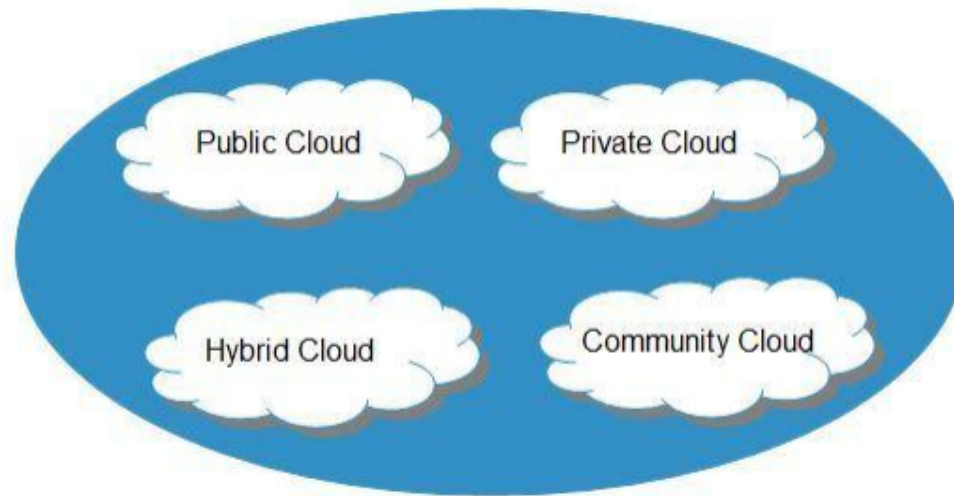


Cloud



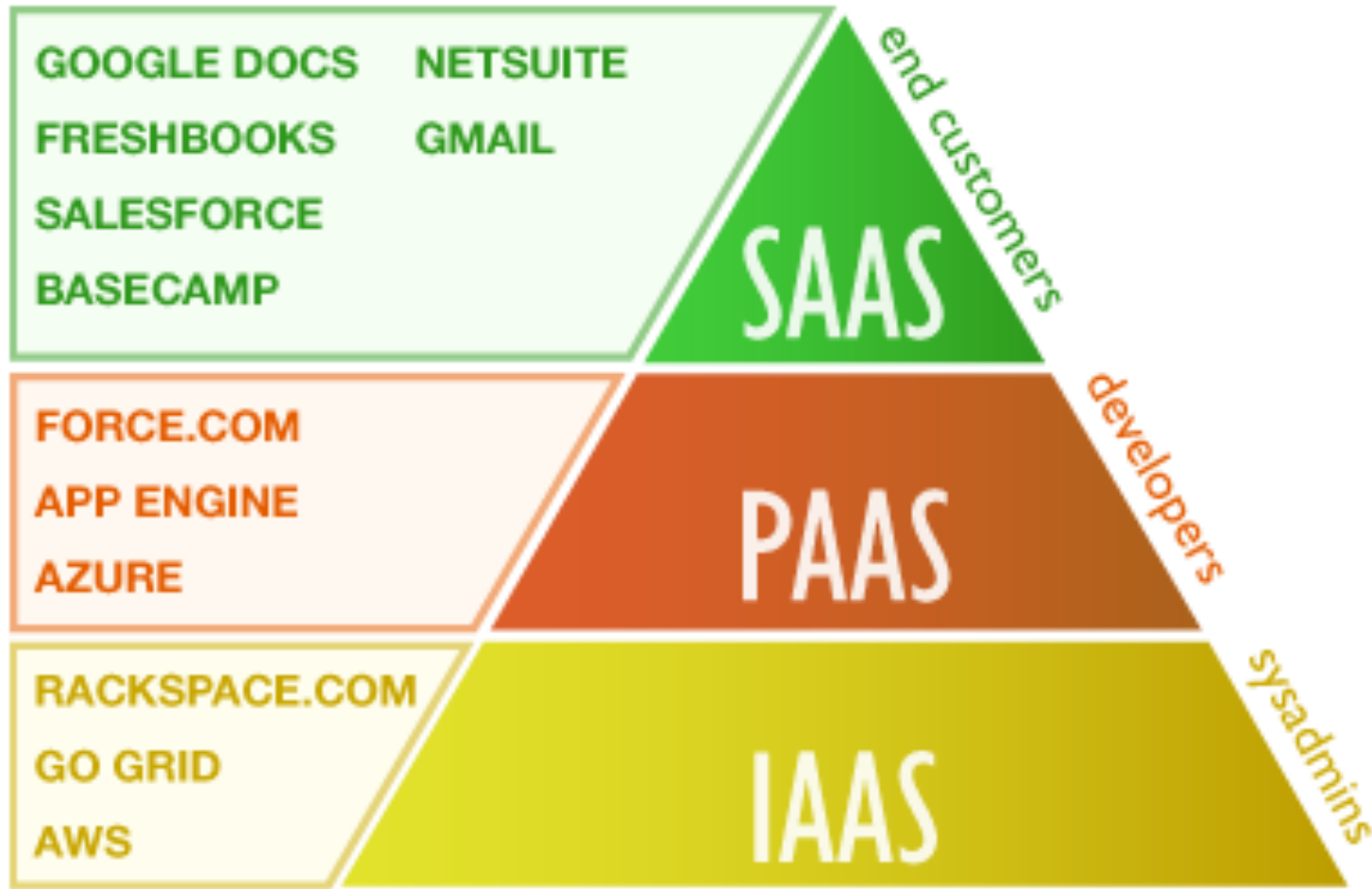
What is a cloud?

Collection of computational resources (hardware and software) delivered over a network, usually the Internet.

3 distinct aspects makes something a “cloud”:

- Resources are usually metered (pay-per-use).
- Resources can be provisioned on-demand.
- Resources can be manipulated via API.

Service Models



Desktop as a service (DaaS), backend as a service (BaaS), and information technology management as a service (ITMaaS).



Service Models

Software as a service (**SaaS**) is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted, also known as "software on-demand".

Platform as a service (**PaaS**) provides computing platforms and solution stacks as service.

Infrastructure as a service (**IaaS**) provides computing facility as a service.

Examples



Image from <http://thegadgetsquare.com/1552/what-is-cloud-computing/>

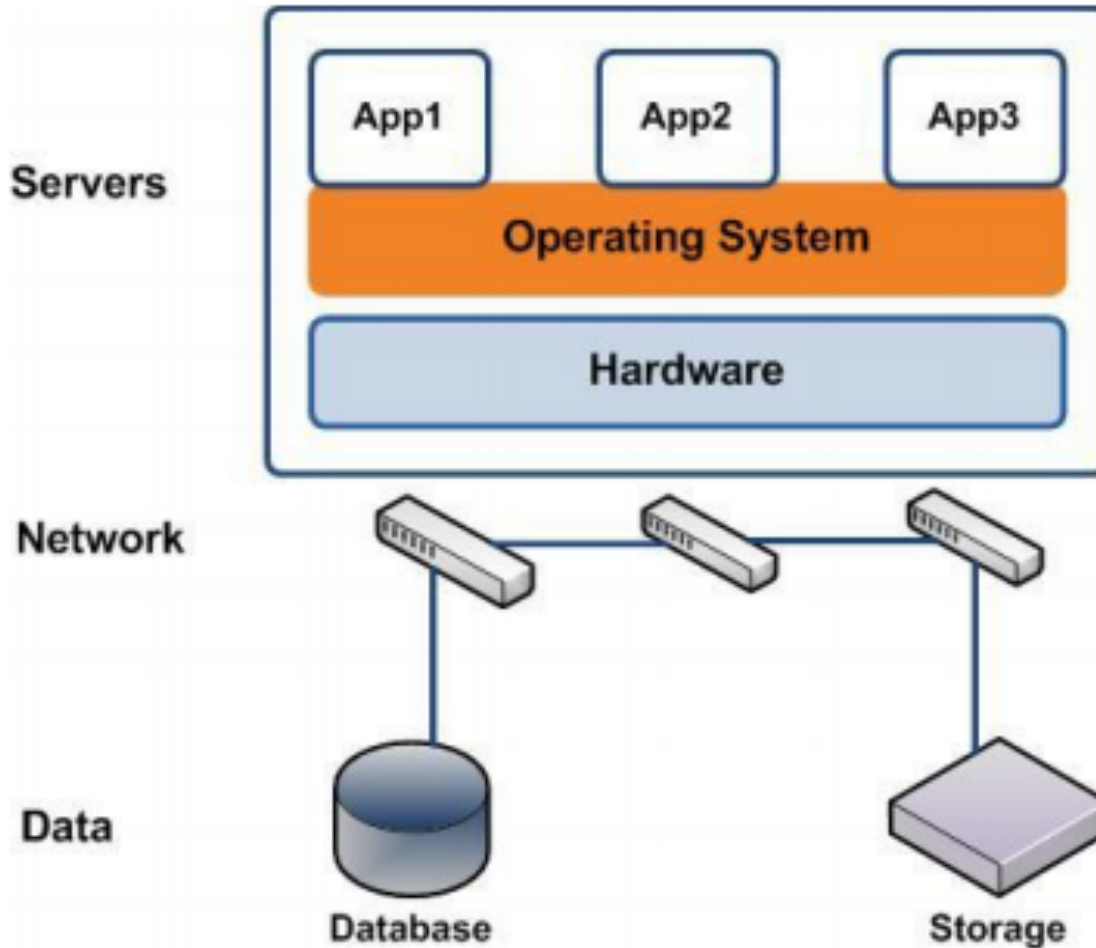
Shared Hosting

- Share same hardware and OS.
- Low cost.
 - HostGator starts at \$3.96/mo
 - GoDaddy starts at \$1.99/mo
- Fewer options and less flexibility.
- Less performant. Frequent outages.
- Security implications.

Dedicated Hosting

- Leased dedicated hardware (servers, network switches, etc...).
- High Cost.
 - Typical monthly fee starts at \$200/mo.
- Greater flexibility and options.
- Higher performance.
- Long contracts (typically 1 year, but can be upwards of 3 years).

Dedicated Hosting



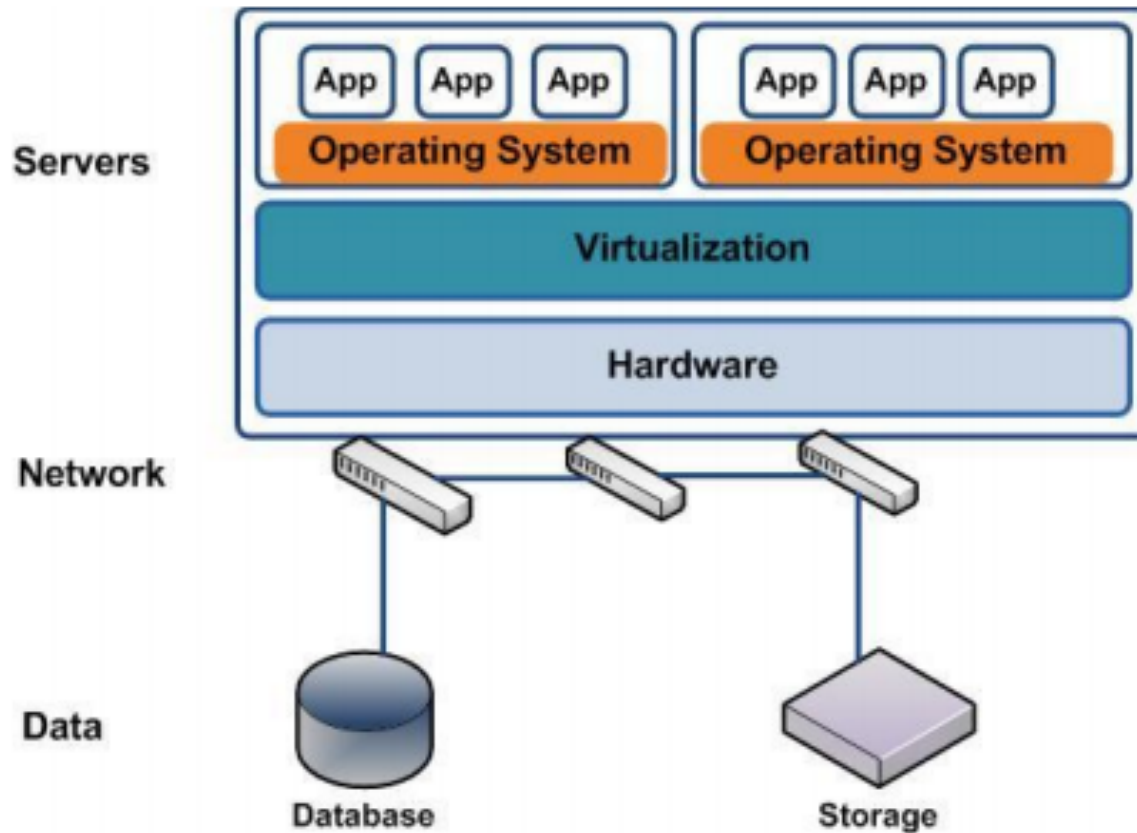
Co-location

- Purchase and host your own hardware.
- High Initial Cost (CAPEX).
 - A good server can cost upwards of \$10k.
- Monthly fees for power, network, cooling.
- Long contracts (typically 1 year, but can be upwards of 3 years).

Virtual private server (VPS)

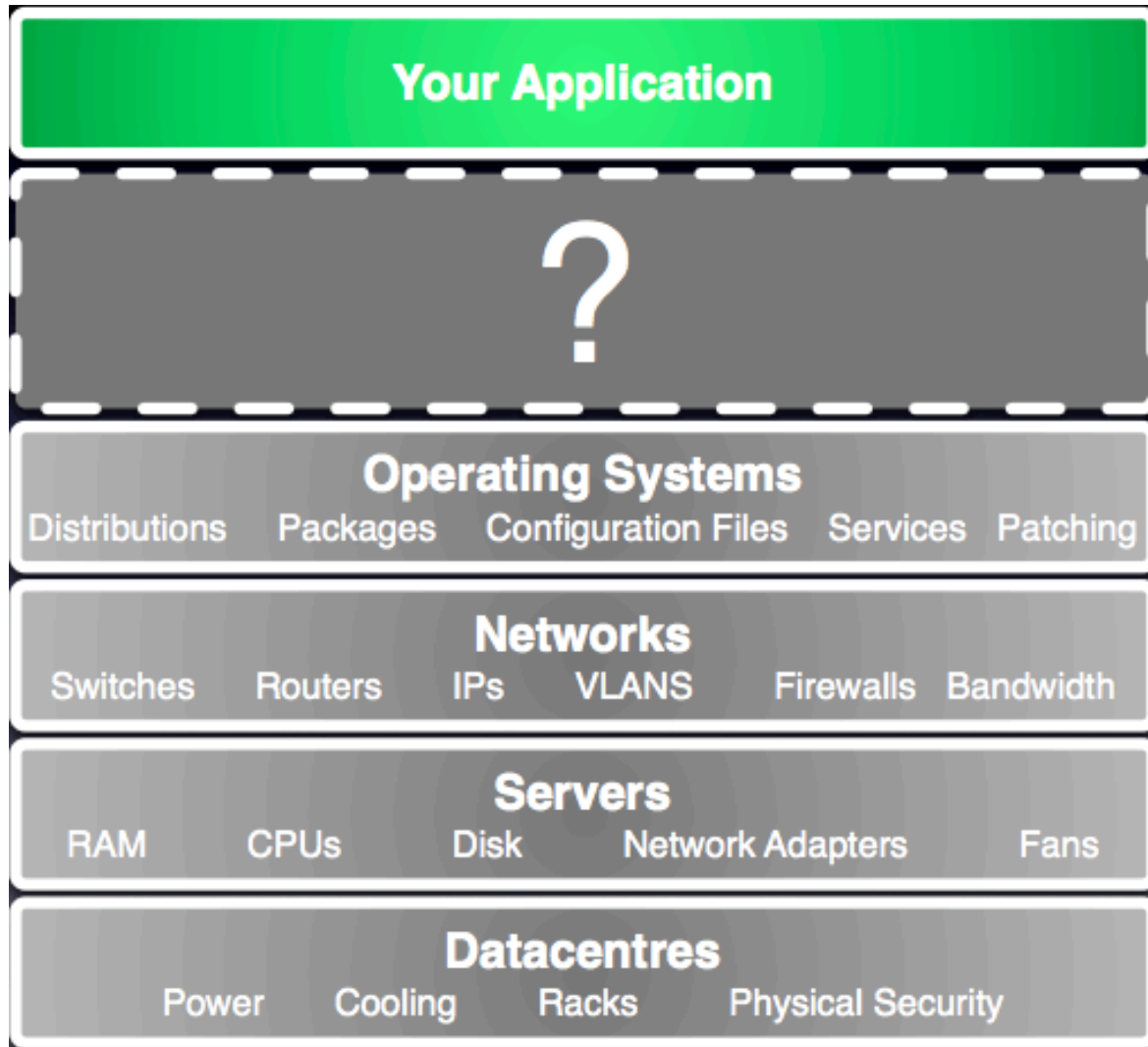
- Best compromise between price and performance.
- Utilized primitive incarnations of virtualization.
- Pay monthly fee for VPS (\$40-\$100/mo).
- Security implications.

Virtual private server (VPS)



Which option do I choose?

Something's missing...



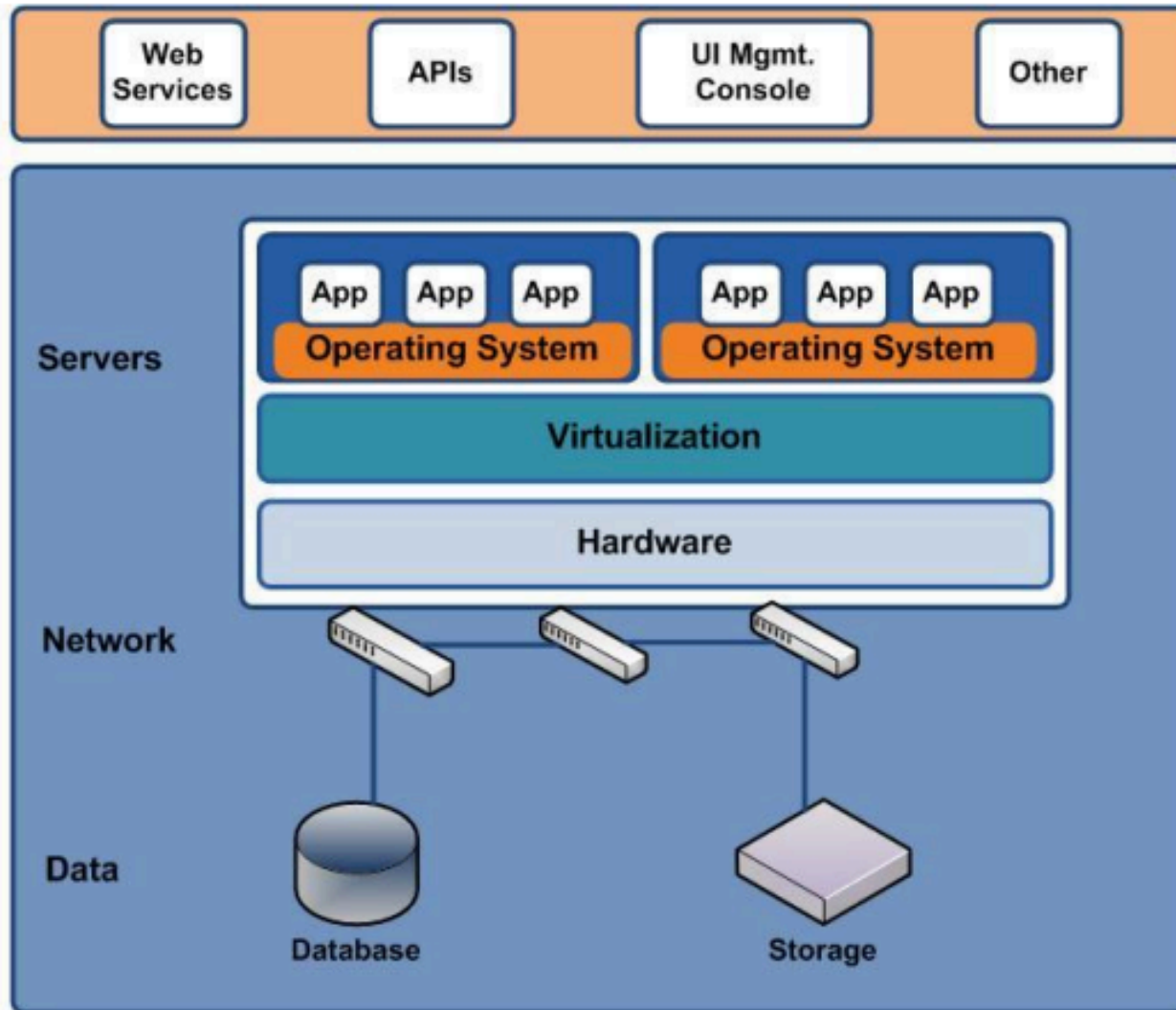
I just want to deploy code...

Hire a System Admin

- Due to complexity, the only option available was to hire a system admin that knew how to navigate that world.
- Sys. Admin would prepare the environment, and deploy your code on your behalf since they know the system best.
- This leads to System Admin vs. Developer wars.

The Glory of the Cloud

Cloud Interface and Mgmt layer



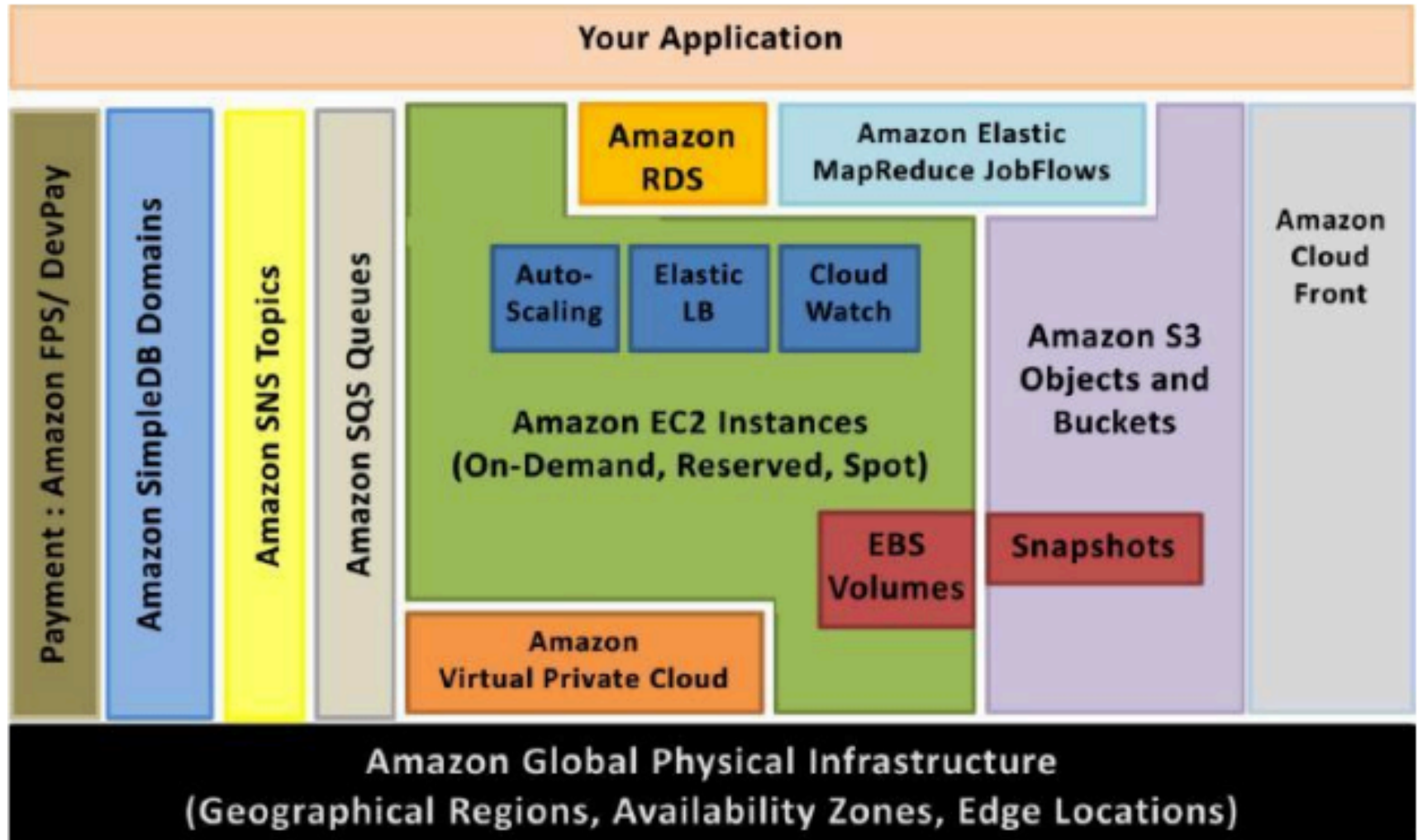
Simplified cloud infrastructure



The Cloud...

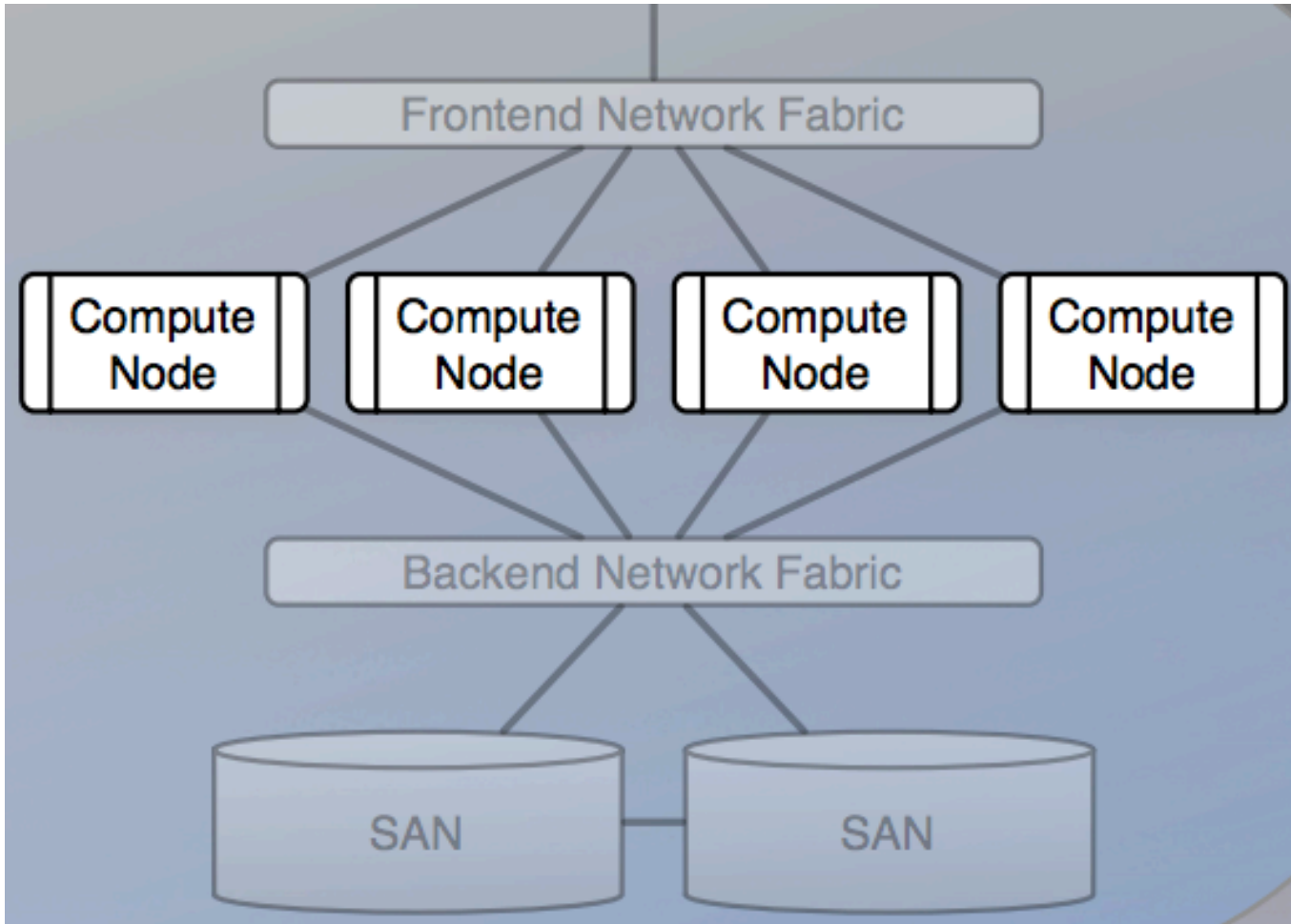
- Abstracts away the complication of running a proper server environment.
- Controlled through an API so you can “deploy” infrastructure.
- Entire environments can be deployed in minutes.

Amazon Web Services cloud



What's it made of?

Anatomy of a cloud



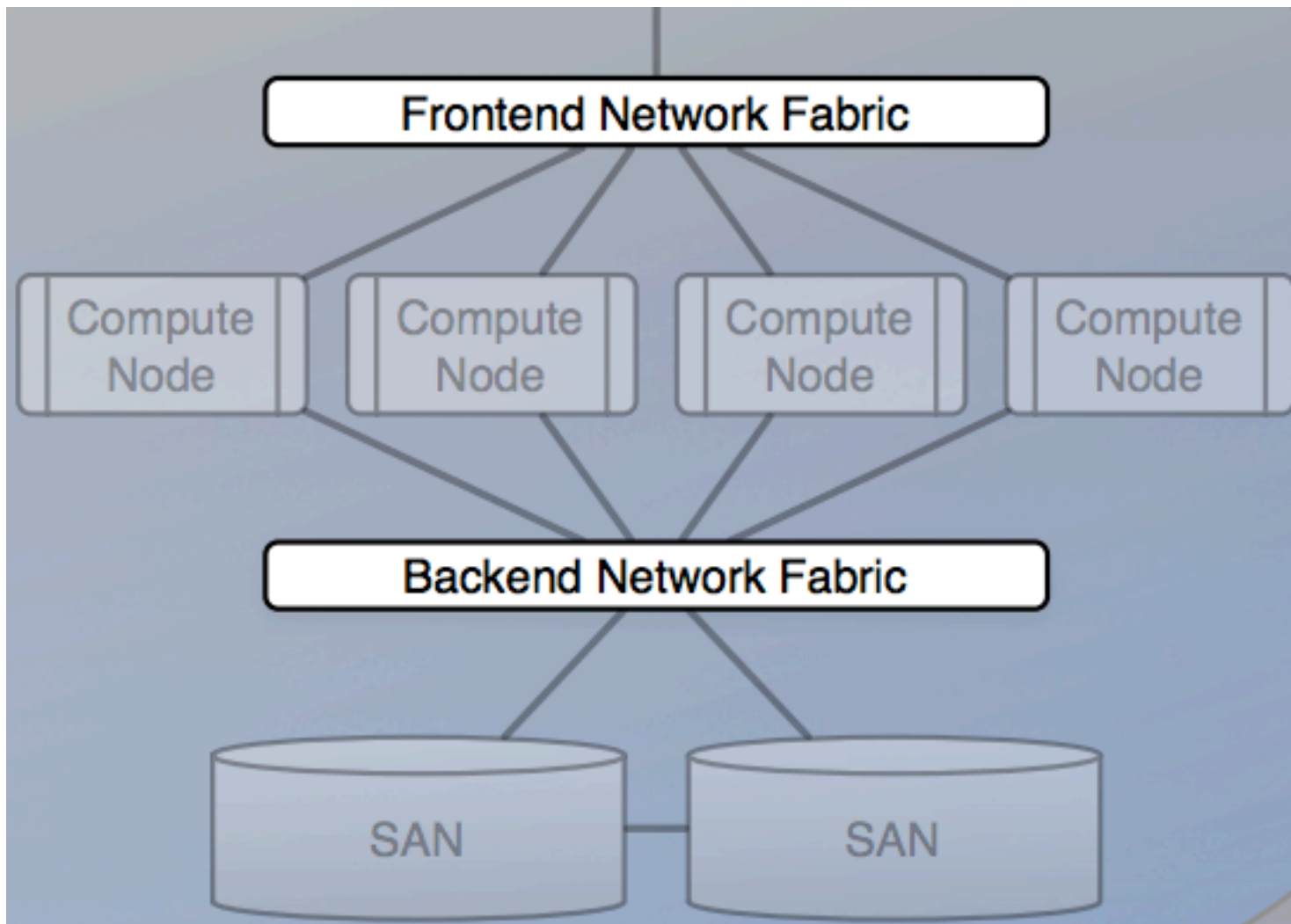
Compute Nodes

- Physical servers running virtualization software.
- Provided CPU and Memory resources.
- Usually don't store any permanent data
- Connected to multiple networks.

Virtualization

- Virtualization allows you to run multiple operating systems on a single server.
- Virtualization usually refers to the Hypervisor.
- Motivation for virtualization - most hardware is under-utilized.
- Virtualization increases utilization to get the most out of expensive hardware.

Anatomy continues...



Network Layers

- One network sits in front of Compute Nodes to provide Internet access.
- One network sits in the back of Compute Nodes to provide access to Storage layer.
- Usually Ethernet and Fibre Optic based.
- Not uncommon to see 10GigE switches.

Storage Layer

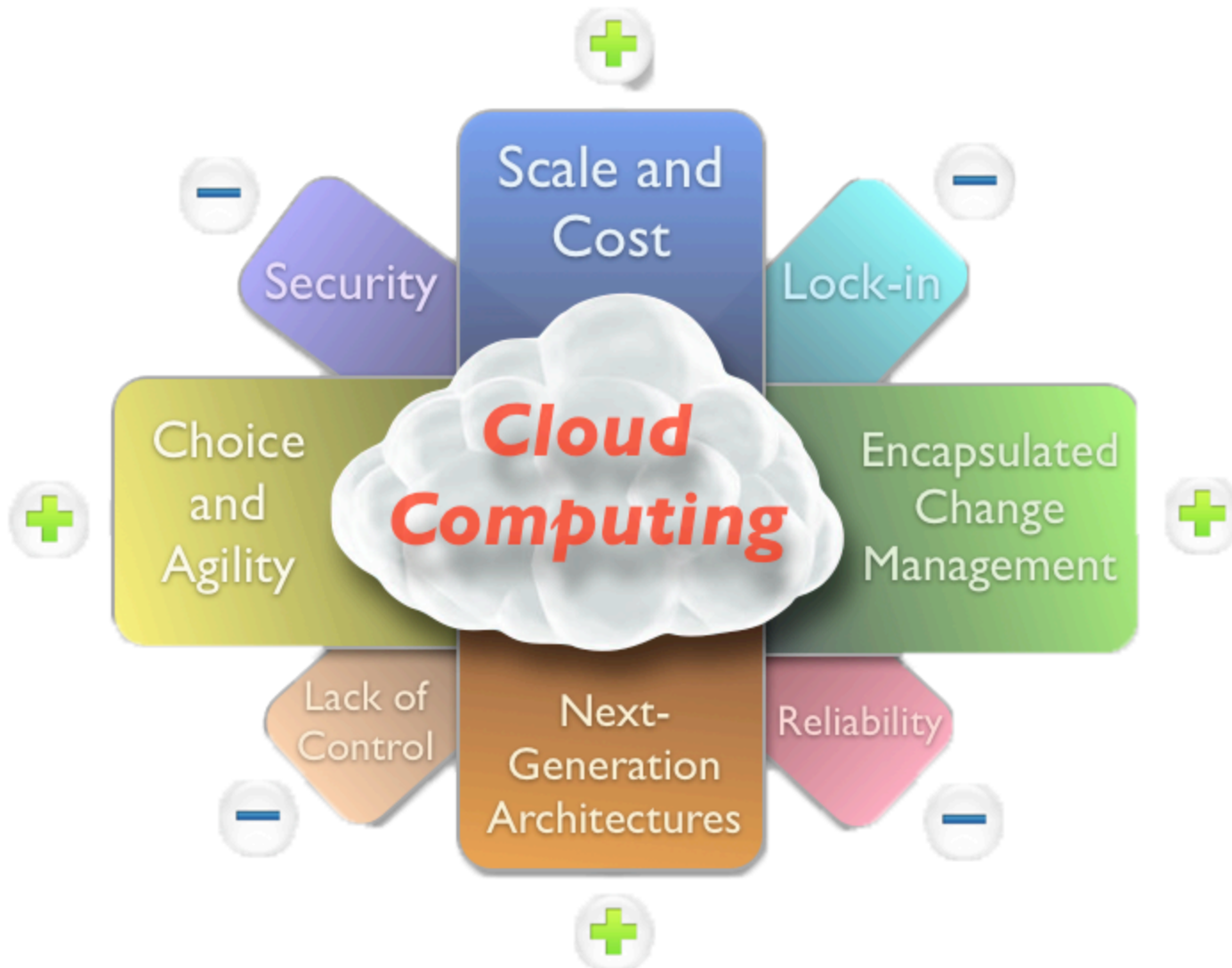
- Use of Storage Area Networks (SANs), Network Attached Storage (NAS), Direct Attached Storage (DAS).
- Usually in the form of specialized commercial hardware with lots and lots of drives.
- Very Expensive.
- Failures can be catastrophic.
- You usually have to buy 2 for redundancy.



Failure example

- On April 20, 2011, some parts of Amazon Web Services suffered a major outage.
- A portion of volumes utilizing the Elastic Block Store (EBS) service became "stuck" and were unable to fulfill read/write requests.
- It took at least five days for service to be fully restored.

Advantage and disadvantages



The Future...

- A WSJ article cites “cloud computing” market to explode to \$241B by 2020 (up from \$41B in 2011).
- Dec 2010 - Heroku was acquired by Salesforce.com for \$212M!
- <https://aws.amazon.com/solutions/case-studies/> lists hundreds of major websites using AWS, and that's just Amazon's list.

The Future...

- Openstack.org is supported by more than hundred “corporate” contributors, with individual contributors in the thousands.
- Data locality will continue to be a big concern for all players (providers, end users, government bodies) as more legislation is passed.
- The US EPA estimates that servers and data centers are responsible for up to 1.5% of the total US electricity consumption.

References

1. <http://uoft.fabspaces.cc/wp-content/uploads/2013/11/Clouds.pdf>
2. <http://web.mit.edu/smadnick/www/wp/2013-01.pdf>
3. <http://thegadgetsquare.com/1552/what-is-cloud-computing/>
4. http://www.tutorialspoint.com/cloud_computing/cloud_computing_tutorial.pdf