Middleware Architectures 1

Lecture 6: High Availability and Performance

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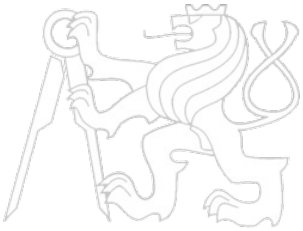

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Modified: Sun Nov 22 2020, 21:28:55
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Good Performance

- What influences good performance?
  - *Number of users and concurrent connections*
  - *Number of messages and messages' sizes*
  - *Number of services*
  - *Infrastructure – capacity, availability, configuration, ...*
- How can we achieve good performance?
  - *Infrastructure*
    → *Scalability, failover, cluster architectures*
  - *Performance tuning*
    → *Application Server, JVM memory, OS-level tuning, Work managers configuration*
  - *Service configuration*
    → *Parallel processing, process optimization*

Overview

- Definitions
- Load Balancers

Definitions

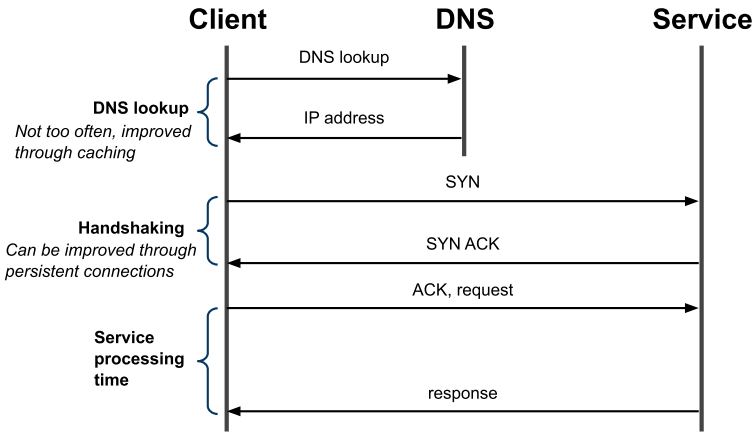
- Scalability
  - *server scalability*
    - → *ability of a system to scale – when input load changes*
    - → *users should not feel a difference when more users access the same application at the same time*
    - → ***horizontal scaling***
      - → *adding new instances of applications/servers*
    - → ***vertical scaling***
      - → *adding new resources (CPU, memory) to a server instance*
  - *network traffic*
    - → *bandwidth capacity influences performance too*
    - → *service should limit the network traffic through caching*
- Availability
  - *probability that a service is operational at a particular time*
    - → *e.g., 99.9987% availability – downtime ~44 seconds/year*
- SLA – Service Level Agreement
  - *Guarantee of service availability*
  - *When availability is below a guaranteed value, a customer can get a discount*

Definitions (Cont.)

- High Availability
  - *When a server instance fails, operation of the application can continue*
  - *Failures should affect application availability and performance as little as possible*
- Application Failover
  - *When an application component performing a job becomes unavailable, a copy of the failed object finishes the job.*
  - *Issues*
    - → *A copy of the failed object must be available*
    - → *A location and operational status of available objects must be available*
    - → *A processing state must be replicated*
- Load Balancing
  - *Distribution of incoming requests across server instances*

Performance Metrics

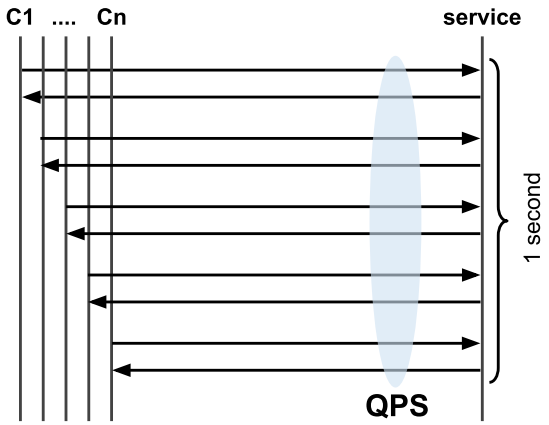
- Response Time
  - *A client-side metric*



  - *CPU intensive service or a bad configuration of a service*
    - → *consider asynchronous processing when CPU intensive*
  - *Writing to a data store*

Performance Metrics

- Queries/Requests per Second (QPS)
  - *A server-side metric*



  - *Caching may improve performance*
    → *even if data changes often, with high QPS caching improves a lot*

Overview

- Definitions
- Load Balancers

Load Balancing

- Distributes a load to multiple app/object instances
  - *App instances run on different machines*
  - *Load sharing: equal or with preferences*
  - *Health checks*
- Types
  - *DNS-based load balancer*
    - → *DNS Round Robin*
  - *NAT-based load balancer (Layer-4)*
  - ***Reverse-proxy load balancer** (Layer-7)*
    - → *application layer*
    - → *Sticky sessions*
      - → *JSession, JSession-aware load balancer*
  - *Client-side load balancer*
    - → *LB run by a client*
    - → *a client uses a replica-aware stub of the object from the server*

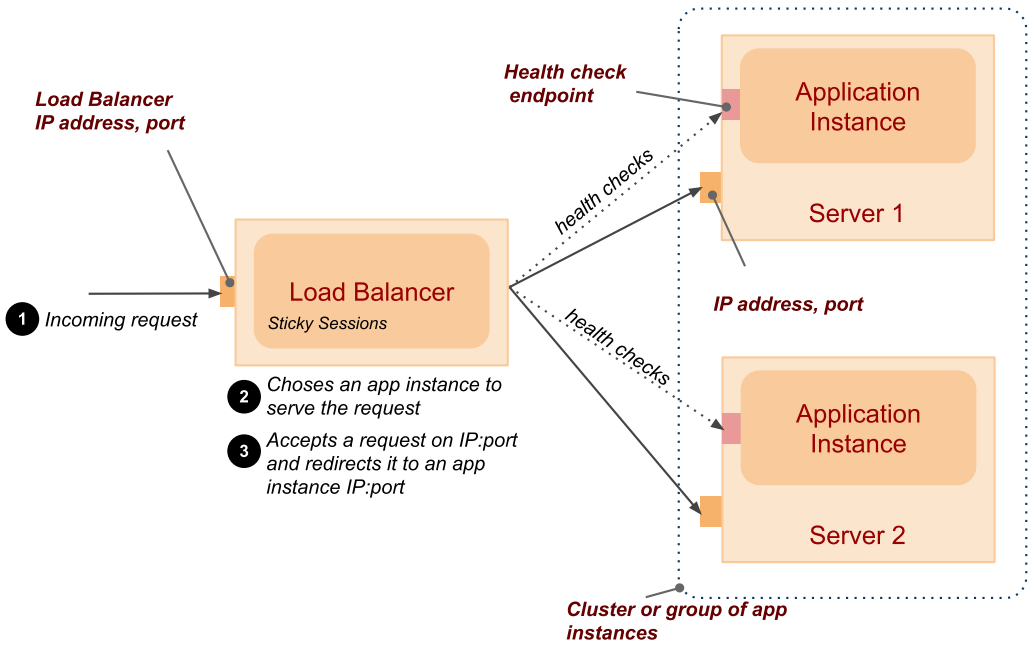
DNS-based Load Balancer

- DNS Round Robin
  - *A DNS record has multiple assigned IP addresses*
  - *DNS system delivers different IP addresses from the list*
  - *Example DNS A Record:*

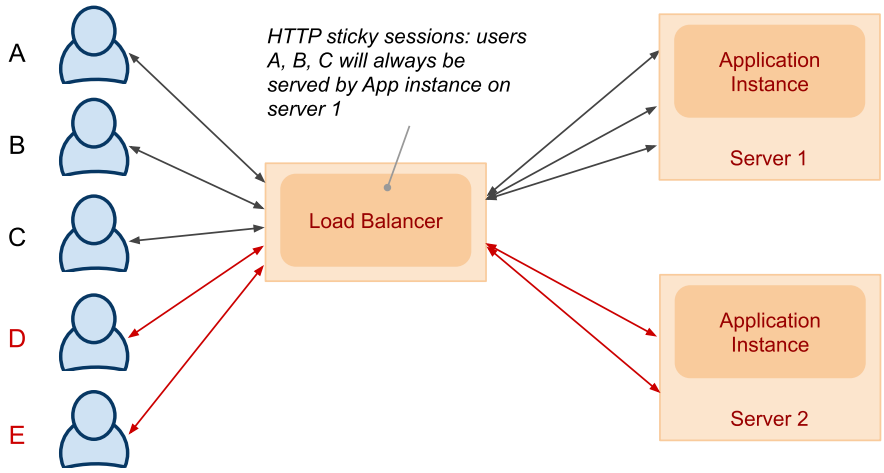
```
company.com A 147.32.100.71 147.32.100.72 147.32.100.73
```

- Advantages
  - *Very simple, easy to implement*
- Disadvantages
  - *IP address in cache, could take hours to re-assign*
  - *No information about servers' loads and health*

Reverse Proxy Load Balancer



HTTP Sticky Sessions Example



- How to identify a server that hosts the session state
  - *Passive cookie persistence – LB uses a cookie from the server*
  - *Active cookie persistence – LB adds its own cookie*

Types of Load Balancers

- Software
  - *Apache* `mod_proxy_balancer`
    - → *HTTP Session persistence – sticky sessions*
  - *WebLogic proxy plug-in*

```
<Location /soa-infra>
    SetHandler weblogic-handler
    WebLogicCluster czfmwapp03-vf:8001,czfmwapp04-vf:8001,czfmwapp05-vf:800
</Location>
```

`/soa-infra` *is a first part of an URL path that rules in this* `Location` *will be applied (this is a standard Apache configuration mechanism)*
`czfmwapp{N}` *is a hostname that corresponds to a virtual IP to which the managed server JVM processes is bounded (using the tcp port* `8001`*).*
`WebLogicCluster` *specifies the list of servers for load balancing*

- Hardware
  - *Cisco, Avaya, Barracude*

Round-Robin Algorithm

- Uses

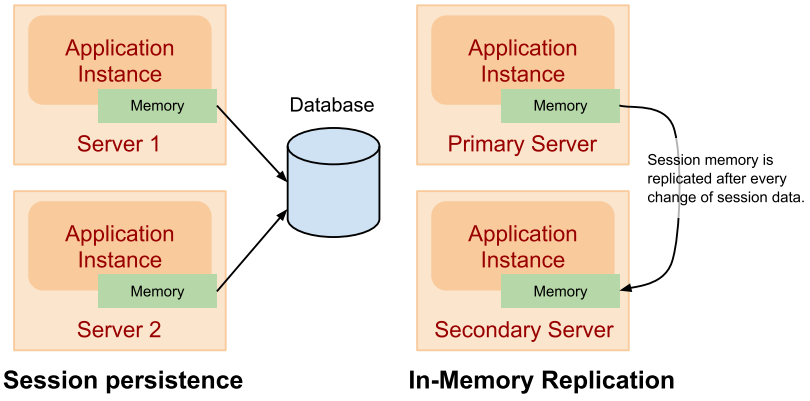
`request` – *client request with or without a cookie information*
`server_list` – *a list of servers that can process the request*
`rbinx` – *round robin index*
`sticky_sessions` – *associative array of pairs* `<session_id,server>`
`unhealthy_treshhold` – *a number of negative consecutive health checks before moving the server to the "unhealthy" state.*

- Round Robin Algorithm
  - *if* `session_id` *exist in the* `request` *and in* `sticky_sessions`
    - → *send the* `request` *to the server* `sticky_sessions[session_id]`
  - *otherwise*
    - → *send the* `request` *to the* `rbinx` *server in the* `server_list`
    - → *extract* `session_id` *from the response from the server*
    - → *if the* `session_id` *exist, add a pair* `<session_id;server_list[rbinx]>` *to* `sticky_sessions`
    - → *increase* `rbinx` *by one or reset it to* `0` *if it exceeds the length of* `server_list`

Health Check

- Health Check
  - *For each server in the* `server_list`
    - → *call the server's heatlhcheck endpoint*
    - → *if a number of failed health checks for the server exceeds the* `unhealthy_threshold`
      - → *remove the server from the* `server_list`
    - → *if the server was unhealthy and a there was a successful healthcheck*
      - → *add the server back to the* `server_list`

Session State Persistence and Replication



- Session persistence
  - *Session information is maintained in the database*
  - *Does not require sticky sessions*
  - *Implements* `HttpSession` *interface that writes data to the DB*
- In-memory replication
  - *A* ***primary server*** *holds a session state, the* ***secondary server*** *holds its replica.*
  - *Information about primary and secondary servers are part of JSession*

In-Memory Replication

- Session format
  - *It's a cookie*
  - `JSESSIONID=SESSION_ID!PRIM_SERVER_ID!SEC_SERVER_ID!CREATION_TIME`

    `SESSION_ID` – *session id, generated by the server to identify memory associated with the session on the server*

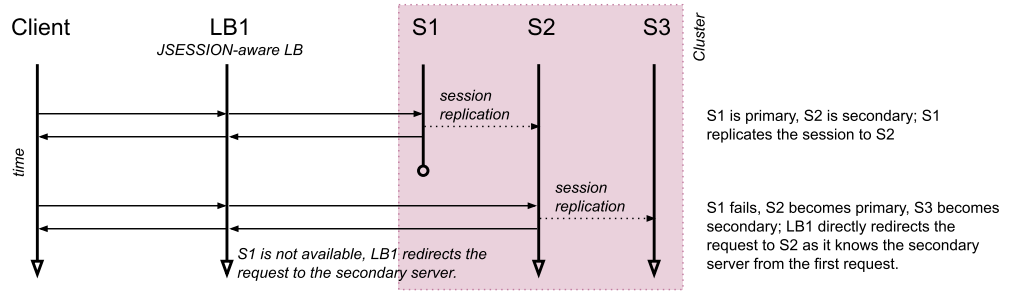
    `PRIM_SERVER_ID` – *ID of the managed server holding the session data*

    `SEC_SERVER_ID` – *ID of the managed server holding the session replica*

    `CREATION_TIME` – *time the session data was created/updated*
- How LB uses this information
  - *LB has information whether the server is running or not (via healthchecks)*
  - *if the primary server is running, it redirects the request there*
  - *if the primary server is not running, it redirects the request to the secondary server directly*
  - *if primary and secondary servers are not running, it redirect the request to any other server it has in the list – this may cause side effects!*

In-Memory Replication Scenarios

Scenario A: JSession-aware load balancer



Scenario B: HTTP sticky session load balancer