Middleware and Web Services

Lecture 1: Introduction to Application Server

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Overview

- Architecture
  - *I/O Communication Models*
- Servlet Technology

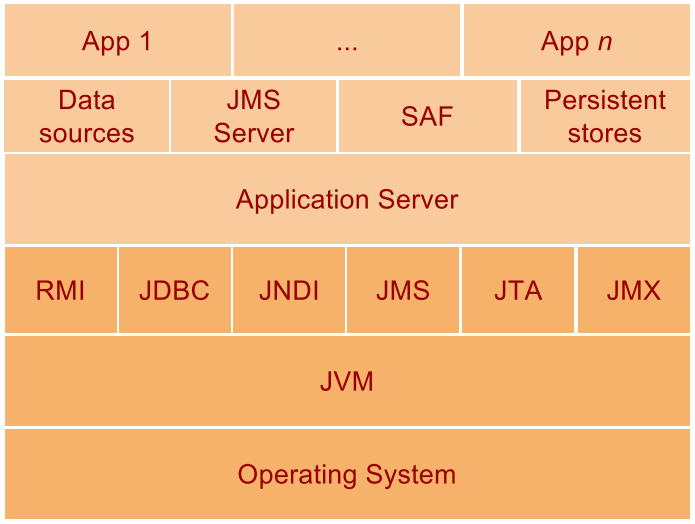
Application Server Overview

- An environment that runs an application logic
  - *A client communicates with the server using an application protocol*
- Application Server
  - *A modular environment*
    - → *provides technology to realize enterprise systems*
    - → *JEE containers – Java technology for AS components*
    - → *Supports a variety of objects such as Servlets, JPSs, JMS*
  - *Provides services such as naming and directory, performance, failover*
  - *Provides Web server capabilities*
  - *Can be a single server or multiple servers*
- Web Tier – HTTP Server
  - *Web Server supports HTTP only*
  - *HTTP request/response, security, proxy, caching*
- Communication models
  - *Blocking I/O (also called synchronous I/O)*
  - *Non-blocking I/O (also called asynchronous I/O)*

Java Enterprise Edition – JEE

- Java Enterprise Edition (JEE)
  - *Collection of technologies for server-side programming*
  - *Programming of application components*
  - *Main technologies*
    - → *Servlet technology and Java Server Pages (JSP)*
    - → *Remote Method Invocation (RMI)*
    - → *Java Database Connectivity Services (JDBC)*
    - → *Java Messaging System (JMS)*
- Basis for many application servers such as
  - *Oracle WebLogic*
  - *Google AppEngine (Java)*
  - *JBoss*
  - *GlassFish*
  - *IBM WebSphere*

Application Server Layers



console app, custom-built Web app, middleware apps

shared services used by applications - data sources, JMS queues, JCA adapters

Application Server core libraries, communication management, cluster communication, distributed cache

JEE Technology

Java environment, memory management, garbage collection

OS services, I/O

- Features
  - *AS appears as a single process in the OS*
    - *→ you can use standard OS commands to investigate its operation*
    - *→ AS listens on a single or multipe IPs (VIPs) and a tcp port*
  - *AS is a Java process*
    - *→ you can use Java tools to investigate its operation*
    - *→ Garbage collector stats, thread dumps, memory allocations, etc.*

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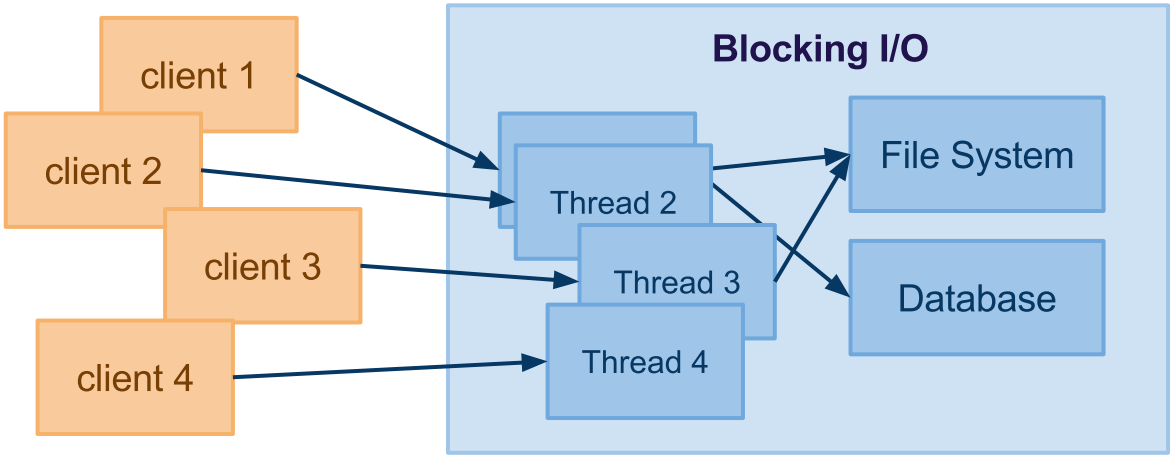
Blocking I/O Model

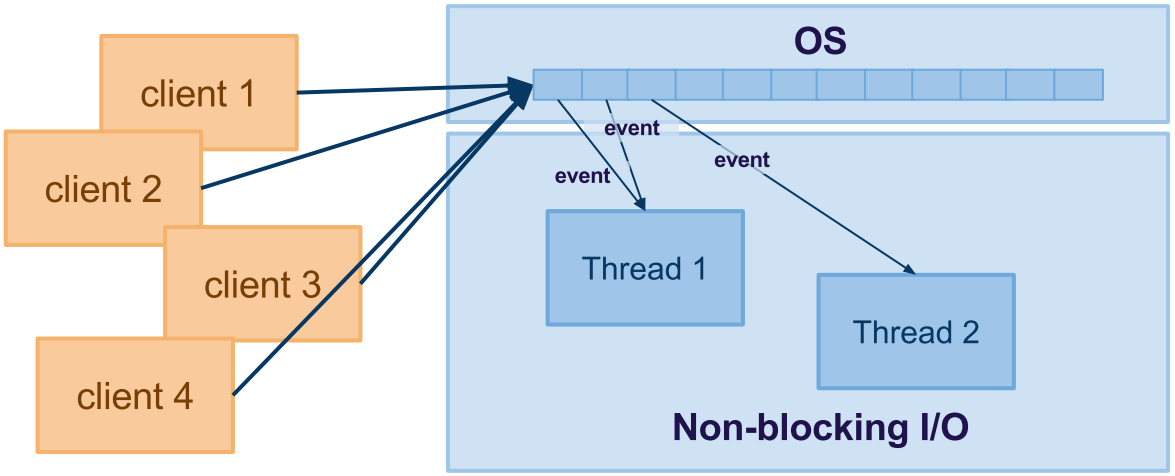
- The server creates a thread for every connection
  - *For example, 1K connections = 1K threads, big overhead*



- Characteristics
  - *the thread is reserved for the connection*
  - *When processing of the request requires other interactions with DB/FS or network communication is slow*
    → scales very bad as the thread's execution is "blocked"

Non-Blocking I/O Model

- Connections maintained by the OS, not the Web app
  - *The Web app registers events, OS triggers events when occur*



- Characteristics
  - *Event examples: new connection, read, write, closed*
  - *The app may create working threads, but controls the number!*
    → much less number of working threads as opposed to blocking I/O

Overview

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- Servlet Technology

Overview

- Technology to extend application server functionalities
  - *A Java class that can respond to any type of requests*
    - → *A servlet defines an interface for a specific protocol*
    - → *Your application implements the servlet's interface*
- Commonly used to respond to HTTP requests
  - *A basis for an application running on an application server*
  - *HTTP Servlet Java classes*
    - → `HttpServlet` – *provides HTTP protocol interface*
    - → `HttpServletRequest` – *represents HTTP request*
    - → `HttpServletResponse` – *represents HTTP response*

Directory Structure

- Your application
  - *collection of documents and libraries your application requires*
  - *packaged in* `war` *or* `ear` *archive*
    - → *JAR that includes not only java classes but also additional resources such as* `.xml`, `.html`, `.js`, `.css`, `.jpg` *files.*
- Content of `war` package

```
# web archive root
war
 |   # directories and documents accessible through the app root /
 |   # such as img, css, js, ...
 |-- (public-directory | public-document)*
 |   # directories and documents internal to your application
 |-- WEB-INF
        |-- (private-directory | private-document)*
        |   # compiled java classes of your application
        |-- classes
        |   # all java libraries your application requires
        |-- lib
        |   # configuration of your application
        |-- web.xml
        |-- # other platform-specific configurations
            # such as app-engineweb.xml for GAE
```

Configuration in web.xml

- `web.xml` defines configuration for
  - *list of servlets, mapping of servlets to URL paths, welcome files, filters, EJB references, authentication mechanism, etc.*
  - *basic configuration example:*

```xml
<?xml version="1.0" encoding="utf-8"?>
<web-app
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://java.sun.com/xml/ns/javaee">

    <servlet>
        <servlet-name>main</servlet-name>
        <servlet-class>com.vitvar.mdw.main</servlet-class>
    </servlet>

    <servlet-mapping>
        <servlet-name>main</servlet-name>
        <url-pattern>/</url-pattern>
    </servlet-mapping>

    <welcome-file-list>
        <welcome-file>index.jsp</welcome-file>
    </welcome-file-list>
</web-app>
```

Handling HTTP Requests

- HTTP Servlets
  - *Servlet is a class that extends capabilities of application servers via a request-response programming model*
  - *HTTP servlets are classes that extend* `HTTPServlet` *abstract class*
  - *Example:*

```
1  package com.vitvar.mdw;
2
3  import javax.servlet.http.HttpServlet;
4  import javax.servlet.http.HttpServletRequest;
5  import javax.servlet.http.HttpServletResponse;
6
7  public class Main extends HttpServlet {
8      public doGet(HttpServletRequest request, HttpServletResponse response) {
9          // GET method implementation here
10     }
11
12     public doPost(HttpServletRequest request, HttpServletResponse response) {
13         // POST method implementation here
14     }
15
16     // other methods such as doPost, doDelete, doOptions
17 }
```

Support for Sessions

- `HttpSession` interface
  - *Allows to store session data in the memory*
  - *Java API for HTTP State Management*
    - → *Hides details from developers*

```
1  // method doGet in a servlet
2  public doGet(HttpServletRequest request, HttpServletResponse response) {
3      // access the session object through the request
4      HttpSession session = request.getSession();
5
6      // unique identification of the session, the value used for the cookie
7      String id = session.getId();
8
9      // get the value of the attribute
10     Object value = session.getAttribute("data");
11
12     // set the value of the attribute
13     session.setAttribute("data", new String("some data"));
14
15     // this will set a max-age of the session cookie
16     session.setMaxInactiveInterval(3600);
17 }
```