PaaSing a Java EE Application

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Cloud Computing

Essential Characteristics

- On-demand Self-Service
- Broad network access
- Resource Pooling
- Rapid Elasticity
- Measured Service

(*) NIST Definition of Cloud Computing – 800-145

Cloud Computing

Deployment Models

- Private Cloud
  - Operated solely for an organization
  - On-premise or off-premise
- Community Cloud
- Public Cloud
  - Access to general public
- Hybrid Cloud
  - 2 or more clouds, Cloud Bursting

(*) NIST Definition of Cloud Computing – 800-145

Cloud Computing

Service Models

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
  - – Deploy customer-created applications
  - – Using languages and tools supported by PaaS Provider
  - – No control of underlying cloud infrastructure
  - – Control over deployed applications, hosting env. Configurations
- Infrastructure as a Service (IaaS)

(*) NIST Definition of Cloud Computing – 800-145

PaaS and Java EE

Java EE design principles and capabilities

- Common programming model for enterprise developers
- Runtime handles application’s infrastructure concerns
- Declarative resource references
- Scalable (scale-out) component models

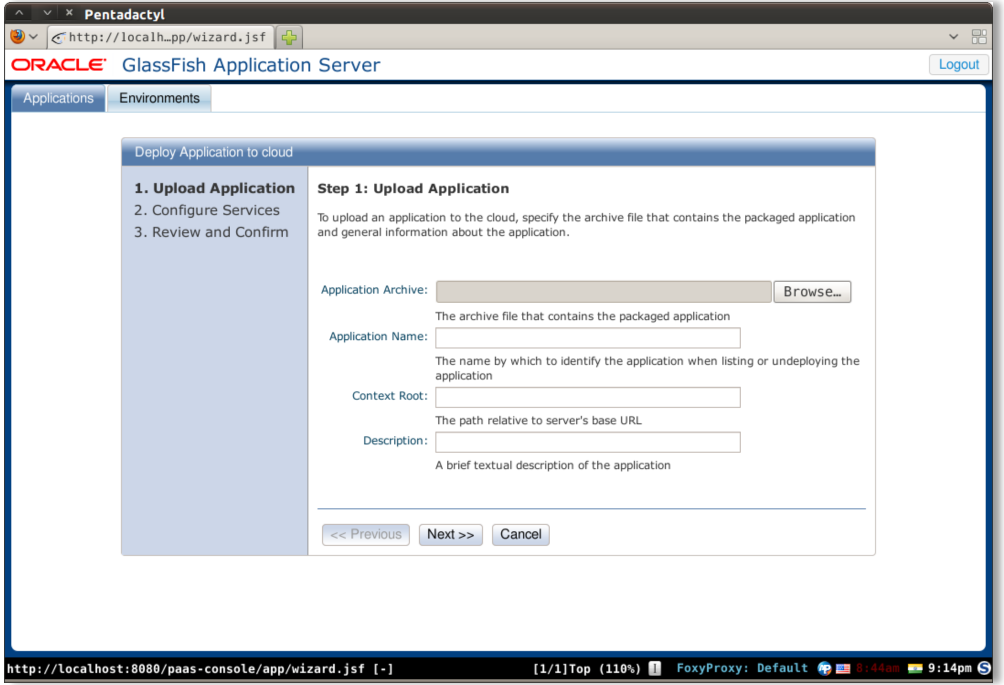
PaaS and Java EE

Java EE 7: “Making Java EE ready for the cloud”

- Enhancements
  - New Roles for PaaS
  - Services as first class citizens
  - Multitenancy
- Evolution, not a revolution!

PaaS Implications on Deployment

- Simplified PaaS Application Deployment
  - Single-click, self-service, “push to cloud”


Pentadactyl
http://localh…pp/wizard.jsf
ORACLE GlassFish Application Server
Logout
Applications
Environments
Browse…
<< Previous
Next >>
Cancel
http://localhost:8080/paas-console/app/wizard.jsf [-]
[1/1]Top (110%)
FoxyProxy: Default
9:14pm

Deploy Application to cloud

1. Upload Application
2. Configure Services
3. Review and Confirm

Step 1: Upload Application

To upload an application to the cloud, specify the archive file that contains the packaged application and general information about the application.

Application Archive:
The archive file that contains the packaged application

Application Name:
The name by which to identify the application when listing or undeploying the application

Context Root:
The path relative to server's base URL

Description:
A brief textual description of the application

PaaS Implications on Deployment

Services Management

- Automatic Service Provisioning and Management
  - Service Orchestration
    - Automatic Service Dependency discovery
    - Service Provisioning and Association
  - Handle operational infrastructure concerns automatically
    - Network configuration, HA, Clustering, Load Balancing …
  - Application and Service deployment versioning

PaaS Implications on Deployment

Virtualized runtimes

- Scalable virtualized on-demand environment
  - Support multiple cloud deployment models
    - Public, Private, Hybrid
  - PaaS Provider decoupled from IaaS infrastructure
  - Multi-tenancy

PaaS Implications on Deployment

Scaling and Operations

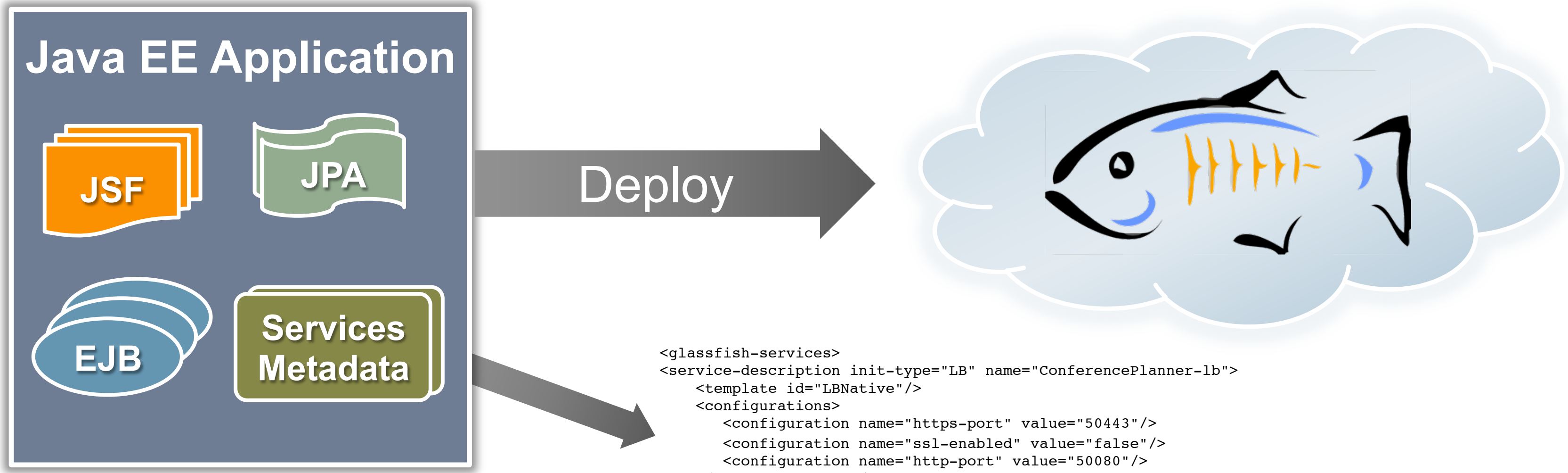
- Automatic Scaling of Services
  - Scale to application's needs
  - User-defined alerts and actions
- Control over application hosting environment
  - Flexibility in choice of application services, framework
  - Rich service configuration
  - Shared services
  - Extensible runtime to allow new Services

Demo

PaaSing a Java EE Application in the Cloud

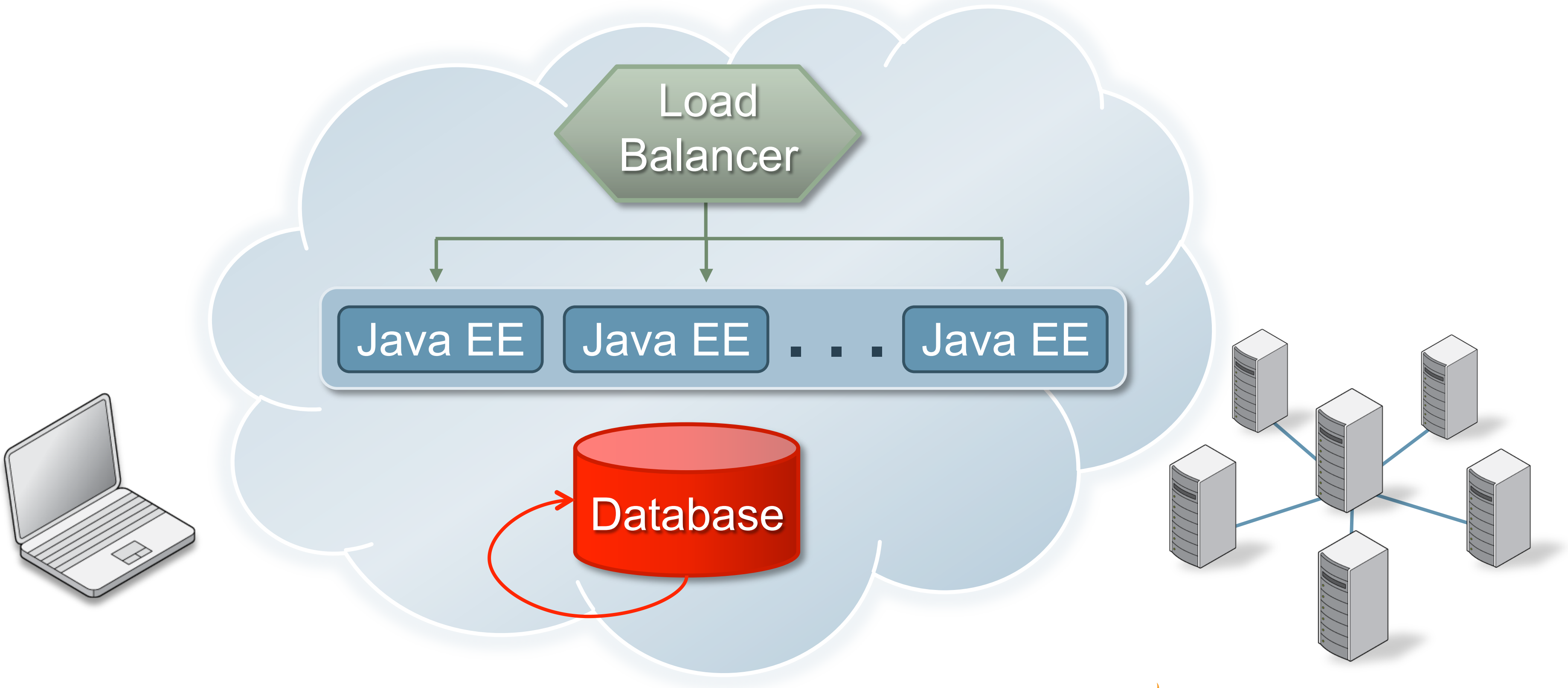
glassfish.org/javaone2011

Conference Planning in the Cloud

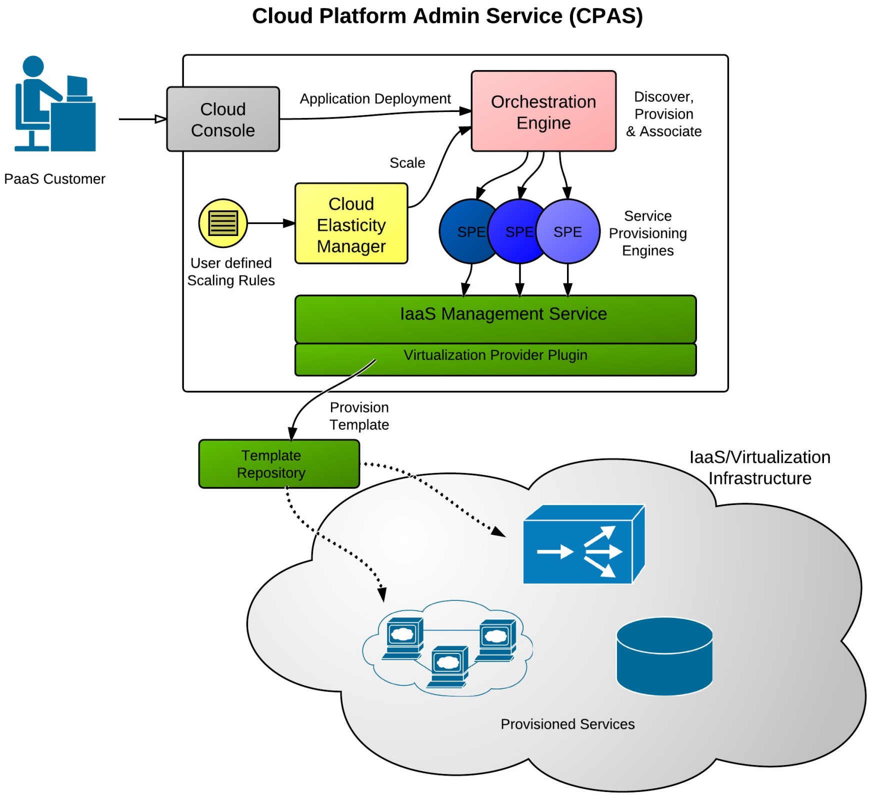


```
<glassfish-services>
<service-description init-type="LB" name="ConferencePlanner-lb">
    <template id="LBNative"/>
    <configurations>
       <configuration name="https-port" value="50443"/>
       <configuration name="ssl-enabled" value="false"/>
       <configuration name="http-port" value="50080"/>
    </configurations></service-description>
<service-description init-type="JavaEE" name="ConferencePlanner">
    <characteristics>
       <characteristic name="service-type" value="JavaEE"/>
    </characteristics>
    <configurations>
       <configuration name="max.clustersize" value="4"/>
       <configuration name="min.clustersize" value="2"/>
    </configurations>
</service-description>
. . .
</glassfish-services>
```

Service Provisioning



GlassFish PaaS Runtime Architecture



Service Terminology

- Service
- ServiceType
  - – Java EE, RDBMS, HTTP Load Balancer etc.
- Services – scope and lifecycle
  - – Provisioned Services
    - Application scoped
    - Shared
  - – External (*a priori*) services

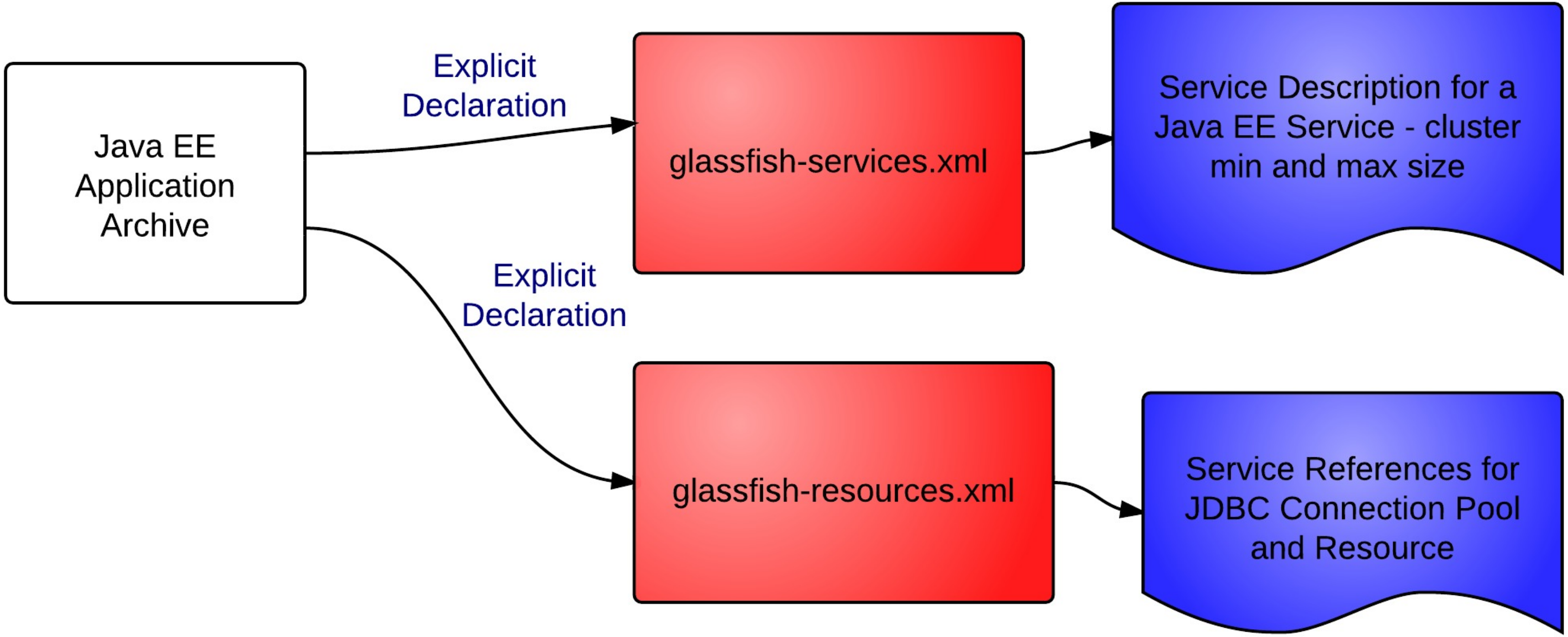
Specification of Service Metadata

- Optional!
  - When not specified (vanilla EE app archives)
    - Orchestration Engine automatically handles discovery of service deps
    - Automatic wiring to default Service Templates
  - Metadata may be specified when:
    - Finer grain control of application environment desired
    - Application-specific Service configuration

Specification of Service Metadata

- Service Definition
  - Metadata used to provision and configure a Service
    - ***What :*** Service characteristics (functional and non-functional) → Template matching
    - ***How :*** Explicit Template specification → Template wiring
- Service Reference
  - An application component's dependency on a Service
    - **Explicit :** User-specified through deployment descriptors
    - **Implicit** and **Discovered**: Information contained within the archive

Service Dependency Specification



Java EE Application Archive

Explicit Declaration

glassfish-services.xml

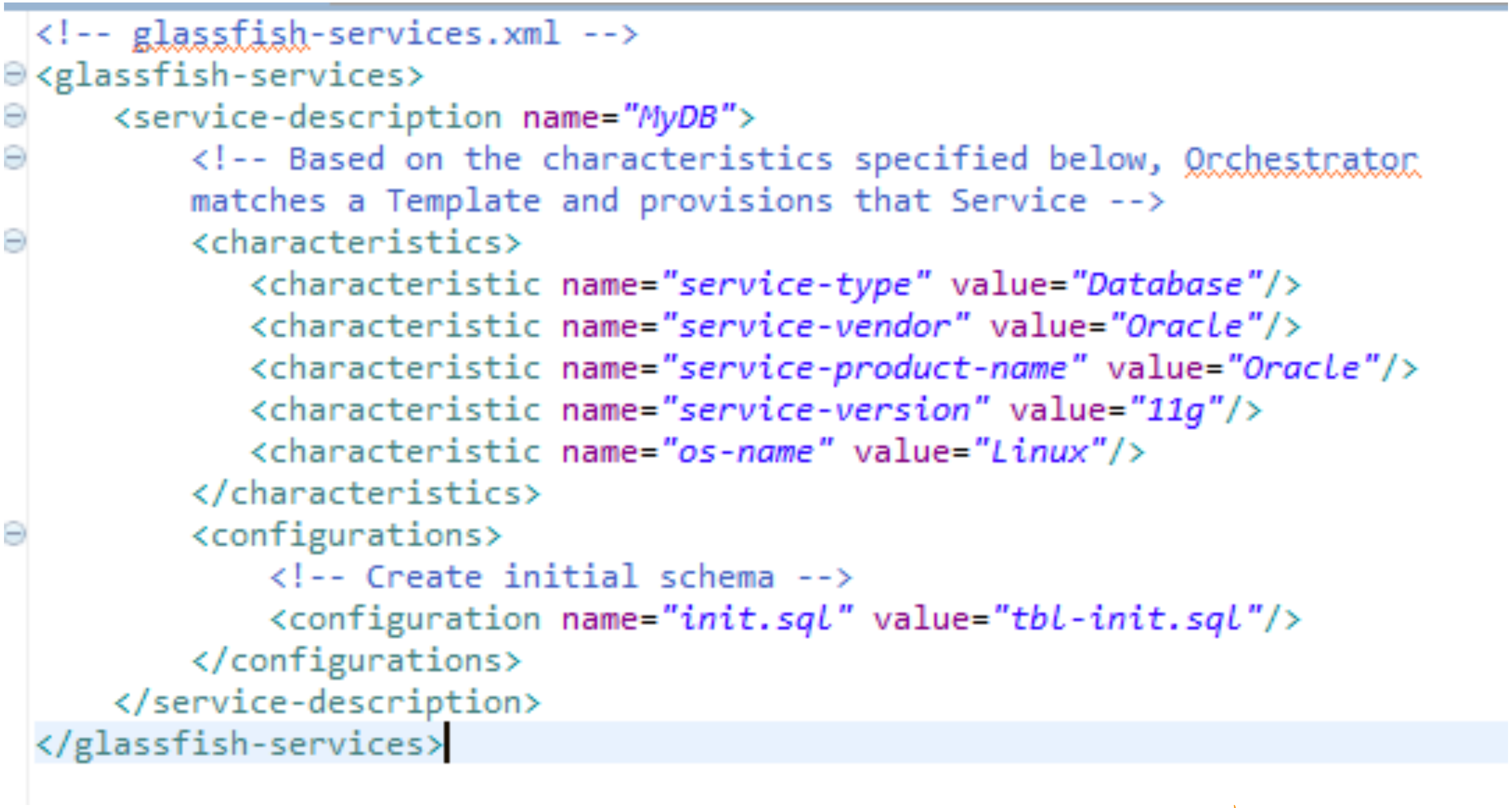
Service Description for a Java EE Service - cluster min and max size

Explicit Declaration

glassfish-resources.xml

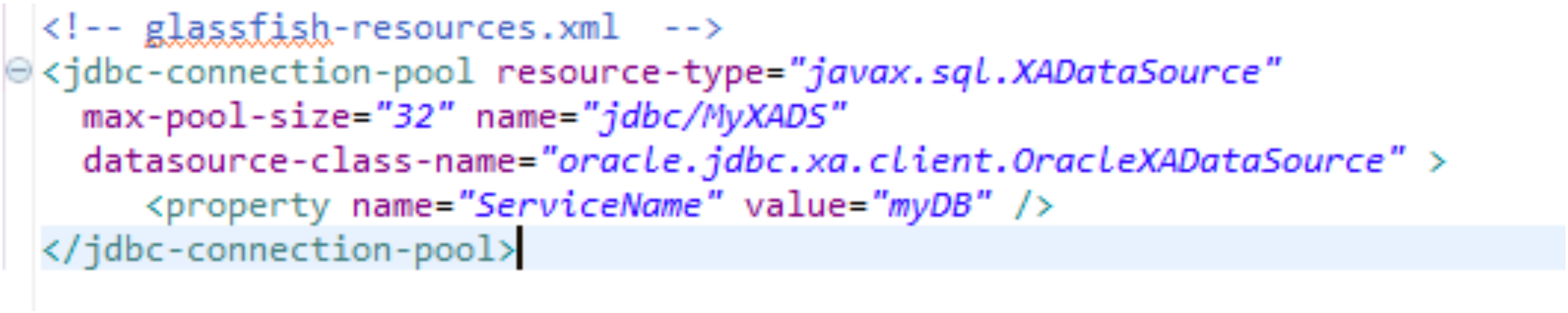
Service References for JDBC Connection Pool and Resource

Sample Service Definition



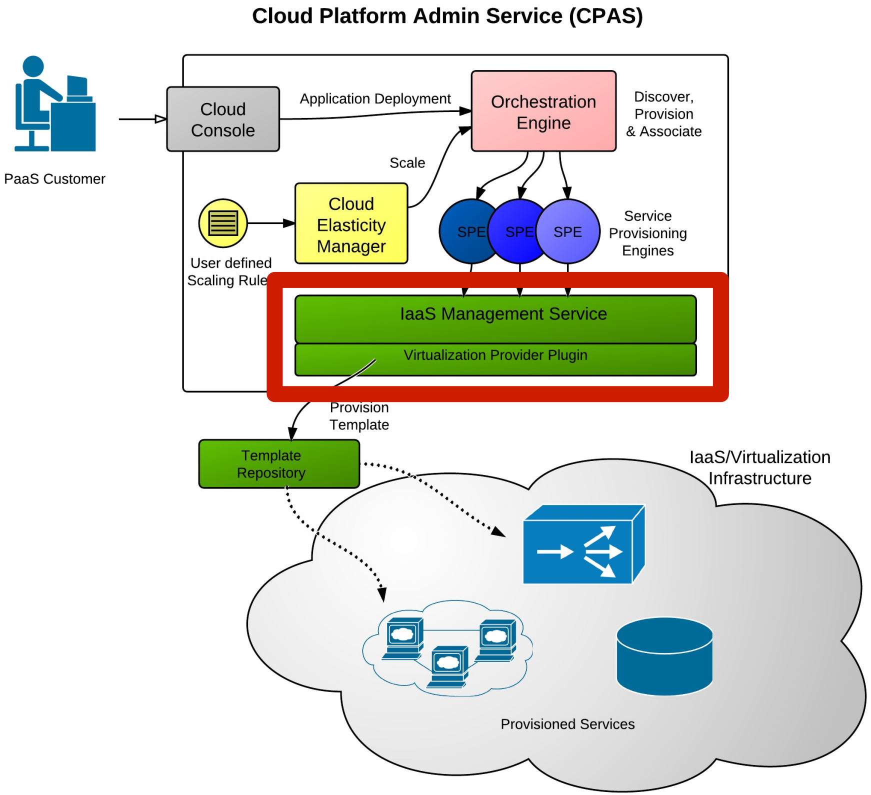
```
<!-- glassfish-services.xml -->
<glassfish-services>
    <service-description name="MyDB">
        <!-- Based on the characteristics specified below, Orchestrator
        matches a Template and provisions that Service -->
        <characteristics>
           <characteristic name="service-type" value="Database"/>
           <characteristic name="service-vendor" value="Oracle"/>
           <characteristic name="service-product-name" value="Oracle"/>
           <characteristic name="service-version" value="11g"/>
           <characteristic name="os-name" value="Linux"/>
        </characteristics>
        <configurations>
            <!-- Create initial schema -->
            <configuration name="init.sql" value="tbl-init.sql"/>
        </configurations>
    </service-description>
</glassfish-services>
```

Sample Service Reference



```
<!-- glassfish-resources.xml  -->
<jdbc-connection-pool resource-type="javax.sql.XADataSource"
  max-pool-size="32" name="jdbc/MyXADS"
  datasource-class-name="oracle.jdbc.xa.client.OracleXADataSource" >
     <property name="ServiceName" value="myDB" />
</jdbc-connection-pool>
```

GlassFish PaaS Runtime Architecture

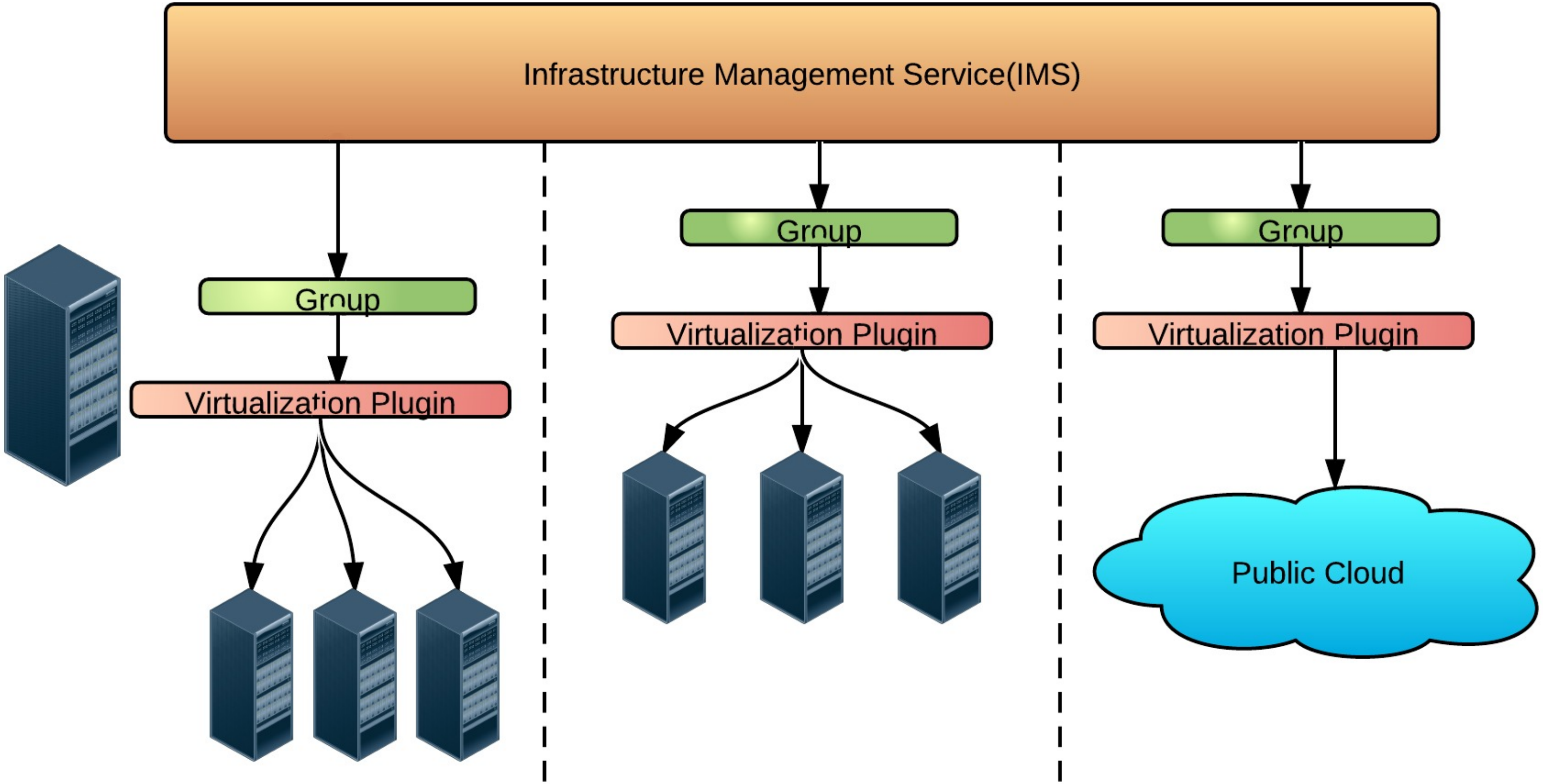


IaaS Management Service (IMS)

One-liner

Provide common management interface across different virtualization technologies

IMS


Infrastructure Management Service(IMS)
Group
Virtualization Plugin
Group
Virtualization Plugin
Group
Virtualization Plugin
Public Cloud

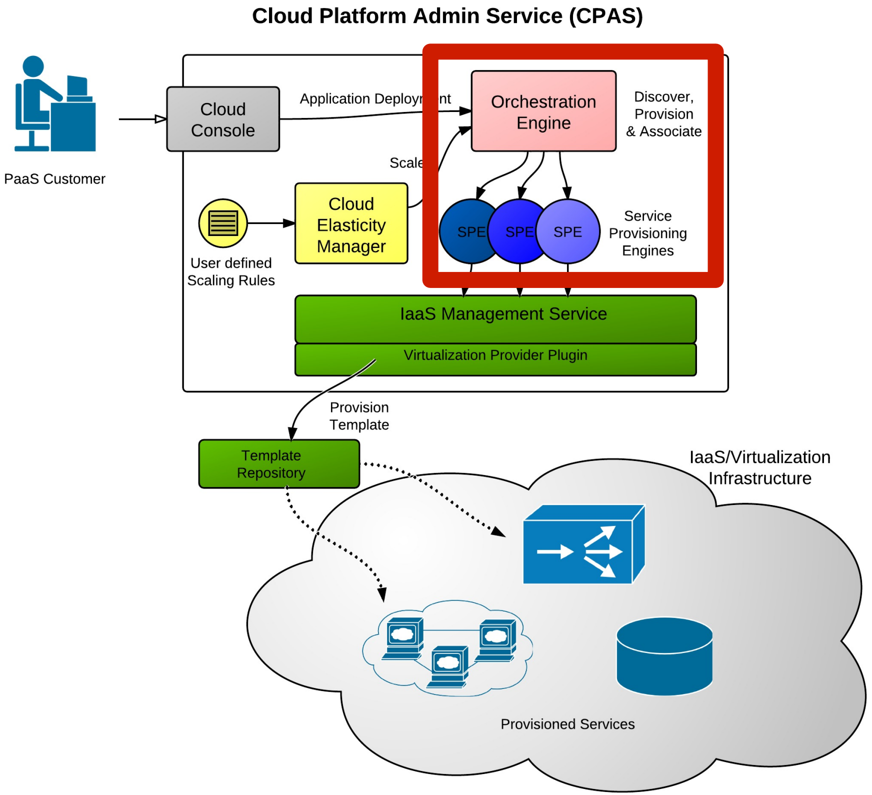
IMS functionalities

- Support virtualization definitions
- Isolates from low level Virtual Machine allocation/interface
  - *Integrates with native solutions through Plug-in/SPI mechanism.*
- Template management
- ServerPool / Hardware management (depending on the virtualization technology).

Templates

- A virtual-machine disk
  - can be duplicated
  - used to instantiate a virtual-machine.
- Virtualization Specific
- Provides 1 to many service types (usually one).
- Template are customized during the first startup
  - DAS location
  - Template parameters like instance name
  - Customization mechanism is virtualization specific

GlassFish PaaS Runtime Architecture

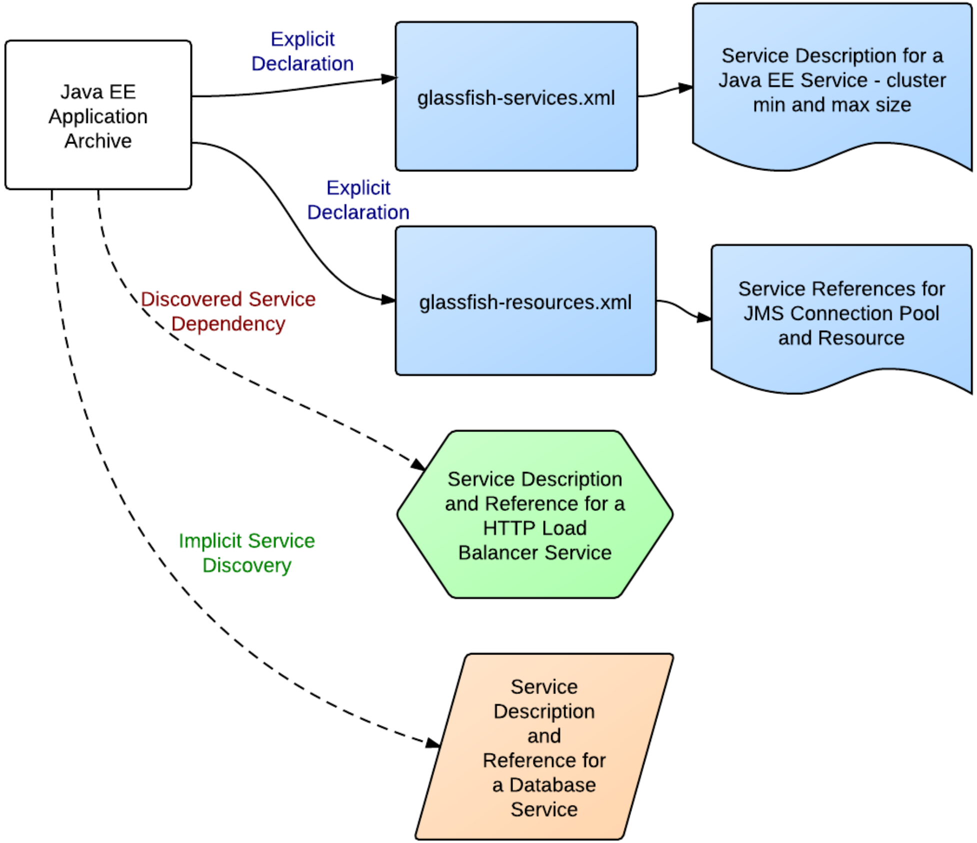


Service Orchestration

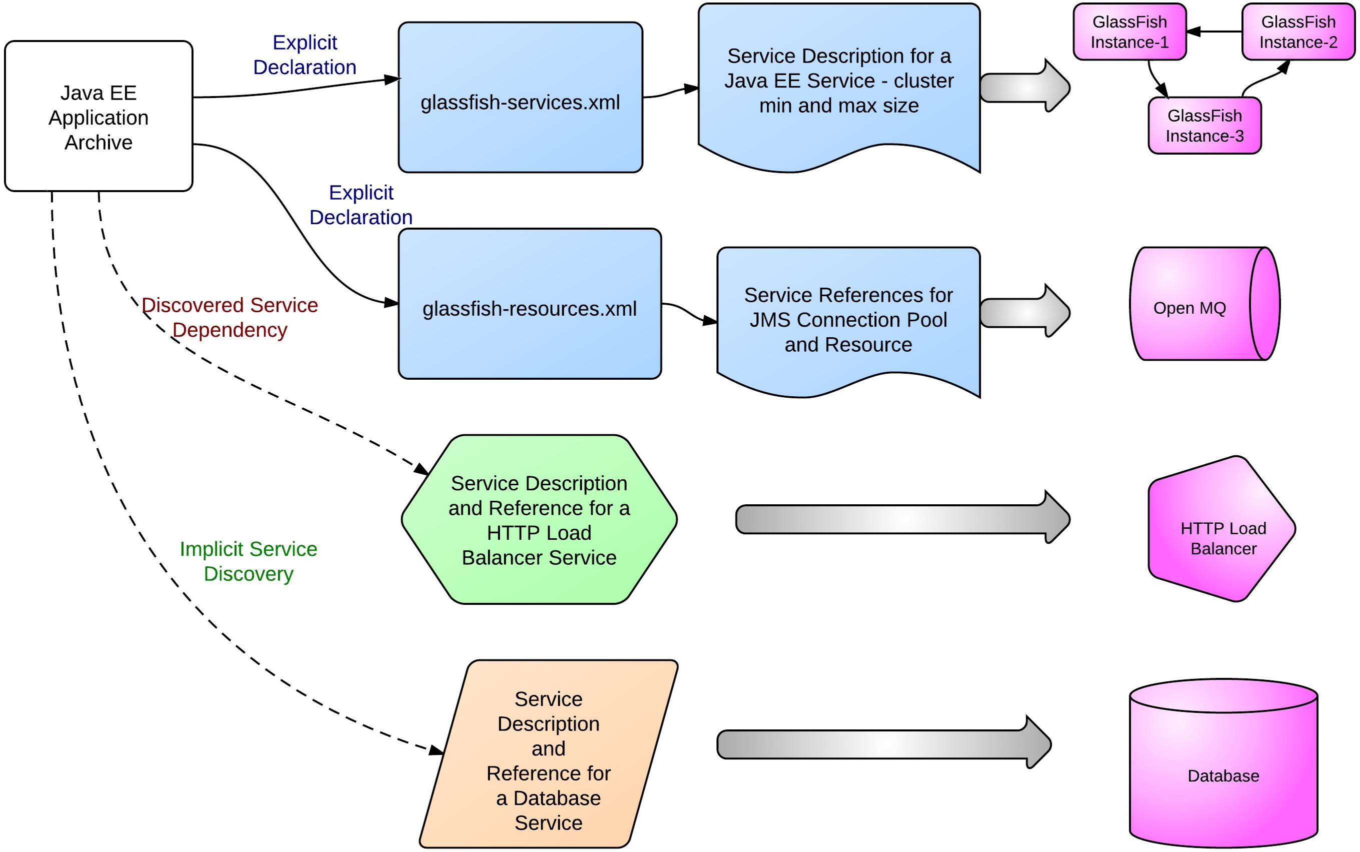
One-liner

Enable single-click deployment of a PaaS application through automatic service dependency discovery, service provisioning and service association

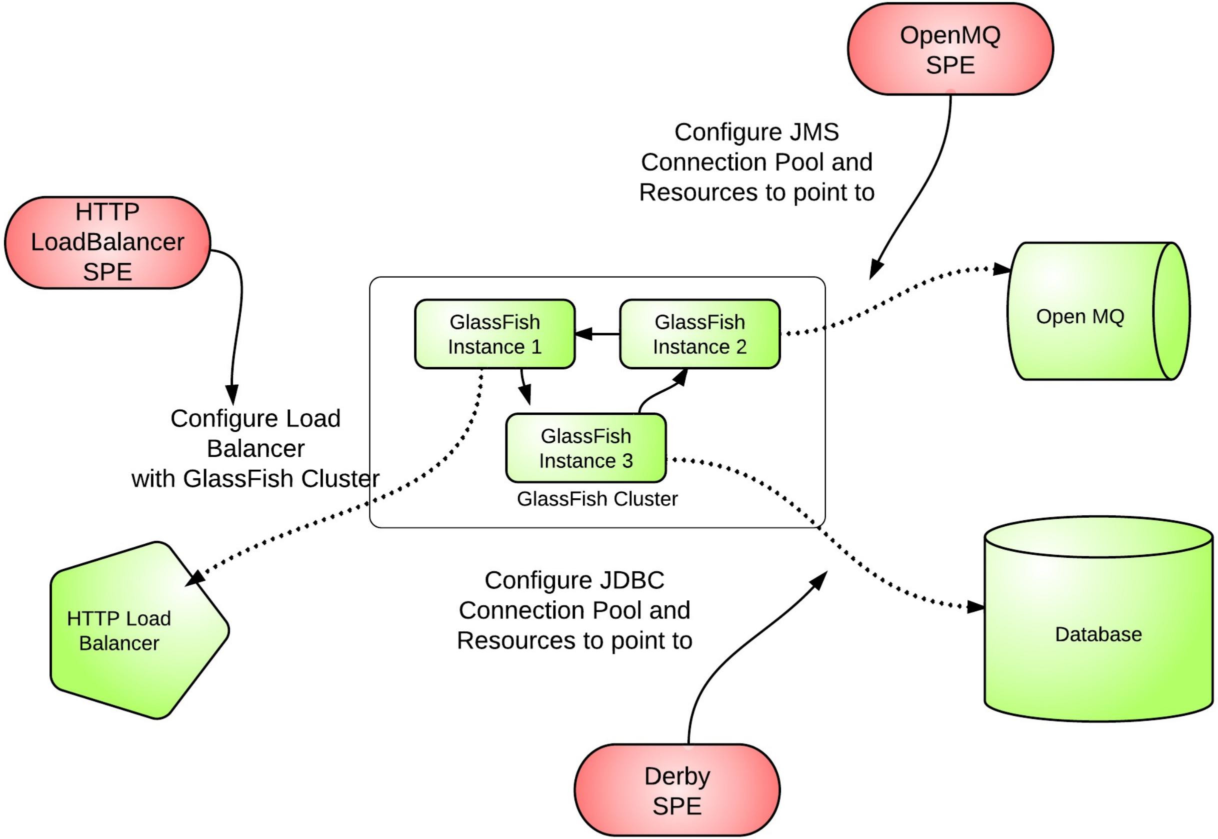
Service Dependency Discovery


Java EE Application Archive
Explicit Declaration
glassfish-services.xml
Service Description for a Java EE Service - cluster min and max size
Explicit Declaration
glassfish-resources.xml
Service References for JMS Connection Pool and Resource
Discovered Service Dependency
Service Description and Reference for a HTTP Load Balancer Service
Implicit Service Discovery
Service Description and Reference for a Database Service

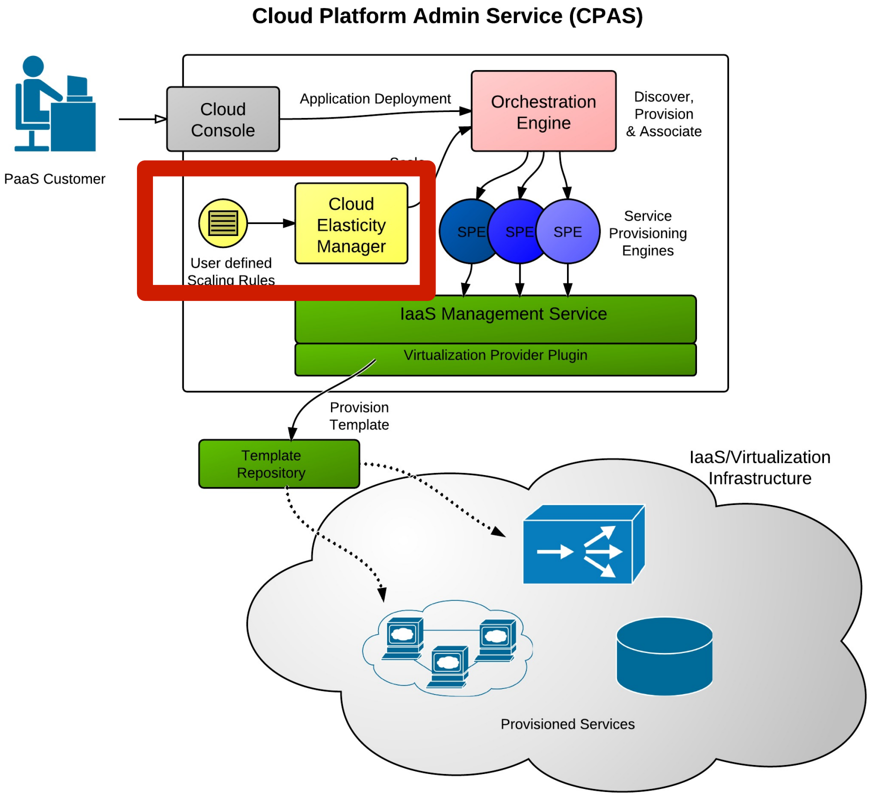
Service Provisioning


Java EE Application Archive
Explicit Declaration
glassfish-services.xml
Service Description for a Java EE Service - cluster min and max size
GlassFish Instance-1
GlassFish Instance-2
GlassFish Instance-3
Explicit Declaration
glassfish-resources.xml
Service References for JMS Connection Pool and Resource
Open MQ
Discovered Service Dependency
Service Description and Reference for a HTTP Load Balancer Service
HTTP Load Balancer
Implicit Service Discovery
Service Description and Reference for a Database Service
Database

Service Association


OpenMQ SPE
Configure JMS Connection Pool and Resources to point to
HTTP LoadBalancer SPE
Open MQ
GlassFish Instance 1
GlassFish Instance 2
GlassFish Instance 3
GlassFish Cluster
Configure Load Balancer with GlassFish Cluster
HTTP Load Balancer
Configure JDBC Connection Pool and Resources to point to
Database
Derby SPE

GlassFish PaaS Runtime Architecture



Auto-Scaling

One-liner

The ability of a system to automatically adapt to volume of traffic without impacting throughput and availability

What we need

- To determine the health of Services in the System
  - Number of metrics can be used
  - An arbitrary / complex condition need to be evaluated
  - Arbitrary actions can be taken

- A framework that allows
  - Ability to define new Metric sources easily (Extensible)
  - Ability to express complex queries easily
  - Ability to create new Actions easily

Determining State of Services

- Monitor System Resources
  - CPU
    - Used and idle CPU times
  - Memory
    - Process memory: Allocated, Resident etc.
    - JVM memory: Used, Committed and Max memory
  - Disk
    - Reads, Writes per seconds
    - Bytes read, written etc.

Determining State of Services (Contd.)

– Monitor Application Related Objects

- HTTP Sessions created / destroyed per second
- Number of HTTP requests that arrived
- Connection Pools: Number of connections acquired / released etc.
- Database Queries executed
- Transaction status: Number of commits / rollbacks
- Response time of a specific URL

– ***Many, many, many other metrics…***

We have metrics. Now what?

- Use relevant metrics to determine health of the services
  - Such as Java EE Clustered Instances, Clustered DB
- Use Trends
  - Average memory usage above 60% for last 10 min
  - Avg Response times of 90% of requests in last 10 min below 5ms
- Use Combinations
  - Are both CPU and Memory usages high ?
  - Is CPU usage of Java EE Cluster and number of queries executed on Database within certain limits ?

What Actions can you take?

- Possible Actions
  - Send email to admin
  - Log some info
  - Scale up / Scale down to meet the load
  - Send a (JMX) notification
  - *And many, many, many more…*

Call to Action

- Java EE 7 Expert Group Project
  - http://javaee-spec.java.net
- Java EE 7 Reference Implementation
  - http://glassfish.org
- The Aquarium
  - http://blogs.oracle.com/theaquarium

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