A Peer-to-peer XML Database

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Introduction

- Short history of the Internet and P2P systems
  - DNS, Usenet
  - Moving to client/server model
- Trends
  - Moore’s law in the real life
  - More freedom from the infrastructure
Current Status

Systems
- Content sharing
  - Napster, Gnutella, KaZaA, eDonkey, OverNet
- Content storing
  - OceanStore, Freenet, Past, GNUNet

Drawbacks
- Working on the file level
- File not writable after storing
- Poor searching capabilities

Motivation

A P2P database could be useful as
- A basis for P2P applications
  - Resource sharing
  - Data sharing
- An ad-hoc storage
  in business processes and workflows
- A distributed discovery service
- A storage for sensor and ad-hoc networks
- A distributed index for the Web
- A service for Grid computing
Example 1: Content Sharing

KaZaA, Gnutella or similar...

Sharing of metadata about songs (author, title, location,....)

Example 2: Ad-hoc Storage for Web Services

Company

Customer

Billing 1

Billing 2
Example 4: Sensor Networks

Measuring current, gas, water spending

Related Work

- Distributed databases
  - XPRS, Gamma, Teradata, Tandems NonStopSQL
- Distributed filesystems
  - NFS, AFS, xFS
- Drawbacks:
  - Made for stable, well connected environments
  - Crashed node eventually replaced
  - Global system view
Related Word (contd.)

- Existing P2P storages
  - OceanStore, Freenet, GNUNet, Freehaven
- Drawbacks:
  - Coarse-grained granularity
  - Lack of relationships among stored objects
  - Updating difficulties
  - Limited querying possibilities

Proposed Solution

- XML documents are spread in the community
- Peers store only document parts
- Documents are modified by the community during the system run-time
- P2P XML datastore mimics DOM interface
- Every XML document has a tree representation
- Tree structures can be represented using hash table structures
- Distributed tree -> DHT
P2P Datastore challenges

The same like in classical databases

- Durability
- Consistency
- Reliability
- Concurrency and transactions
- Security
- Scalability

Tree Operations

- Creating a root node
  - Who will create the root?
- Getting a node
  - Figuring out what is the current value
- Updating a node
  - Propagate changes to all replicas
- Adding a node
- Removing a node

Node reference is DHT key
DOM Particularities

- Serialized objects are DOM sub-trees
- Managing all nodes separately has drawbacks:
  - Complicated undo
  - Objects spread across many peers
  - Objects consume larger portion of key space

Querying

- XPath and XQuery use DOM for accessing XML documents
- It is possible to apply them directly on the top of proposed storage
- Index structures are needed to get decent performances
Summary

Peer-to-peer is a hype today

Peer-to-Peer can be a powerful architecture
  ▶ Scalability, availability, flexibility, ...

But we need a more sophisticated data management
  ▶ Proposed P2P DOM for data storage