

HyperCuP – P2P Network

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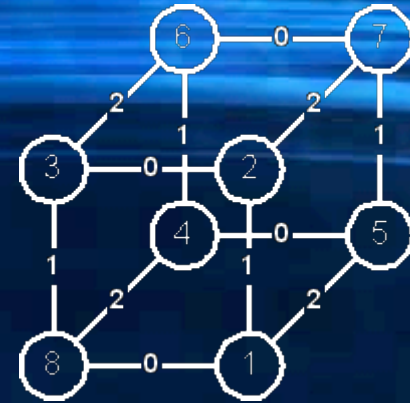
Outline

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

What is it?

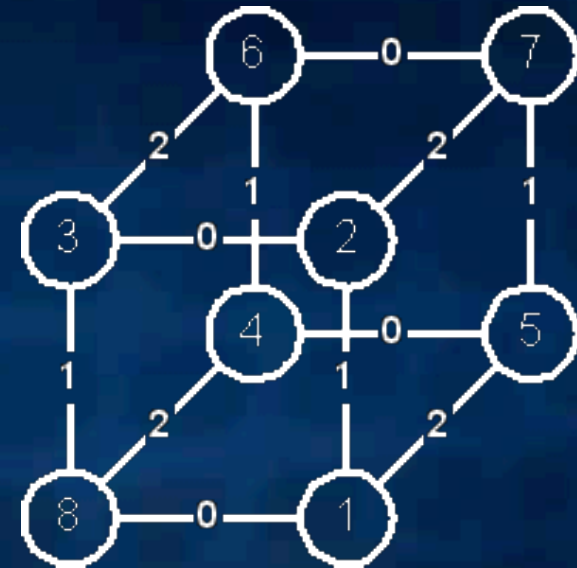
- ❑ HyperCuP: HyperCube P2P network
 - ❑ Cayley Graph
 - ❑ Efficient broadcast and search
 - ❑ Reach all nodes in the network with the minimum number of messages possible
 - ❑ Efficient topology construction and maintenance algorithm
 - ❑ Not require central servers

Basic Concepts for HyperCube



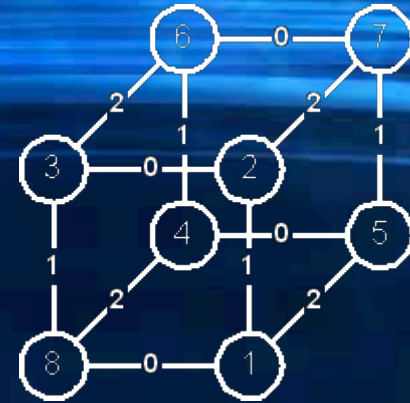
- ❑ Consists of $N = b^{L_{\max}+1}$ nodes
 - ❑ Base b : number of nodes in one dimension
 - ❑ $L_{\max}+1$ = number of dimensions
 - ❑ Each node has exactly $(b - 1) \cdot (L_{\max}+1)$ neighbors
 - ❑ Shortest path between two most distant nodes = $\log_b N$
 - ❑ Neighbor link set
 - ❑ $\{0, 1\}$ leads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

Basic Concepts for HyperCube



- Neighbor link set
 - $\{0,1\}$ leads from node 4 to 7 or from 2 to 8

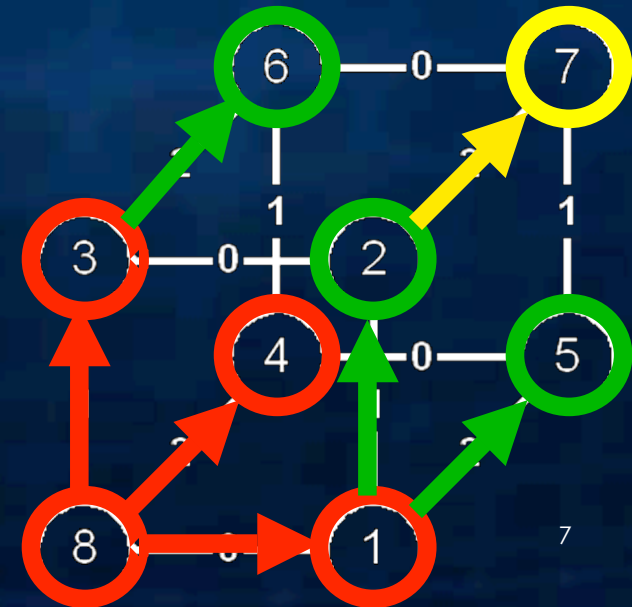
Basic Concepts for HyperCube



- ❑ 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



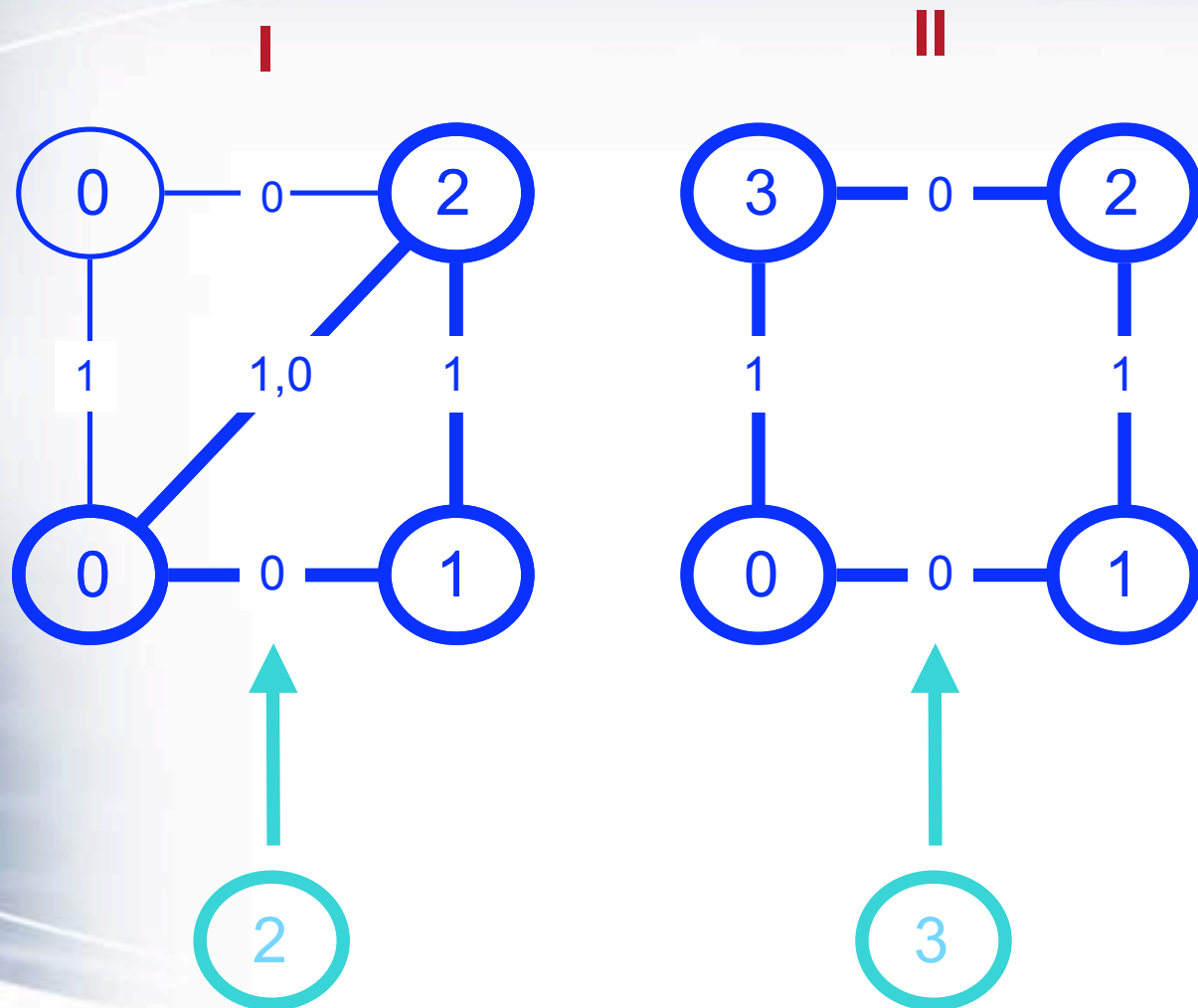
Topology Construction and Maintenance Algorithm

- ❑ 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

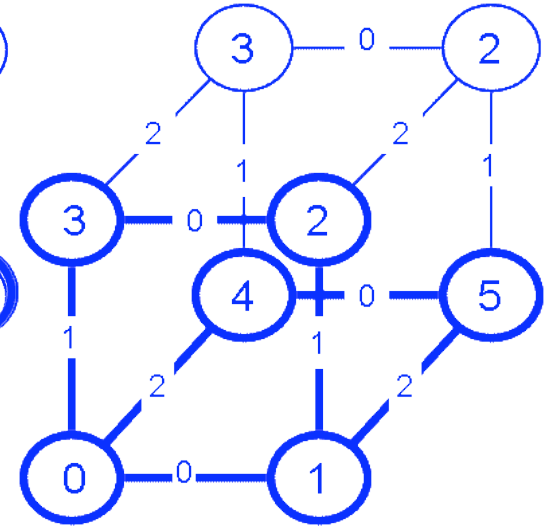
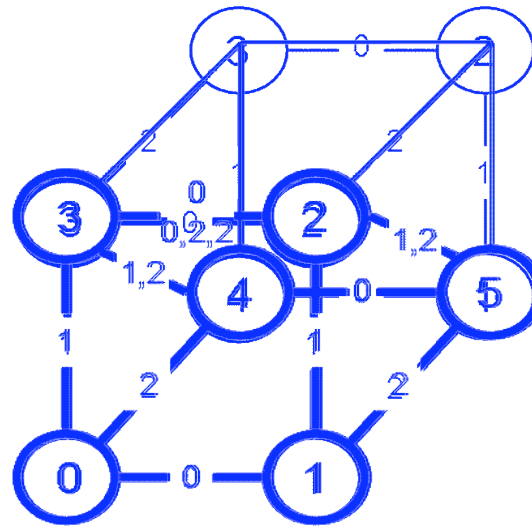
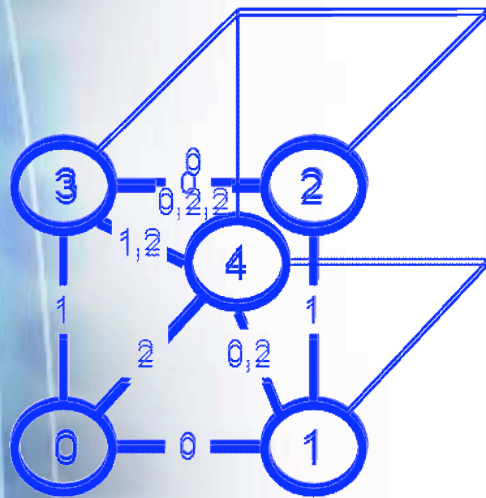
Topology Construction I



Topology Construction II

III

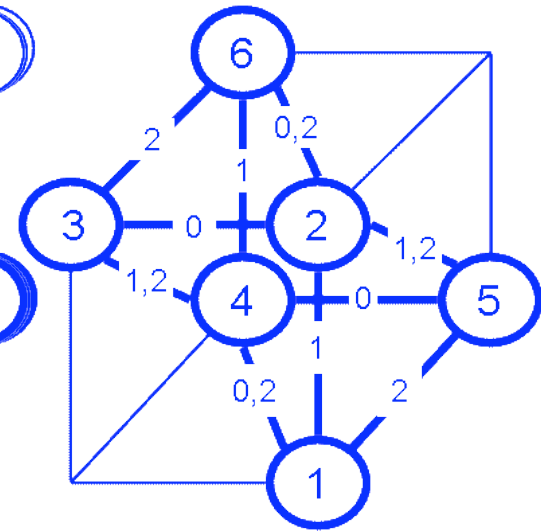
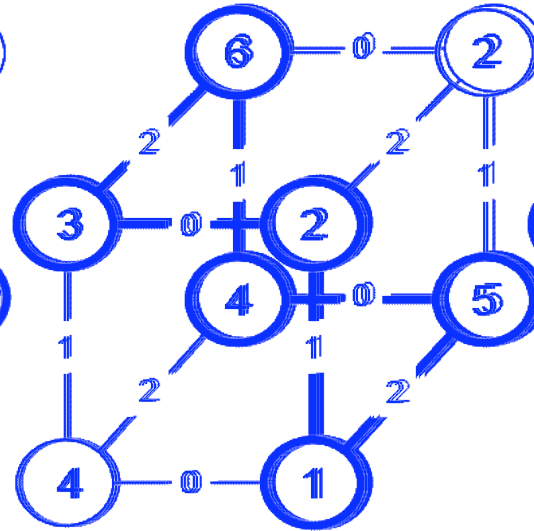
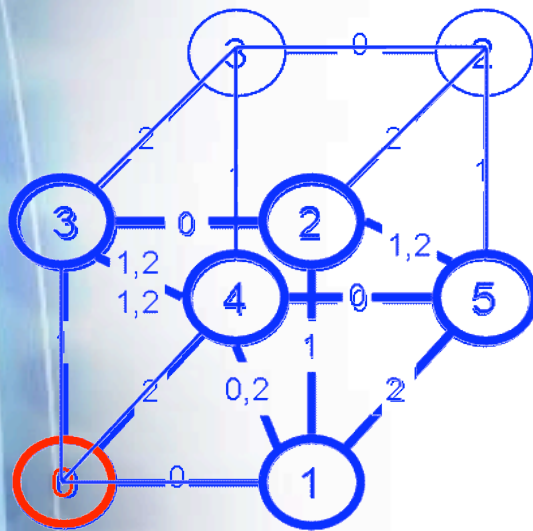
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Topology Construction III

V

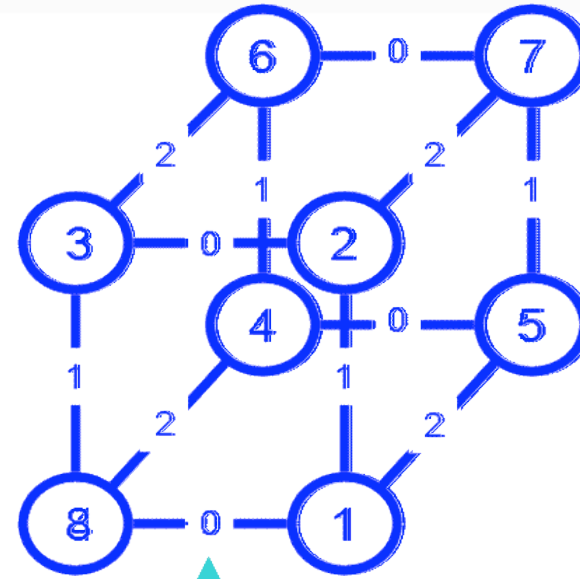
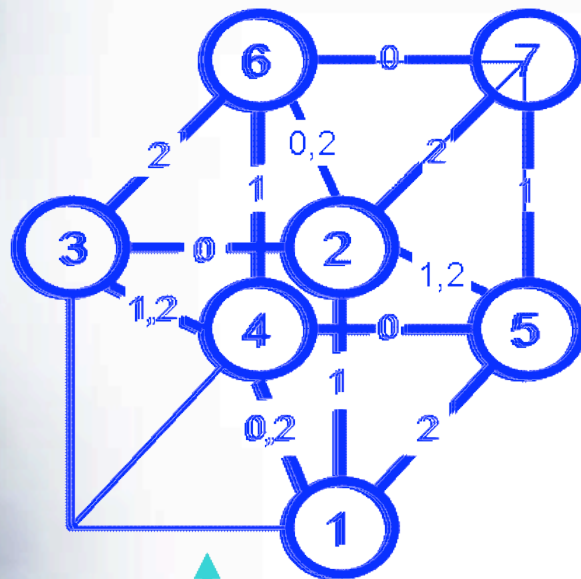
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Topology Construction IV

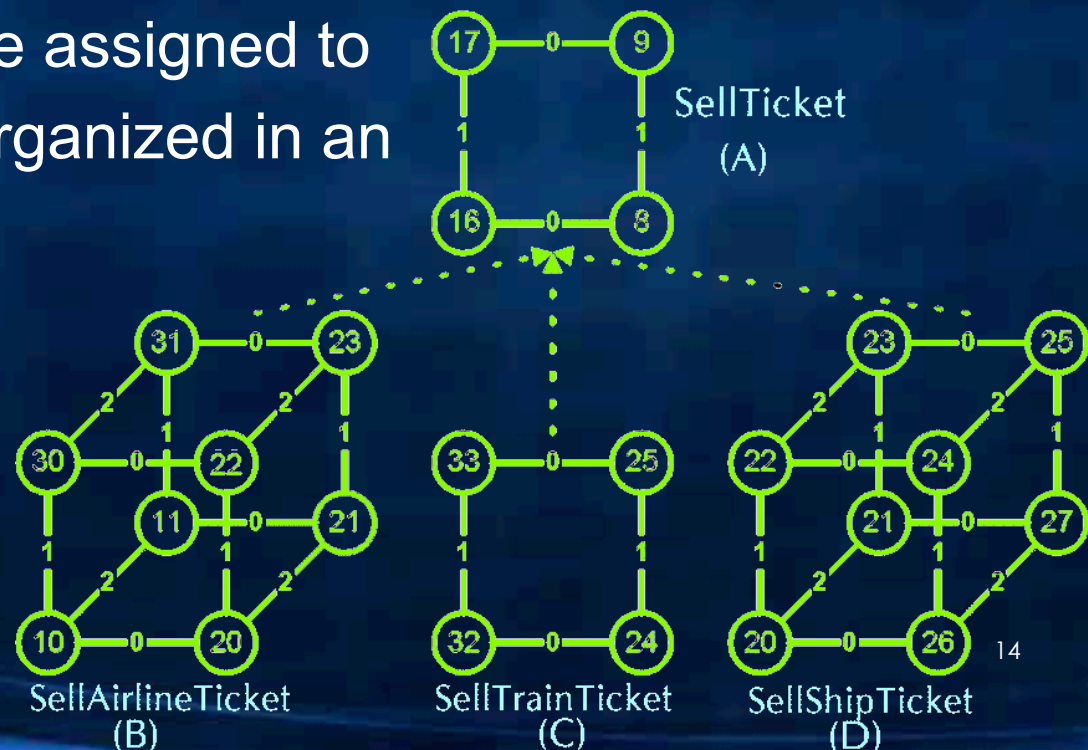
VII

3 Hypercube



Ontology-based Routing

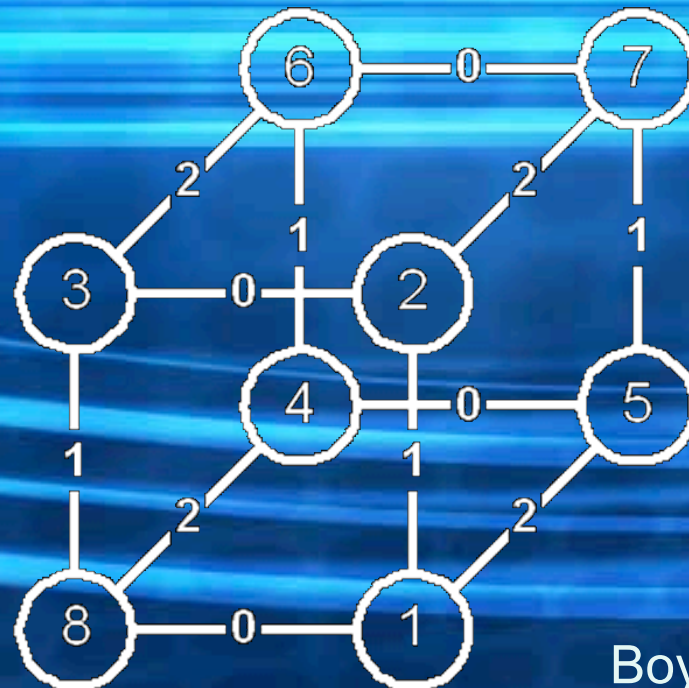
- ❑ Goal: Use additional global knowledge to improve search performance of P2P network
- ❑ Partitioning of network into concept clusters
 - ❑ Clusters are assigned to concepts organized in an ontology



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 !



Boyko Syarov