A Reference Architecture for Web Servers

Ahmed Hassan and Richard Holt

Software Architecture Group
University of Waterloo
CANADA
Reference Architecture

- Architecture template for software systems in a domain
- A product architecture is an instantiation of the reference architecture
- Defines the fundamental components and the relations between them
- Well known for mature domain (e.g., Compilers, Operating Systems)
Compiler Ref. Arch.

Reference Architecture Benefits

• Documents existing well-proven designs
• Helps build complex systems
• Provides a common vocabulary
• Aids in the comparison of different architectures in the same domain
• Improves code reuse
Paper Overview

• We present:
  – A process to derive a reference architecture by non-domain experts
  – A reference architecture for web servers
  – Mapping it to different product architectures
The Web Server Domain
Web Servers

- Apache
- Microsoft - IIS
- Netscape - iPlanet Server
- AOL Server
- Jigsaw
## Summary: 3 Servers

<table>
<thead>
<tr>
<th>Web Server</th>
<th>Main arch.</th>
<th>Dev type</th>
<th>1st release</th>
<th>Code size (KLOC)</th>
<th>Lang.</th>
<th>Arch. stable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache</td>
<td>Robert Thau</td>
<td>Open source</td>
<td>April 1995</td>
<td>80</td>
<td>C</td>
<td>5 yrs</td>
</tr>
<tr>
<td>AOL Server</td>
<td>-</td>
<td>Commercial</td>
<td>May 1995</td>
<td>164</td>
<td>C &amp; TCL</td>
<td>-</td>
</tr>
<tr>
<td>Jigsaw</td>
<td>Yves Lafon</td>
<td>Experimental</td>
<td>May 1996</td>
<td>106</td>
<td>Java</td>
<td>2.5 yrs</td>
</tr>
</tbody>
</table>

Apache Web Server (Open source, April 1995, 80 KLOC) in C.

AOL Server (Commercial, May 1995, 164 KLOC) in C & TCL.

Jigsaw Server (Experimental, May 1996, 106 KLOC) in Java.
Conceptual vs. Concrete Architecture

- **Conceptual Architecture:**
  - Resides in the head(s) of the developer(s)
  - Mental model: incomplete, inaccurate, ideal

- **Concrete Architecture:**
  - Extracted from the system’s implementation
  - Many mismatches with the conceptual architecture
Process for Deriving Ref. Arch.

Reference Architecture for Web Servers

- Conceptual Architecture
  - Concrete Architecture
    - Apache
- Conceptual Architecture
  - Concrete Architecture
    - AOLServer
- Conceptual Architecture
  - Concrete Architecture
    - Jigsaw
Web Server Reference Architecture
Web Server Reference Architecture

Reception

- Request Analysis
- Access Control
- Util

Record Transaction

Resource Handler

Operating System Abstraction Layer

Control flow

All depend on
Mapping the Reference Architecture to a Web Server
The Apache Web Server
Apache Conceptual Architecture to ref. architecture mapping
The AOL Web Server
AOLServer: Conceptual to ref. architecture mapping

- Recep. & Req. Analysis
- Communication Driver
- Daemon – Core
- Request Trans.
- Access Ctrl.
  - NSPerm
- Req. Handler.
  - URL Handle
- Util.
  - Timer
  - Database Interface
  - Util
  - TCL Interpreter
- OSAL.
  - NSThread

AOLServer: Conceptual Architecture
Mapping Summary

• Conceptual arch. of 3 servers maps nicely to ref. arch.
• Main differences are splitting and merging of subsystems
• The derived architecture is independent of development methodology
Conclusions

- Ref. arch.: Framework to assist in forward and reverse engineering
- Conceptual arch: Each server maps nicely to the derived reference architecture
- Needs more validation