J2EE Performance
Scalability and
Clustering
Part 1

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Goal
- J2EE performance scalability evaluation
- Performance factors
  - design patterns
  - container design
  - communication layers
  - Java Virtual Machine

Outline
- Background
- Performance factors
- RUBiS benchmark
- Performance results
- Scaling further with clustering
- Conclusion

J2EE architecture
- Presentation and business logic separation

Enterprise JavaBeans
- Entity beans
  - map data stored in the database
  - Bean Managed Persistence (BMP)
  - Container Managed Persistence (CMP)
- Session beans
  - stateless: temporary operations
  - stateful: temporary objects

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Design patterns: Servlets only
- Presentation and business logic mixed

Design patterns: Session Beans
- Presentation and business logic separation

Design pattern: Entity Beans
- Data Access Objects separation with Entity Beans (BMP or CMP)

Design patterns: Session façade
- Façade session bean with EJB 1.1

Design patterns: EJB 2.0 local
- Session façade with EJB 2.0 local interface

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Container design

- Reflexive approach (JBoss 2.4)
  - dynamic proxy
  - home and component interfaces generated at run-time
  - reflection to locate a bean or map method signatures
- Precompiled approach (JOnAS)
  - custom implementations of home and component interfaces
  - direct call of the bean instance
  - need a specific “compiler”

Communication layers

<table>
<thead>
<tr>
<th>Comm. layer</th>
<th>Protocol on TCP/IP</th>
<th>Object passing</th>
<th>Local calls optimized</th>
<th>EJB container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard RMI</td>
<td>JRMP</td>
<td>value</td>
<td>no</td>
<td>JBoss JOnAS</td>
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<tr>
<td>Optimized RMI</td>
<td>JRMP</td>
<td>reference</td>
<td>no</td>
<td>JBoss</td>
</tr>
<tr>
<td>Jeremie</td>
<td>GIOP</td>
<td>reference</td>
<td>yes</td>
<td>JOnAS</td>
</tr>
</tbody>
</table>

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RUBiS

- Auction site modeled after eBay
- 26 interactions
- Browsing mix: read-only mix
- Bidding mix: 15% read-write interactions
- Database: 1.4 GB
  - 1 million users, ~500000 comments
  - >500000 items, 330000 active bids

Code complexity

- Beans are easy but verbose to write
- Large number of beans result in large code base
- Main portability issues
  - naming conventions
  - deployment descriptors
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Design pattern evaluation

- Comparison of the 6 design patterns
- Results using:
  - Sun JVM
  - best container design
  - best communication layer
- Metric: throughput in interactions per minute

Design pattern results

- Session Beans = Servlets only
- Entity Beans
  - BMP = CMP
  - data access too fine grain
- Session façade
  - allows coarser grain access
  - 2.5 times slower than Session Beans

Other performance factors

- Comparison of the 5 EJB design patterns
  - Varying:
    - container design
    - communication layer
  - Metric: throughput in interactions per minute

RUBiS – Overall results
Performance factor analysis

- Container design
  - pre-compiled scales better than dynamic proxy
  - significant impact on Entity Beans

Container design

- RUBiS – Session façade

Performance factor analysis

- Communication layers
  - optimized layers needed for scalability
  - EJB 2.0 local interfaces to avoid local communications

Communication layers

- RUBiS – Session façade

JVM Performance

- IBM 1.3.1 is the best performance/stability tradeoff
- JRockit is very unstable and performance can dramatically drop
- Sun 1.3.1 or 1.4.x is the worst performer but is quite stable
Other results
- Monitoring of CPU, disk, network and memory
- CPU profiling at the peak point using Optimizelt
  - 45-90% spent in communication
  - up to 32% in reflection
- JDK 1.4 does not improve performance

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J2EE Clustering
- Web server clustering
  - hardware: L4-switch
  - software: LVS, RR-DNS, ...
- Servlet/JSP server clustering
  - in-memory session replication

J2EE Clustering
- EJB Server clustering
  - cluster stubs for load-balancing
  - database based persistency
- Database clustering
  - Oracle RAC
  - Clustered-JDBC

Conclusion
- Design pattern determines performance
- Communication accounts for 45-90% of CPU time
- Reflection limits container scalability
- Less than 2% of execution time in user bean code
- JVM limits overall scalability
- Clustering can help scaling further
Some links

- RUBiS: http://www.objectweb.org/rubis
  - JMS
  - EJB 2.0 CMP
  - JDO
- JOnAS: http://www.objectweb.org/jonas
- jBoss: http://jboss.org
  - http://c-jdbc.objectweb.org

More to come on J2EE Clustering …

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Part 2

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