Deployment

Chris Wilson, AfNOG 2016

About this presentation

Based on previous talks by Joel Jaeggli, Evelyn Namara and NSRC, with thanks!

You can access this presentation at:

- Online: http://afnog.github.io/sse/apache/
- Local: http://www.ws.afnog.org/afnog2016/sse/apache/index.html
- Github: https://github.com/afnog/sse/blob/master/apache/presentation.md
- Download PDF: http://www.ws.afnog.org/afnog2016/sse/apache/presentation.pdf

Acknowledgements:

- Cover photo by MarianZubak at en.wikipedia, CC BY 2.5

What is Deployment

Now you have this pretty shiny new thing!

- E.g. a web service, mail service, storage service

How do we make it:

- Reliable
- Scalable
- Secure
- Efficient (cheap)
- Fast

For heavy load (thousands of users?)

What is Deployment

- Wrong time to ask!
- Needs to have been designed for all this (architecture)
- Better hope the designers thought of it!

Design for Deployment

So how do we **design** something:

- Reliable
- Scalable
- Secure
- Efficient (cheap)
- Fast

Design for Deployment

Two ways: scale UP (bigger boxes) or scale OUT.

- Scale UP is appropriate when:
  - size is limited (e.g. internal service for <1000 users) and
  - reliability is not critical (<99% uptime) so you can restore from backups
- Otherwise you must scale OUT

Scaling UP

Scaling UP is boring:

- More expensive boxes and disks
- RAID arrays
- Large backups
- Slow restores
- Hard to move
- More complicated when service is layered (e.g. web app + database)
- Ultimately limited by how much (data/CPU) you can fit in 1-2 instances

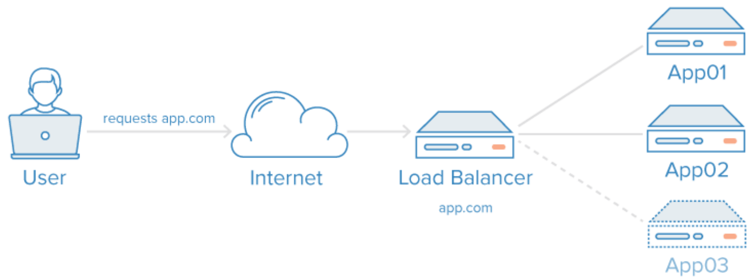
Scaling OUT

Build it out of smaller things (microservices) which are:

- Reliable
- Secure
- Small (cheap)
- Efficient (cheap)
- Fast

And connect them using an architecture which also is.

Note: the small things do not have to be scalable if your architecture scales!



Organisation

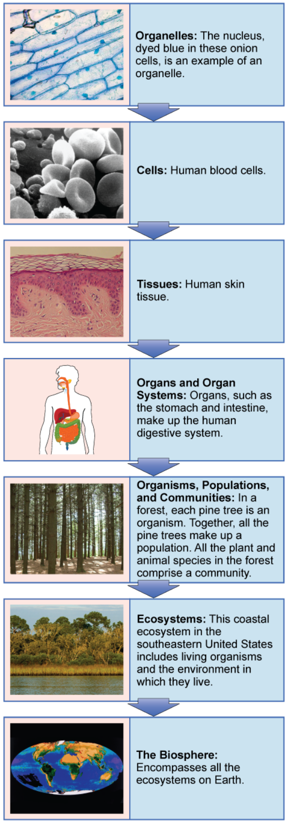
What else is a large system organised out of smaller components?

Organisation

What else is a large system organised out of smaller components?

WE ARE!

Note the hierarchical structure of complex organisms (see right)



Characteristics of Life

RED GIRL:

- Respiration (energy use)
- Excretion (energy use)
- Death (plan for unit loss)
- Growth (possible but better avoided)
- Irritability (responds to events, I/O)
- Reproduction (create from saved image)
- Locomotion (migration)

Microservices

Need to be/should be easy to:

- Maintain
- Monitor
- Manage
- Move

Microservices

Examples of microservices (microservers):

- File server
- Database server
- RADIUS server
- LDAP server
- HTTP reverse proxy/load balancer/SSL wrapper
- Static content HTTP server
- PHP/Python/Node.js server
- SMTP server
- IMAP server/load balancer
- DNS server

So how do we make these things?

Microservice outsourcing

Most of these you can buy as a service online:

- File server: not exactly, but Amazon S3/OpenStack Swift
- Database server: Amazon RDS, OpenStack Trove
- Authentication service: Amazon Directory Service (hosted AD), OpenID
- HTTP reverse proxy/load balancer/SSL wrapper: CloudFront
- Static content HTTP server: CDN (CloudFront etc)
- PHP server: most web hosts
- Ruby/Python/Node.js server: Engine Yard, Heroku
- SMTP server: MailChimp, Mandrill, SendGrid
- IMAP server/load balancer: not really
- DNS server: Dyn, Amazon Route 53, most web hosts

But if you want to build your own, read on…

Microserver template

- Application/daemon
- Reliable
- Secure
- Small (cheap)
- Efficient (cheap)

Which application/daemon do we run, and how do we use it to achieve each of these requirements?

File microserver

- Application/daemon: SMB server (Samba) or NFS or cluster FS
- Reliable -> replicated to another unit (DRBD or cluster FS)
- Secure:
  - Against **all kinds** of unauthorised access?
  - Network encryption
  - Authenticate against RADIUS/LDAP/Kerberos
- Small (cheap) -> 20-100GB size?
  - Forces us to break up our large storage requirements
- Efficient (cheap):
  - SMB and NFS are both lightweight
  - Network and disk encryption are costs - do we need them?

SQL database microserver

- Application/daemon: MySQL or PostgreSQL
- Reliable -> database replication
- Secure:
  - Built-in authentication and authorisation
  - No external authentication?
- Small (cheap) -> 20GB size?
  - Forces us to break up our large database requirements (AKA sharding)
  - Design for isolation where possible, e.g. one DB per customer
  - Per-customer DBs are too small, so combine multiple DBs per server with migration plan
- Efficient (cheap):
  - SQL database servers are heavyweight!
  - Only master servers are writable!
  - Queries are expensive, so run them on read-only slaves

HTTP microserver

- Application/daemon: Nginx
- Reliable -> stateless
- Secure:
  - Nginx is small (but had many vulnerabilities)
- Small (cheap) -> Nginx is lightweight
- Efficient (cheap) -> Nginx is lightweight

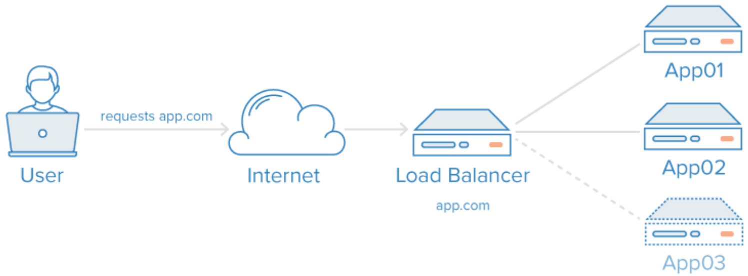
Routing

How to connect up these services:

- How do people access them (front end)
- How do they locate/find each other?
  - How does webserver B know which database/IMAP server to use for this customer?

Routing

This is how we actually **build** a service out of simple components (**architecture**):



- Applies at every level: front end->web server, web server->database/IMAP, IMAP->file server
- DNS, load balancer or application logic
- What happens if the user's host instance is down?
  - Need an automated fault detection and failover system!
  - Probably need to engineer this yourself
- Ignore the problem and hard-code it like we always did before

Routing

DNS

Use the DNS to send clients (users or applications) to an instance:

- Direct: john.provider.com
  - Just add A records to DNS
  - Beware: DNS cannot be changed instantly (failover is slow)
- Indirect: login first and redirect to instance
  - Requires server-side application logic/support
- Potential many-to-one: john.provider.com and steve.provider.com -> same web/DB server
  - Can be changed transparently to user and without downtime
  - Note: migration (planned) is easy, failover (unplanned) is hard

Routing

DNS

Load balancer

Place a load balancer in front of servers, and direct clients to it.

Advantages:

- Transparent to users
- Instant failover (unlike DNS)
- You may need a reverse proxy anyway (for SSL, static content routing)
- Typically good routing flexibility (reason for existence!)

Disadvantages:

- Single point of failure
- Can interfere with application
  - HTTP Host header, cookie, redirect rewriting
  - Application state: need stateful routing?
- Another layer adds complexity and latency

Routing

DNS

Load balancer

Application logic

Application designed (or modified) to choose which backend to use based on an algorithm.

- Lookup which database to use... in the database?
- Doesn't work for the user frontend!
- Could be based on username:
    - john -> server j.sql.provider.com
    - steve -> server s.sql.provider.com
    - Or first 2 letters, etc.
- Using DNS for indirection makes migration easier

In some cases, only app logic is needed, e.g. store files in Amazon S3 and let Amazon handle load balancing and HA.

Routing, Monitoring and Failover

- Nagios monitors your web/DB/IMAP backend servers
- Failure detected -> run event handler (Nagios feature)
- Handler initiates failover:
  - Change the DNS
  - Reconfigure load balancers
  - Rewrite application config files and restart
  - Update database -> web application responds
  - Start a VRRP IP failover/takeover
  - New master may need reconfiguration (e.g. read-only slave -> read-write master DB)
  - Assume fail-hard: consistency check may be required

Routing, Monitoring and Failover

Recovery handling

- Recovery detected -> run a different event handler
  - What should it do?
  - Fail back immediately?
  - Reconfigure recovered instance as a slave?
  - Recovery is often harder than failover!

FIN

Any questions?

(yeah, right!)