TACT: Tunable Availability and Consistency Tradeoffs for Replicated Internet Services

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Dynamic Replication in the Internet

- Replication for increased availability and performance
  - Internet makes the need real

- Static content replication: We know the answers
  - Static web pages
  - Images
  - Audio/Video

- Dynamic content replication? Still hard after decades of research
  - Airline reservation system
  - Online bookstore
  - Stock-trading system

- Key question: How to get consistency without sacrificing availability?
The World Today: A Switch

- Two choices

  - one-copy availability, weak consistency (Bayou, Coda, Ficus, etc)
  - strong consistency, reduced availability (replicated databases)
A Better Tomorrow: A Knob

- TACT: continuously tunable tradeoffs

- Consistency is continuous rather than binary for many Internet services
  - Airline reservation system: percentage of aborted reservations
  - Application-specific quantification of consistency
Quantifying Consistency in TACT

- In TACT

  **Consistency of a replica** = (Unseen Writes, Uncommitted Writes, Staleness)
  - *Unseen Writes*: Number of updates not seen by a replica
  - *Uncommitted Writes*: Number of uncommitted updates on a replica
  - *Staleness*: The age of the “oldest” update not seen by this replica
  - These metrics are directly related to the consistency observed by apps

- Arbitrary consistency level achieved by bounding three metrics
- At two extremes, TACT demonstrates the behavior of
  - Voting algorithm (read quorum 1; write quorum n)
  - Optimistic replication system
  - TACT’s goal is to provides everything in between
Trading Consistency for Availability

- Access to a service replica may be denied if specified consistency cannot be obtained due to partitions.

- The weaker the consistency level =>
  - The smaller set of servers that must be contacted to get consistency =>
  - The higher probability these servers can be contacted =>
  - The higher the availability

- Weaker the consistency level =>
  - Improved performance
Status and Future Work

- We are using simulation to:
  - Validate our consistency metrics
  - Validate TACT toolkit design

- Next step:
  - Prototype implementation
  - Sample Internet service implementation on top of TACT

- Further investigation of availability/performance/consistency tradeoffs
TACT: Turning the Switch into a Knob

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QUESTIONS?