PIX-Grid: A Platform for P2P Photo Exchange

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Overview

- Motivation
- Brief overview of the P-Grid P2P system
- PIX-Grid functionalities
  - Structured search
  - Interoperability
  - Authorization and access
  - Information dissemination
  - Handling hot-spots
- PIX-Grid architecture
- Status and conclusions

Motivation

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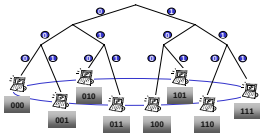
  - Powerful cell phones and new protocols (MMS)
  - Powerful digital cameras (partly integrated with phones)
  - Users interested in sharing and finding photos
  - Devices already produce some meta-data (date, time, GPS coordinates, user, etc.)
  - ⇨ Large-scale system to study (P2P, self-organization, etc.)
- Requirements
  - Powerful (structured) search functionality
  - Emergent, incremental ontologies
  - Decentralized peer-to-peer system
  - Self-organizing system (minimal maintenance)

P-Grid [Aberer01, Aberer02]

Goal
Scalability through self-organization

Properties
- Scalable, distributed search tree: distributed hash table (DHT)
- Randomized algorithms
- Purely local decisions
- Efficient search and load balancing
- Robust through massive replication
- Support for updates
- Support for identification
- Semantic integration
- Java implementation

http://www.p-grid.org/

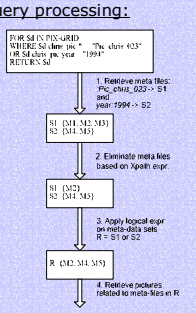


Applications
- Trust assessment of peers
- Peer commerce
- Scalable, semantic Internet search
- Decentralized public key infrastructure

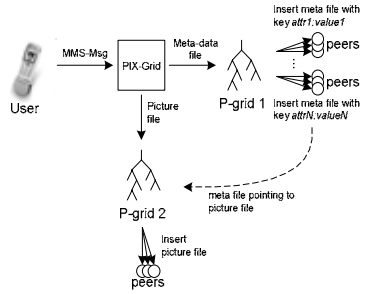
XPath-like structured search in PIX-Grid

- DHTs allow equality search (only CAN and P-Grid can do substring search)
- How to support structured search in DHTs (brute force):
  - Index data files based on filename
  - Meta-data (XML) files reference filenames
  - Index all *attribute-name:value* expressions in meta-data files plus their *suffix closure* to enable substring search
  - Queries use index plus some post-processing to emulate XQuery/XPath like behavior

Query processing:



Inserting a photo into PIX-Grid



Mobility support

- Peer (phone) goes offline and comes online again
  - Other peers must be able to detect a different peer at the old address of the offline peer
  - Peer comes only again and must communicate its new address to the system securely (changes the routing)
- Approach [Hauswirth03]:
  - Self-signed certificates for secure identification
  - Replication
  - PGP-like security guarantees (multiple paths)
  - Based on P-Grid

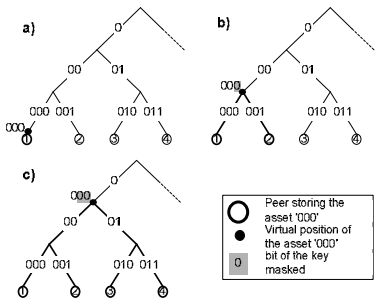
Authorization and access

- Offer access only to certain users / user groups
- Prerequisites
  - Public key infrastructure (PKI)
  - Identification service
- Approach
  - Distributed PKI based on identification service [Datta03]
  - Based on P-Grid
  - Standard distributed authorization and access schemes

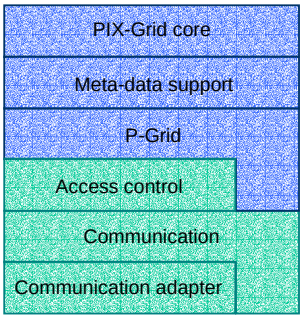
Information dissemination

- P-Grid and DHT are great for discovery
- What about notification?
- Simple P/S system
  - Index queries/filters
  - New content is matched against indexed queries/fliters
- Ultimate goal: "permanent" queries/filters
- Requires in-depth analysis and research

Handling hot-spots [Cudré-Mauroux02]



PIX-Grid architecture



Status and conclusions

- PIX-Grid defines part of our research plan rather than an existing system
- Current work focuses around providing structured search (XPath expressions)
- P2P photo sharing has the potential to be a new killer application
- If many people use PIX-Grid we have the possibility to study many interesting phenomena in a large-scale, real-world system

References

- [Aberer01] Karl Aberer: *P-Grid: A self-organizing access structure for P2P information systems*. Sixth International Conference on Cooperative Information Systems (CoopIS 2001), Trento, Italy, September 5-7, 2001.
- [Aberer02] Karl Aberer, Manfred Hauswirth, Magdalena Punceva, Roman Schmidt: *Improving Data Access in P2P Systems.* IEEE Internet Computing, 6(1), January/February 2002.
- [Cudré-Mauroux02] Philippe Cudré-Mauroux, Karl Aberer: *A Decentralized Architecture for Adaptive Media Dissemination*. IEEE International Conference on Multimedia and Expo (ICME 2002), Lausanne, Switzerland, 2002.
- [Datta03] Anwitaman Datta, Manfred Hauswirth, Karl Aberer: *Beyond "web of trust": Enabling P2P E-commerce*. To be published in the Proceedings of the IEEE Conference on Electronic Commerce (CEC'03), June 24-27 2003, Newport Beach, California, USA.
- [Hauswirth03] Manfred Hauswirth, Anwitaman Datta, Karl Aberer: *Efficient, self-contained handling of identity in Peer-to-Peer systems*. Technical Report TR-IC-2003-36, École Polytechnique Fédérale de Lausanne. Submitted to IEEE Transactions on Knowledge and Data Engineering.

