



# Cloud compting 101

was cloud computing  
needed



# Mainframes

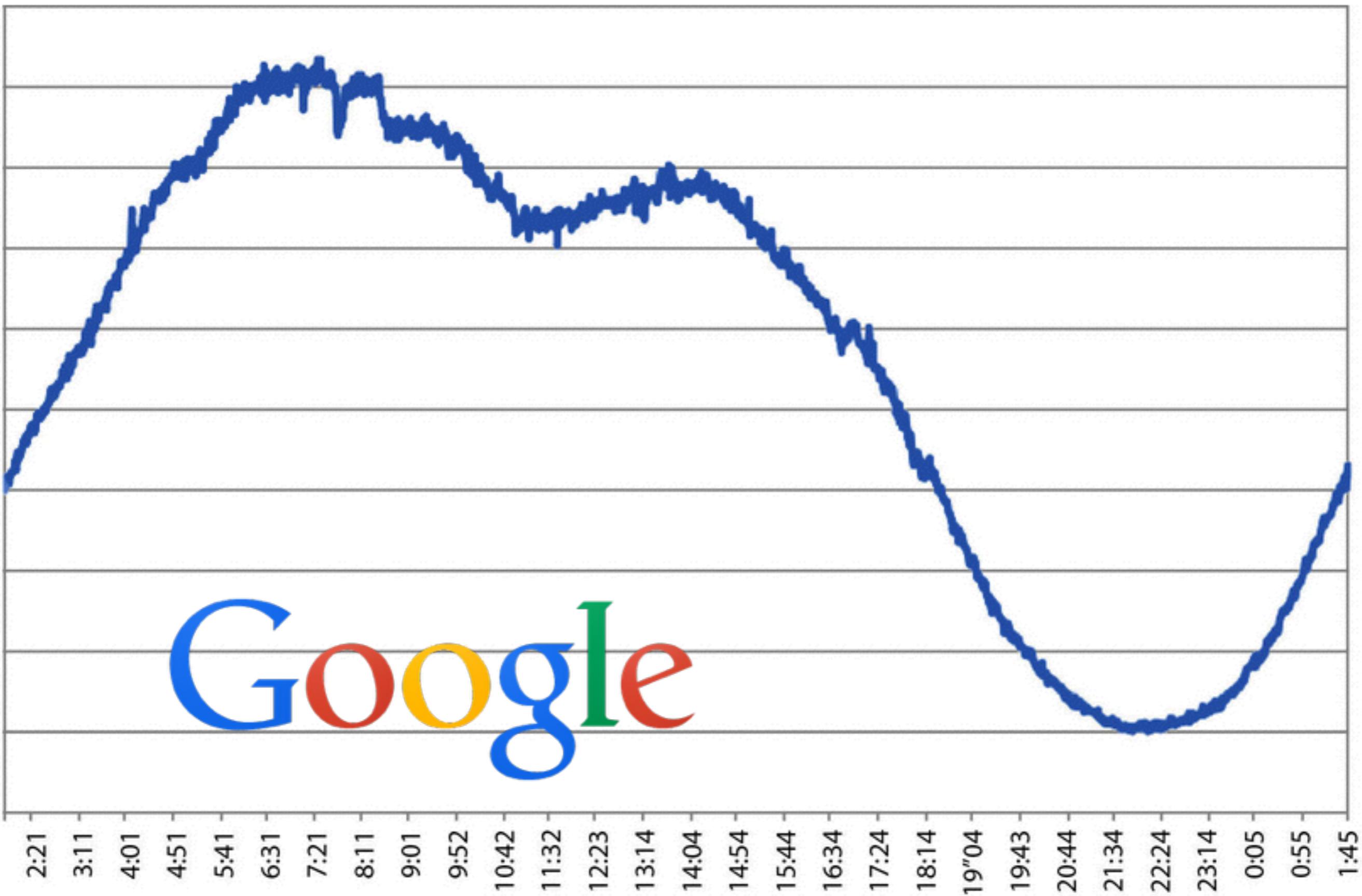


Then IBM came with affordable PCs



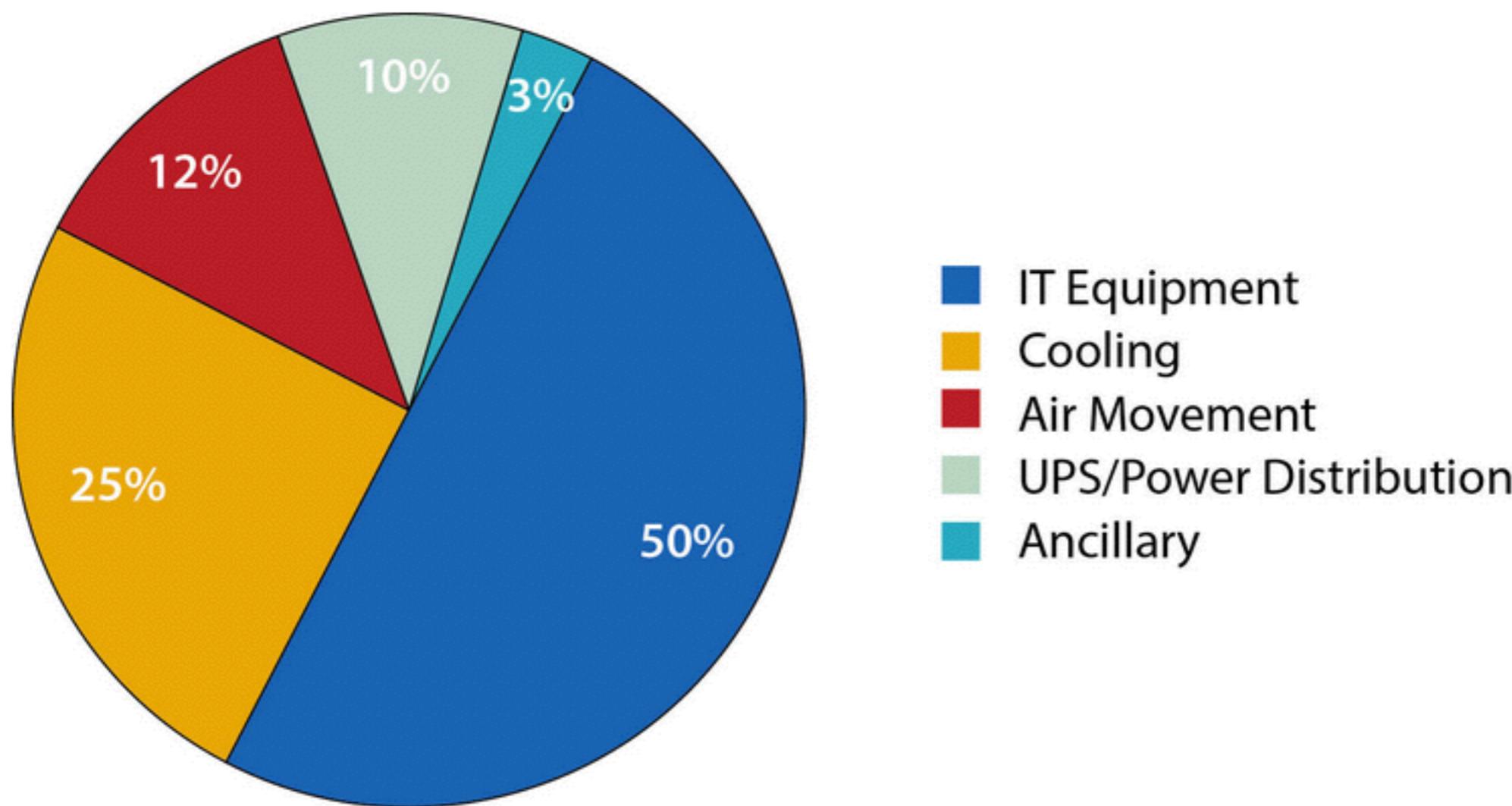
Then we spread out the load for security,  
performance, manageability

Then we bought tons of servers to support  
load spikes





Amazon X-mas 2013  
426 items sold each second



Where is energy spent?



episode 0  
rise of the cloud



**National Institute of  
Standards and Technology**  
U.S. Department of Commerce

2011

“ Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

# 1

On-demand self-services

self-provisioning,  
no human intervention

[Shop All Categories](#)[GO](#)[Your Software](#)**Software Infrastructure**

Application Development

Application Servers

Application Stacks

Big Data

Databases &amp; Caching

Network Infrastructure

Operating Systems

Security

**Developer Tools**

Issue &amp; Bug Tracking

Monitoring

Source Control

Testing

**Business Software**

Business Intelligence

Financial Services

Collaboration

Content Management

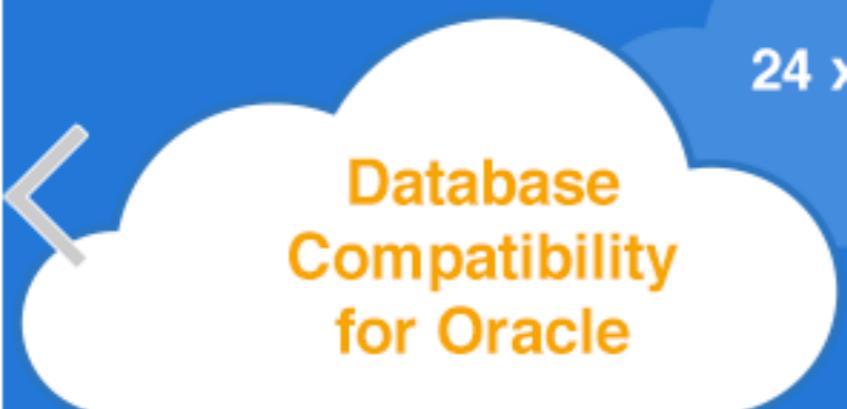
CRM

eCommerce

Education &amp; Research

High Performance

# Postgres Plus Cloud Database Advanced Edition



Database  
Compatibility  
for Oracle

24 x 7 premium support included

from EnterpriseDB  
the Postgres Database Company

[LEARN MORE](#)

## Featured Products



[Postgres Plus Cloud Database Advanced](#)  
EnterpriseDB Corporation  
**\$0.26 to \$20.24/hr** for software



The PHP Company

[PHP 5.5 - Zend Server Developer Editi...](#)  
Zend Technologies USA,...  
**\$0.03/hr** for software  
[Free Trial](#)



Simplifying Information Assurance

[GoldDisk Plus - DISA STIG Windows 200...](#)  
SteelCloud  
**\$49.00/mo + \$0.00 to \$0.06/hr** for software + Charges for EC2 with Windows

## Operating Systems



Amazon Linux AMI (HVM / 64-bit)

Amazon Web Services  
**\$0.013 to \$8.14/hr** incl EC2 charges



CentOS 7 (x86\_64) with Updates HVM

Centos.org  
**\$0.00/hr** for software



Ubuntu Server 14.04 LTS (HVM)

Canonical Group L...  
**\$0.00/hr** for software

## Popular Products





broad network access

availability over the network  
standard mechanisms

# 3

## resource pooling

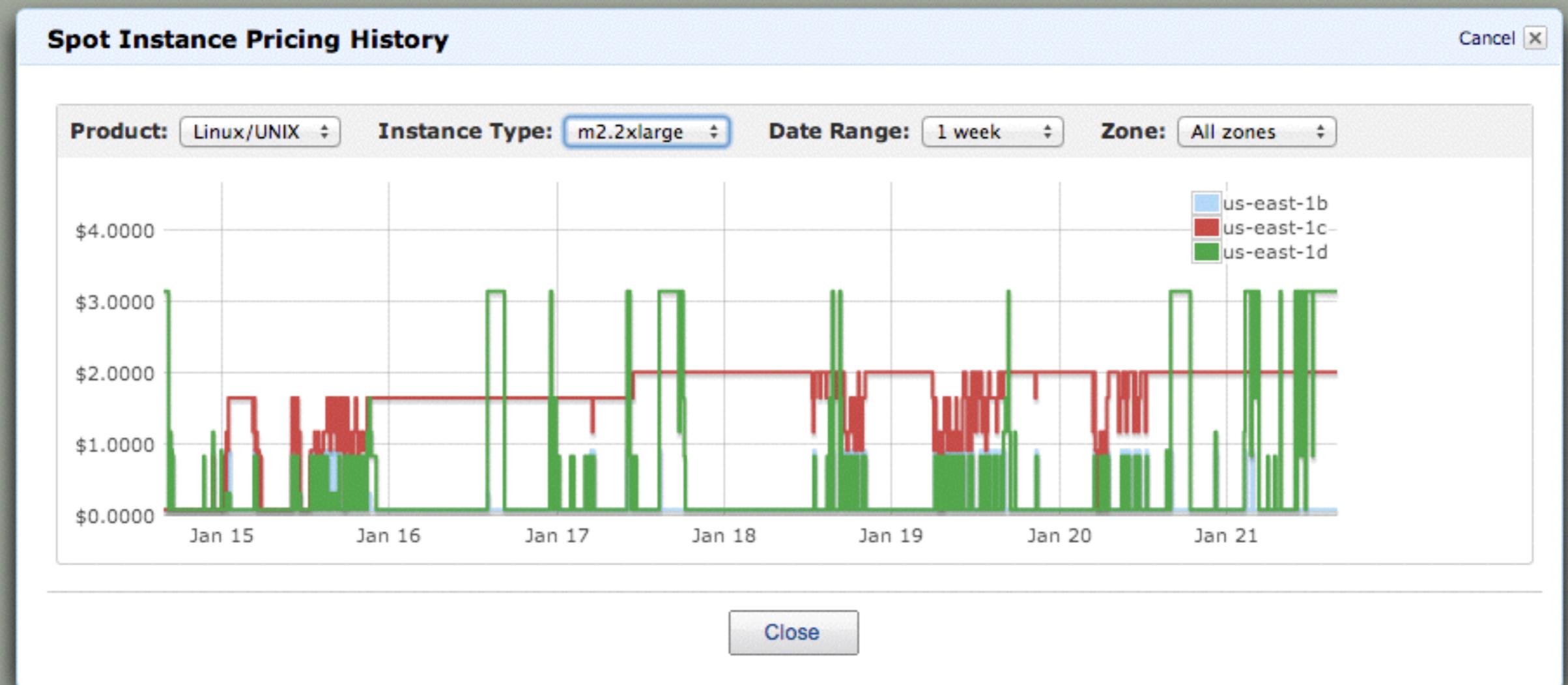
multi-tenant  
virtual or physical resources  
on-demand allocation  
location independance



reserved instances (yearly based)  
on-demand instances (hourly based)  
hotspot instances (market based)

# Amazon EC2

# HotSpot instances



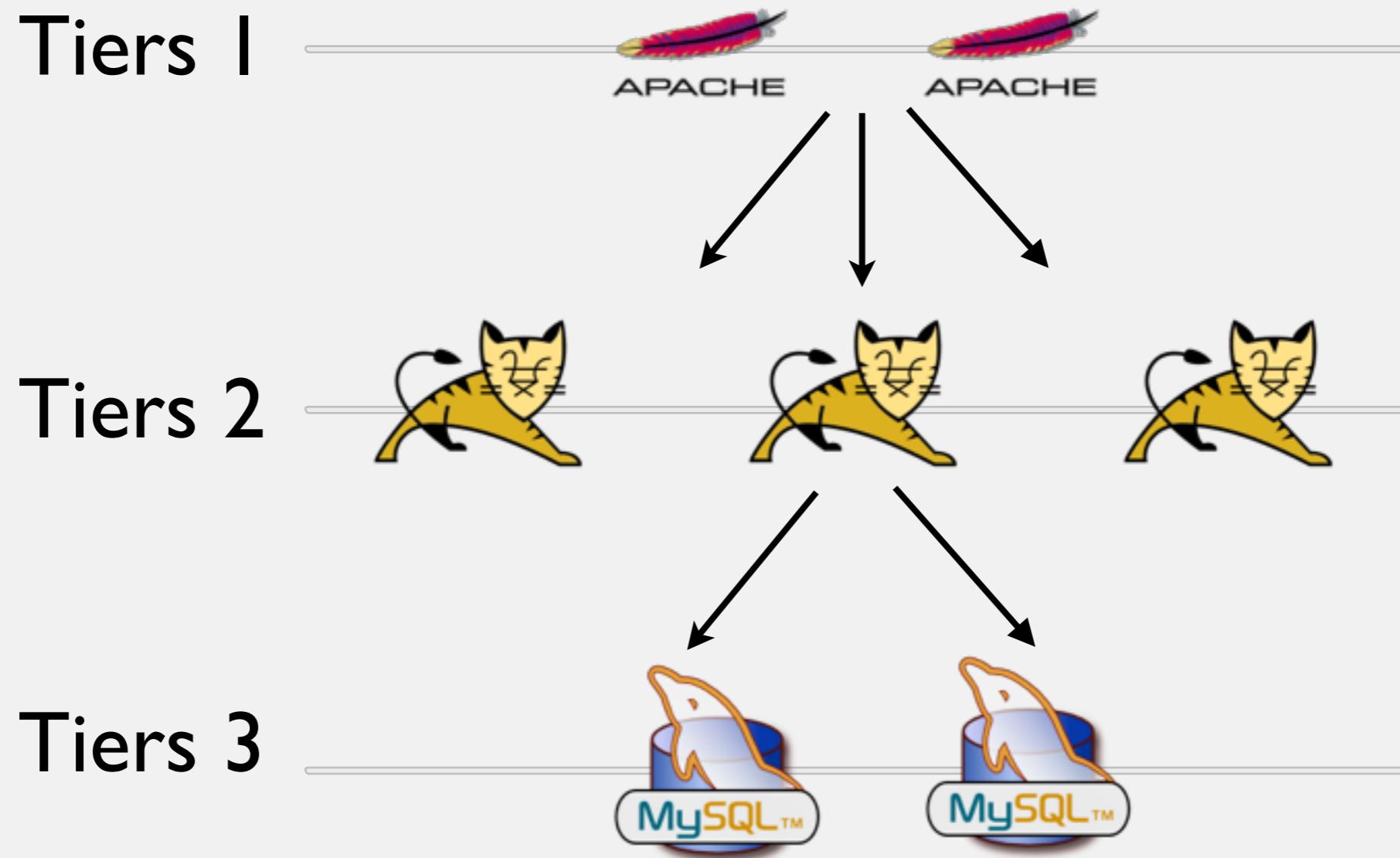
bid over the market price to get the instance

rapid elasticity

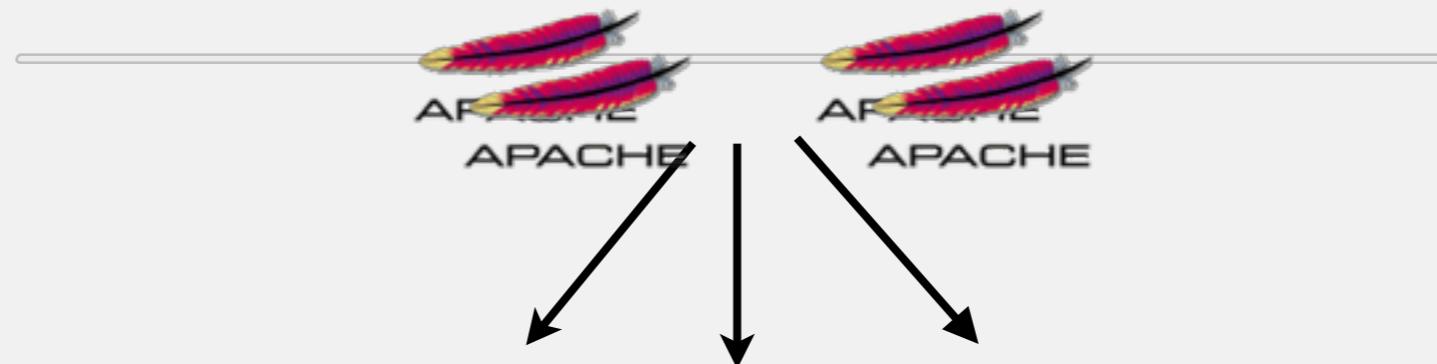
fast (de-)allocation of resources  
scale to infinity



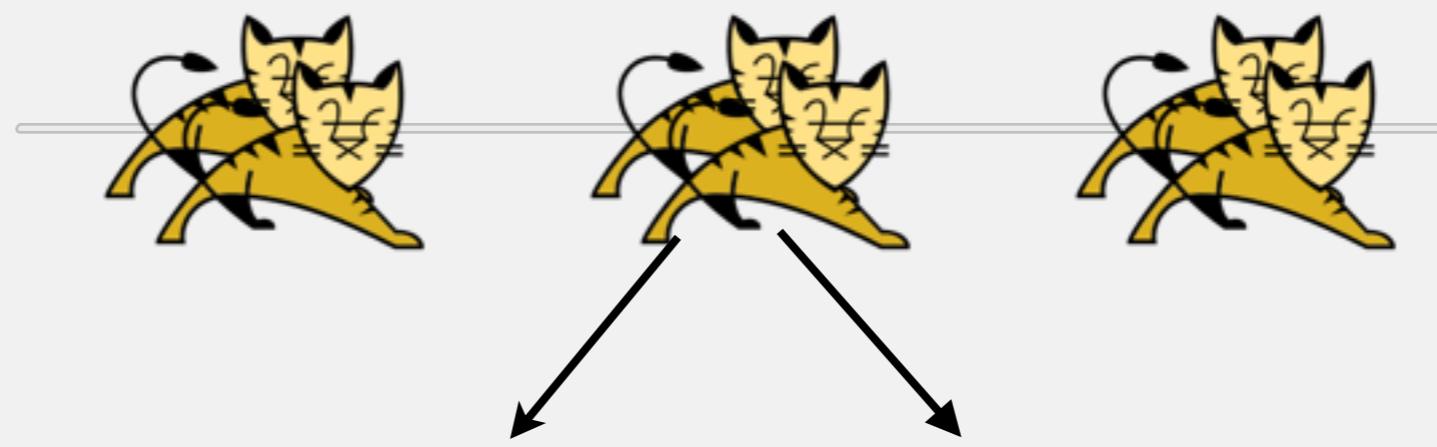
# vertical elasticity



Tiers 1



Tiers 2



Tiers 3



horizontal elasticity



measured service  
metering capabilities  
transparent reporting



RunAbove

Hourly      Monthly

LABS

### Cloud Sandbox

\$ 0.004

\$ 0.010

M

1 Core

2 GB RAM

LABS | Get 1 month Free!

### Steadfast Resources

\$ 0.014

\$ 0.028

\$ 0.056

S

M

L

1 Core

1 Core

2 Cores

2 GB RAM

4 GB RAM

8 GB RAM

Launch Now !

### 1 VM/HOST

\$ 0.110

\$ 0.140

XL3

4 Cores

XL4

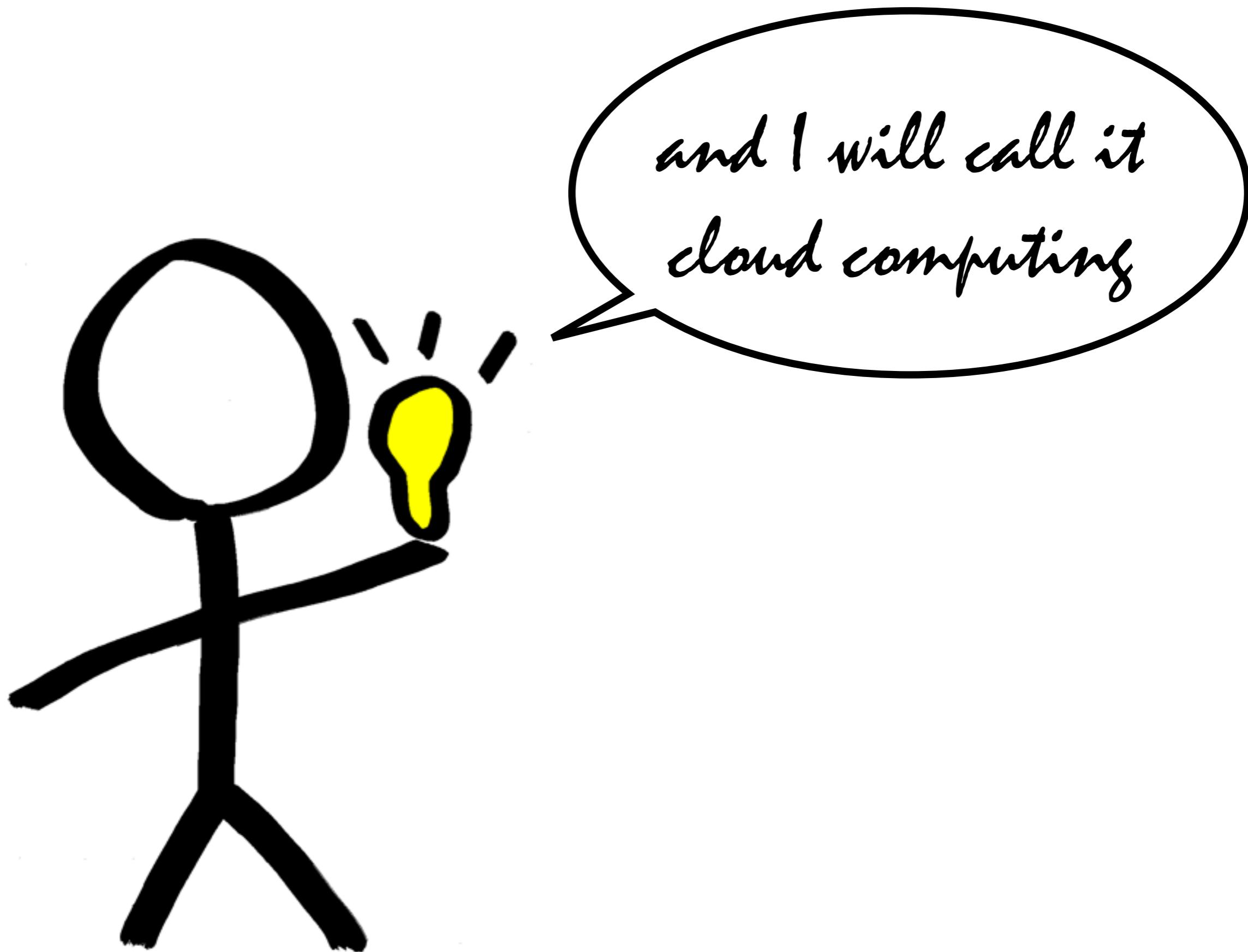
6 Cores

16 GB RAM

24 GB RAM

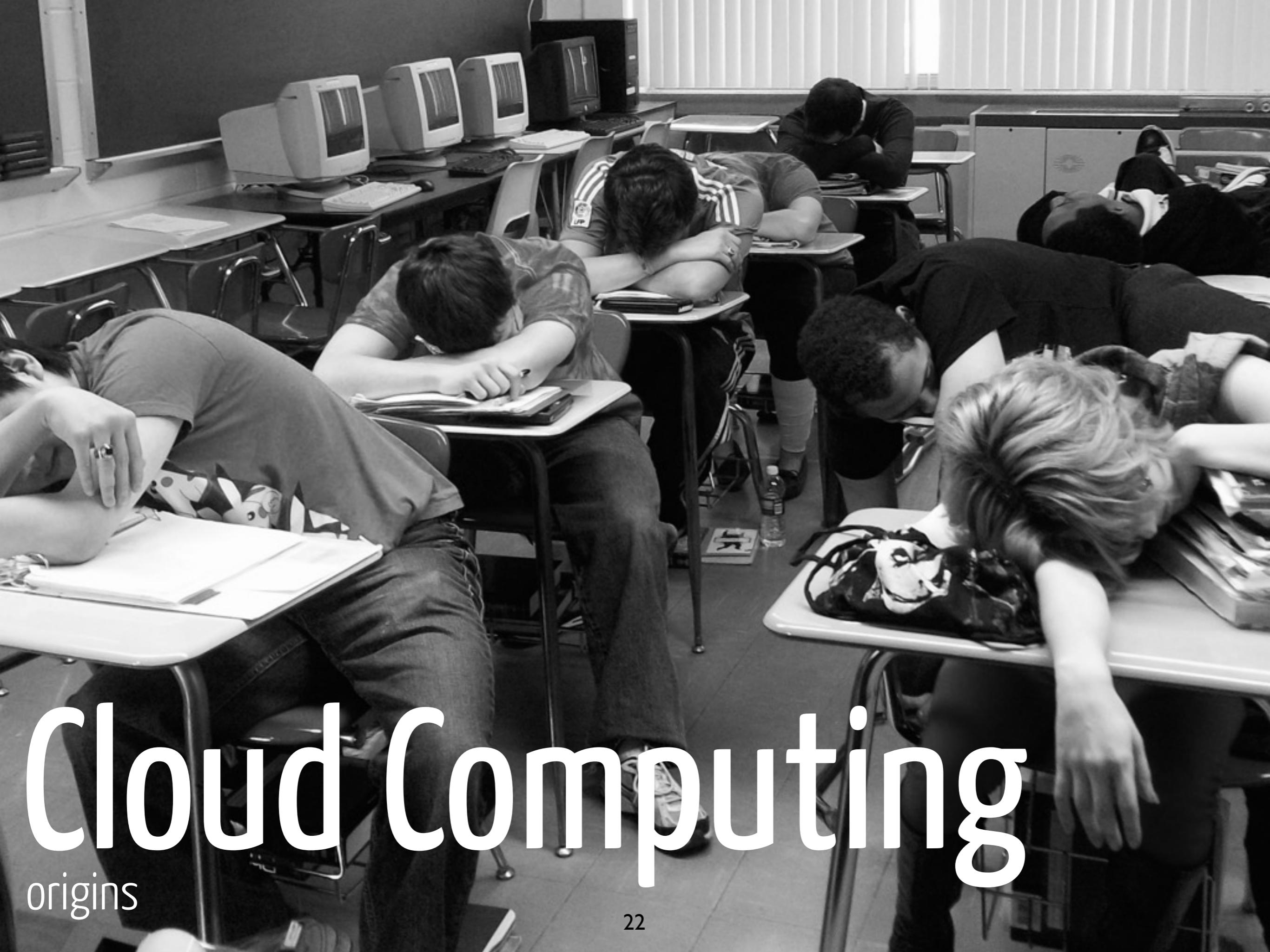
Launch Now !

More Info ▾



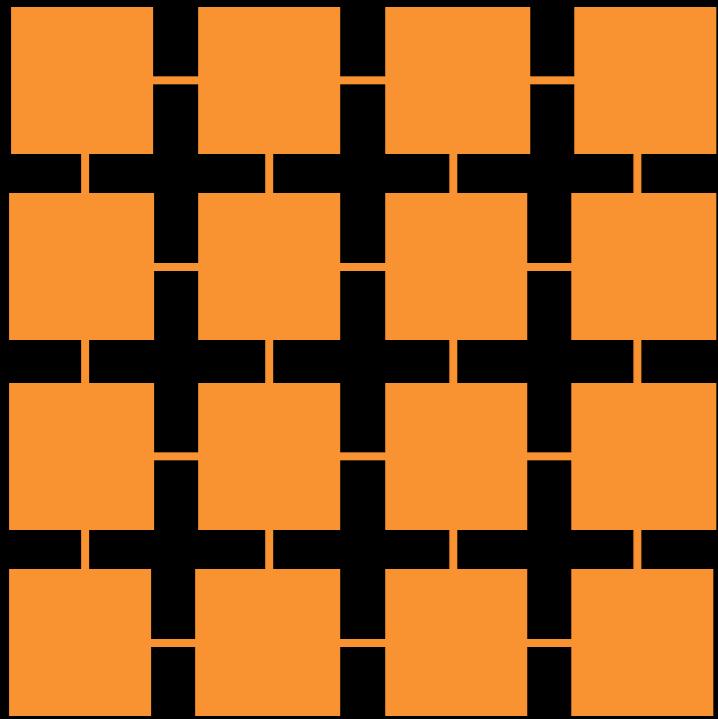
# Cloud Computing

origins



“ If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility... The **computer utility** could become the basis of a new and important industry.”

John McCarthy, 1961



# cluster computing

loosely coupled co-located servers

single tenant

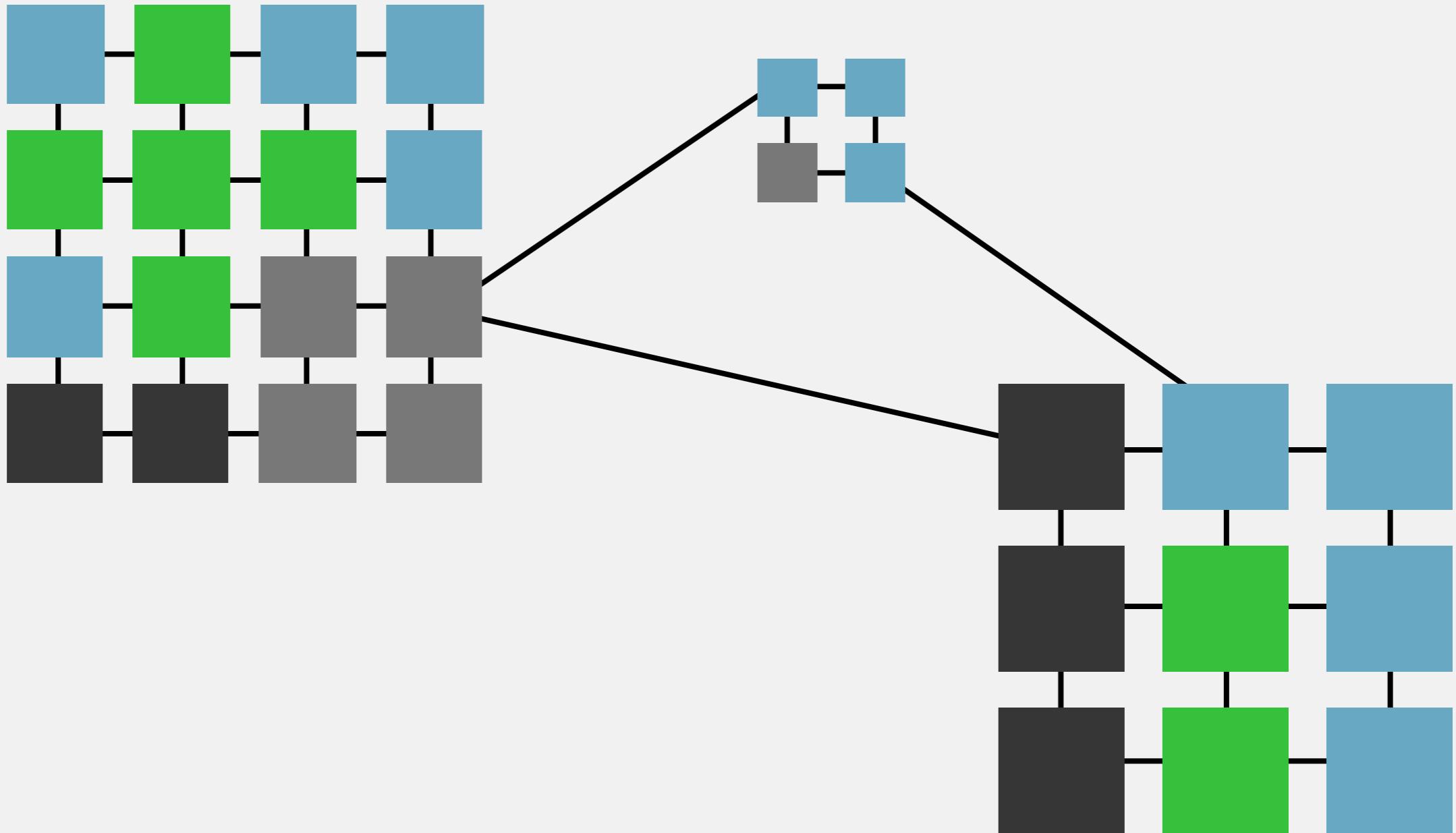
non-interactive workload

rigid jobs

80s

- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

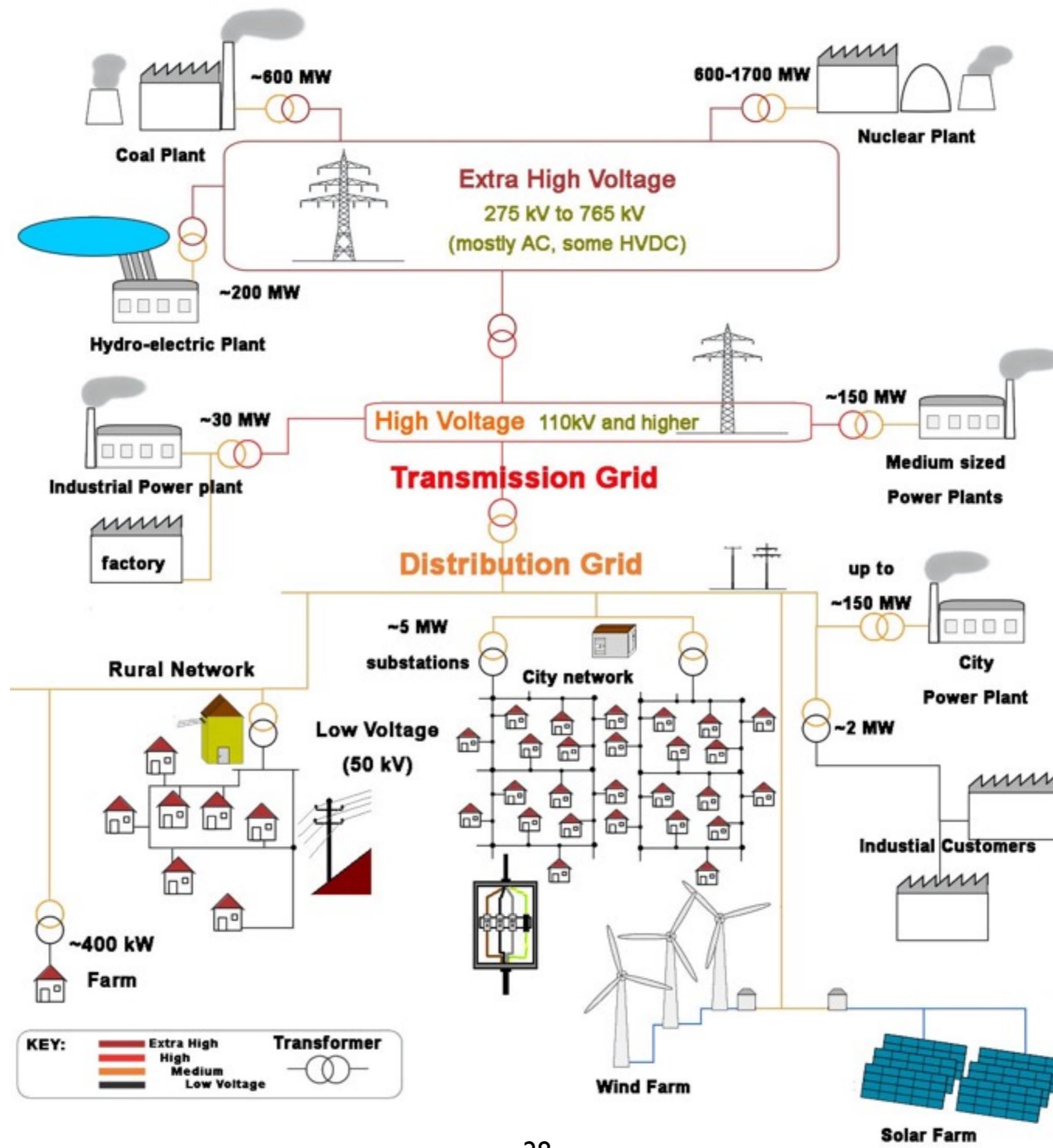
- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service



# grid computing

Ian Foster et al. 2001

# Power Grid Analogy



# Power grid

multiple providers  
heterogeneous sources

multiple clients

abstract source

**live consumption**

location  
doing \* at

# Computing grid

virtual organisation

heterogeneous hw.

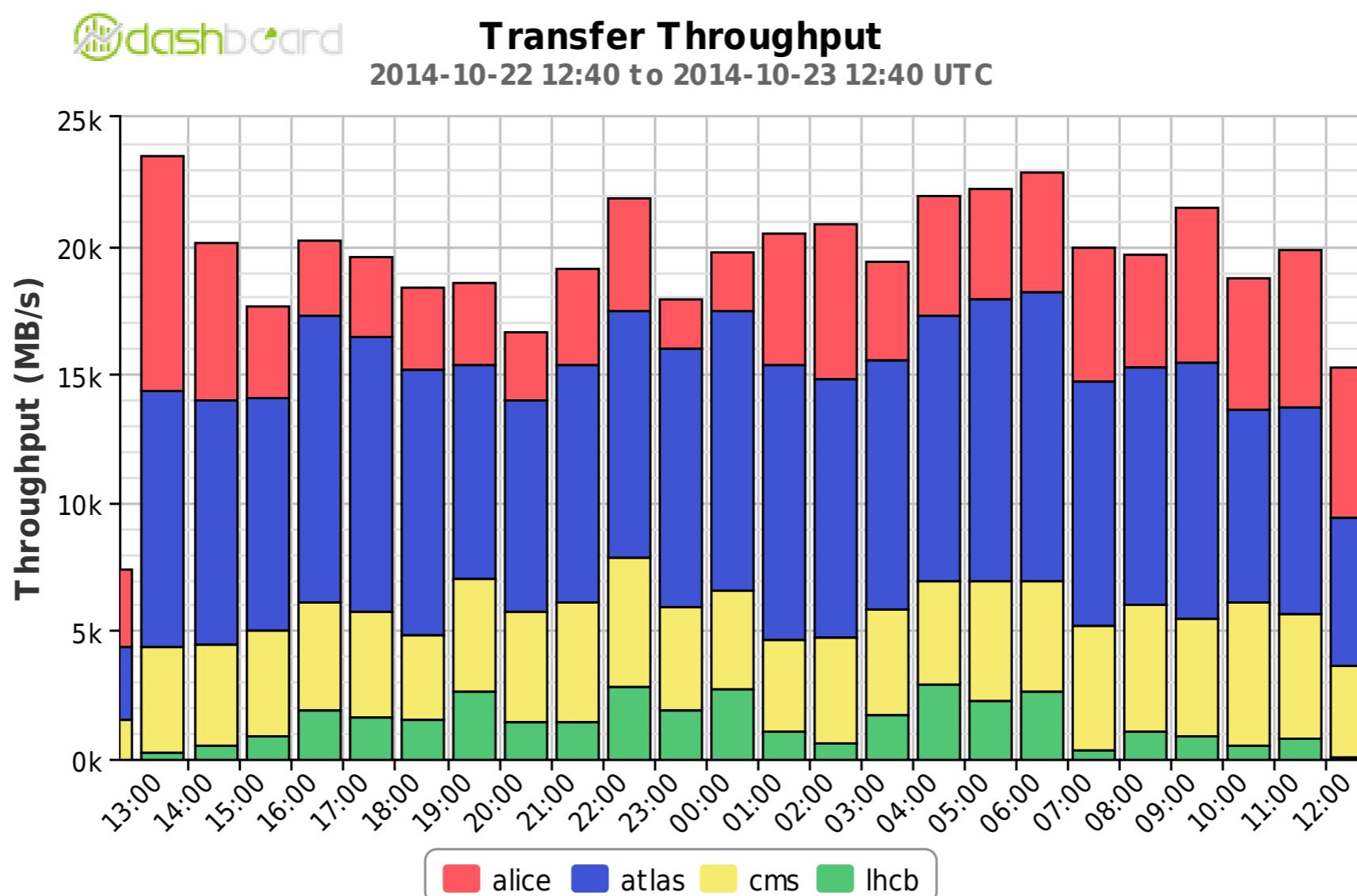
multiple applications

abstract resources

**batch jobs**

independence  
large scale

# Worldwide LHC Computing grid



170 centres to analyse 30 PB / year

- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

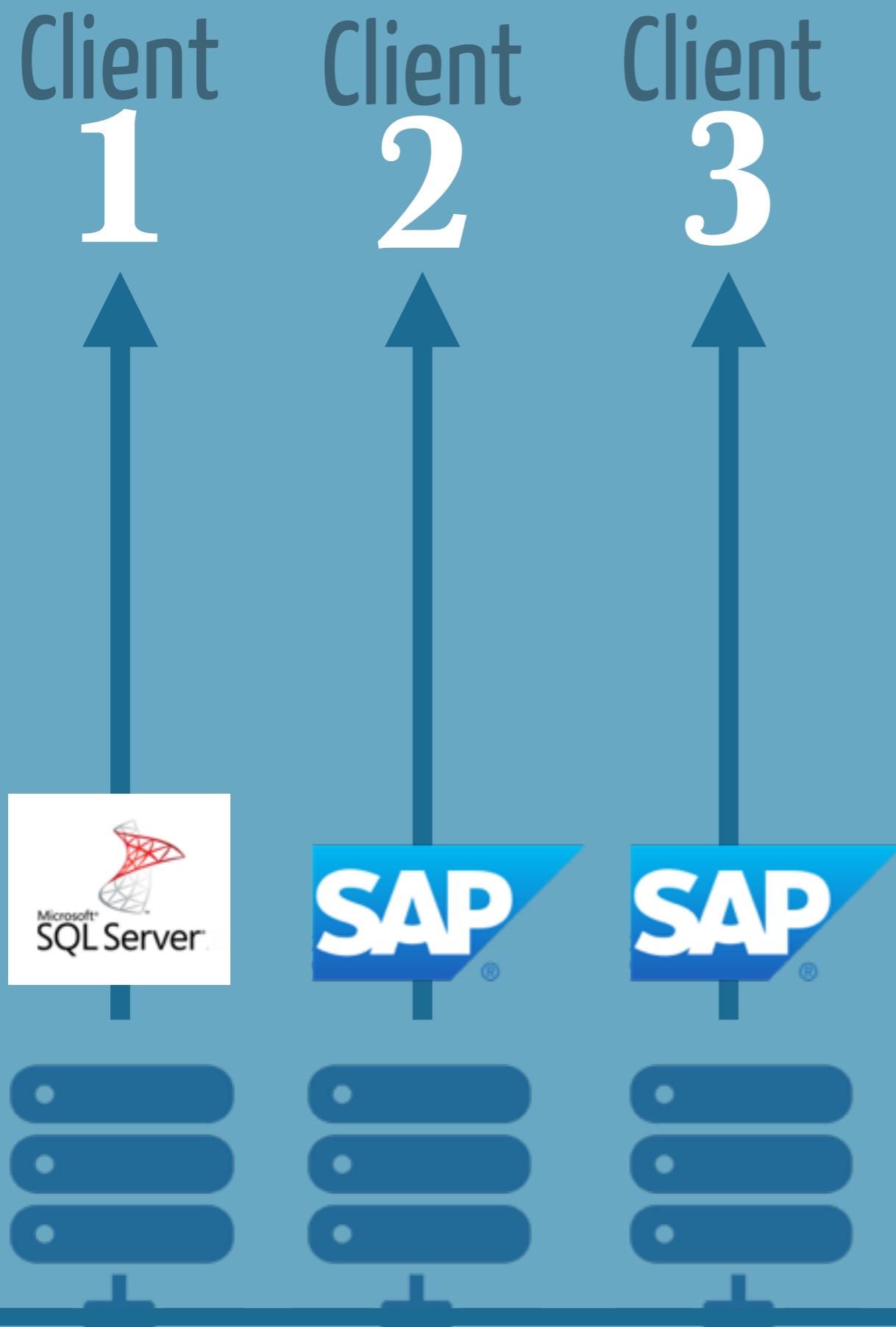
- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

# Application Service Provider

95+

remote access to  
dedicated applications

service oriented  
pay as you go



- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

on demand self-services

broad network access

resource pooling (not real hw resources)

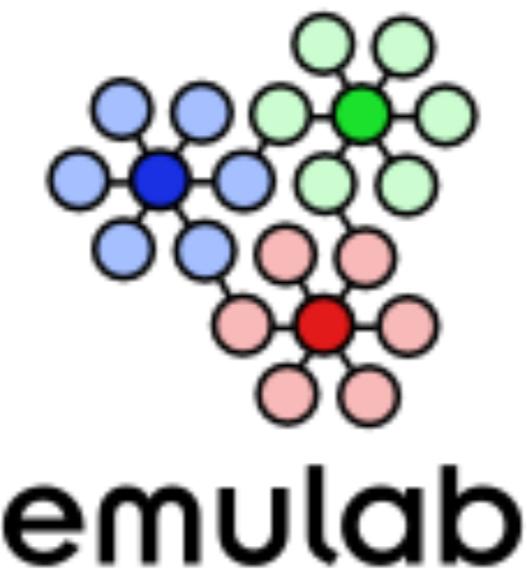
rapid elasticity

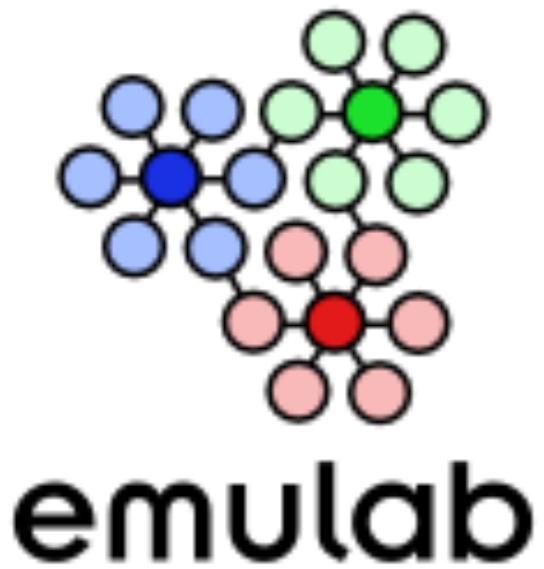
measured service

# 2002

computers on demand.

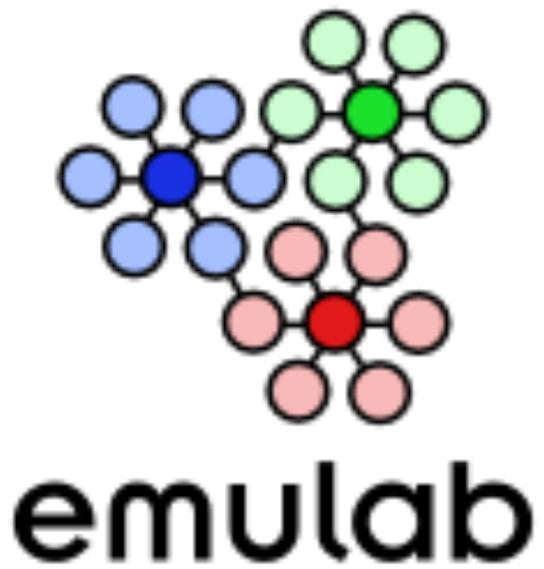
Deploy full custom stacks (OS to applications)



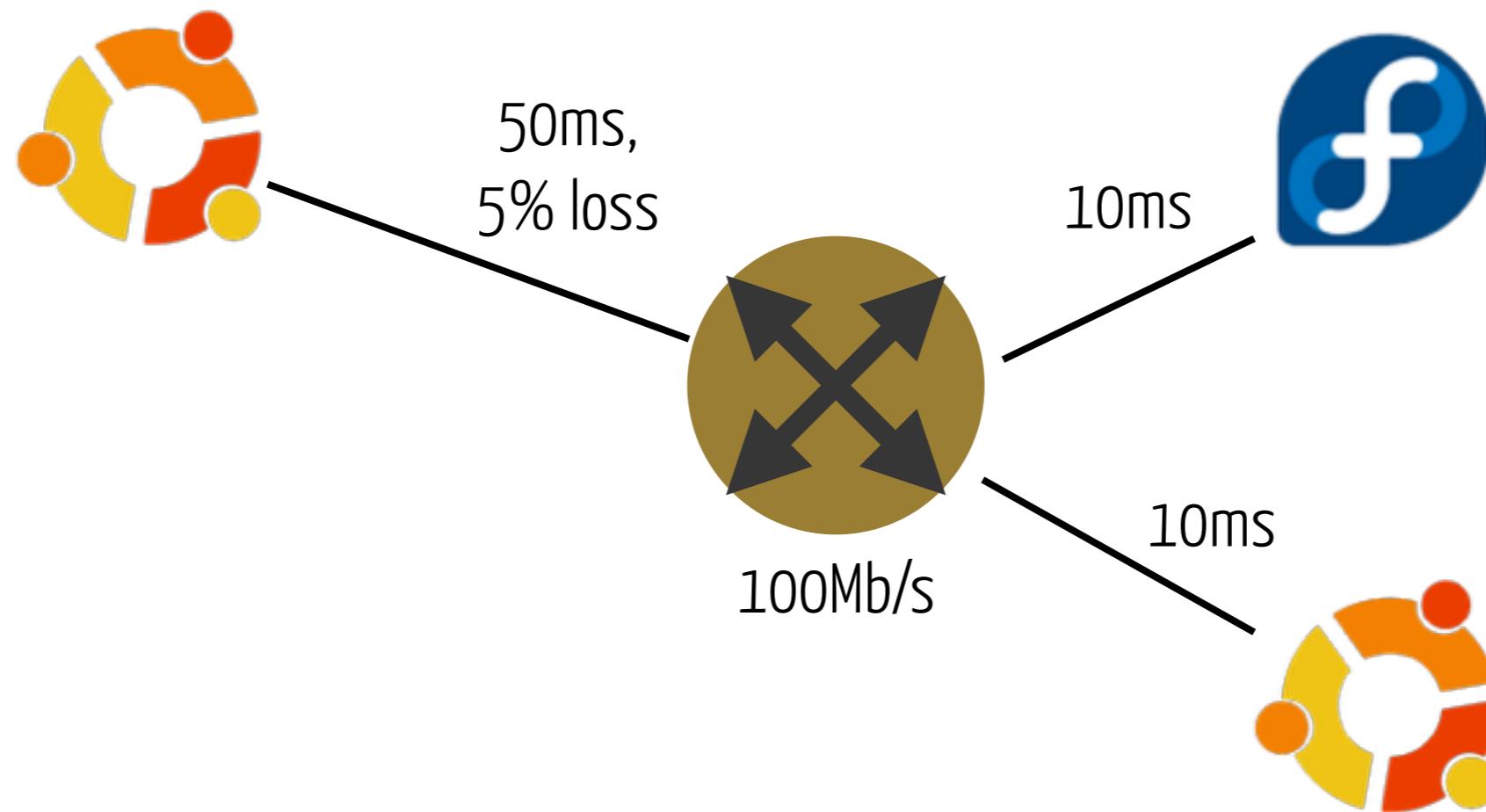


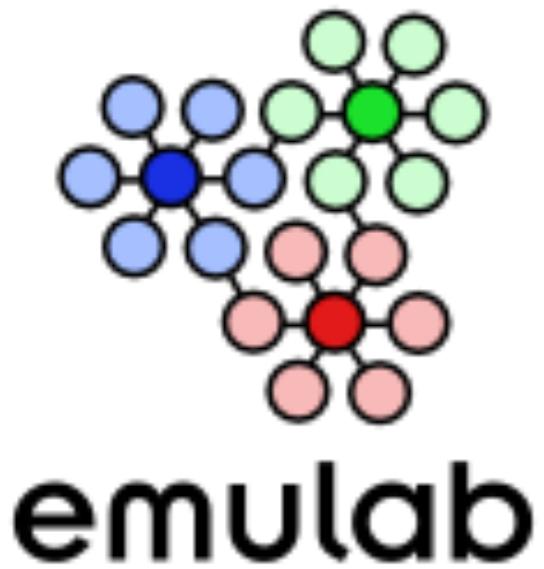
to (re)deploy reproducible  
network experiments

multi-tenant,  
(limited on purpose) resource pooling,

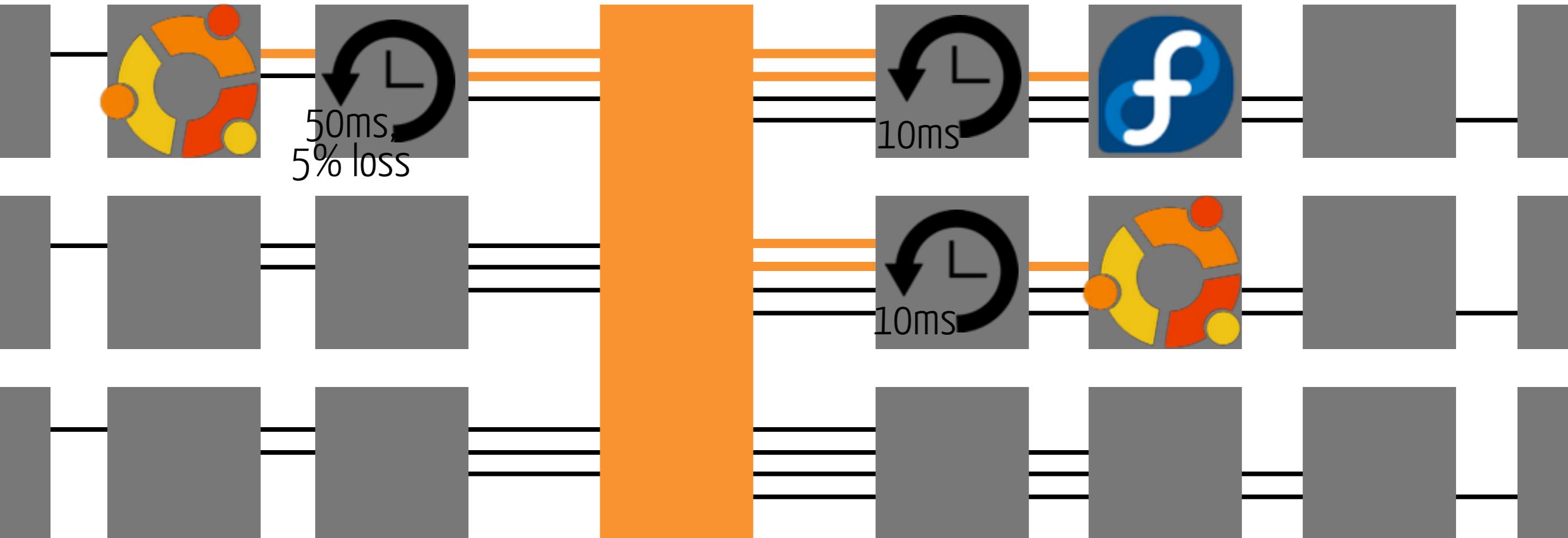


# to (re)deploy reproducible network experiments





# to (re)deploy reproducible network experiments



- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

on demand self-services

broad network access

resource pooling

rapid elasticity

measured service

2001+

Service  
oriented  
Architecture

composable unassociated, loosely coupled units



exponential grows since 2001  
private and public services to support its growth

## Two pizza rule

If a team can't be fed by two pizzas  
then it is too big

- Jeff Bezos (founder/ CEO of amazon.com)

800 x 

**tons of API, mini-services devoted to automation,  
flexibility, on-demand services for public and  
private use**

# 2006



scalable web services for other  
websites or client-side applications



SOAP & REST over HTTP  
pay as you go  
elastic \*-oriented services

\*data, network or computation

Cloud

- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

# RECAP

“ I have a dream, it was about Utility Computing ,”

John McCarthy - 1961

web  
+ grid computing  
+ resources on demand  
+ service oriented architectures

---

cloud computing (2006)



can we talk about  
cloud computing now ?

?adS

# SaaS Service as a Service

web access to commercial sw.

“one to many” model

customers don't handle upgrades

API for integration



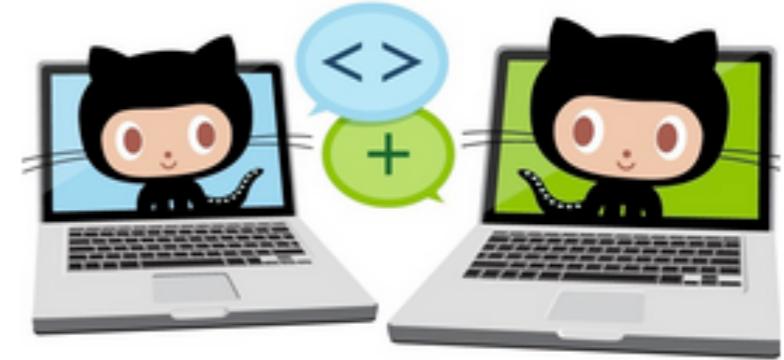
## Users.messages

For Users.messages Resource details, see the [resource representation](#) page.

Method	HTTP request	Description
URIs relative to <a href="https://www.googleapis.com/gmail/v1/users">https://www.googleapis.com/gmail/v1/users</a> , unless otherwise noted		
delete	<code>DELETE /userId/messages/id</code>	Immediately and permanently deletes the specified message. This operation cannot be undone. Prefer <code>messages.trash</code> instead.
get	<code>GET /userId/messages/id</code>	Gets the specified message.
insert	<code>POST https://www.googleapis.com/upload/gmail/v1/users/userId/messages</code> and <code>POST /userId/messages</code>	Directly inserts a message into only this user's mailbox similar to <code>IMAP APPEND</code> , bypassing most scanning and classification. Does not send a message.
list	<code>GET /userId/messages</code>	Lists the messages in the user's mailbox.
modify	<code>POST /userId/messages/id/modify</code>	Modifies the labels on the

# Plans and pricing

GitHub is free to use for public projects. Collaborate on private repositories with any of our paid plans.



[Sign up now](#)

## Personal plans

[Display estimated prices in EUR](#)

For individuals looking to share their own projects and collaborate with others.

	<b>Free</b> \$0/month	<b>Micro</b> \$7/month	<b>Small</b> \$12/month	<b>Medium</b> \$22/month	<b>Large</b> \$50/month
<b>Collaborators</b>	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
<b>Public repositories</b>	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
<b>Private repositories</b>	0	5	10	20	50

**Do you offer education discounts?**

Yes, we offer free and discounted plans to students, teachers, and schools. You can find more information and apply on our [education site](#).

# Platform as a Service

jailed runtime available to host applications  
generic or provider-specific APIs  
no control over the environment



Elastic  
Beanstalk





[Download Heroku Toolbelt for Mac OS X](#)



```
$ heroku login
```

...

```
$ git clone https://github.com/heroku/java-getting-started.git  
$ cd java-getting-started
```

```
$ heroku create
```

Creating warm-eyrie-9006... done, stack is cedar-14

<http://warm-eyrie-9006.herokuapp.com/> | <git@heroku.com:warm-eyrie-9006.git>  
Git remote heroku added

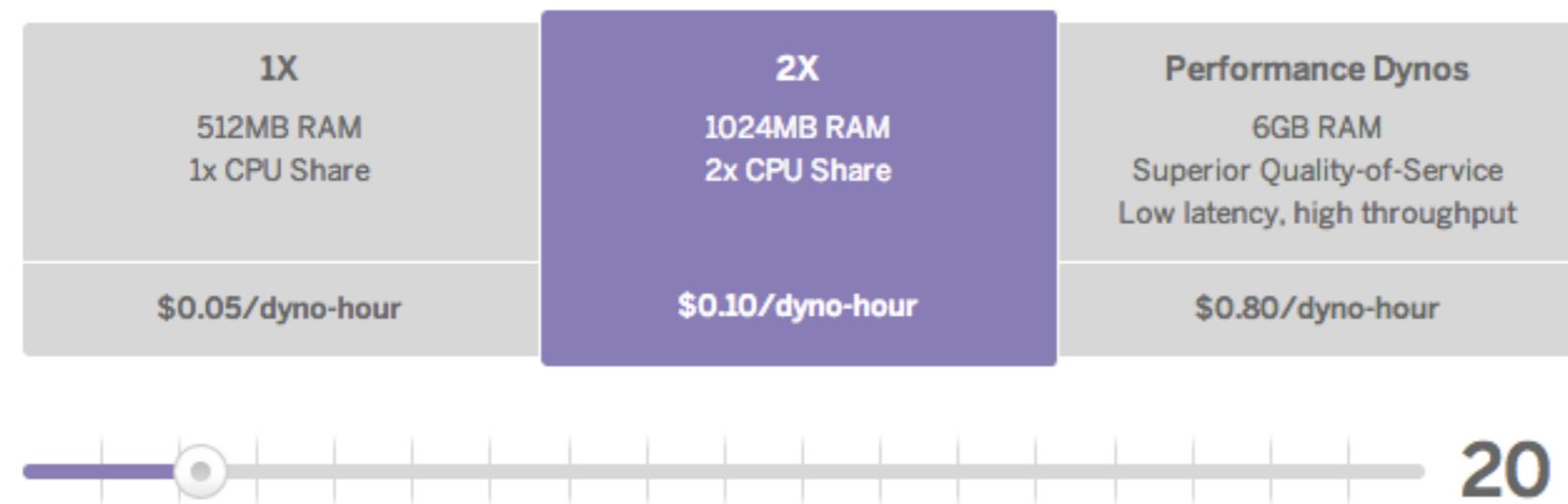
```
$ git push heroku master
```

...

<http://warm-eyrie-9006.herokuapp.com/> deployed to Heroku

```
$ heroku ps:scale web=1
```

## Scale & estimate your dyno cost



## Summary

Dynos	\$682.50
Databases	\$0.00
Support	\$0.00
Add-ons	\$0.00

**\$682.50**  
Estimated monthly cost

[Sign up for free](#)



**IronMQ** from \$0/mo

Highly available elastic message queuing service.

## Plans

Lite	Free
<b>Starter</b>	<b>\$29/mo</b>
Dev	\$129/mo
Pro	\$499/mo

Requests per month

10M

Unlimited Queues



High Availability



Persistent Messages



Push Queues



# IaaS Infrastructure as a Service

low-level resources to deploy arbitrary software stacks  
complete control over its network, storage and OS





Services

Edit

Fabien Hermenier

Ireland

Support

## EC2 Dashboard

Events

Tags

Reports

Limits

### INSTANCES

Instances

Spot Requests

Reserved Instances

### IMAGES

AMIs

Bundle Tasks

### ELASTIC BLOCK STORE

Volumes

Snapshots

### NETWORK & SECURITY

Security Groups

Elastic IPs

Placement Groups

Load Balancers

Key Pairs

Network Interfaces

## Resources

You are using the following Amazon EC2 resources in the EU West (Ireland) region:

2 Running Instances

9 Volumes

1 Key Pair

0 Placement Groups

0 Elastic IPs

6 Snapshots

2 Load Balancers

6 Security Groups

Easily deploy Ruby, PHP, Java, .NET, Python, Node.js & Docker applications with [Elastic Beanstalk](#).

Hide

## Create Instance

To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

[Launch Instance](#)

Note: Your instances will launch in the EU West (Ireland) region

## Service Health

### Service Status:

EU West (Ireland):  
This service is operating normally

### Availability Zone Status:

eu-west-1a:  
Availability zone is operating normally

## Scheduled Events

### EU West (Ireland):

No events

## Account Attributes

[Supported Platforms](#)

Default VPC

vpc-e1b57684

## Additional Information

[Getting Started Guide](#)

[Documentation](#)

[All EC2 Resources](#)

[Forums](#)

[Pricing](#)

[Contact Us](#)

## AWS Marketplace

Find [free software trial products](#) in the AWS Marketplace from the [EC2 Launch Wizard](#).

Or try these popular AMIs:

[Vyatta Virtual Router/Firewall/VPN](#)

Provided by Vyatta, Inc.

Rating ★★★★☆

Pay by the hour for software and AWS usage

[View all Networking](#)

Date: November 2014

 [Download CSV](#) [Print](#)

Summary	Amount
AWS Service Charges	\$0.00
<i>There are no invoices for the selected month.</i>	
<a href="#">+ Expand All</a>	

Details	Total
AWS Service Charges	\$0.00
▶ Data Transfer	\$0.00
▼ Elastic Compute Cloud	\$0.00
EU (Ireland) Region	Usage
Amazon CloudWatch	
\$0.00 per alarm-month - first 10 alarms	0.373 Alarms
\$0.00 per metric-month - first 10 metrics	0.826 Metrics
Total:	\$0.00
Amazon Elastic Compute Cloud running Linux/UNIX	
Region Total:	\$0.00
▶ Simple Notification Service	\$0.00
▶ Simple Queue Service	\$0.00
▶ Simple Storage Service	\$0.00
▶ CT to be collected	\$0.00

“

Assume you could start with super reliable servers (MTBF of 30 years)  
Build computing system with 10 thousand of those  
Watch one fail per day

Things will crash. Deal with it!

”

Dean Keynote, LADIS 2009

# Typical first year for a new google cluster

- ~0.5 overheating (power down most machines in <5 mins, ~1-2 days to recover)
- ~1 PDU failure (~500-1000 machines suddenly disappear, ~6 hours to come back)
- ~1 rack-move (plenty of warning, ~500-1000 machines powered down, ~6 hours)
- ~1 network rewiring (rolling ~5% of machines down over 2-day span)
- ~20 rack failures (40-80 machines instantly disappear, 1-6 hours to get back)
- ~5 racks go wonky (40-80 machines see 50% packetloss)
- ~8 network maintenances (4 might cause ~30-minute random connectivity losses)
- ~12 router reloads (takes out DNS and external vips for a couple minutes)
- ~3 router failures (have to immediately pull traffic for an hour)
- ~dozens of minor 30-second blips for dns
- ~1000 individual machine failures
- ~thousands of hard drive failures  
slow disks, bad memory, misconfigured machines, flaky machines, etc.
- Long distance links: wild dogs, sharks, dead horses, drunken hunters, etc.

“ A **distributed system** is one in which the failure of a computer you didn't even know existed can render your own computer unusable ”

Leslie Lamport

# Building fault tolerant services

at every level

be pessimistic

deal with failures  
deal with inconsistency

# 0l' school IT

— you manage —

applications

runtimes

integration/security

database

servers

virtualisation

server HW

storage

network

# SaaS



# PaaS

you manage [

applications

runtimes

integration/security

database

servers

virtualisation

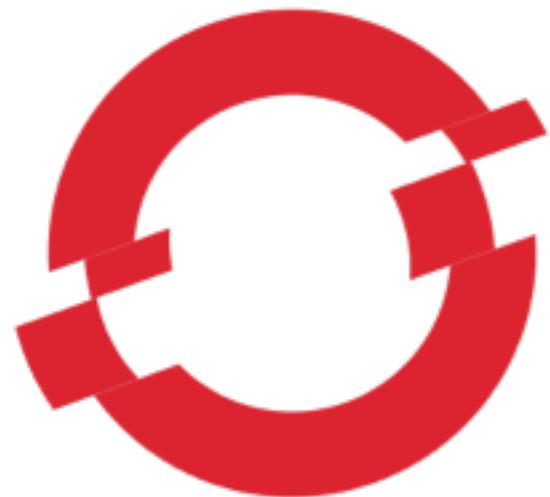
server HW

storage

network

|  
managed by vendor

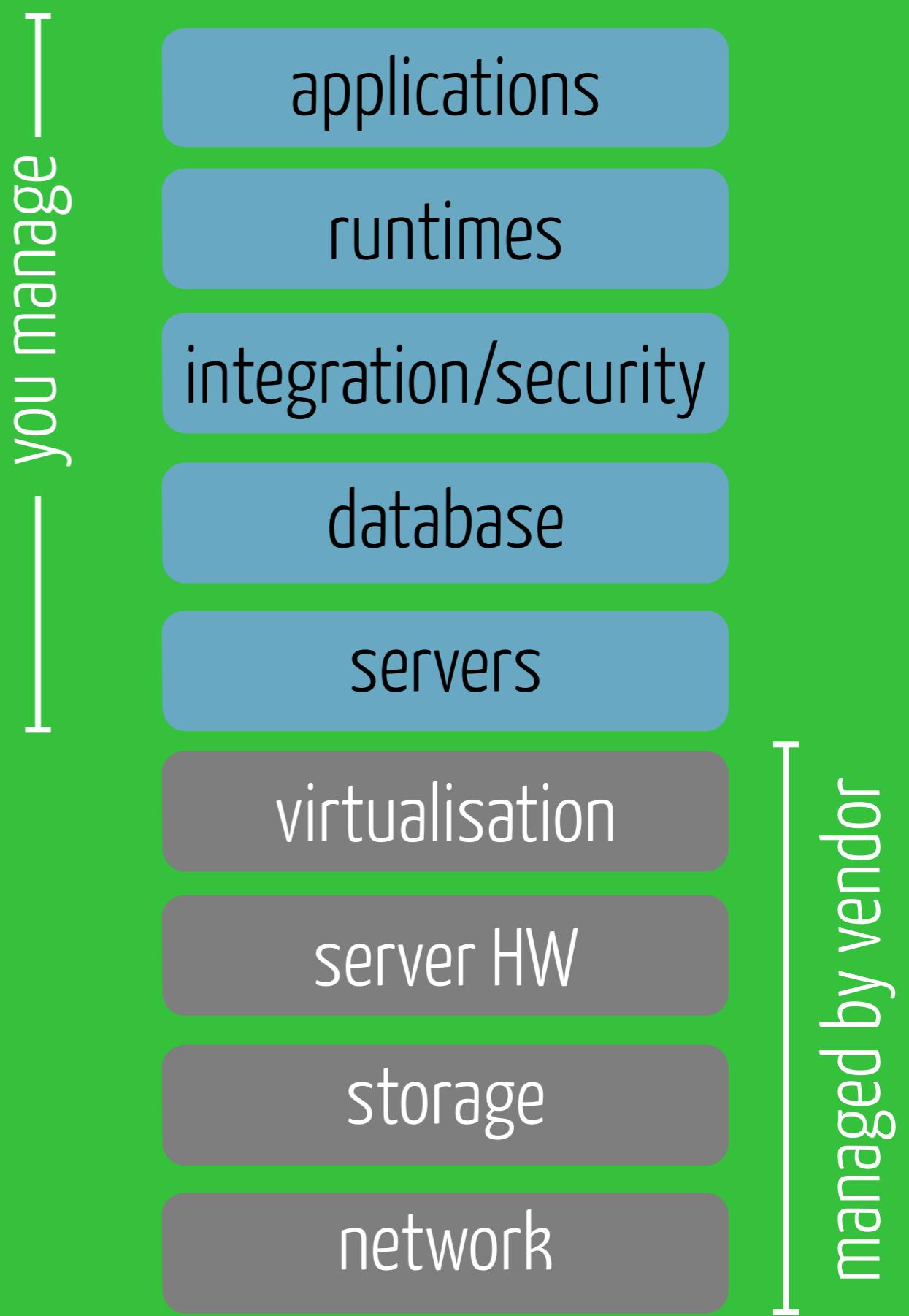
# Open-source PaaS stacks



**OPENSHIFT**



# IaaS



# Open-source IaaS stacks

 EUCALYPTUS

(2008+)



openstack™ (2010+)



cloudstack (2012+)



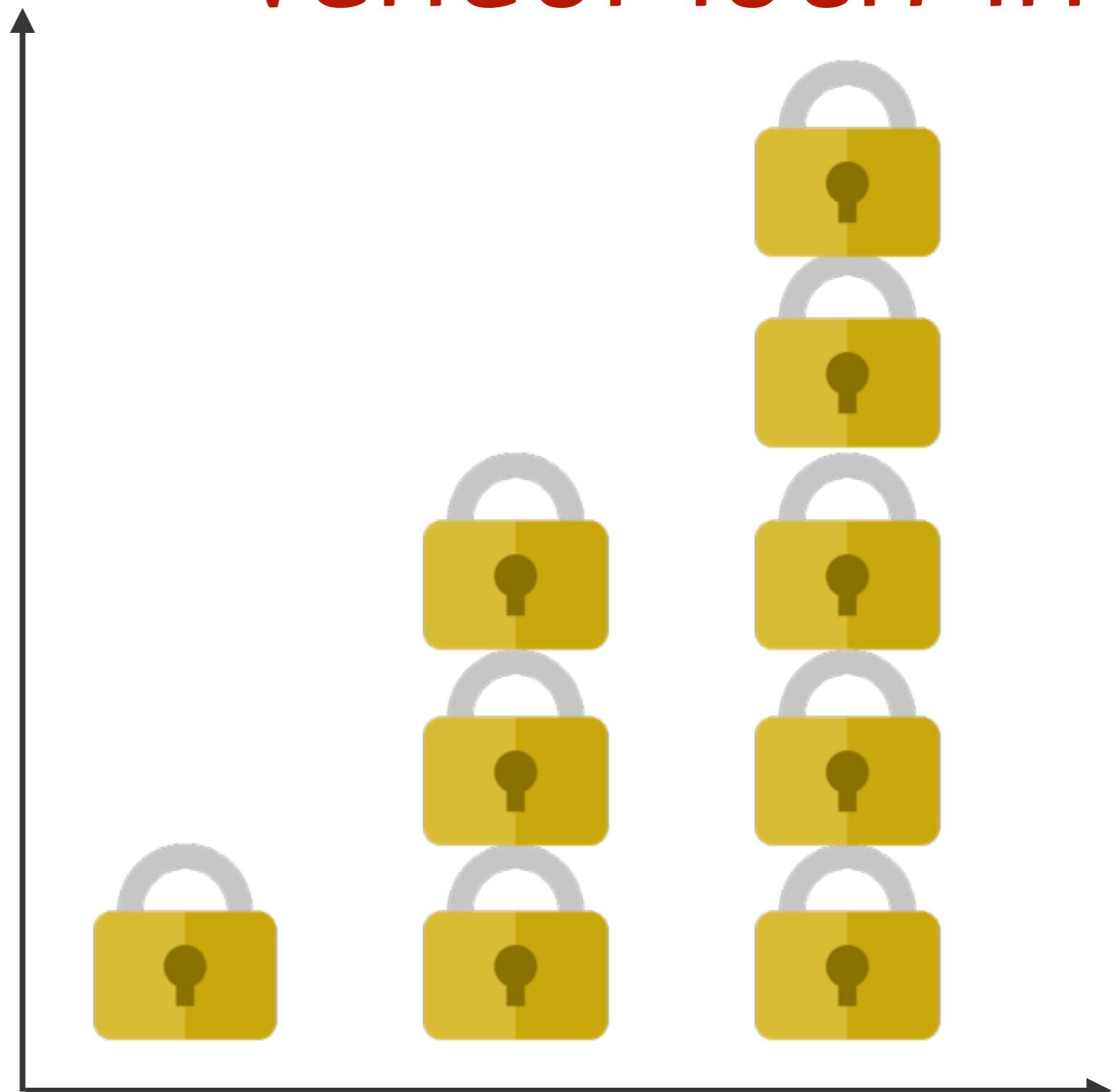
 **amazon  
DynamoDB**



Cloud Storage



Cloud Datastore



IaaS  
73

PaaS

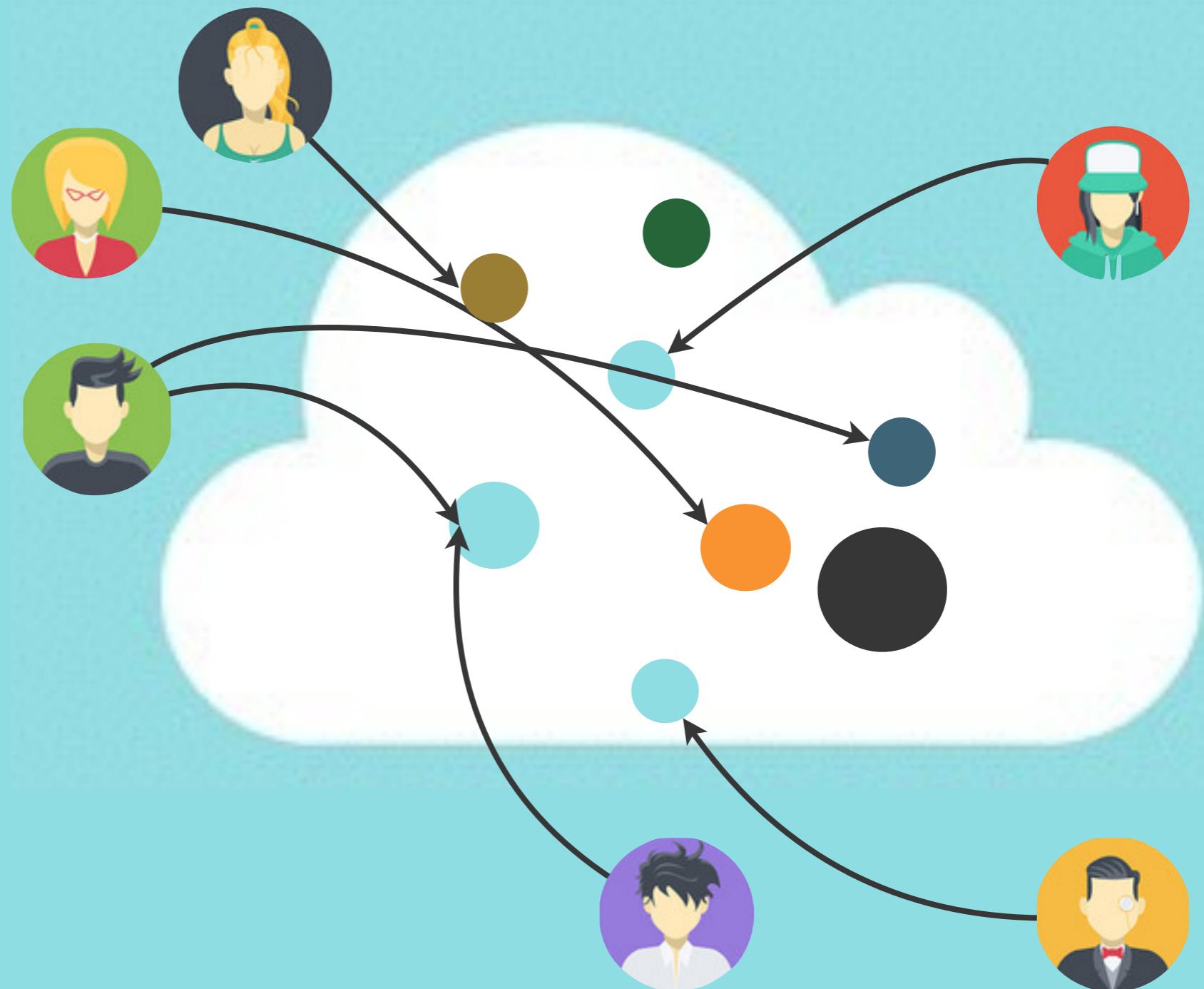
SaaS

vendor lock-in

# Deployment models

# public cloud

general availability to everyone



the “real” cloud  
reduced costs  
trust issues?

cloud computing  
vs.  
fog of war





give me your code & data

Trust in me

I'm aware



read my mails

what is my



is hacked ?



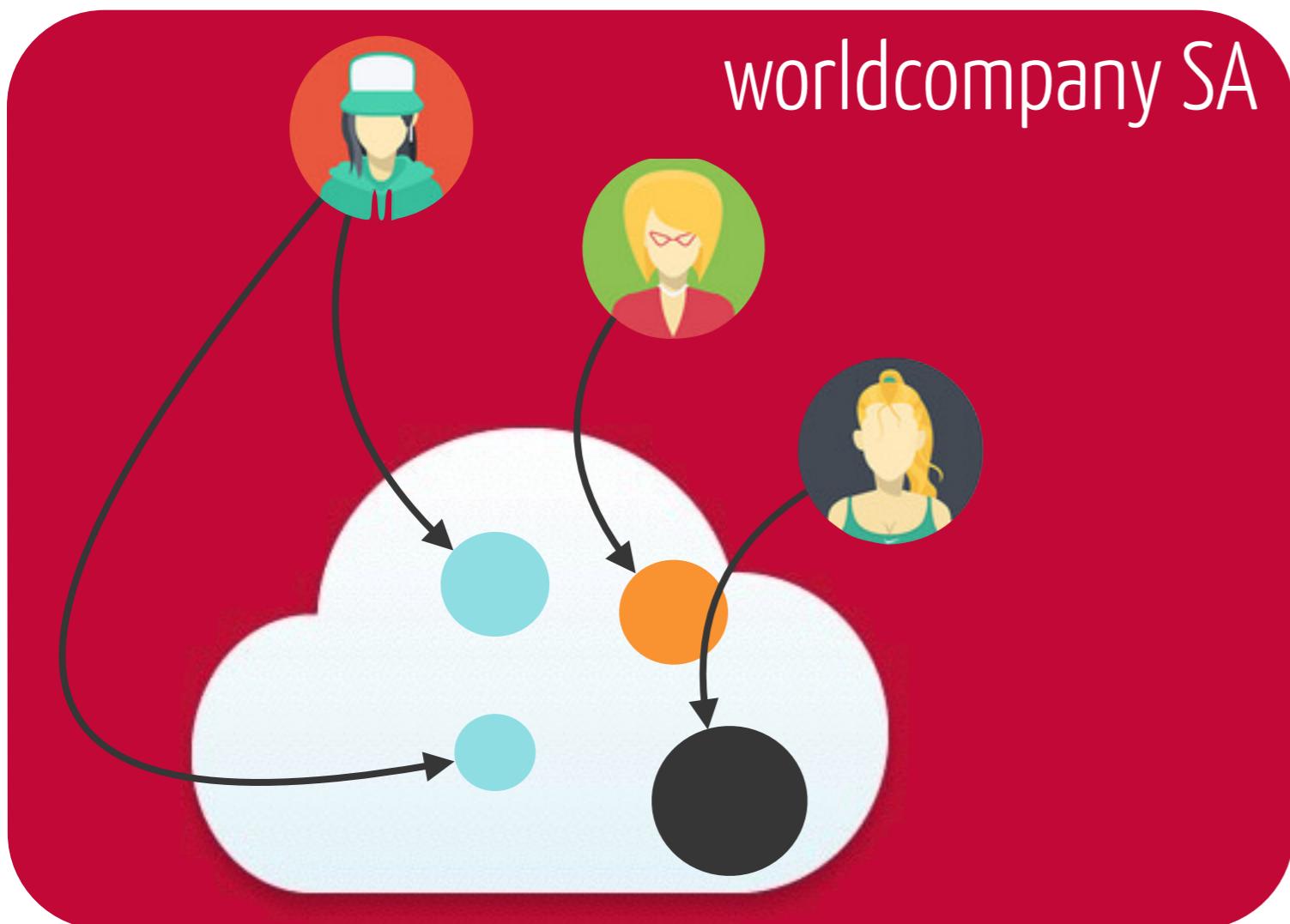
# private cloud

self hosted cloud

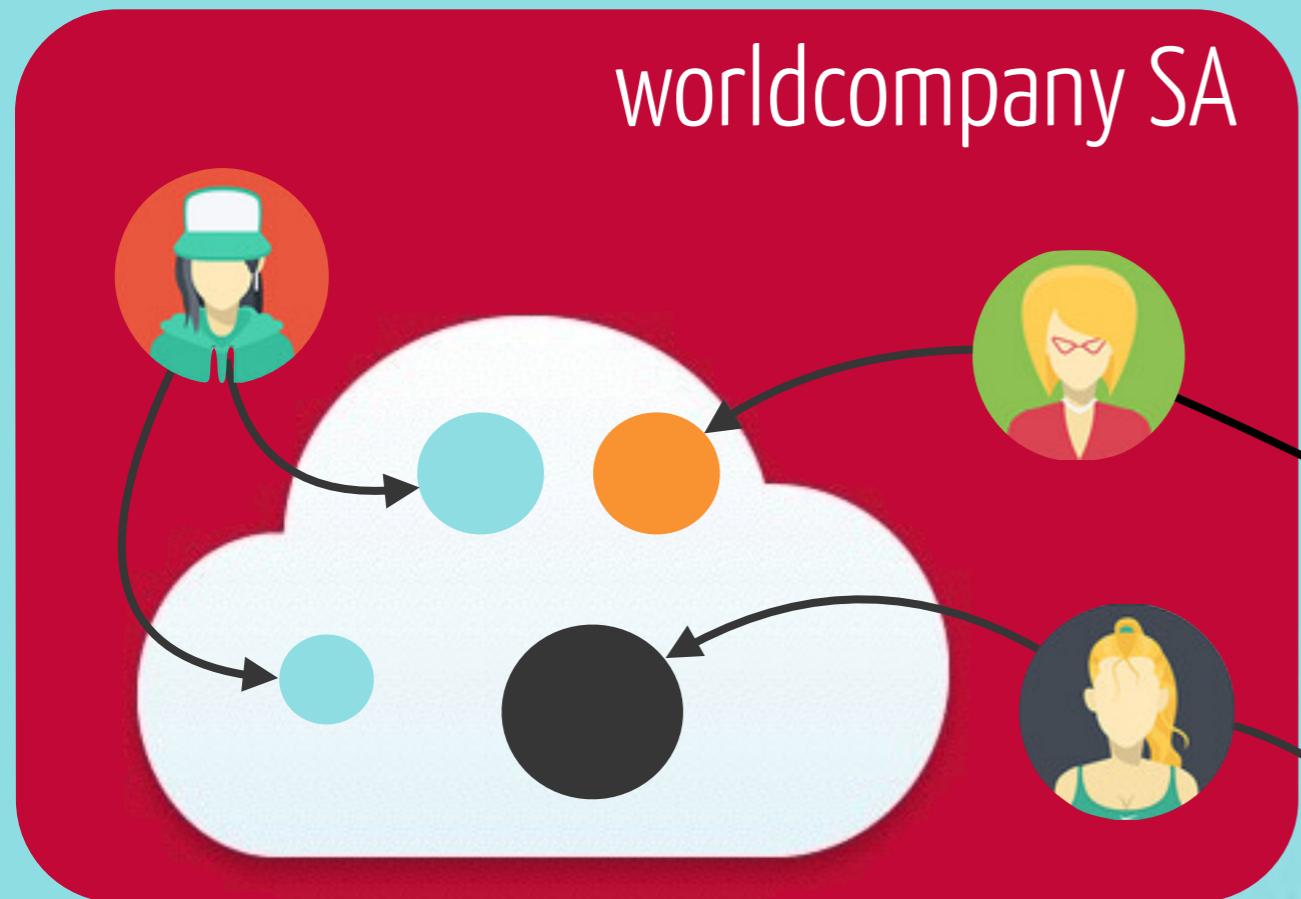
might reduce TCO

stronger trust

better manageability



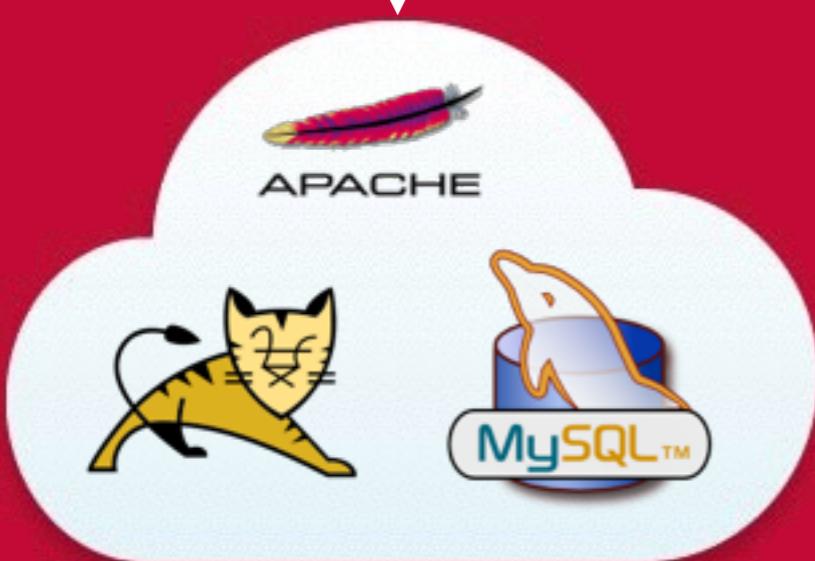
# hybrid cloud



LB

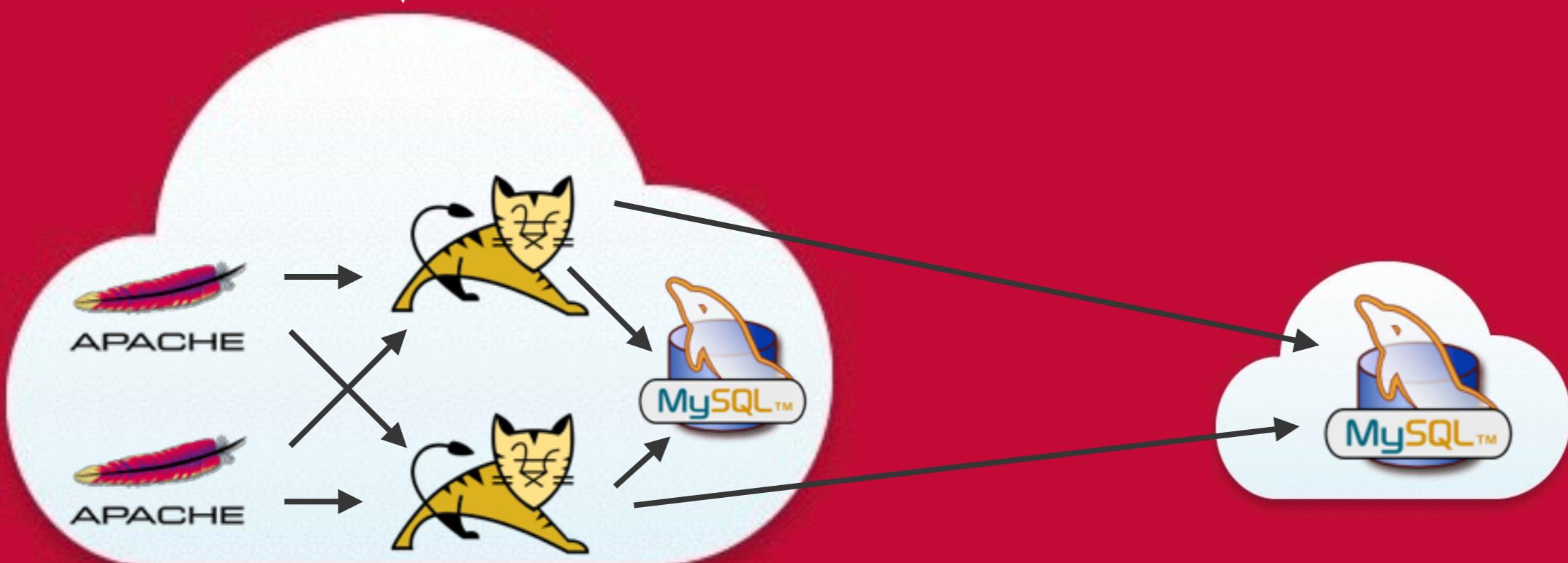
# multi-clouds

**you** spread your application  
avoid Single Point of Failures\*  
take the benefits of each cloud



# inter-clouds

they outsource your components  
agreements between the providers  
“cloud of clouds”

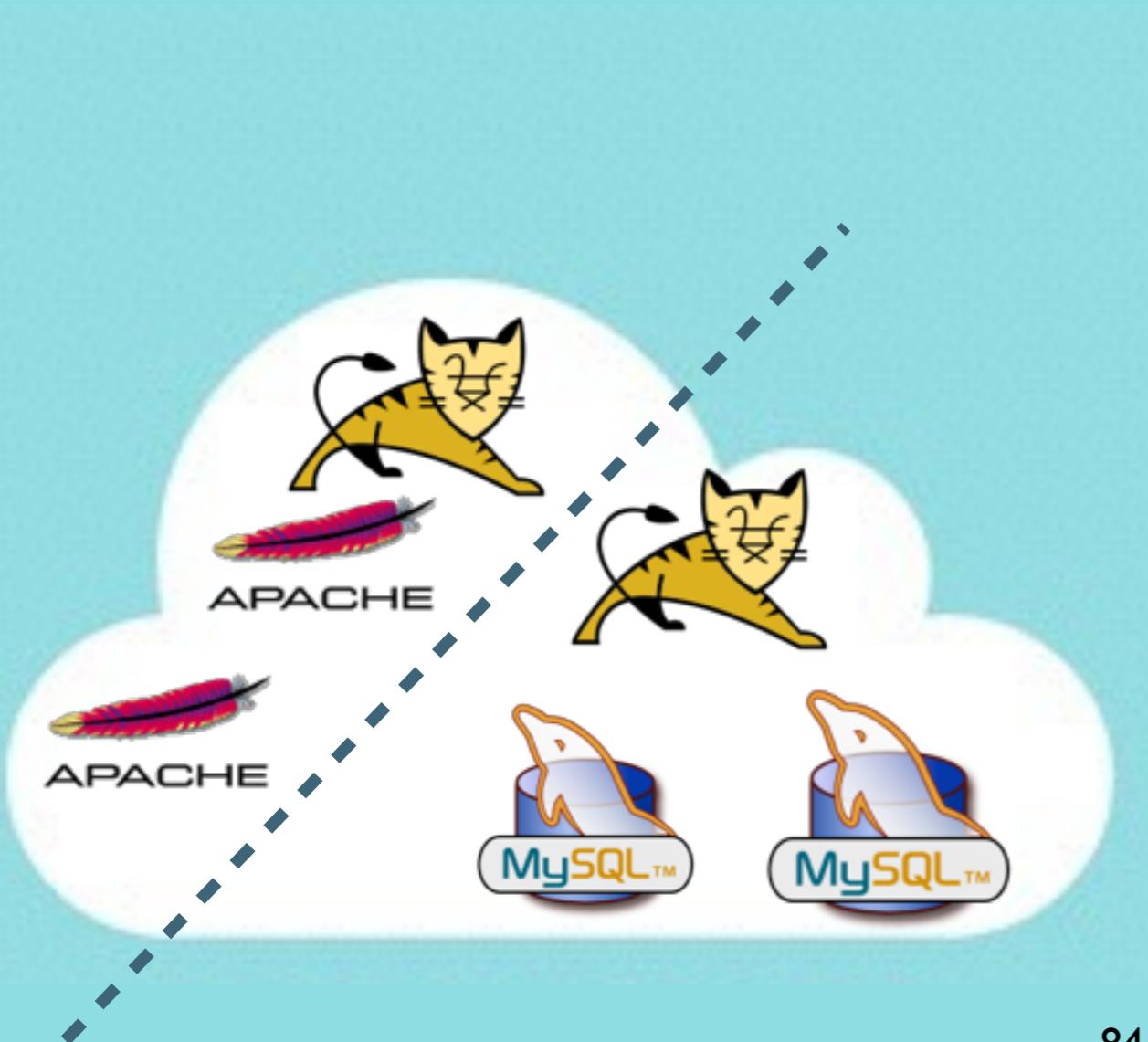


# distributed clouds

back to volunteer computing  
(Boinc, cloud@home, ...)

# community cloud

private cloud by and for  
multiple organizations



# RECAP

CLOUD IS ABOUT  
REDUCING COSTS

CLOUD IS ABOUT  
SCALABILITY

CLOUD IS ABOUT  
RESILIENCY

CLOUD IS ABOUT  
TRUST