This job is too hard.

Brendan Burns – @brendandburns

Distinguished Engineer – Microsoft Azure

Co-Founder Kubernetes

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The job.

- Build new features?
- Weekly releases?
- Perfect uptime?
- Remain buzzword compliant?

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The tools.

- Patterns and practices.
- Infrastructure support.
- Code re-use.
- Hacker news.

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The approach.

- Learn everything.
- Build everything.
- Explain everything.
- Monitor everything.
- Rinse and repeat.

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We can’t keep doing this.

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Fortunately, history repeats

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What happens when the job gets to hard?

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We build tools.

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We find patterns

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Historical reference points

- Machine code - 1940s
  - Fortran - 1956
  - The art of computer programming - 1968

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Historical reference points

- Software Scaling - 1980s
  - Java/C# - 1990s
  - Design Patterns - 1995

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Historical reference points

- Reliable Distributed Systems - 2010s
  - Docker & Kubernetes – 2013-14
  - ????

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Solutions: Tools

- Examples:
  - Compilers
  - Debuggers
  - Unit testing
  - Integrated Development Environments
  - …

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Solutions: Tools

- Helm (https://helm.sh)
- Kubernetes Extension for Visual Studio Code
- Draft (https://draft.sh)
- Telepresence (https://telepresence.io)
- Jenkins X (https://github.com/jenkins-x)
- Spinnaker (https://spinnaker.io)
- …

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Demo: Visual Studio Code for Kubernetes

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Demo: Draft (https://github.com/Azure/draft)

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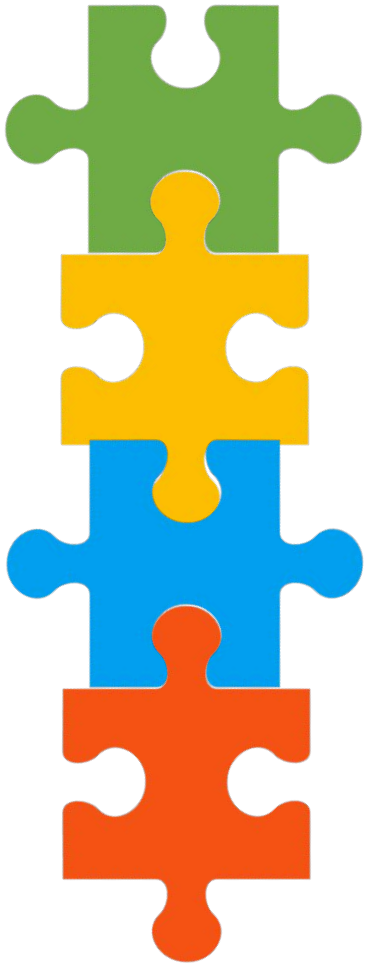
Cluster Services



- Cluster wide standardization of common services
  - e.g Logging, Monitoring, Security
- Automatically enabled by ***deploying into the cluster***
- Ensure consistency, concentration of skills & best practices

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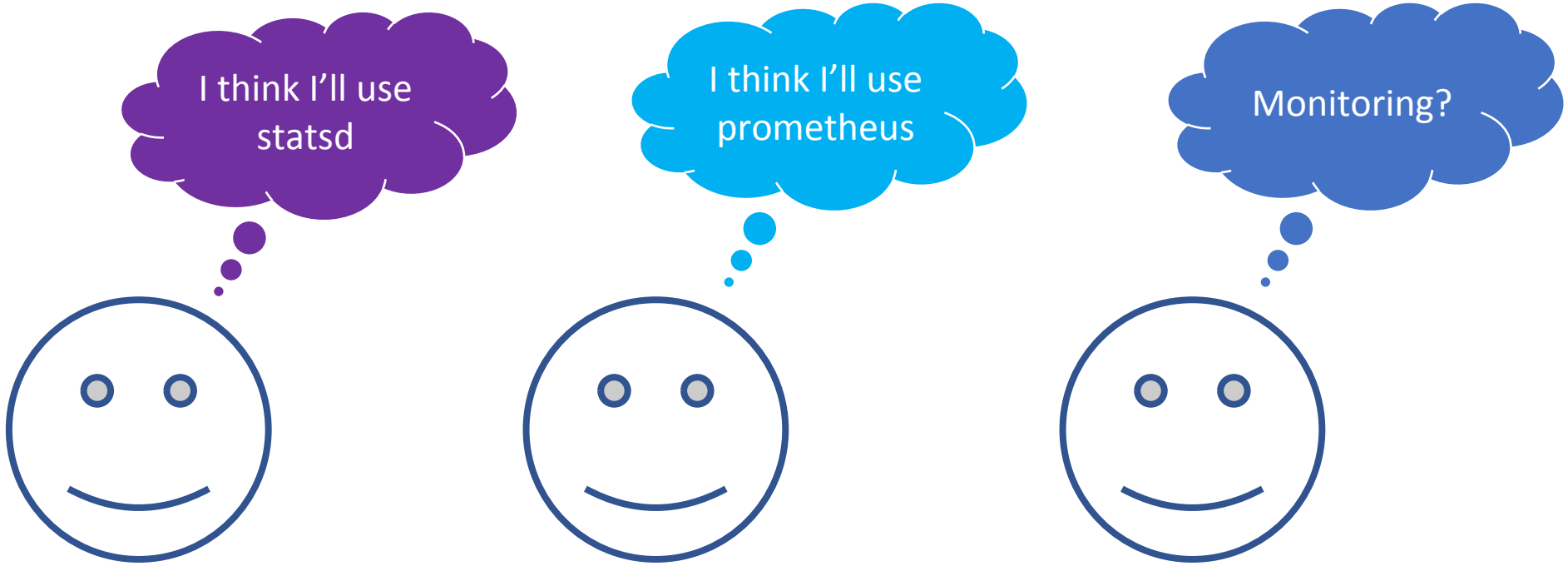
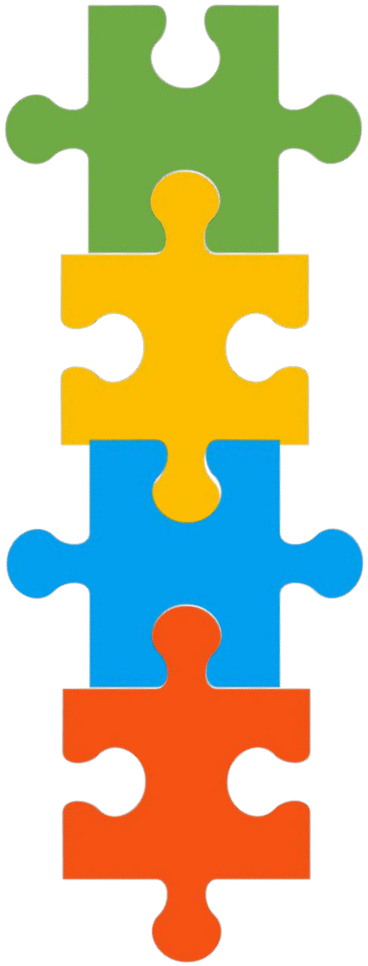
Cluster Services





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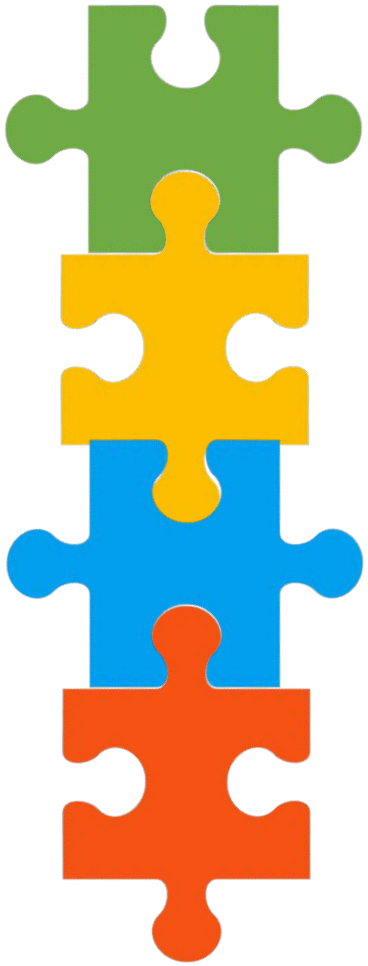
Cluster Services



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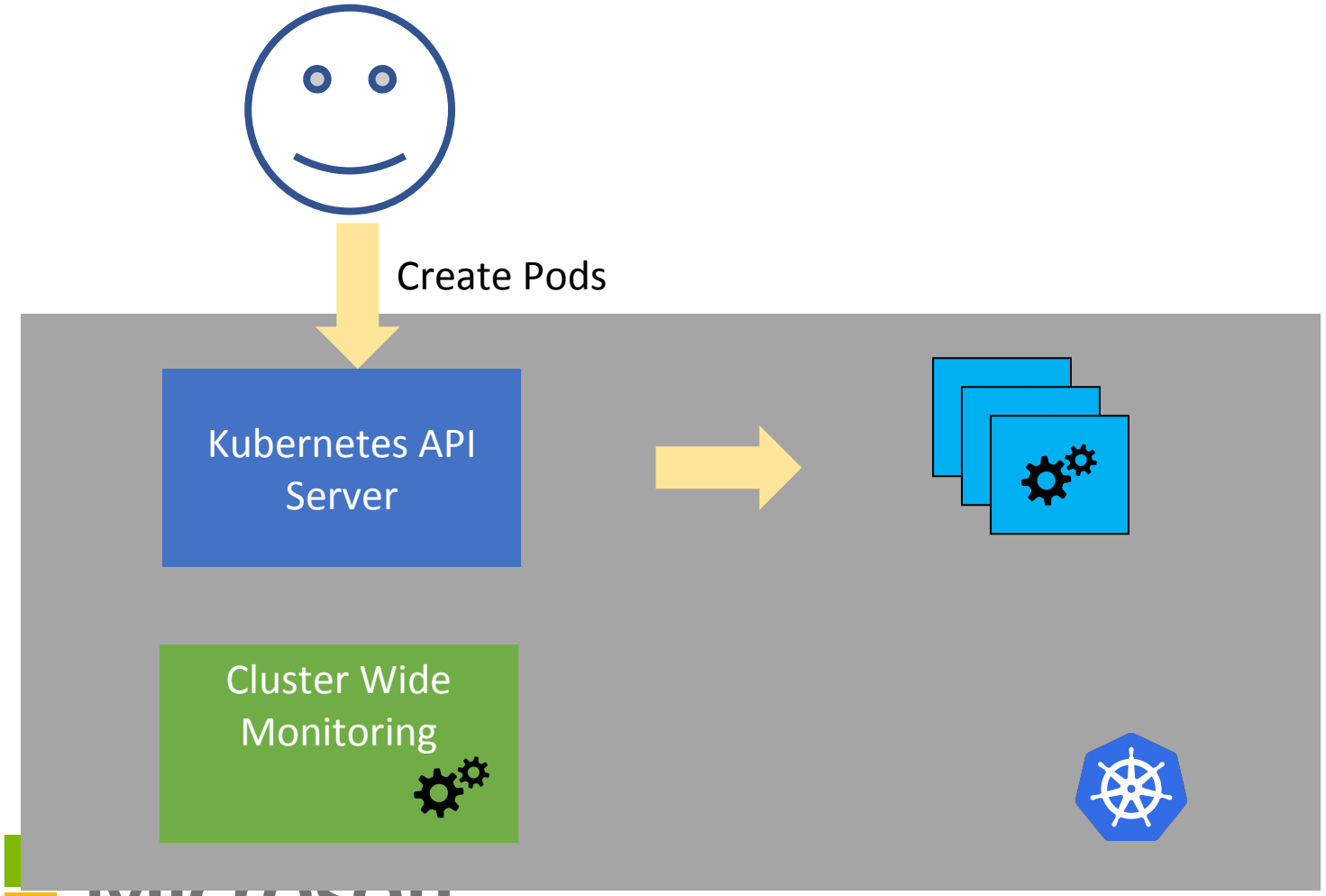
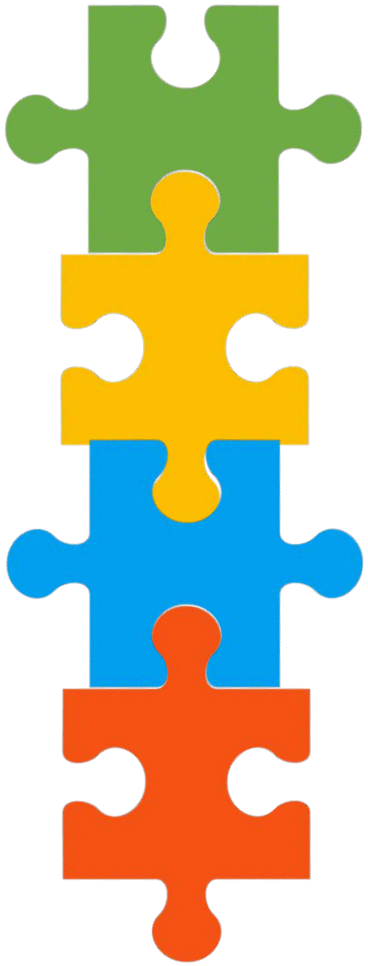
Cluster Services





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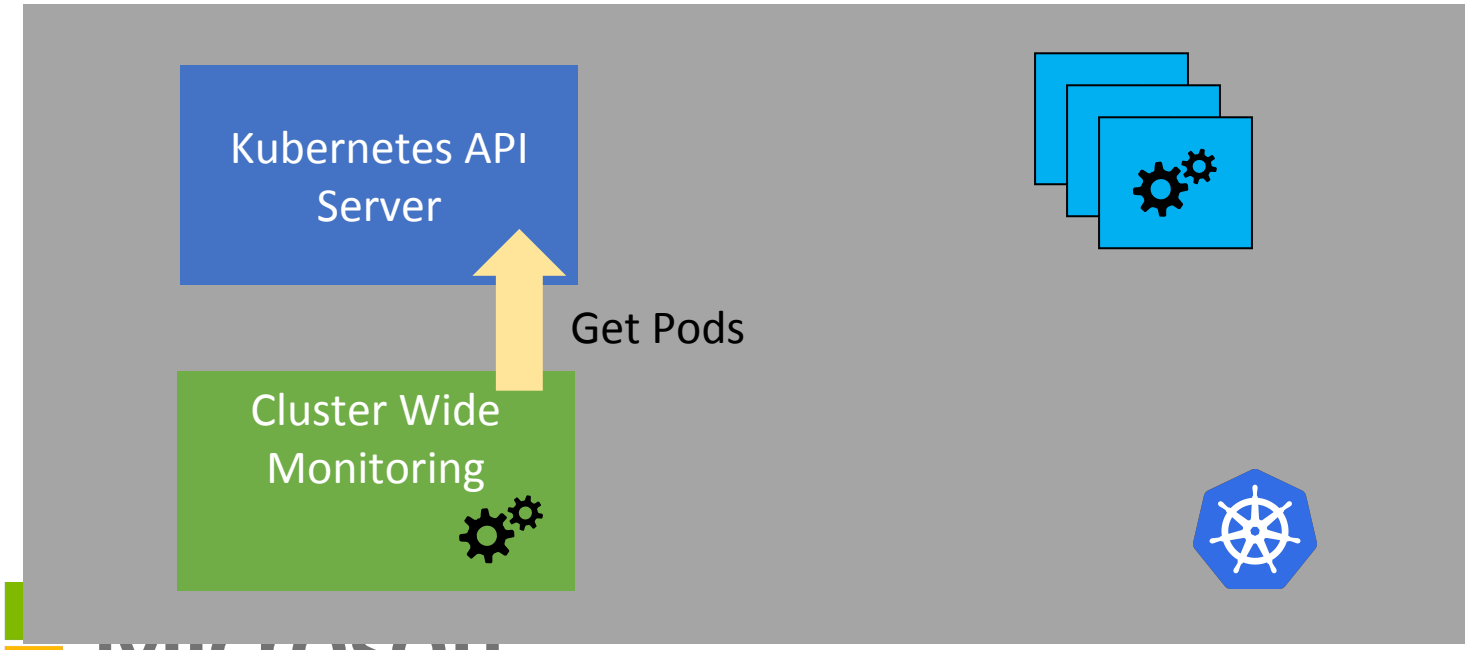
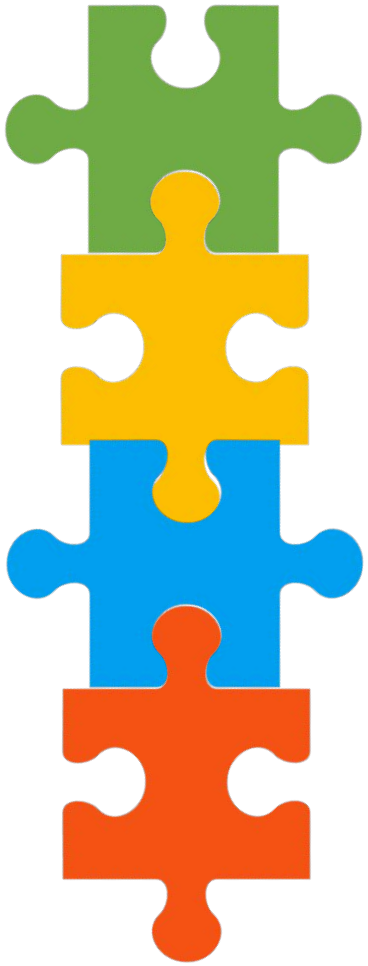
Cluster Services





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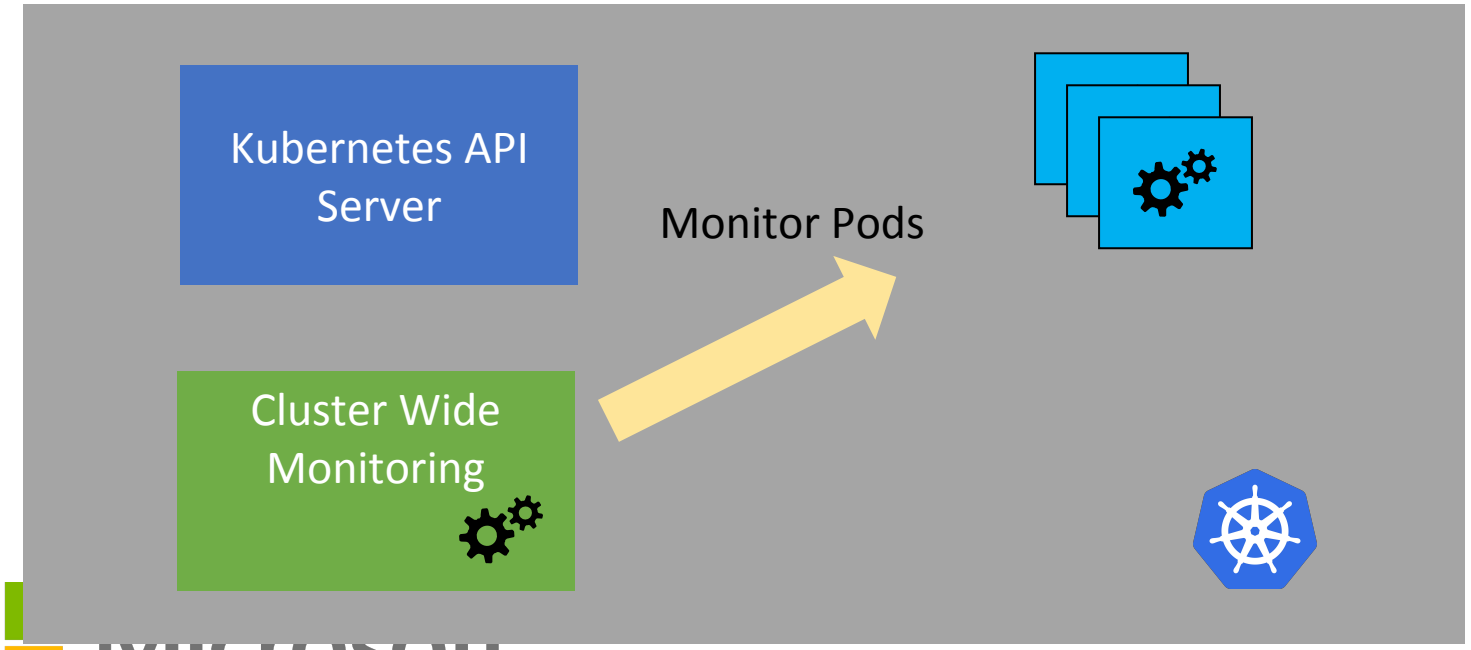
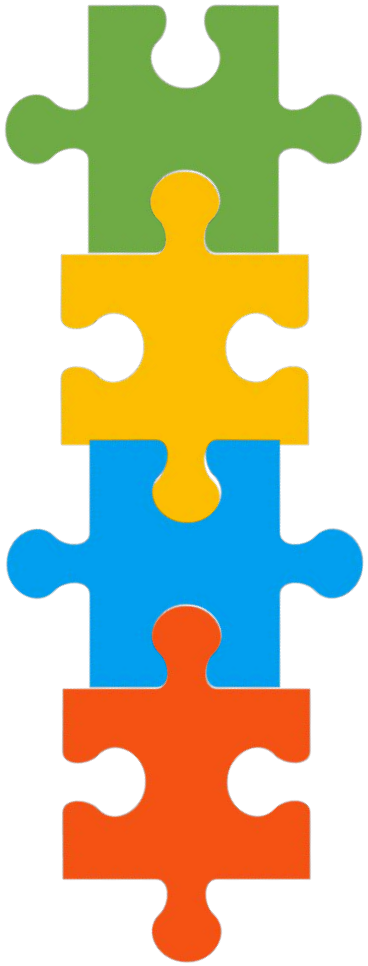
Cluster Services





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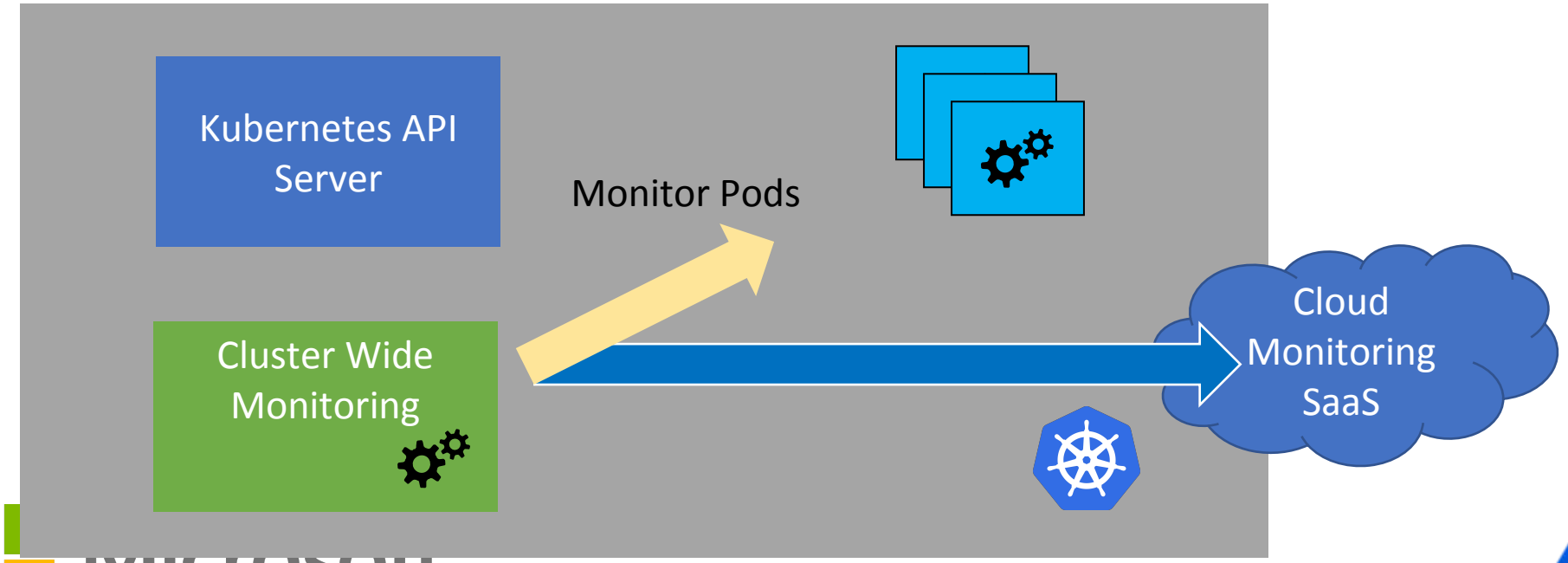
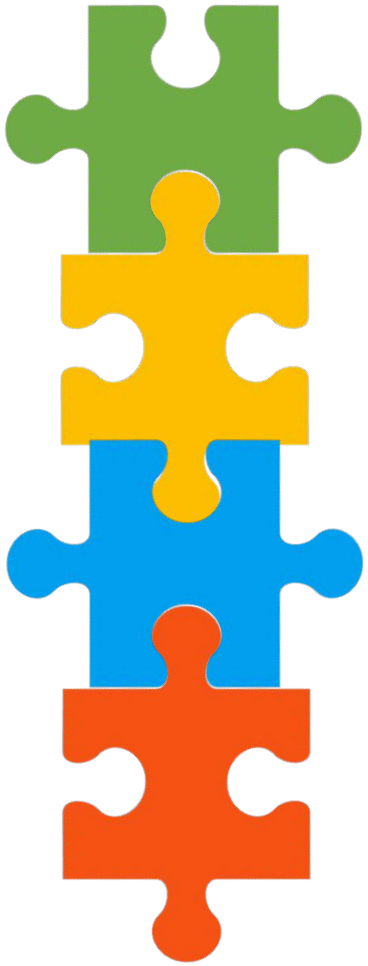
Cluster Services





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Solutions: Patterns & Libraries

- Examples:
  - Posix
  - `npm install …`
  - Unit testing
  - Extensible libraries of patterns
  - …

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Solutions: Patterns and libraries

- Brigade (https://brigade.sh)
- Service Mesh
  - Istio (https://istio.io)
  - linkerd (https://buoyant.io)
- Hadoop/Spark/…
- PaaS on top of Kubernetes

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Brigade (https://brigade.sh)

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Brigade (https://brigade.sh)

```
const { events, Job , Group} = require("brigadier");
const dest = "$GOPATH/src/github.com/technosophos/ulid";

events.on("push", (e, p) => {
    var gh = JSON.parse(e.payload)
    var test = new Job("test", "golang:1.9")
    test.tasks = [
        "mkdir -p " + dest,
        "cp -a /src/* " + dest,
        "cd " + dest,
        "go get -u github.com/golang/dep/cmd/dep",
        "dep ensure",
        "make test"
    ];
    test.run() });
```

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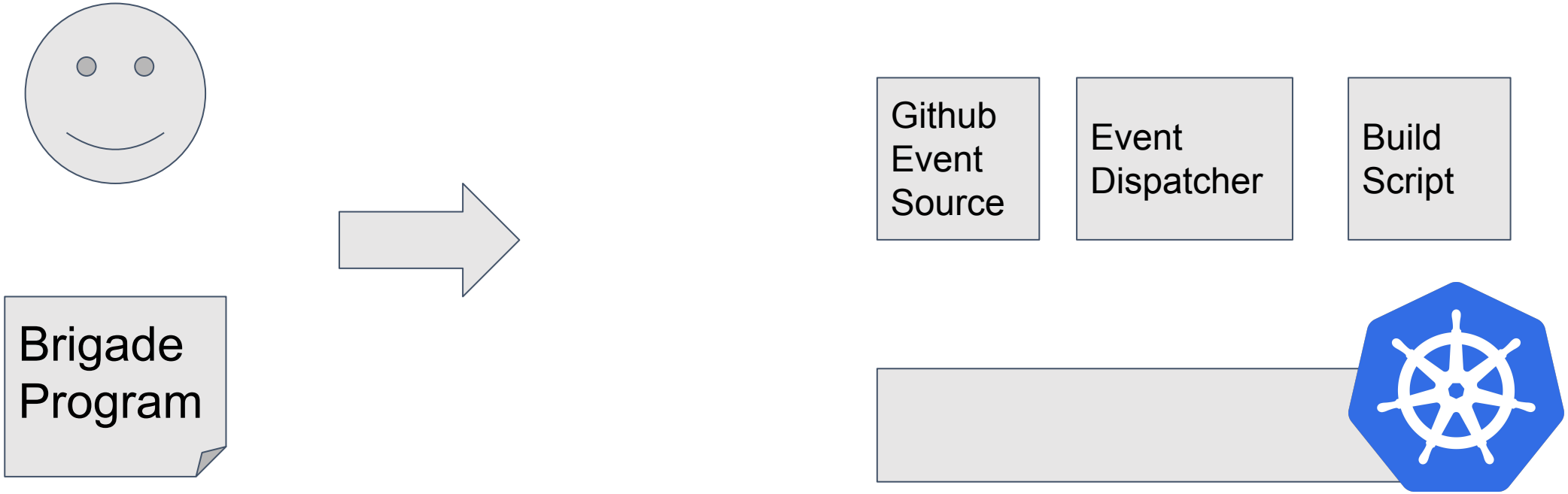
Brigade (https://brigade.sh)



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Solutions: Language Features

- Examples:
  - `synchronized`
  - `async/await`
  - Garbage Collection
  - Single threading
  - Channels
  - …

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How do we build a language idiomatic cloud?

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The problem(s).

- Code to cloud*
- Cloud* to distributed system

* 'cloud' represents API driven deployment infrastructure

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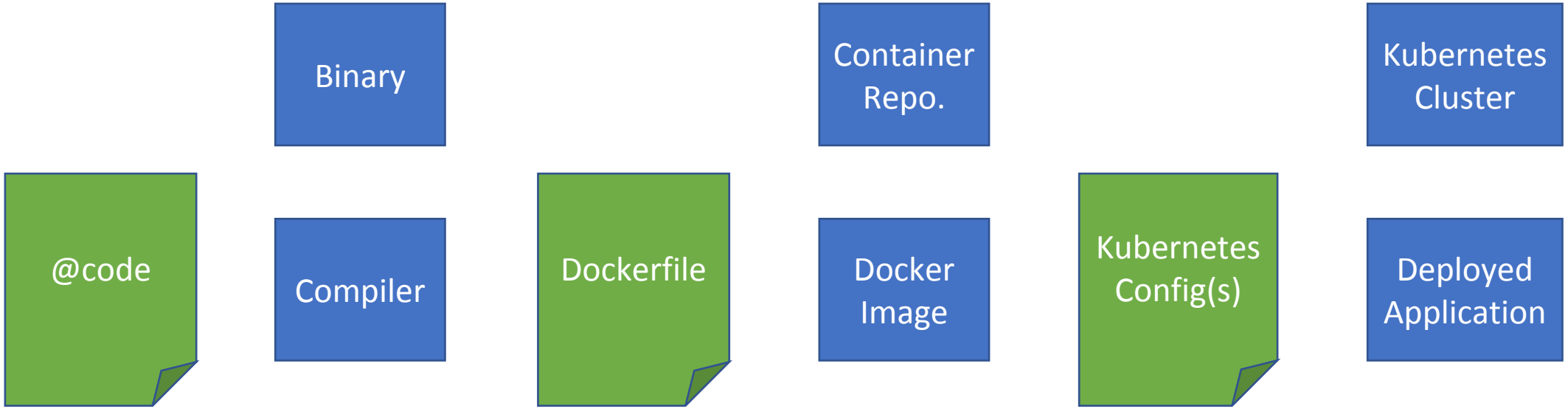
From code to cloud



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From code to cloud

- At *least* three files
  - Code, Dockerfile, Kubernetes Config
- At *least* three languages
  - Code, Dockerfile, YAML
- At *least* three tools
  - Editor, docker, kubectl

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And we haven't talked distributed systems...

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Or day two operations…

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Does this seem ok?

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Design Principles

It has to be a formal programming language

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Design Principles

It can’t be a PaaS/Walled Garden

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Design Principles

It needs to be idiomatic

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Design Principles

It has to be open source

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More learning from history

```
public class MyMapper { … }

public class MyReducer { … }
```

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More learning from (recent) history

```
values = [...]
values.map(lambda x … )
```

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More learning from (recent) history

```
values = [...]
values.map(lambda x … )

pywren.map(values, lambda x …)
```

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Metaparticle (https://metaparticle.io)

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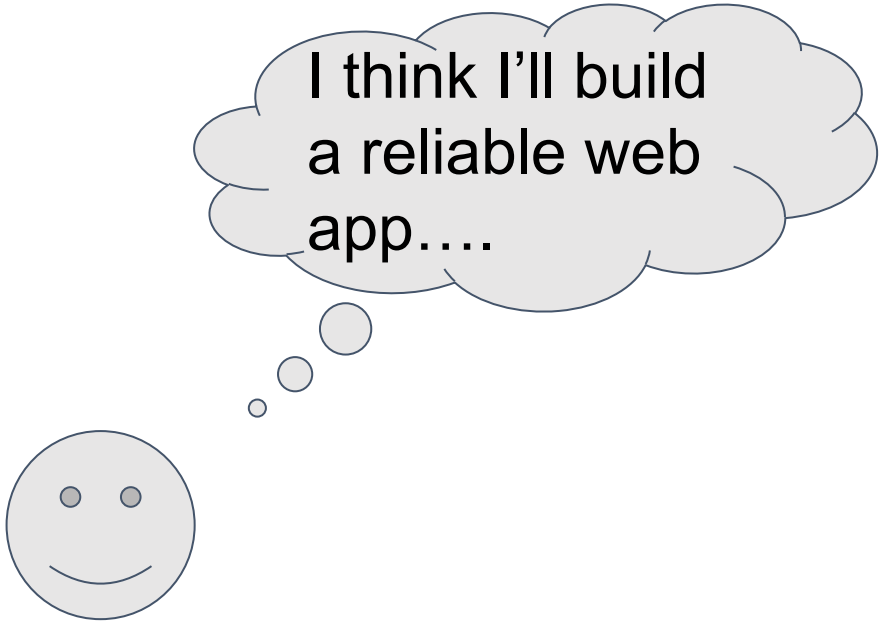
Metaparticle (https://metaparticle.io)



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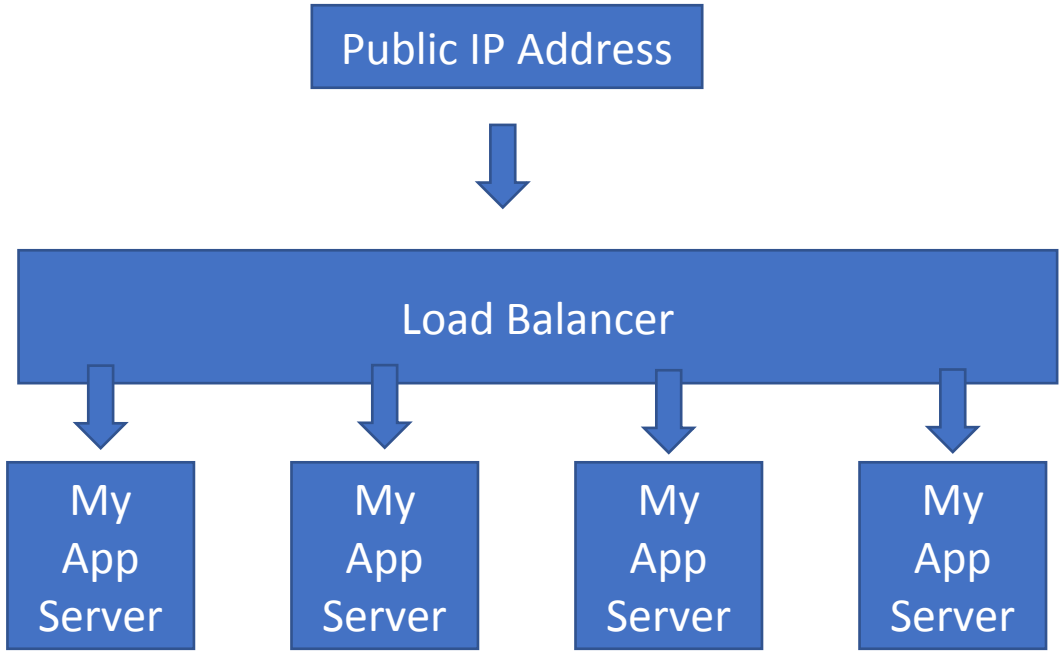
Metaparticle (https://metaparticle.io)



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Metaparticle (Python)

```
from metaparticle import containerize

@containerize(
    options={
        'ports': [8080],
        'replicas': 4,
    })

def main():
    Handler = MyHandler
    httpd = SocketServer.TCPServer(("", port), Handler)
    httpd.serve_forever()
```

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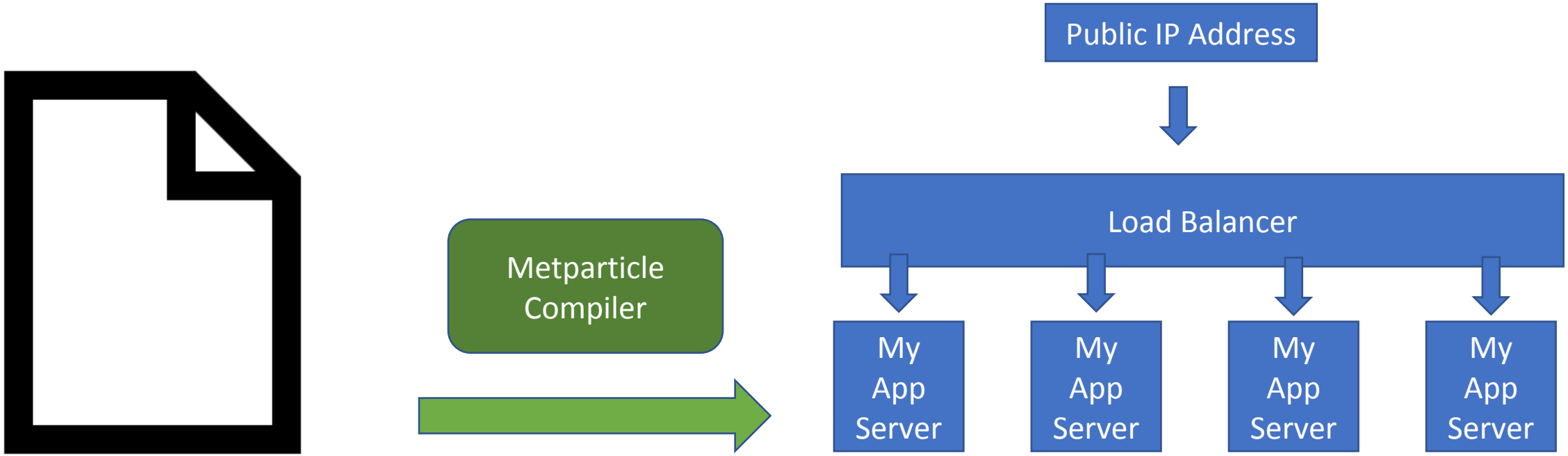
Metaparticle



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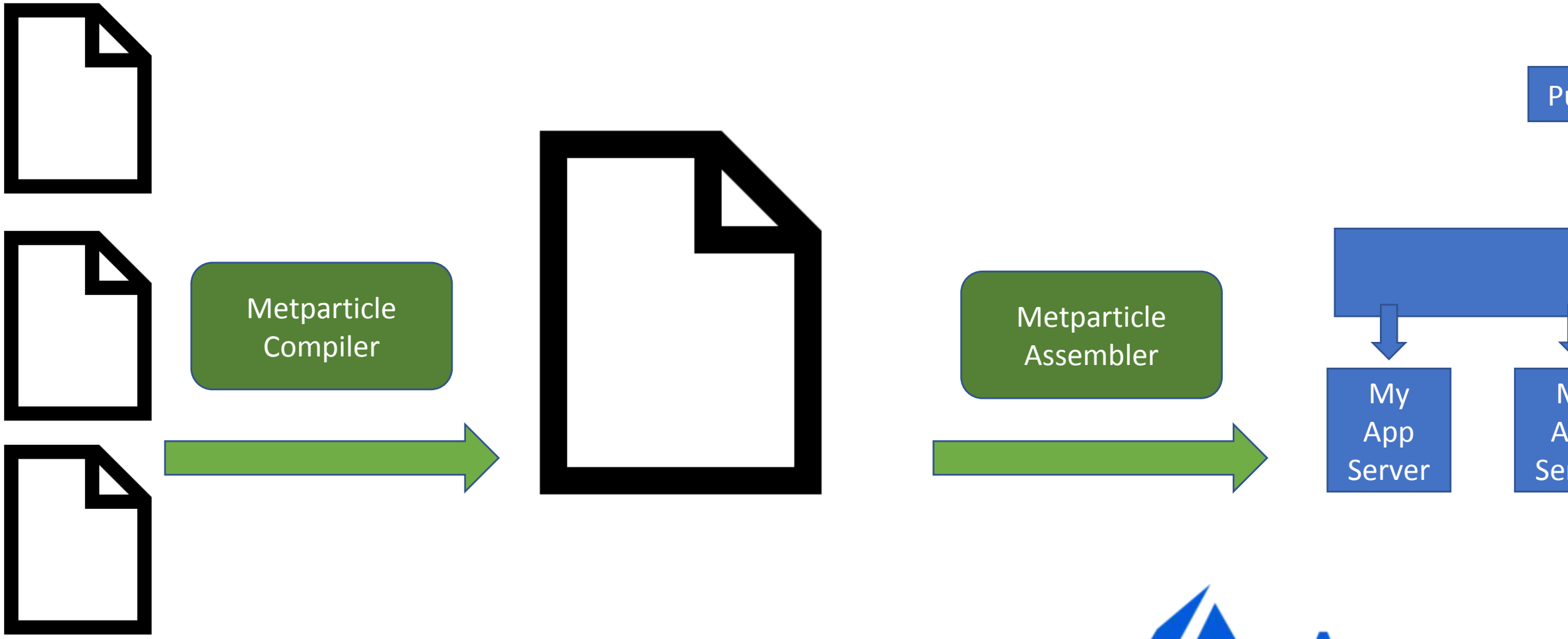
Metaparticle



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Metaparticle (Javascript)

```
const mp = require('@metaparticle/package');

const server = http.createServer((request, response) => {
   response.end(`Hello World: hostname: ${os.hostname()}\n`);
});

mp.containerize(
   {
      'replicas': 4
   },
   () => {
      server.listen(port, () => {
         console.log(`server up on ${port}`);
      });
   }
);
```

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Metaparticle Languages

- Python
- Javascript
- Java
- C#
- Go
- Rust
- Ruby
- <your favorite language here>

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Metaparticle: Demo

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more containers, more problems...

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Metaparticle: Synchronization

```
import io.metaparticle.sync.Lock;

public class Main {
    public static void main(String[] args) throws InterruptedException {
        Lock lock = new Lock("test");

        lock.lock();
        Thread.sleep(45 * 1000);
        lock.unlock();
    }
}
```

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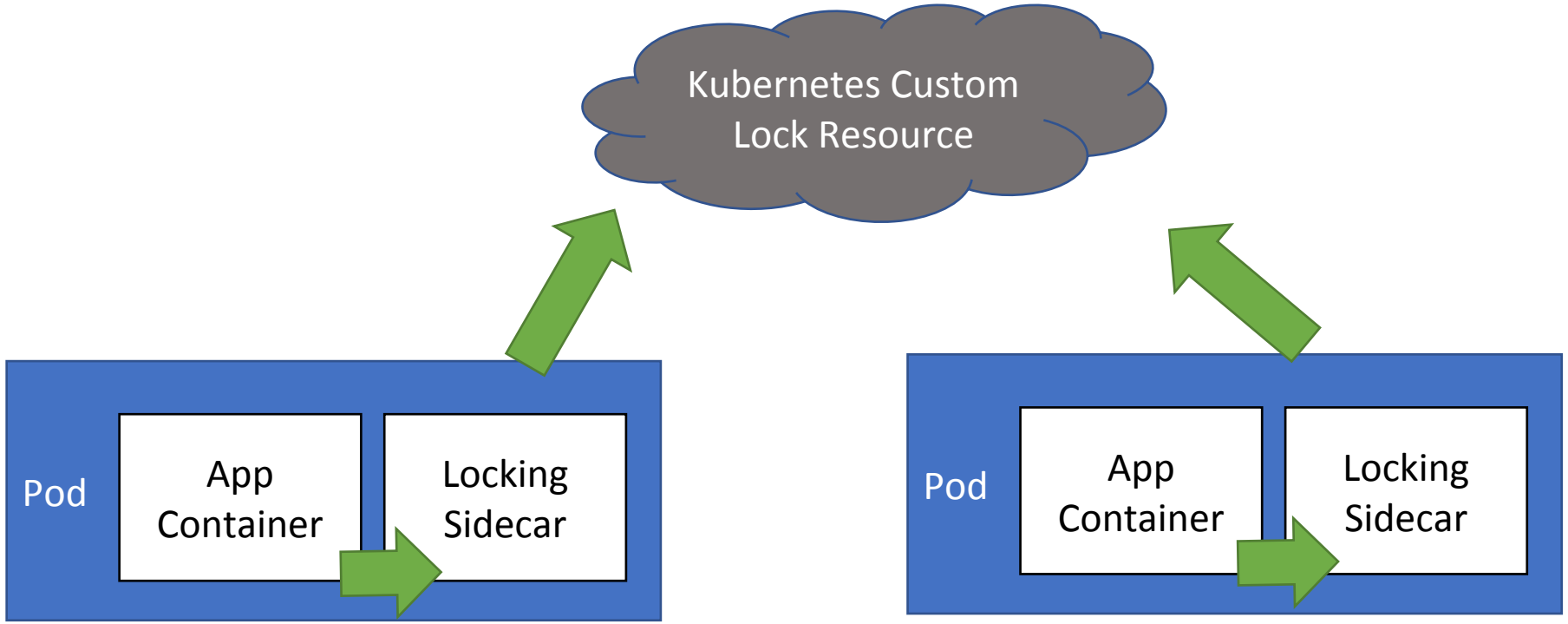
Metaparticle Synchronization



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Metaparticle: Synchronization

```
import metaparticle_sync

def master_fn():
    print('I am the master')

def lost_master_fn():
    print('I lost the master')

el = metaparticle_sync.Election('test', master_fn, lost_master_fn)
el.run()
```

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Moving on…

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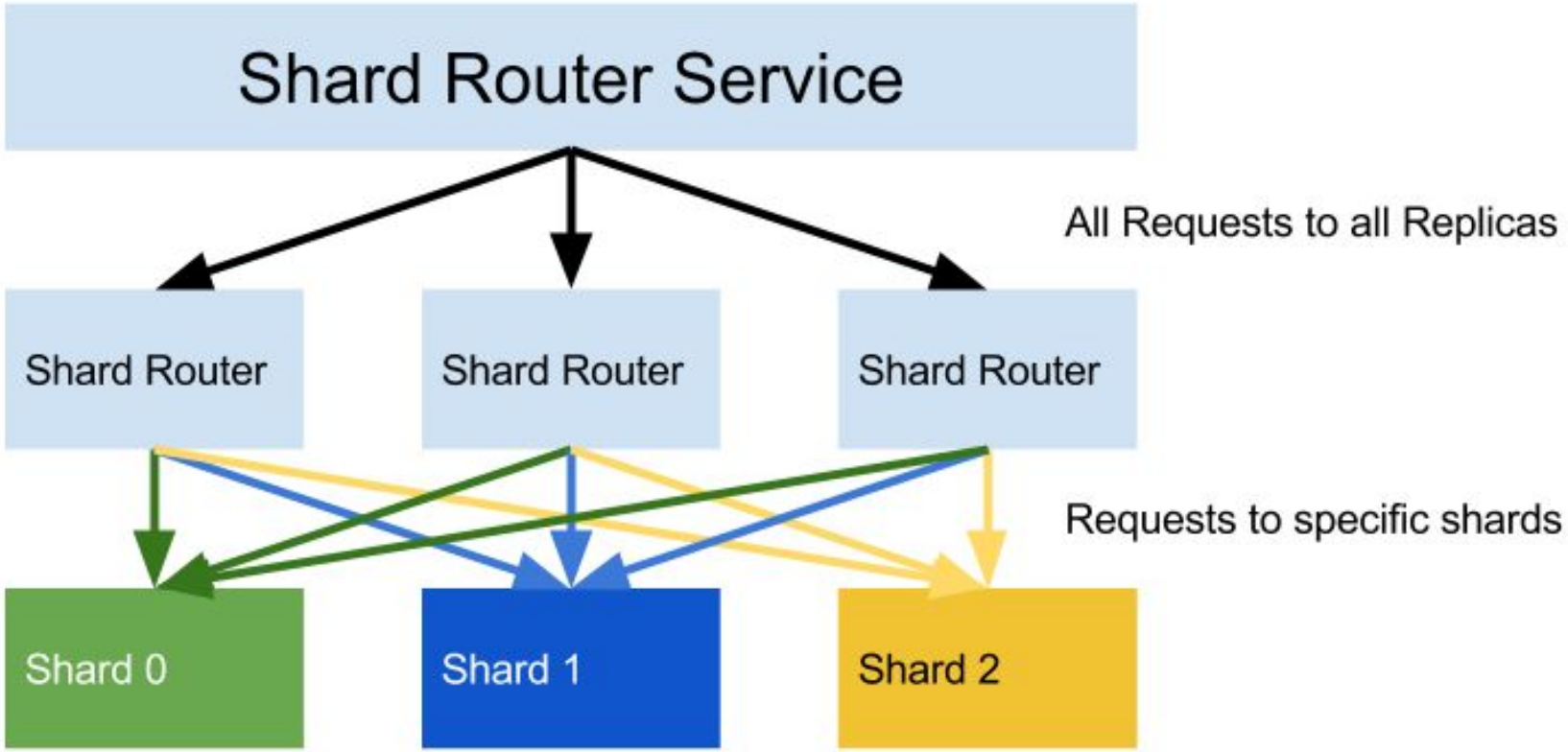
Metaparticle: Sharding



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Metaparticle: Sharding

```
@Runtime(
   shards = 4,
   urlShardPattern = "^\\/users\\/([^\\/]*)\\/.*")
@Package(
   repository="brendanburns",
   jarFile="target/metaparticle-package-0.1-SNAPSHOT-jar-with-dependencies.jar")

public static void main(String[] args) {
   Containerize(() -> {
      try {
         HttpServer server = HttpServer.create(new InetSocketAddress(8080), 0);
         server.createContext("/", new HttpHandler() {
               . . .
         });
   });
}
```

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Metaparticle: Demo

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Taking it further: MetaML

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MetaML Example

https://aka.ms/metaml

```
@Train(
  package={
    'name': 'some_image_name',
    'repository': 'some_docker_repo',
    'publish': True},
  strategy=HyperparameterTuning({
    'learning_rate': random.normalvariate(0.5, 0.5)},
     parallelism=3),
  tensorboard={ 'log_dir': FLAGS.log_dir, } )

def my_training_function(learning_rate):
   # some training logic ...
```

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MetaML Example

```
from metaml.serve import Serve

@Serve(package={
    'name': 'simple-serve',
    'repository': 'wbuchwalter',
    'publish': True})

def func():
  return "hello world"

func()
```

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Where to next?

- https://metaparticle.io
- https://github.com/metaparticle-io/

- https://aka.ms/metaml

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