



Cloud computing 101

was cloud computing
needed



Mainframes

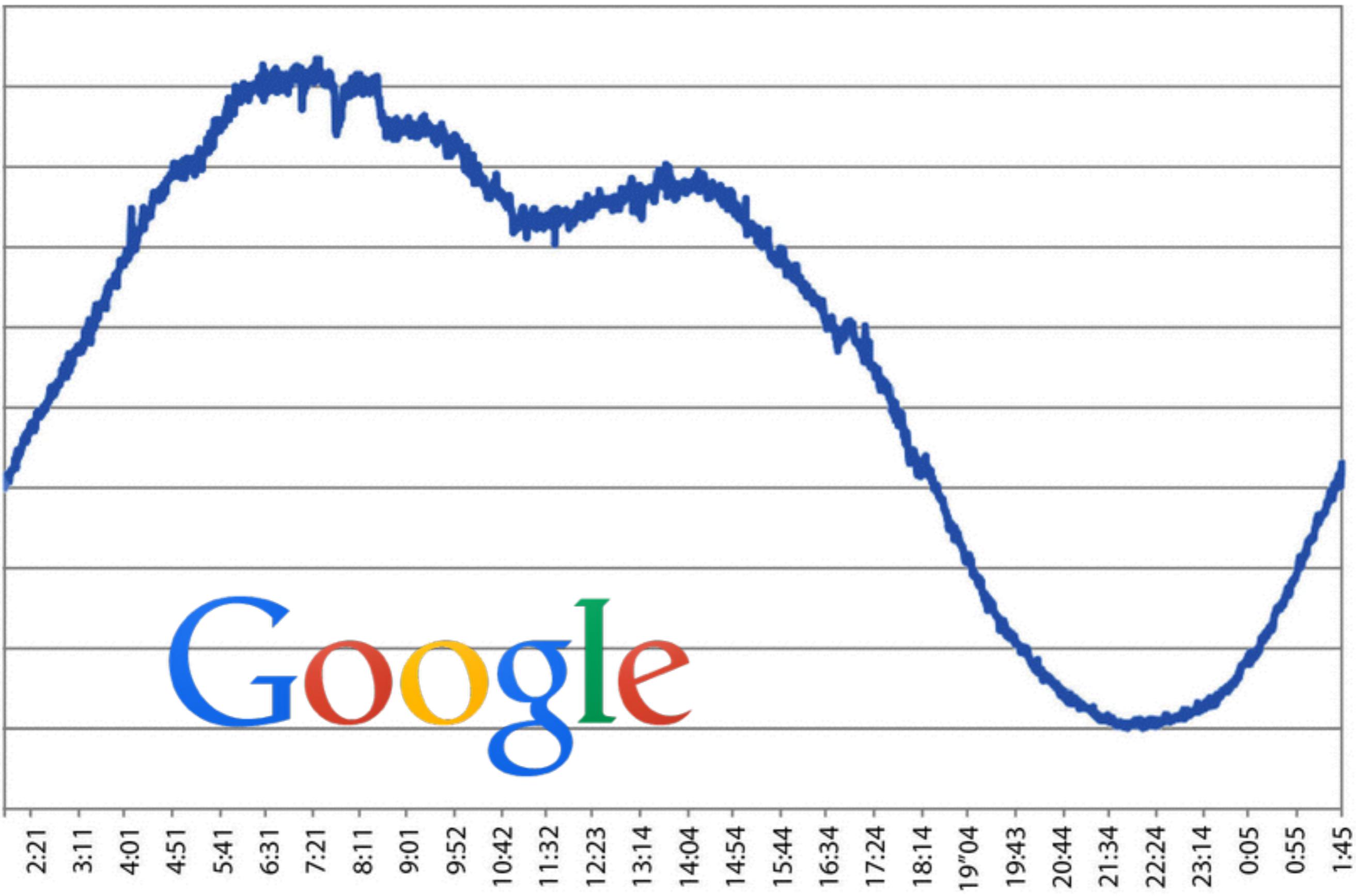


Then IBM came with affordable PCs



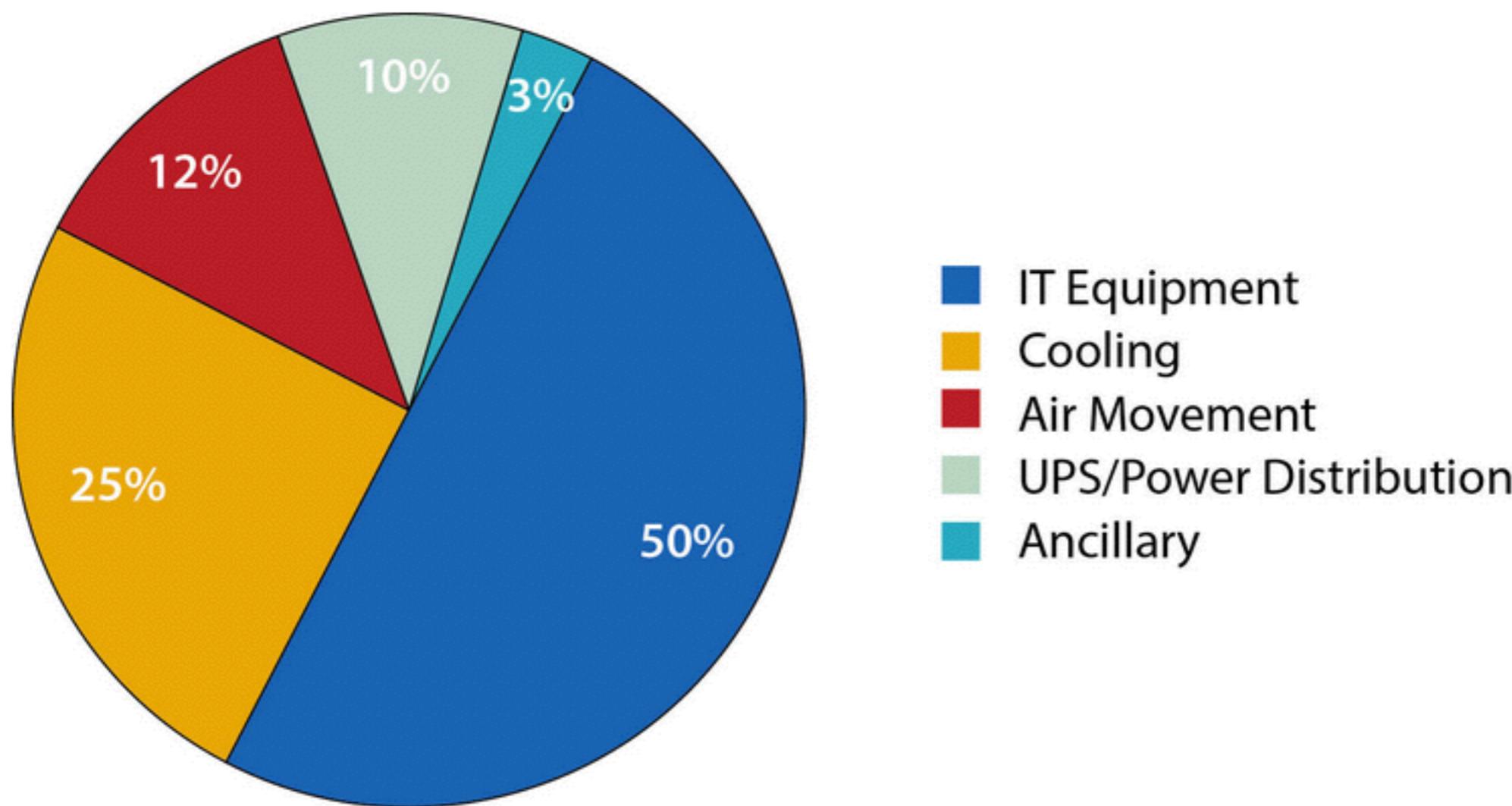
Then we spread out the load for security,
performance, manageability

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

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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 Ltd. \\$0.00/hr for software](#)

Popular Products



2

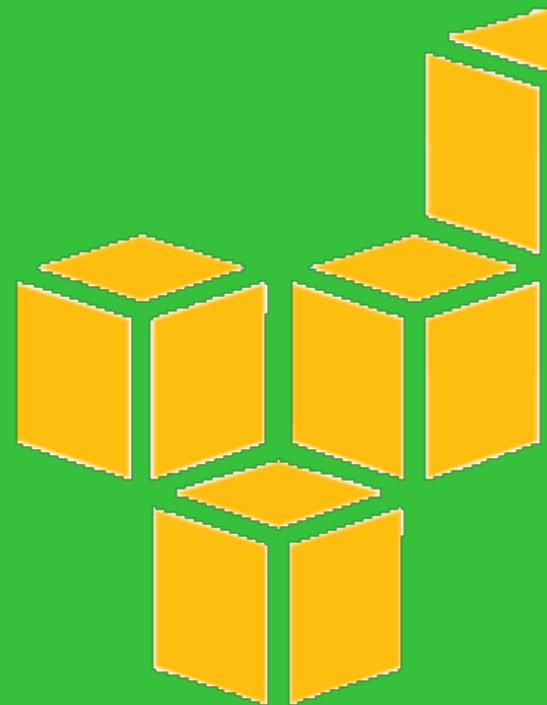
broad network access

availability over the network
standard mechanisms

3

resource pooling

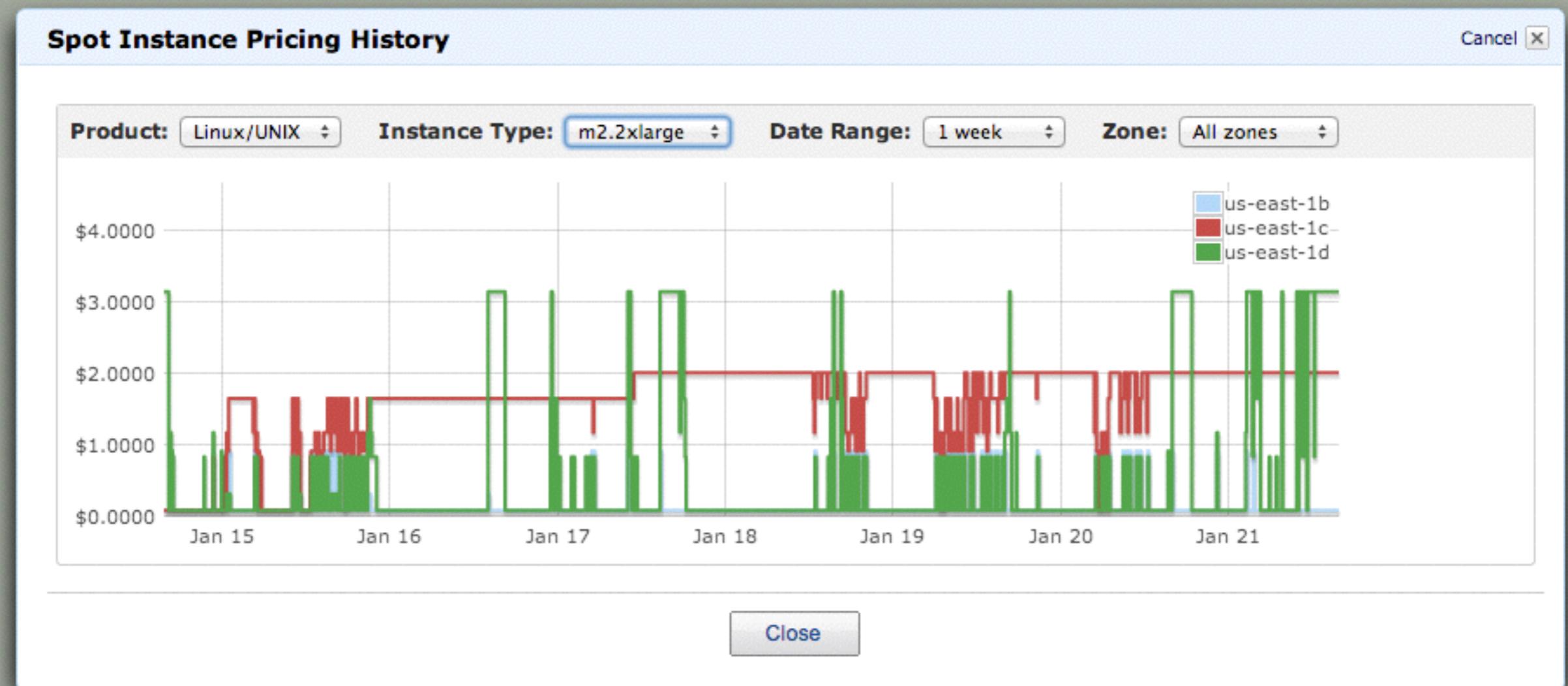
multi-tenant
virtual or physical resources
on-demand allocation
location independance



amazon
web services™

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

Amazon EC2 HotSpot instances



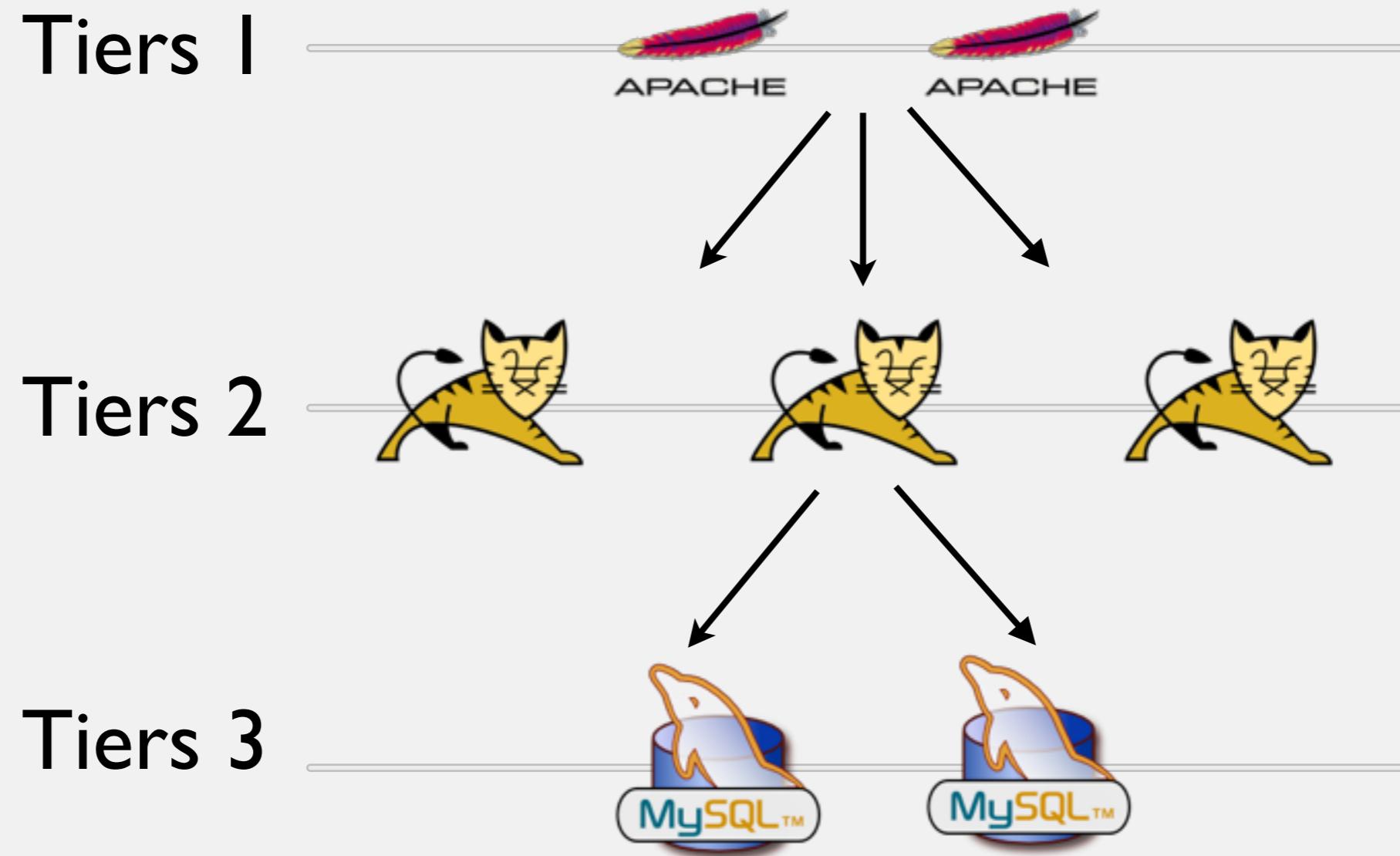
bid over the market price to get the instance

rapid elasticity

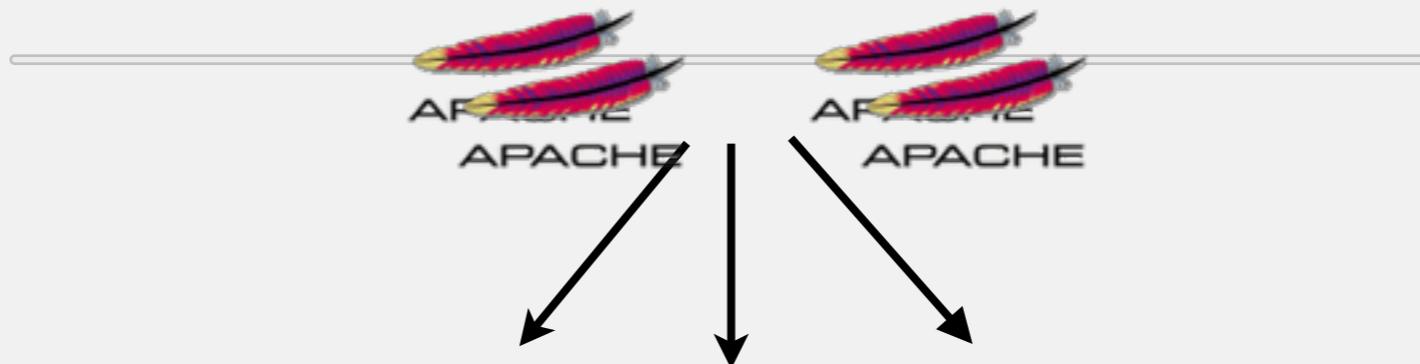
fast (de-)allocation of resources
scale to infinity



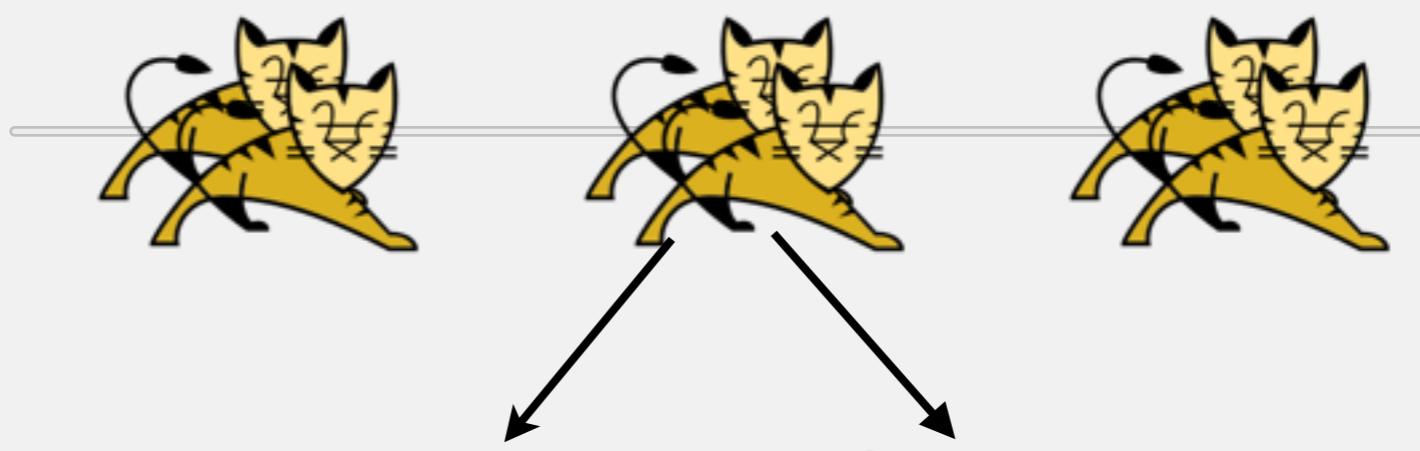
vertical elasticity



Tiers 1



Tiers 2



Tiers 3



horizontal elasticity

5

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

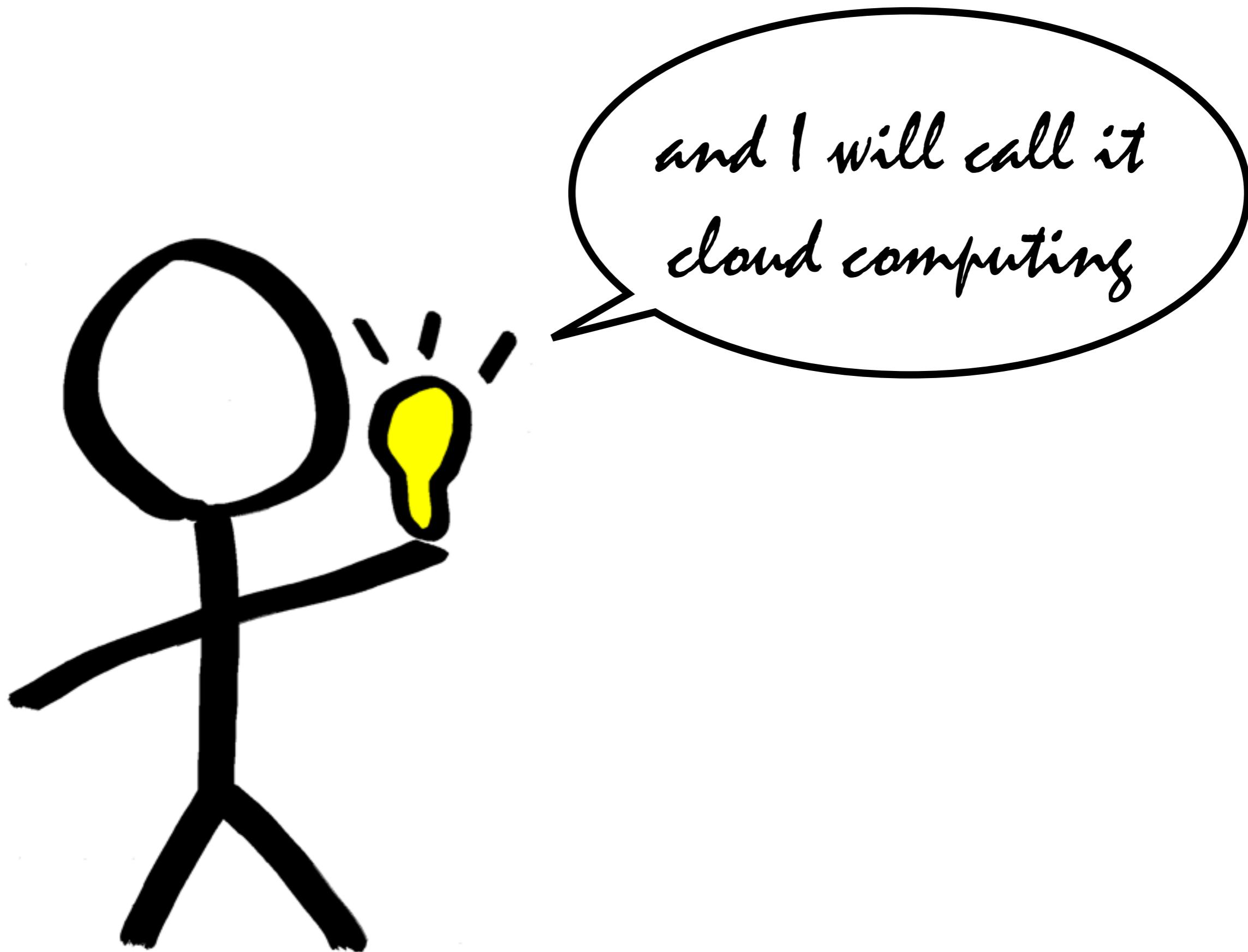
6 Cores

16 GB RAM

24 GB RAM

Launch Now !

More Info ▾



Cloud Computing

origins



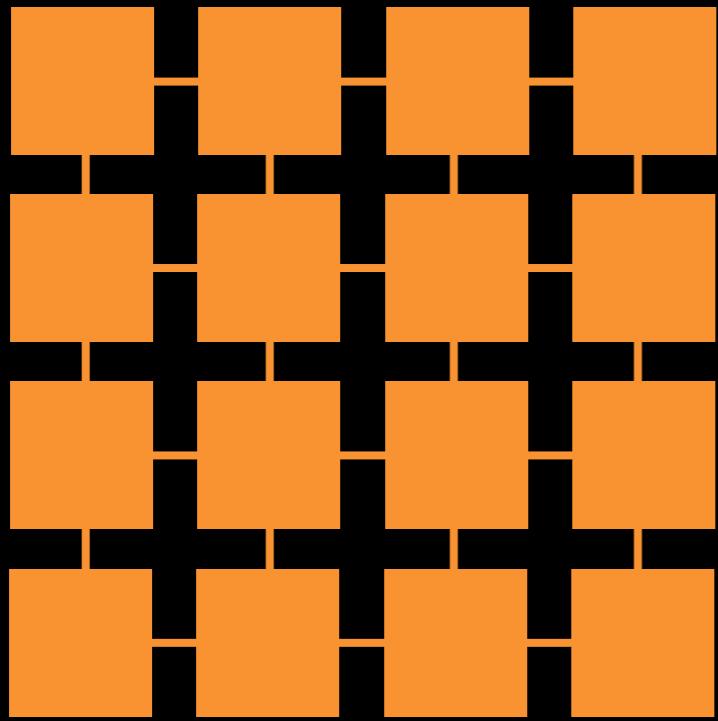
“

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



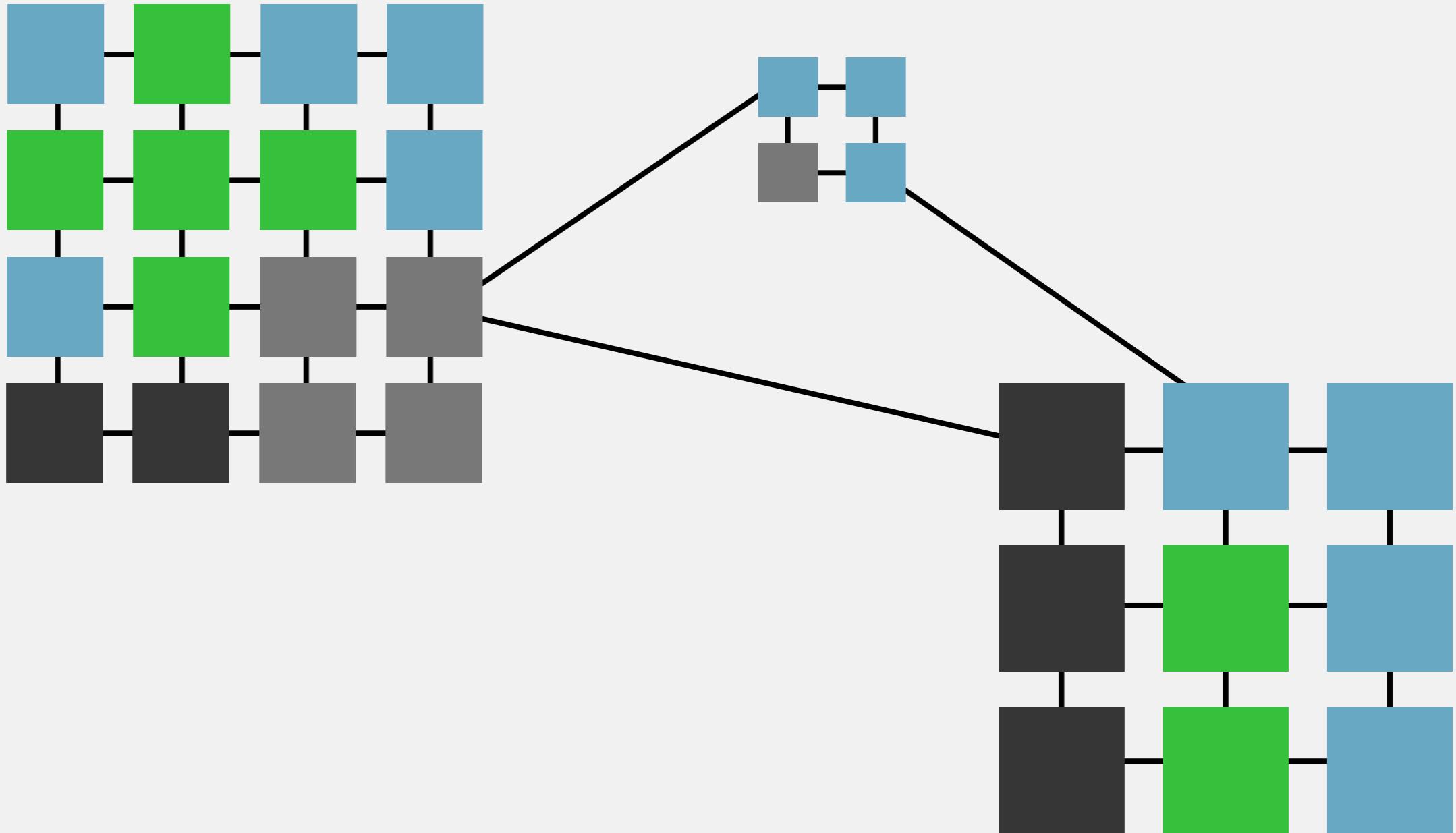
cluster computing

80s

loosely coupled co-located servers
single tenant
non-interactive workload
rigid jobs

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

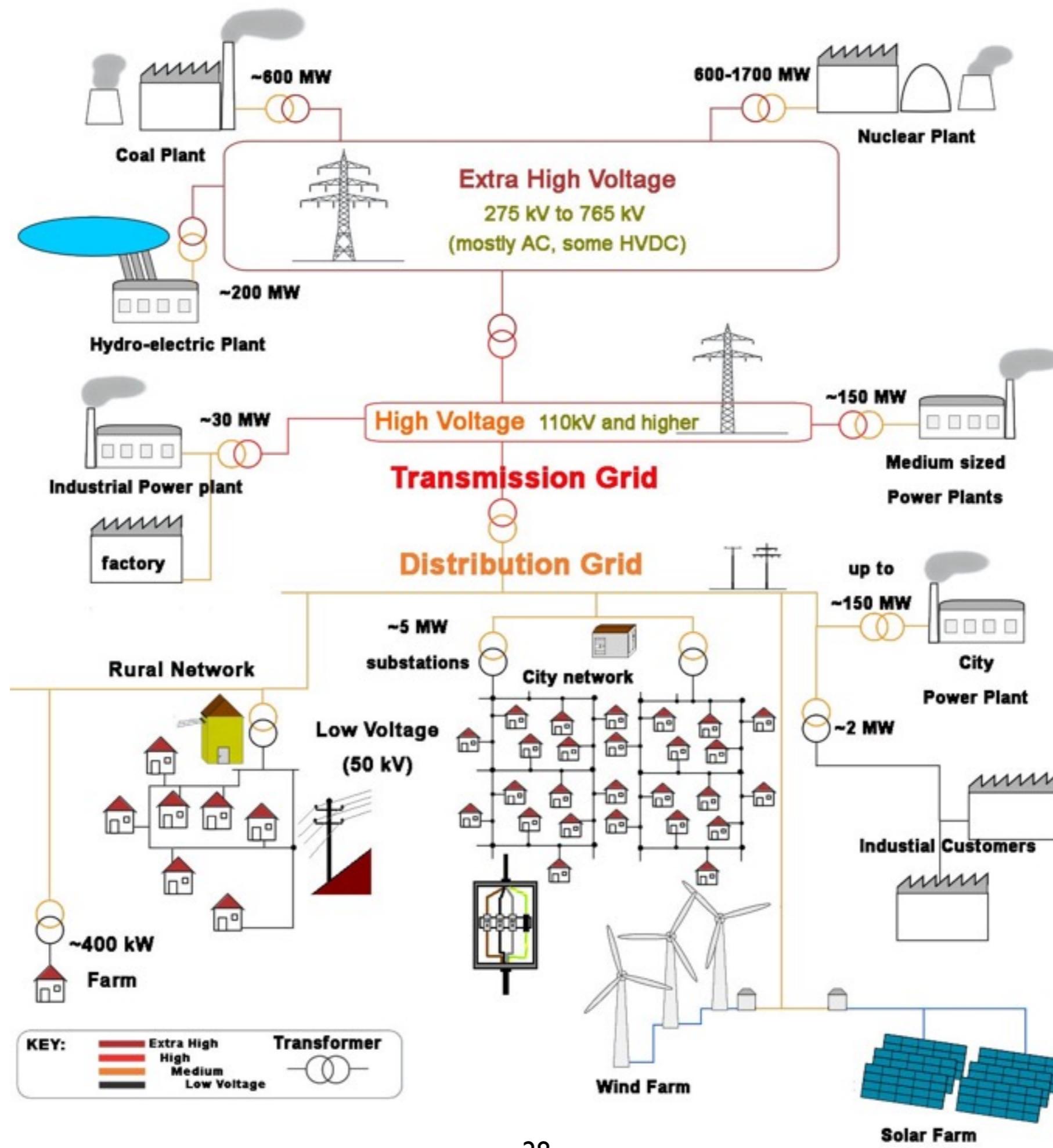
- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service



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

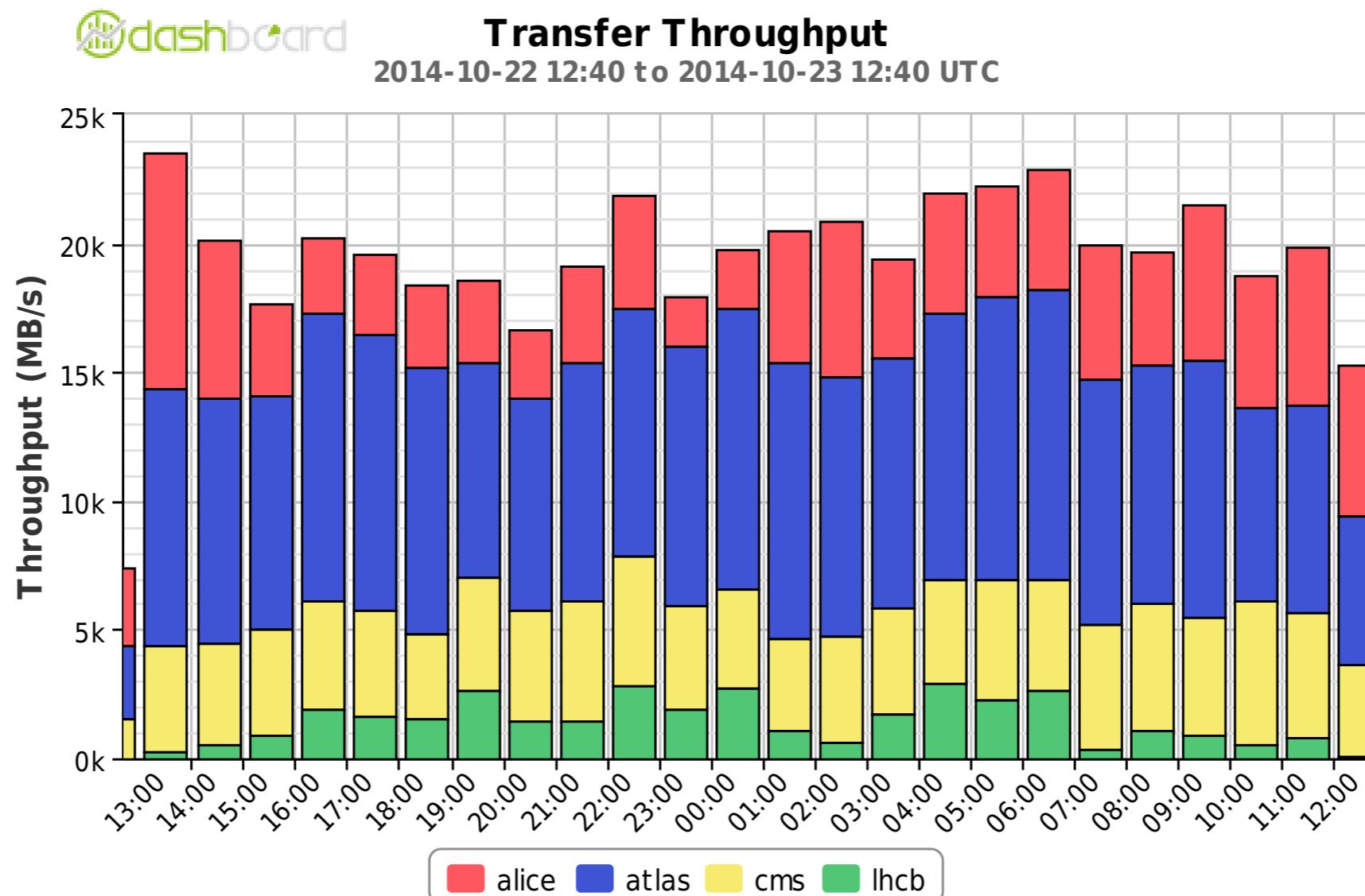
Computing grid

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

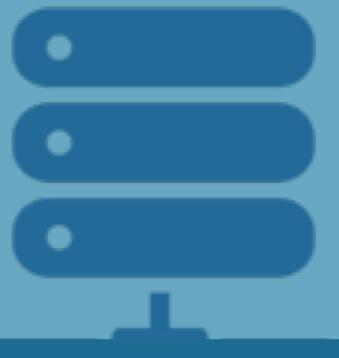
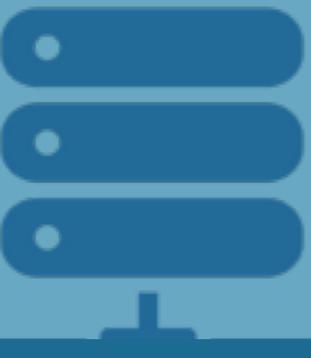
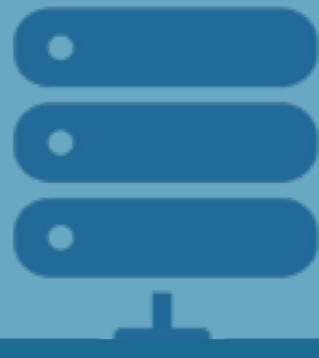
- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

Client Client Client

1

2

3



Application Service Provider

95+

remote access to
dedicated applications

service oriented
pay as you go

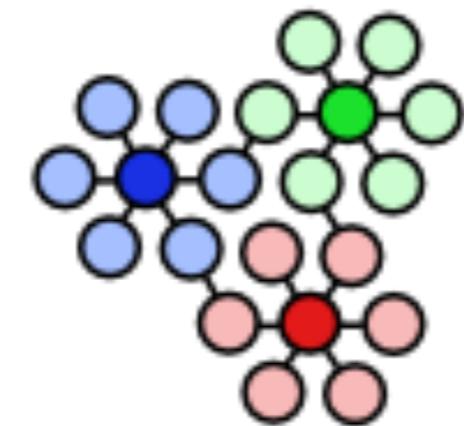
- on demand self-services
- broad network access
- resource pooling
- rapid elasticity
- measured service

- on demand self-services
- broad network access
- resource pooling (not real hw resources)
- rapid elasticity
- measured service

2002

computers on demand.

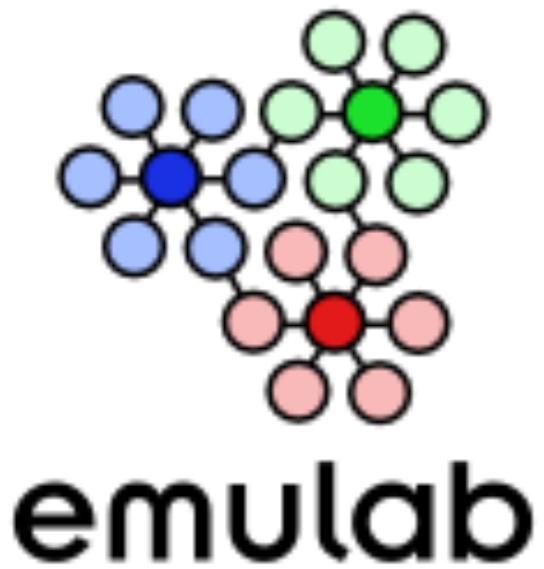
Deploy full custom stacks (OS to applications)



emulab

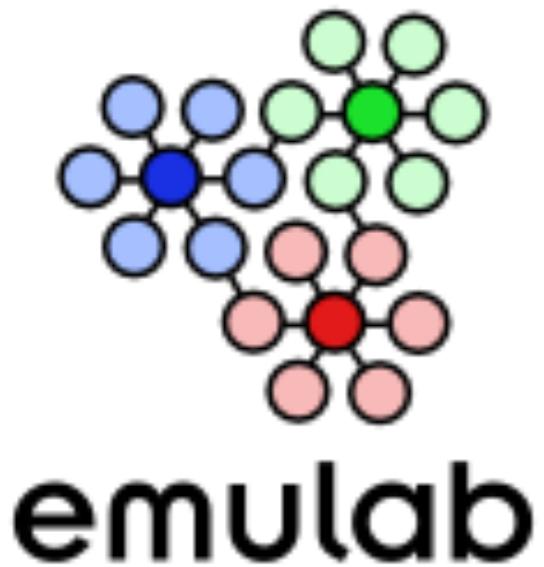


PLANETLAB

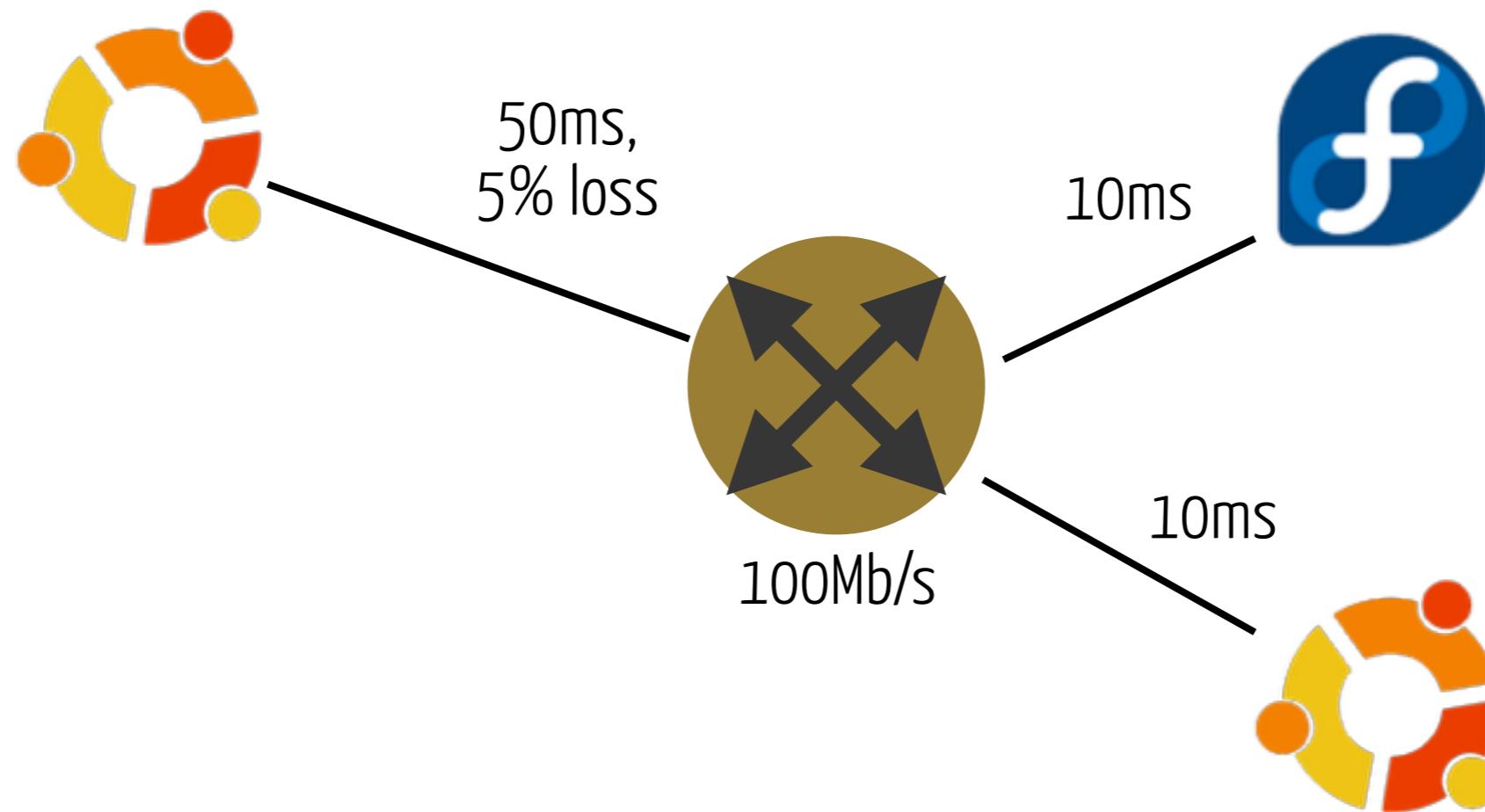


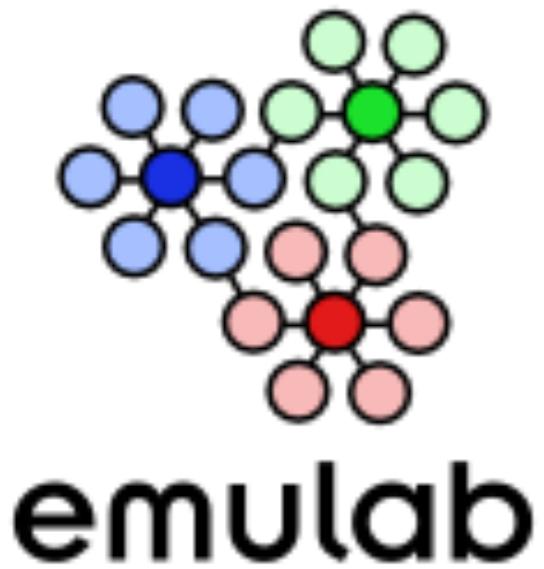
to (re)deploy reproducible
network experiments

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

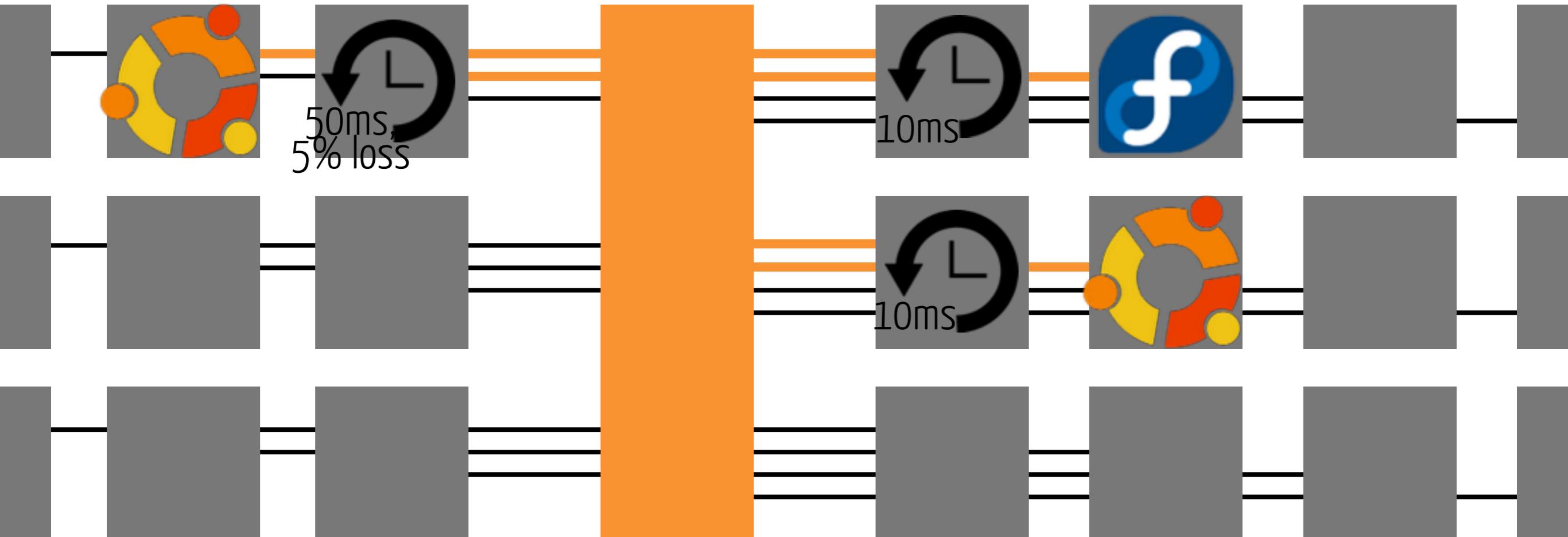


to (re)deploy reproducible network experiments





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



- 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 ?

? as

SaaS

Service

as a Service

web access to commercial sw.
“one to many” model
customers don’t handle upgrades
API for integration



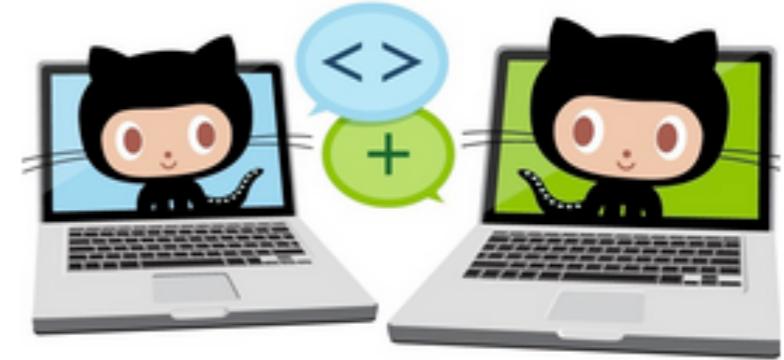
Users.messages

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

Method	HTTP request	Description
URIs relative to https://www.googleapis.com/gmail/v1/users , 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.



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Personal plans

[Display estimated prices in EUR](#)

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

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

Do you offer education discounts?

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PaaS 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

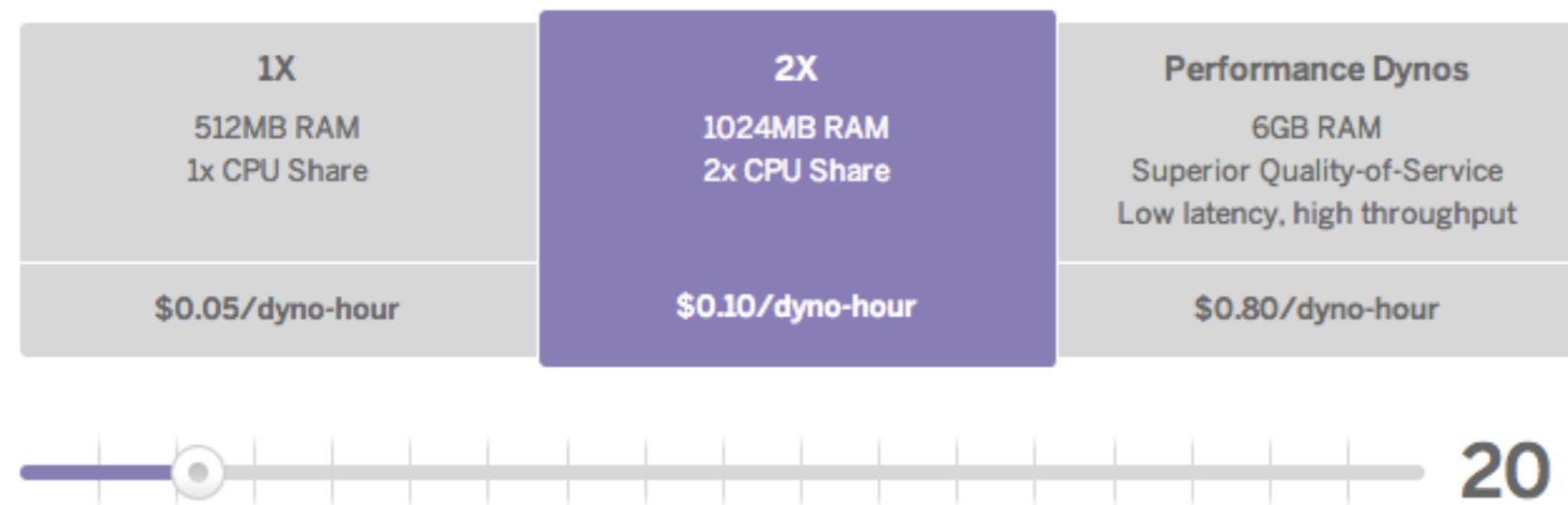
```
$ git push heroku master
```

...

<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
Starter	\$29/mo
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>	
	+ Expand All

Details	Total
AWS Service Charges	\$0.00
▶ Data Transfer	\$0.00
▼ Elastic Compute Cloud	\$0.00
EU (Ireland) Region	
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

old school IT

you manage

applications

runtimes

integration/security

database

servers

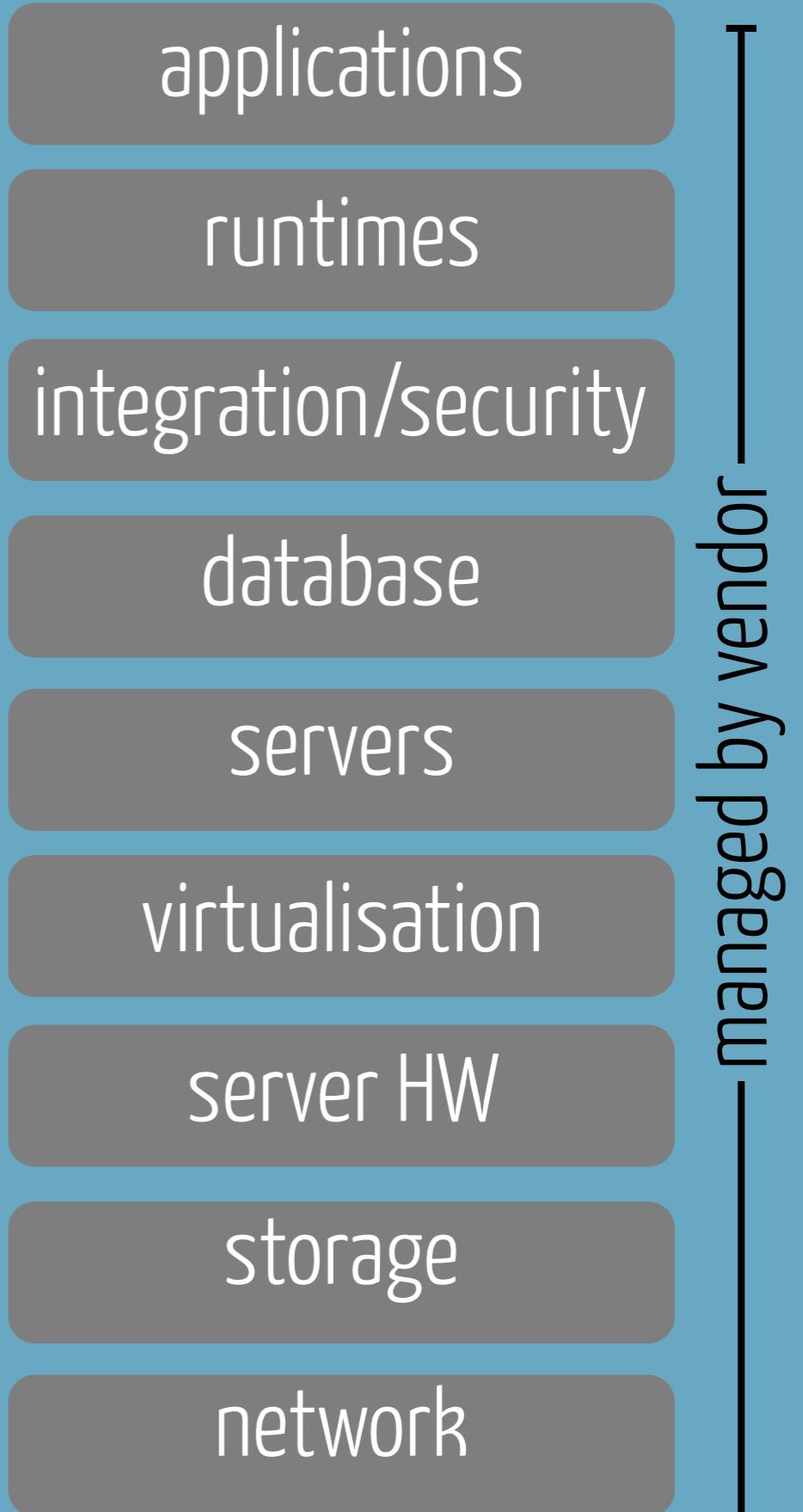
virtualisation

server HW

storage

network

SaaS



PaaS

you manage [

applications

runtimes

integration/security

database

servers

virtualisation

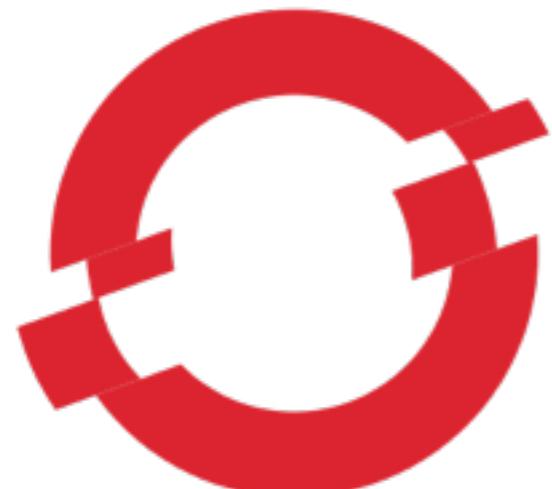
server HW

storage

network

|
managed by vendor

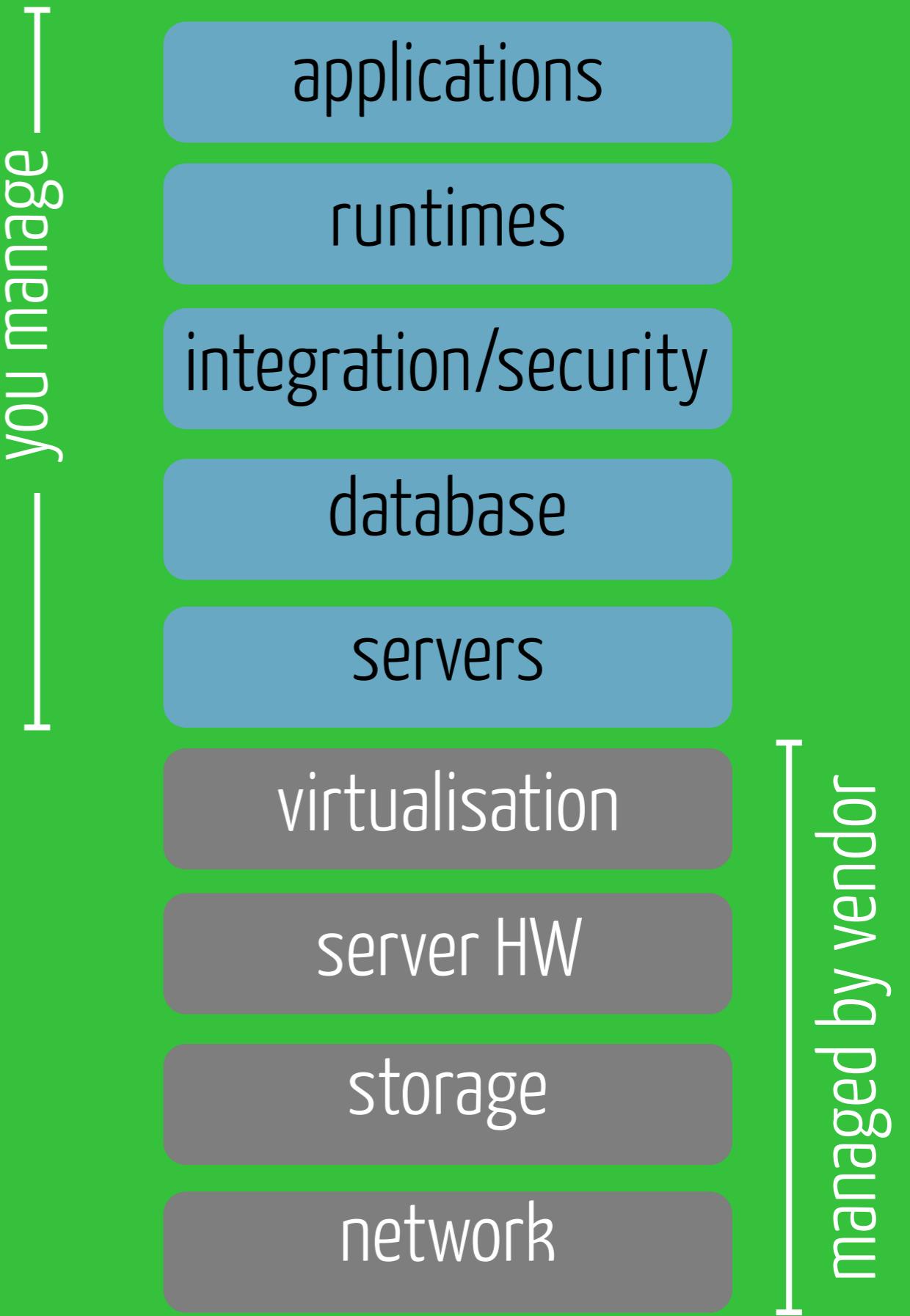
Open-source PaaS stacks



OPENSHIFT



IaaS



Open-source IaaS stacks

 EUCALYPTUS
(2008+)

 OpenNebula (2008+)

 openstack™ (2010+)



cloudstack (2012+)

vendor lock-in



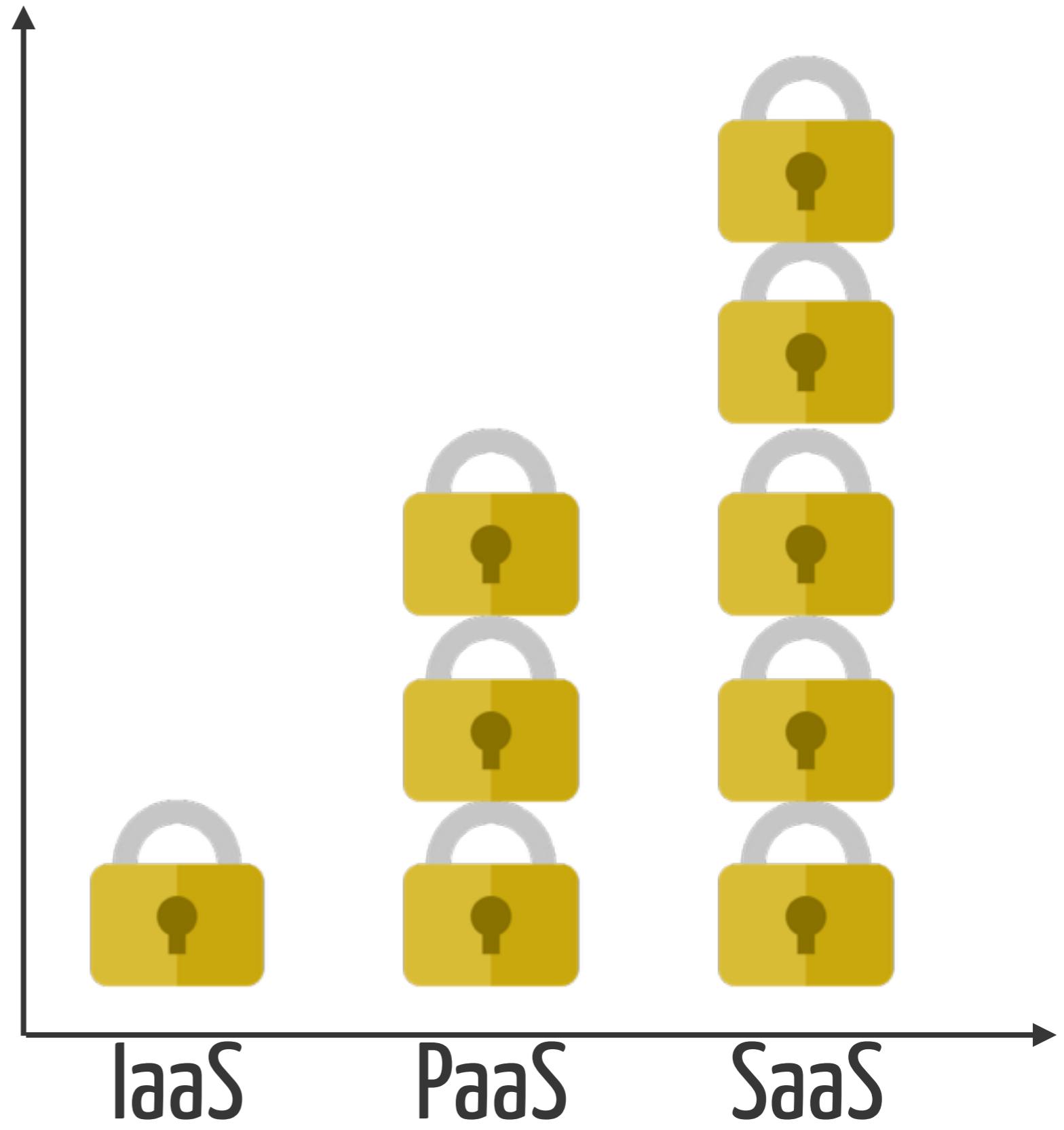
 **amazon
DynamoDB**



Cloud Storage



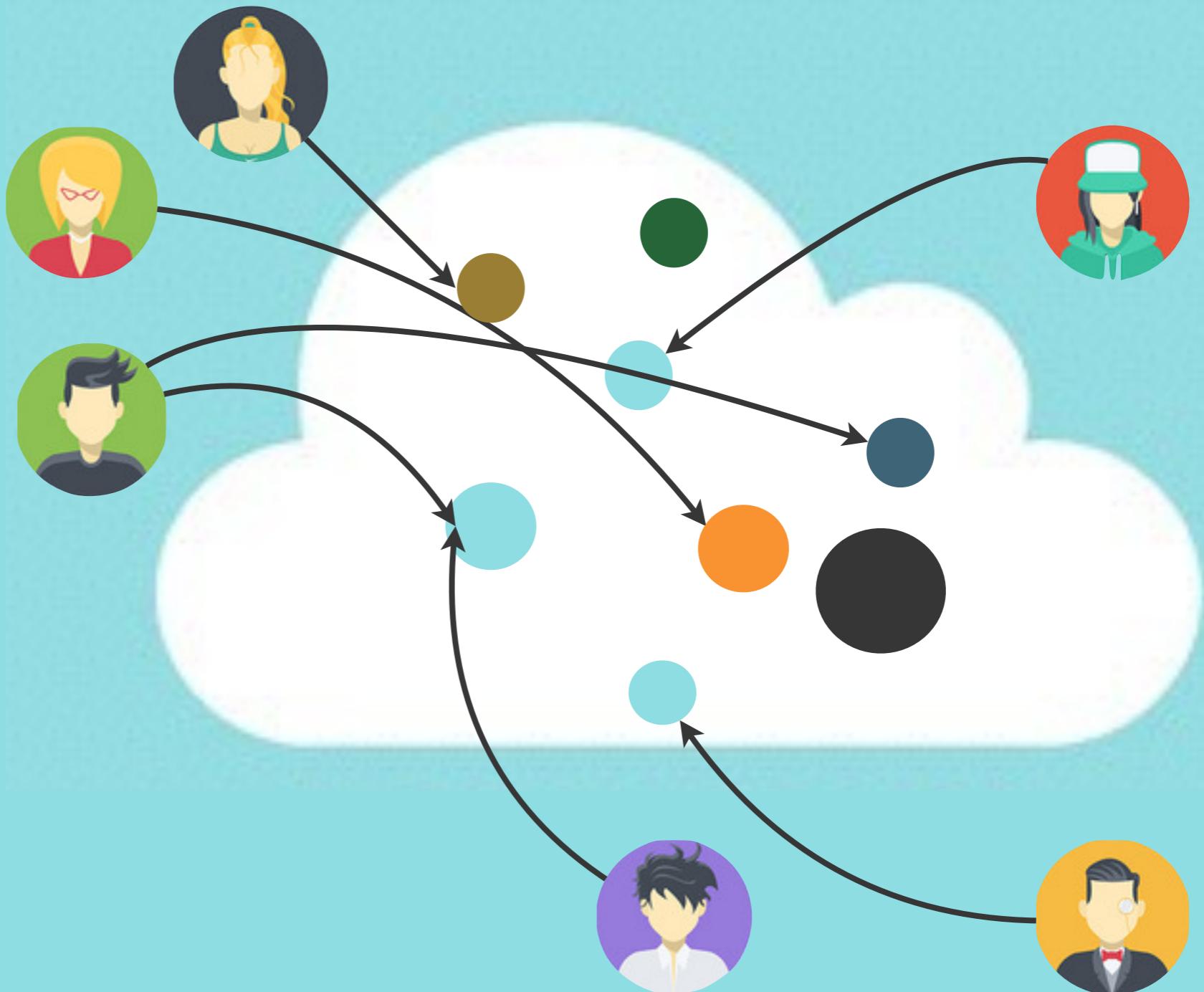
Cloud Datastore



Deployment models

public cloud

general availability to everyone



the “real” cloud
reduced costs
trust issues ?

cloud computing
vs.
fog of war





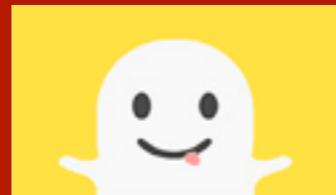
give me your code & data

Trust in me

I'm aware read my mails

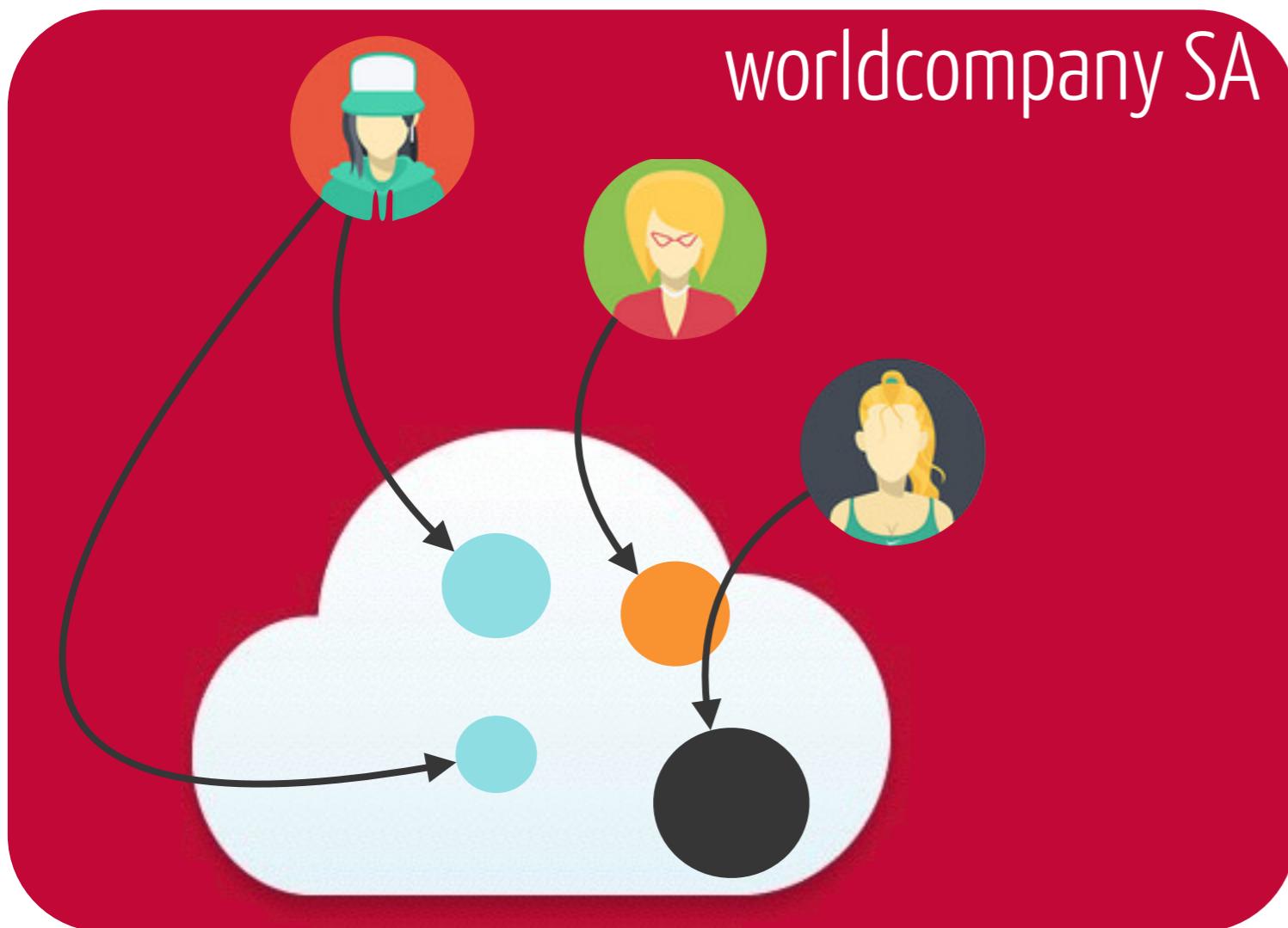


what is my is hacked ?



private cloud

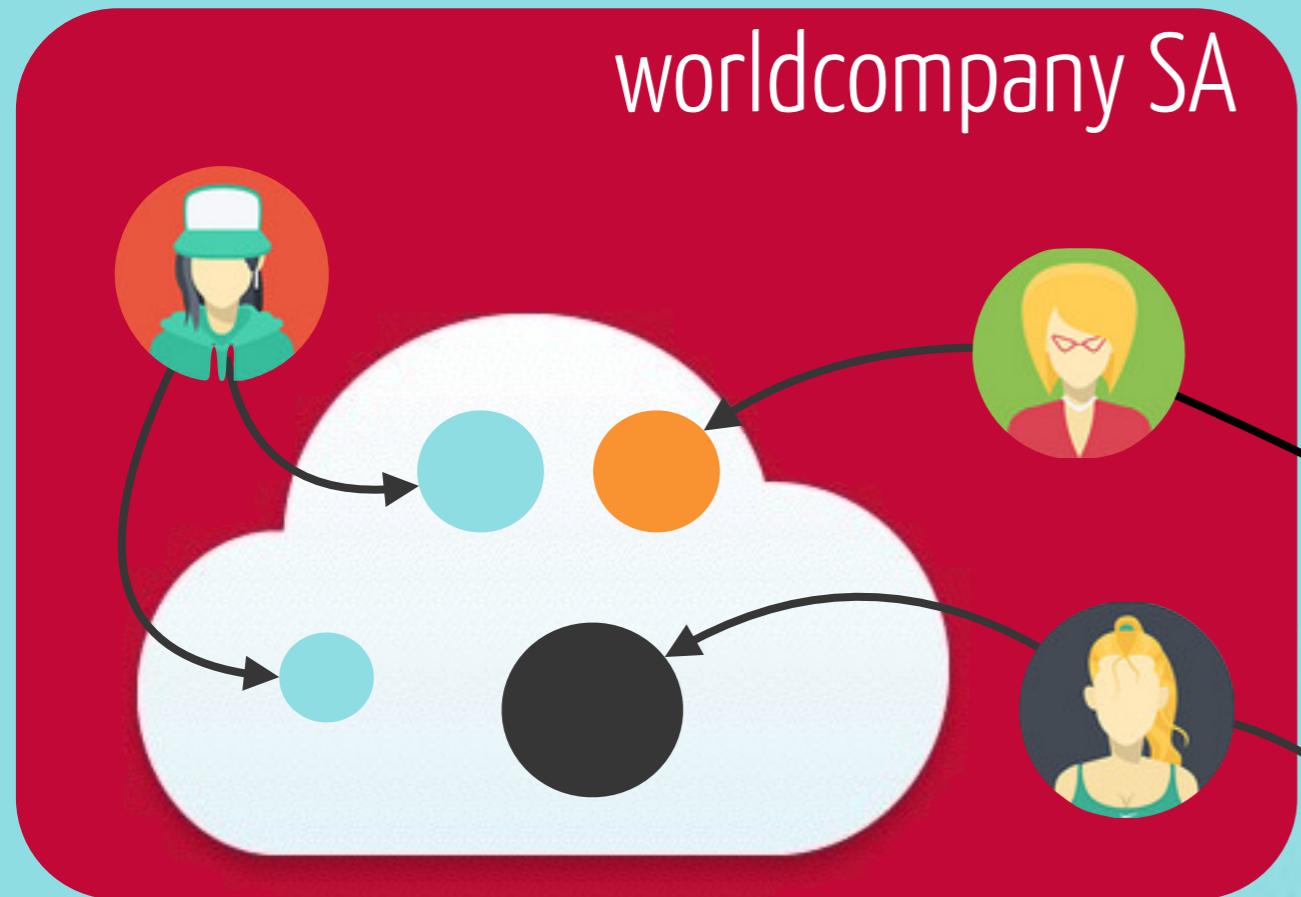
self hosted cloud



might reduce TCO
stronger trust
better manageability



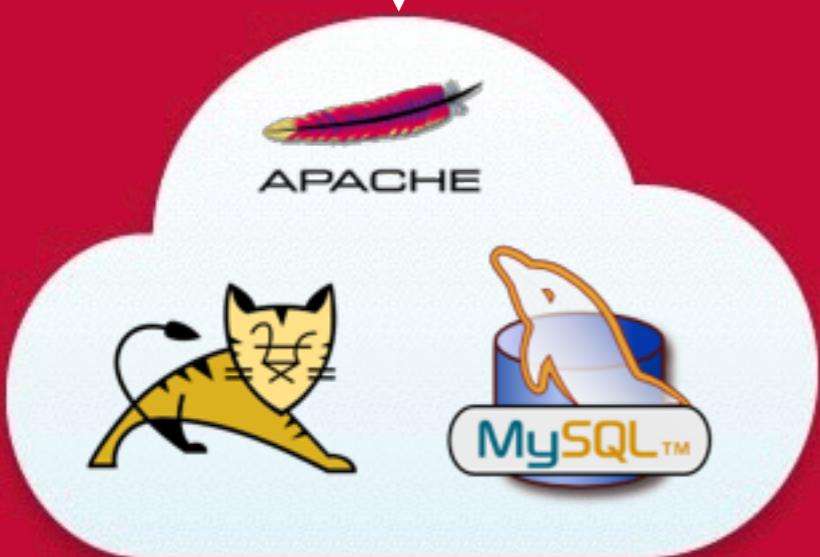
hybrid cloud



LB

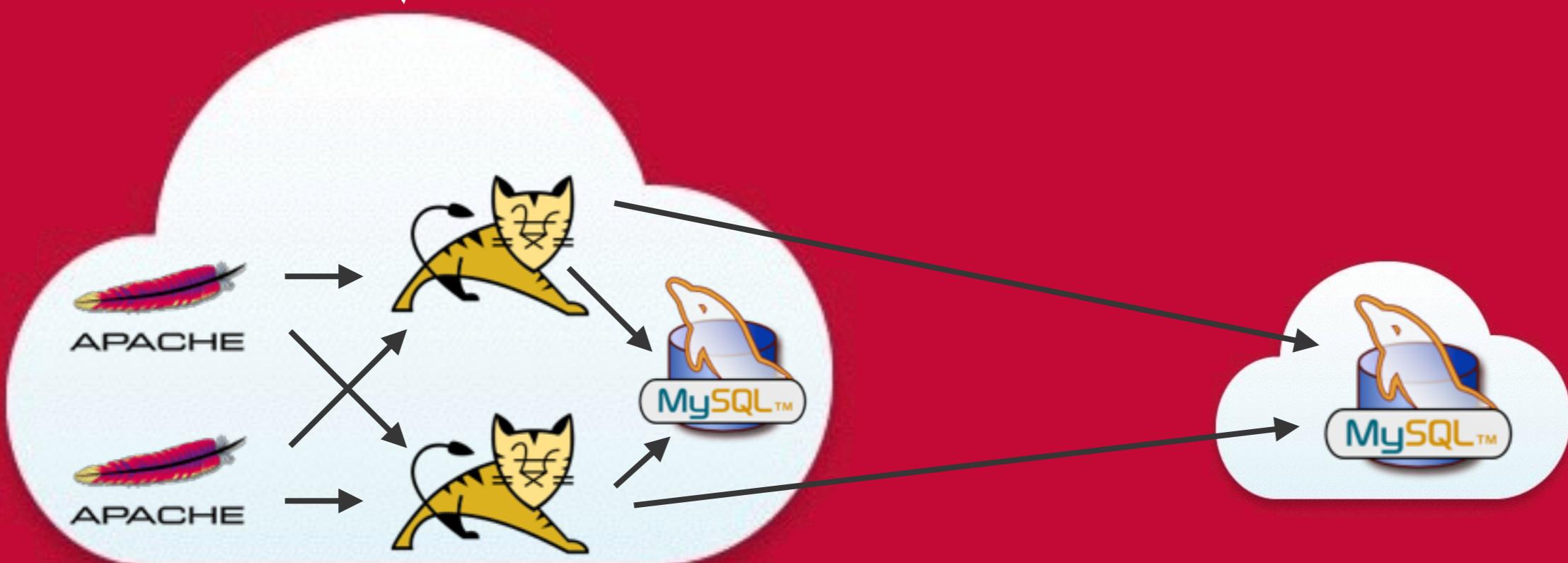
multi-clouds

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”

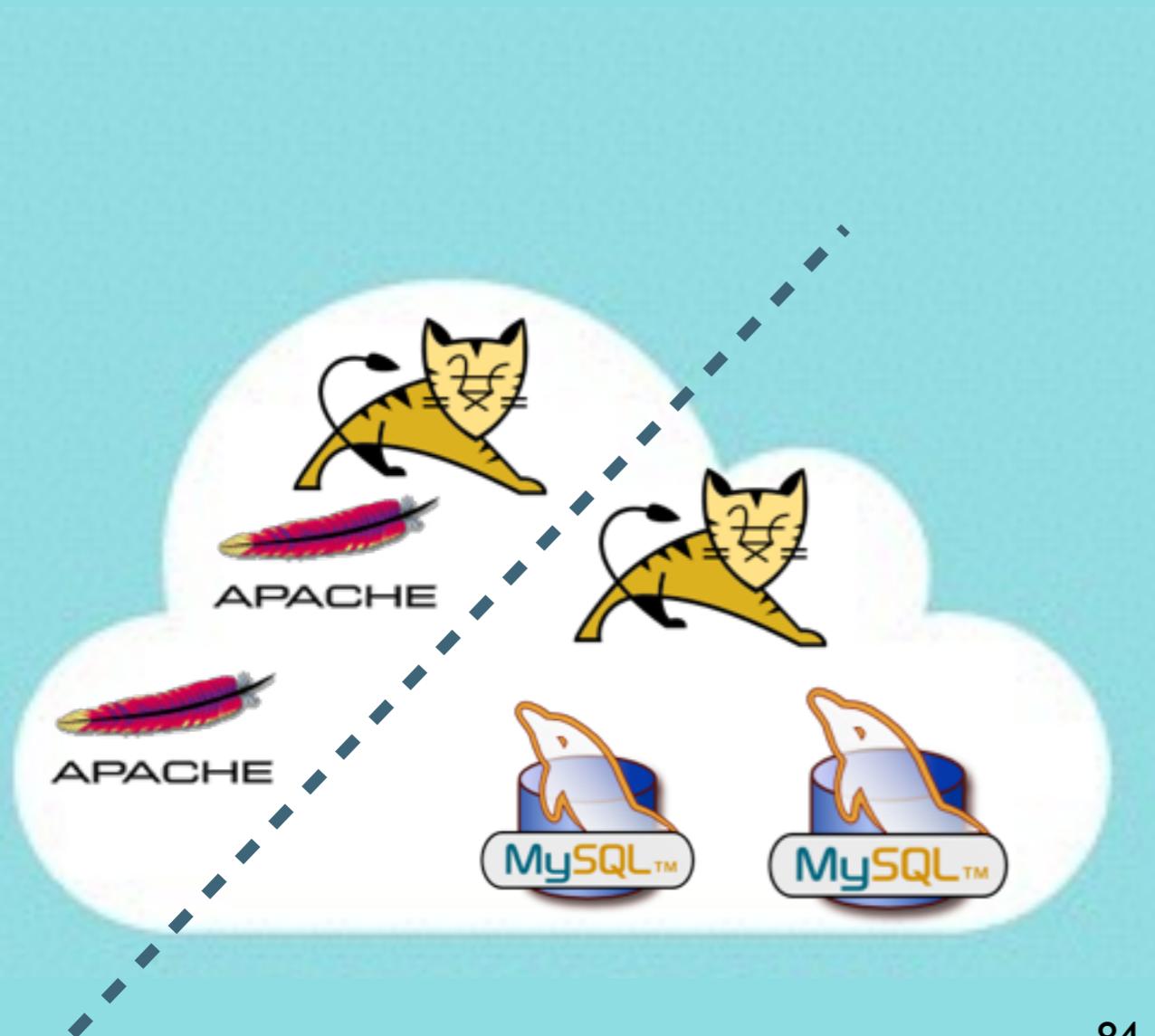


A network graph consisting of 10 white circular nodes and 15 white straight-line edges connecting them. The nodes are arranged in a roughly circular pattern, with some nodes having multiple connections.

fog computing

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