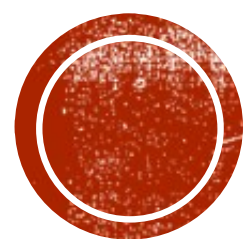BEFORE CLOUDING, LET'S DISCUSS SOME

CLOUD CONCEPTS

BIG DATA

DO YOU REMEMBER?

- Moore's law on Doubling Periods

  - Storage: 12 months → **Volume**
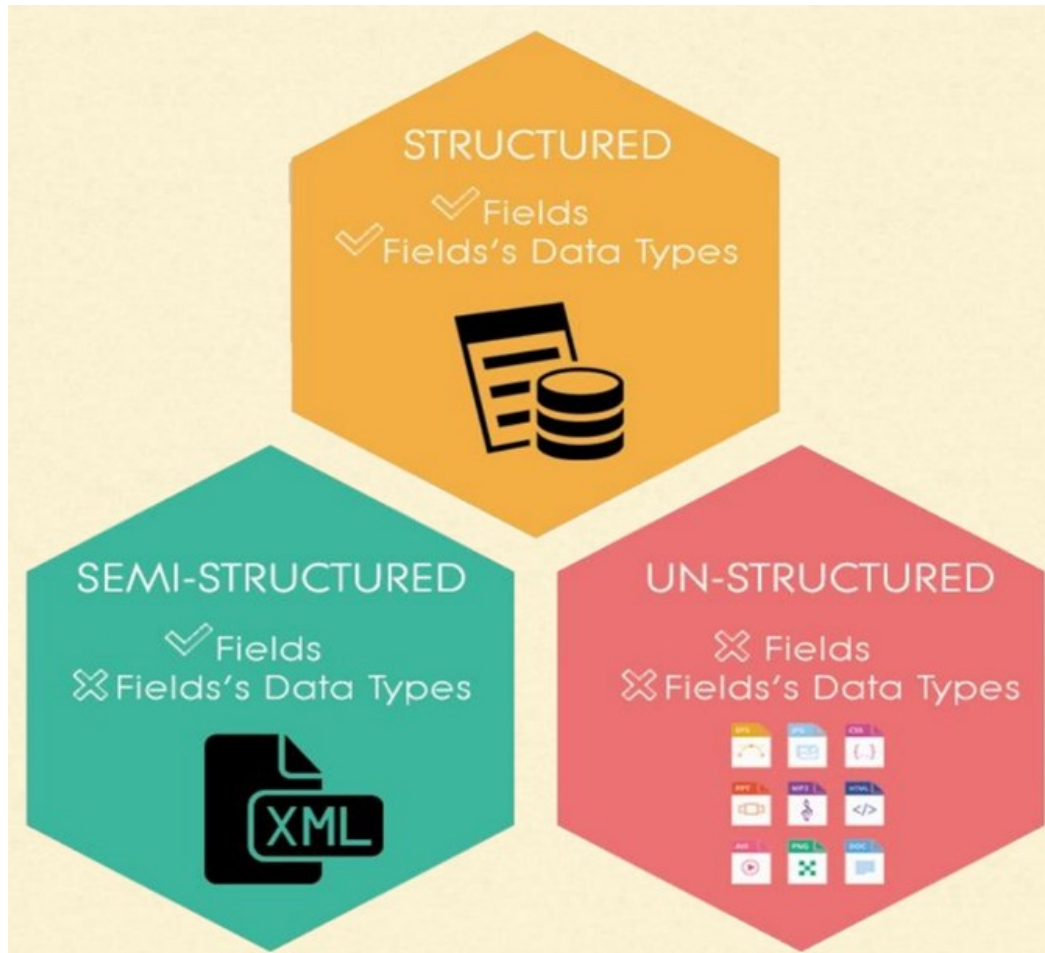
  - Bandwidth: 9 months
  - CPU Computing: 18 months → **Velocity**
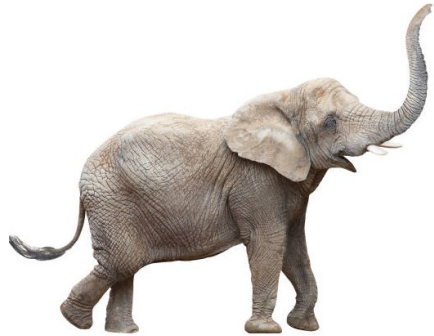
DATA FORMS

Big Data Characteristics

Volume

Facebook stores
300 Petabytes of data

Velocity

AppLovin processes more than
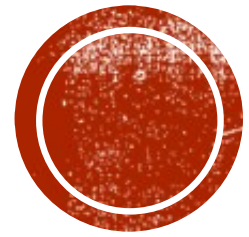500k transactions/second

Variety

Google provides text-based
and image-based searching
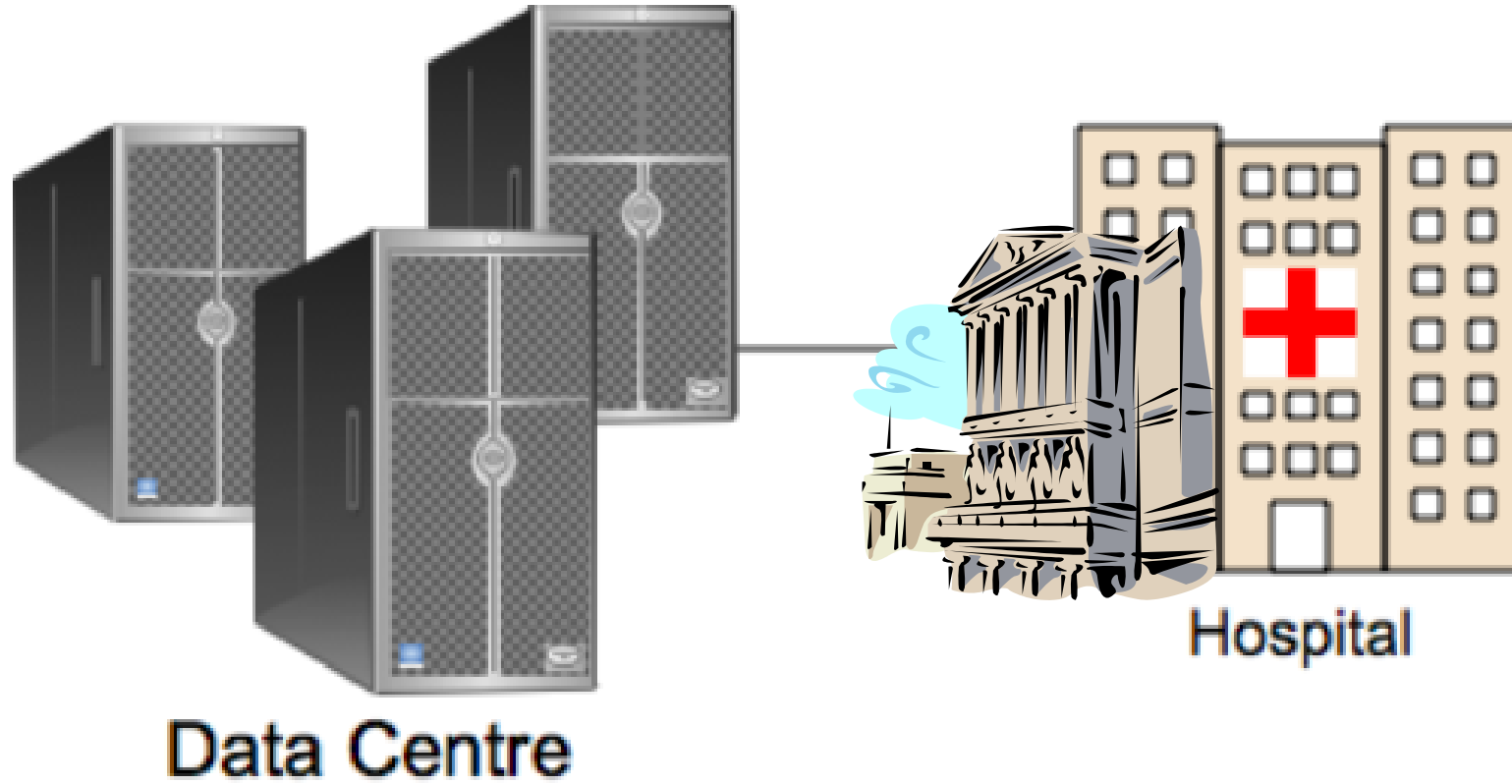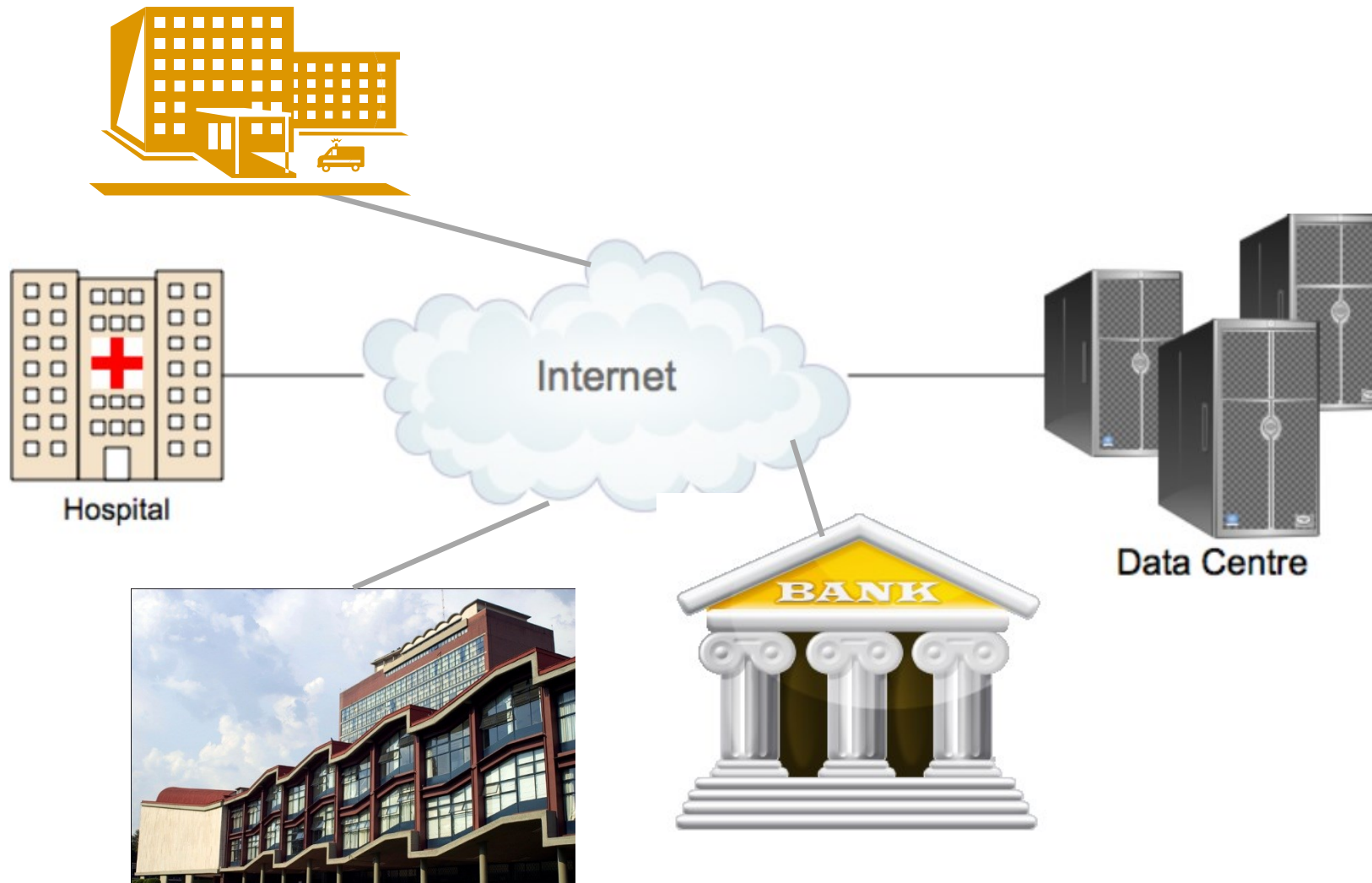
- Cloud is all about Big Data

CLOUD TYPES

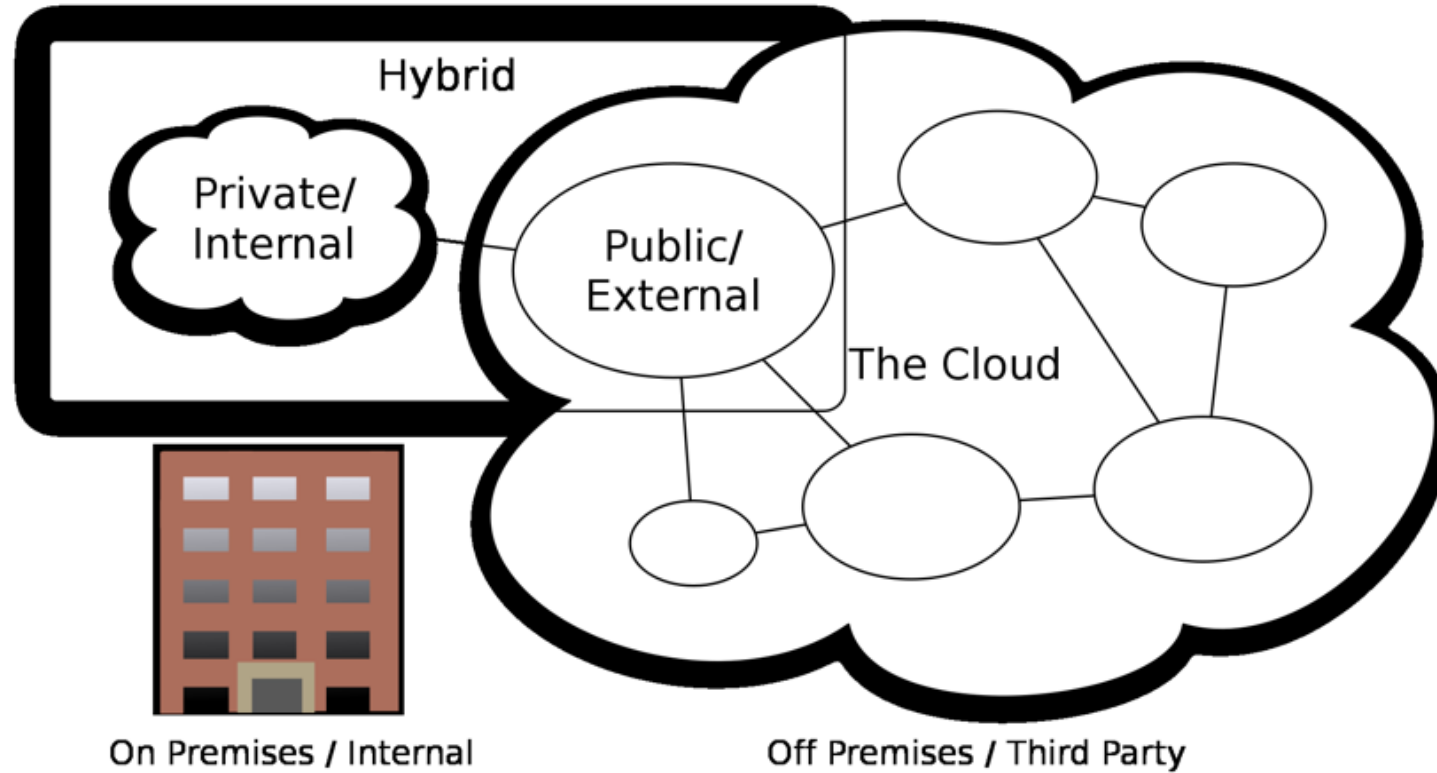# PRIVATE CLOUD

Data Centre

Hospital

PUBLIC CLOUD

HYBRID CLOUD

PUBLIC OR PRIVATE?

Medium-sized organization: wishes to run a service for M months

Service requires 128 servers (1024 cores) and 524 TB
Same as UIUC CCT cloud site

Outsource (e.g., via AWS): monthly cost

S3 costs: $0.12 per GB month. EC2 costs: $0.10 per CPU hour (costs from 2009)

Storage = $ 0.12 X 524 X 1000 ~ $62 K

Total = Storage + CPUs = $62 K + $0.10 X 1024 X 24 X 30 ~ $136 K

Own: monthly cost

Storage ~ $349 K / M

Total ~ $ 1555 K / M + 7.5 K (includes 1 sysadmin / 100 nodes)

using 0.45:0.4:0.15 split for hardware:power:network and 3 year lifetime of hardware

Breakeven analysis: more preferable to own if:

$349 K / M < $62 K (storage)
$1555 K / M + 7.5 K < $136 K (overall)

Breakeven points
M > 5.55 months (storage)
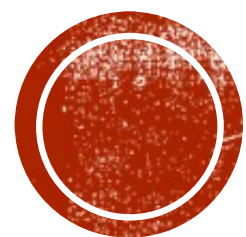M > 12 months (overall)

As a result

Startups use clouds a lot
Cloud providers benefit monetarily most from storage

- **Other Factors:**
  - Legal Requirements
  - Capital Budget

CLOUD INFRASTRUCTURE

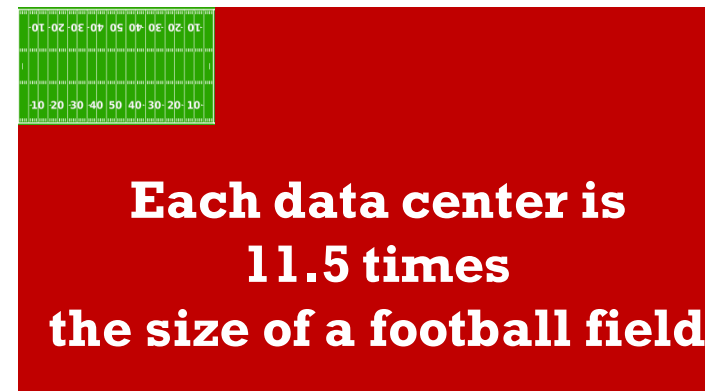# DATA CENTERS - ELEMENTS

- Facility: location and "white space".

- Support infrastructure:
  - Uninterruptible Power Sources (UPS): battery banks, redundant power sources and generators.
  - Environmental Control: cooling systems.
  - Physical Security Systems: biometrics and video surveillance systems.

- IT Equipment: servers, storage hardware, cables, racks, firewalls, etc.

- Operations Staff.

CLOUDS ARE BUILT ON DATA CENTERS

- Range in size from "edge" facilities to mega scale.

- Economies of scale

  - Approximate costs for a small size center (1000 servers) and a larger, 100K server center.

Technology	Cost in small-sized Data Center	Cost in Large Data Center	Ratio
Network	$95 per Mbps/month	$13 perMbps/month	7.1
Storage	$2.20 per GB/month	$0.40 per GB/month	5.7
Administration	~140 servers/Administrator	>1000 Servers/Administrator	7.1

Each data center is 11.5 times the size of a football field

DATA CENTERS EFFICIENCY METRICS

- Power Usage Effectiveness (PUE)

  - $$\frac{Total\ Power\ Into\ Data\ Center}{IT\ Equipment\ Power}$$

- If the power entering data center is 100 kw and the power consumed by the IT load is 50 kw, PUE = 100/50 = 2.0

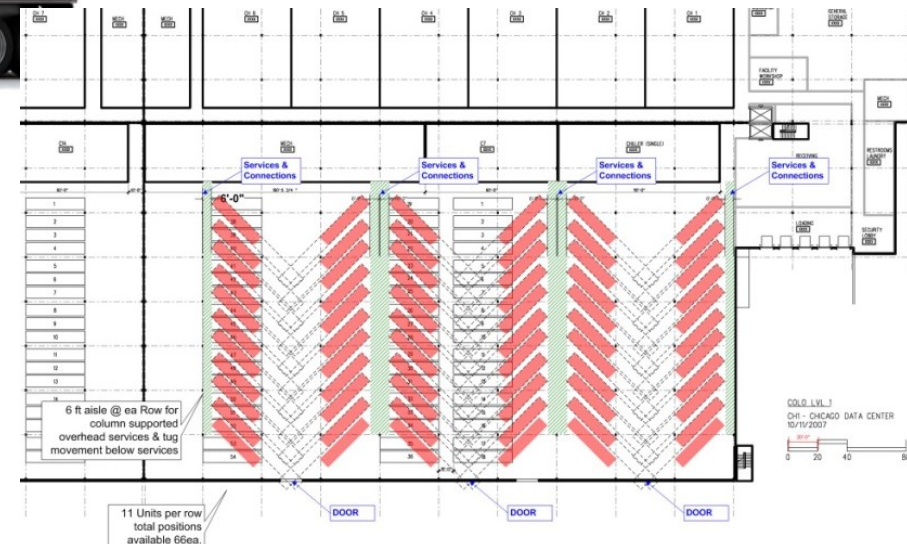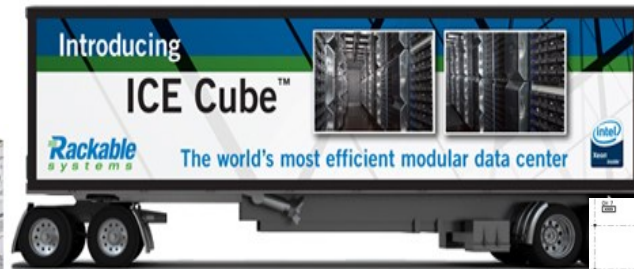 - For every watt to power a server, 2 watts are consumed.

- Data Center Infrastructure Efficiency (DCIE)
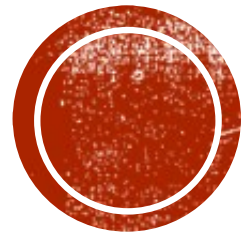
  - 1/PUE

ADVANCES IN DC DEPLOYMENT

- Conquering complexity.
  - Building racks of servers & complex cooling systems all separately is not efficient.
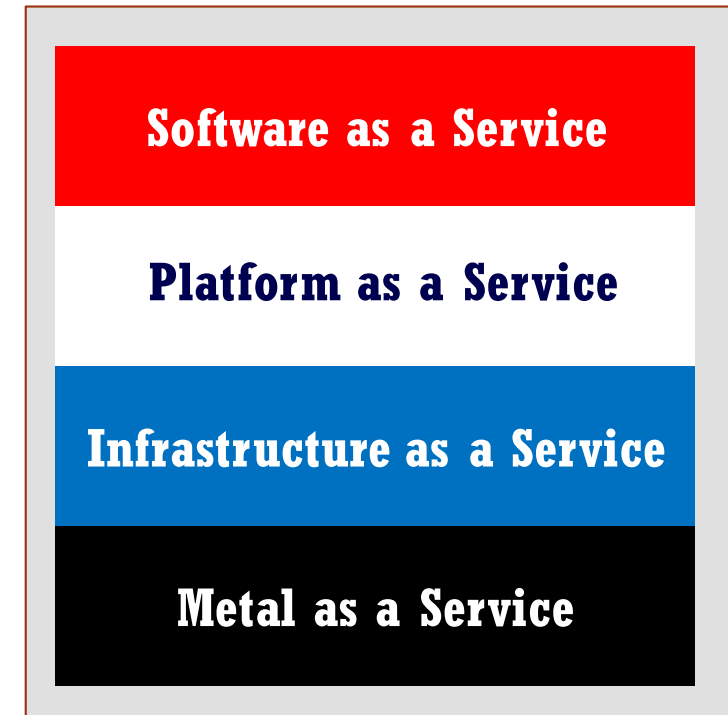 - Package and deploy into bigger units

CLOUD COMPUTING SERVICE CATEGORIES

THE CLOUD COMPUTING SERVICE CATEGORIES

- Software as a Service (SaaS)

- Platform as a Service (PaaS)

- Infrastructure as a Service (IaaS)

- Metal as a Service (IaaS)

SAAS: Software as a Service

- Provided with access to application software in the cloud
  - On-demand software

- Most applications can be run directly from web browser

- Largest cloud market

- Examples
  - Google Apps, Microsoft Office 365, saleforce.com, Oracle's Netsuite, SAP's Concur, Cisco WebEx, GoToMeeting

PaaS: Platform as a Service

- Provides computing platforms which typically includes operating system, programming language, execution environment, database, web server etc to build cloud applications.

- Applications using PaaS inherit cloud characteristic such as scalability, high-availability, multi-tenancy, SaaS enablement, and more.

- Examples
  - Google App Engine, AWS Elastic Beanstalk, Salesforce.com
 - Amazon EMR, MS Azure HDInsight, GCP Dataproc

IAAS: INFRASTRUCTURE AS A SERVICE

- Offers storage and computing resources that developers and IT organization use to deliver custom business solutions

- Examples
  - Amazon EC2, VMWare vCloud, GCP Compute Engine

Infrastructure
(as a Service)

You manage

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

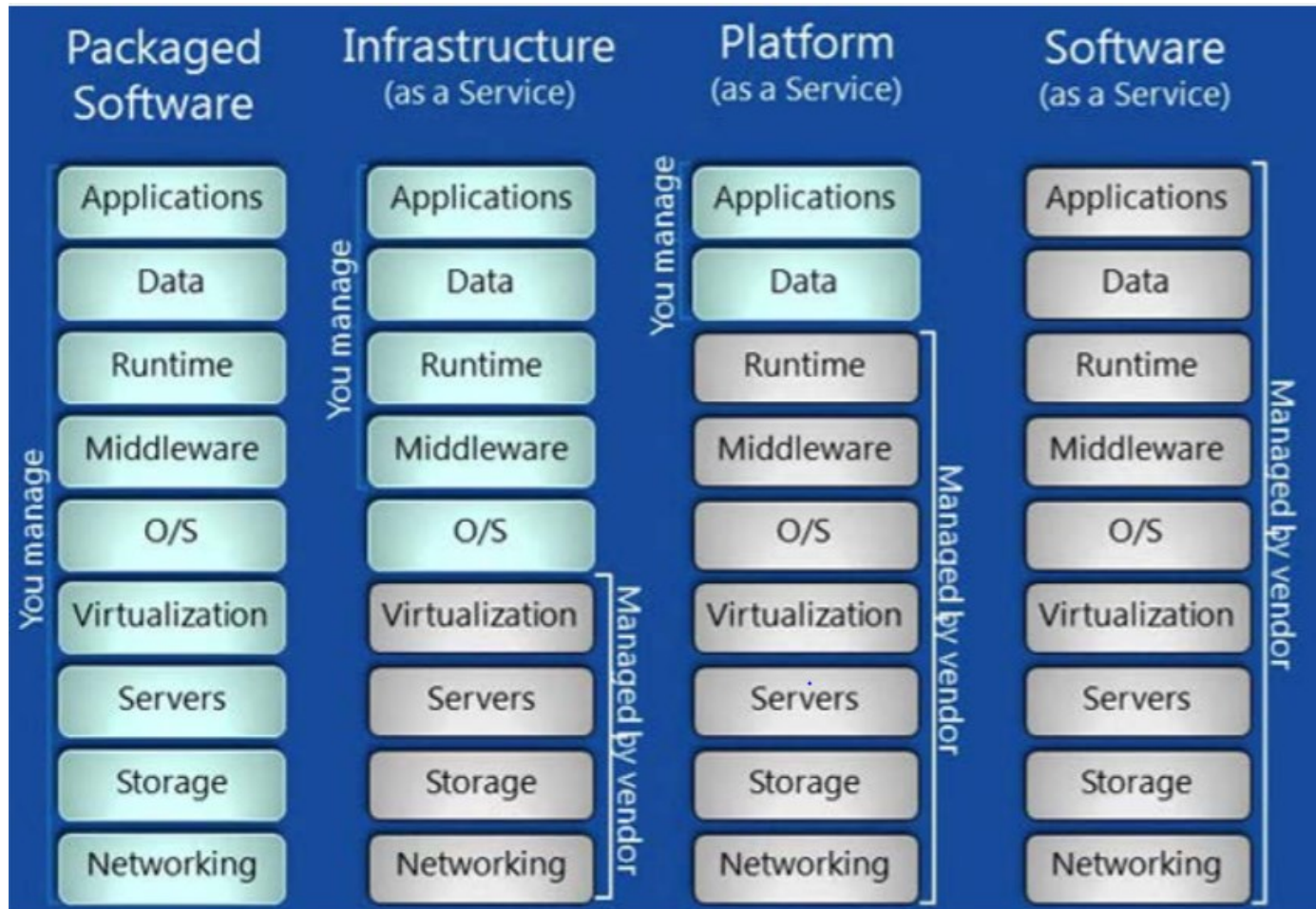Storage

Networking

Managed by vendor

MAAS: METAL AS A SERVICE

- Combines the flexibility and scalability of the cloud with the ability to harness the power of physical servers.

- Examples
  - Juju

- For more information, watch this video (optional):
  - https://www.youtube.com/watch?time_continue=280&v=FBCKCO45xIw
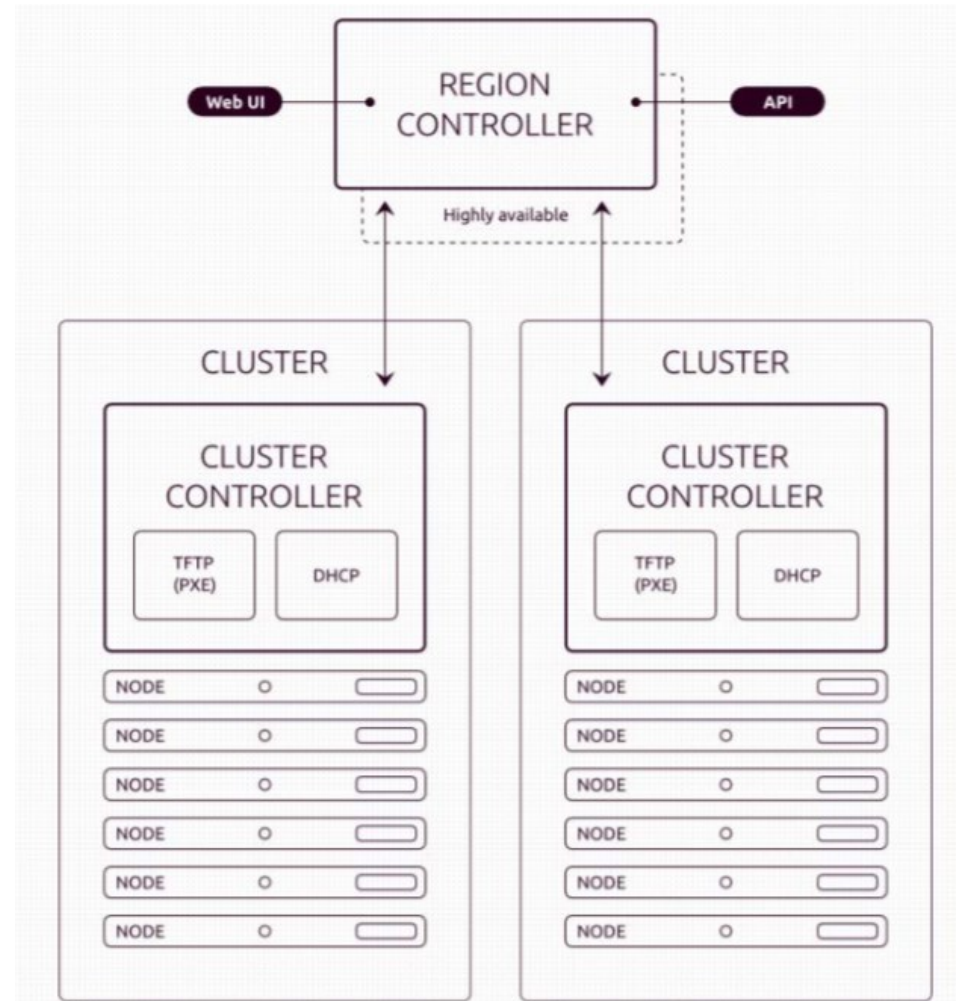
CLOUD SERVICES

- In MAAS
  - You will have the option to control everything!

PAAS OR IAAS?

- **Multi-tenancy**: Many users may share same physical computer and database.
  - PaaS is best suited for multi-tenancy.
    - IaaS creates a clear separation of resources.

- **Vendor Lock-in:** the ability to use "what you manage" in cloud environment with different cloud provider.
  - PaaS may lock-in applications by requiring users to develop apps based on their specific APIs.
    - If you are using PaaS, it might be difficult to switch to different vendor.

- **Development Tools**
  - PaaS providers usually allow a set of development tools for their users to shorten development time.
    - Another trick for vendor lock-in!

Download a digital copy or nominate your company: bvp.com/cloud

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