

Quilt

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Everything has an API



Compute



Network



DevOps

1. Choose a Compute API
2. Choose a Network API
3. Write a Deployment Script



Deployment Script

Simple right?



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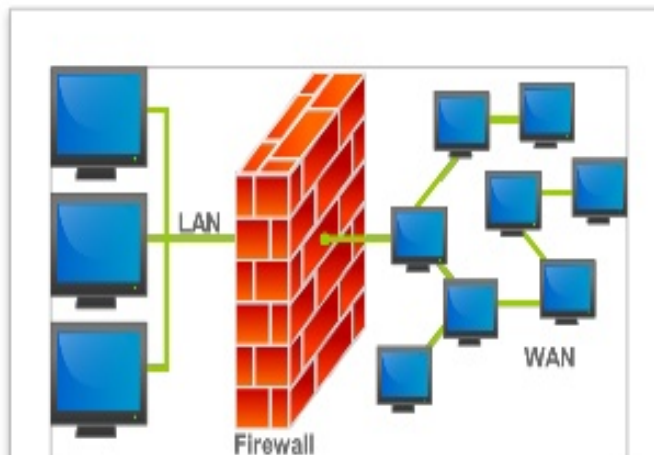
spark-ec2.py

- Official Spark Script
- 1528 Lines of Code
- Incomprehensible



Network Security

- Status Quo
 - Secure the Perimeter
- A Better Way
 - Tight East-West Firewall
 - Increased script complexity

[illegible]

Portability



Microsoft Azure



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spark_ec2.py
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spark_ec2.py
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Quilt

Automated Deployment



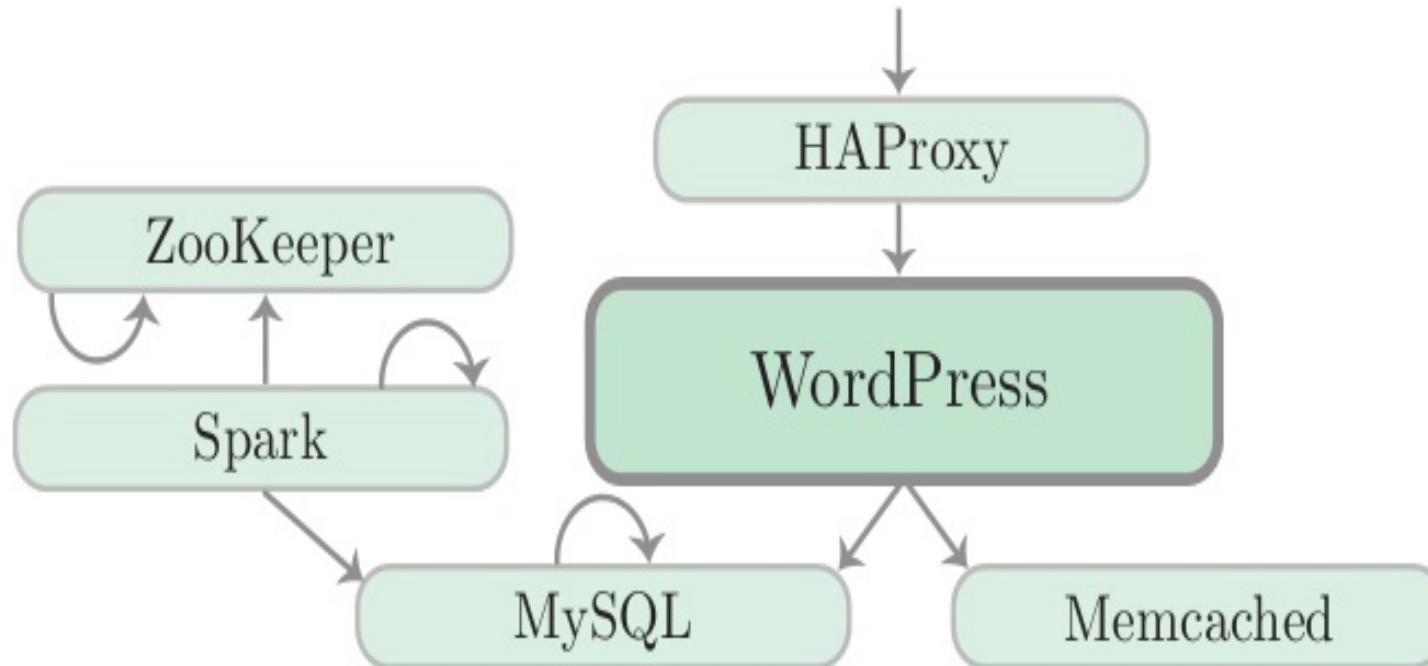
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Quilt DSL: Stitch

- Declarative Application Specification
- Lisp Dialect
- Declaration Includes:
 - Application Network and Compute
 - Infrastructure

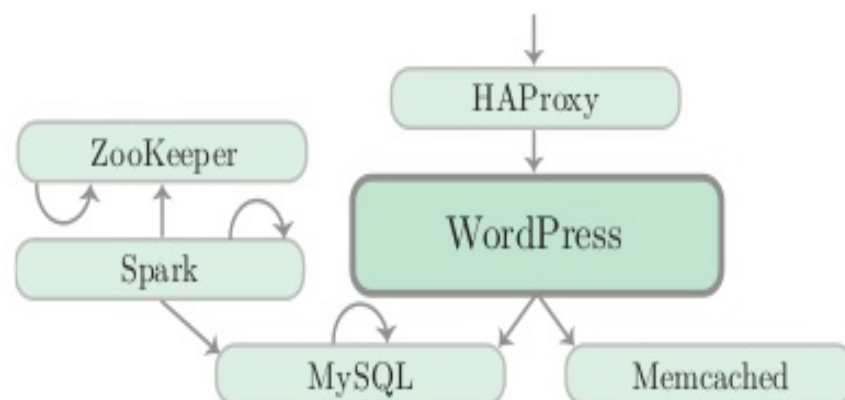


Example: Wordpress



WordPress

```
1 (import "haproxy")
2 (import "memcached")
3 (import "mysql")
4 (import "spark")
5 (import "wordpress")
6 (import "zookeeper")
7
8 (let ((db (mysql.New "db" 2))
9       (memcd (memcached.New "memcd" 3))
10      (wp (wordpress.New "wp" 8 db memcd))
11      (hap (haproxy.New "hap" 2 wp))
12      (zk (zookeeper.New "zk" 3))
13      (spark (spark.New "spark" 2 4 zk)))
14   (connect 7077 (hmapValues spark)
15           (hmapValues db))
16   (connect 80 "public" hap))
```



wordpress.New

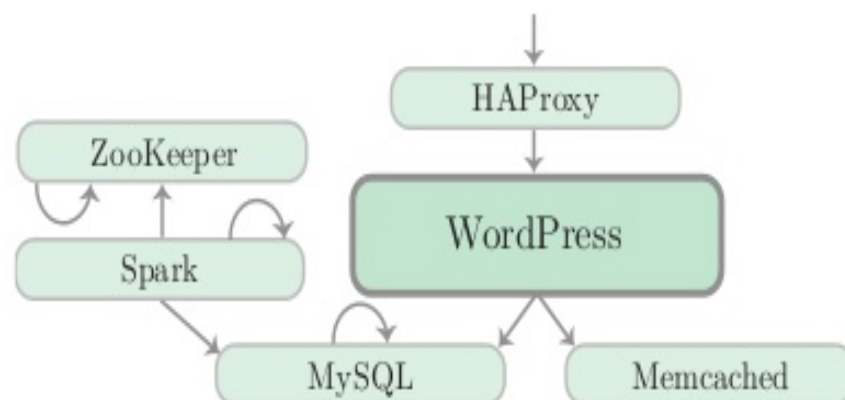
```
1 (define (New name n db memcd)
2   (let ((dk (makeList n (docker image))))
3     (labelNames (strings.Range name n))
4     (wp (map label labelNames dk)))
5   (configure wp db memcd)
6   (connect 3306 wp (hmapGet db "master"))
7   (connect 3306 wp (hmapGet db "slave"))
8   (connect 11211 wp memcd)
9   wp) )
```

(wordpress.New "wp" 8 db memcd)

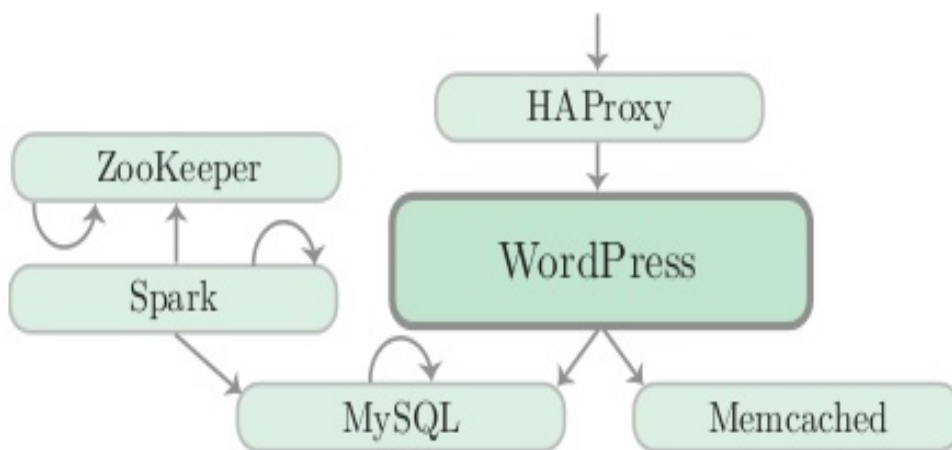


WordPress

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```

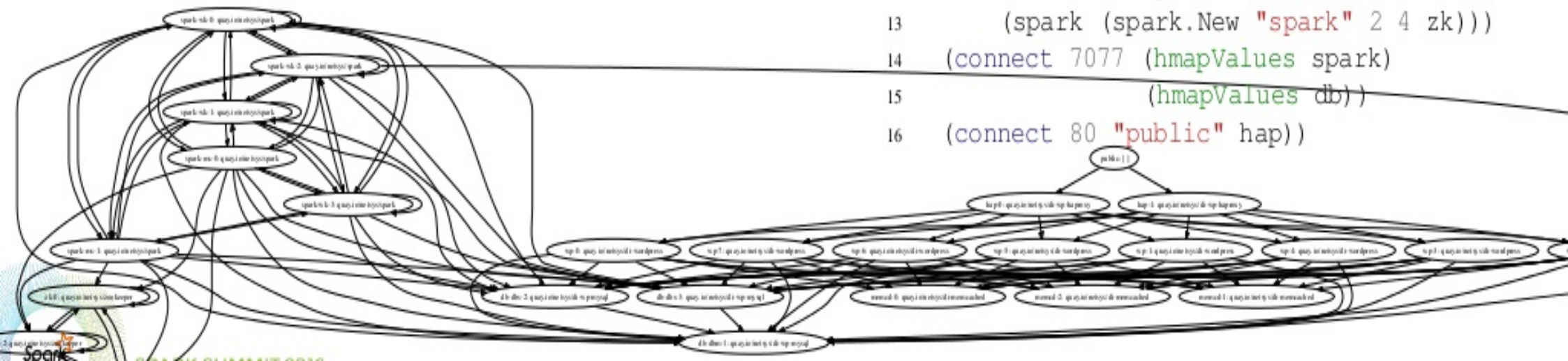


WordPress



```

1 (import "haproxy")
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3 (import "mysql")
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7
8 (let ((db (mysql.New "db" 2))
9       (memcd (memcached.New "memcd" 3))
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12      (zk (zookeeper.New "zk" 3))
13      (spark (spark.New "spark" 2 4 zk)))
14 (connect 7077 (hmapValues spark)
15              (hmapValues db))
16 (connect 80 "public" hap))
    
```



Infrastructure

```
1 (define cfg
2   (list (provider "Amazon") (region "us-west-1")
3         (ram 32 64) (cpu 4 8) (sshkey "elided")))
4
5 (makeList 3 (machine (role "Master") cfg))
6 (makeList 32 (machine (role "Worker") cfg))
```



Infrastructure

```
1 (define cfg
2   (list (provider "Amazon") (region "us-west-1")
3         (ram 32 64) (cpu 4 8) (sshkey "elided")))
4
5 (makeList 3 (machine (role "Master") cfg))
6 (makeList 32 (machine (role "Worker") cfg))
```



Infrastructure

```
1 (define cfg           Azure           Central US
2   (list (provider "Amazon") (region "us-west-1")
3         (ram 32 64) (cpu 4 8) (sshkey "elided")))
4
5 (makeList 3 (machine (role "Master") cfg))
6 (makeList 32 (machine (role "Worker") cfg))
```



EC2

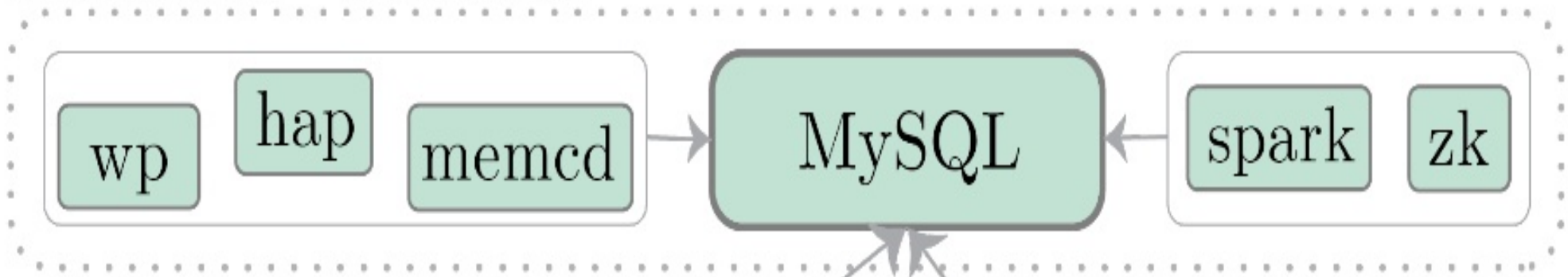


Microsoft Azure

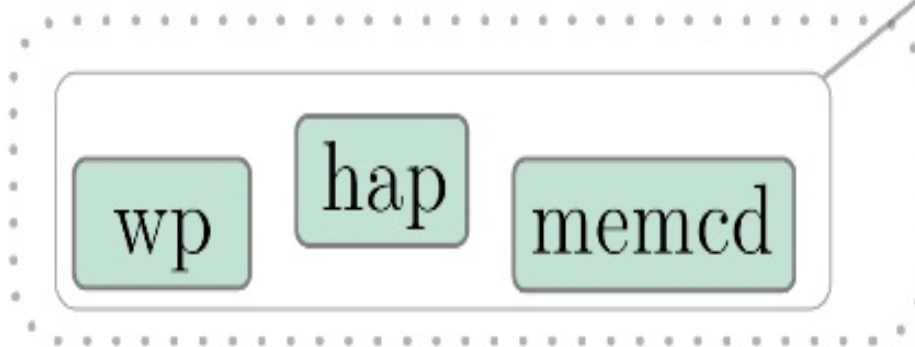


Geographical Distribution

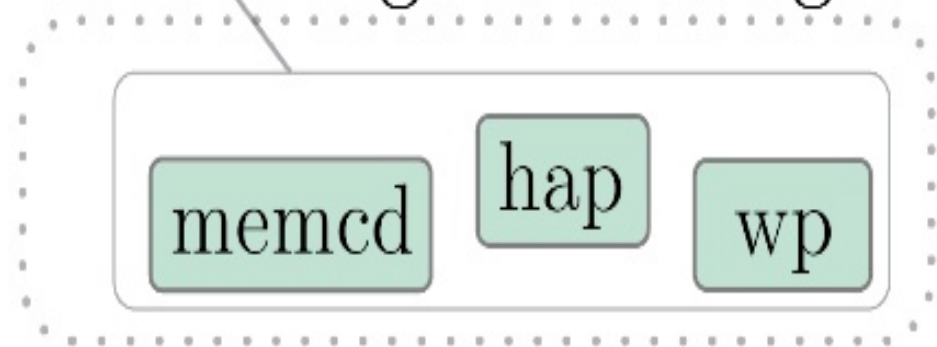
Australia - Amazon



Iowa - Microsoft

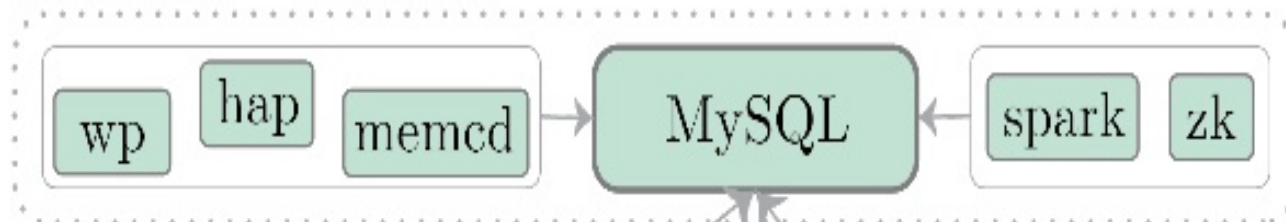


Belgium - Google

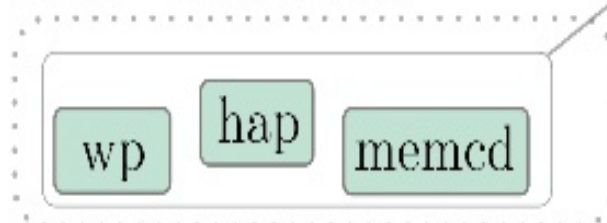


Geographical Distribution

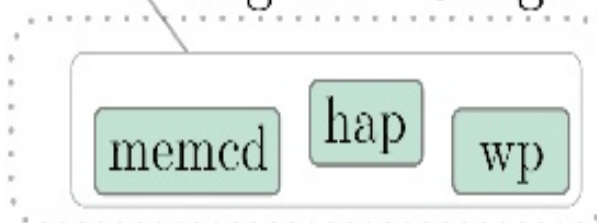
Australia - Amazon



Iowa - Microsoft



Belgium - Google



```
1 (define cfg (list (ram 32 64) (cpu 4 8)
2                   (sshkey "<elided>")))
3
4 (define db (mysql.New "db" 2))
5 (define zk (zookeeper.New "zk" 3))
6 (define spark (spark.New "spark" 2 4 zk))
7 (connect 7077 (hmapValues spark) (hmapValues db))
8
9 (define (makeLoc prvd rgn)
10   (list (provider prvd) (region rgn)))
11
12 (define (makePod name)
13   (let ((memcd (memcached.New (+ name "-mem") 1))
14         (wp (wordpress.New (+ name "-wp")
15                             2 db memcd))
16         (hap (haproxy.New (+ name "-hap") 1 wp)))
17     (connect 80 "public" hap)
18     (list memcd wp hap)))
19
20 (define (deploy pod loc)
21   (makeList 16 (machine (role "Worker") cfg loc))
22   (place (machineRule "on" loc) pod))
23
24 (deploy (makePod "gce")
25         (makeLoc "Google" "europe-west1-b"))
26
27 (deploy (makePod "azure")
28         (makeLoc "Azure" "Central US"))
29
30 (let ((loc (makeLoc "Amazon" "ap-southeast-2"))
31       (nodes (append (makePod "aws") zk
32                       (hmapValues db)
33                       (hmapValues spark))))
```



Stitch



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Stitch

- Lisp (Scheme)
 - Variables
 - Arithmetic
 - Functions
 - Modules
- Domain Specific Primitives



Stitch — Primitives

- Application Primitives
 - “docker”, “label”, “connect”, “place”, “setEnv”
- Infrastructure Primitives
 - “machine”
 - “role”, “provider”, “region”, “ram”, “cpu”, “size”



Stitch — Primitives

```
(label "spark-master" (docker "quilt/spark" "start-master.sh"))
```

```
(label "spark-worker"  
  (makeList 10 (docker "quilt/spark" "start-worker.sh"  
    "spark://spark-master.di:7077"))))
```

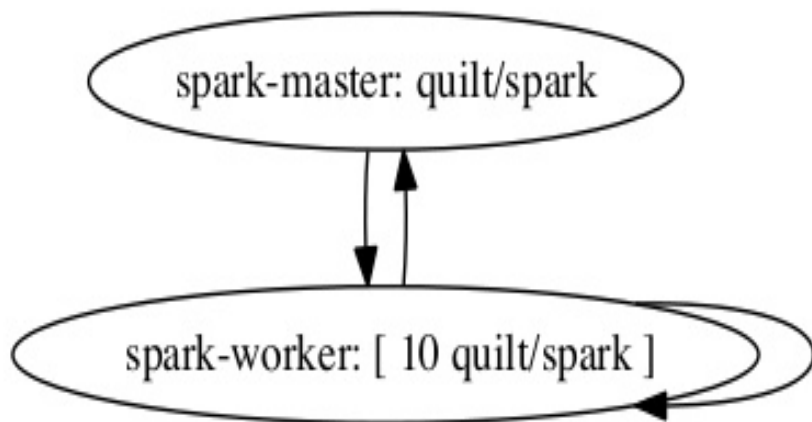
```
// Spark workers listen on random ports. Must open up everything.
```

```
(connect (list 1000 65535)  
  (list "spark-master" "spark-worker")  
  "spark-worker")
```

```
(connect 7077 "spark-worker" "spark-master")
```



Stitch — Primitives



```
(label "spark-master" (docker "quilt/spark" "start-master.sh"))
```

```
(label "spark-worker"  
  (makeList 10 (docker "quilt/spark" "start-worker.sh"  
    "spark://spark-master.di:7077")))
```

```
// Spark workers listen on random ports. Must open up everything.  
(connect (list 1000 65535)  
  (list "spark-master" "spark-worker")  
  "spark-worker")
```

```
(connect 7077 "spark-worker" "spark-master")
```



Quilt Architecture



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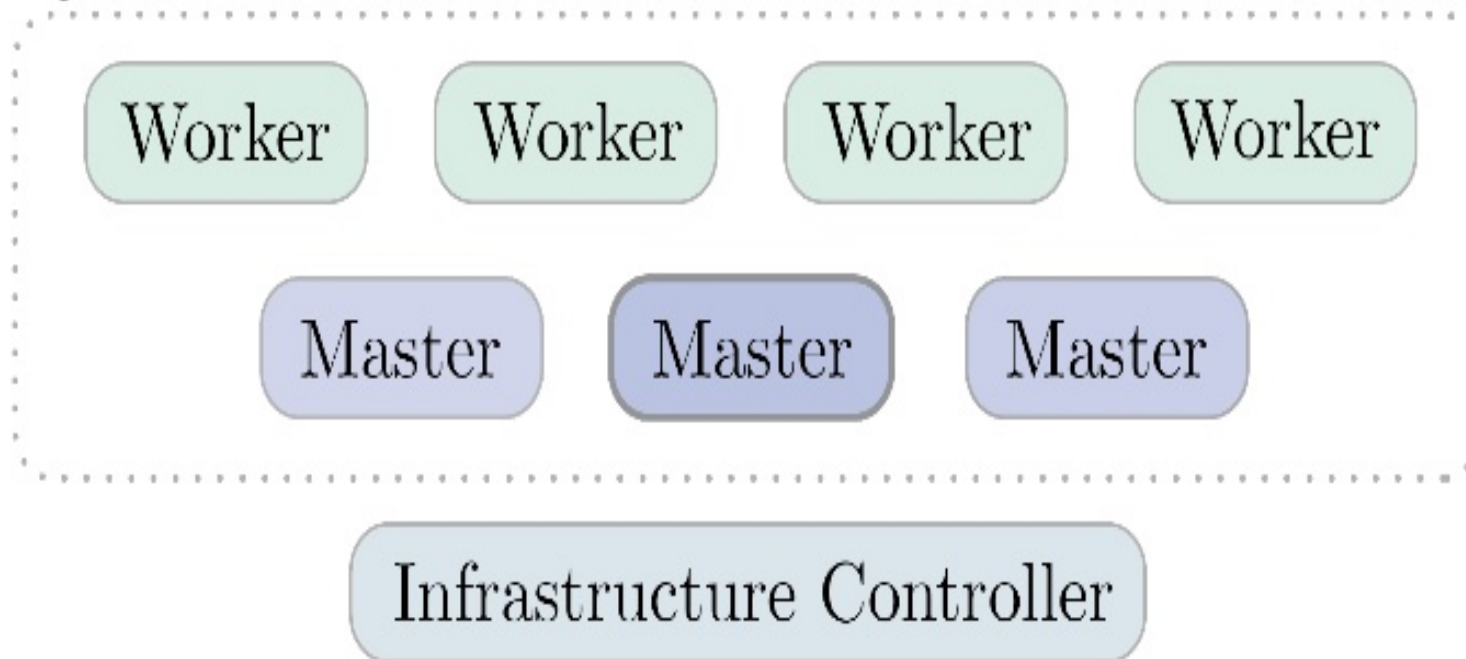
Goals

- Simple
- Robust
- Portable



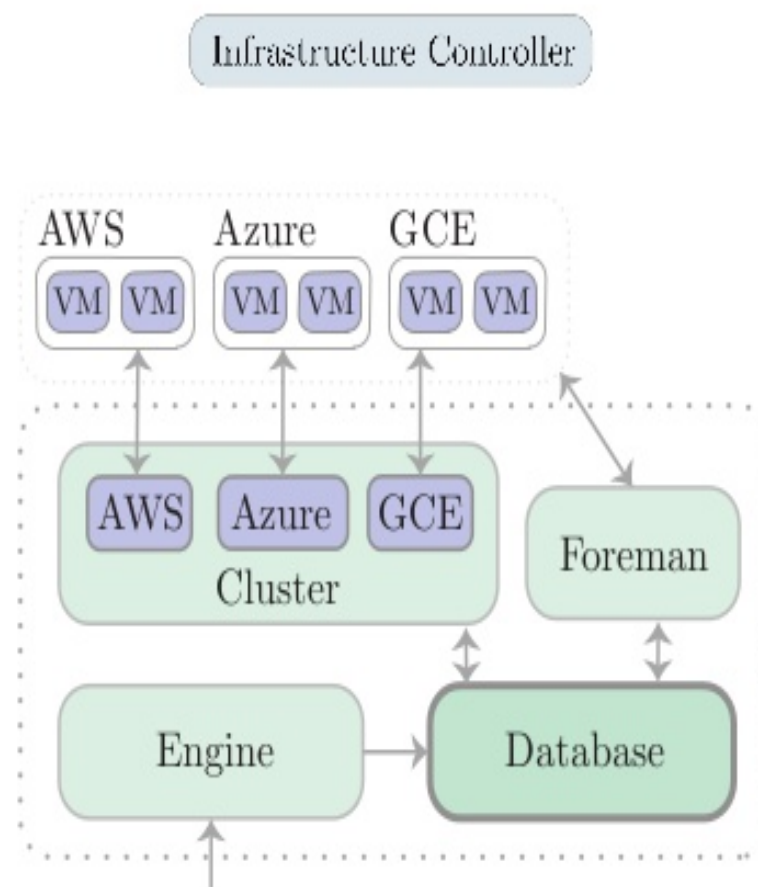
Quilt Architecture

Cluster



Infrastructure Controller

- Import Infrastructure Spec
- Update Cluster
- Cloud Provider Plugins
 - Amazon EC2
 - Google Compute Engine
 - Microsoft Azure



Cloud Provider

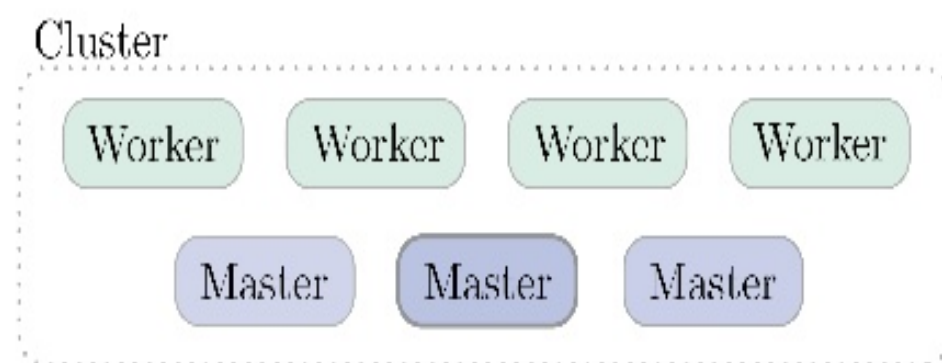
- Boot, Stop, List
- Network Reachability
- **Application Agnostic**

```
type Provider interface {  
    Connect(namespace string) error  
  
    List() ([]Machine, error)  
  
    Boot([]Machine) error  
  
    Stop([]Machine) error  
  
    SetACLs(acls []string) error  
  
    Disconnect()  
  
    ChooseSize(ram dsl.Range, cpu dsl.Range,  
              maxPrice float64) string  
}
```



Quilt Cluster

- Virtual Machines Running ...
- Application Containers
- Open Virtual Network
 - SDN Overlay
- **Infrastructure Agnostic**



Unsolved Problems

- Application Configuration
- Container Security
- State
- External Services



Related Work



Related Work

- Container Orchestrators
 - Kubernetes, Docker Swarm, Mesos, Nomad
 - No explicit application specification
 - No tight network firewall
- Quilt is a policy layer above these systems



Related Work

- Docker Compose / Kubernetes Helm
 - Declare Groups of Containers to Boot
- Static Data Serialization Format
 - Poor modularity
- Missing network graph



Future Work



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Stitch: New Domains

- Security policy
 - Key Management
 - User Management
- Data
- Application Configuration



Stitch Analysis

- Verification
 - Stitch specifies app *entirely*
 - Simpler to verify than deployed systems
- Reachability
- Availability



Summary

- Portable Application Deployment
- Strict Network Security
- Modular, Shareable, Reusable Specifications
- In Future — Formal Analysis



Thank you

quilt.io

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