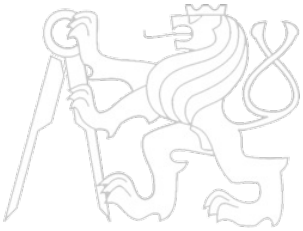
Middleware Architectures 1

Lecture 5: Application Server Architecture

doc. Ing. Tomáš Vitvar, Ph.D.
tomas@vitvar.com • @TomasVitvar • https://vitvar.com



Czech Technical University in Prague
Faculty of Information Technologies • Software and Web Engineering • https://vitvar.com/lectures

Modified: Fri Nov 12 2021, 18:47:41
Humla v1.0

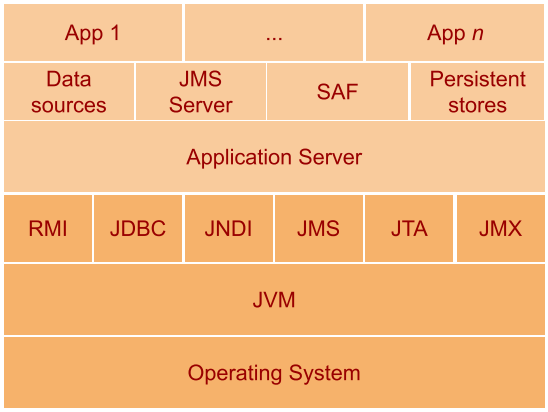
Overview

- Application Server Architecture
- Serving Requests
- Objects Distribution

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, JSPs, 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*

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

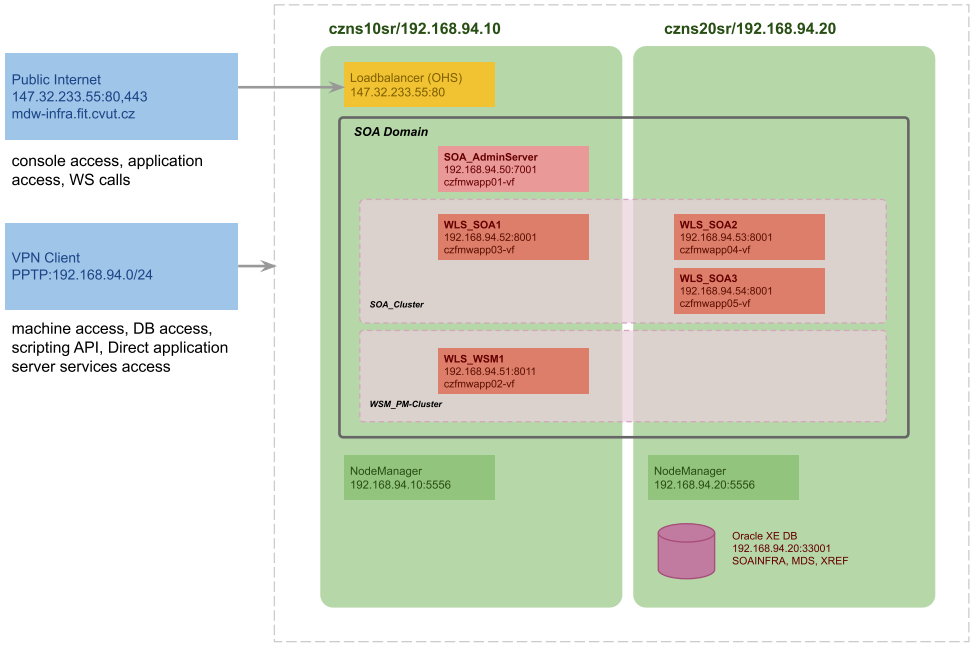
Java Technology

Java environment, memory management, garbage collection

OS services, I/O

- Features
  - *AS instance 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.*

Example Weblogic Infrastructure



Terminology

- Domain
  - *A group of servers with specific configuration of applications and objects*
- Administration Server
  - *An instance of application server that manages the domain*
- Managed Server
  - *An instance of application server running instances of applications and objects*
- Cluster
  - *A group of managed servers; they contain the same copy of applications and objects*
- Machine
  - *A physical machine and OS running one or more servers (Admin or Managed)*
- Node Manager
  - *A process that provides an access to admin and managed servers on the machine*
- Load Balancer
  - *A network element that distributes client requests to managed servers based on a specific algorithm*

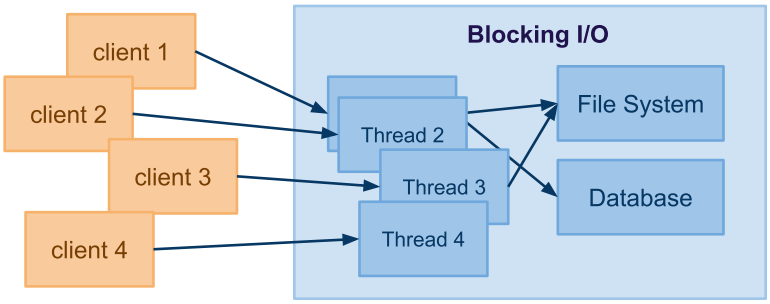
Servlet Technology

- 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*

Overview

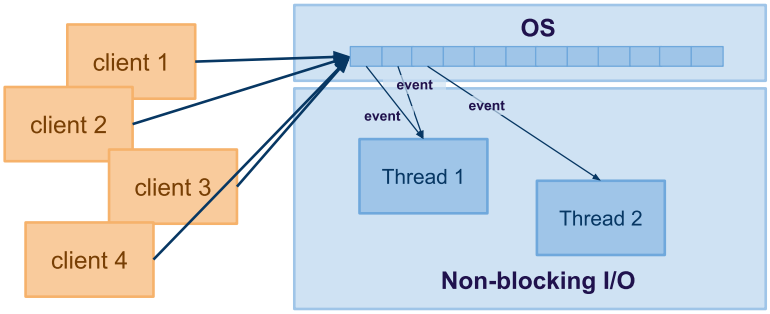
- Application Server Architecture
- Serving Requests
- Objects Distribution

Blocking (Synchronous) I/O



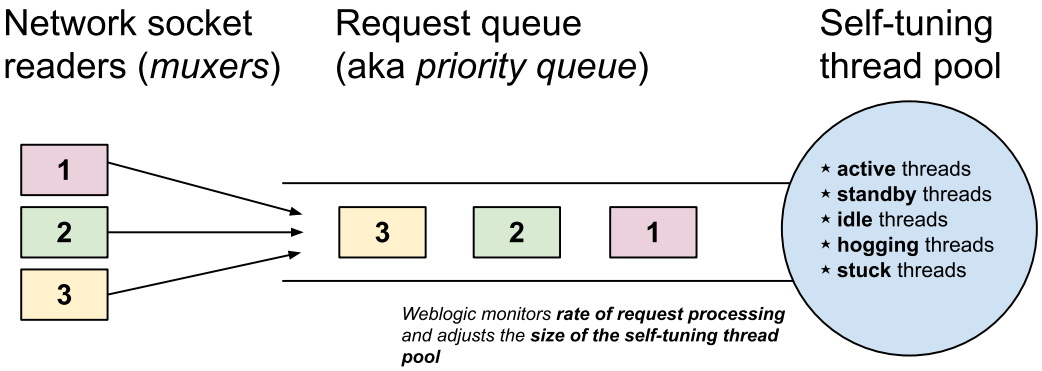
- Inbound connection
  - *A server creates a thread for every inbound connection*
  - *For example, 1K connections = 1K threads, big overhead*
  - *A thread is reserved for the entire duration of the request processing*
- Outbound connection
  - *A thread is blocked when outbound connection is made*
  - *When outbound connection is slow, the scalability is poor*

Non-Blocking (Asynchrnous) I/O



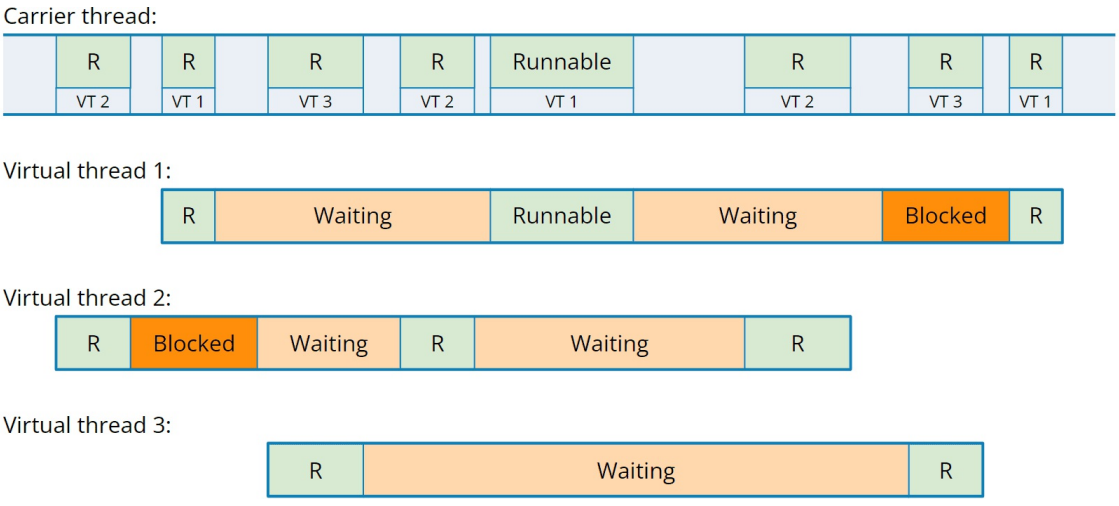
- Inbound connections
  - *The connection is maintained by the OS, not the server app*
  - *The Web app registers events, OS triggers events when they occur*
  - *The app may create working threads and controls their number*
- Outound connections
  - *The app registers a callback that is called when the data is available*
  - *Event loop*

Components



- **Muxer** – component that handles communication via network sockets.
- **Request queue** – queue of requests to be processed.
- **Self-tunning thread pool** – a pool of threads in various states.
- **Work manager** – a configuration of **maximum threads** and a **capacity** that can be used to handle requests for a specific application/service.

Java Virtual Threads



- Virtual threads mapped to a platform threads (carrier threads)
- Blocking operations do not block carrier threads

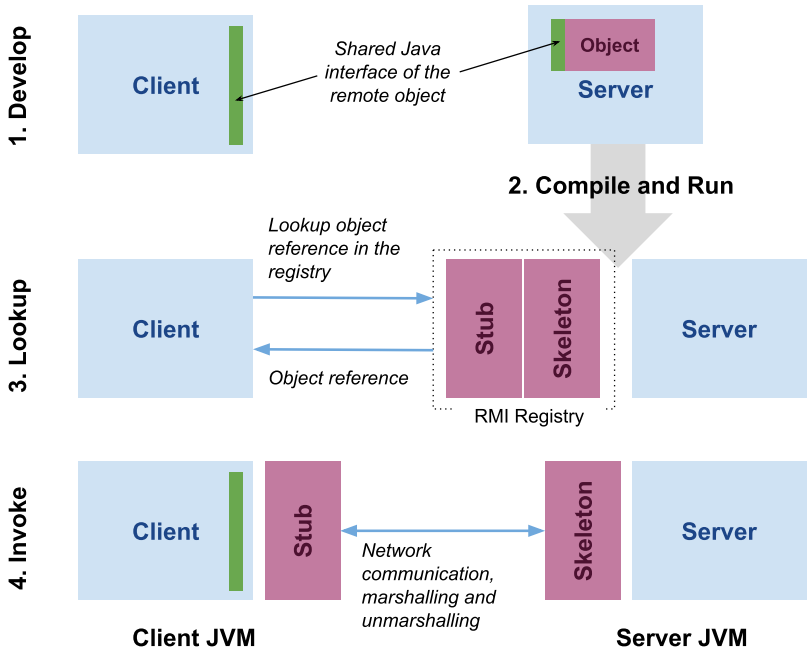
Overview

- Application Server Architecture
- Serving Requests
- Objects Distribution

Remote Method Invocation

- Communication among Java-based applications
  - *Methods of a Java class can be invoked by other Java class remotely*
  - *Uses Java Remote Method Protocol (JRMP)*
    → Java-specific application protocol over TCP/IP
  - *Basis for JEE technologies, such as JMS*
- Terminology
  - ***Client*** *– a program that invokes a remote method*
  - ***Server*** *– a program that exports a remote object*
  - ***Stub*** *– a representation of the client-side object for communication*
  - ***Skeleton*** *– a representation of the server-side object for communication*
  - ***Registry*** *– a component that holds a stub*
  - ***Marshalling/Unmarshalling*** *– a process of transforming memory representation of the object to a form suitable for network transmittion and vice-cersa*

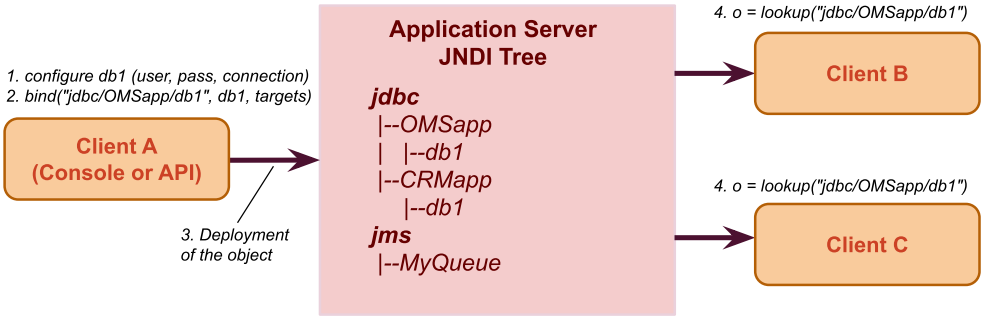
RMI Stubs and Skeletons



Java Naming and Directory Interface

- Distribution of objects
  - *Application Server is a central directory for various objects*
    → Datasources, JMS queues, etc.
  - *Clients store objects in the central directory*
    → Administrator configures objects using a console or API
  - *Clients retrieve objects from the central directory*
- Benefits
  - *replication of objects across clients*
  - *central configuration of objects' parameters*
  - *scalability – allowing/disabling connections as required*

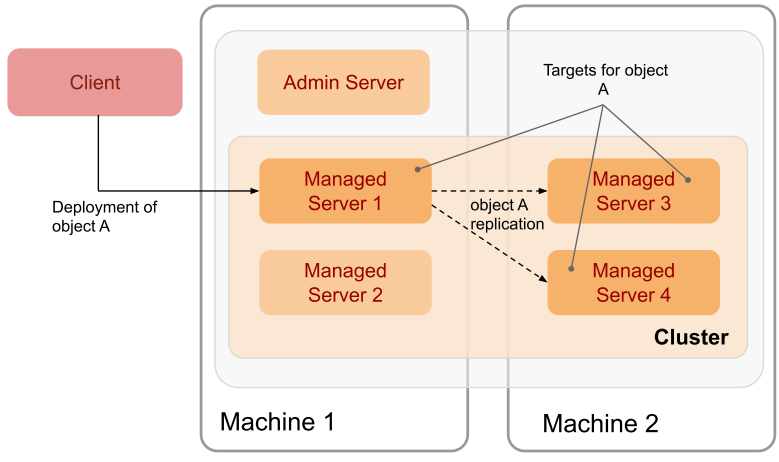
JNDI Example



- Example Scenario
  - *Client A creates a datasource, configures it and registeres it in the JNDI tree*
    → Client A is a Admin server console app
  - *Client B and C lookup the object under specific JNDI name and retrieves the object from the tree*
    → They get the object from the tree and use it to connect to the DB
    → They do not need to know any DB specific details
    → The object is pre-configured from the server

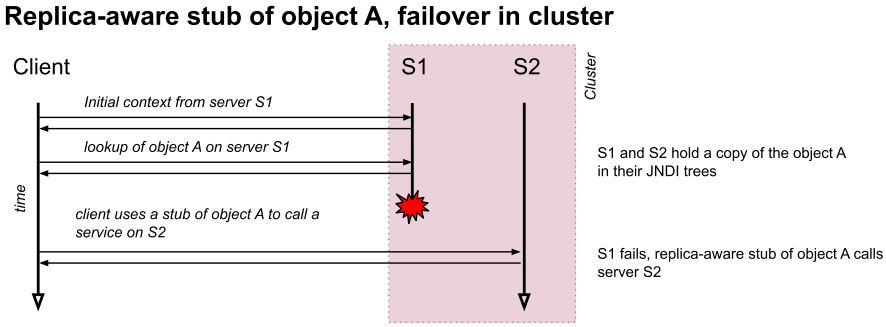
Deployment to Cluster

- Deployment of an object
  - *Client deploys to one managed server in the cluster*
  - *Object gets replicated to its targets*
    → Targets can be configured for the object, usually all servers but can be selected servers



Object Failover

- Failover
  - *Failover = ability to locate an object on another server that holds a copy of the object without impact on the performace and configuration*



  - *A client gets a stub of the object by calling `lookup` on the context*
  - *A client uses the stub of the object to access the object on the server*
  - *When a server fails, **replicate-aware stub** calls the next server that holds the object copy*