

# GRIDS, clouds and DATA CENTERS

## GRIDS

A distributed computing system that allows users to access large amounts of computing power and data storage over a network to run large computing tasks. often scheduled.

A predecessor to Cloud

technology but different emphasis.

Types:

- (1) Computational Grid
- (2) Data Grid
- (3) Grid Monitoring Systems

Notes

- often used for embryonically parallel problems
- ongoing work on simplifying grid use and design.

# Cloud

- Arose out of sm computing

- Aiming to deliver

services + resources

## Type:

Software as a service (SaaS) →

SaaS

→ we need only web browser.  
→ software on cloud

Infrastructure as a service (IaaS) →

IaaS

(virtual computing, storage etc...)

Platform as a service (PaaS) →

PaaS

→ virtual platform

Private Cloud

Public Cloud

+

Community Cloud

(selling cloud services)

Hybrid Cloud

(community as needed entities)



## Cloud Principles:

- Multi-Tenancy
- Horizontal Scaling (some jobs in parallel)

## Andale's Law

$$T(n) = \underbrace{\beta T(1)}_{\text{time on } n \text{ processes}} + \underbrace{\frac{1-\beta}{n} T(1)}_{\text{parallel fraction of job}}$$

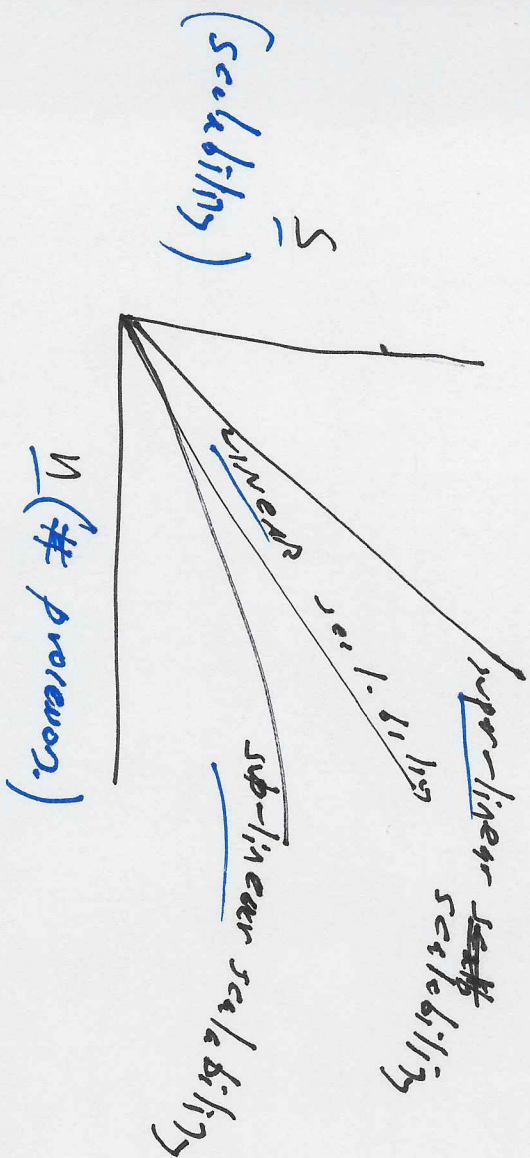
fraction of job that is serial must be run on one processor

time on one processor

$$\underline{S_{\text{speedup}}} = \frac{T(1)}{T(n)} = \frac{1}{\beta + \frac{1-\beta}{n}}$$

example

$\beta = 0.1$   
max speedup is 10.



- Cloud Monitoring (Data Collection, Analysis, Decision Making)
- Resource Provisioning
- Cloud Security
- Mobile Cloud Computing

# Cloud Reliability / Resiliency

## Security:

- Failure Prediction and Resolution

- Protection (use redundancy to bring back service after failure)

- Replication (All or partial duplication of resources)

- Check pointing (save system every so often to recover from a crash)

- Restoration or Recovery

(create new data to mitigate errors or failures after they manifest themselves)



## Data Center

Networked collection of computers usually at one location providing computational resources for web-browsing, e-commerce, Ind cloud computing and social networking.

2016: Google has 36 data centers.  
Building 10 more.

<u>USA</u>	<u>19</u>
Europe	12
Asia	3
Russia	1
Japan	1
America	

Build in dedicated buildings  
or in modular shipping containers.

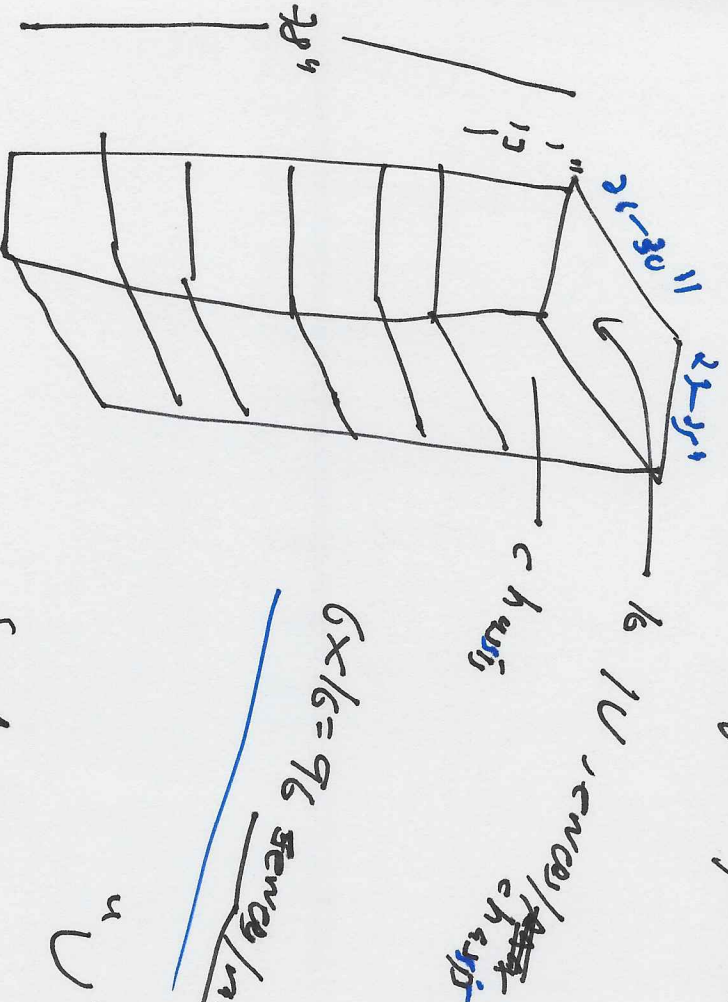
Shipping container hold,

- servers
- UPS
- memory
- networking
- 100 km wires
- racks

# Rack:

Servers mounted in RACKS

RACK hold also storage + specialized device



6x16 = 96 server/rack

- Rack can store in complex

1U - 45mm or 1.8in

Single 1U or 2U 1U or 2U

Four socket multi processor ≥ 20U



# Network:

Access: Client-server

Server-server

Access to storage

Management Network

- Switch-Server Architecture:

Mobile Switch for mobile

Server

Server in charge:

of network + routing

switch

WLAN or LAN

"Over-subscribed"

10 Gbps

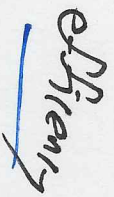
15 Mbps

←

16 Gbps

Over-subscribed  
1 Mbps to 1.5





Cooking is 25% of date

pour éphémère

Far book

$\frac{1}{16}$        $\frac{1}{25}$

Google  
Selling children  
DATA  
CARE

## Storage

MASSIVE AMOUNTS OF STORAGE USED

Storage can be 20-30% of data center floor size

USUALLY ROTATING DISCS (HARD DRIVES)

- DAS (Direct Access Storage): direct connection to server

- SAN (Storage Area Network): storage area network

- NAS (Network Attached Storage): 1/3 or 2/3 of server network

## Security

- Denial of service attacks

- 1/2 hour same data (until) attacks