Portable Cloud Applications with Java EE

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September, 2016

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Agenda

1 Overview

2 Packaging

3 Provisioning

4 Clustering

5 Availability

6 Versioning

7 Demo

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Application Development Is Changing

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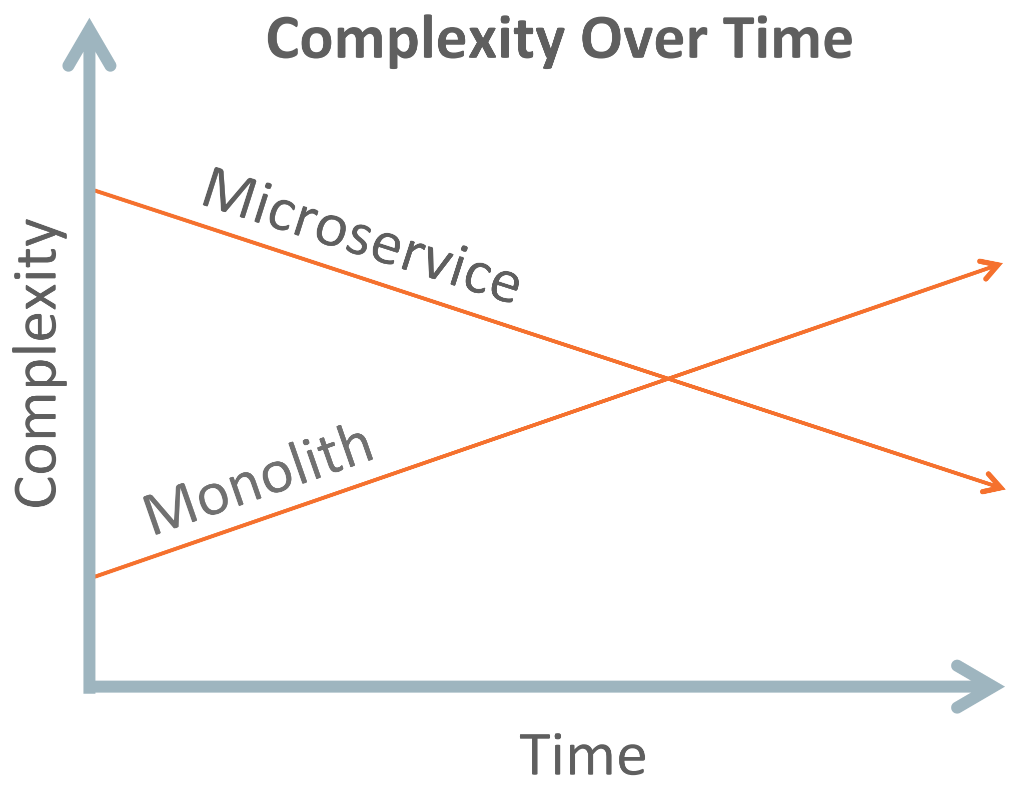
Rapid Changes Over Past Few Years

Driven by increasing business needs

- Many small blocks of code, each developed and deployed independently
- Focus on Business Capabilities
- Better adhere to Continuous Delivery principles
- Distributed and decentralized architectures are inherently more resilient
- Each microservice is easy to develop but hard to deploy



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Microservice Trends

- Distributed Single Purpose Services
  - Results in a lot of remote calls
- Interact via REST / JSON making remote calls asynchronously
- Eventual consistency for data persistence as well as across service calls
- Reactive style programming
  - Eventing
- Built in resiliency in the runtime utilizing health check, circuit breaker and bulkhead patterns

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Technical Focus Areas

Programming Model

- Extend for reactive programming
- Unified event model
- Event messaging API
- JAX-RS, HTTP/2, Lambda, JSON-B, ...

Packaging

- Package applications, runtimes into services
- Standalone immutable executable binary
- Multi-artifact archives

Key Value/Doc Store

- Persistence and query interface for key value and document DB

Eventual Consistency

- Automatically event out changes to observed data structures

Serverless

- New spec – interfaces, packaging format, manifest
- Ephemeral instantiation

Configuration

- Externalize configuration
- Unified API for accessing configuration

Multitenancy

- Increased density
- Tenant-aware routing and deployment

State

- API to store externalized state

Resiliency

- Extension to support client-side circuit breakers
- Resilient commands
- Standardize on client-side format for reporting health

Security

- Secret management
- OAuth
- OpenID

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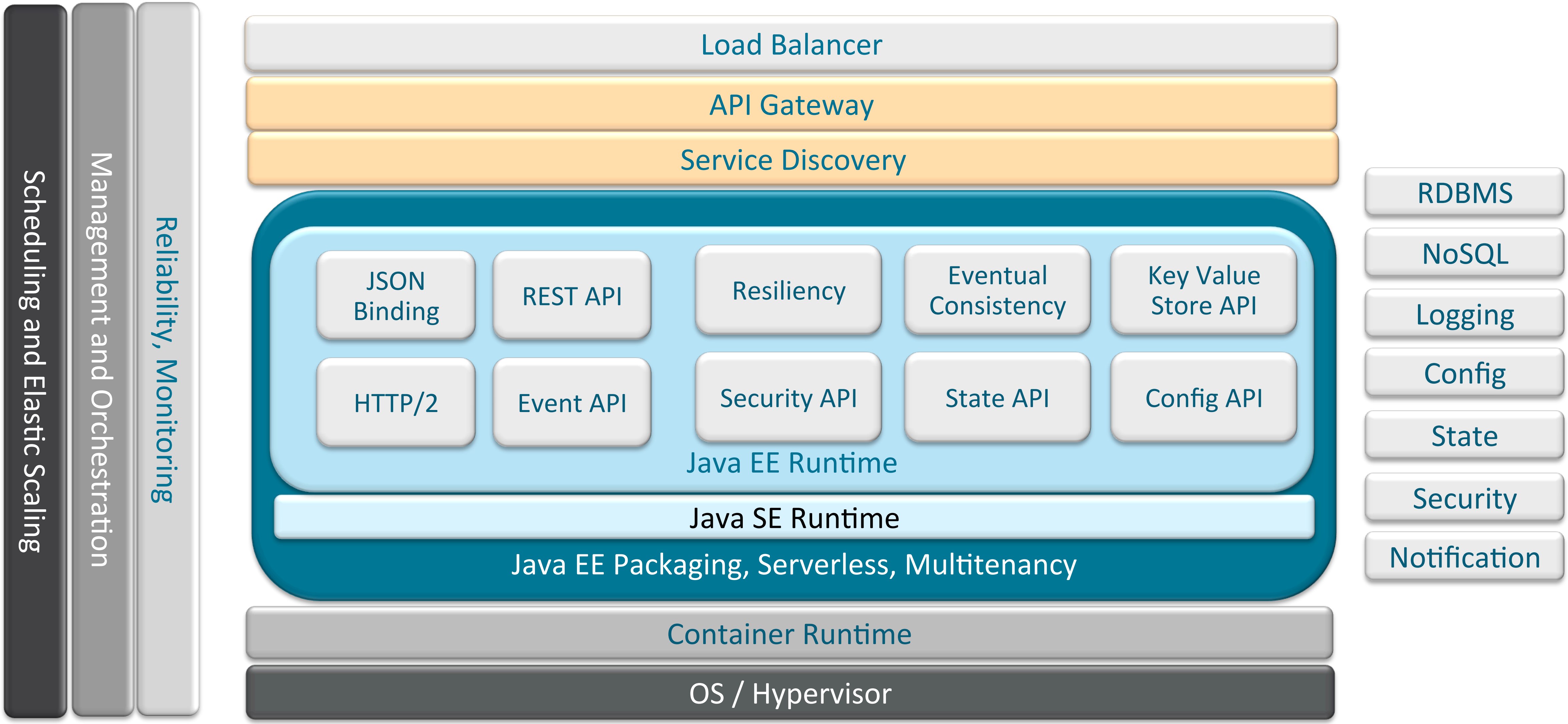
Proposed Platform Architecture



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Application Portability

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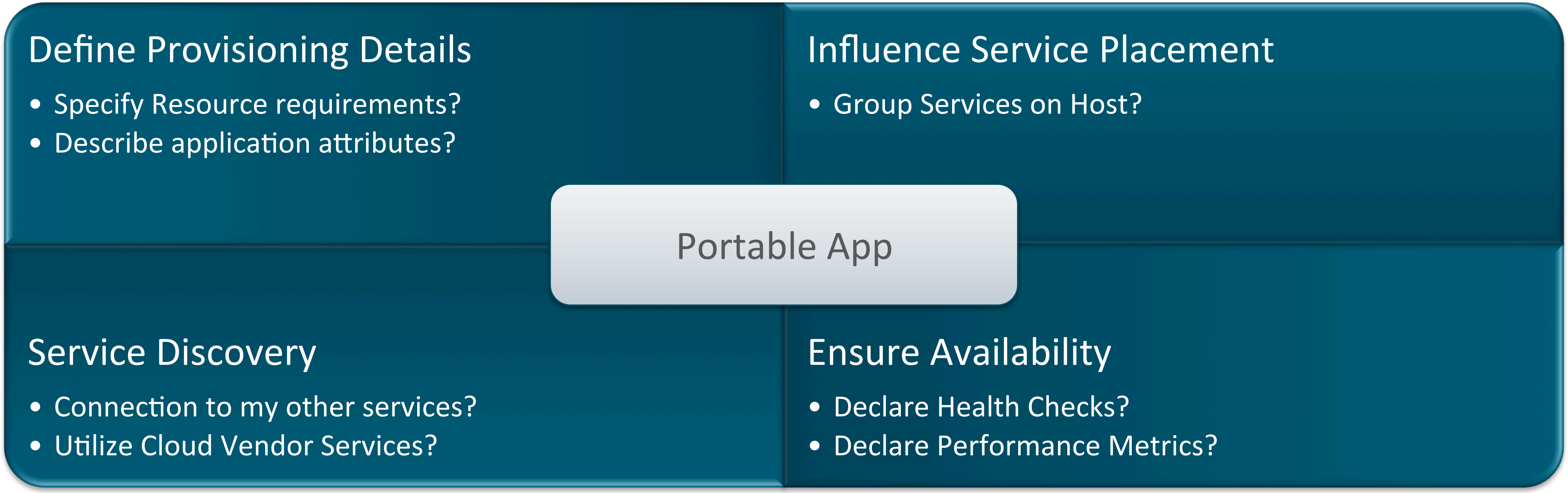
Portable Java EE 9 Microservice

Common Application Requirements Across Different Java EE 9 Environments



Define Provisioning Details

- Specify Resource requirements?
- Describe application attributes?

Influence Service Placement

- Group Services on Host?

Portable App

Service Discovery

- Connection to my other services?
- Utilize Cloud Vendor Services?

Ensure Availability

- Declare Health Checks?
- Declare Performance Metrics?

Common Cloud Infra - Cloud Infrastructure **NOT** Considered for Java EE 9

Java EE 9 - Suggestion for Java EE 9

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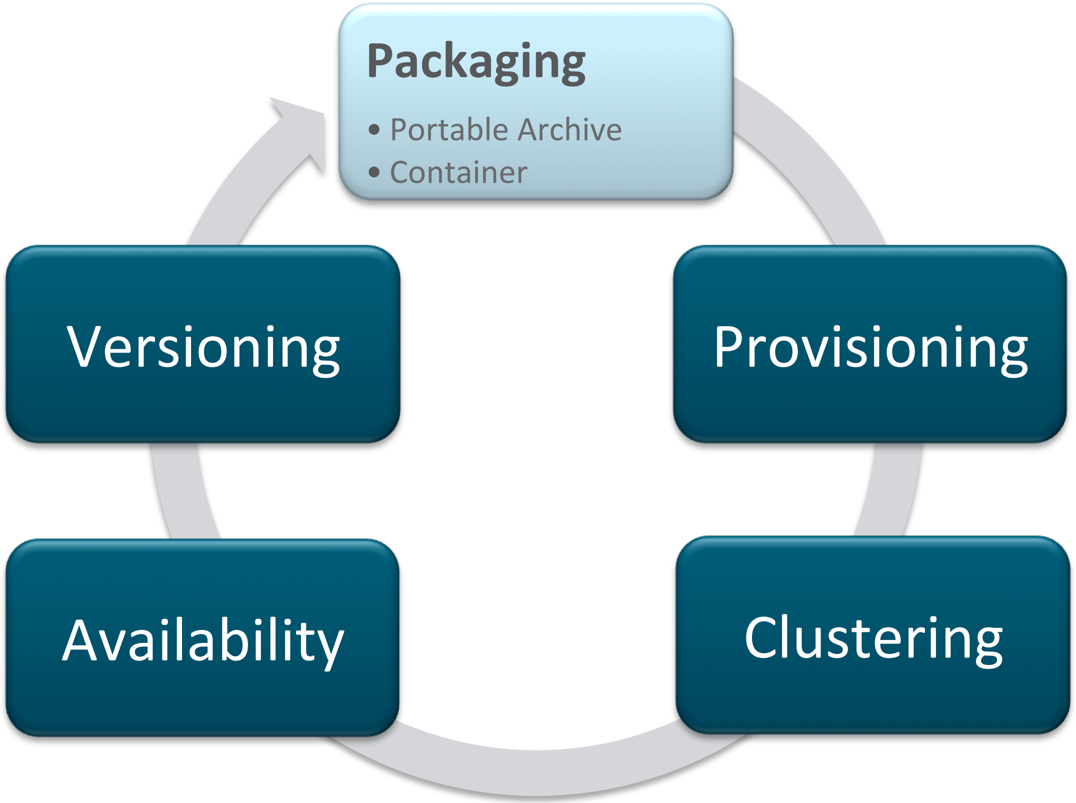
Walking Through a Microservice Lifecycle

Package the application code



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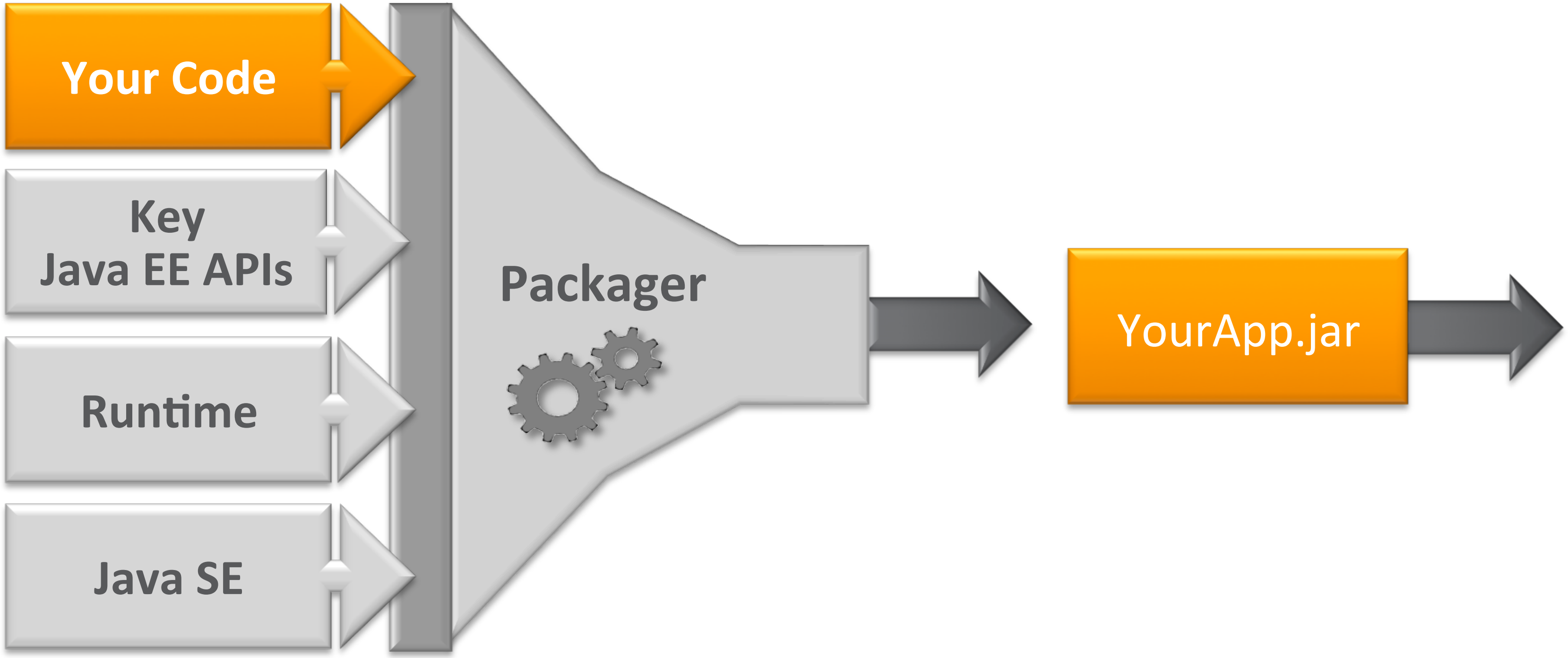
A Next Generation Application Runtime

Java EE 9



Any JVM

docker

ORACLE Cloud

amazon web services

OPENSHIFT

heroku

CLOUD FOUNDRY

Google Cloud Platform

Microsoft Azure

IBM Bluemix

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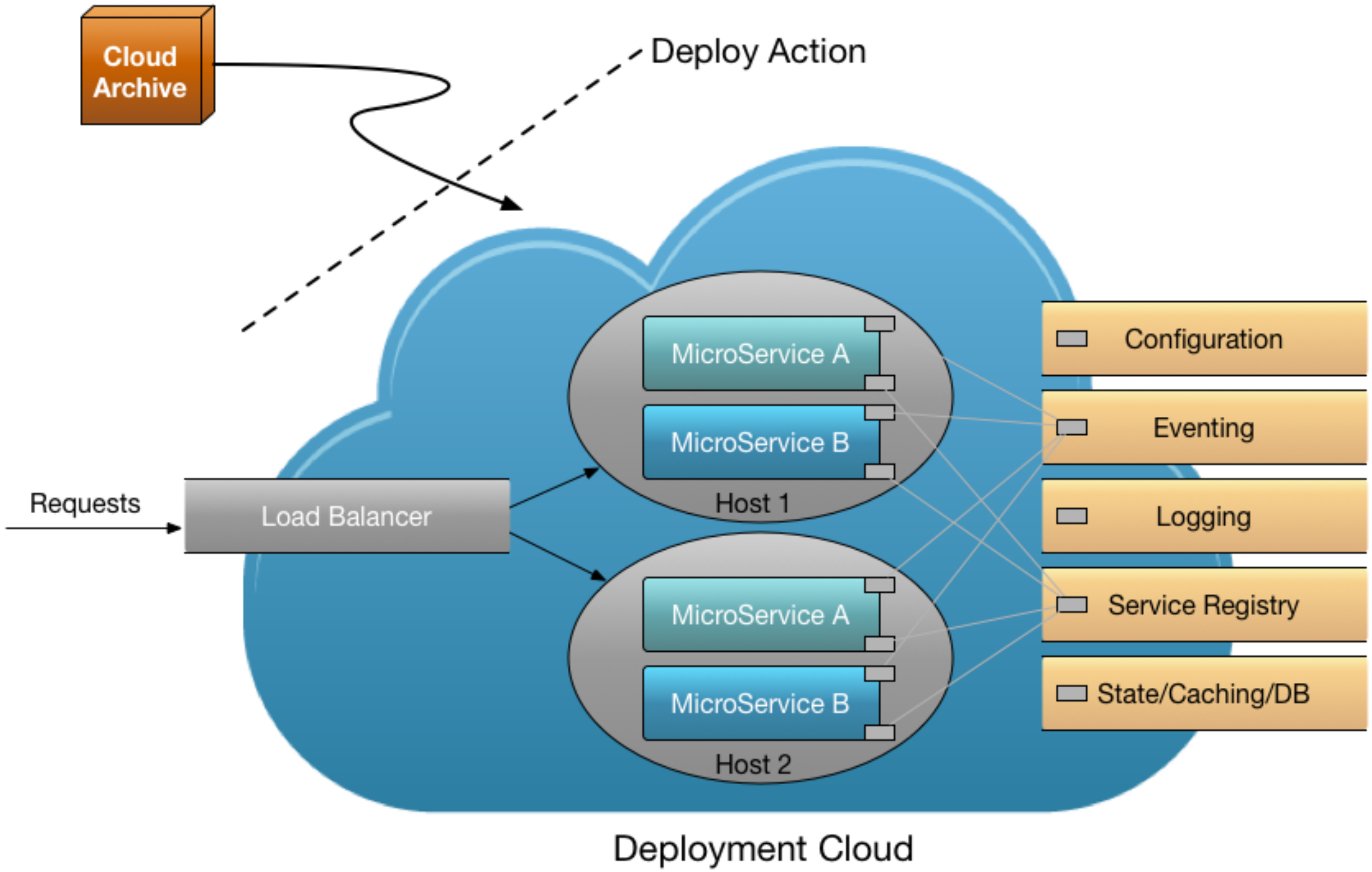
Intelligent Platform for Portable Applications

Java EE 9

- Our Goal is to make Microservices easy, fast, portable
- One archive with proper meta data could be deployed to any Java EE 9 Environment
- Environment can provide services that a Microservice can be automatically wired to



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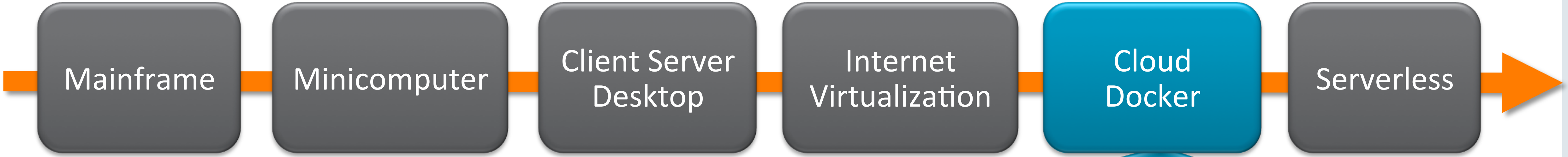
Technology Advances Have Driven the Platform to Cloud

Today’s infrastructure is completely different



- Containers
  - De-facto packaging mechanism
  - Immutable
  - Dynamically scheduled
  - No fixed host names, IPs, ports, …
- *‘You build it, you own it’*
- Workloads distributed across DCs, regions, ...
- Infrastructure is disposable

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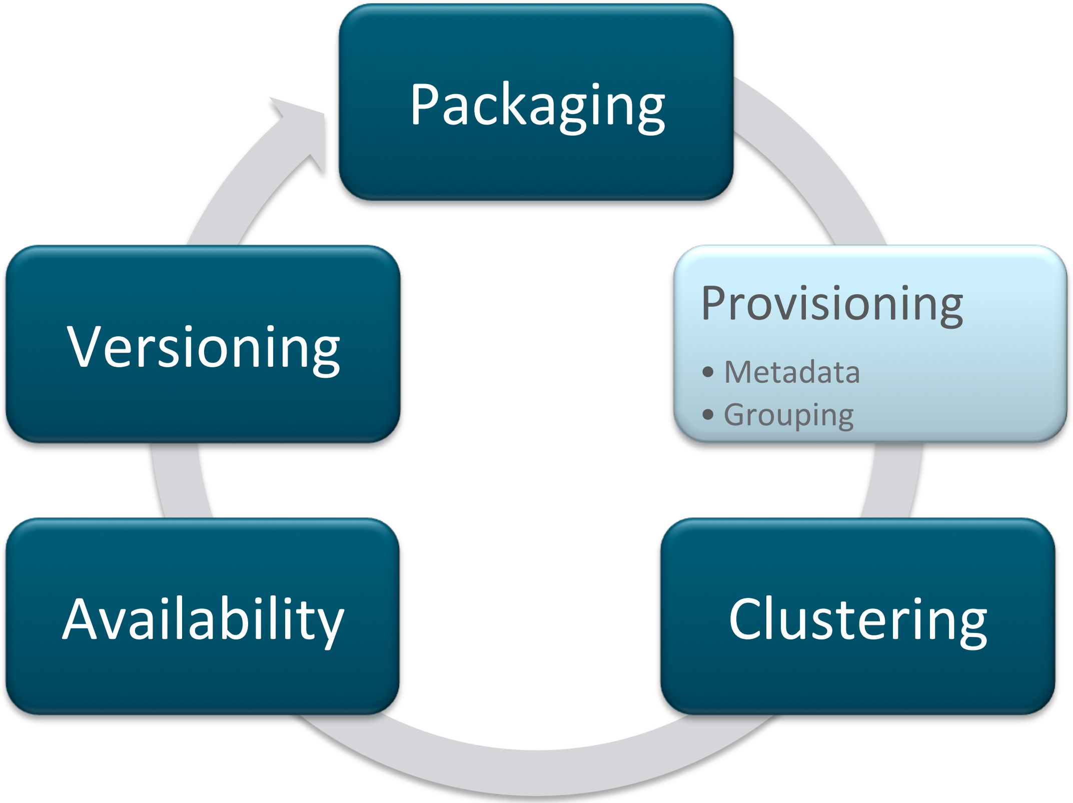
Walking Through a Microservice Lifecycle

Provision the Microservice instance in the cloud



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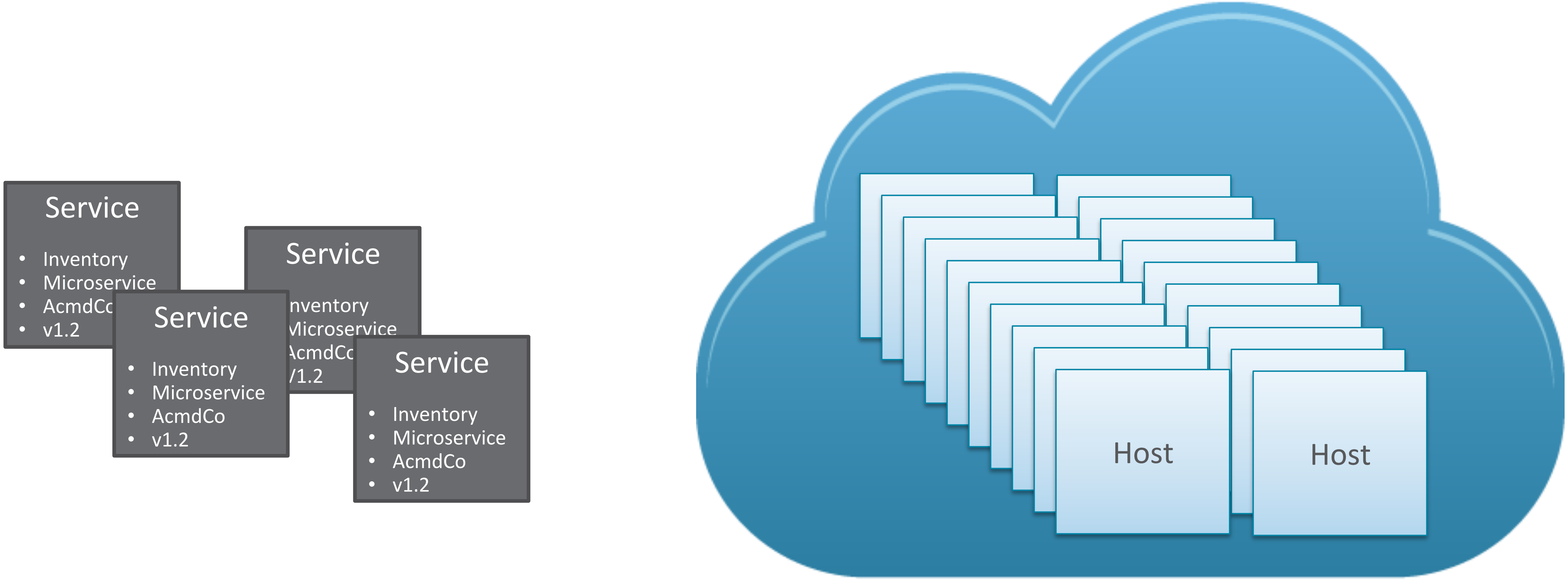
Common Cloud Infra

Microservice Location in an Abstract Environment



Service
- Inventory
- Microservice
- AcmdCc
- v1.2

Service
- nventory
- Microservice
- AcmdCc
- /1.2

Service
- Inventory
- Microservice
- AcmdCo
- v1.2

Service
- Inventory
- Microservice
- AcmdCo
- v1.2

Host

Host

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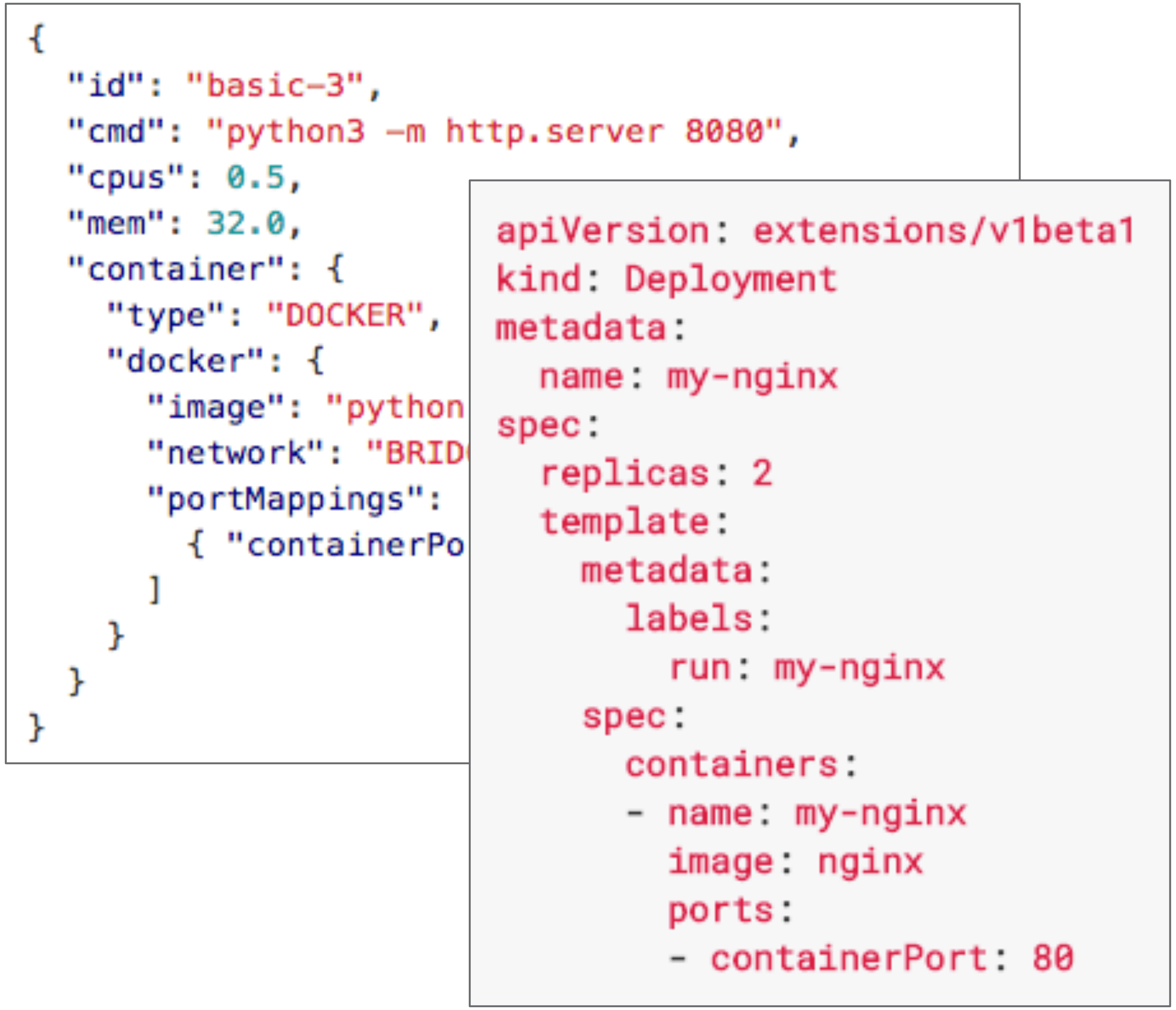
Java EE 9

Information Required for Provisioning

Common metadata worth standardizing

- Various Formats
  - YAML, JSON, Annotations, Properties
- Common Attributes
  - Name, Version
  - CPUS, Memory, Resource Dependencies
  - Grouping



```
{
  "id": "basic-3",
  "cmd": "python3 -m http.server 8080",
  "cpus": 0.5,
  "mem": 32.0,
  "container": {
    "type": "DOCKER",
    "docker": {
      "image": "python
      "network": "BRID
      "portMappings":
        { "containerPo
      ]
    }
  }
}
```

```yaml
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  name: my-nginx
spec:
  replicas: 2
  template:
    metadata:
      labels:
        run: my-nginx
    spec:
      containers:
      - name: my-nginx
        image: nginx
        ports:
        - containerPort: 80
```

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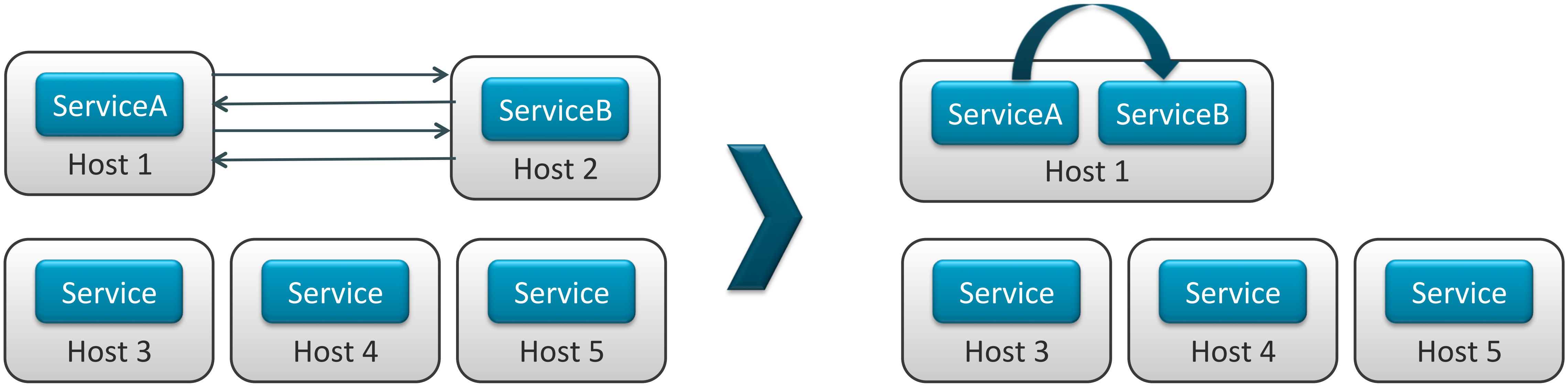
Instance Location In Cloud Environment

Naively placed instances versus grouping



- Typical Cloud Distribution
  - Services run anywhere in the cluster
- Service Grouping
  - Select services can be collocated
  - Reduce network traffic

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Microservice Grouping Strategies

- Tight Groups (Collocated)
  - Shared Host
  - Scale entire group
  - New instances form new group
- Benefits of Tight Groups
  - Low latency
  - Shared Disk Space
  - Reduce Network Traffic

- Loose Groups / Tags
  - Affinity Level
  - Request low latency between them
  - Replicate and Scale at service level
  - New services included into group
- Benefits of Loose Groups
  - Health and Performance Monitoring
  - Log Consolidation

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Microservice Grouping Examples

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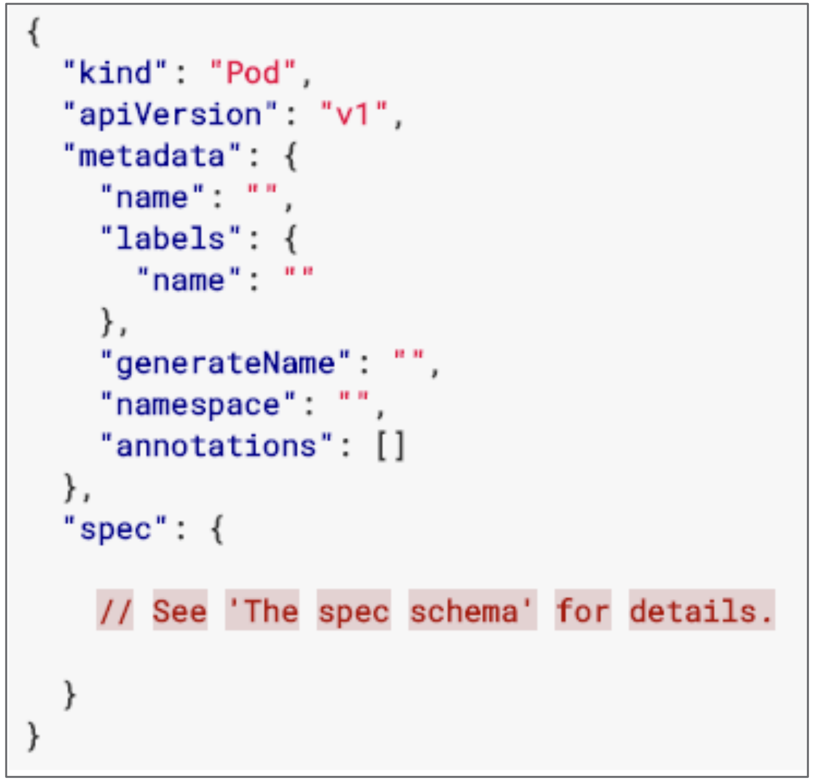
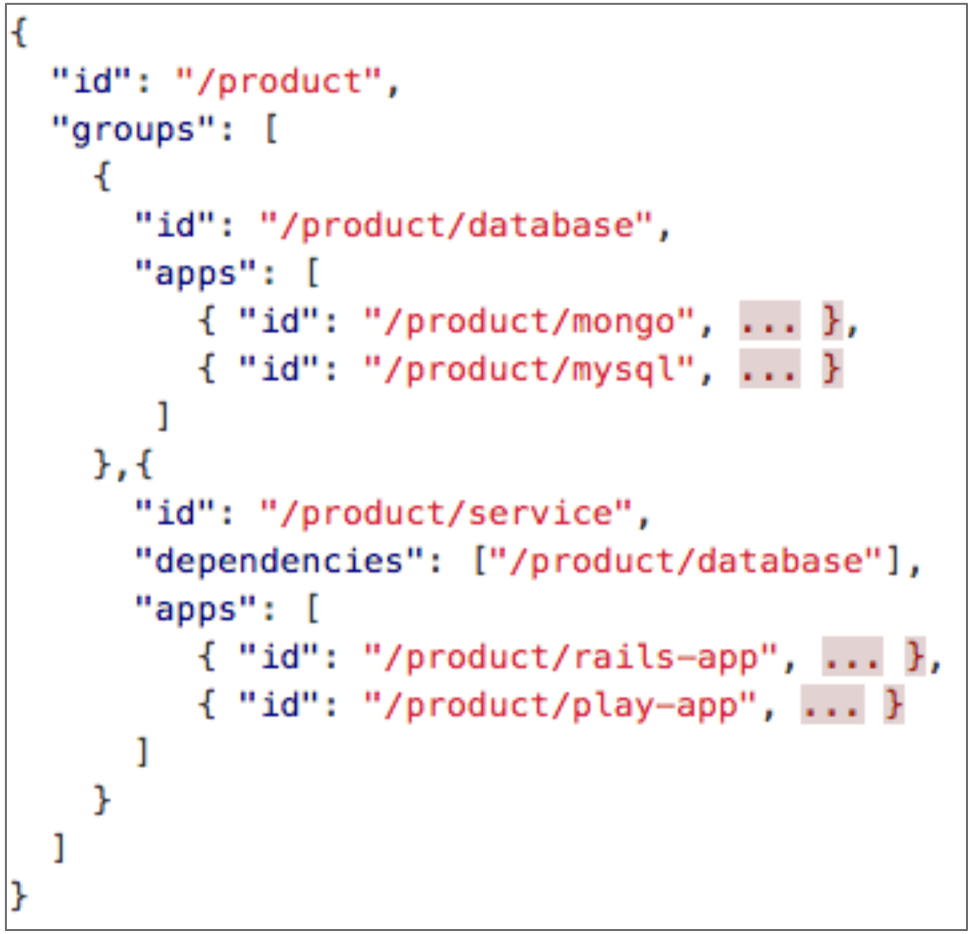


```
{
  "kind": "Pod",
  "apiVersion": "v1",
  "metadata": {
    "name": "",
    "labels": {
      "name": ""
    },
    "generateName": "",
    "namespace": "",
    "annotations": []
  },
  "spec": {

    // See 'The spec schema' for details.

  }
}
```



```
{
  "id": "/product",
  "groups": [
    {
      "id": "/product/database",
      "apps": [
         { "id": "/product/mongo", ... },
         { "id": "/product/mysql", ... }
       ]
    },{
      "id": "/product/service",
      "dependencies": ["/product/database"],
      "apps": [
         { "id": "/product/rails-app", ... },
         { "id": "/product/play-app", ... }
      ]
    }
  ]
}
```

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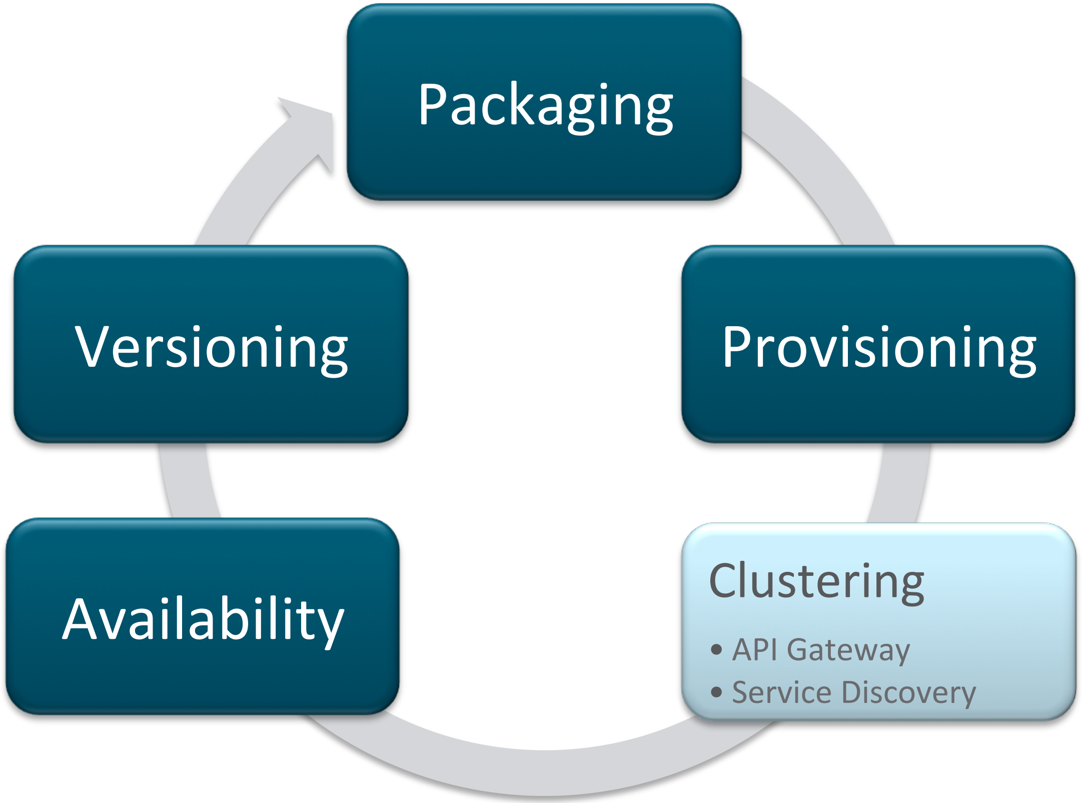
Walking Through a Microservice Lifecycle

Microservice clustering



Packaging

Provisioning

Clustering

- API Gateway
- Service Discovery

Availability

Versioning

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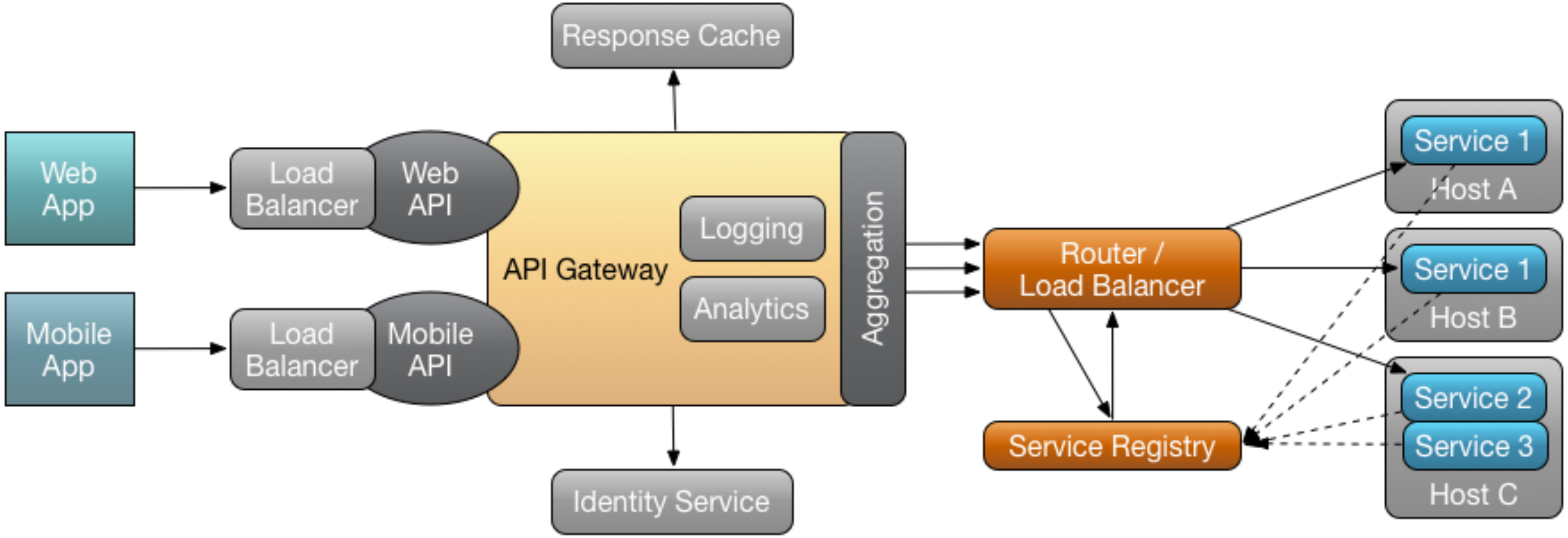
High Level Architecture

Key Microservices technology – API gateway

- API Gateway is single entry point for all clients
  - Access control, protocol translation, content aggregation, response caching, logging



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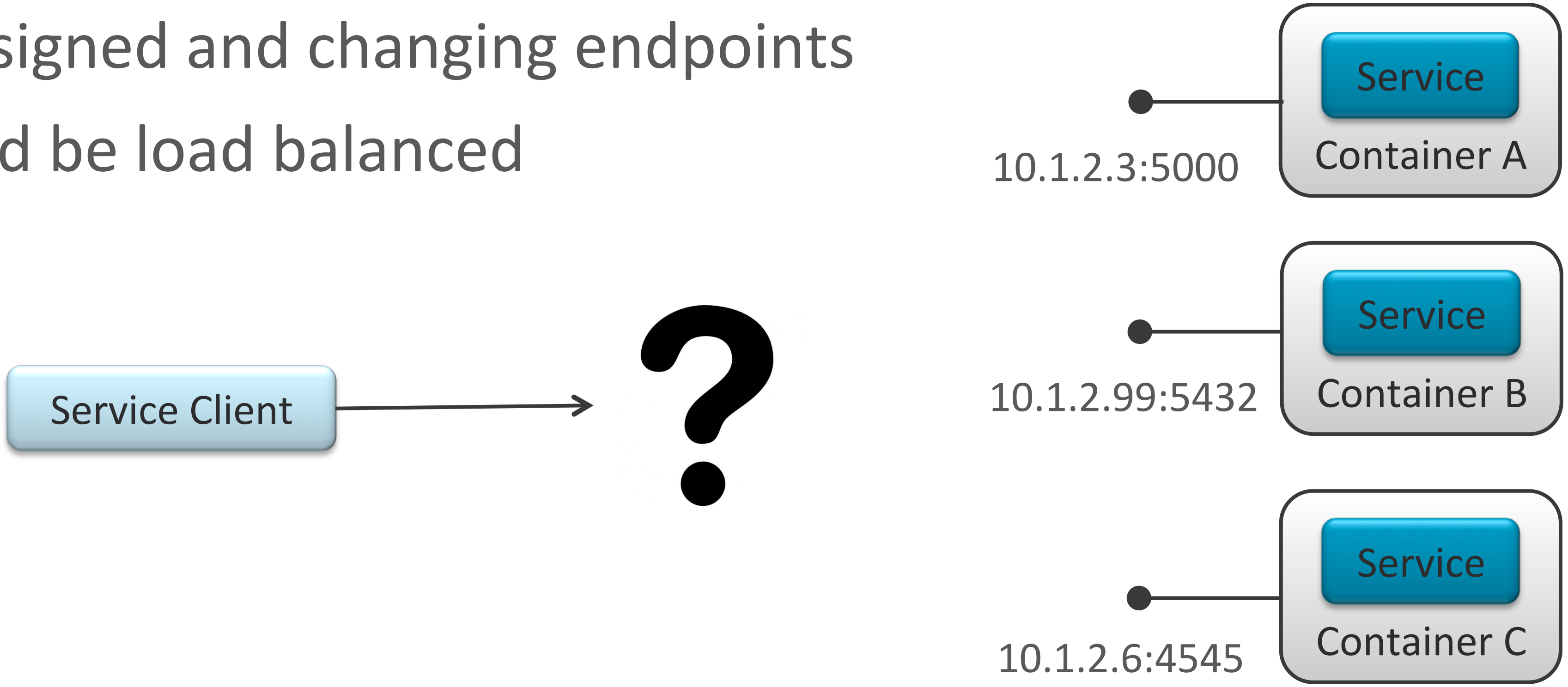
Service Registration and Discovery Issue

- How does my service find other back end services efficiently?
- Dynamically assigned and changing endpoints
- Requests should be load balanced



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Client Side Service Discovery

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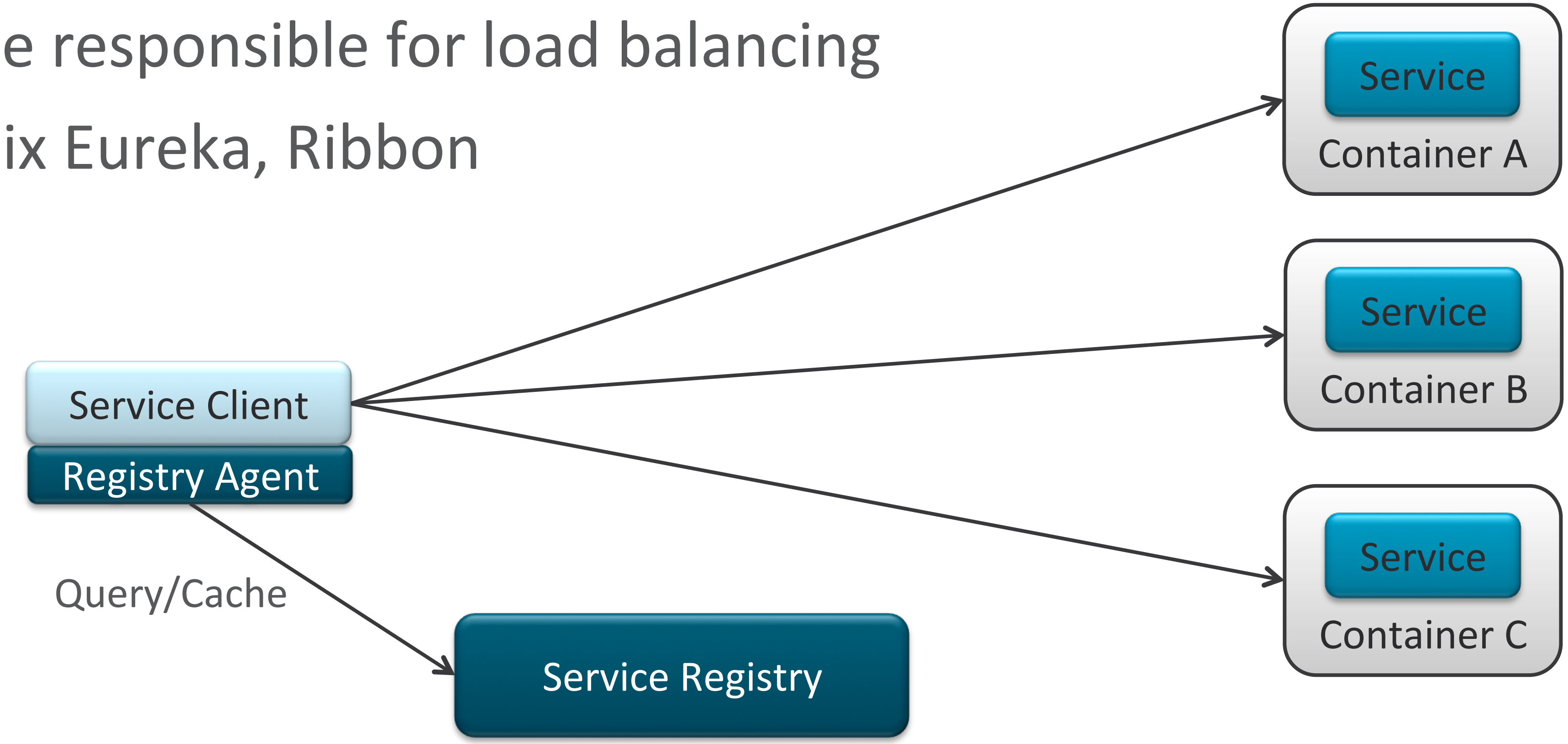
- Registry client caches queries from a dedicated Service Registry
- Client side code responsible for load balancing
- Example: Netflix Eureka, Ribbon



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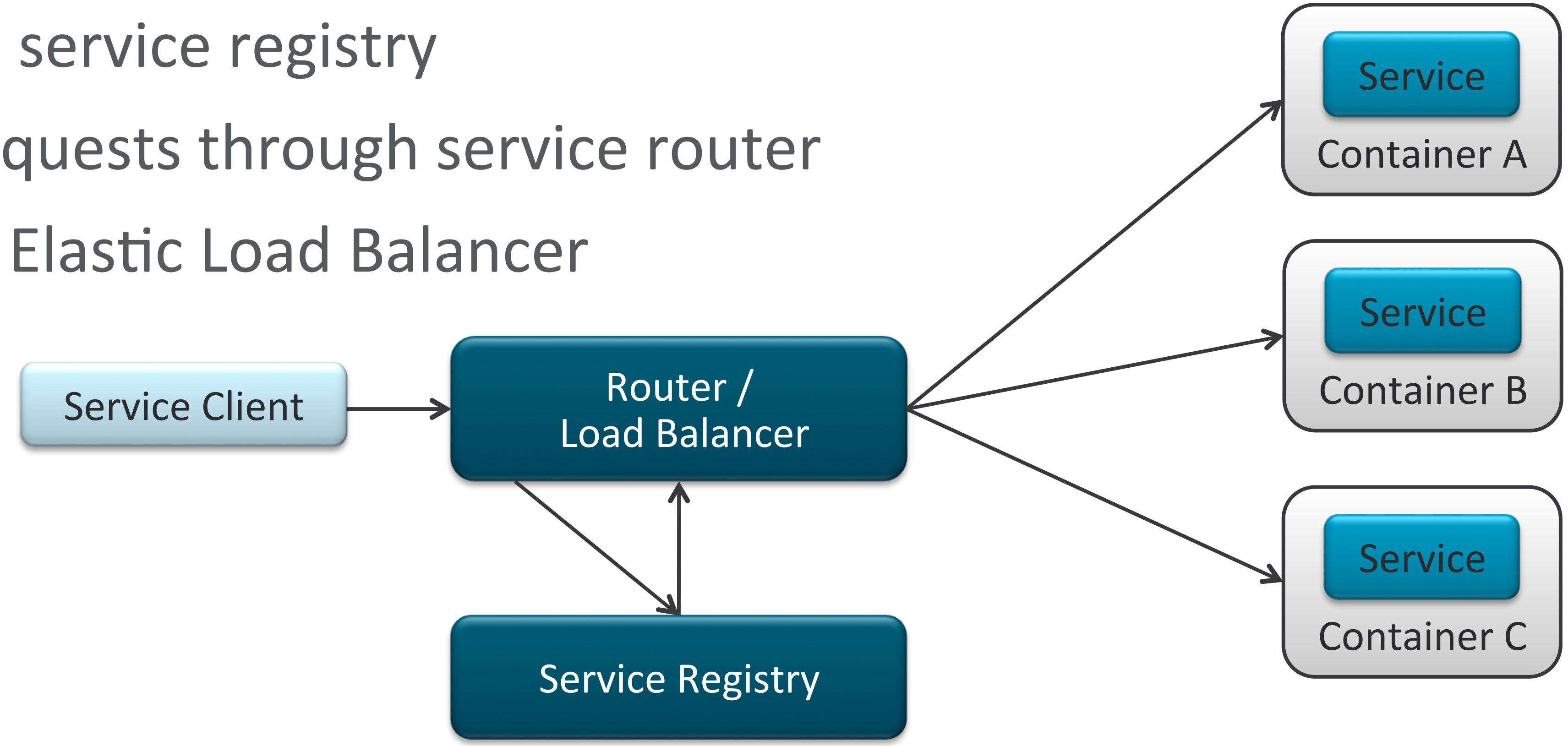
Server Side Service Discovery

- Discovery and Load Balancing abstracted away
- Router queries service registry
- Client sends requests through service router
- Example: AWS Elastic Load Balancer



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Application Impact of Service Discovery

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Service Discovery Client Examples

```
HttpClient.connect("http://localhost:8001");
```

```
HttpClient.connect("http://service_dns.example.com");
```

```
Springframework DiscoveryClient getInstances("SERVICE-NAME");
```

Application Developer Needs a Standard

- Service name + version + namespace

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Java
EE 9

Supporting Service Registration and Discovery

Metadata for services suggested for Java EE 9

- ServiceName
- Compatibility Version(s)
- Implementation Version
- Dependencies
  - (service/version pairs)
- Internal vs. External

```
@InternalService

@Service(name=“userProfiles”, compatibilityVersions=“1,2”)

@Depends(services={“userAvatars:2”,”userAddresses:5”})

…

public ProfileData getUserProfile(ID userId) {

    …
```

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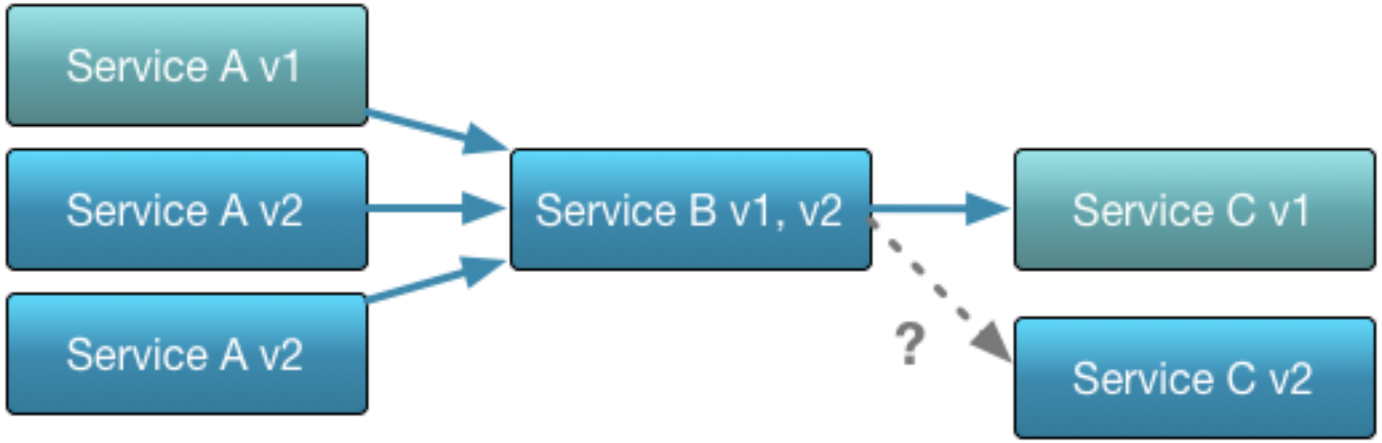
Dependency Graphs

- It may not be obvious whether a service can be safely upgraded unless dependencies between services are tracked



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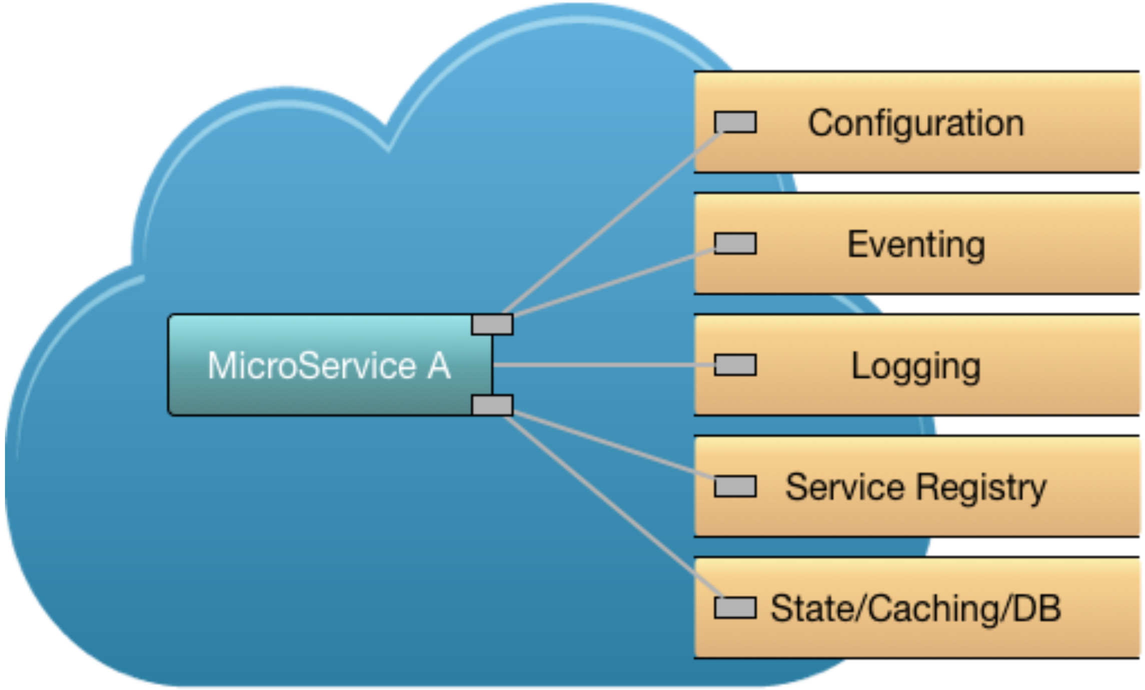
Connecting to Vendor Cloud Services

- Cloud services, Config service, eventing, state/cache/DB, can be provided as service.
- With a standard API in front of each type of platform service, Vendor can inject its specific implementation
- Annotation or Meta-Data driven



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Vendor Cloud Service Examples for Java EE 9

Java EE 9

```
public class MyService {
   @EventService()
   EventService eventService;

  public MyService() {
      eventService.subscribe(“StateChanges”)
  }
}
```

```
public class MyService {
  @ConfigService(namespace=“MyService”)
  ConfigService configService;

}
```

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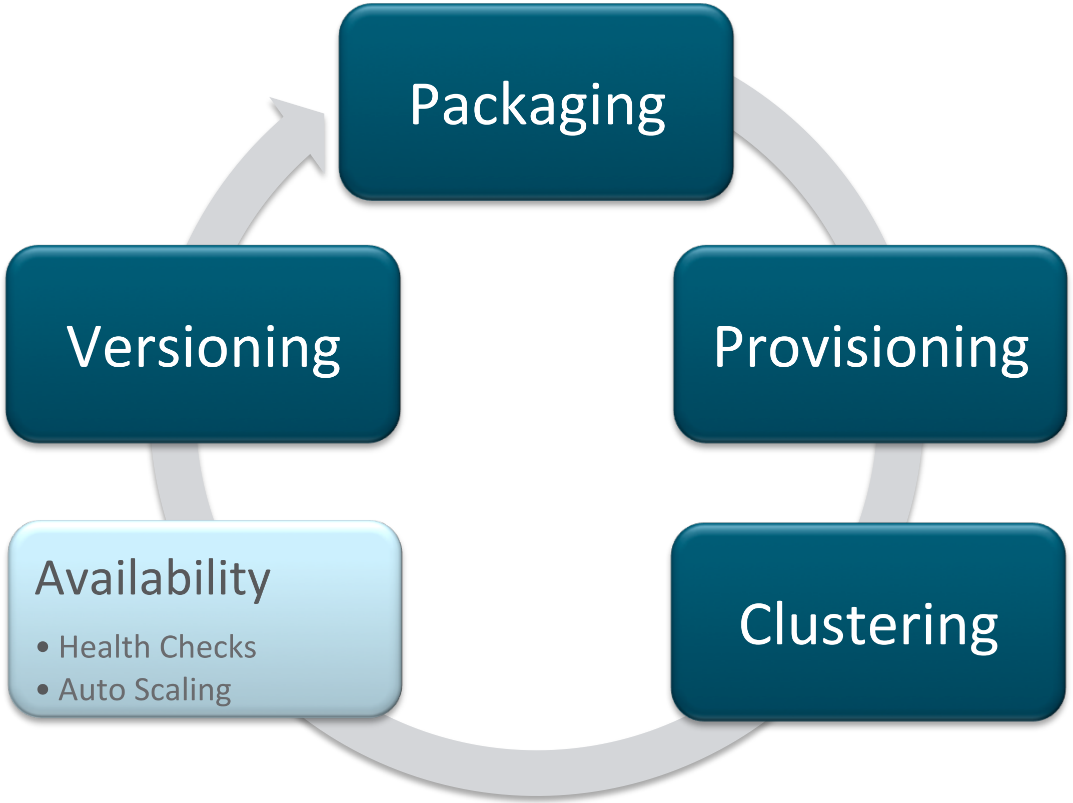
Walking Through a Microservice Lifecycle

Ensuring service availability



Packaging

Provisioning

Clustering

Availability

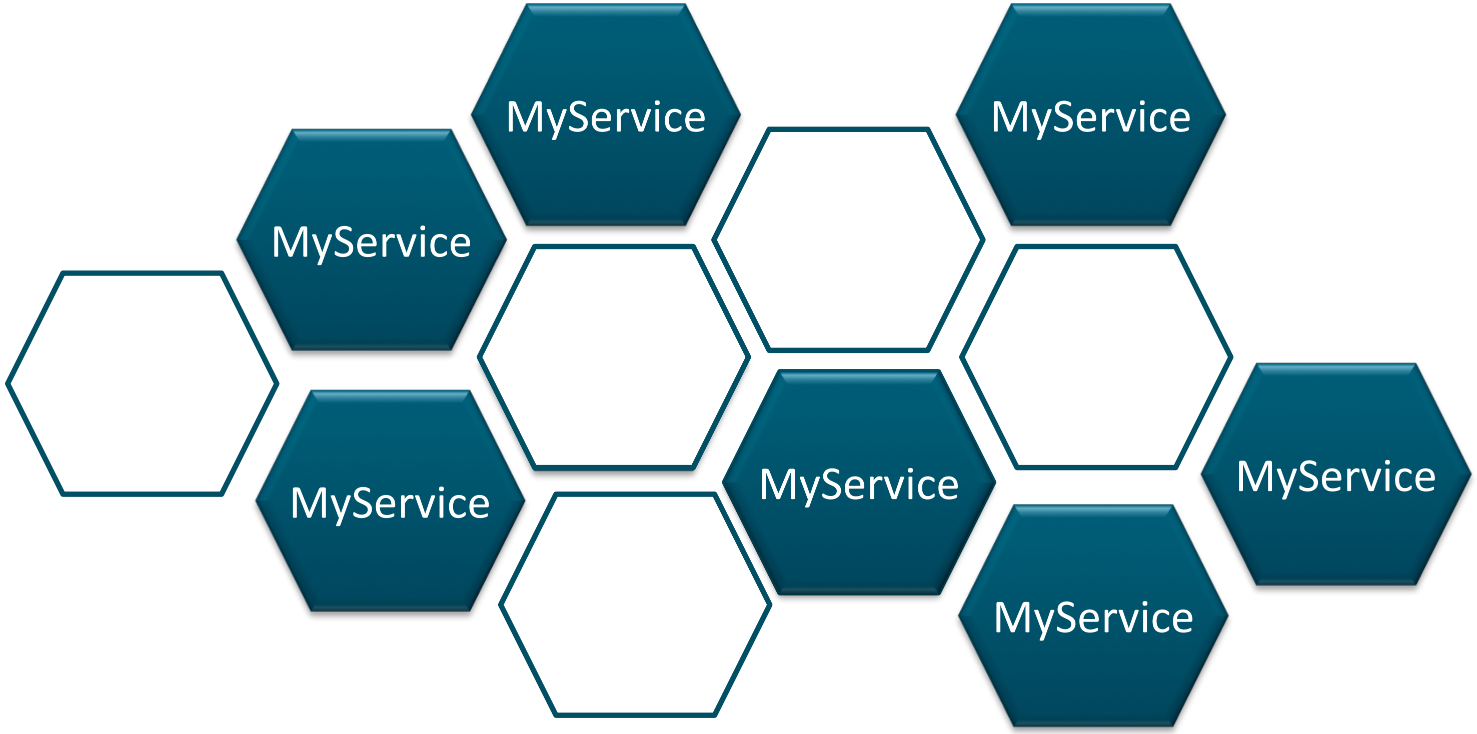
- Health Checks
- Auto Scaling

Versioning

Common Cloud Infra

High Availability Through Service Replacement

Stateless ephemeral services



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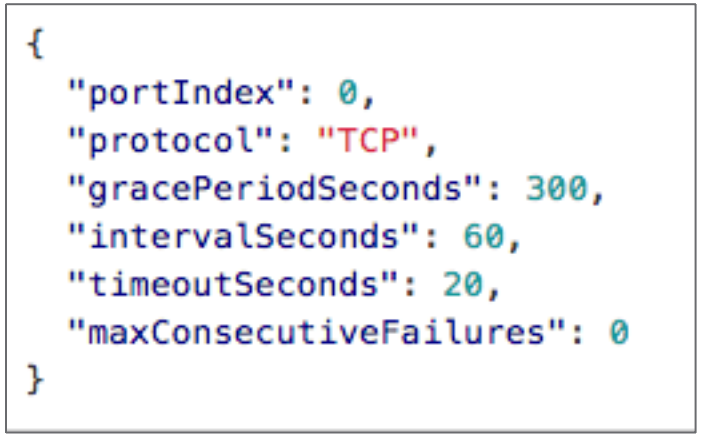
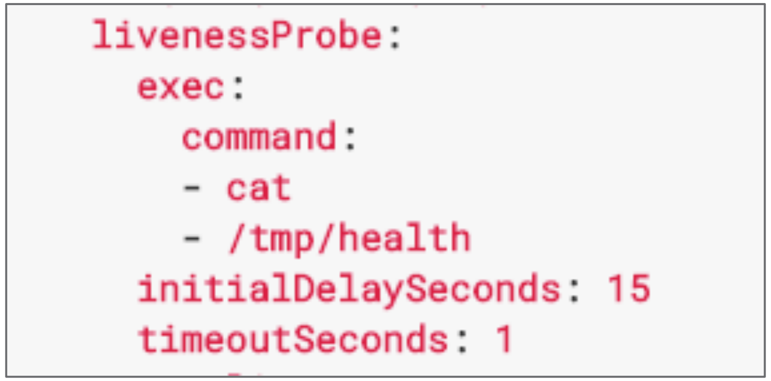
High Availability Through Service Replacement

Health check monitoring

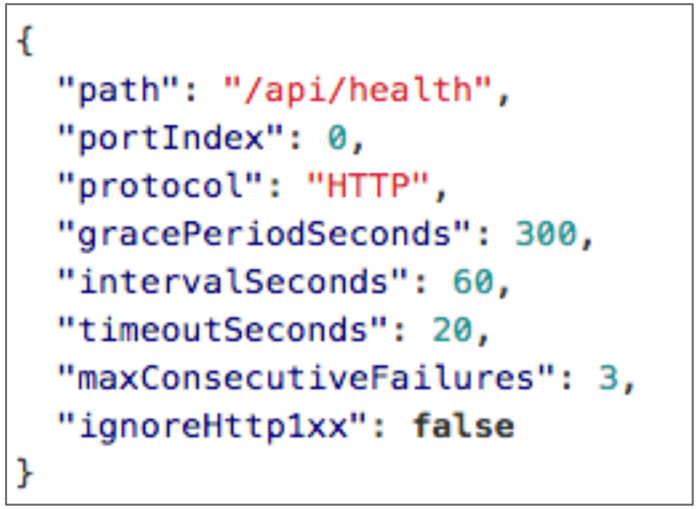
- HTTP Health Checks with simple response results 200-399
- Container Exec for script or process invocation expecting status 0
- TCP Port Check
- Build on Java EE 8 Health Checking to support options



```
{
  "portIndex": 0,
  "protocol": "TCP",
  "gracePeriodSeconds": 300,
  "intervalSeconds": 60,
  "timeoutSeconds": 20,
  "maxConsecutiveFailures": 0
}
```



```
livenessProbe:
  exec:
    command:
    - cat
    - /tmp/health
  initialDelaySeconds: 15
  timeoutSeconds: 1
```



```
{
  "path": "/api/health",
  "portIndex": 0,
  "protocol": "HTTP",
  "gracePeriodSeconds": 300,
  "intervalSeconds": 60,
  "timeoutSeconds": 20,
  "maxConsecutiveFailures": 3,
  "ignoreHttp1xx": false
}
```

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HealthCheck For Java EE 8

Java EE 8

- Define an EE specific proposal
  - REST API which allows callers to list and execute health checks
- Declared bootstrapping end-point (/management/endpoints)
  - management/endpoints will return endpoints for health (i.e. /management/health)
  - Enable a generic client that is EE aware to discover URLs for health endpoints defined
  - Enables implementations to own forming actual URLs for health endpoints defined
- New annotations and descriptors to specify health endpoints
- Helper classes to assist with health report structure
- Implementations map from the annotations/descriptors marking health endpoints to the actual URLs

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Java EE 8

HealthCheck For Java EE 8

- "Scope" is defined by the implementation, for example:
  - One implementation may limit available health checks to only what can be specified with the EE annotations/descriptors
  - Another implementation may include scoping levels which provide the health of implementation specific concepts (domain, servers, clusters, partitions/tenants, load balancers, micro-services, etc...)
- Security requirements are dictated by the implementation, for example:
  - One implementation may allow simple status checks to be unauthenticated, restricting access to checks with detailed reasons
  - Another implementation may restrict all checks, etc...

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Metrics & Performance Monitoring for Java EE 8

Java EE 8

- Define Performance Monitoring Configuration/Declaration
  - REST API which allows callers to identify and access metric information
- New annotations and descriptors to allow developers to specify custom metric endpoints and custom metric metadata
- Helper classes to assist with surfacing metrics
- Implementations map from the annotations/descriptors marking metric endpoints to the actual URLs
- SPI to allow vendors to provide implementations for in-process agents for harvesting metric collections into a centralized service
- Security requirements are dictated by the implementation

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High Availability Through Horizontal Scaling

Common cloud infrastructure supported scaling

- Declaratively specify the number of instances for their service. This should automatically adjust the current number.
- Specify AutoScaling policies supporting
  - CPU consumption
  - Memory consumption
  - Request routing information
  - Custom metrics collecting summarized information from the app
  - Predictive scheduling
- Dynamic Service/Feature Configuration of Scaling Policies

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Policy Based Scaling

- A standardized performance check could be used to create automatic scaling policies that can be applied to any service
- Example Policy:
  - Scale out if all instances report 75% utilization or higher for 3 minutes
  - Scale out if all instances report 90% utilization or higher
  - Scale back if all instances report 20% utilization or less for 15 minutes
  - Scale back if average utilization is 40% or less and number of instances > 6
  - Minimum and Maximum Bounds on number of instances
  - Policy can be schedule-based to accommodate anticipated peaks and troughs

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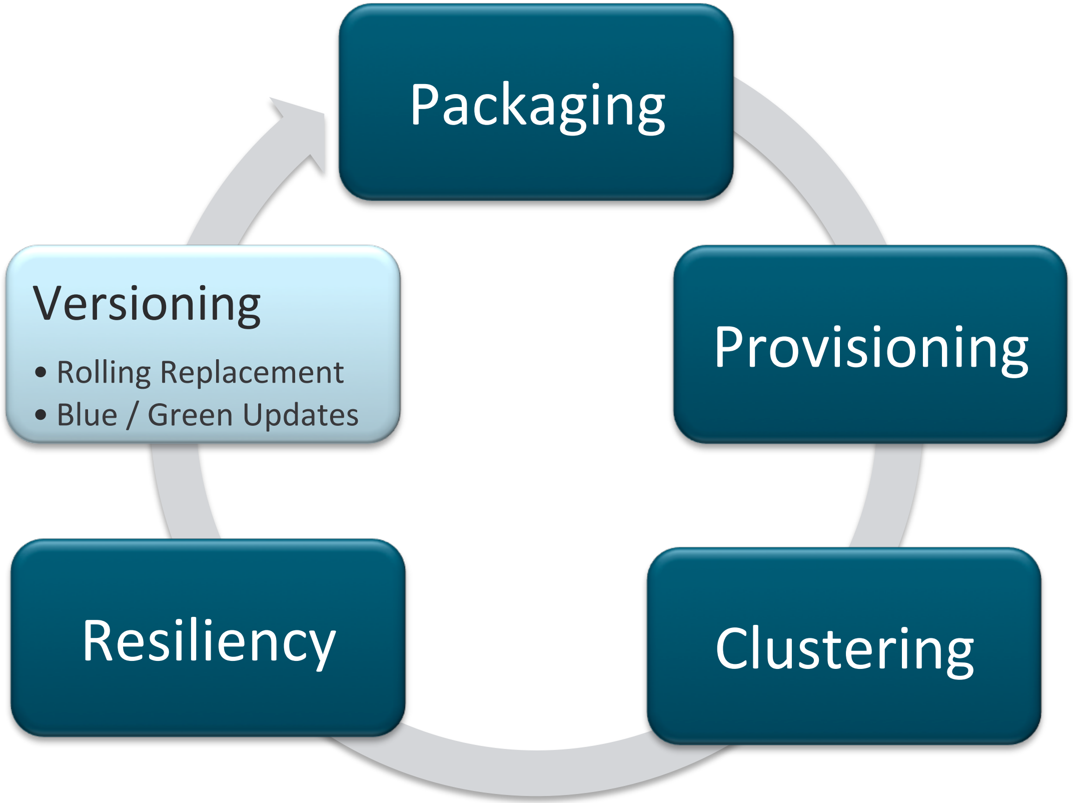
Walking Through a Microservice Lifecycle

Independent service versioning



Packaging

Provisioning

Clustering

Resiliency

Versioning

- Rolling Replacement
- Blue / Green Updates

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Versioning and Upgrades Common Strategies

- Incompatible Upgrades
  - Deploy each new version as a unique service (Netflix)
  - Register the new version at a new location (different port, or version number in path)
  - Leverage auto-scaling to allow new version to scale up and older version to scale down as client base shifts
- Backward Compatible Upgrades
  - Each new service version is written to translate and emulate current and previous compatibility version (provides backwards compatibility)
  - Data Model conversion techniques
  - Blue / Green or Rolling Replacement

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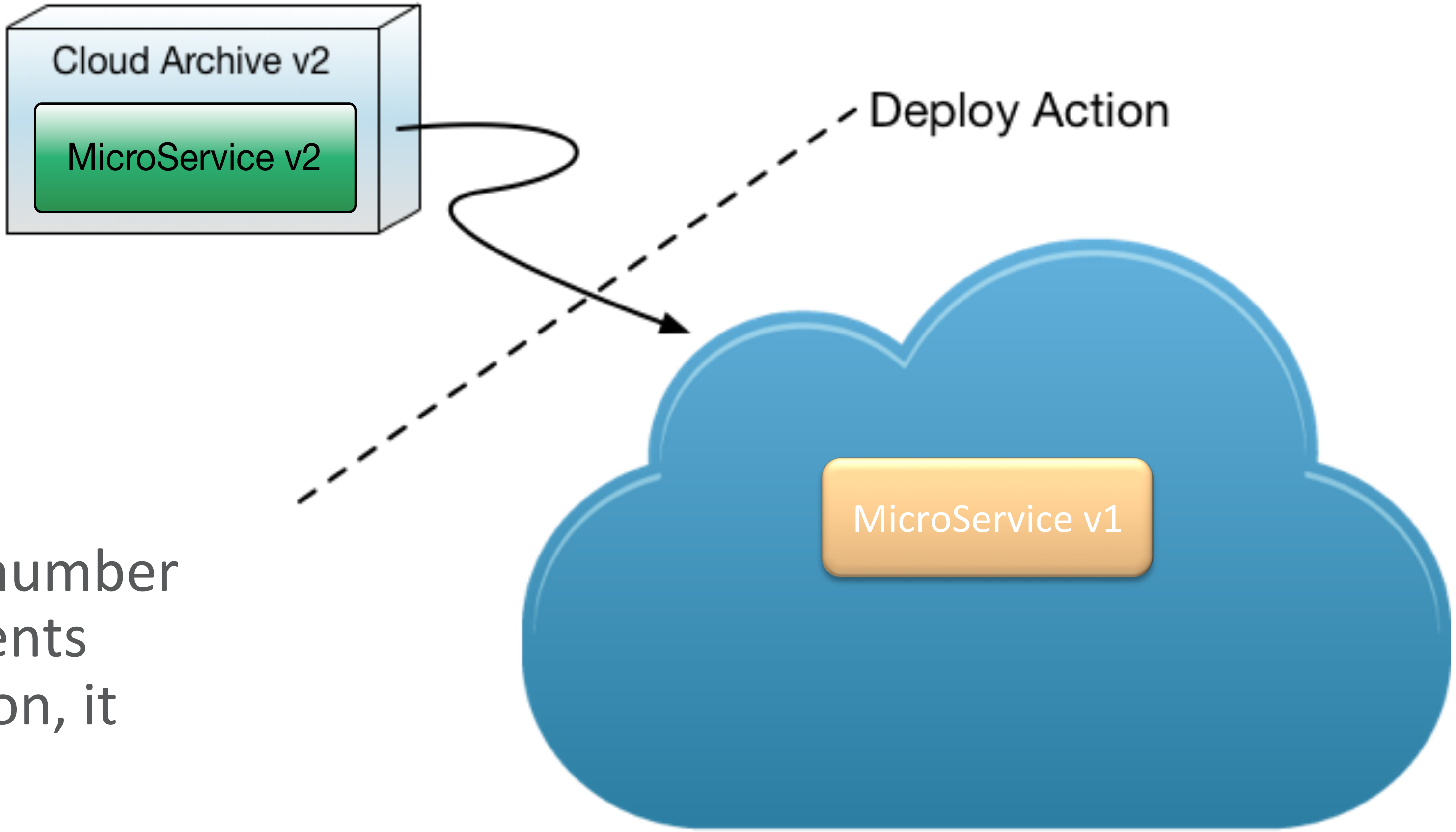
Incompatible Upgrades

- Service MetaData includes compatibility version
- If compatibility version of new service doesn't include compatibility version of old service instance, then we need side by side deployment
- Auto Scaling will decrease the number of v1 instances over time as clients move to v2. For the same reason, it will increase the number of v2 instances



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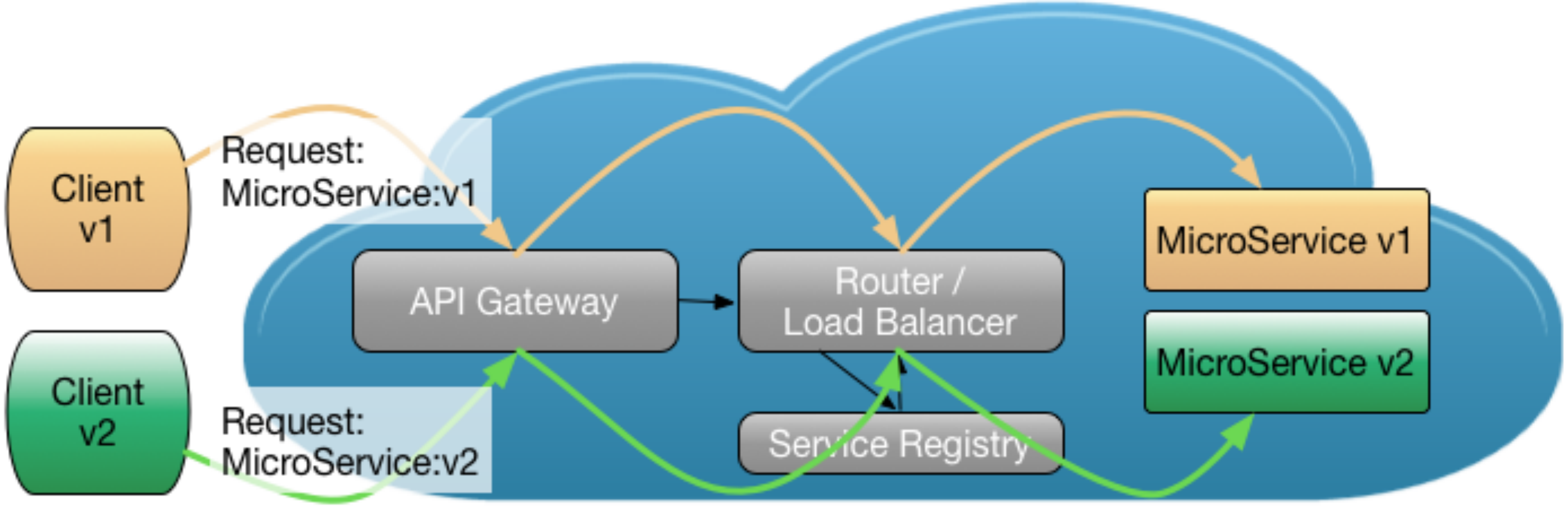
Side By Side Versions

- All client requests include a version (either in the path or name or metadata)
- The service registry is used to route the request to an instance that supports that version
- In this case a different instance is used for each version



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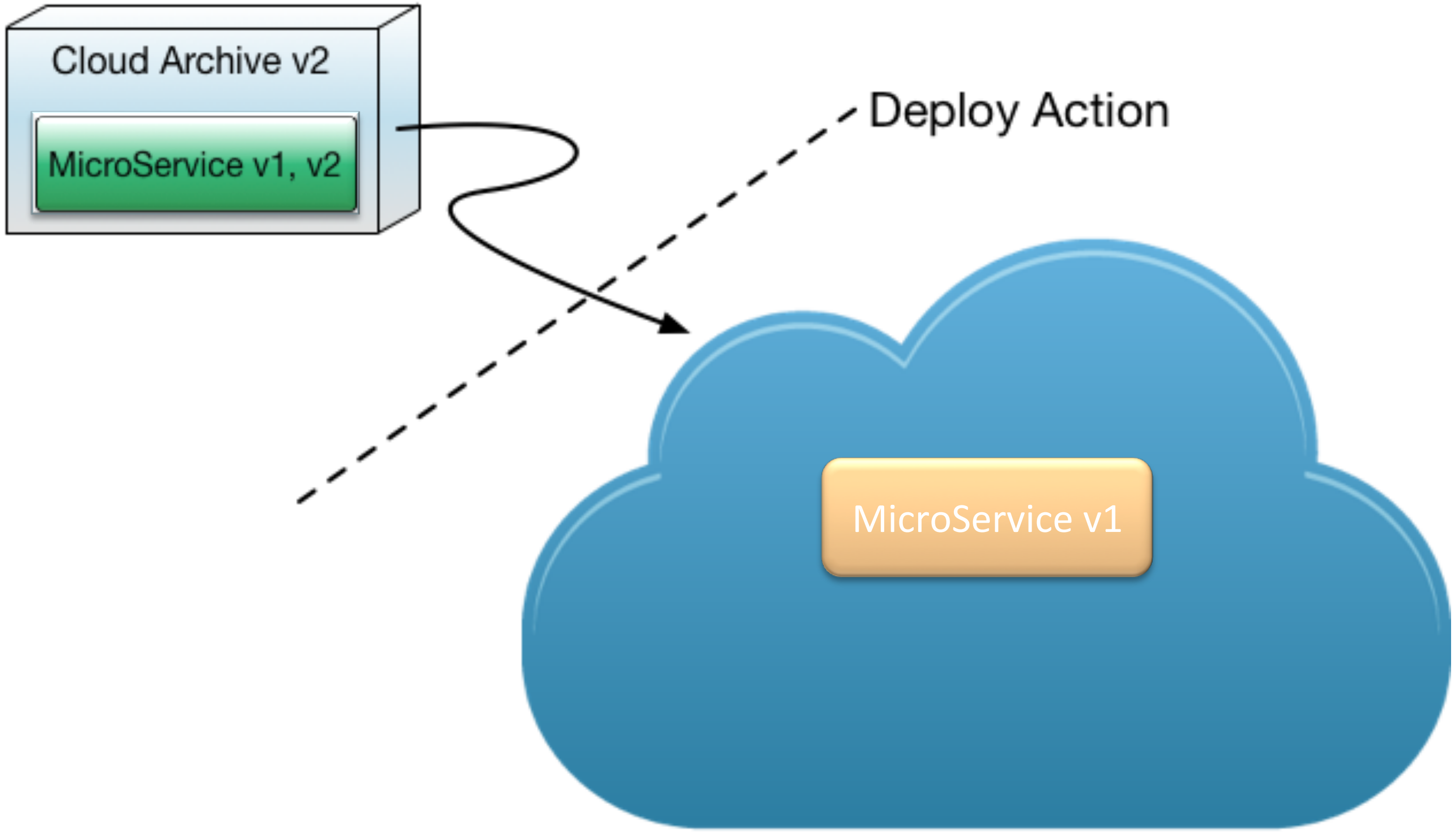
Backwards Compatible Upgrades

- Service MetaData includes compatibility version
- If compatibility version of new service includes compatibility version of old service instance, then we can replace original instance
- Creating the new instance before removing the old ensures continuity of availability



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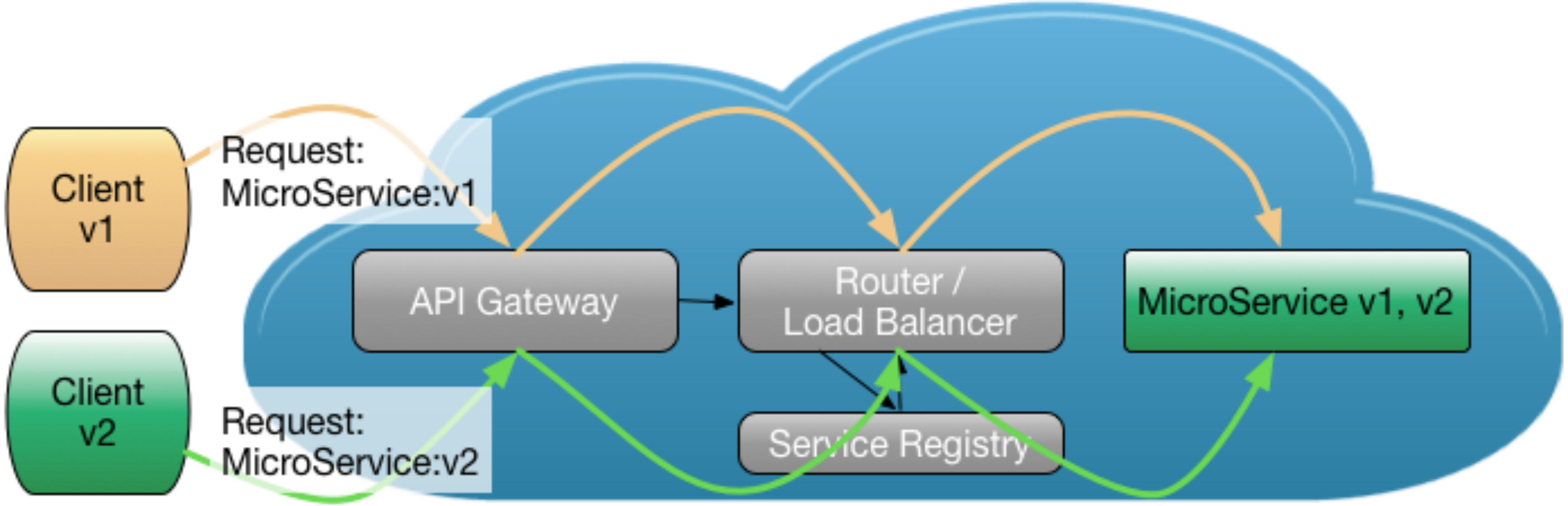
Backwards Compatible Requests

- All client requests include a version (either in the path or name or metadata)
- The service registry is used to route the request to an instance that supports that version
- In this case the same instance can support both versions



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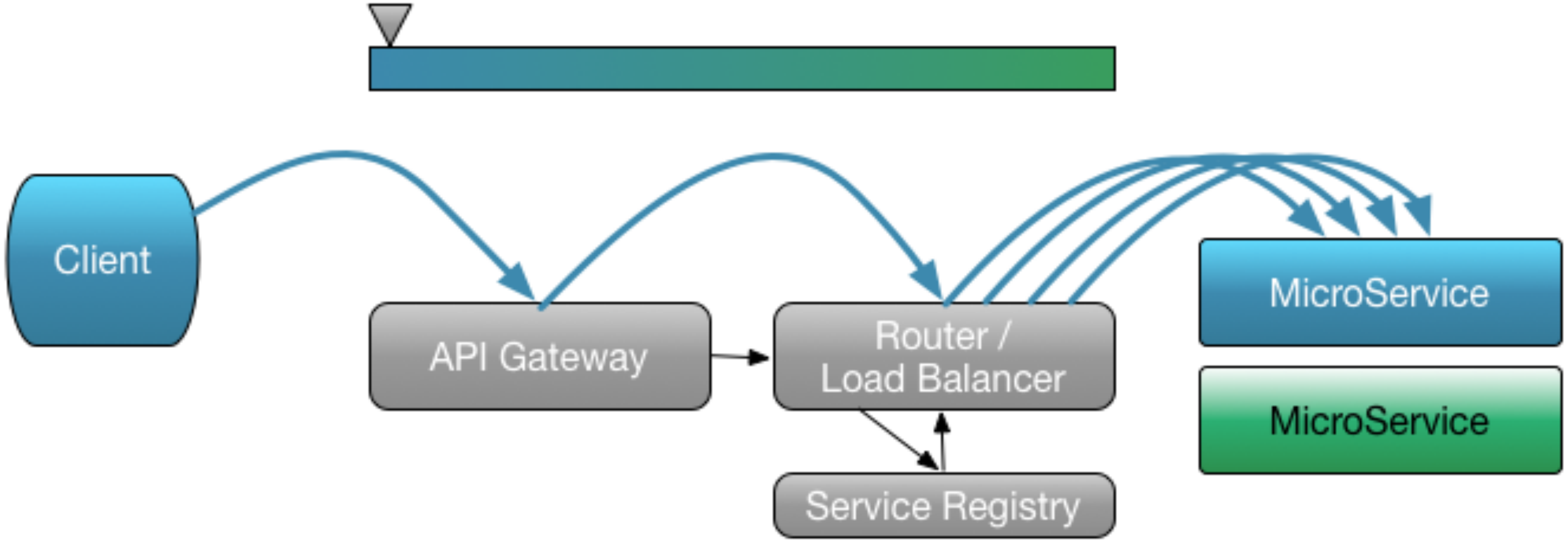
Blue / Green Requests

- All client requests include a version (either in the path or name or metadata)
- The service registry is used to route the request to an instance that supports that version
- In this case a different instance is used for each version



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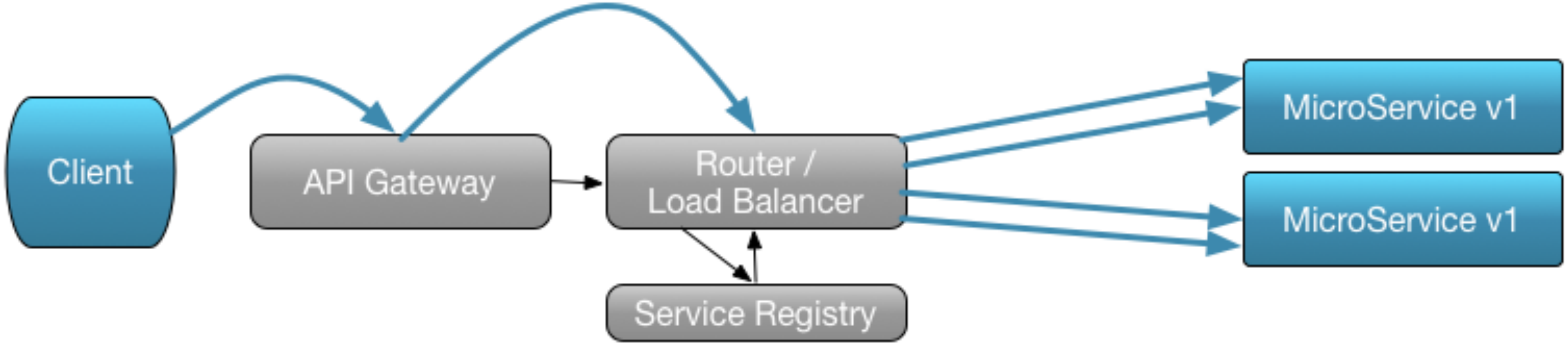
Common Cloud Infra

Compatible Requests

Rolling Replacement



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Java
EE 9

Java EE 9 Portable Application Requirements

Areas for exploration with EG for Spec drafts

Service Metadata

- Declare Required Resources (CPU, Memory, etc.)
- Describe Application Metadata
  - Versioning Information for Routing and Discovery
  - Dependency Information
- Service Grouping

Service Discovery

- Utilize consistent naming pattern to discover service dependencies
- Easily find Vendor Cloud Services with Injection/Auto Wiring

Availability

- Provide Health Check Method Through Metadata or Annotations
- Custom Service Performance Metrics Through Metadata or Annotations

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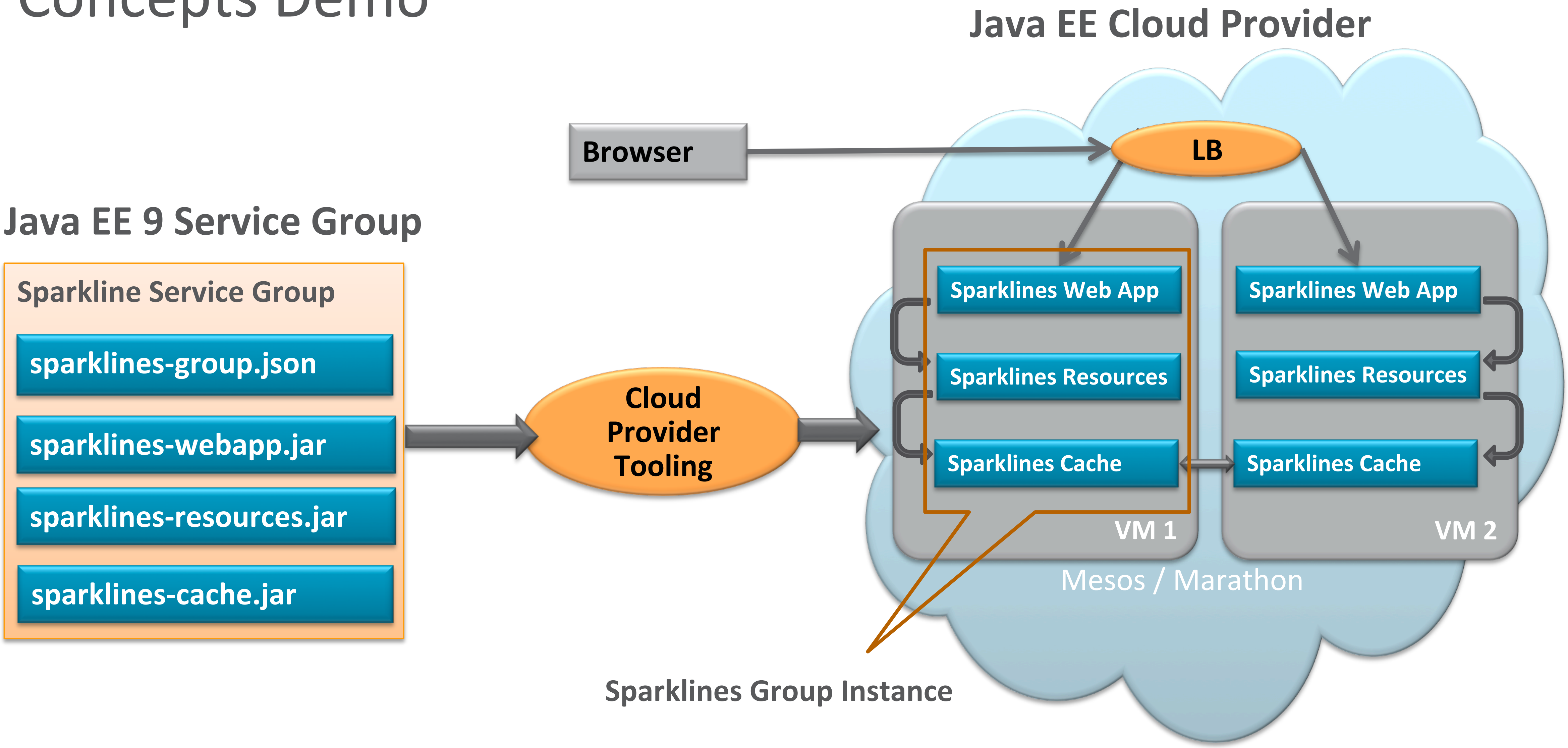
Concepts Demo



Summary

- Java EE 9 enables **portability of applications** across multiple vendors
  - Bring standards around microservices and developing for the cloud
  - leverage the features that the cloud offers, like resiliency, scalability, and efficiency
- Want to work with existing solutions and vendors
- Standardize commonly faced problems for developers in the new environment

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Next Steps

Give us your feedback

- Take the survey
  - http://glassfish.org/survey
- Send technical comments to
  - users@javaee-spec.java.net
- Join the JCP – come to Hackergarden in Java Hub
  - https://jcp.org/en/participation/membership_drive
- Join or track the JSRs as they progress
  - https://java.net/projects/javaee-spec/pages/Specifications
- Adopt-a-JSR
  - https://community.oracle.com/community/java/jcp/adopt-a-jsr

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Where to Learn More at JavaOne

Session Number	Session Title	Day / Time
CON7980	Servlet 4.0: Status Update and HTTP/2	Tuesday 4:00 p.m.
CON7978	Security for Java EE 8 and the Cloud	Tuesday 5:30 p.m.
CON7979	Configuration for Java EE 8 and the Cloud	Wednesday 11:30 a.m.
CON7977	Java EE Next – HTTP/2 and REST	Wednesday 1:00 p.m.
CON6077	The Illusion of Statelessness	Wednesday 4:30 p.m.
CON 7981	JSF 2.3	Thursday 11:30 a.m.

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