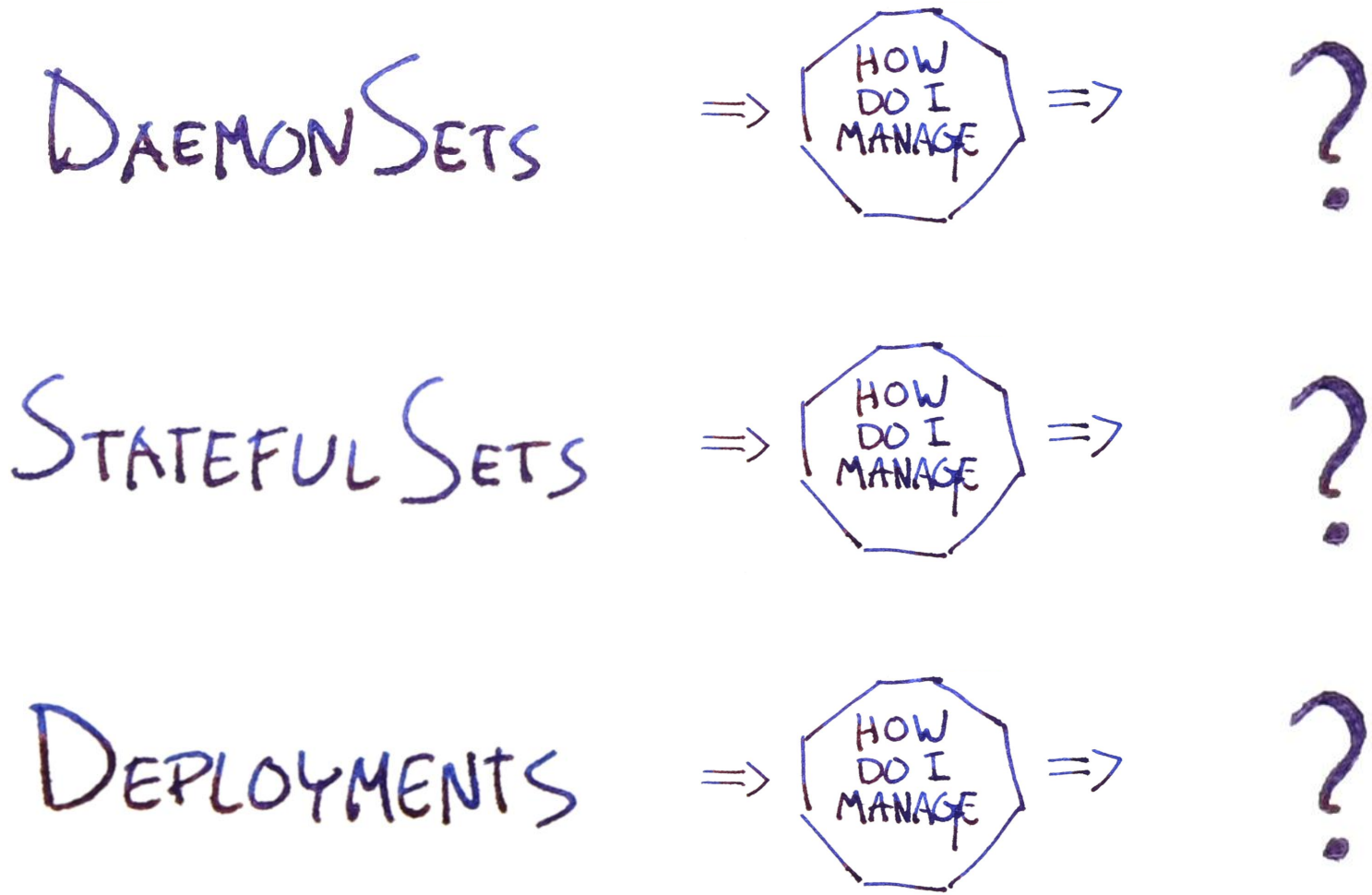
⇒ VMs

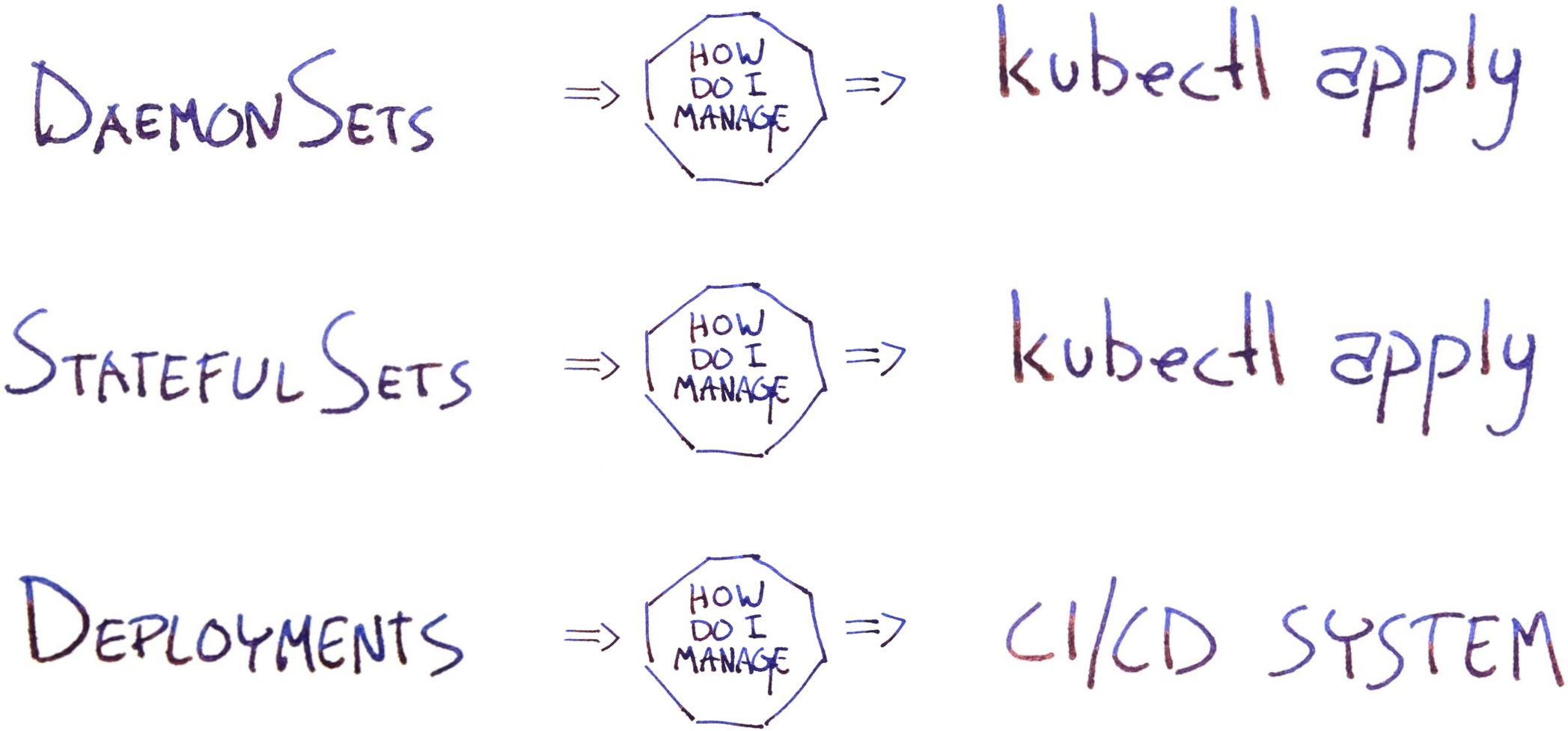
BINARIES
&
DEPENDENCIES ⇒ 

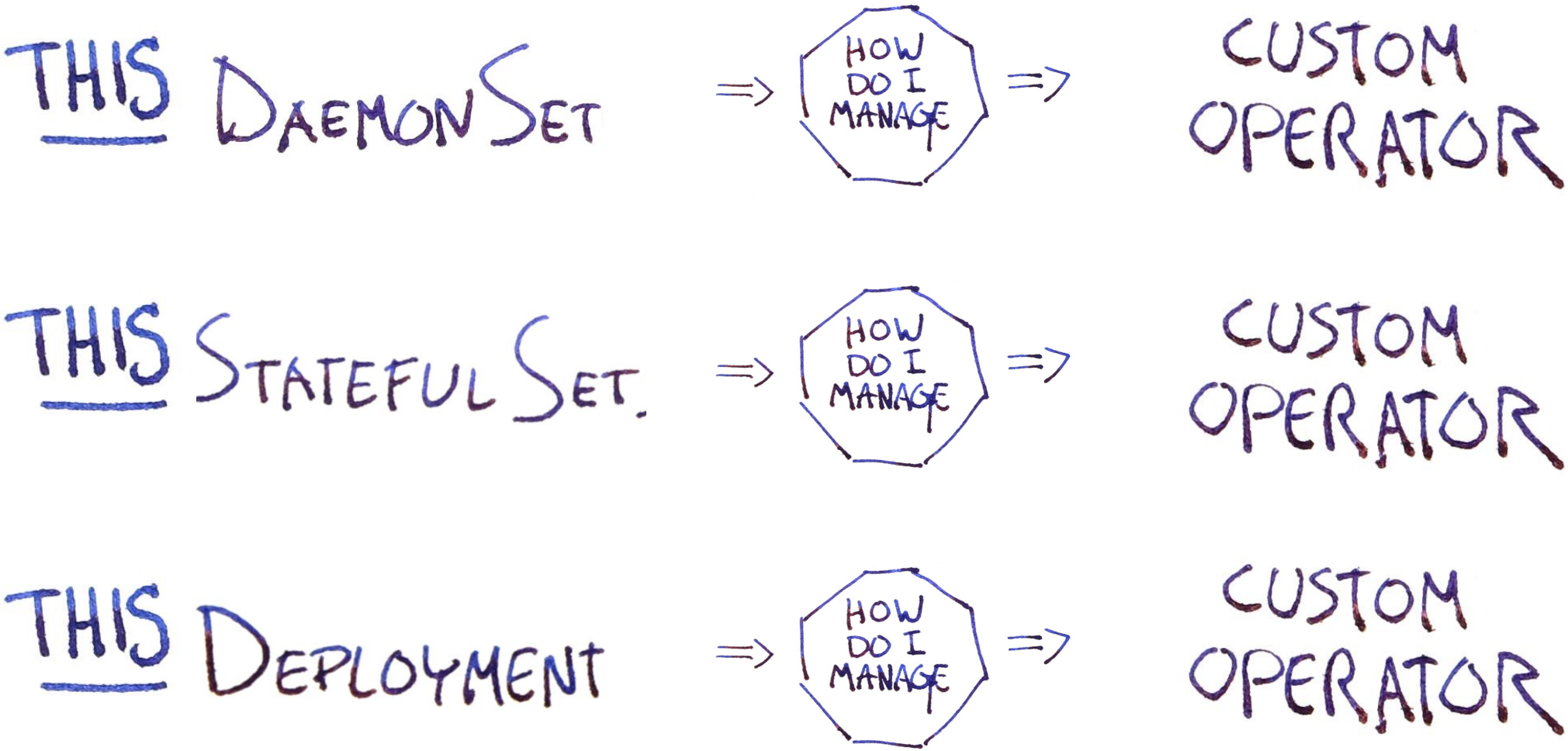
⇒ CONTAINERS

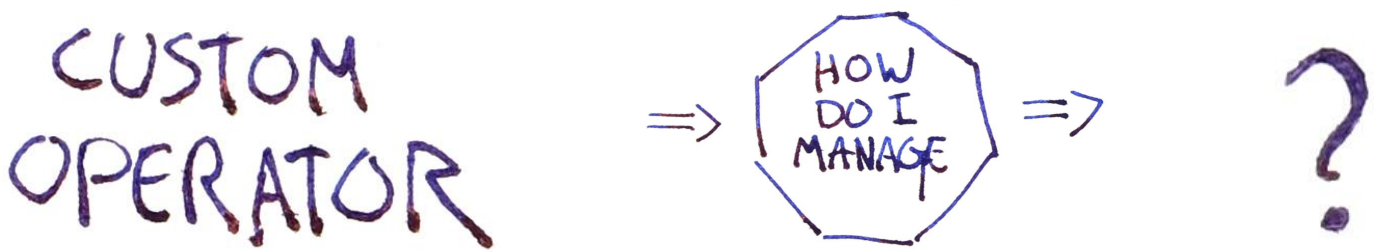

CONTAINERS
HOW DO I MANAGE
PODS
PODS
HOW DO I MANAGE
REPLICASETS
REPLICASETS
HOW DO I MANAGE
DEPLOYMENTS


CONTAINERS
HOW DO I MANAGE
PODS
PODS
HOW DO I MANAGE
REPLICASETS
DAEMONSETS
STATEFULSETS
REPLICASETS
HOW DO I MANAGE
DEPLOYMENTS

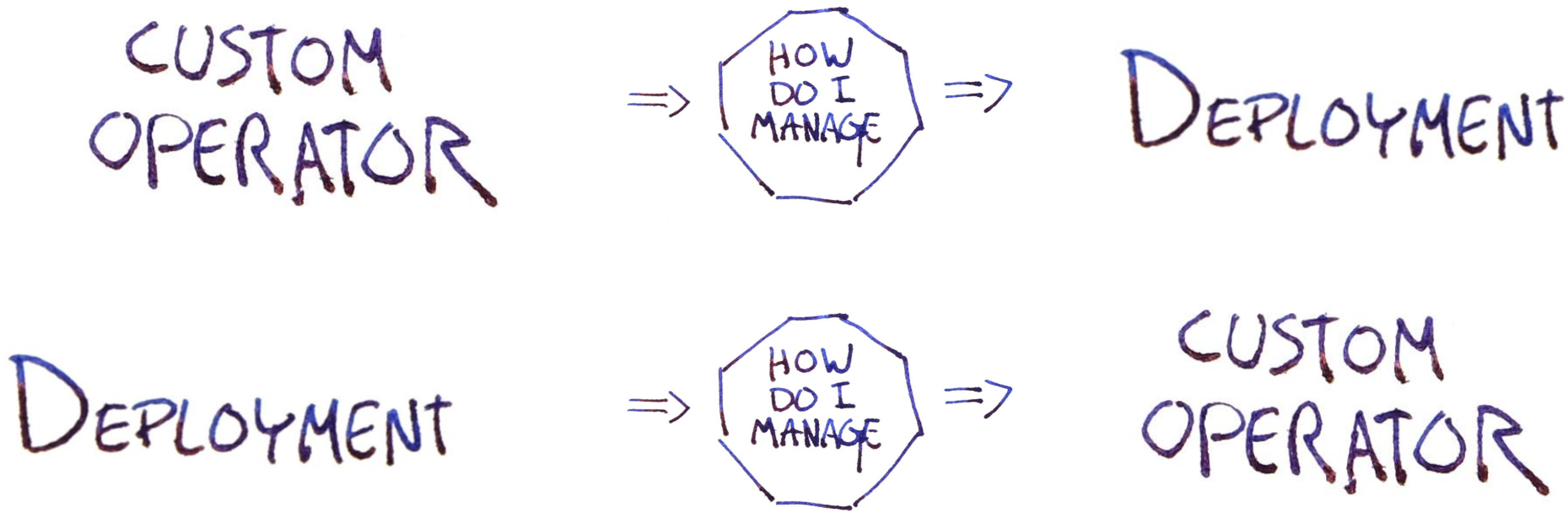

DaemonSets
HOW DO I MANAGE
?
StatefulSets
HOW DO I MANAGE
?
Deployments
HOW DO I MANAGE
?


DaemonSets
=>
HOW DO I MANAGE
=>
kubectl apply
StatefulSets
=>
HOW DO I MANAGE
=>
kubectl apply
Deployments
=>
HOW DO I MANAGE
=>
CI/CD SYSTEM


THIS DAEMONSET
HOW DO I MANAGE
CUSTOM OPERATOR
THIS STATEFULSET
HOW DO I MANAGE
CUSTOM OPERATOR
THIS DEPLOYMENT
HOW DO I MANAGE
CUSTOM OPERATOR


CUSTOM
OPERATOR
HOW
DO I
MANAGE
?


CUSTOM
OPERATOR
HOW
DO I
MANAGE
DEPLOYMENT


CUSTOM OPERATOR
HOW DO I MANAGE
DEPLOYMENT
DEPLOYMENT
HOW DO I MANAGE
CUSTOM OPERATOR

AN OPERATOR OPERATOR
IS STILL
AN OPERATOR!

NO ADDITIONAL ABSTRACTIONS ARE NECESSARY

... YOU DO NEED AN API FOR EACH OPERATOR...

WHERE WE ARE

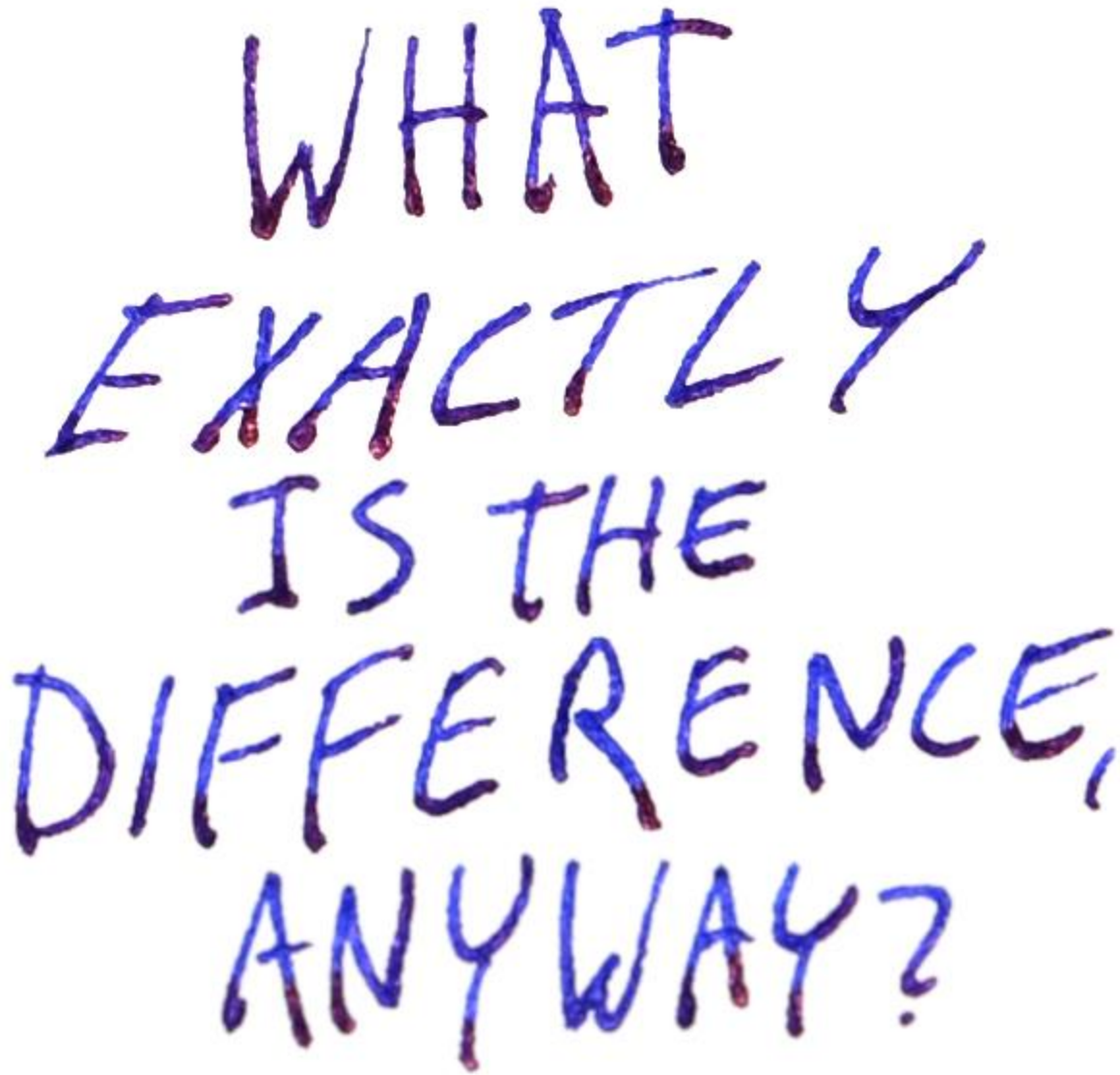
KUBERNETES

HAS A CONSISTENT ~~API~~ RESOURCE MODEL

* COMPARTMENTAL
* REUSABLE

API MACHINERY SUPPORTS AN EXTENSIBLE API

* TYPE
* POLICY


WHAT
EXACTLY
IS THE
DIFFERENCE,
ANYWAY?

Kubernetes APIs

Deployment

Pod

Endpoints

Node

API Machinery APIs

CustomResourceDefinition

APIService

Namespace

MutatingWebhookConfiguration

ValidatingWebhookConfiguration

ARE ROOMMATES IN kube-apiserver

Kubernetes

built in api handlers / validation

custom “subresource” handlers

API Machinery

kube-aggregator (APIService)

extensions-apiserver (CRDs)

policy hook calls

apiserver framework itself

Kubernetes

k8s.io/api

API Machinery

Multiple locations:

- k8s.io/api
- k8s.io/apimachinery/pkg/apis

BOTH HAVE CONTROLLERS

Kubernetes Controllers

Deployment

ReplicaSet

Endpoints

Node

API Machinery Controllers

Namespace Lifecycle

Garbage Collector

Kubernetes

Controllers for built in APIs

Cloud-specific controllers

API Machinery

Namespace / GC controllers

Controller framework:

- Reflector
- Informer (code generator!)
- workqueue

META STUFF IS ALL API MACHINERY

Kubernetes meta

none?

API Machinery meta

ListMeta/ObjectMeta

Optimistic concurrency

OwnerReferences (GC)

Watch: wire format(s)

Proto wire format

Status (error return format)

CONCRETE STUFF IS MOSTLY KUBERNETES

Kubernetes concrete

Liveness / readiness checks

Service selectors

Pod / node binding

PV / PVC mechanism

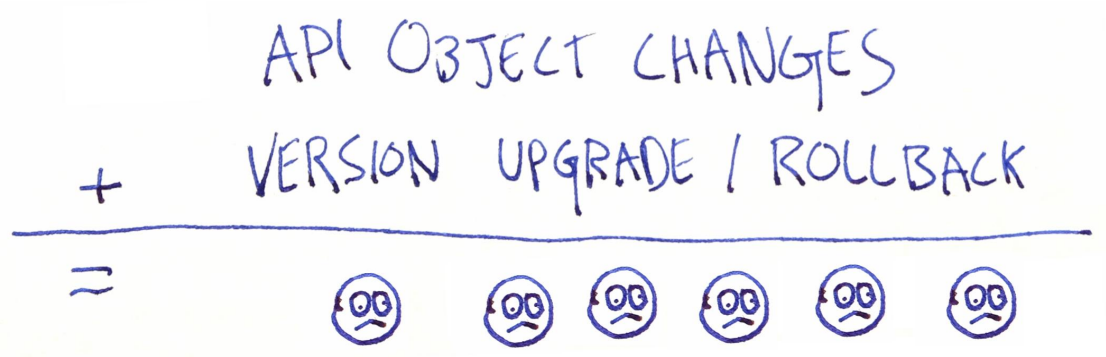
Ingress :)

API Machinery concrete

Flat namespace hierarchy

OPERATIONAL ISSUES

Kubernetes



API Machinery

No apiserver replica coordination

Insufficient scale:

- # API Objects
- Monolithic controllers

OPERATIONAL ISSUES HAVE A CROSS PRODUCT

Suppose Kubernetes:

Adds a field in a v1 resource

Adds a new webhook

And API Machinery:

adds a new proto encoder

Adds a webhook requirement
(e.g., side effects y/n)

WHERE WE SHOULD GO

GOALS

EMBRACE THE DISTINCTIONS
TO BETTER SUPPORT

THE KUBERNETES ECOSYSTEM

THE KUBERNETES PROJECT


INTEROPERABILITY

CLIENT-SIDE INTEROPERABILITY

kubectl

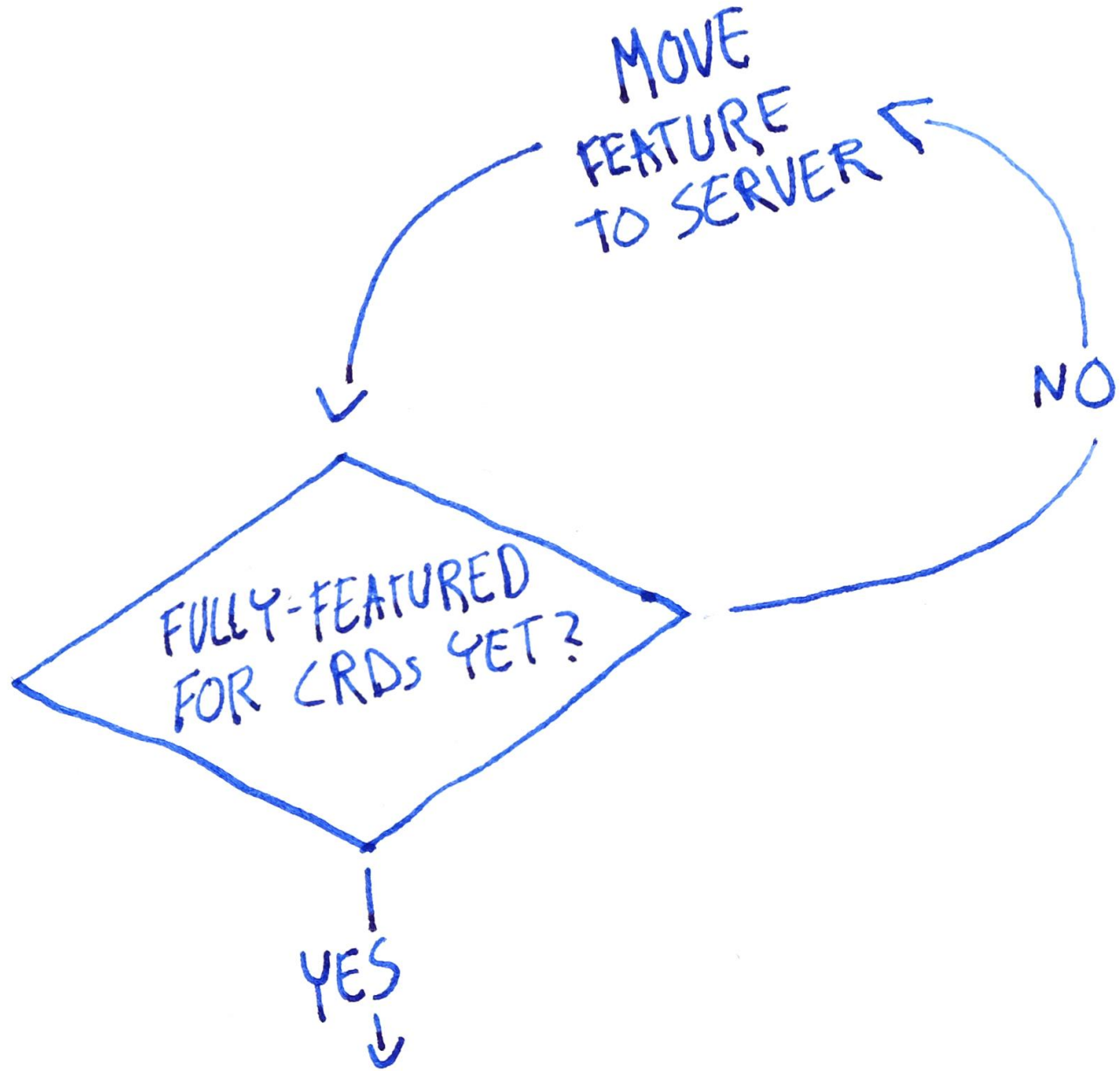
ONLY ONE CTL SHOULD BE NECESSARY

NO LANGUAGE LEFT BEHIND

CLIENT-SIDE INTEROPERABILITY

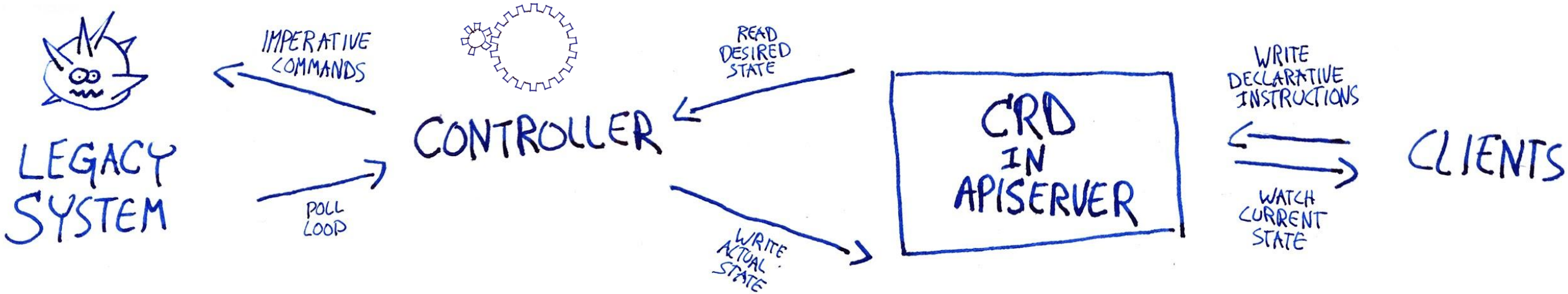
kubectl

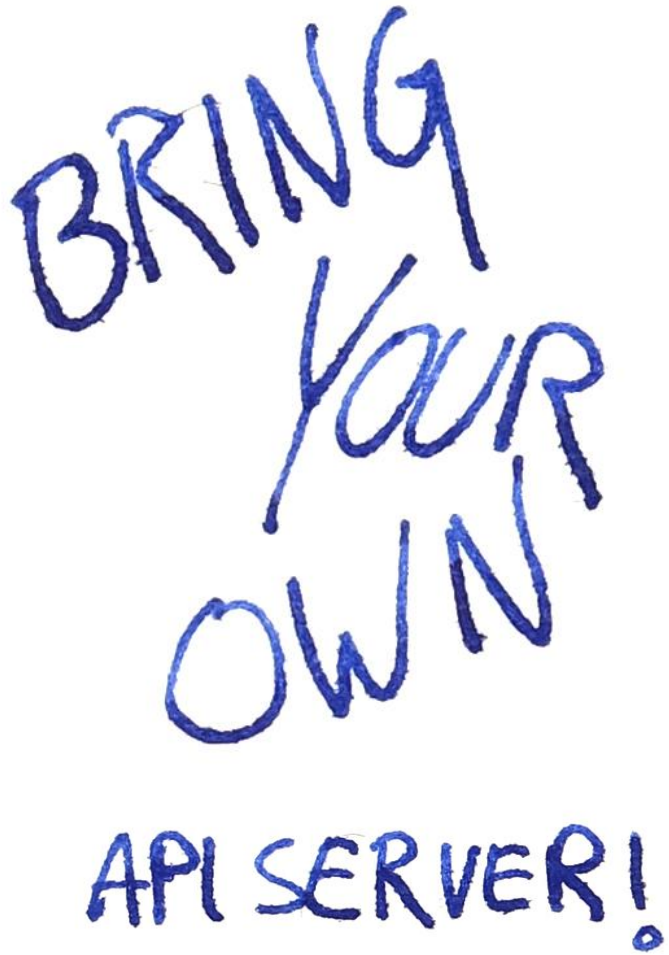
P.S. PRONOUNCED: "CUBE CONTROL"



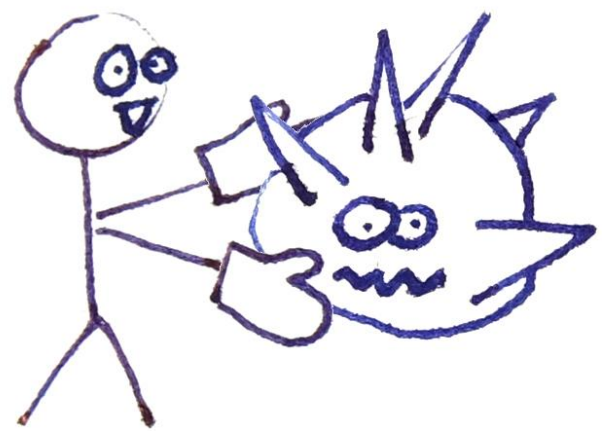
SERVER-SIDE INTEROPERABILITY

LEGACY
SYSTEM

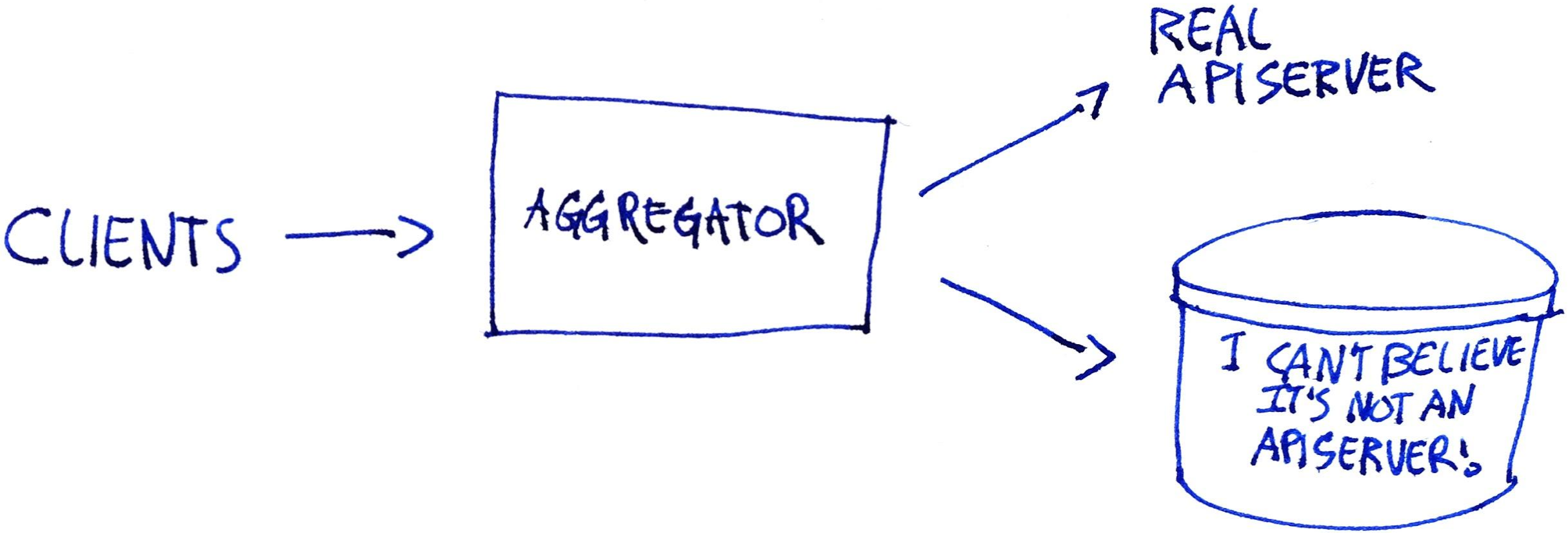

LEGACY SYSTEM
IMPERATIVE COMMANDS
POLL LOOP
CONTROLLER
READ DESIRED STATE
WRITE ACTUAL STATE
CRD IN APISERVER
WRITE DECLARATIVE INSTRUCTIONS
WATCH CURRENT STATE
CLIENTS

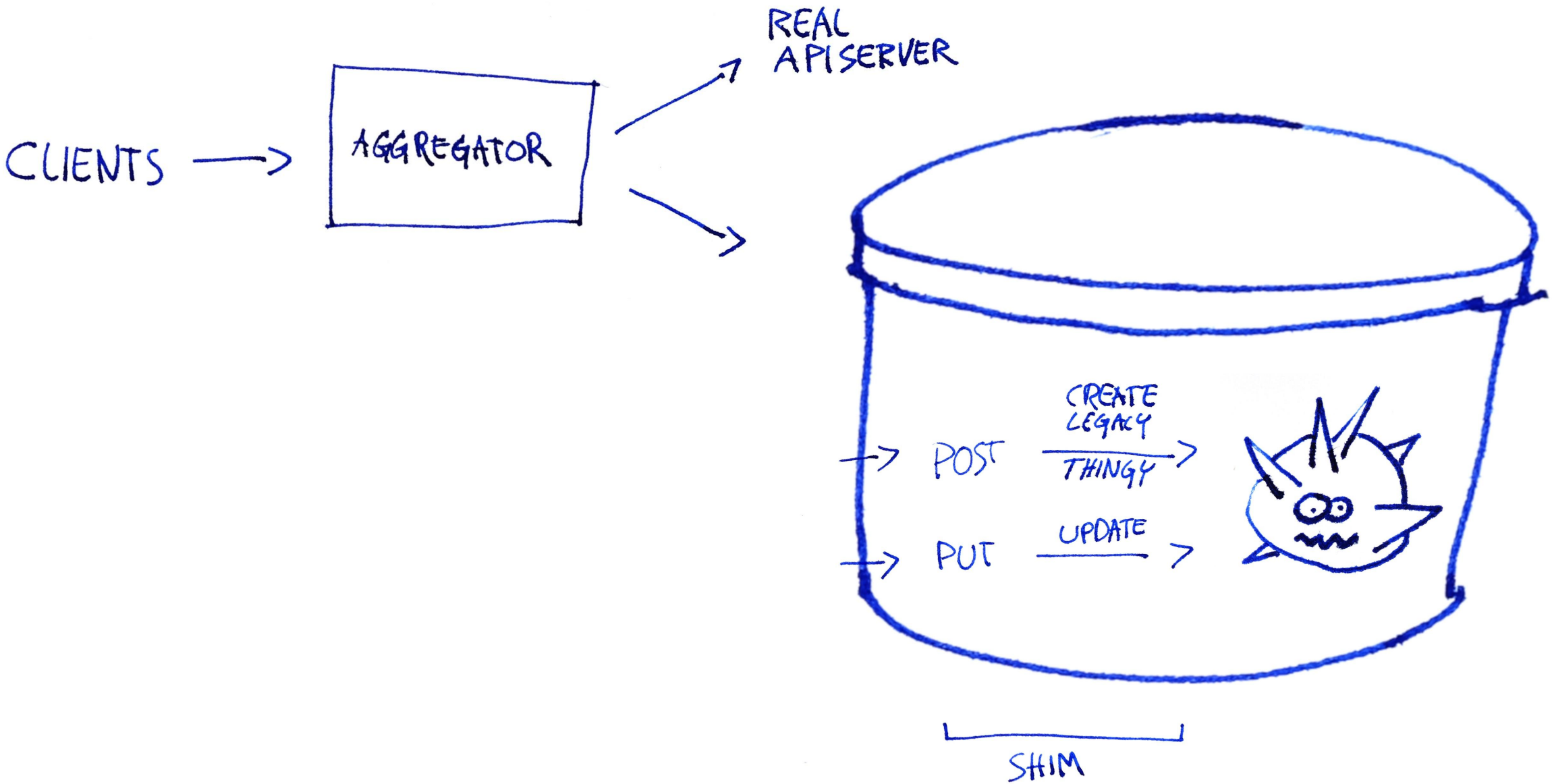

BRING
YOUR
OWN
API SERVER!

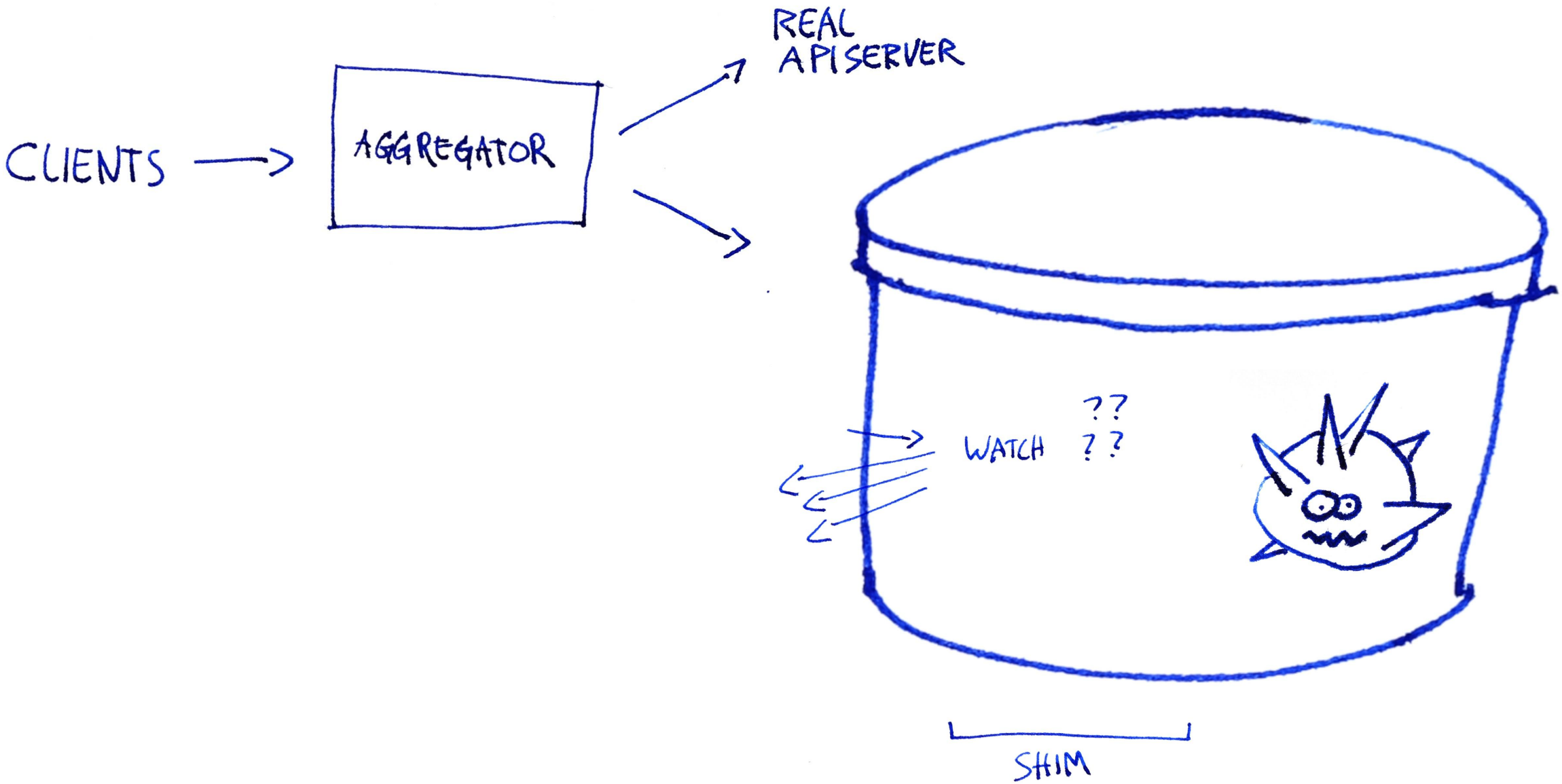
"HI! I WANT TO HOOK MY LEGACY APP UP AS THE SOURCE OF TRUTH, LIKE AN AGGREGATED API SERVER!"

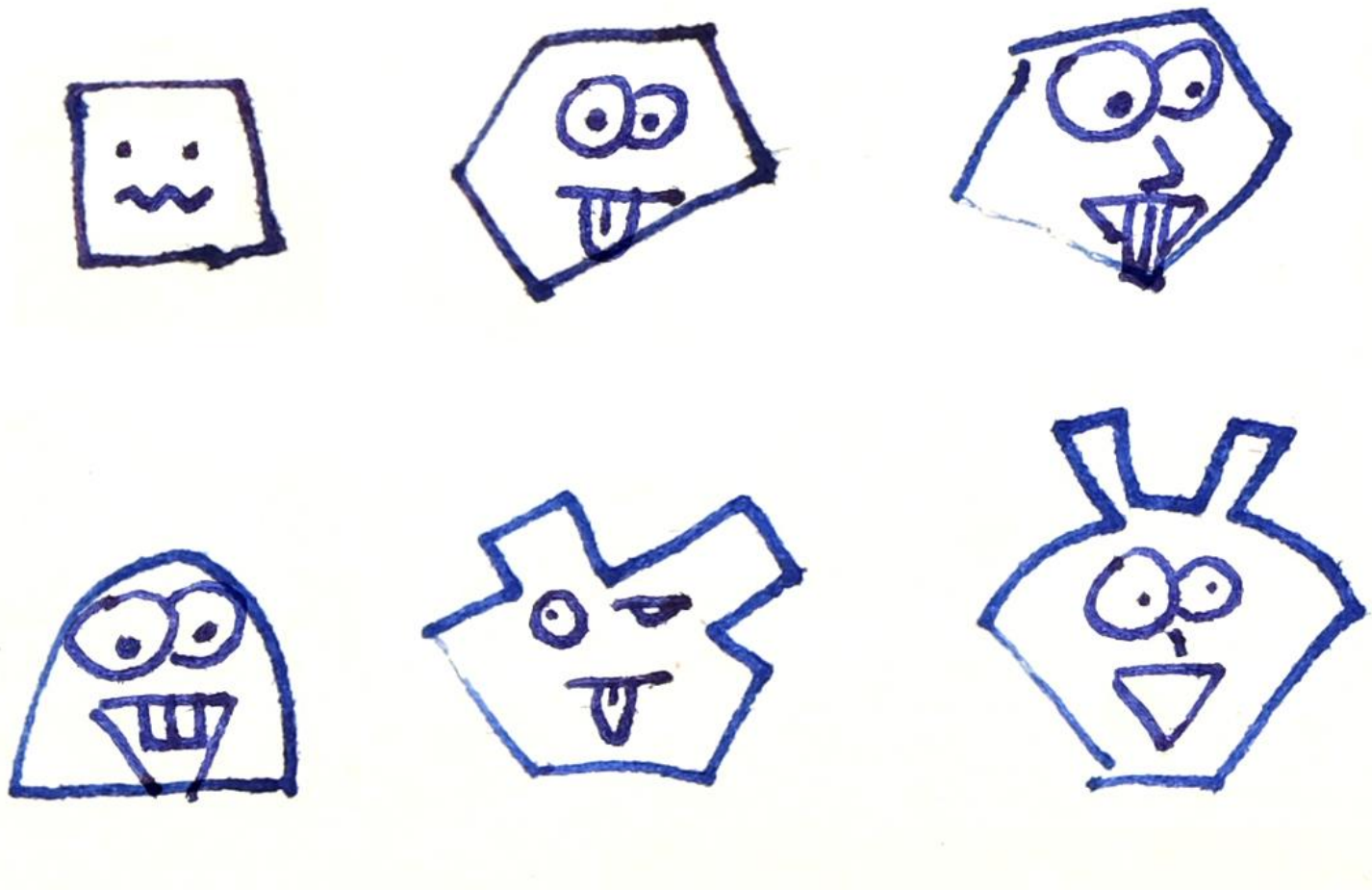


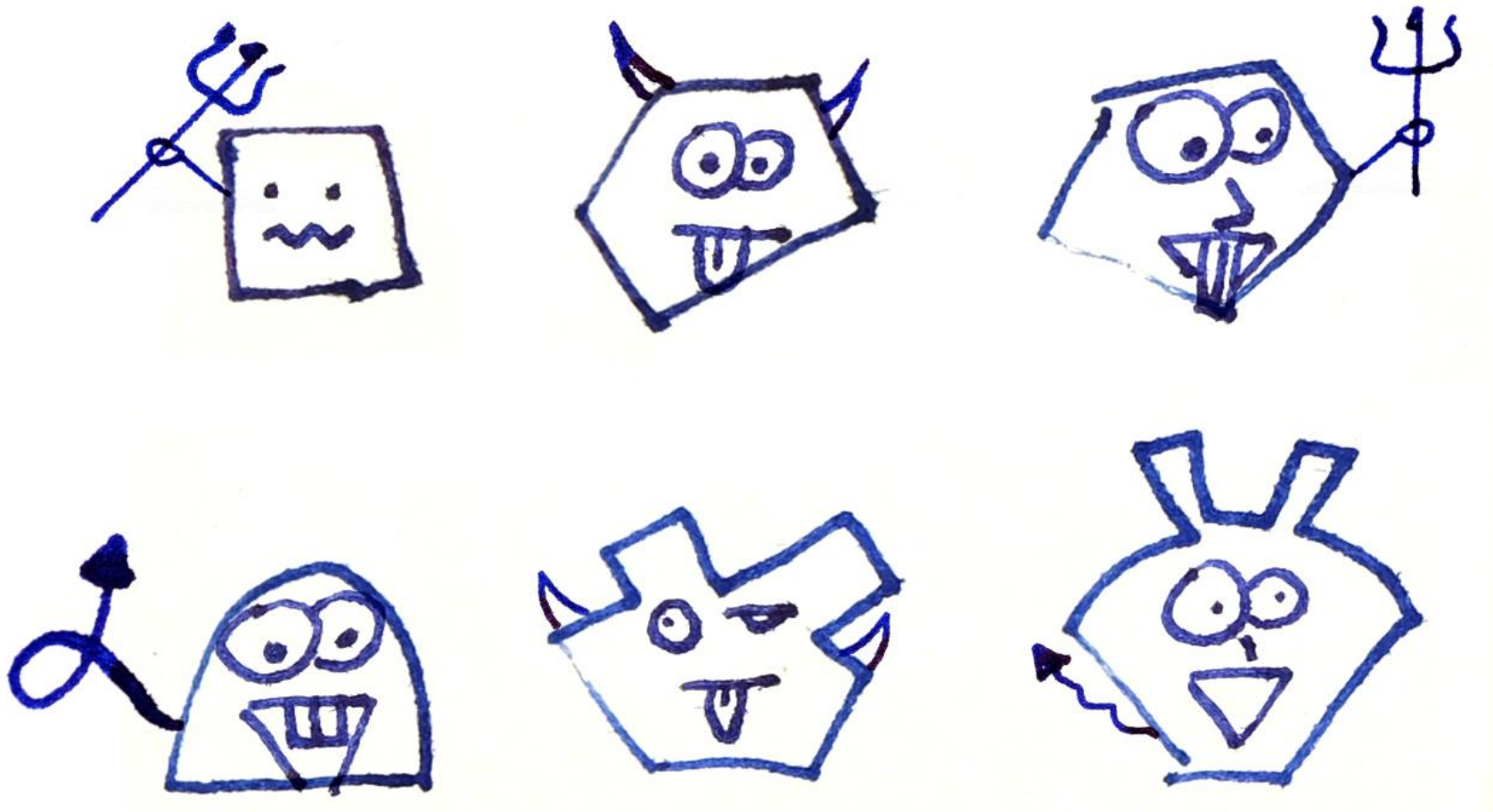
INSTANT APISERVER! JUST ADD ~~WATER!~~ LEGACY SYSTEM!


CLIENTS
AGGREGATOR
REAL APISERVER
I CAN'T BELIEVE IT'S NOT AN APISERVER!


CLIENTS
AGGREGATOR
REAL
APISERVER
POST
CREATE
LEGACY
THINGY
PUT
UPDATE
SHIM


CLIENTS
AGGREGATOR
REAL
APISERVER
??
WATCH
??
SHIM





EMBRACE THE DISTINCTIONS
TO BETTER SUPPORT

THE KUBERNETES PROJECT

CLARIFY BOUNDARIES

* CODE
* LIBRARIES
* REPOSITORIES

* BINARIES
* RELEASE ARTIFACTS
* OPERATIONALLY

GENERAL API CONFORMANCE TESTS

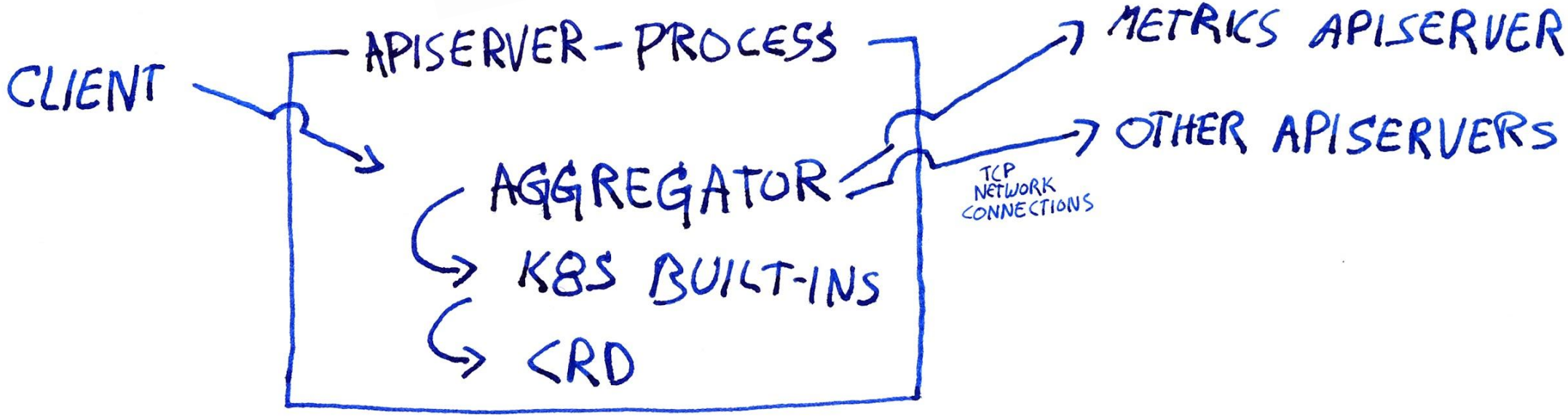
* CLIENT
* SERVER

IDEAS

REFACTOR BINARIES

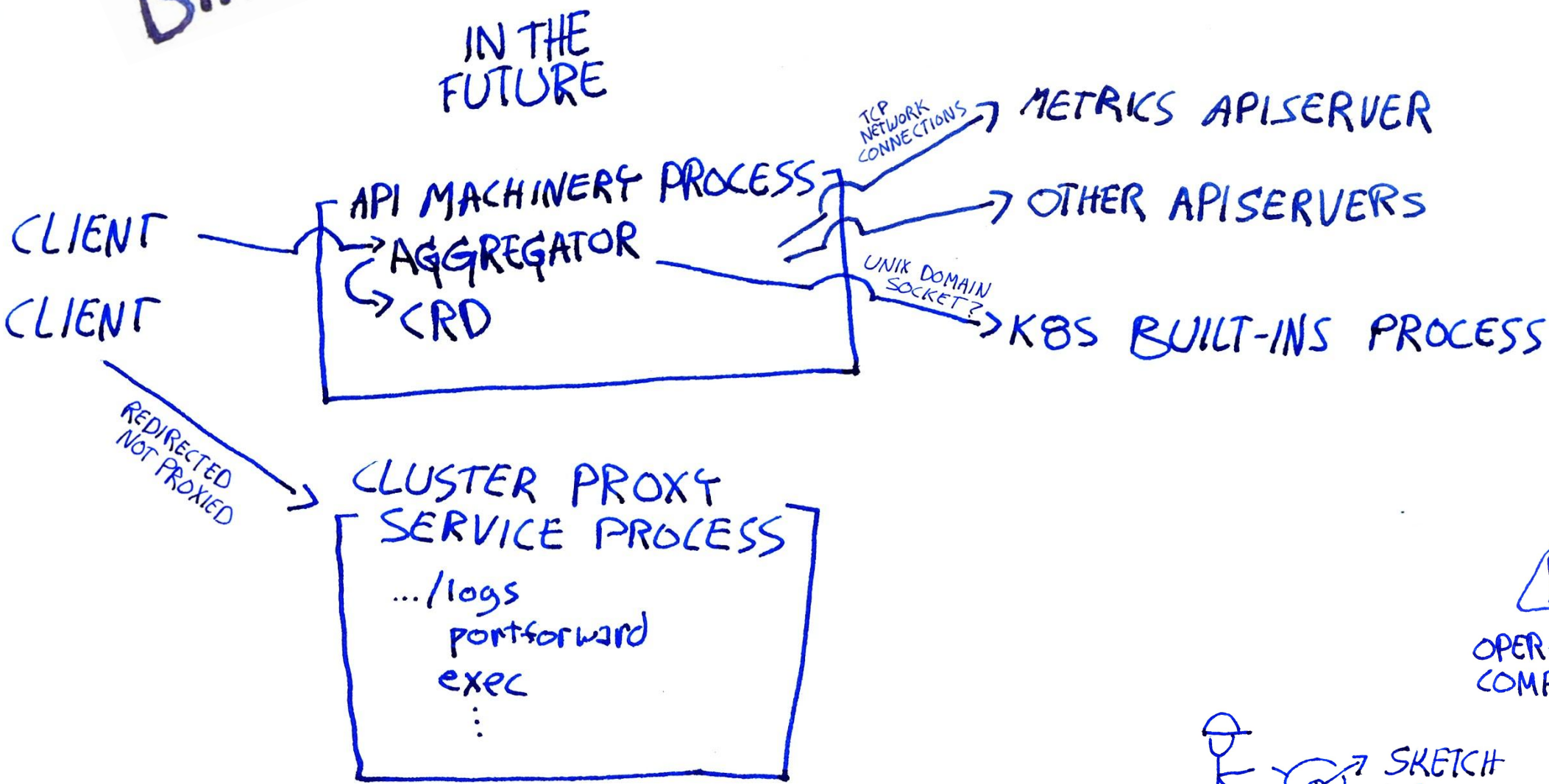
kube-apiserver

TODAY



REFACTOR BINARIES

kube-apiserver

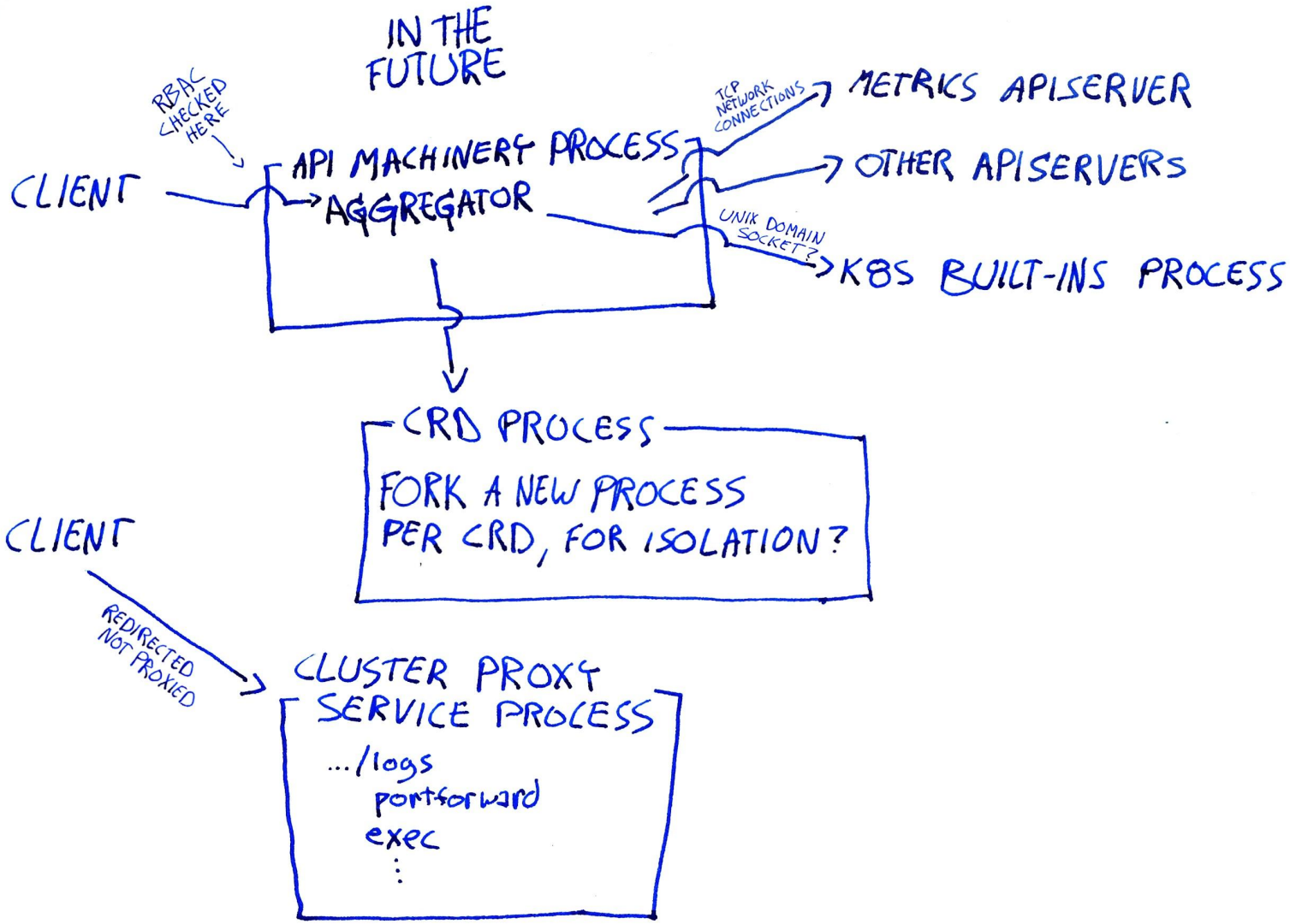


OPERATIONAL COMPLEXITY

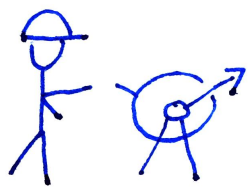
SKETCH
DETAILED DESIGN
IMPLEMENTED

REFACTOR BINARIES

kube-apiserver



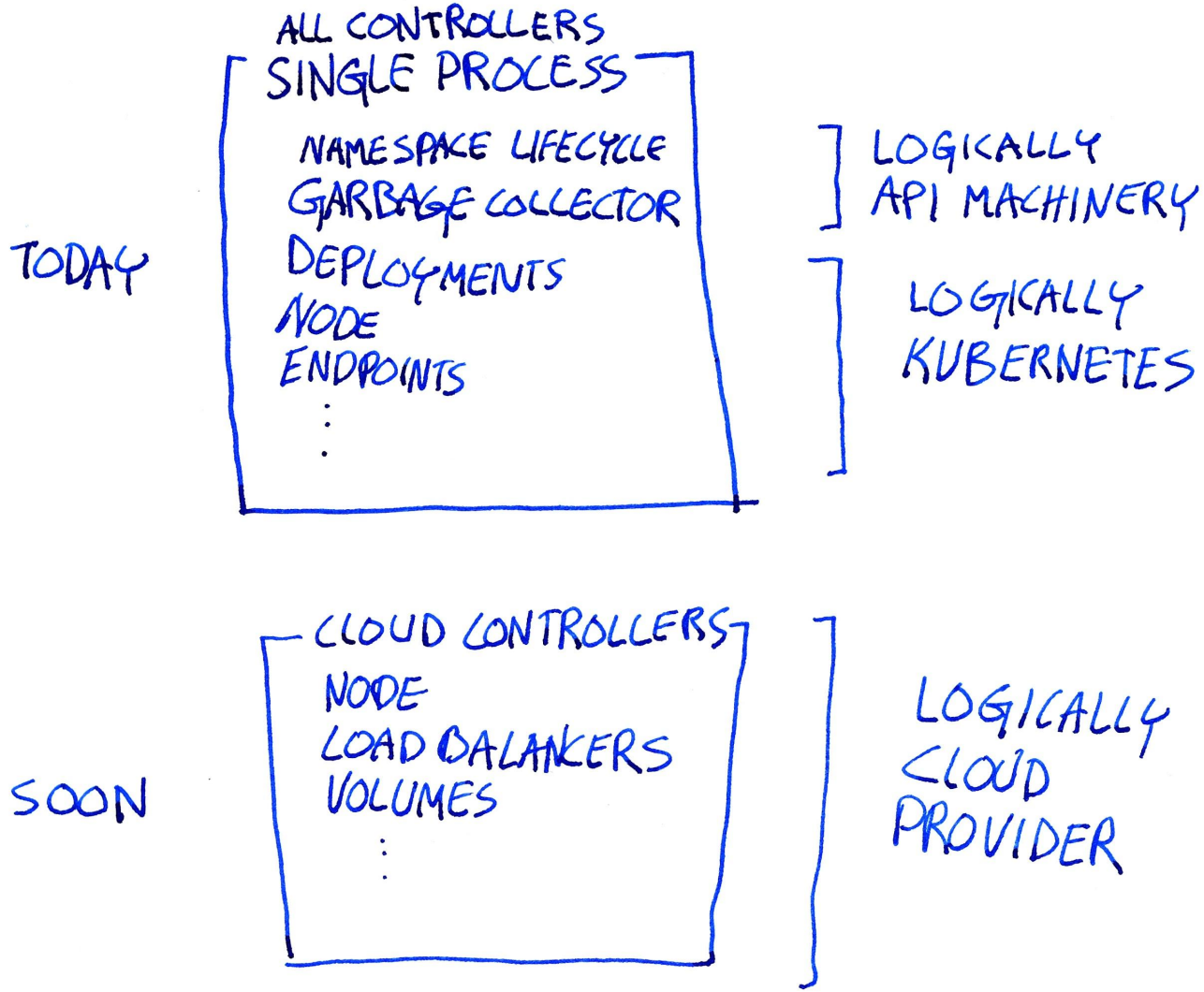
OPERATIONAL COMPLEXITY



SKETCH
DETAILED DESIGN
IMPLEMENTED

REFACTOR BINARIES

kube-controller-manager



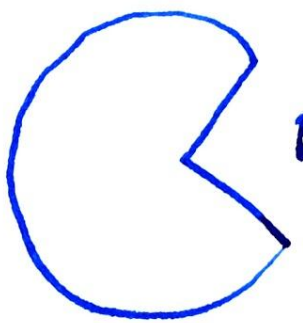
REFACTOR BINARIES

kube-controller-manager

REFACTOR BINARIES

kube-controller-manager

RESOURCE USAGE



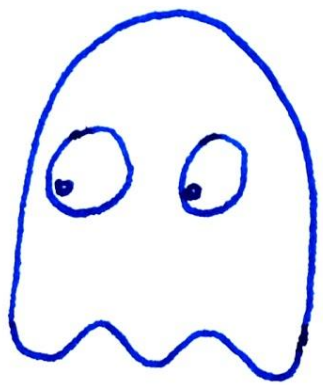
RAM RAM RAM **CPU** RAM RAM

RAM

RAM

CONTROLLER BINARY

(SHARED INFORMERS)

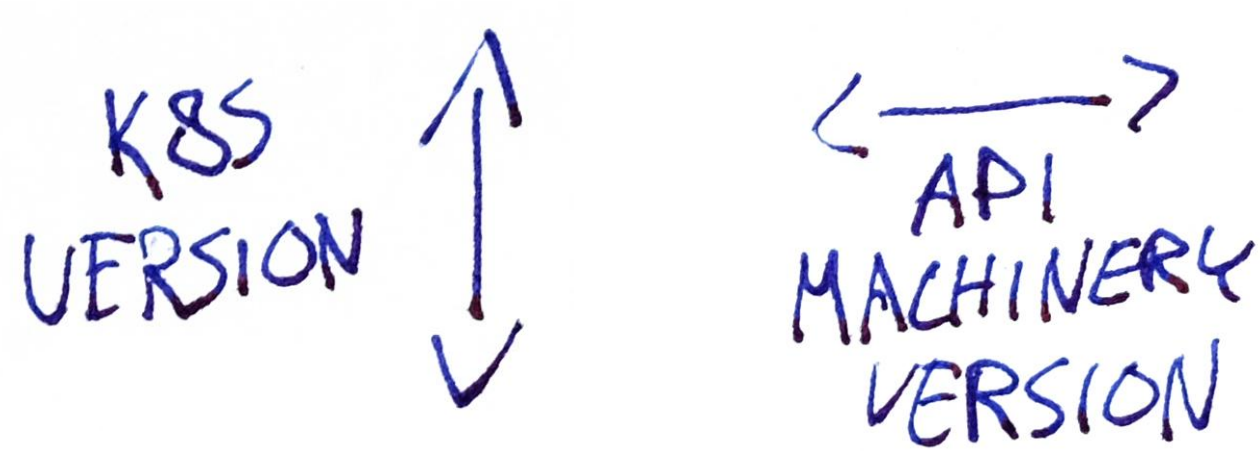


ACCOUNTING

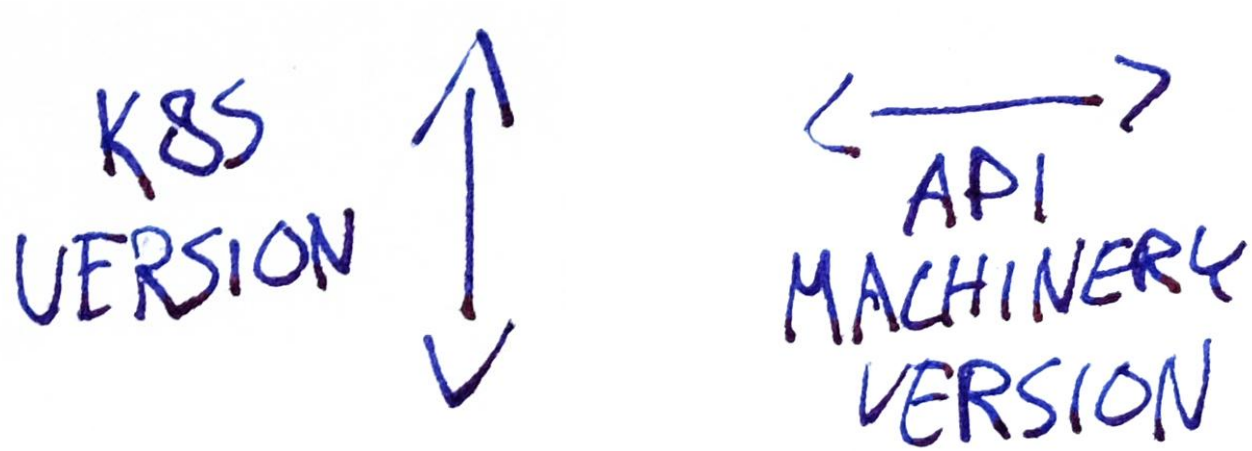
OPERATIONAL COMPLEXITY

REFACTOR PROCESS

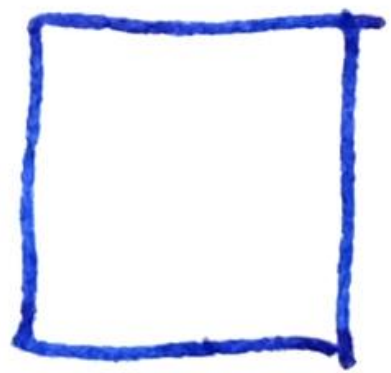
* FREQUENT RELEASES
* TAKE INTERFACES SERIOUSLY



* CHANGE SCHEMAS
  ... but BUT NOT MECHANISMS
* CHANGE MECHANISMS
  ...BUT NOT SCHEMAS



DIFFERENT
RISK
PROFILES



DAYS SINCE
LAST CVE

REFACTOR

SOCIAL STRUCTURE

NEW GITHUB ORG?

HOW DO WE REALIZE THIS FUTURE?

TWO POTENTIAL APPROACHES

/staging

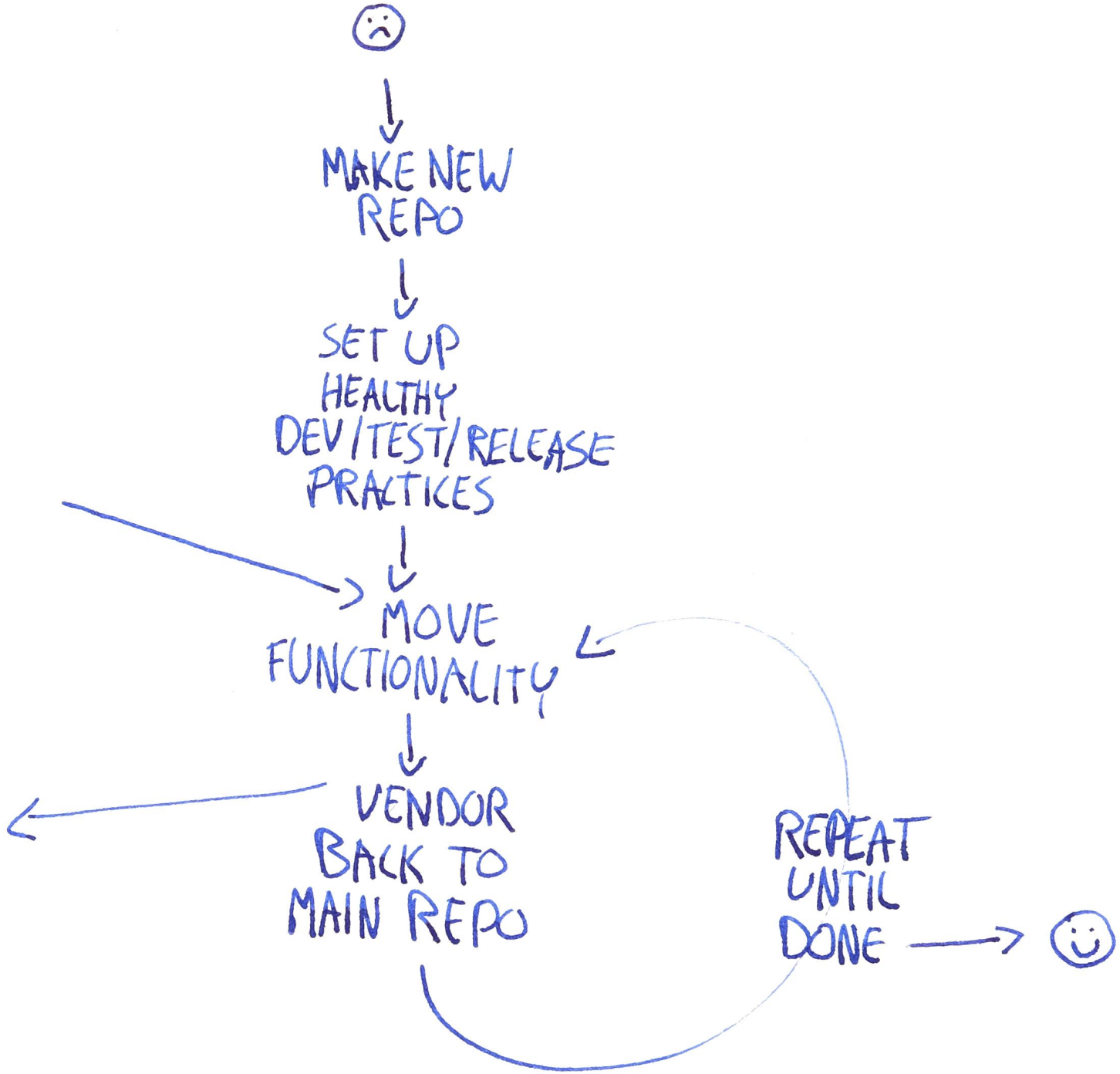
/STAGING ++

/staging

/STAGING ++

/staging

EVERYONE'S FAVORITE DIRECTORY!!


MAKE NEW REPO
SET UP HEALTHY DEV/TEST/RELEASE PRACTICES
MOVE FUNCTIONALITY
VENDOR BACK TO MAIN REPO
REPEAT UNTIL DONE

SOUNDS

$ $ $

EXPENSIVE

IS IT
WORTH IT ???

IS IT WORTH IT ???

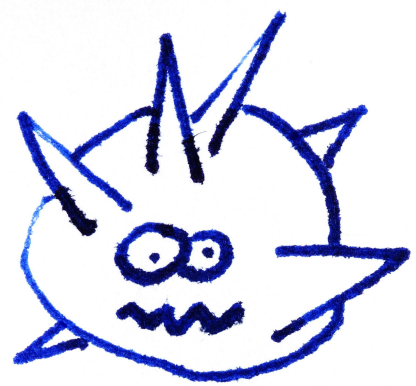
* ECOSYSTEM GROWTH RATE MULTIPLIER
* ARCHITECTUAL CLARITY FOR NEW ENTRANTS
* IMPROVED TESTING & CONFIDENCE

VELOCITY:
→ SLOWER, THEN FASTER (NEW FEATURES)
→ FASTER (# COMMITS / LOC CODE CHANGES)

"I LIKE THESE IDEAS, HOW CAN I HELP?"

"I HAVE CONCERNS, WHERE CAN I LEAVE FEEDBACK?"

"I NEED A CONFIG CHANGE"

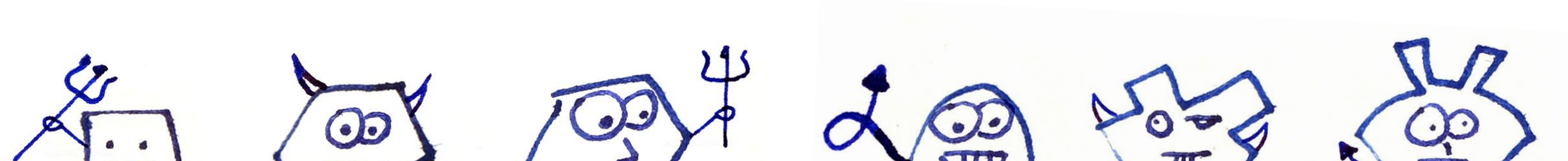


HOW DO I GET INVOLVED?

SIG API MACHINERY
&
SIG ARCHITECTURE

MEETING
&
EMAIL LIST

WE CAN'T DO THIS
WITHOUT YOU




KubeCon
CloudNativeCon
North America 2018