HyperCuP – P2P Network

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Outline

- HyperCup: What is it?
- Basic Concepts
- Broadcasting Algorithm
- Topology Construction
- Ontology Based Routing
- Related Work
What is it?

- HyperCuP: HyperCube P2P network
  - Cayley Graph
  - Efficient broadcast and search
    - Reach all nodes in the network with the minimum number of messages possible
  - Efficient topology construction and maintenance algorithm
    - Not require central servers
Basic Concepts for HyperCube

- Consists of $N=b^{L_{\text{max}}+1}$ nodes
  - Base $b$: number of nodes in one dimension
  - $L_{\text{max}}+1 =$ number of dimensions
  - Each node has exactly $(b-1)(L_{\text{max}}+1)$ neighbors
  - Shortest path between two most distant nodes=$\log_b N$
- Neighbor link set
  - $\{0,1\}$ leads from node 4 to 7 or from 2 to 8
Basic Concepts for HyperCube

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Basic Concepts for HyperCube

- Symmetric
  - No node incorporates a more prominent position than others (load balancing)
  - Every node can be the root for the spanning tree

- Connectivity
  - Removed nodes doesn’t lead to disconnecting the graph
  - No hampering search and broadcast
Hypercube Broadcast

- Broadcast with non-faulty nodes
  - Each node broadcasts message in sub-hypercube denoted by dimension of link on which it received the broadcast message
  - Tag message with dimension of link on which it is sent and forward message only on links of higher dimension
Nodes can join at any node in the network
No central servers, no super nodes
Reasonable message complexity for node joins and departures – clearly below $O(n)$
Recovering from sudden node departures
Resiliency towards temporary node failures
Algorithm

- Nodes take over responsibility for more than one position

- Node departures: Neighbors of a departing node jump in to cover the position(s) previously occupied and covered by the departing node
  - Complete hypercube topology is collapsed and stored among the existing nodes, allowing for any number of nodes in the network

- Node arrivals: Collapsed topology is reconstructed, new node takes over responsibility for one or more positions
  - Unfold topology by retrieving topology information from nodes in the network
Topology Construction I

I

II

0 0 1
1 1,0 1

0 1

3 0 2
1 1

0 0 1

2

3
Topology Construction II

III

IV

[Diagram of network structures with labels 0, 1, 2, 3, 4, 5 and numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 on the edges]
Topology Construction III
Topology Construction IV

VII 3 Hypercube

[Graph showing the 3 Hypercube topology]
Ontology-based Routing

- Goal: Use additional global knowledge to improve search performance of P2P network
- Partitioning of network into concept clusters
  - Clusters are assigned to concepts organized in an ontology
Related Work

- Implemented functions:
  - creating new networks
  - connecting peers
  - sending messages
  - cloning nodes

- Things to be done:
  - explicit disjoining peers
  - implicit disjoining peers
  - repairing network state
Thank You !