Module 6: Reference Architectures (Web Servers and Web Browsers)

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A Reference Architecture for Web Servers

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CANADA
Reference Architecture

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

Source \(\rightarrow\) Scanner \(\rightarrow\) Parser \(\rightarrow\) Sem. Analyzer \(\rightarrow\) Code Gen. \(\rightarrow\) Binary
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>
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
Reception

Request Analysis

Access Control

Record Transaction

Resource Handler

Util

Operating System Abstraction Layer

Web Server Reference Architecture

Control flow

All depend on
Mapping the Reference Architecture to a Web Server
The Apache Web Server
Apache: Conceptual Architecture

- req. handler
- request trans.
- core
- logging
- translation

Access Ctrl.

- authen.
- authorization

Util.

OSAL.
The AOL Web Server
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
Reference Architectures for Web Browsers

A Case Study in Architectural Analysis: The Evolution of the Modern Web Browser

Alan Grosskurth and Michael W. Godfrey
History of Web Browsers
Reference Architecture

User Interface

Browser Engine

Rendering Engine

Networking

JavaScript Interpreter

XML Parser

Display Backend

Data Persistence
### Studied Browsers

Table 1: Approximate web browser statistics

<table>
<thead>
<tr>
<th>Project</th>
<th>Version</th>
<th>Language</th>
<th>Files</th>
<th>kLOC</th>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mozilla</td>
<td>1.7.3</td>
<td>C++, C</td>
<td>10,700</td>
<td>2,400</td>
<td>1998</td>
</tr>
<tr>
<td>Konqueror</td>
<td>3.3.2</td>
<td>C++</td>
<td>3,150</td>
<td>600</td>
<td>1996</td>
</tr>
<tr>
<td>Epiphany</td>
<td>1.4.6</td>
<td>C++, C</td>
<td>7,230</td>
<td>1,540</td>
<td>2000</td>
</tr>
<tr>
<td>Safari</td>
<td>1.2</td>
<td>C++, Obj C</td>
<td>&gt;1,550</td>
<td>&gt;230</td>
<td>2003</td>
</tr>
<tr>
<td>Lynx</td>
<td>2.8.5</td>
<td>C</td>
<td>200</td>
<td>120</td>
<td>1989</td>
</tr>
<tr>
<td>Mosaic</td>
<td>2.7b6</td>
<td>C</td>
<td>295</td>
<td>88</td>
<td>1993</td>
</tr>
<tr>
<td>Firefox</td>
<td>1.0</td>
<td>C++, C</td>
<td>10,700</td>
<td>2,400</td>
<td>2002</td>
</tr>
</tbody>
</table>
Konqueror
Epiphany

User Interface

Browser Engine

Gecko

Rendering Engine

User Pref.
Persistence
(GConf)

User Data
Persistence
(libxml2)

Engine
Persistence
(Mozilla)

Data Persistence

Necko

Security
(NSS/PSM)

Networking

Spider-
Monkey

JavaScript
Interpreter

Expat

XML
Parser

GTK+
Adapter

GTK+ / X11 Libraries

Display Backend
Mosaic

Common Client Interface

User Interface

Browser Core

Browser Engine

Data Persistence

Networking

libwww

JavaScript Interpreter

XML Parser

libhtmlw

Rendering Engine

motif / X11

Display Backend