Lecture 11:
Reference Architecture

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Recap of Last Class

- Architecture Recovery
  - Conceptual Architecture
    - In the mind of the developers
  - Concrete Architecture
    - The real architecture based on the code
Reference Architecture

What is a reference architecture?

Defines the fundamental components for a domain and the relations between them.
Why do we need a reference architecture?

Different domains have common requirements that largely shape their architecture.
Advantages of Reference Architecture

■ Provides a common nomenclature across all software systems in the same domain

■ Establishes common understanding and assists in comparing different architectures

■ Provides a set of expected subsystems and relations between them (in RE)
Reference vs. Conceptual

- Architecture of a product is an instance of the reference architecture
  - Specific products refine and extend the reference architecture based on the product’s requirements and constraints
Reference Architecture of Web Servers
Reference architecture of web servers

- Investigated 3 different web servers
  - Developed by 3 different organizations
  - Using different development techniques
  - Different programming languages
  - Source code publicly available
Web Browsers and Web Servers

- Web servers provide features for users, email, news etc..
- Need a web browser to access these features
Web Browsers and Web Servers

- Web servers are different, but usually have common features
  - All web servers can serve simple text
  - Not all can serve Java servlets

- Existence of common features leads to common reference arch
Example of Web Request

Enter URL
(www.cnn.com)

HTTP request
Locate resource

WEB SERVER

Operating System

Resources

Dynamic resources
Servlet CGI Program

Static resources
Files
Step 1: Derive conceptual architecture

- Propose a conceptual architecture based on domain knowledge and documentation
- Refine conceptual architecture using concrete architecture
Deriving the Reference Architecture

**Step 2:** Derive reference architecture using the conceptual architectures

- Propose reference architecture based on domain knowledge and common structure between conceptual architectures
- Refine the reference architecture using conceptual architectures
Reference Architecture Derivation Process

Reference Architecture for Web Servers

- Conceptual Architecture
  - Concrete Architecture
  - Apache

- Conceptual Architecture
  - Concrete Architecture
  - AOLServer

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

Control flow

All depend on
Reception

- Interprets resource request protocol
- Waits for browser requests
- Determines capabilities of the browser
- Data structure and logic to handle multiple requests simultaneously
Request Analyzer

- Operates on the internal representation of the request
- Translates the location of the resource from a network location to a local file name
  - e.x. ~/index.html -> /usr/https/pub/webfiles/index.html
Access Control

- Enforces access rules employed by the server
- Authenticates the browser and authorizes access to requested resources
  - e.x. username and password
Resource Handler and Transaction Log

- Determines the type of the resource requested by the browser, executes and generates response
  - e.x. Resource Handler determines if requested resource is static response that is sent directly to the user or dynamic

- Transaction log records all requests and their results
Support layer

- Utility contains functions used by all subsystems
  - e.x. string manipulation

- OSAL encapsulates operating system specific functionality to support porting of the server to different platforms
Apache
Waits for incoming requests
Creates Request_rec

Determines local location

Determine type of requested resource
Generate response

Record request

Username, password
Check if client authorized for resource

Facilitates porting Apache to multiple platforms

Regex engine
URL and string manipulation libraries

Send response back

Apache conceptual architecture
AOLServer
Interface that is communication protocol independent (e.x. supports SSL, TCP sockets)

Translates client’s requests

Conn structure

Checks for requested resources

Schedule events at different times

Interface to different types of databases

Records processing of request

Portable thread library implementation

AOLServer: Conceptual Architecture
Summary

■ Reference Architecture must be flexible enough to encompass many product archs
  – Does not determine implementation details

■ Conceptual architecture fits well in the reference architecture

■ Structure may be different due to splitting and merging of some subsystems