Quasar: A Probabilistic Publish-Subscribe System for Social Networks

Bernard Wong and Saikat Guha

Cornell University

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Contribuition

Quasar

A simple efficient topic-based publish-subscribe system for unreliable data
Problem Statement

Topic-based pub-sub routing that . . .

► more efficient than flooding, simpler than DHT
  ► trades off reliability
► works with many overlays
  ► Latency-aware, unstructured, social-networks, . . .
  ► Good for small-world network
► does not use rendezvous nodes
  ► Avoid hot spots, single points of failure
► supports a large number of topics
  ► Cheap subscribe and unsubscribe process
Quasar: Summary

- Limited proactive dissemination of positive information
- Per-message negative information
- Combination of parallel random walks and directed routing
Quasar: Big Picture

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Quasar: Probabilistic Public-Subscribe
Subscriptions disseminated proactively to a fixed depth: gravity well
Subscriptions disseminated proactively to a fixed depth: gravity well
Different topics create own gravity wells
Message routed by random walk until reaching a gravity well
Message routed progressively closer to node in gravity well
Multiple walks issued simultaneously
Quasar: Big Picture

Messages republished for greater coverage
Duplicates suppressed (Unique message ID)
Random-walk length limited (TTL)
Republishing limited (Generation count)

... and, of course, topic ID and negative information
Problem: Self-loops
Quasar: Big Picture

Problem: Self-loops
Gravity wells indexed by topic ID as well as node ID
Effects of gravity well nullified per message
Nullifying a gravity well does not affect overlapping gravity wells
Nullifying a gravity well does not affect overlapping gravity wells
Multiple gravity wells can be nullified for a message
Quasar: Big Picture

Details: soft state, attenuated bloom filters. See paper
Properties

- Per-Node State
  - Depends on the density of subscriptions
  - Not on the total number of nodes or topics
  - Can be controlled by choice of overlay

- Stretch
  - Ratio of hops in Quasar to a dissemination tree
  - Depends on the density of topic subscribers
  - Can be controlled by higher layers

- Coverage
  - Fraction of topic subscribers receiving the message
  - Seems to be independent* of system size!
  - Perhaps dependent on the underlying overlay?

*Based on our simulations
Evaluation

- Custom simulator
- Number of nodes between 1K–32K
- Topic sizes sampled from MySpace
  - By scraping public profiles
  - Mostly individuals
  - Some communities
- Approx 17.5K users
- Topic size: \( \sim 1.5K \) average, \( \sim 37 \) online
  - 33% topics have < 10 online users
- Also simulated synthetic topic sizes
  - Constant size
  - Size proportional to network size
Stretch

![Graph showing stretch versus number of nodes for Myspace samples.](image)

- **X-axis:** Number of nodes (log scale)
- **Y-axis:** Stretch (vs. shortest-path tree)
- **Group Size:** Myspace samples

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Quasar: Probabilistic Public-Subscribe
Coverage

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Quasar: Probabilistic Public-Subscribe
Quasar, only a small piece of the puzzle

- **Reliability layer**
  - Reactive or periodic polling
  - Erasure coded messages

- **Privacy and Security layer**
  - Can we do onion routing on top of Quasar?

- **Persistence layer**
  - A distributed object store on top of Quasar
  - One topic per object
  - Replication and reliability under the hood
  - Peer-to-peer photo sharing (ala Flickr)
Summary

- Quasar: publish-subscribe routing primitive
  - Best effort (probabilistic)
  - Overlay agnostic (unstructured)
  - Scalable (number of nodes and topics)
- Building P2P applications by composing layers
- Coming soon: reliability and persistence layers
This is not the slide you are looking for.