Towards a cloud-enabled Java EE platform
Cloud Computing

- Paradigm for provisioning computing resources

- The most attention was recently given to:
  - Infrastructure as a Service (IaaS),
  - Platform as a Service (PaaS),
  - Software as a Service (SaaS)

- For this work, platform is the most relevant resource as a service

- Existing well-known PaaS providers:
  - Windows Azure
  - Google App Engine
  - Elastic Beanstalk
Current Java EE containers are not fully architected to execute applications in the cloud.

- No support for: **multitenancy, elasticity** and **monitoring**
- Multitenancy: Principle of sharing resource among several tenants
- Elasticity, scaling: Meeting the demand by scaling-up resources
- Monitoring: Monitoring usage, scaling, SLA/SLO...

**Methodology:**
- Identifying models of multitenant environment
- Identifying metrics to support scaling
- Identifying monitoring metrics
- Defining parameter system for identified metrics
- Defining Java meta-data based on parameter system
- Validate meta-data system
Multitenancy models

- Model type 1

  Tenant 1

  Tenant 2
Multitenancy models

- Model type 2
Multitenancy models

- Model type 3
Multitenancy models

- Model type 4 (Shared/Non-shared container)
### Proposed parameter system

<table>
<thead>
<tr>
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<th>Description</th>
</tr>
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Metadata system

- Metadata system is developed from parameter system:
  - 9 monitoring, 4 elascitcy, 9 mutitenancy metadata

Multitenancy parameter

@Multitenant
@JMSConsumer
@TenantScoped
@DataSourceDefinition
@MailSession
**Metadata system**

- **Example 1 (Annotation):**

  **Declaration**
  ```java
  @Target(value=TYPE)
  @Retention(value=RUNTIME)
  public @interface Multitenant {
      MultitenantType type() default MultitenantType.SHARED;
  }
  ```

  **Use case**
  ```java
  @Multitenant(type=SHARED)
  @WebServlet(urlPatterns = {"/SimpleServlet"})
  public class SimpleServlet extends HttpServlet {
      ...
  }
  ```

- **Example 2 (global application descriptor):**

  ```xml
  <application id="ID_app">
      <display-name>Application.ear</display-name>
      <description> Description. </description>
      ...
      <provisioning-policy>
          <container name="EJB">
              <instances count="5" />
          </container>
          ...
      </provisioning-policy>
  </application>
  ```
Evaluation and conclusion

- Metadata for specifying number of EJB and number of Web containers was implemented on Java EE 6 compliant Oracle Glassfish Server

- Exchange rates application was implemented:
  - Once on server without cloud specific extensions
  - Once on server with cloud specific extensions

- Configuration time:
  - In first case it took the user on average 54 seconds of manual intervention to configure cluster (trigger VM deployment, configure server)
  - In second case, configuration tasks were executed in a just over 2 seconds.

- Even more important then time to configure:
  - No need for personnel on stand-by waiting to take scaling action.
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