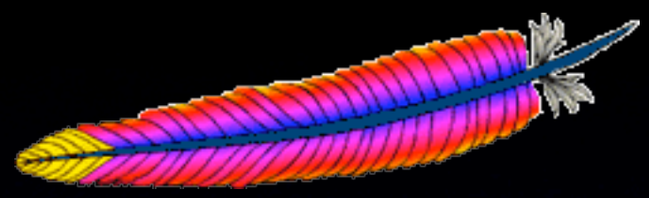


Apache HTTP Server

Load-Balancing with Apache HTTPD 2.2 and later

Erik Abele
www.eatc.de

About Me

- Working internationally as IT Consultant
- Areas: Administration & Operations
- Working on and with Open Source
  - Apache Software Foundation
  - Other projects (Ruby, Zenoss, ...)
- Living in South Germany

Content

- Basics
- Strategies
- Examples
- Questions

Basics

Why Load-Balancing?

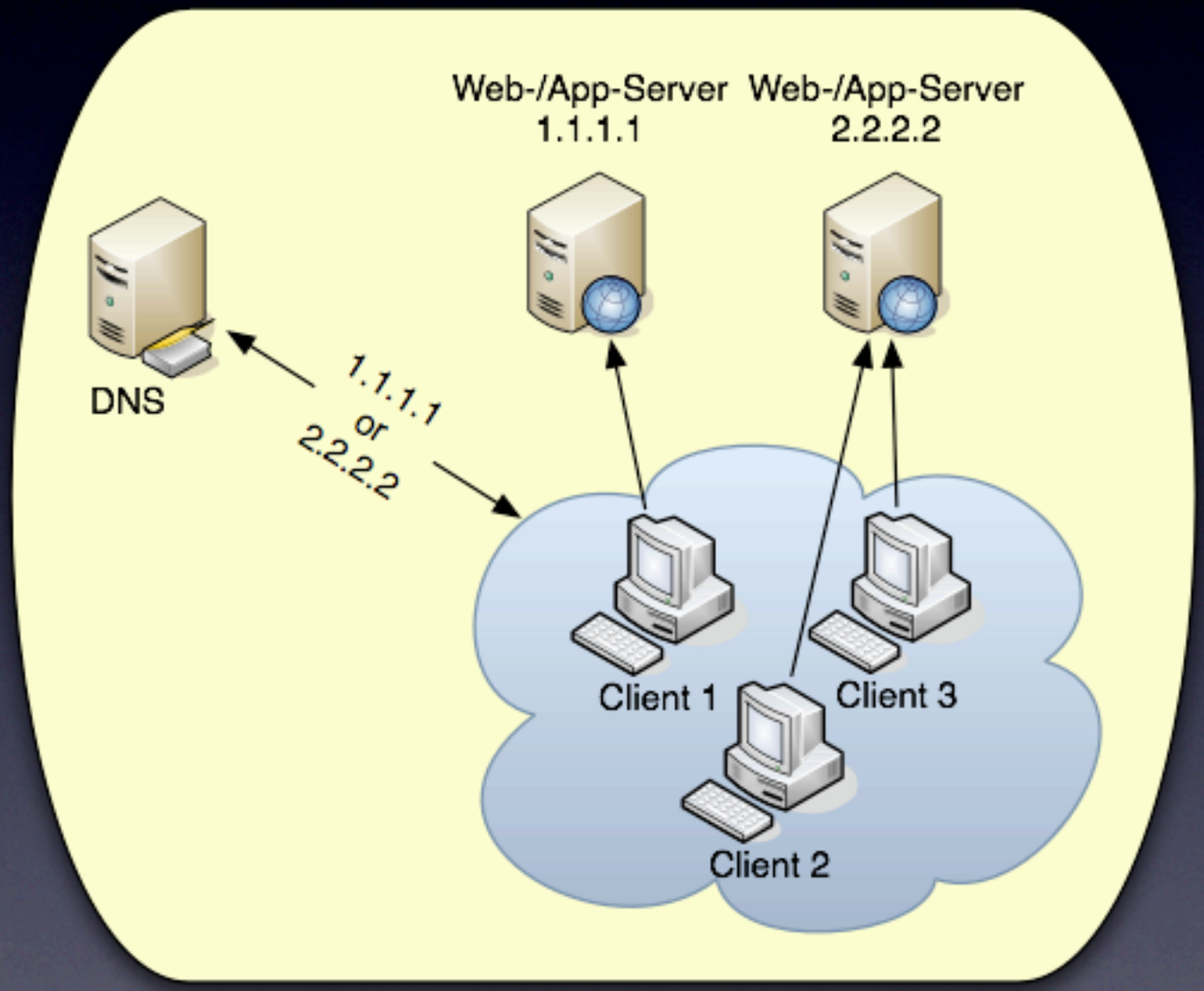
- Optimizing Resource Utilization
- Maximizing Quality of Service
- Increasing Reliability & Availability
- Improving Security
- Lowering Administration Risks

Approaches

- DNS-Based Load-Balancing
  - Round Robin
  - Geographical Scheduling
- Layer 4 Load-Balancing
- Layer 7 Load-Balancing
- Hardware-/Software-Based Load-Balancers

DNS-Based Balancing

- Clients resolve FQDN
- Response with several IPs or choosen randomly or e.g. according to proximity



Layer 4 Balancing

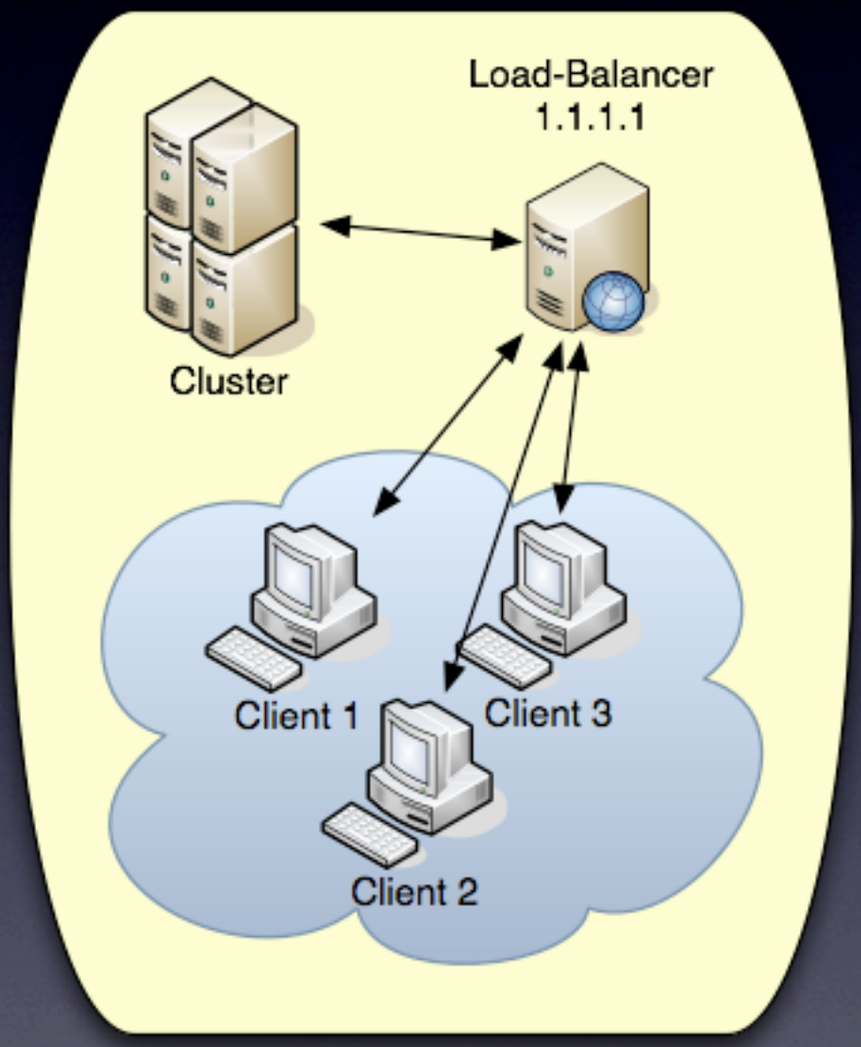
- Transport Layer
- Deals with TCP connections
- Routes pure packets
- NAT with port and transaction awareness

Layer 7 Balancing

- Application Layer
- Deals with HTTP requests
- Forwards whole requests
- Gateway / Reverse Proxy

Layer 4-7 Balancing

- Combination: routing packets but aware of HTTP content
- Load-Balancer acts as a multilayer switch
- Basic schema always the same



Hardware-Based LBs

- Mostly real routers/switches with ML capabilites
- Pros
  - Very fast
- Cons
  - Expensive
  - Proprietary
- Examples: Cisco LoadDirector, F5 Big/ip, Barracuda

Software-Based LBs

- Software-based appliances or just packages
- Pros
  - Cheaper and also available as Open Source
  - Simpler to configure and often more flexible
- Cons
  - Not as fast as hardware based solutions
- Examples: Pen, Pound, Squid, Linux VS, Zeus ZXTM

Balancer Features I

- TCP Offloading
- TCP Buffering
- SSL Offloading & Acceleration
- HTTP Caching
- HTTP Compression
- Client Authentication
- Attack Protection & Firewalling

Balancer Features 2

- Content-Aware Load-Balancing
- Request Rate Shaping
- Bandwidth Shaping
- Traffic Valuation & Prioritization
- Programmatic Traffic Manipulation

Balancing Algorithms

- Random Choice
- Round Robin
- Weighted Round Robin
  - Request counting algorithm
  - Weighted traffic counting algorithm
- Based on other factors (load, response time, ...)

Strategies

Gateway

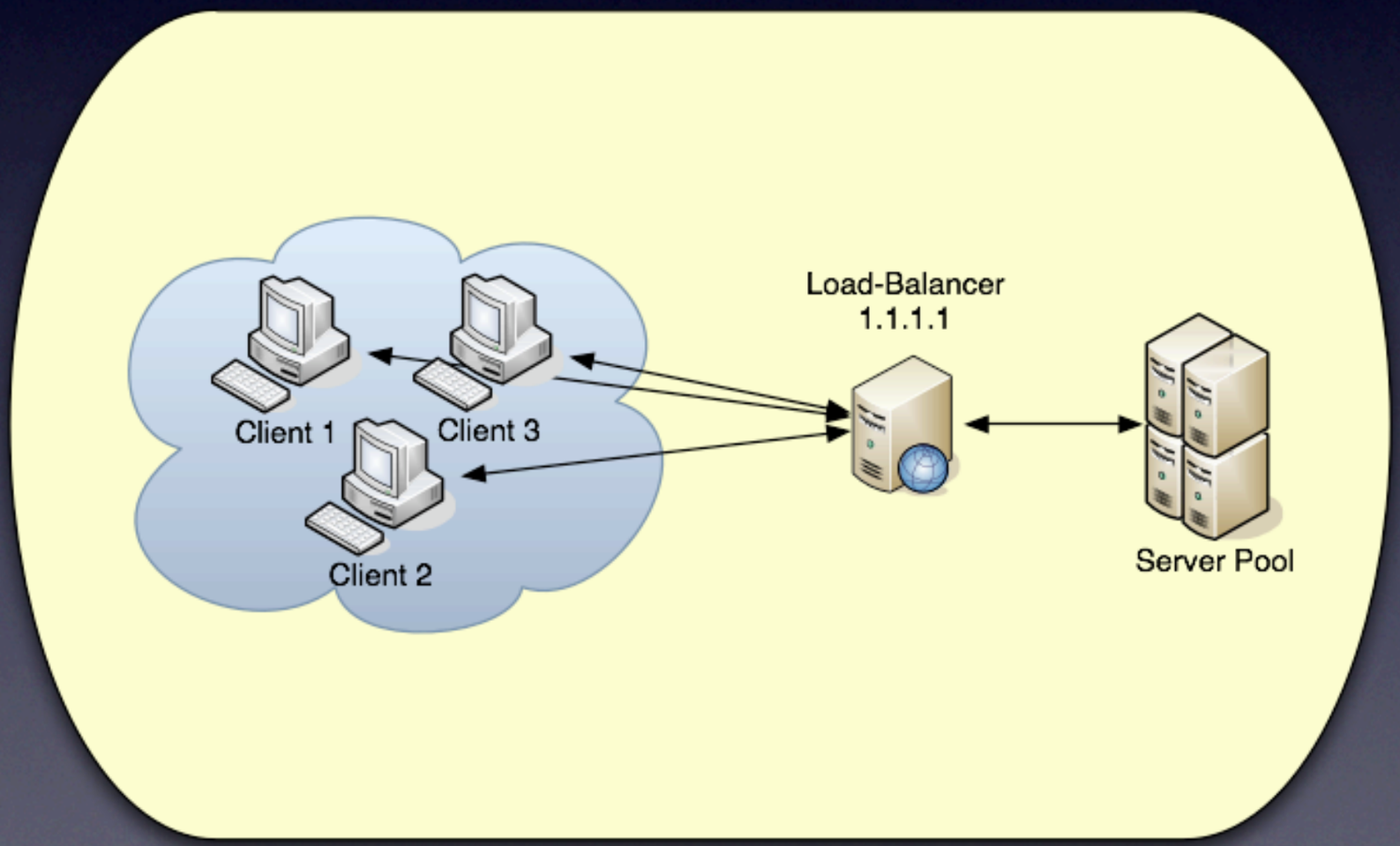
- “Reverse Proxy” - the frontend:
  - Apache HTTPD with mod_proxy and mod_proxy_balancer as well as one of:
    - mod_proxy_http
    - mod_proxy_ajp

Application Servers

- A pool of servers - the backend:
  - Apache HTTP with PHP, Perl, ...
  - Apache Tomcat, JBoss, Glassfish, ...
  - Zope, CherryPy, Mongrel, WebRick
  - ...

Focus: Scalability

- A single load-balancer in front of a pool of application servers

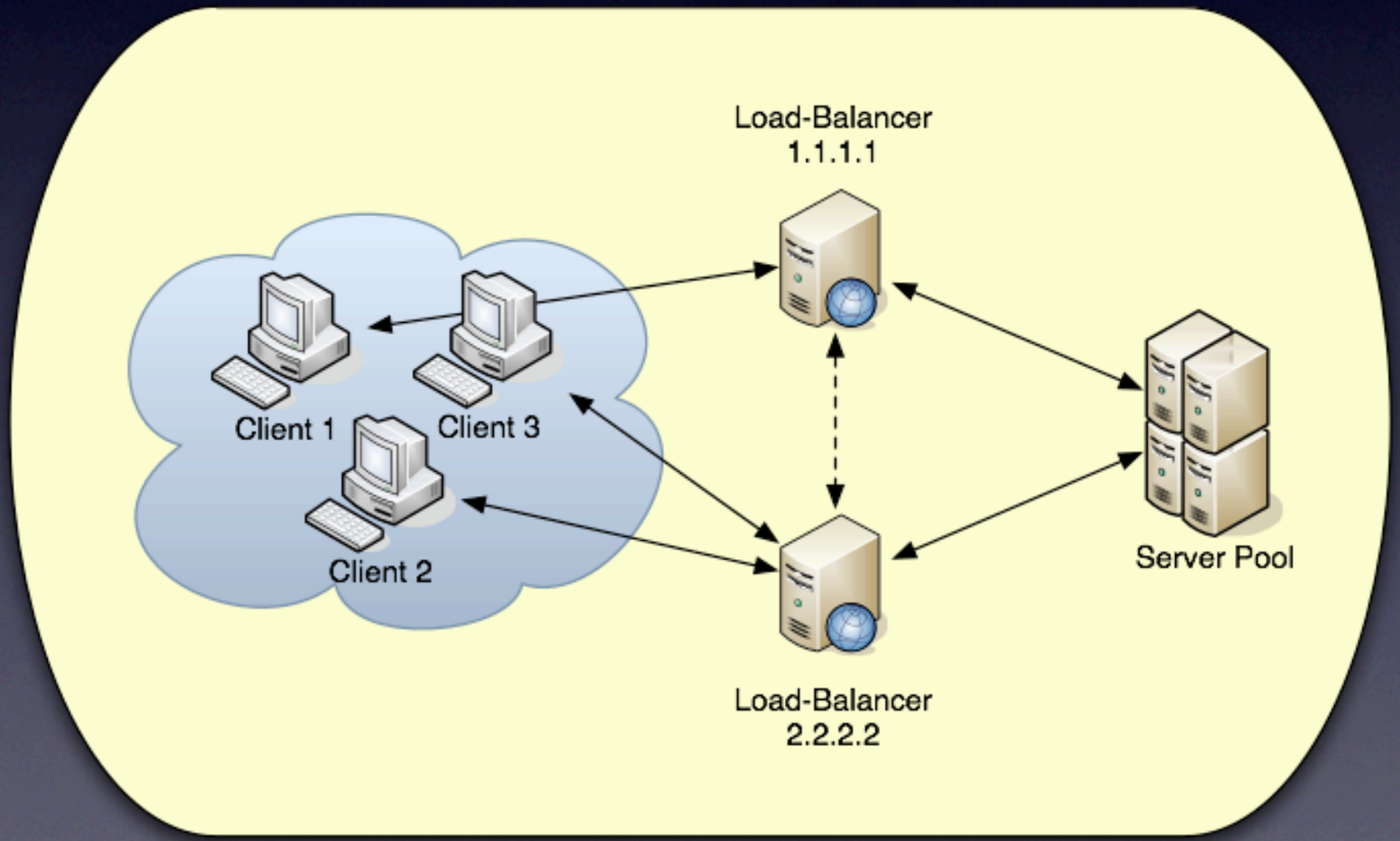


Persistence

- "Session Stickiness"
- A problem when not able to use a shared data store for the application (e.g. when using multiple physical locations where replication becomes problematic)
- Alternative: using cookies as data store

Focus: Resilience

- Two or more load-balancers in front of a pool of application servers

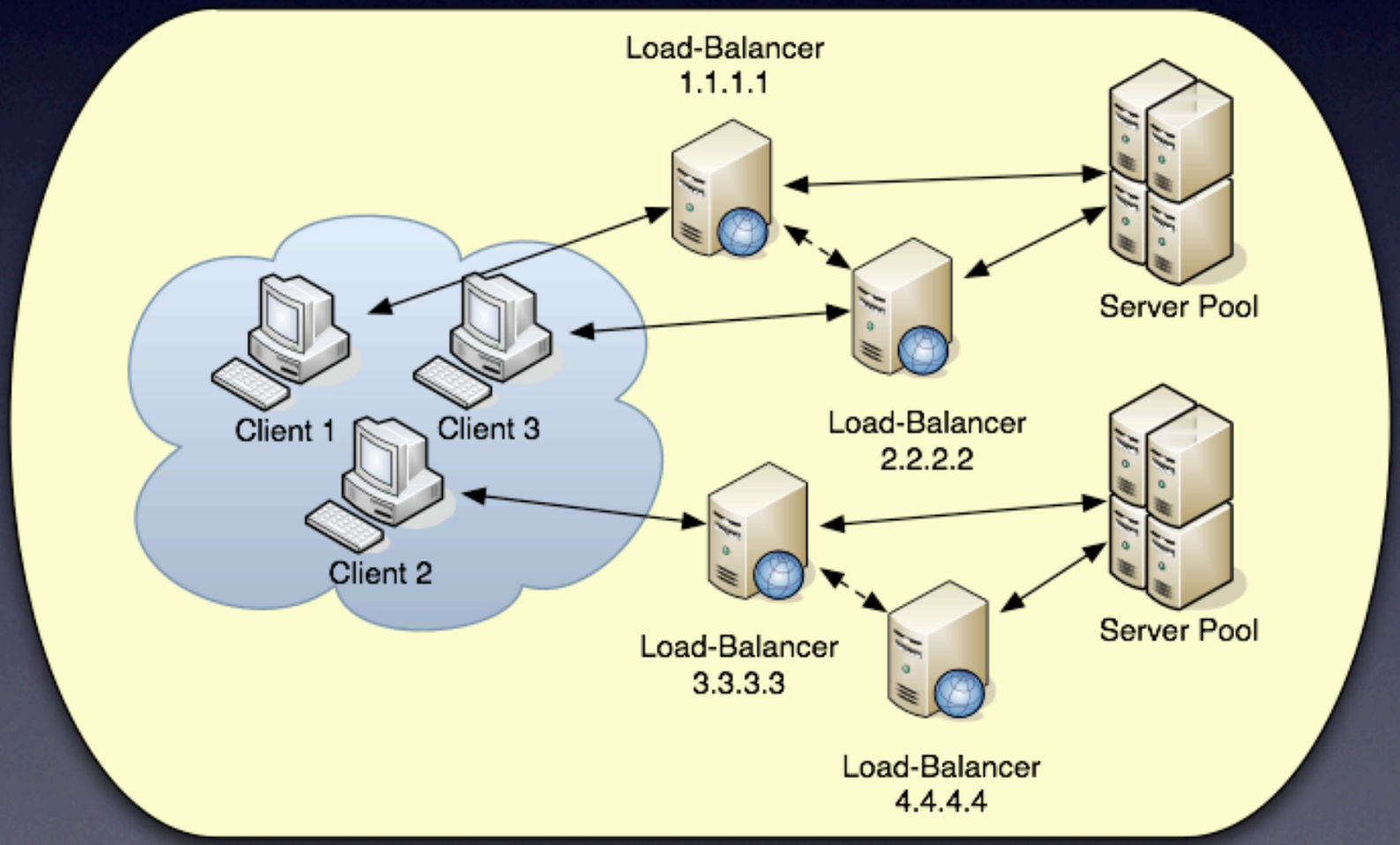


Failover

- Active/Active
  - Both load-balancers are actively serving requests
- Active/Passive
  - Only one load-balancer is actively serving requests, the other one takes over in case of failure
- There needs to be a way to detect failures

Focus: Globalization

- Several groups of load-balancers in more than one physical location



Location Selection

- DNS-Based
  - Round Robin
    - Based on geographical proximity
    - Based on utilization of location
- FQDN-Based (e.g. wwwN.example.com)

Examples

HTTPD as Gateway

- Required Modules:
  - mod_proxy
  - mod_proxy_balancer
  - mod_proxy_http / mod_proxy_ajp
  - mod_proxy_ftp

HTTP Backends

- Requires extension module:
  mod_proxy_http
- Usage:
  `BalancerMember http://1.1.1.1:8080 ...`

AJP Backends

- Requires extension module:
  mod_proxy_ajp
- Usage:
  `BalancerMember ajp://1.1.1.1: 8009 ...`

Basic Configuration

```
<VirtualHost *:80>
    ServerName www.example.com
    ...
    ProxyRequests Off
    ProxyVia Off
    ProxyErrorOverride On
    ProxyPreserveHost On
    ProxyTimeout 30

    ProxyPass / balancer://app_farm lbmethod=byrequests maxattempts=3 \
                                    nofailover=Off stickysession=SID

    <Proxy balancer://app_farm>
        BalancerMember http://1.1.1.1:8080 smax=15 max=50 lbfactor=2
        BalancerMember http://1.1.1.2:8080 smax=15 max=50 lbfactor=2
        BalancerMember http://1.1.1.3:8080 smax=10 max=25 lbfactor=1
    </Proxy>
</VirtualHost>
```

Connection Pooling

- min
  Minimum number of connections that will always be open to the backend server
- max
  Hard Maximum number of connections that will be allowed to the backend server
- smax & ttl
  Soft Maximum number of connections that will be created on demand, TTL for connect's above smax

Parameters I

- lbmethod
  The load-balancing scheduler method to use, e.g.
  - weighted request counting
  - weighted traffic counting
- lbset
  Assigns a specific cluster set to members

Parameters 2

- loadfactor
  Defines the normalized weighted load applied to this balancer member, e.g.
  - loadfactor=1
  - loadfactor=2 <- twice as much req's / IO
- status
  Defines the initial state of this member

Hot-Standby

```
<VirtualHost *:80>
    ServerName www.example.com
    ...

    ProxyPass / balancer://app_farm lbmethod=byrequests maxattempts=3 \
                                    nofailover=Off stickysession=SID

    <Proxy balancer://app_farm>
        BalancerMember http://1.1.1.1:8080 ...
        BalancerMember http://1.1.1.2:8080 ...
        BalancerMember http://1.1.1.3:8080 ... status=+H
    </Proxy>
</VirtualHost>
```

Sticky Sessions

- Supported by stickysession flag:
  `stickysession=PHPSESSID`
  `stickysession=JSESSIONID|jsessionid`

Environment Variables

- Generated by mod_proxy
  - `X-Forwarded-For`
  - `X-Forwarded-Host`
  - `X-Forwarded-Server`
- Influence mod_proxy
  - `SetEnv force-proxy-request-1.0 1`
  - `SetEnv proxy-nokeepalive 1`

ProxyPassReverse

```
ProxyPass / balancer://app_farm ...
ProxyPassReverse / http://1.1.1.1:8080/
ProxyPassReverse / http://1.1.1.2:8080/

<Proxy balancer://app_farm>
    BalancerMember http://1.1.1.1:8080 ...
    BalancerMember http://1.1.1.2:8080 ...
</Proxy>
```

URL Rewriting

```
ProxyPass ~ ^/+(.*)$ balancer://app_farm/$1 ...

[or]

ProxyPassMatch ^/+(.*)$ balancer://app_farm/$1 ...
```

```
[or]

RewriteEngine On

RewriteCond %{REQUEST_URI} ^/.balancer
RewriteRule ^(.*)$ - [L]

RewriteRule ^/+(.*)$ balancer://app_farm/$1 [P,L]

ProxySet balancer://app_farm lbmethod=bytraffic
```

Using Headers

```
<VirtualHost *:443>
    ServerName www.example.com
    ...
    RequestHeader set Front-End-Https "On"
    ...
    ProxyPass / balancer://app_farm lbmethod=byrequests maxattempts=3 \
                                    nofailover=Off stickysession=SID

    <Proxy balancer://app_farm>
        BalancerMember http://1.1.1.1:8080 smax=15 max=50 lbfactor=2
        ...
    </Proxy>
</VirtualHost>
```

Filtering Content

- mod_mime, e.g.

```
AddOutputFilter INCLUDES .shtml
```

- mod_filter
- mod_proxy_html

Using Compression

- We can use mod_deflate as usually:

```
AddOutputFilterByType DEFLATE text/html
```

Offloading SSL

- Simply configure SSL on the frontend server as you would do without a balancer

Caching

```
<VirtualHost *:80>
    ServerName www.example.com
    ...
    CacheEnable mem /
    CacheEnable disk /
    CacheDefaultExpire 1800
    CacheMaxExpire 3600
    ...

    ProxyPass / balancer://app_farm lbmethod=byrequests maxattempts=3 \
                                    nofailover=Off stickysession=SID

    <Proxy balancer://app_farm>
        BalancerMember http://1.1.1.1:8080 smax=15 max=50 lbfactor=2
        ...
    </Proxy>
</VirtualHost>
```

Failover

- Automatically done
  - if a member is in-error the next one is tried
- Can be switched off if backend servers do not support session replication

Balancer Management

- Requires mod_status
- Allows for real-time monitoring
- Allows for dynamic updates of parameters of balancer members
  - enable/disable balancer members
  - specify balance factors, methods, sets

Screenshot

Load Balancer Manager for localhost

Server Version: Apache/2.2.8 (Unix)
Server Built: Apr 9 2008 14:12:12

LoadBalancer Status for balancer://app_cluster

StickySession	Timeout	FailoverAttempts	Method
-	0	3	byrequests

Worker URL	Route	RouteRedir	Factor	Set	Status	Elected	To	From
http://192.168.1.1			10	0	Ok	0	0	0
http://192.168.1.2			10	0	Ok	0	0	0

LoadBalancer Status for balancer://app_farm

StickySession	Timeout	FailoverAttempts	Method
-	0	3	byrequests

Worker URL	Route	RouteRedir	Factor	Set	Status	Elected	To	From

---

Edit worker settings for http://192.168.1.1

Load factor: 10
LB Set: 0
Route:
Route Redirect:
Status: Disabled: ○ | Enabled: ◉
Submit

Example Configuration

```
<Location /.balancer>
    SetHandler balancer-manager

    AuthType Digest
    AuthName "Balancer Manager"
    AuthDigestDomain /.balancer
    AuthDigestProvider file
    AuthUserFile /www/etc/httpd/balancer.passwd

    Require user operations
</Location>

...

ProxyPass /.balancer !
ProxyPass / balancer://app_farm ...
```

Questions?