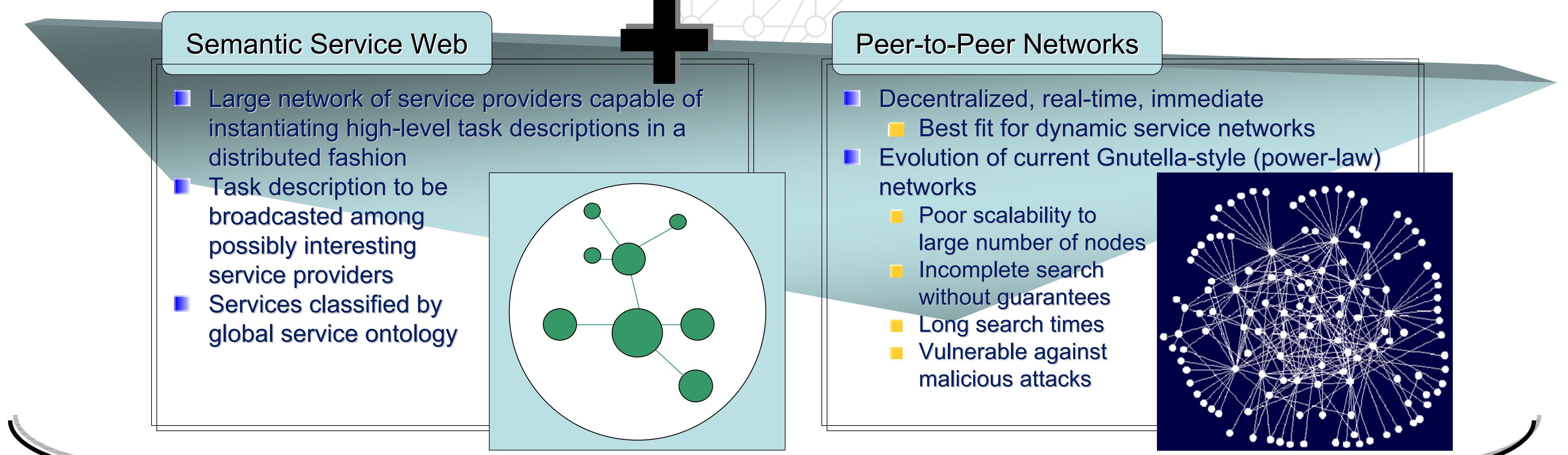
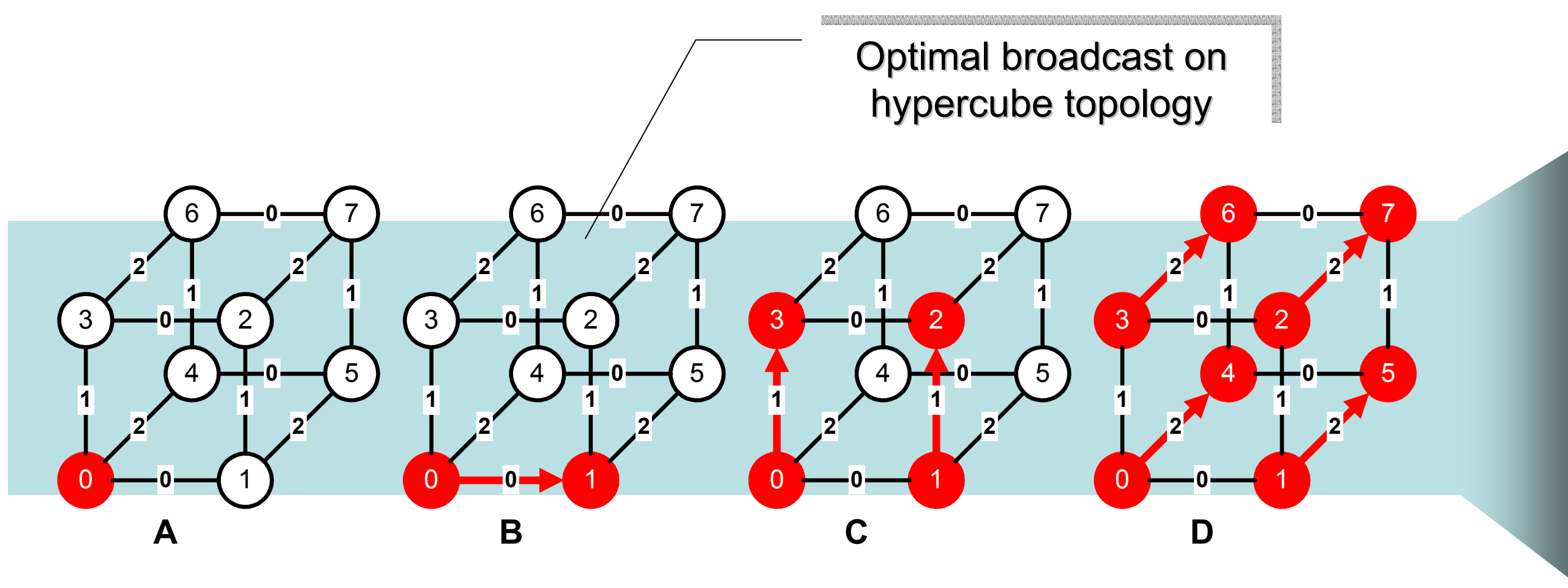


HyperCuP – A Scalable and Ontology-Based Peer-to-Peer Infrastructure for Semantic Web Services

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Deterministic and Semantically Organized Network Topology

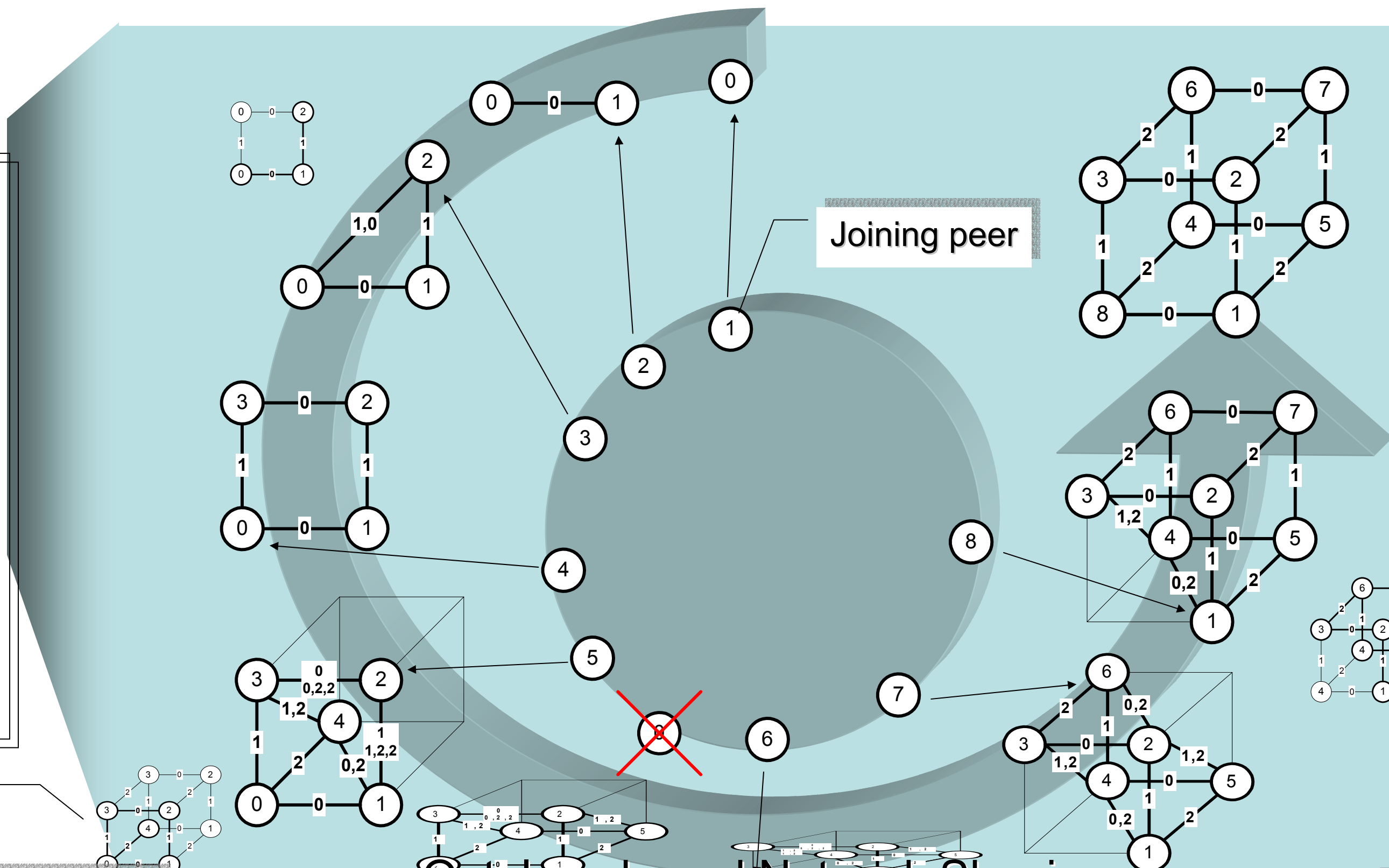


Hypercubes: A Deterministic P2P Topology

- Interesting topology properties
 - Logarithmic diameter – bounded search times
 - Vertex symmetry – load balancing over nodes
 - Fault tolerance – protection against attacks
- Efficient search and broadcast algorithms
 - Optimal broadcast, one message per peer
 - Shortest path routing to any peer

Distributed Topology Construction

- Properties
 - Decentralized: No central servers, no super peers
 - Message and time complexity: Logarithmic to number of peers in the network
 - Self healing: Recovery from node failures
- Algorithm
 - Always implicitly maintain topology of next biggest hypercube in node connections
 - Remaining nodes cover positions of departing nodes based on deterministic buffering scheme
 - Arriving nodes are able to join via any peer in the network and take over position(s) in the hypercube



1

Network Topology

2

Ontology-Based Construction Routing

Storage and concept coordinates
 External address: Peer's storage address sub-ontology
 str: {0,1,0}, concept coordinates: {0,1,0} denote support of concept B

Ontology-based Network Shaping

- Concept-driven peer clustering
 - Hypercube network is decomposed into concept clusters, containing peers associated with a particular combination of ontology concepts supported by those peers
 - Concept clusters are sub hypercubes of top hypercube
 - Addressing scheme: Ontology concept coordinates represent logical conjunction of supported concepts, storage coordinates allow for multiple peers per cluster
- Algorithms
 - Shortest path routing on ontology coordinates
 - Flooding optimal broadcast on storage coordinates to reach all peers in concept sub hypercubes
 - Restricted optimal broadcast on ontology coordinates and logic minimization to answer queries consisting of conjunctions and disjunctions of ontology concepts
- Scales to millions of peers while allowing for complex queries and providing search guarantees at optimal routing behavior

Ontology-Based Construction Routing