Cloud Computing

DB Special Topics Lecture (10/5/2012)

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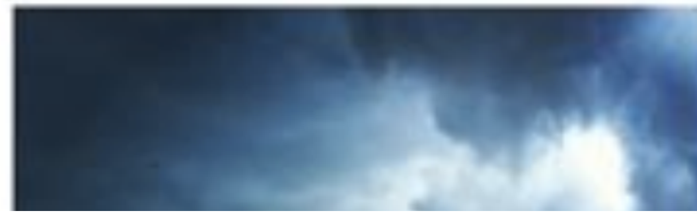
51% Of People Think Stormy Weather Affects 'Cloud Computing'

Jay Yarow | Aug. 30, 2012, 12:14 PM | 9,169 | 11

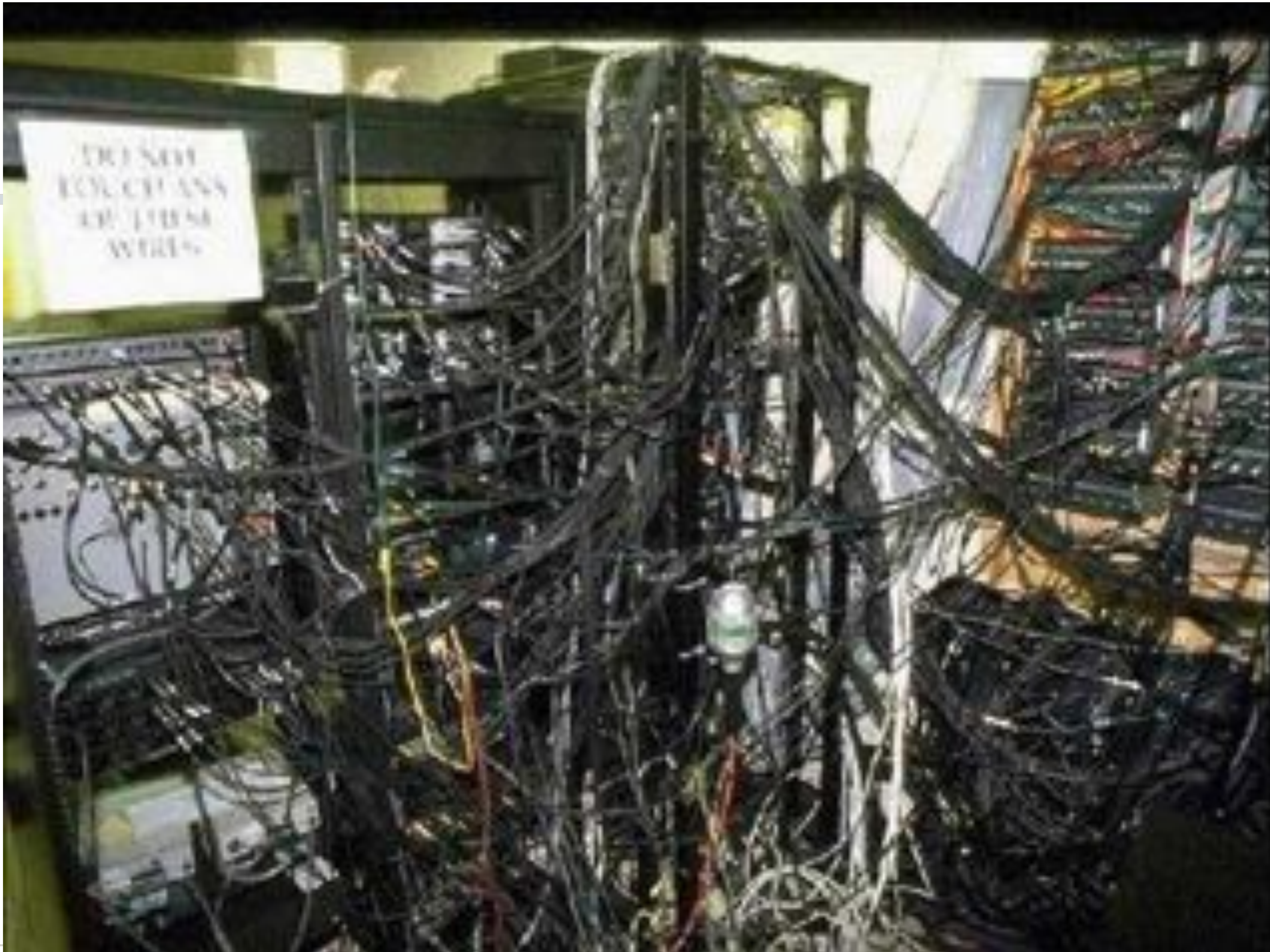


If there's a buzzword that's more soporific/confusing than "cloud computing" we're not sure what it is.

A survey from Citrix confirms that

Managing servers isn't for everyone…

- What are some prohibitive issues? (we touched on these last time)



- Cost (initial/operational)
- Setup/Software installation
- Manageability
- Space
- Development

So what is cloud computing?

- A shift in responsibility
- Let someone else manage hardware infrastructure/ software environment/applications
- But why “cloud”?

Cloud Service Models

The Usual Case

- You buy/manage/build everything

Infrastructure as a Service (IaaS)

- What are we buying here?
  - A remote machine (not necessarily a physical one!)
  - E.g. "I don't want to manage my own cluster!"

the rackspace cloud

openstack CLOUD SOFTWARE

GOGRID

Google Compute Engine

Windows Azure

amazon web services

SOFTLAYER

Why Virtualization?

- (Hardware virtualization)

Why Virtualization?

- Consolidation
- Flexibility for user (Pick your favorite OS)
- Flexibility for provider (live migration for load balancing, repairs, etc.)
- Performance (e.g. load user's OS image on close-by physical machine)

Platform as a Service (PaaS)

- What are we buying here?
  - A software/hardware framework to build applications on
  - E.g. "I don't want to setup MySQL/Apache/Oracle, I just want to write my web app!"

  - Bonus points: how is this different from a regular hosted environment?

Google App Engine

CLOUD FOUNDRY™

CITRIX®

Windows® Azure™

NETSUITE
ONE SYSTEM. NO LIMITS.

heroku

Software as a Service (SaaS)

- What are we buying here?
  - Functionality (business/personal)
  - We don't have to build anything
  - E.g. "I don't want to buy hardware or install software or write code, I just want to use it!"
  - Think, renting an application
- Bonus points: how is this any different from a webapp?

Some Common Properties of SaaS Applications

- Scales up/down based on usage
- Subscription-based
- Pay-per-use
- Multi-tenancy
- Customizable (e.g. for look-and-feel)
- Collaboration/sharing

Google Apps

Spotify

Cloud9 IDE

Your code anywhere, anytime

NETFLIX

PANDORA

Aviary

Benefits of SaaS

Benefits of SaaS

- Updating applications is easier
- Environment is (mostly) uniform -> portability
- Less worry about having an adequate machine
- Lower cost (for everyone)
- Simplified deployment

Cloud Issues/Problems?

- Weather is the least of them…

Trust

- Users must shift more trust to the provider…
- "Is my stuff going to disappear?"
- "Can someone else see my stuff?" (privacy)

Security

- Providers must protect their infrastructure and users' data
- More software layers (e.g. with virtualization) ➔ More security concerns to manage
- Are cloud administrators honest/vulnerable to social engineering? (also a question of trust)
- Can a provider segregate my data from other users?

Thin Clients

- As we move computation to cloud, need less on client-side
- Modest hardware
- Cheap
- In the Extreme: ultra-thin/zero client. Only enough system software (BIOS/kernel) to boot OS **from the network**
- Require network connectivity

Amazon EC2 demo…

Google Spanner

A globally distributed, temporally versioned database

Key features of Spanner

- Externally consistent global write-transactions with synchronous replication
- Non-blocking reads in the past
- Schematized, semi-relational data model
- SQL-like query interface
- Temporal versioning

Why make this?

- Traditional RDBMS
  - Normalized data
  - Transactions
  - Don't scale well to 'web size'
- NoSQL
  - Scale to size
  - No transactions
  - 'Eventually consistent' data

Why make this? (cont'd)

- People want
  - Scalability
  - Synchronously available data
  - Transaction support

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  - > Google Spanner

Design of Spanner

- "We believe it is better to have application programmers deal with performance problems due to overuse of transactions as bottlenecks arise, rather than always coding around the lack of transactions." – Google

Spanner Design: zones

- Spanner stores data in 'zones' in various 'universes'
- Zones provide
  - Physical isolation
  - Data locality

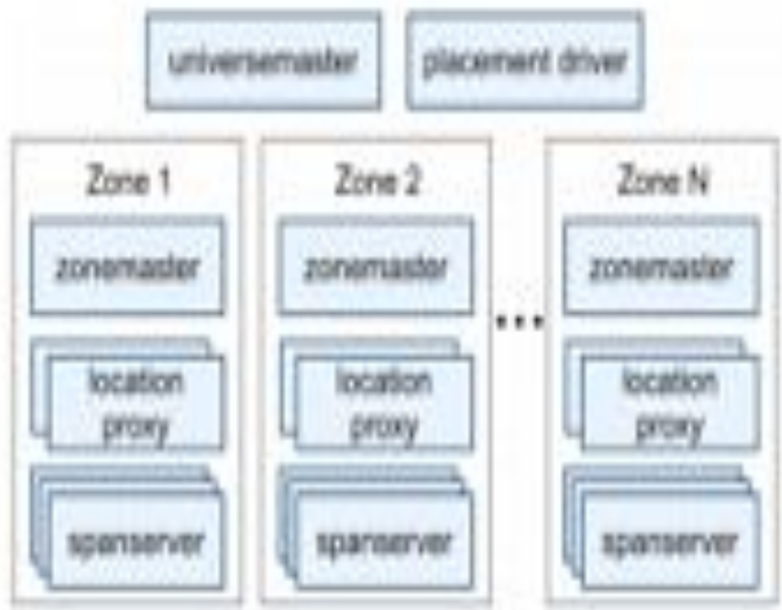


Figure 1: Spanner server organization.

Spanner Design: spanserver

- Transaction manager and lock table ensure concurrency
- Writes go through Paxos layer; non-blocking reads can go directly to data
- If only one Paxos group is involved, transaction manager is bypassed (most transactions)
- Data can be 'sharded' as necessary

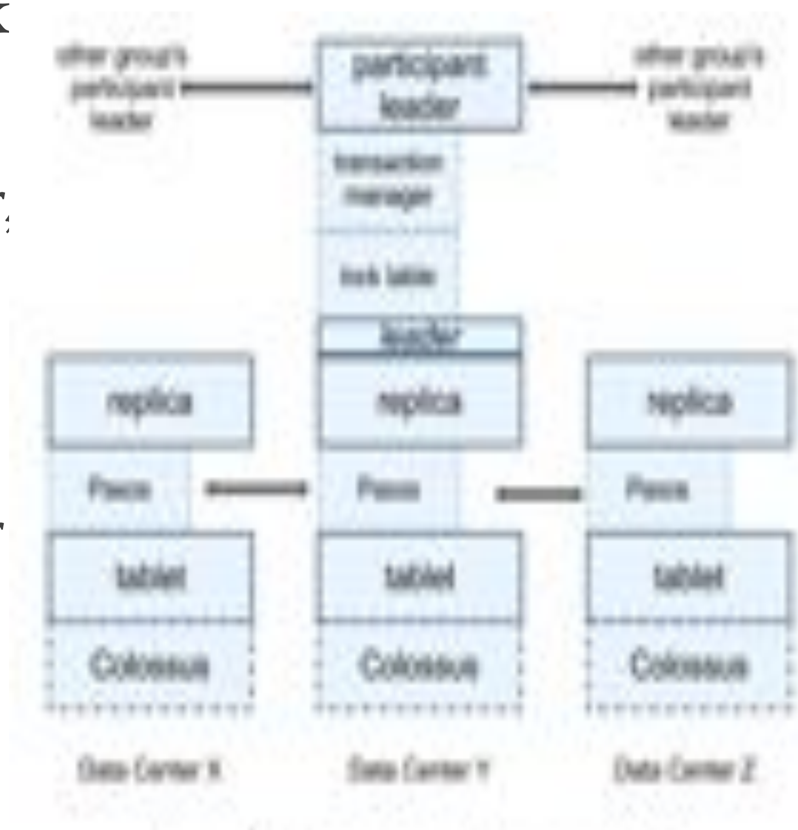


Figure 2: Spanserver software stack.

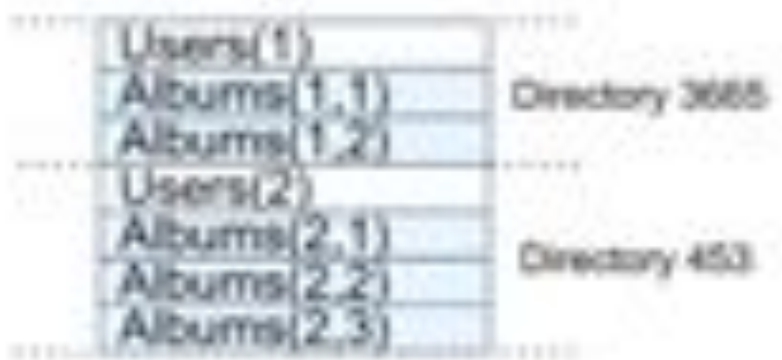
Spanner Design: Data Model

- Schematized semi-relational tables
- SQL-like language
- General-purpose transactions
- Synchronous replication
- An application can contain 1+ databases
  - Each db can contain unlimited number of schematized tables

Spanner Design: SQL

```
CREATE TABLE Users {
  uid INT64 NOT NULL, email STRING
} PRIMARY KEY (uid), DIRECTORY;

CREATE TABLE Albums {
  uid INT64 NOT NULL, aid INT64 NOT NULL,
  name STRING
} PRIMARY KEY (uid, aid),
  INTERLEAVE IN PARENT Users ON DELETE CASCADE;
```



Spanner Design: TrueTime

- Synchronicity is hard, especially across distributed data centers
- How do we solve this?

Spanner Design: TrueTime

- Synchronicity is hard, especially across distributed data centers
- How do we solve this?
- Atomic clocks and GPS!

Method	Returns
TT.now()	*TTinterval*: [*earliest*, *latest*]
TT.after(t)	true if t has definitely passed
TT.before(t)	true if t has definitely not arrived

Table 1: TrueTime API. The argument t is of type *TTstamp*.

Spanner Design: TrueTime

- Using the GPS and atomic clocks, Spanner can figure out serialization of transactions
- If the time uncertainty grows too large, Spanner slows down

What does this give us?

- Transactions!
- Consistent data!
- Global Scalability!
- Failure tolerance!

Drawbacks

- No offline access
- Average latency of ~10ms, but 100ms latencies should be expected (especially on multi-site writes)
- TrueTime requires special hardware (GPS + Atomic clock)