APACHECON
NORTH AMERICA

Apache httpd v2.4: *Reverse Proxy*

(The "Hidden" Gem)

Jim Jagielski

About me

- Jim Jagielski
  - Hacker and developer
    - Wearer o' many hats at the ASF
    - Director and President: Outercurve
    - Council member: MARSEC-XL
  - Consulting Engineer with Red Hat
  - @jimjag

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Apache httpd 2.4

- Currently at version 2.4.12 (2.4.1 went GA Feb 21, 2012)
- Significant Improvements
  - high-performance
  - cloud suitability

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Apache httpd 2.4 - design drivers

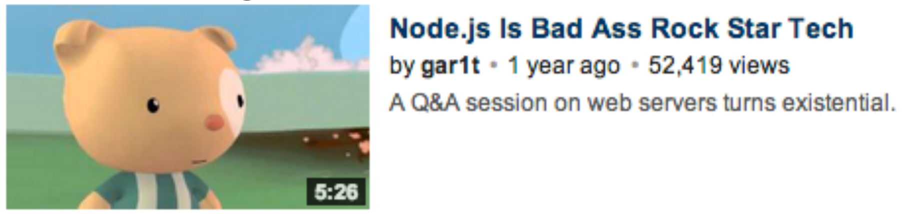
- ➡ Support for async I/O w/o dropping support for older systems
- ➡ Larger selection of usable MPMs: added Event, Simple, etc...
- ➡ Leverage higher-performant versions of APR
- ➡ Increase performance
- ➡ Reduce memory utilization
- ➡ The Cloud and Reverse Proxy

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

httpd is sooo old school *(aka fud)*

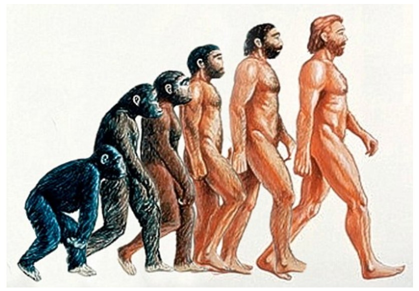
- Apache doesn't scale (its SLOW)

  http://www.youtube.com/watch?v=bzkRVzciAZg



Node.js Is Bad Ass Rock Star Tech
by gar1t • 1 year ago • 52,419 views
A Q&A session on web servers turns existential.

- Apache is too generalized

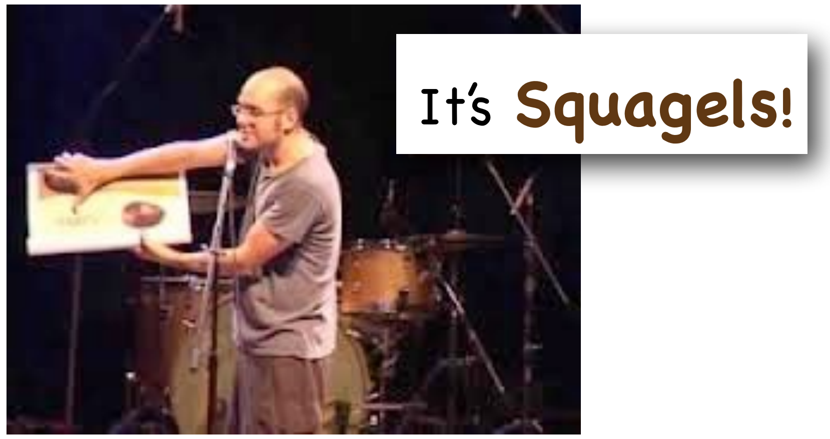


vs

- Apache is too complex (config file)

  really?

- Apache is too old
  (yeah, just like Linux)



This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Cloud and Dynamics

- The Cloud is a game changer for web servers
  - The cloud is a dynamic place
  - automated reconfiguration
  - horizontal, not vertical scaling
  - self-aware environments

OK, maybe not THAT self-aware

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

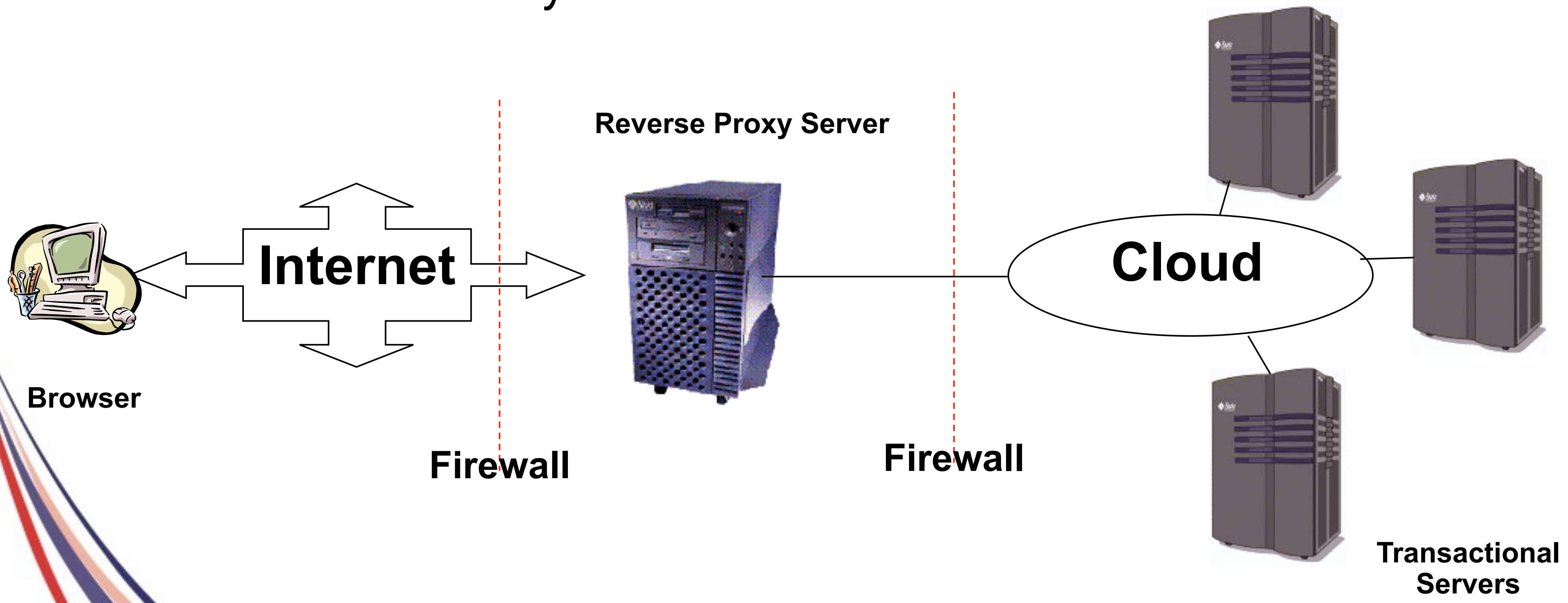
Why Dynamic Proxy Matters

- ➡ Apache httpd still the most frequently used front-end
- ➡ Proxy capabilities must be cloud friendly
- ➡ Front-end must be dynamic friendly

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Reverse Proxy

- Operates at the server end of the transaction
- Completely transparent to the Web Browser – thinks the Reverse Proxy Server is the real server



This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Features of Reverse Proxy Server

- Security
  - Uniform security policy can be administered
  - The real transactional servers are behind the firewall
- Delegation, Specialization, Load Balancing
- Caching
- Performance, HA

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Proxy Design Drivers

- ➡ Becoming a robust but generic proxy implementation
- ➡ Support various protocols
  - HTTP, HTTPS, CONNECT, FTP
  - AJP, FastCGI, SCGI, WSGI
  - Load balancing
- ➡ Clustering, failover
- ➡ Performance

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Apache httpd 2.4 proxy

- Reverse Proxy Improvements
  - Supports FastCGI, SCGI, Websockets in balancer
  - Additional load balancing mechanisms
  - Runtime changing of clusters w/o restarts
  - Support for dynamic configuration
  - mod_proxy_express
  - mod_fcgid and fcgistarter
  - Brand New: Support for Unix Domain Sockets

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Configuring Reverse Proxy

- Set ProxyRequests Off
- Apply ProxyPass, ProxyPassReverse and possibly RewriteRule directives

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Reverse Proxy Directives: ProxyPass

- Allows remote server to be mapped into the space of the local (Reverse Proxy) server
- There is also *ProxyPassMatch* which takes a regex
- Example:

```
ProxyPass /secure/ http://secureserver/
```

Presumably “secureserver” is inaccessible directly from the internet

```
ProxyPassMatch ^/(.*\.js)$ http://js-storage.example.com/bar/$1
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Reverse Proxy Directives: ProxyPassReverse

- Used to specify that redirects issued by the remote server are to be translated to use the proxy before being returned to the client.
- Syntax is identical to *ProxyPass;* used in conjunction with it
- Example:
  - ProxyPass /secure/ http://secureserver/
  - ProxyPassReverse /secure/ http://secureserver/

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Simple Rev Proxy

- All requests for /images to a backend server

  ProxyPass /images http://images.example.com/

  ProxyPass *<path>* *<scheme>*://*<full url>*
- Useful, but limited
- What if:

  images.example.com dies?

  traffic for /images increases

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Load Balancing

- mod_proxy_balancer.so
- mod_proxy can do native load balancing
  - weight by actual requests
  - weight by traffic
  - weight by busyness
  - lbfactors

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Create a balancer "cluster"

- ➡ Create a balancer which contains several host nodes
- ➡ Apache ***httpd*** will then direct to each node as specified

```
<Proxy balancer://foo>
  BalancerMember http://www1.example.com:80/  loadfactor=1
  BalancerMember http://www2.example.com:80/  loadfactor=1
  BalancerMember http://www3.example.com:80/  loadfactor=4 status=+h
  ProxySet lbmethod=bytraffic
</Proxy>
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

➡ For BalancerMembers:

`loadfactor`

normalized load for worker [1]

`lbset`

worker cluster number [0]

`retry`

retry timeout, in seconds, for non-ready workers [60]

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

➡ For BalancerMembers (cont):

`connectiontimeout/timout`

Connection timeouts on backend [ProxyTimeout]

`flushpackets` *

Does proxy need to flush data with each chunk of data?

on : Yes | off : No | auto : wait and see

`flushwait` *

ms to wait for data before flushing

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

- For BalancerMembers (cont):

  `ping`

  Ping backend to check for availability; value is time to wait for response

  `status` (+/-)

  D : Disabled

  S : Stopped

  I : Ignore errors

  H : Hot standby

  E : Error

  N: Drain

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

- For Balancers:
  - `lbmethod`
    - load balancing algo to use [byrequests]
  - `stickysession`
    - sticky session name (eg: PHPSESSIONID)
  - `maxattempts`
    - # failover tries before we bail
  - `growth`
    - Extra BalancerMember slots to allow for

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

- For Balancers:

  `nofailover`

  pretty freakin obvious

- For both:

  `ProxySet`

  Alternate method to set various params

```
ProxySet balancer://foo timeout=10
  ...
ProxyPass / balancer://foo timeout=10
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Connection Pooling

- Backend connection pooling
- Available for named workers:
  - eg: **`ProxyPass /foo http://bar.example.com`**
- Reusable connection to origin
  - For threaded MPMs, can adjust size of pool (min, max, smax)
  - For prefork: singleton
- Shared data held in shared memory

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

➡ For BalancerMembers - connection pool:

`min`

Initial number of connections [0]

`max`

Hard maximum number of connections [1|TPC]

`smax`:

soft max - keep this number available [max]

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Some config params

- For BalancerMembers - connection pool:
  - `disablereuser/enablereuse`:
    - bypass/enable the connection pool (firewalls)
  - `ttl`
    - time to live for connections above `smax`

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Sessions

- Sticky session support
  - aka “session affinity”
- Cookie based
  - stickysession=PHPSESSID
  - stickysession=JSESSIONID
- Natively easy with Tomcat
- May require more setup for “simple” HTTP proxying
- Use of mod_session helps

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Failover control

- Cluster set with failover
- Group backend servers as numbered sets
  - balancer will try lower-valued sets first
  - If no workers are available, will try next set
- Hot standby

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Putting it all together

```
<Proxy balancer://foo>
  BalancerMember http://php1:8080/     loadfactor=1
  BalancerMember http://php2:8080/     loadfactor=4
  BalancerMember http://phpbkup:8080/  loadfactor=1 status=+h
  BalancerMember http://phpexp:8080/   lbset=1
  ProxySet lbmethod=bytraffic
</Proxy>
<Proxy balancer://javaapps>
  BalancerMember ajp://tc1:8089/     loadfactor=10
  BalancerMember ajp://tc2:8089/     loadfactor=40
  ProxySet lbmethod=byrequests
</Proxy>
ProxyPass        /apps/        balancer://foo/
ProxyPassReverse /apps/        balancer://foo/
ProxyPass        /serv/        balancer://javaapps/
ProxyPass        /images/      http://images:8080/
ProxyPass        /foo          unix:/home/www.socket|http://localhost/bar/
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Mass Reverse Proxy

- We front-end a LOT of reverse proxies
  - What a httpd.conf disaster!
  - Slow and bloated
  - mod_rewrite doesn't help

```
<VirtualHost www1.example.com>
   ProxyPass / http://192.168.002.2:8080
   ProxyPassReverse / http://192.168.002.2:8080
</VirtualHost>

<VirtualHost www2.example.com>
   ProxyPass / http://192.168.002.12:8088
   ProxyPassReverse / http://192.168.002.12:8088
</VirtualHost>

<VirtualHost www3.example.com>
   ProxyPass / http://192.168.002.10
   ProxyPassReverse / http://192.168.002.10
</VirtualHost>
 ...
<VirtualHost www6341.example.com>
   ProxyPass / http://192.168.211.26
   ProxyPassReverse / http://192.168.211.26
</VirtualHost>
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Mass Reverse Proxy

- Use the new mod_proxy_express module
  - ProxyPass mapping obtained via db file
  - Fast and efficient
  - Still dynamic, with no config changes required

ProxyExpress map file

```
##
##express-map.db:
##

www1.example.com     http://192.168.002.2:8080
www2.example.com     http://192.168.002.12:8088
www3.example.com     http://192.168.002.10
 ...
www6341.example.com  http://192.168.211.26
```

httpd.conf file

```
ProxyExpressEnable On
ProxyExpressDBMFile express-map.db
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

HeartBeat / HeartMonitor

- Experimental LB (load balance) method
  - Uses multicast between gateway and reverse proxies
  - Provides heartbeat (are you there?) capability
  - Also provides basic load info
  - This info stored in shm, and used for balancing
- Multicast can be an issue
- Use mod_header with %l, %i, %b (loadavg, idle, busy)
  - but no LBmethod currently uses this :(
- We need a universal “load” measure

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

balancer-manager

- Embedded proxy admin web interface
- Allows for real-time
  - Monitoring of stats for each worker
  - Adjustment of worker params
    - lbset
    - load factor
    - route
    - enabled / disabled
    - ...

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Embedded Admin

- Allows for real-time
  - Addition of ***new*** workers/nodes
  - Change of LB methods
  - Can be ***persistent!***
  - More RESTful
  - Can be CLI-driven

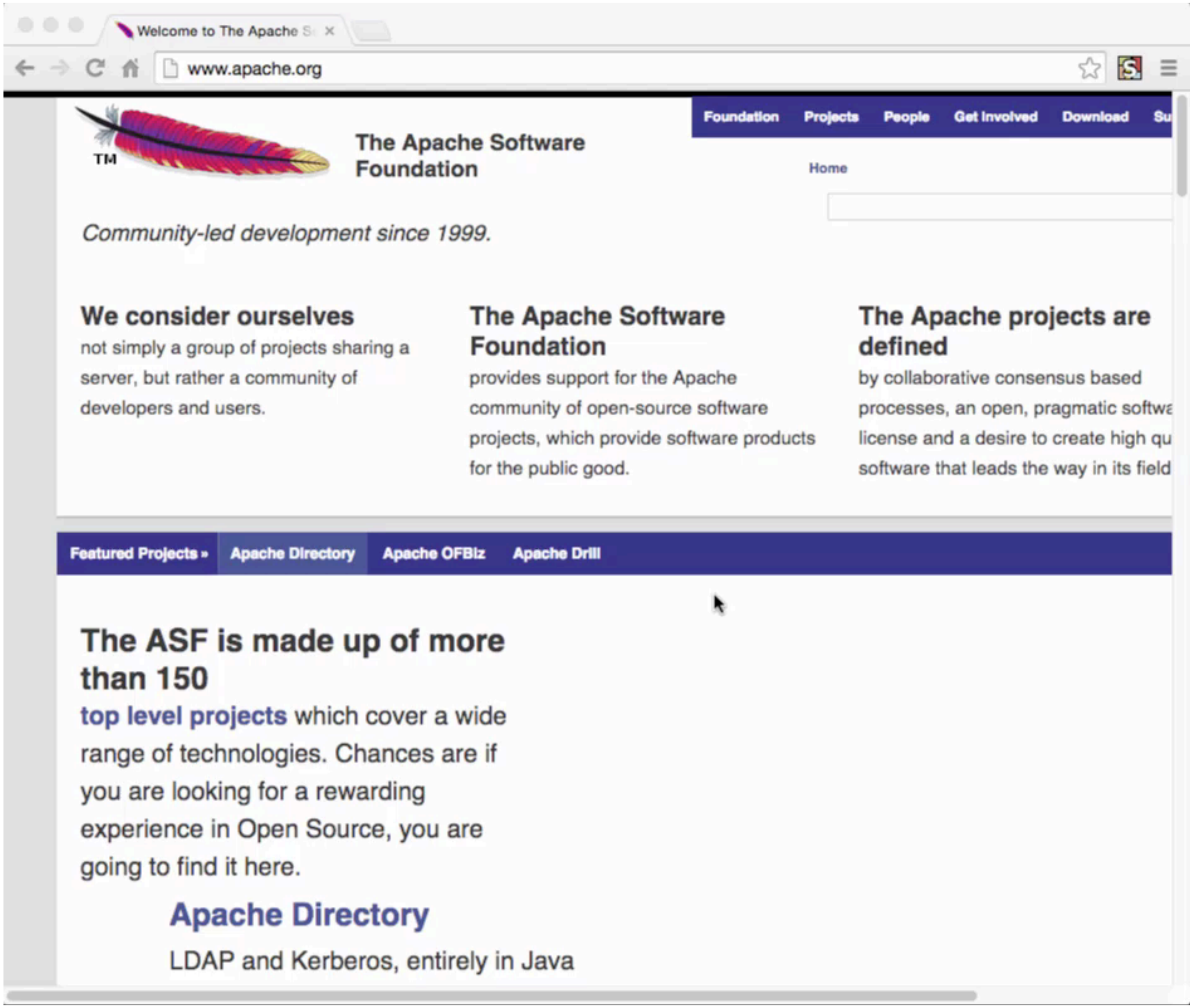
This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Easy setup

```
<Location /balancer-manager>
  SetHandler balancer-manager
  Require 192.168.2.22
</Location>
```

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Admin


Welcome to The Apache S

www.apache.org

Foundation Projects People Get Involved Download Su

The Apache Software Foundation

Home

Community-led development since 1999.

We consider ourselves
not simply a group of projects sharing a server, but rather a community of developers and users.

The Apache Software Foundation
provides support for the Apache community of open-source software projects, which provide software products for the public good.

The Apache projects are defined
by collaborative consensus based processes, an open, pragmatic softwa license and a desire to create high qu software that leads the way in its field

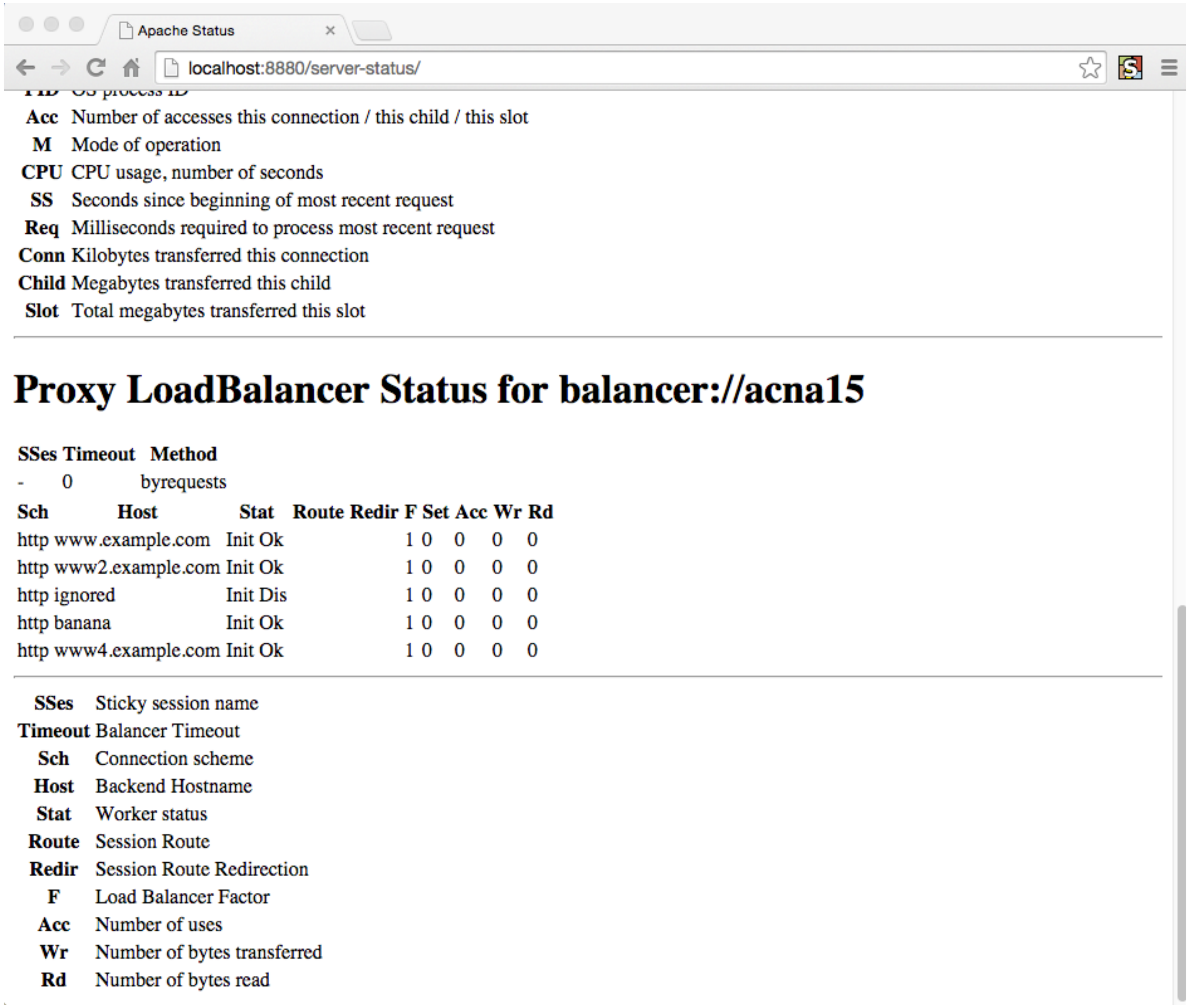
Featured Projects » Apache Directory Apache OFBiz Apache Drill

The ASF is made up of more than 150
top level projects which cover a wide range of technologies. Chances are if you are looking for a rewarding experience in Open Source, you are going to find it here.

Apache Directory
LDAP and Kerberos, entirely in Java

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

server-status aware



Apache Status

localhost:8880/server-status/

PID	OS process ID
Acc	Number of accesses this connection / this child / this slot
M	Mode of operation
CPU	CPU usage, number of seconds
SS	Seconds since beginning of most recent request
Req	Milliseconds required to process most recent request
Conn	Kilobytes transferred this connection
Child	Megabytes transferred this child
Slot	Total megabytes transferred this slot

Proxy LoadBalancer Status for balancer://acna15

SSes	Timeout	Method
-	0	byrequests

Sch	Host	Stat	Route	Redir	F	Set	Acc	Wr	Rd
http	www.example.com	Init Ok			1	0	0	0	0
http	www2.example.com	Init Ok			1	0	0	0	0
http	ignored	Init Dis			1	0	0	0	0
http	banana	Init Ok			1	0	0	0	0
http	www4.example.com	Init Ok			1	0	0	0	0

SSes	Sticky session name
Timeout	Balancer Timeout
Sch	Connection scheme
Host	Backend Hostname
Stat	Worker status
Route	Session Route
Redir	Session Route Redirection
F	Load Balancer Factor
Acc	Number of uses
Wr	Number of bytes transferred
Rd	Number of bytes read

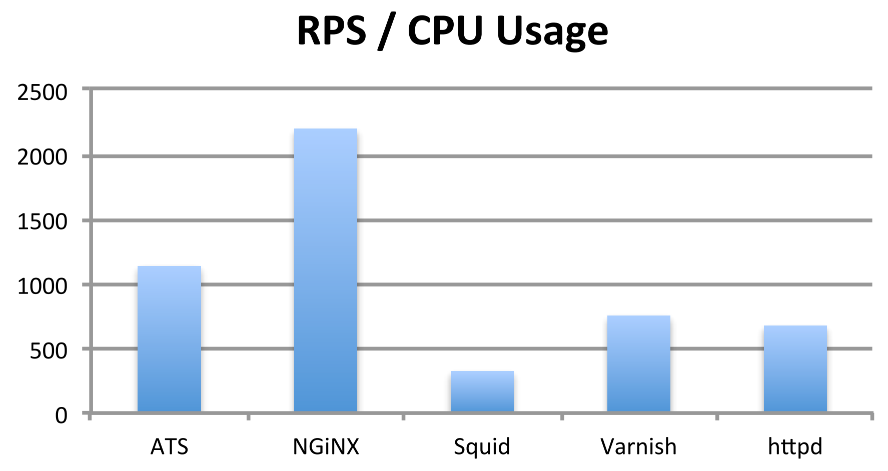
This work is licensed under a Creative Commons Attribution 3.0 Unported License.

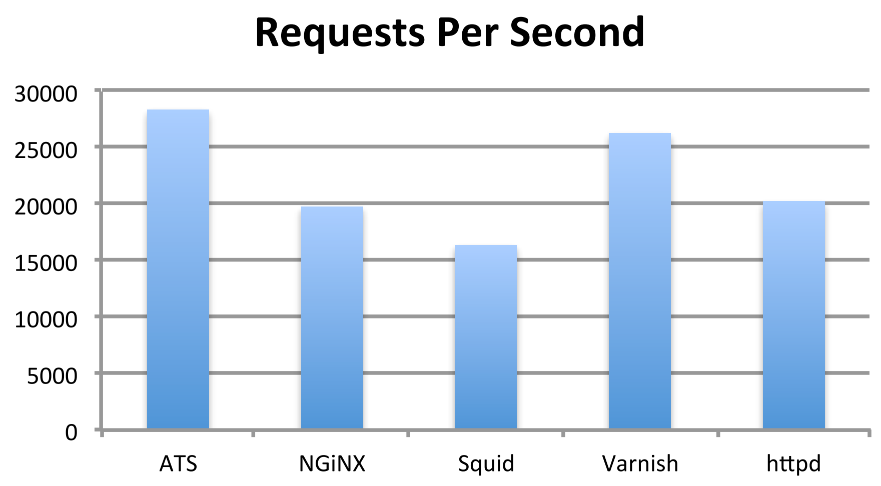
APACHECON NORTH AMERICA

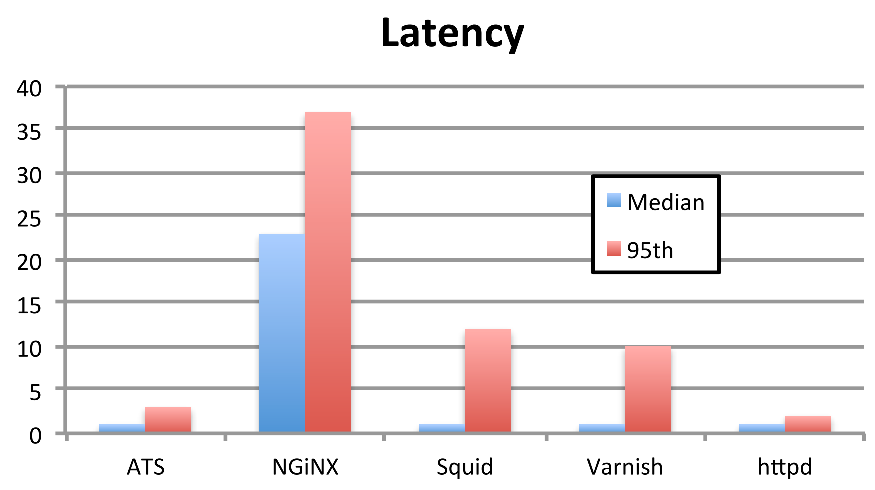
Performance

➡ From Bryan Call's 2014 ApacheCon preso

- Squid used the most CPU again
- NGiNX had latency issues
- ATS most throughput







This work is licensed under a Creative Commons Attribution 3.0 Unported License.

What’s on the horizon?

- Extend mod_proxy_express
- Adding additional protocols
- More dynamic configuration
  - Adding balancers!
- Extend/improve caching
- Performance, of course!

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

APACHECON
NORTH AMERICA

In conclusion…

- For cloud environs and other, the performance and dynamic control of Apache httpd 2.4 in reverse proxies is just what the Dr. ordered (and flexibility remains a big strength)

This work is licensed under a Creative Commons Attribution 3.0 Unported License.

Thanks

Twitter: @jimjag

Emails:
- jim@jaguNET.com
- jjagielski@outercurve.org
- jim@apache.org
- jimjag@redhat.com

http://www.slideshare.net/jimjag/

This work is licensed under a Creative Commons Attribution 3.0 Unported License.