

Agenda



1. What & Why of HLD — High Level Design
Scaling
2. Case Study - del.icio.us
3. Scaling challenges

support@scaler.com

9 pm — 11:30 pm

5-10 min break

Motivation for HLD

Sneak peak / Teasers → into the kind of topics that we're going to learn @ Scaler.



How we usually make applications

Write code — run it on your laptop

application — only people who have physical
access to your system can use it

Or maybe you can create a webserver



Is life really that simple?

- Services must be available across the globe.
- Highly available → 99.9999 % uptime
- distributed across geography.
- Massiv scale → # of google searches in 1 day
8.5 Billion / day
~ 100,000 / sec



The Google question

Staff Engineer

given a file containing search queries
Sort the queries in asc. order

twist

Scale

50 Peta Bytes } data
~~~~~  
50 million Gb } data

| Byte      |               |
|-----------|---------------|
| Kilo Byte | $10^3$ B      |
| Mega      | $10^6$ (M)    |
| Giga      | $10^9$ (G)    |
| Tera      | $10^{12}$ (T) |
| Peta      | $10^{15}$     |



## Del.icio.us Case Study

Bookmarking site → Joshua

? Launched in



2003

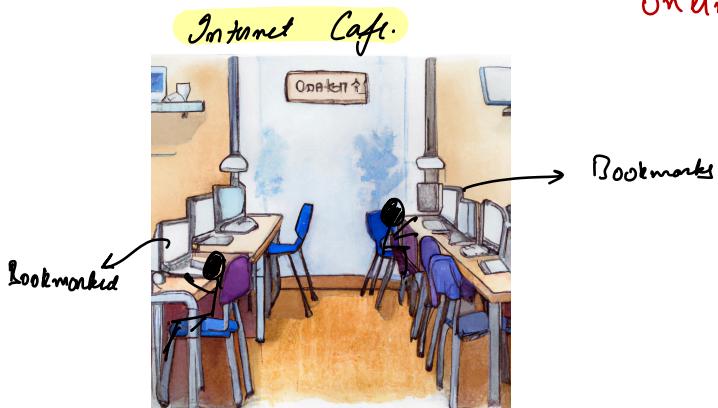
2005

2006

2008

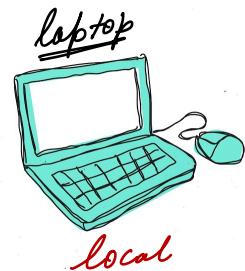
## Motivation

store your bookmark  
online



## Features

1. User registration & Login
2. Add a bookmark
3. List all my bookmarks

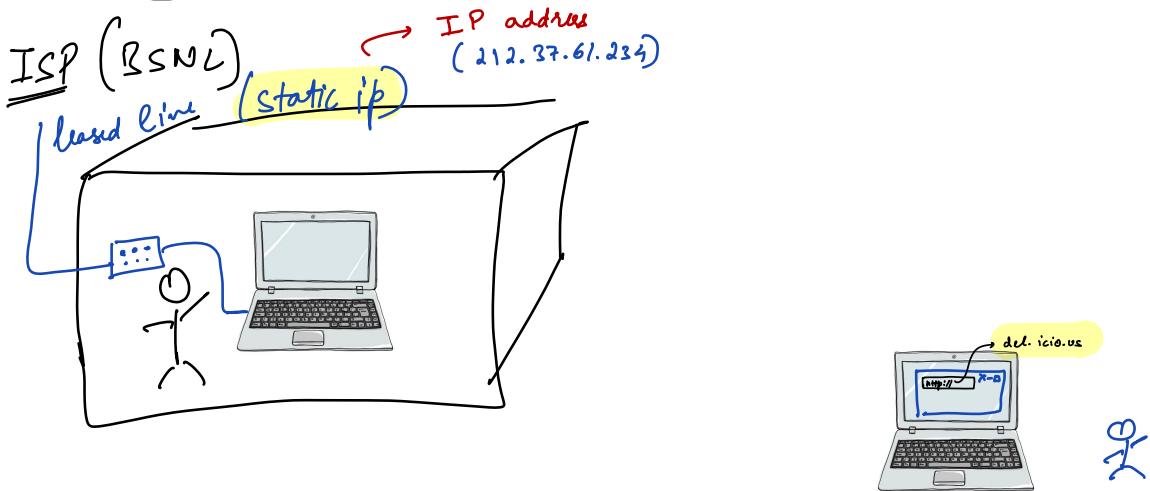


PHP

to be continued..



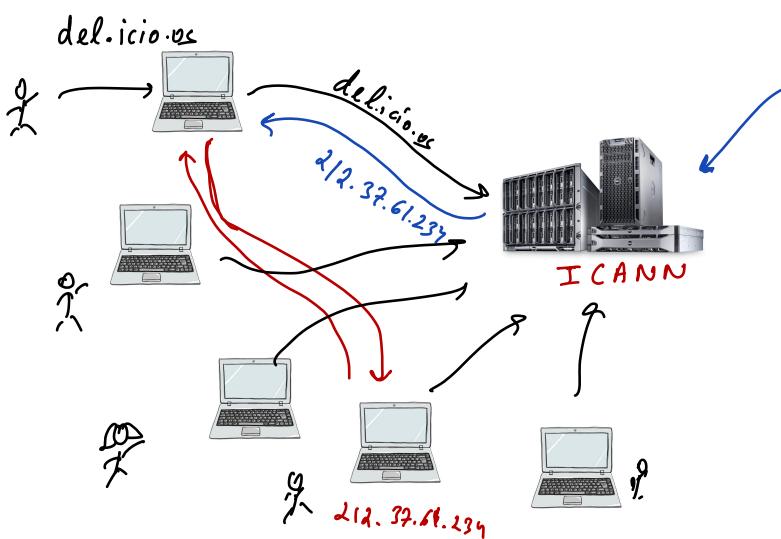
# Fantastic websites & where to find them



? Quiz How does the browser know which IP address to go to?

Domain mapping table

| Host name   | IP address    |
|-------------|---------------|
| google.com  | 172.----.---- |
| del.icio.us | -----         |
| ---         | ---           |
| ---         | ---           |

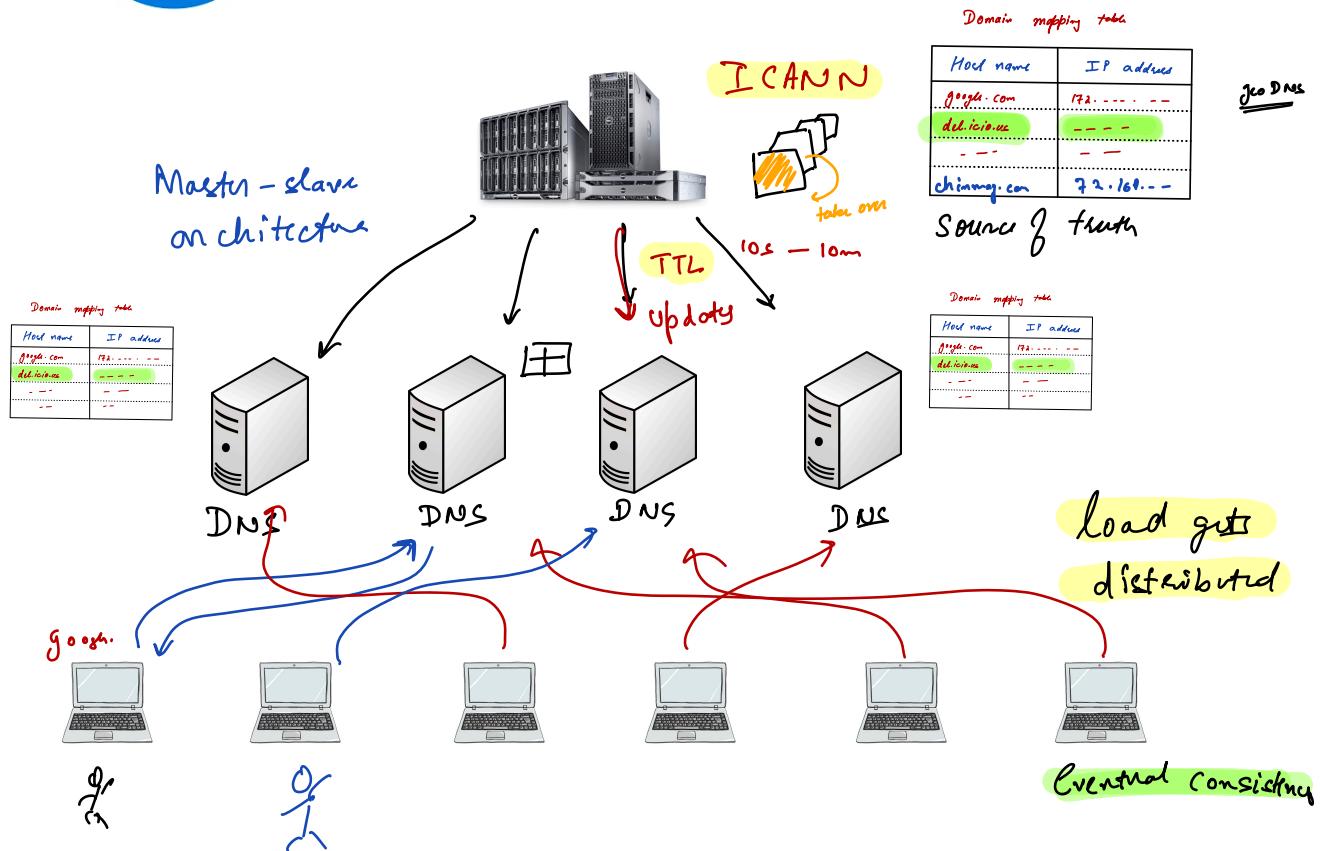


⚠ ICANN servers offline  
cache is busted (internet goes down)



# Domain Name Service

<https://www.cloudflare.com/en-gb/learning/dns/what-is-dns/>



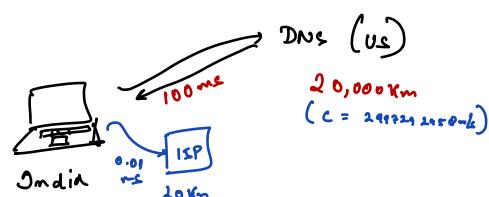
Who maintains the DNS?

any company that benefits from fast internet

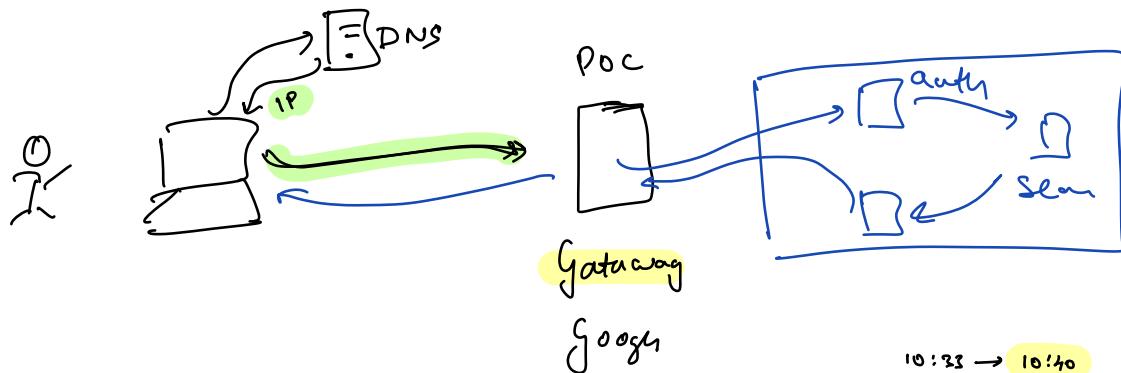
Google

ISP

Microsoft



Demos



10:33 → 10:40



# Del.icio.us

11:30  
L 8.4

continued..

2003

## System Configuration



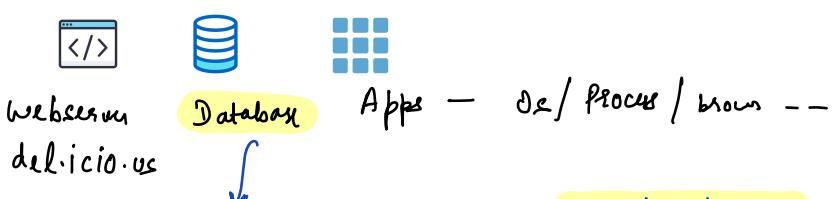
RAM 256 MB

Disk 40 GB

35,000ops

CPU Intel Duo Core  
2.7 GHz

NFS - MW



| User-id | url                  |
|---------|----------------------|
| 2       | wikipedia.com        |
| 2       | scala.com            |
| 3       | http://www.yahoo.com |

User-bookmarks

Users

each row  
? — requires

1000 bytes (1 KB)  
of space

int  $\frac{32}{64}$   
 $2^{32} \approx 4\text{ billion}$   
8 bytes

908 Bytes

? Quiz 1 KB data per record

1 million records each day

( $10^6$ )

$$\begin{aligned} & 1 \text{ KB} \times 1 \text{ Million} \\ & = 10^3 \times 10^6 \text{ Bytes} \\ & = 10^9 \text{ Bytes} \end{aligned}$$

Byte  
KB  
MB  
GB

$\rightarrow 10^3$   
 $\rightarrow 10^6$   
 $\rightarrow 10^9$

= 1 GB

Quiz

1 GB data each day

40 GB disk space

# of days that can be sustained

$$\frac{40 \text{ GB}}{1 \text{ GB/day}} = 40 \text{ day}$$



## Solutions

1. Buy better systems.



PC

100GB disk  
512 MB RAM  
dual core CPU  
CPU

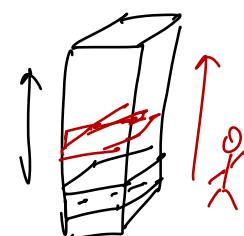
Special  
'Server'  
Hardware



→ 500 GB HDD  
5 CPUs  
2 GB RAM

↑  
Vertical Scaling

Server  
Racks

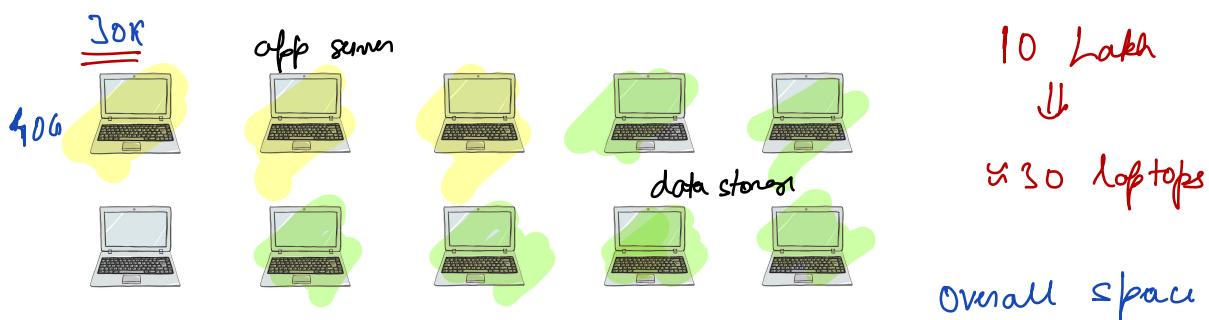


→ 2TB HDD  
5 CPU  
10 GB RAM

↓ more years

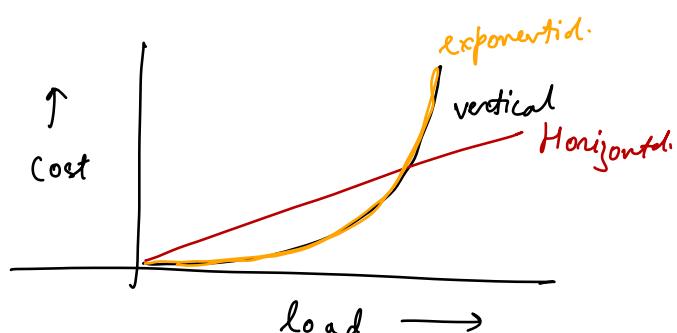
2. Most of the cheap laptops.

### Horizontal Scaling.



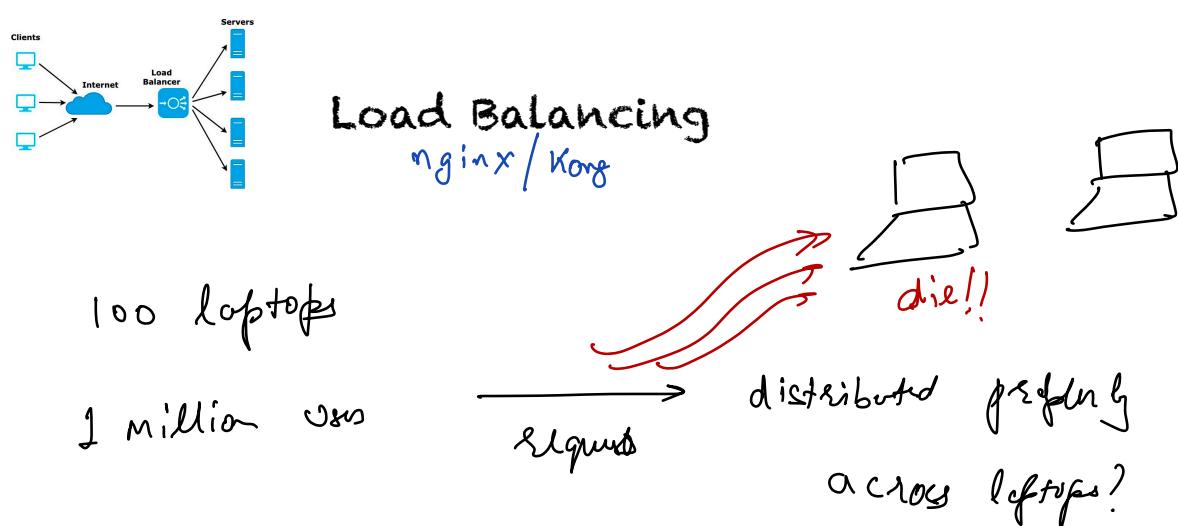
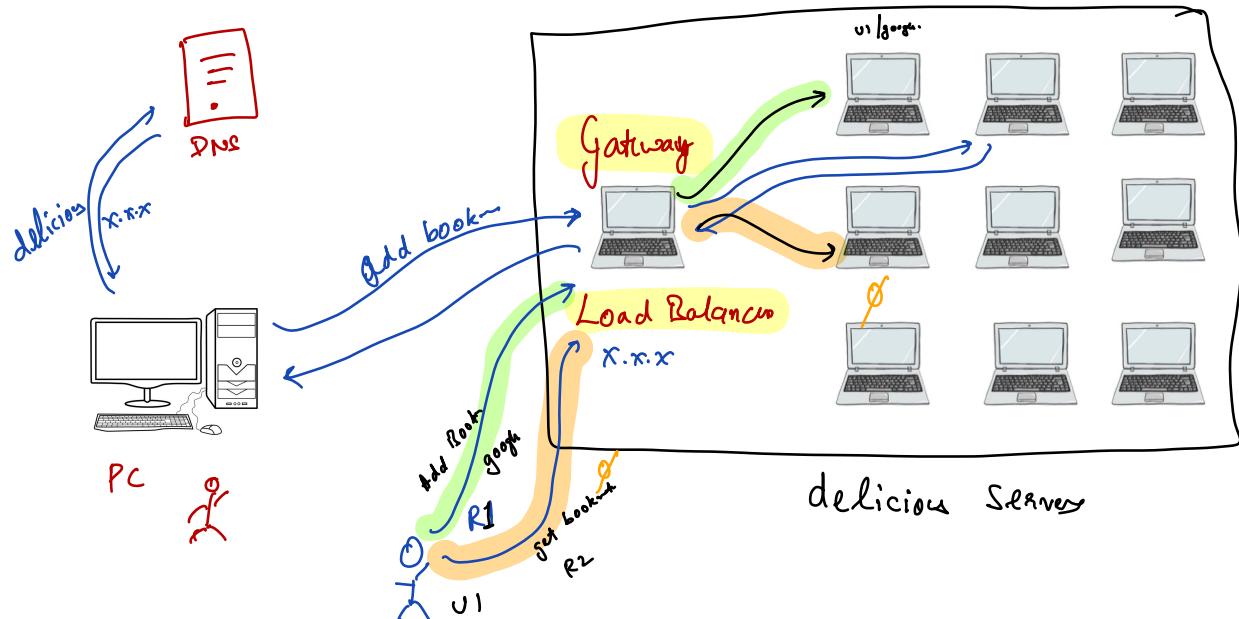
$$1 \text{ G} \Rightarrow 30 \text{ laptops} \\ = 12 \text{ TB } \{ \text{HDD}$$

- | Vertical                                                                     | Horizontal                                                                             |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>— Simple</li><li>— expensive</li></ul> | <ul style="list-style-type: none"><li>— lots of challenges</li><li>— cheaper</li></ul> |



- hard limit
- scale unlimited

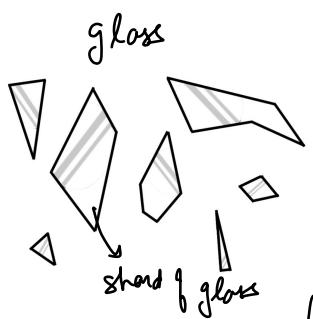
## Quiz



① Round Robin Policy → one by one  
to them start again



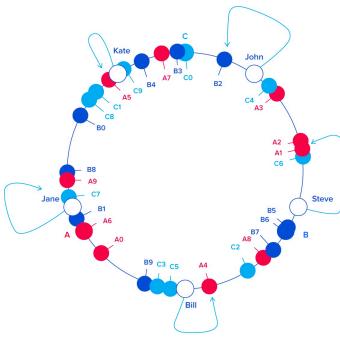
## Further Challenges



How to store the data?

Sharding / Partitioning

- ↳ On what key?
- ↳ What happens if a system goes down?
- ↳ Replication / redundancy
- ↳ New server comes up



Where to find the data?

consistent hashing

- ↳ down
- ↳ new sum
- ↳ new user registers

Prerequisites

- ↳ Master D S A
- ↳ Learn Networks
- OS memory mangmt
- DBMS
- ↳ LLD
- ↳ HLP

Projects

