A Class of CAP-like Theorems

You can't quote me on any of this.

Talk outline

- Overview of the CAP theorem
- Aspects of the CAP theorem
- Alternative CAP Theorems:
  - relaxing consistency
  - changing the failure model
  - focus on transactions

What is CAP?

- Consistency
  - System property
- Availability
  - system property
- Partition-Tolerance
  - failure model (?)
- Pick at most two.

Which Consistency?

- linearizability - from the shared memory world.
- traditional "strong" consistency model
- all operations "appear" to happen at exactly one point
- wall-clock ordering is respected

Which availability and Partition tolerance

- infallible per-node internet link
  - cannot use for system traffic
- potentially-eliminable host-pair links
  - must use for system traffic
- availability: all nodes must respond to all internet-link traffic in finite time.
- partitions: any host-pair link can be removed at any time.

The variants

Many of these variants are real.

Several others are not my invention.

Try to pick out which are which!

The Not-A theorem

- strengthen failure model: all links are fallible
- upon receipt of user request, all system links destroyed.
- availability failure! NOT A!
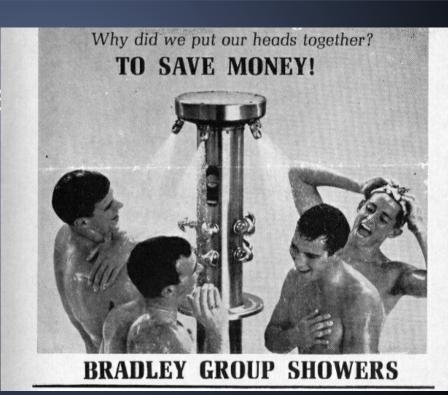
The perfect-world theorem

- weaken failure model - infallible links!
- (this corresponds to taking CA from CAP)

The SHOWER CAP theorem

- causal consistency
- partition-tolerance support

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Automata: the emissions CAP theorem

- define distributed system as Final Coalgebra
- failure model applies to transition matrix
- consistency model applies to emission Matirx
- CAP holds depending on emission Matrix.

Trying again! HAT Theorem

- highly-available transactions
- common isolation models work!
- kinda!

Database	Default	Maximum
Actian Ingres 10.0/10S [1]	S	S
Aerospike [2]	RC	RC
Akiban Persistit [3]	SI	SI
Clustrix CLX 4100 [4]	RR	RR
Greenplum 4.1 [8]	RC	S
IBM DB2 10 for z/OS [5]	CS	S
IBM Informix 11.50 [9]	Depends	S
MySQL 5.6 [12]	RR	S
MemSQL 1b [10]	RC	RC
MS SQL Server 2012 [11]	RC	S
NuoDB [13]	CR	CR
Oracle 11g [14]	RC	SI
Oracle Berkeley DB [7]	S	S
Oracle Berkeley DB JE [6]	RR	S
Postgres 9.2.2 [15]	RC	S
SAP HANA [16]	RC	SI
ScaleDB 1.02 [17]	RC	RC
VoltDB [18]	S	S

RC: read committed, RR: repeatable read, SI: snapshot isolation, S: serializability, CS: cursor stability, CR: consistent read

Adapting: COWBOY HAT

- Let's adopt incompatible models anyway!
- what could go wrong?

Adapting: COWBOY HAT

- Let's adopt incompatible models anyway!
- what could go wrong?

In summary:

- CAP
- Not-A
- SHOWER CAP
- HAT
- COWBOY HAT

There are more!

- baseball CAP
- newsCAP
- winter CAP
- (winter soldier) CAP

Evaluation

- Implemented in Fedora
- Results inconclusive
- one graph...

Human Computer Symbiosis (M = 1)