PyraNet: An Efficient and Reliable Pyramidal Wireless Sensor Network

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Outline

- Introduction
- Proposed Architecture
- Simulation results
- Conclusions

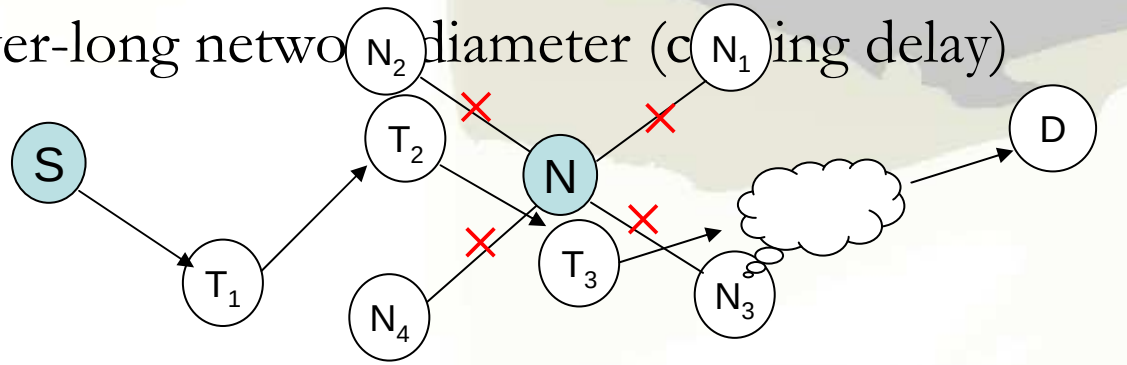
Introduction(1/3)

- Pre-configured WSNs can achieve better efficiency
  - fault-tolerance ability
  - real-time communication
  - high throughput
- Making them suitable for emergency situations
  - fire accident
  - traffic control
  - building monitoring

Introduction(2/3)

- Current Pre-configured WSN topologies
  - Grid topology
  - Hexagonal topology
  - de Bruijn topology

- Common flaws
  - 1) Limited neighbors for each node
  - 2) Over-long netwo diameter (c ing delay)

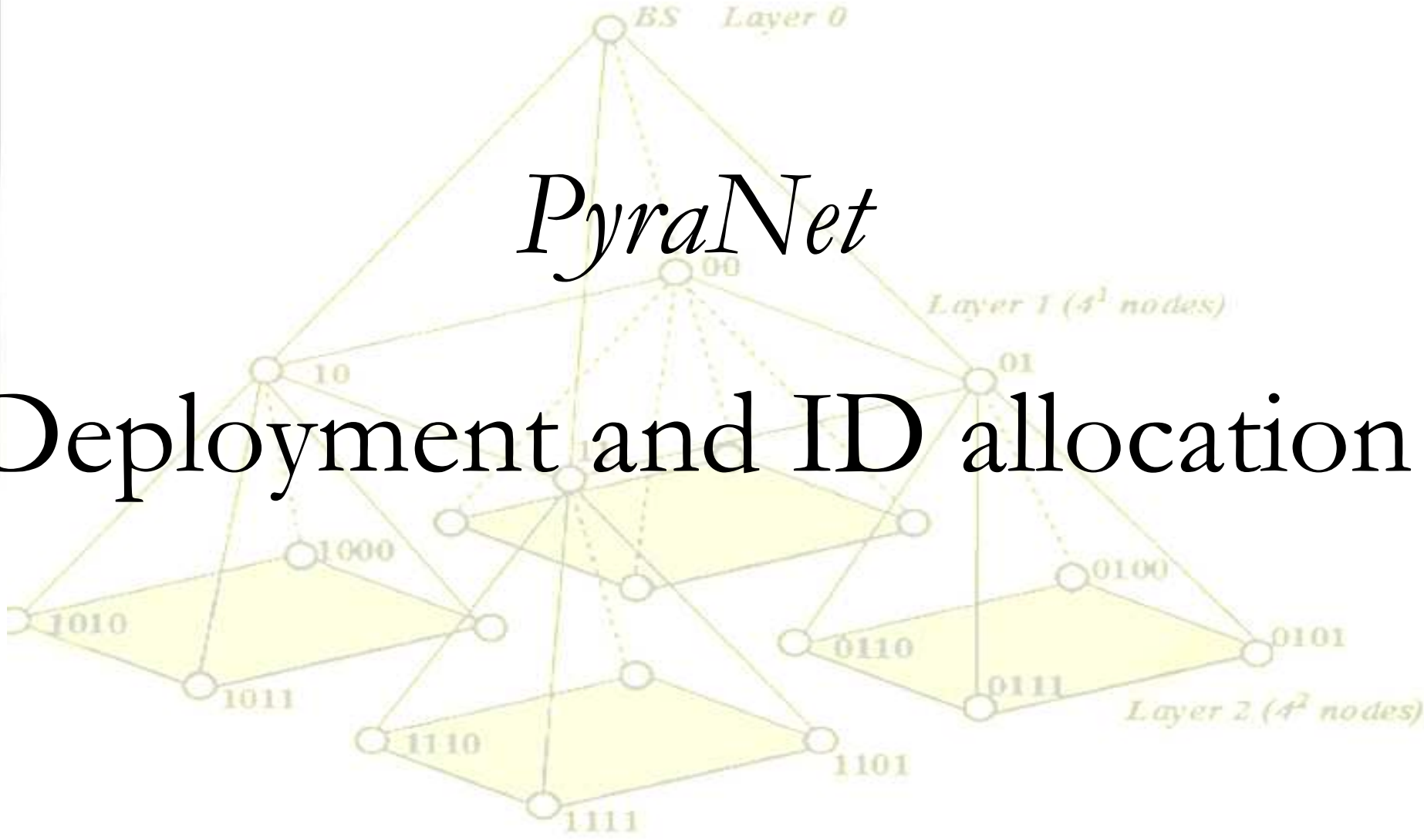


Introduction(3/3)

Objectives of this work:

- *PyraNet*
- An **efficient** and **reliable** pre-configured WSN architecture
- Deploy the network as a **pyramid**, yielding more neighbors and children for each node

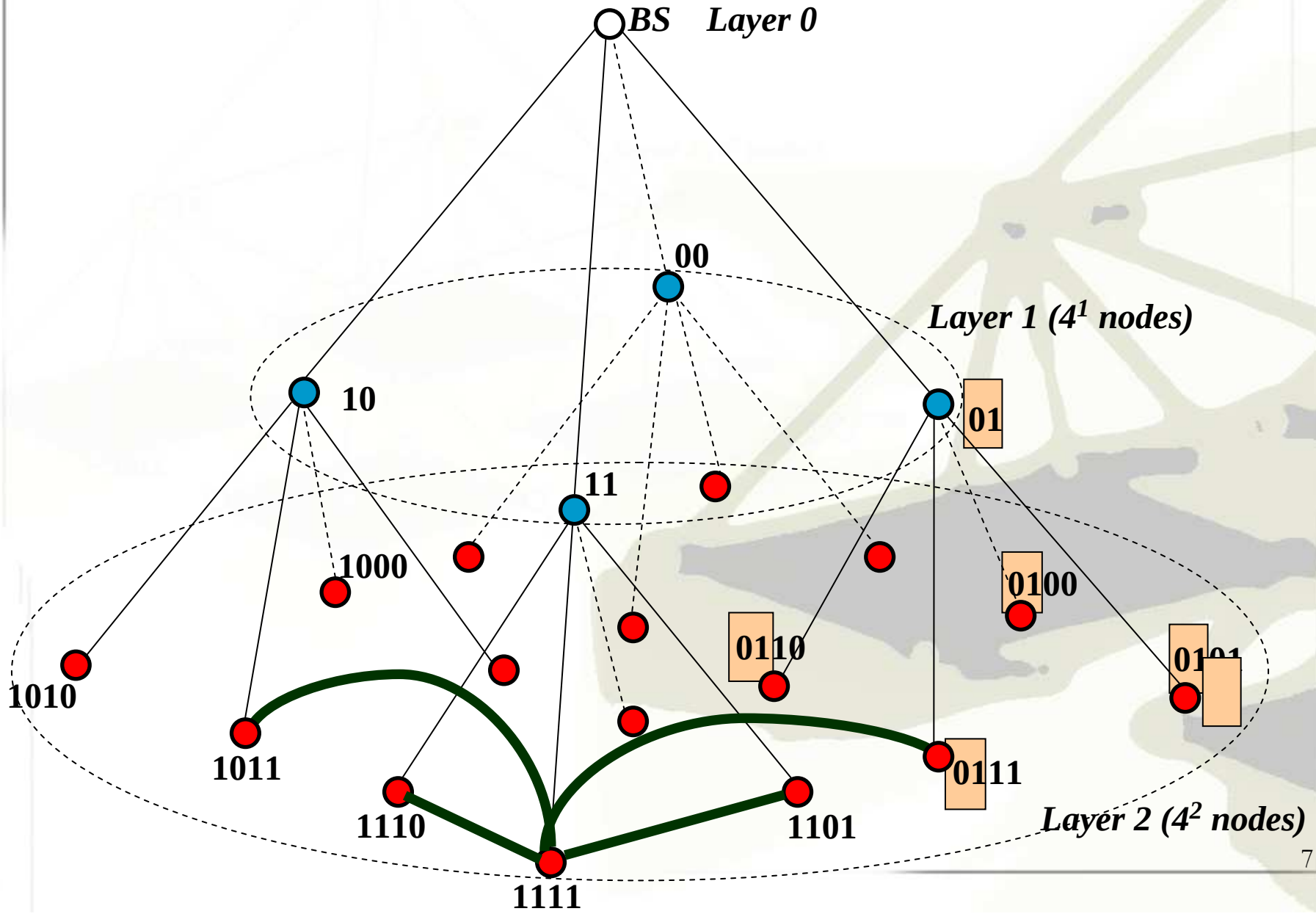
- Hypercube addressing scheme for routing in *PyraNet* :
  - achieving superior **fault-tolerance capability**
  - higher **data delivery** ratio
  - efficient **energy consumption**



PyraNet

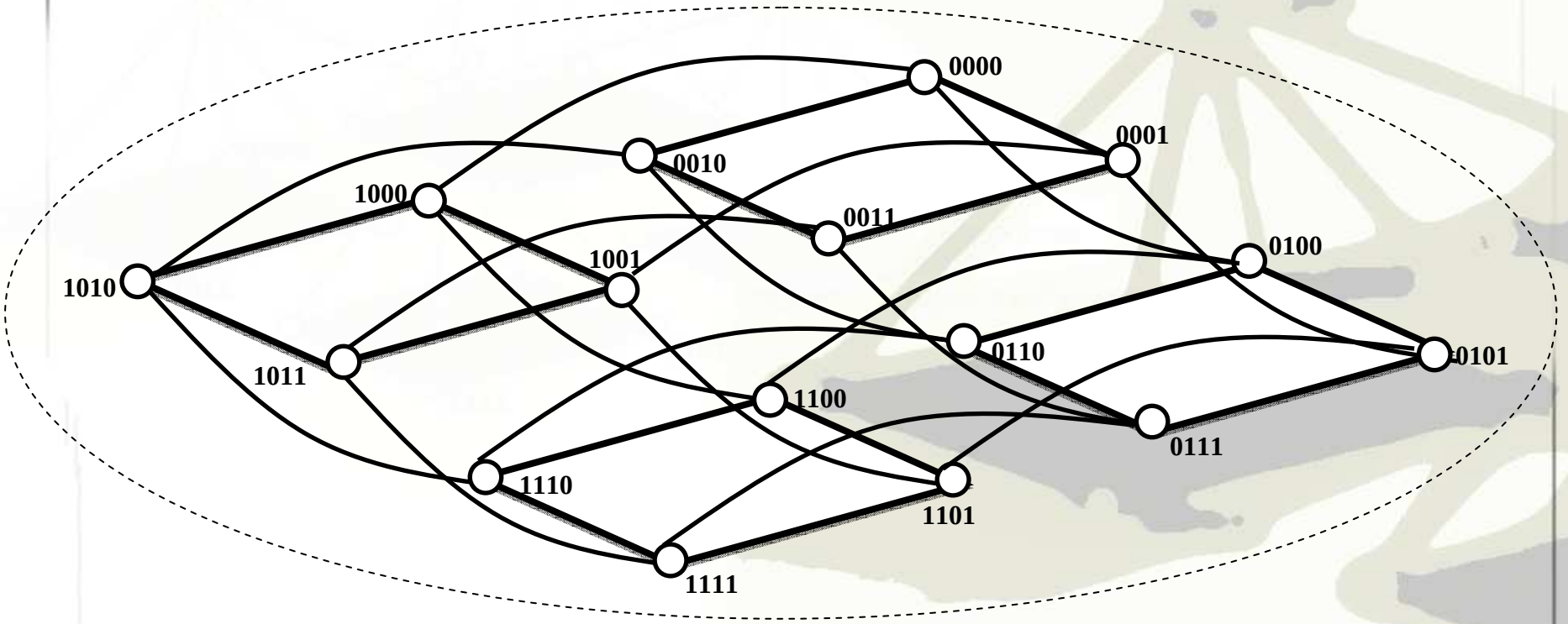
Deployment and ID allocation

Node in Kth layer has 2K neighbors ce is 1 e



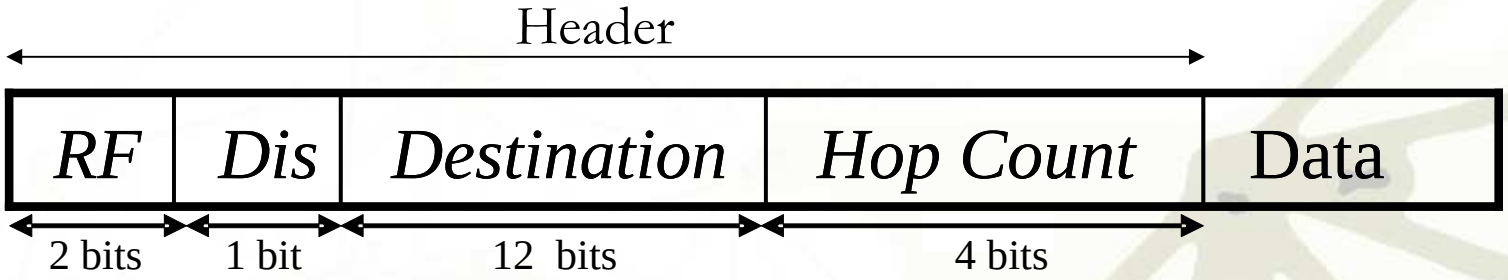
Nodes are connected as a cube in the same layer

Layer 2	4-cube	Higher layer, higher fault tolerance



Routing Algorithm

Packet format



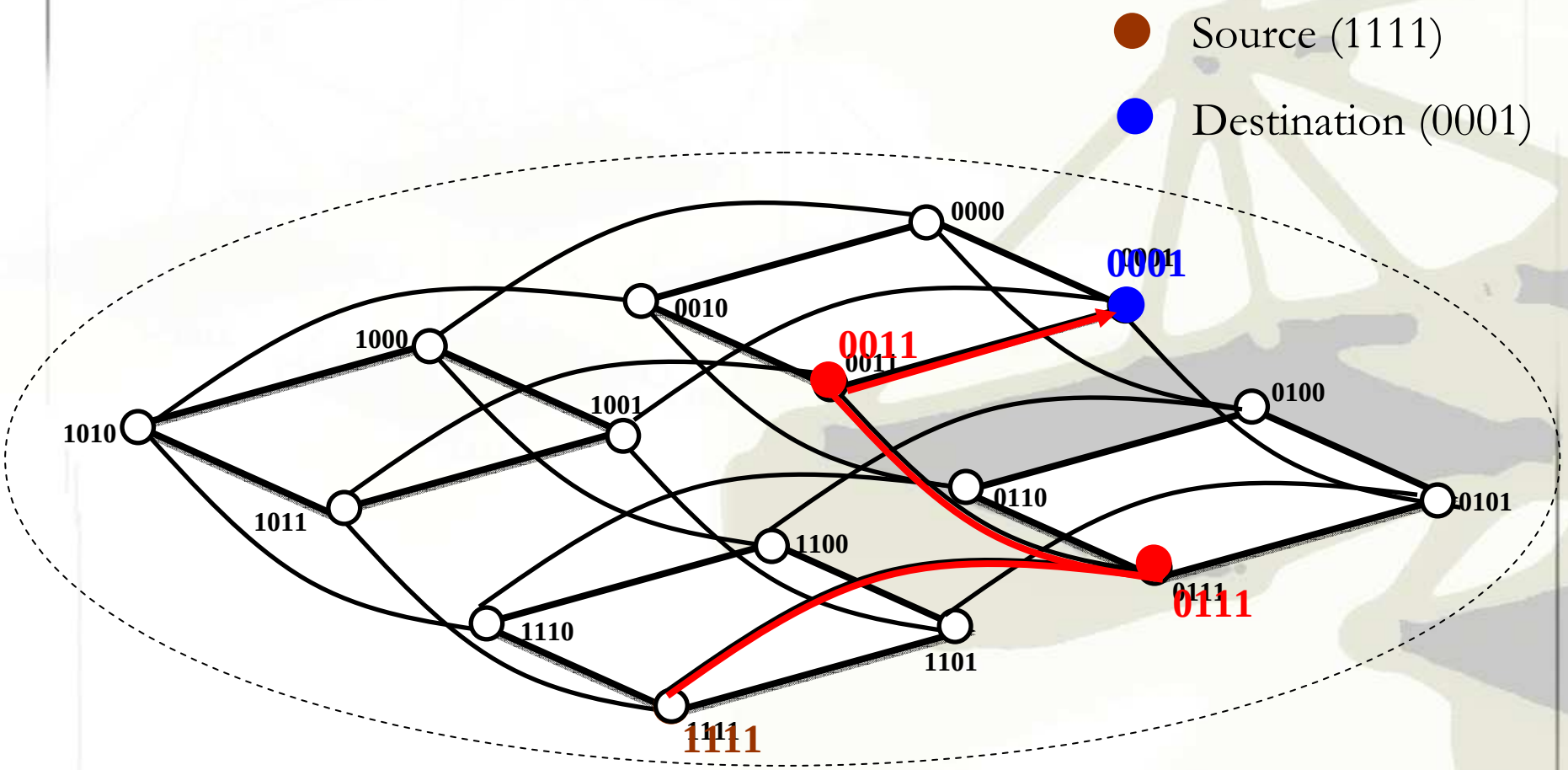
- RF:00(intra-routing)
  01(up to bottom)
  10(bottom to up)
  11(special case)

- Dis:1 (to avoid Ping-Pong effect)

- Each node has a counter starting with 1.

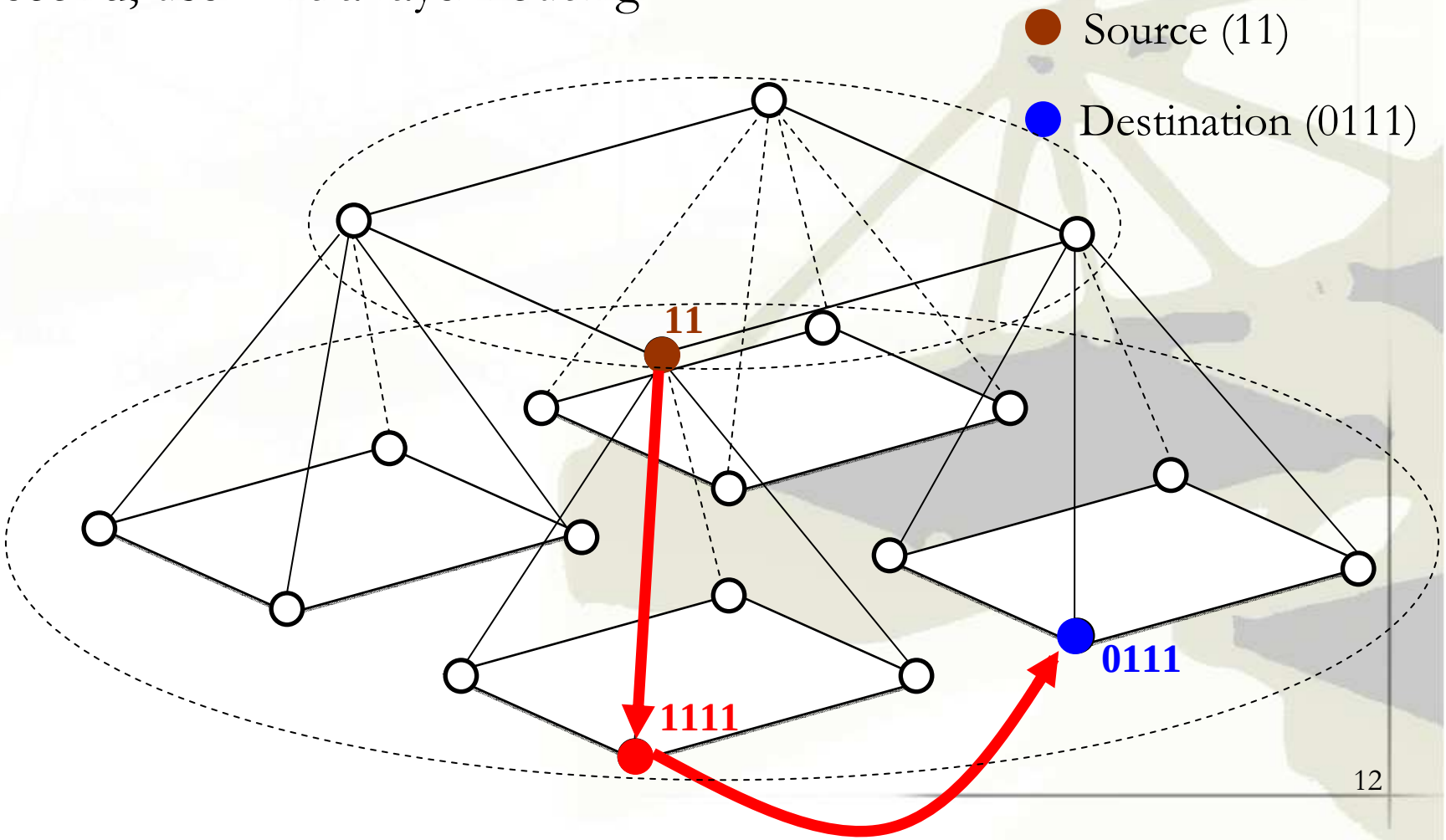
Intra-layer routing

- Compare each bit from MSB (Most Significant Bit)



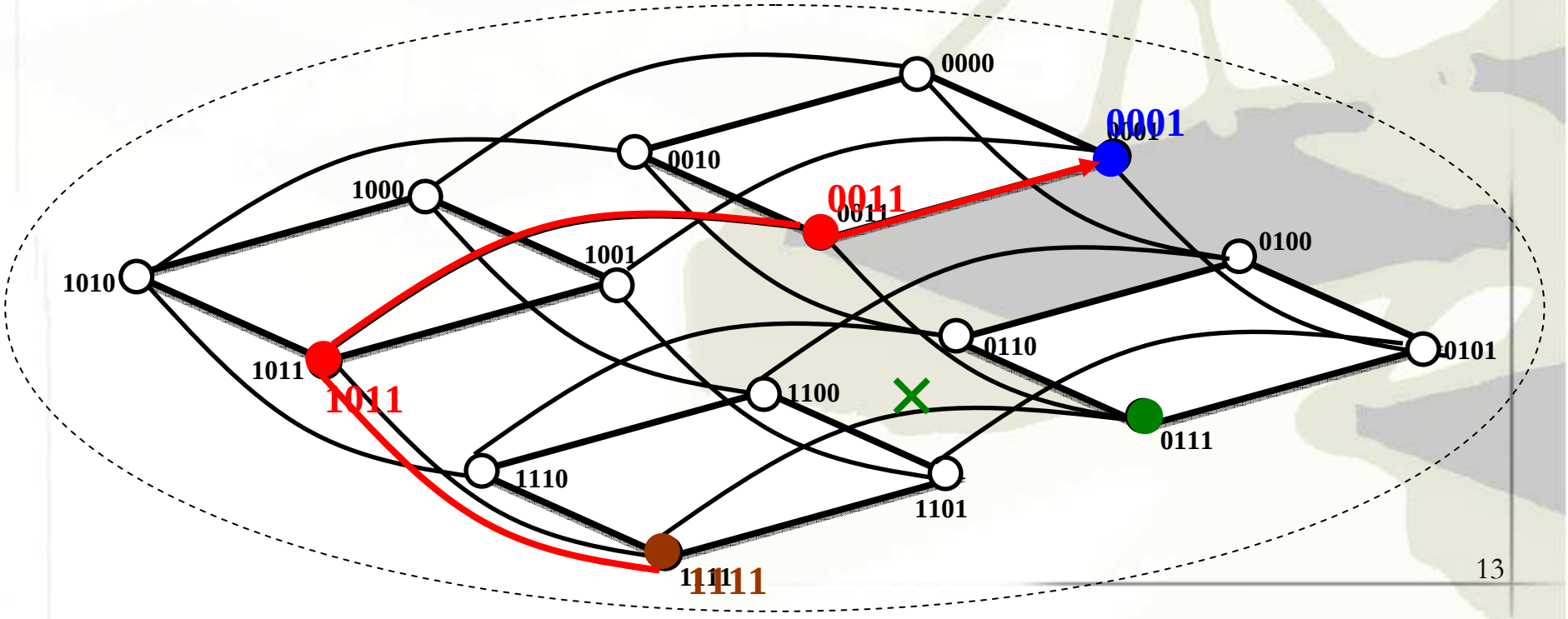
Inter-layer routing

- First, transmit to the layer which destination node located
- Second, use Intra-layer routing



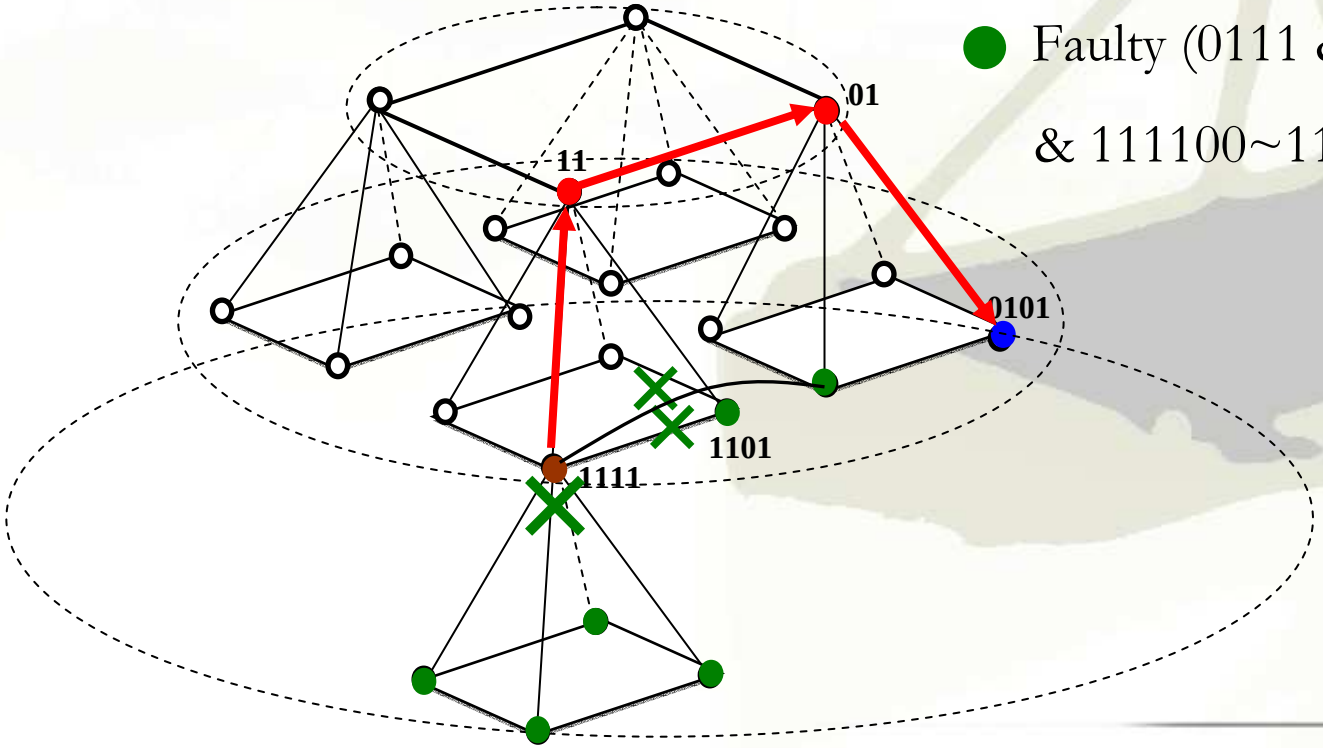
Part of neighboring nodes are faulty

- Compare with the next bit to transmit



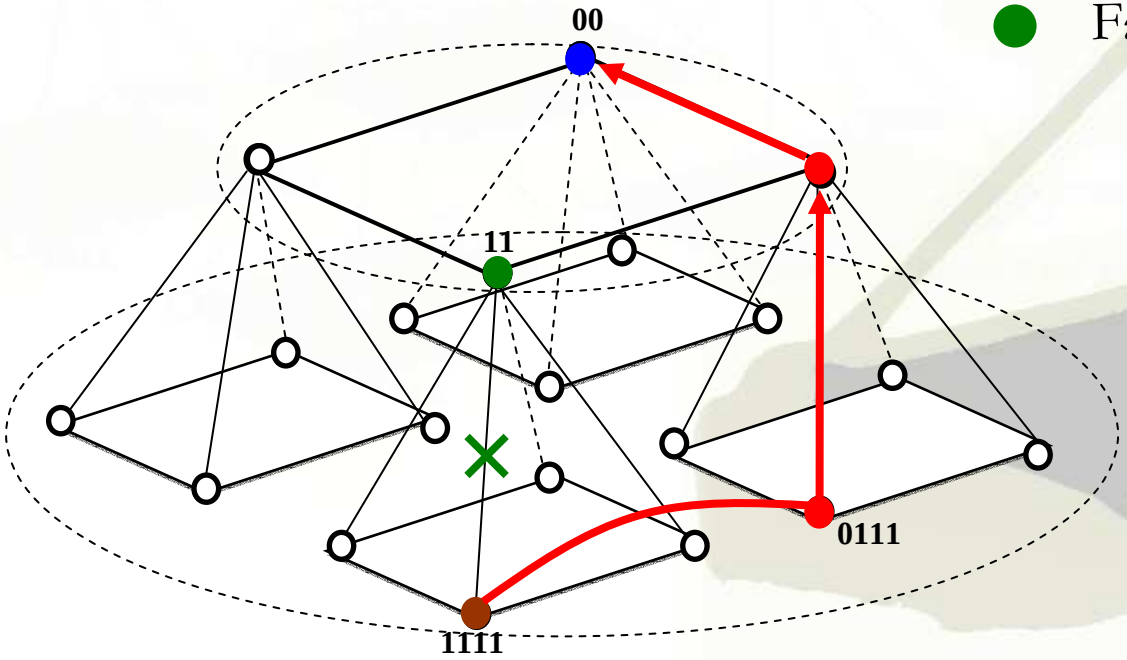
All neighbors and children are faulty

- transmit to parent, and set the "Dis" field to "0"
- change the MSB(couner) bit
- use "Inter-layer routing"



Parent node is faulty

- change the MSB(counter) bit
- use Inter-layer routing

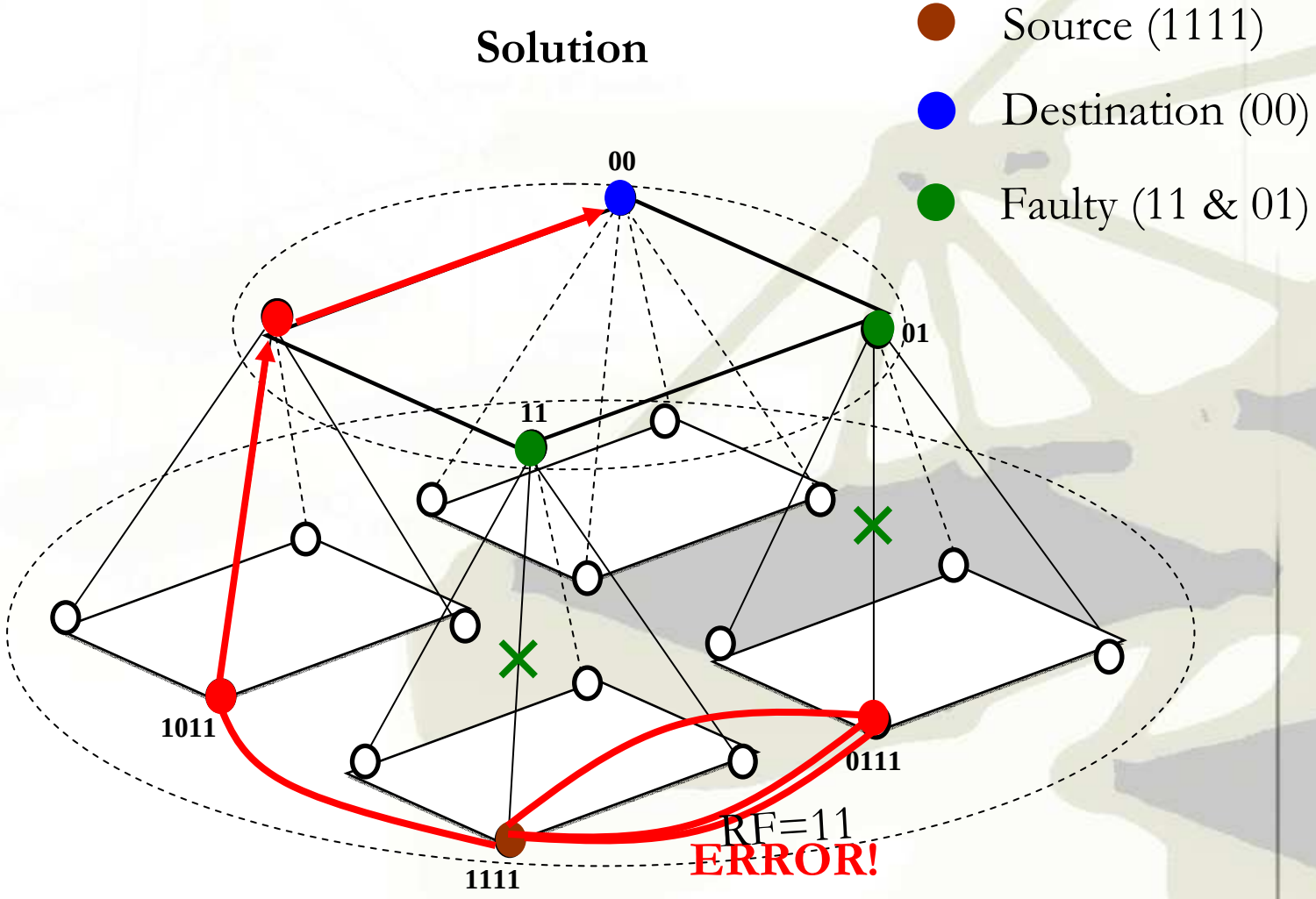


Source (1111)

Destination (00)

Faulty (11)

Special case
neighbor's parent is also faulty



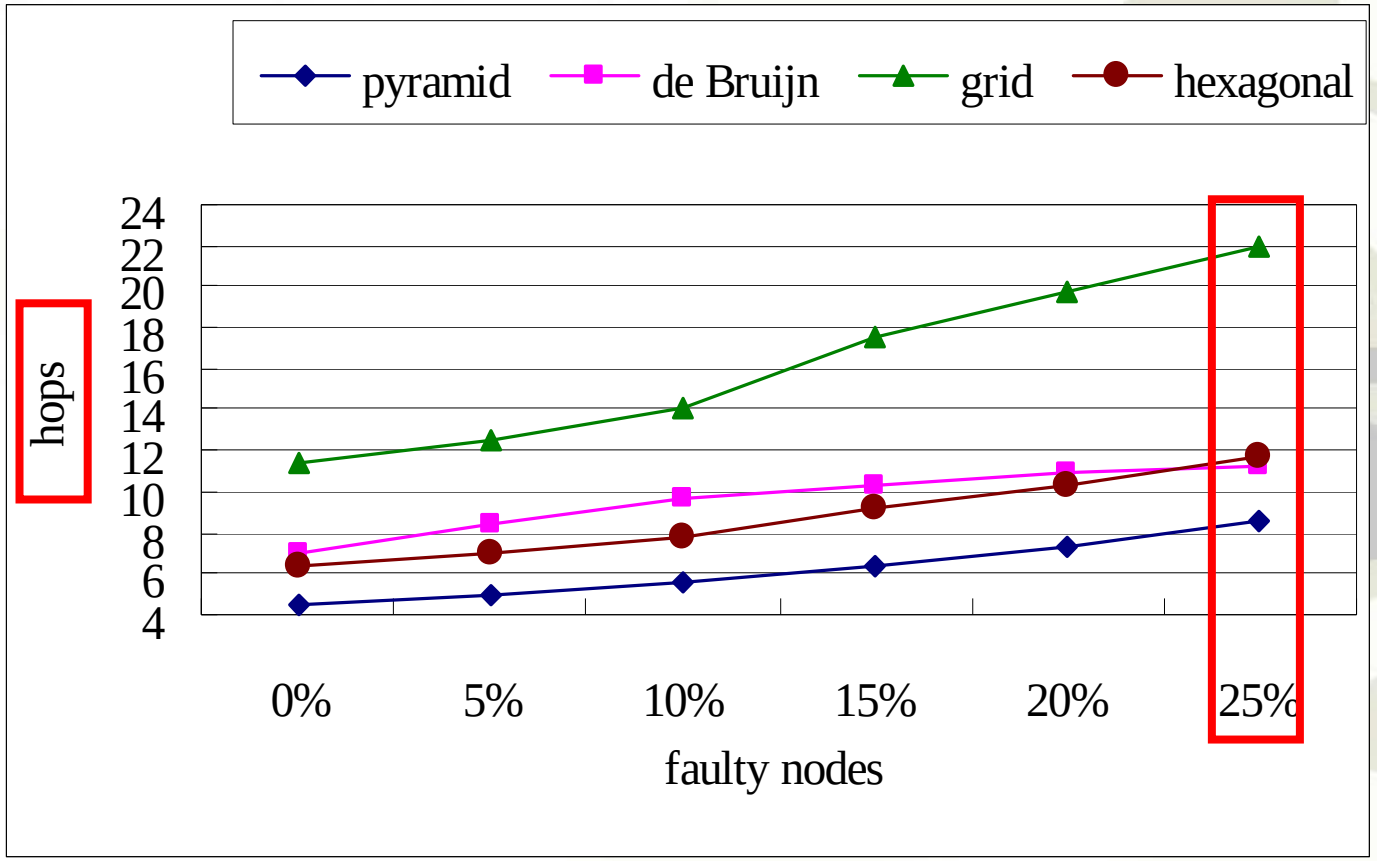
Simulation Results

Preliminaries

- Using MATLAB 7.0 to evaluate the following parameters
  - End-to-end delay time
  - Fault-tolerance and data delivery ratio
  - Power consumption
- Simulation environment
  - 254 nodes (Grid :16×16)
  - faulty node: 0%, 5%, 10%, 15%, 20%, 25%

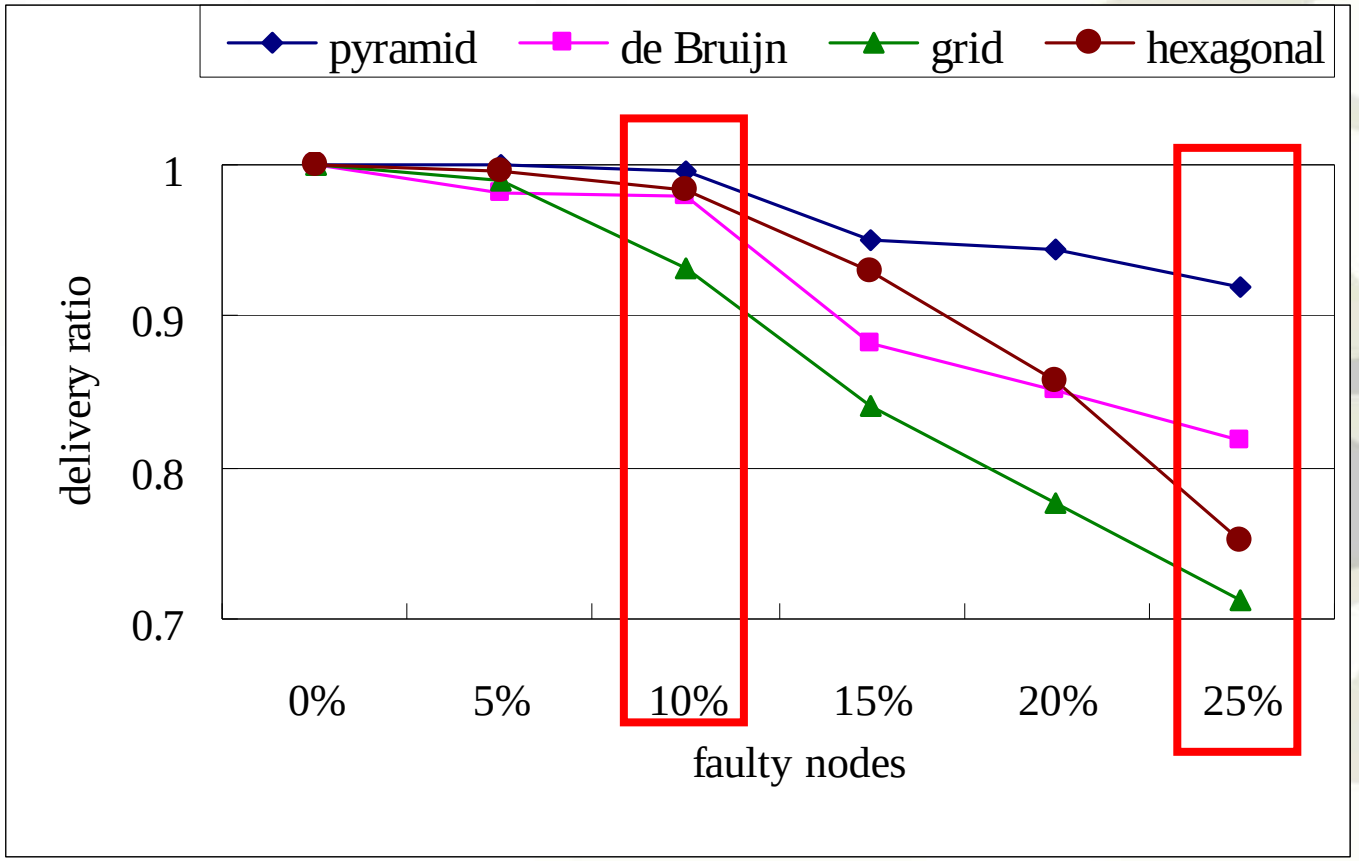
Simulation Results (1/4)

- End-to-end delay time in 254-nodes topology.



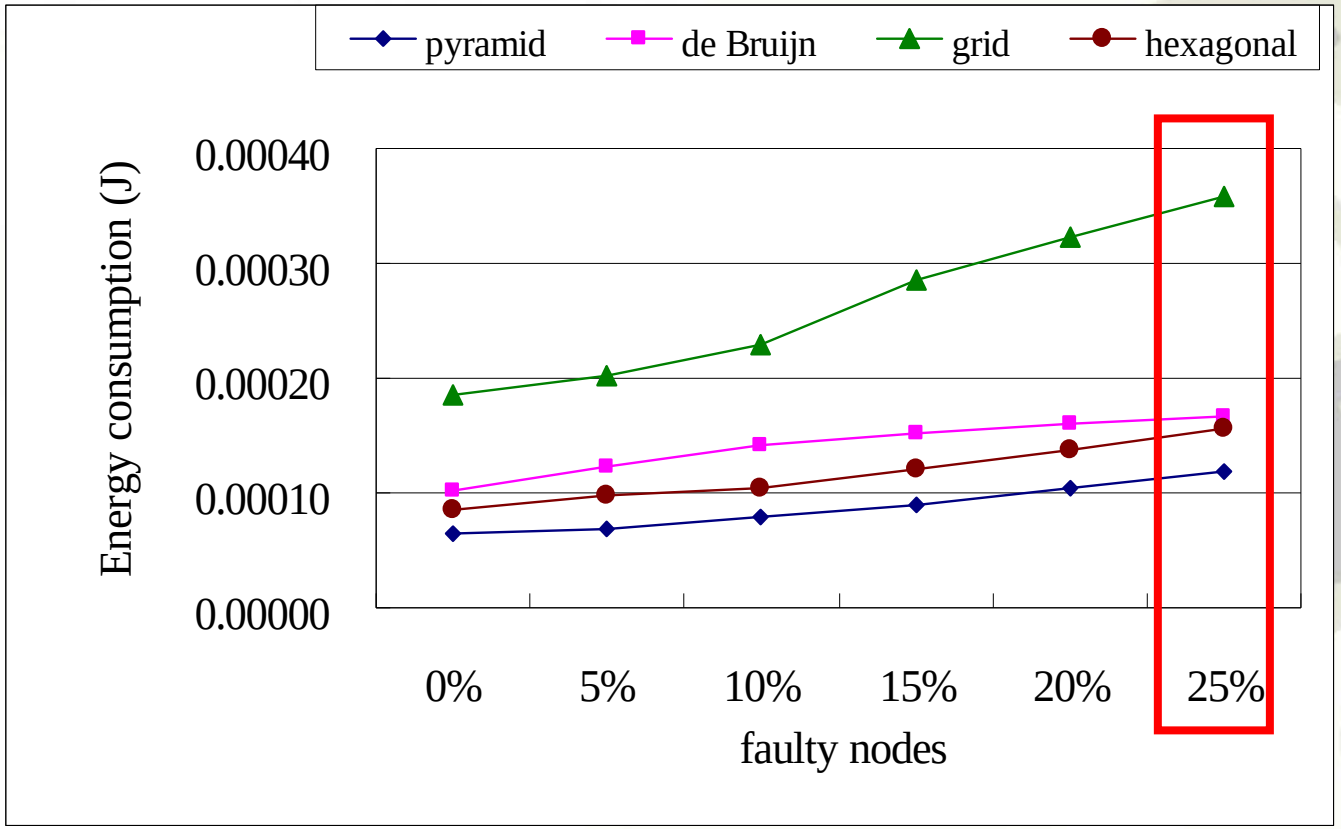
Simulation Results (2/4)

- End-to-end data delivery ratio in 254-node topology.



Simulation Results (3/4)

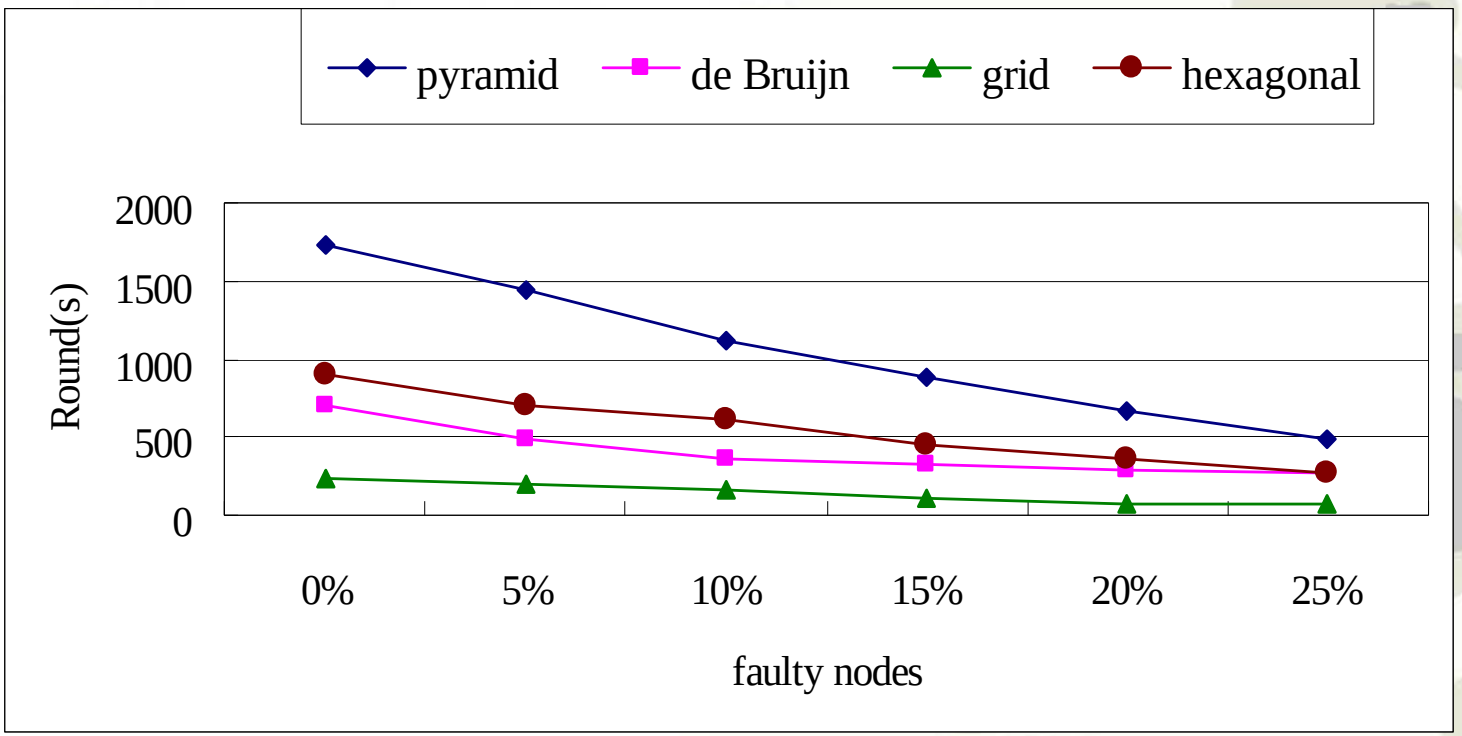
- Average total energy consumption for each pair in 254-node topology.



Relate to end-to-end delay time (Hop counts)

Simulation Results (4/4)

- System life time for each topology in 254-node topology.



The longer path length causes the more consumption of energy

Conclusions

- We deploy the sensor nodes as pyramid topology in advance, and allocate each node a unique address by hypercube scheme.
- By employing our proposal architecture, we can achieve high fault tolerance and high data delivery rate.

Q & A