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Distributed ID/Locator Resolution System for Inter Mesh Networks

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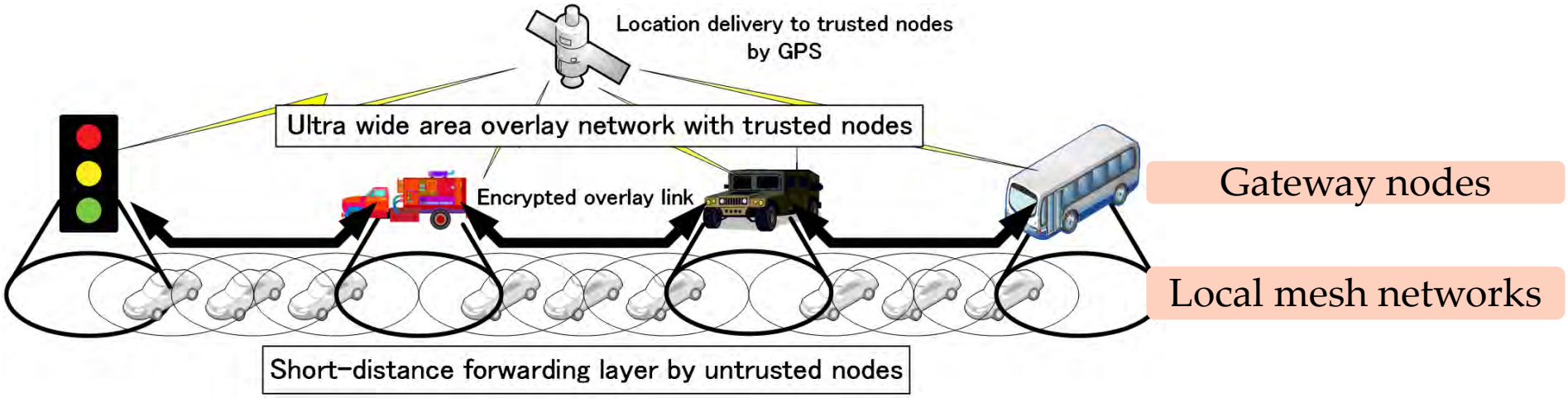
InterMesh: Inter mesh networks

- Network of mesh networks
  - A wide-area network built up from local mesh networks
  - It does not rely on fixed infrastructure.
    - E.g. disaster situations, outside the homeland, …
      - The 1st author suffered a destructive earthquake in 1995.
    - Vehicles and vessels are possible gateway nodes.

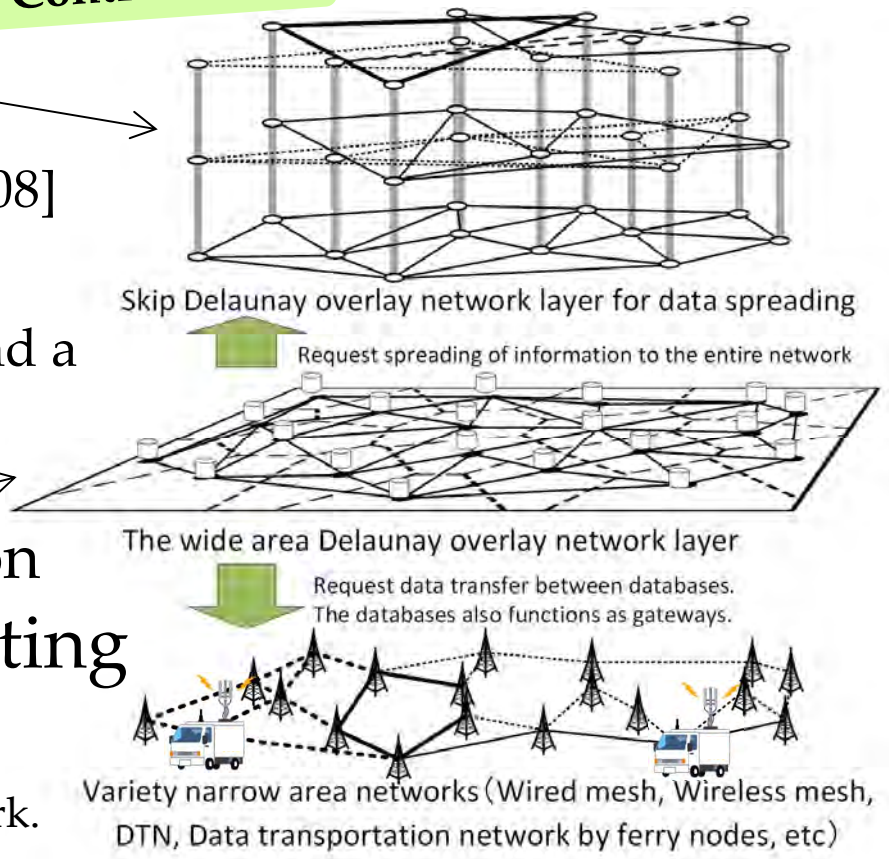


Our design of InterMesh

Contribution

1. An **ID/locator resolution** mechanism utilizing Skip Delaunay network [Tsuboi 2008]
   - enables ID-based communication.
     - An ID is in an arbitrary form, and a locator is a position coordinate.

2. Locator-based communication by geo-assisted greedy routing over Delaunay network
   - Gateway nodes construct a Delaunay network.
   - Decentralized construction [Ohnishi 2005]
   - Detour paths for wireless links [Ohnishi 2013]

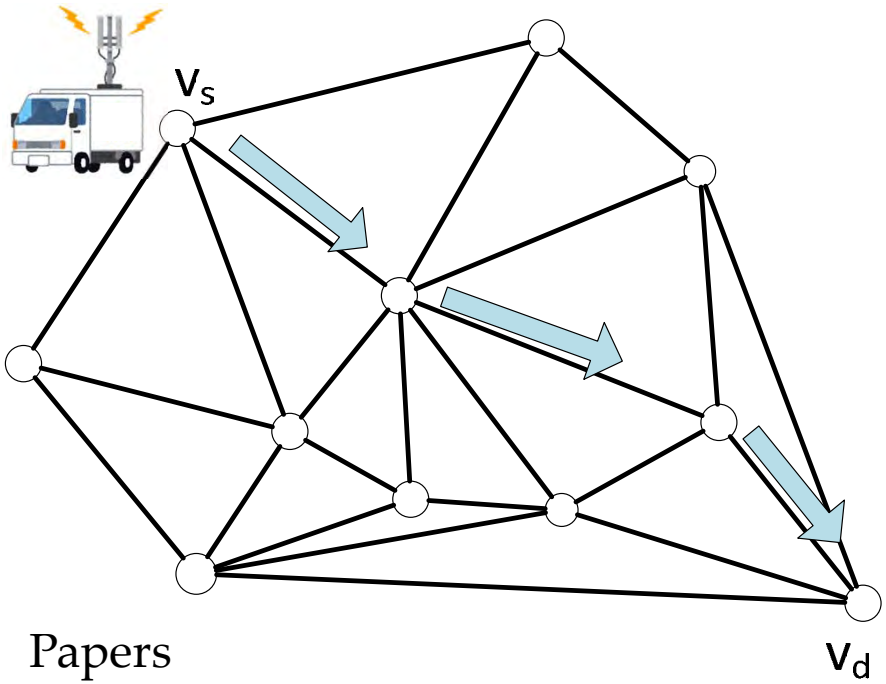


No flooding, less messages

cf. AODV, OLSR, …

Delaunay network [Ohnishi 2005]

- An overlay network
  - based on Delaunay diagram. A node has links only with close nodes.
  - enables geo-assisted greedy routing. No flooding.
  - constructed in a decentralized way.



Node with position coordinate

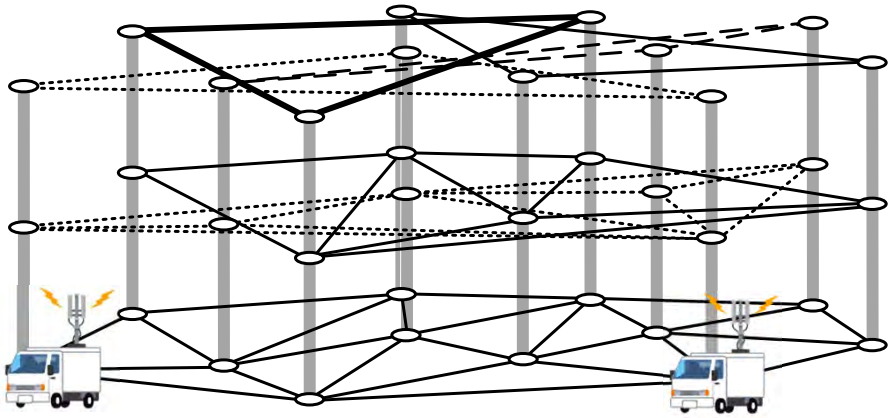
Physical communication links

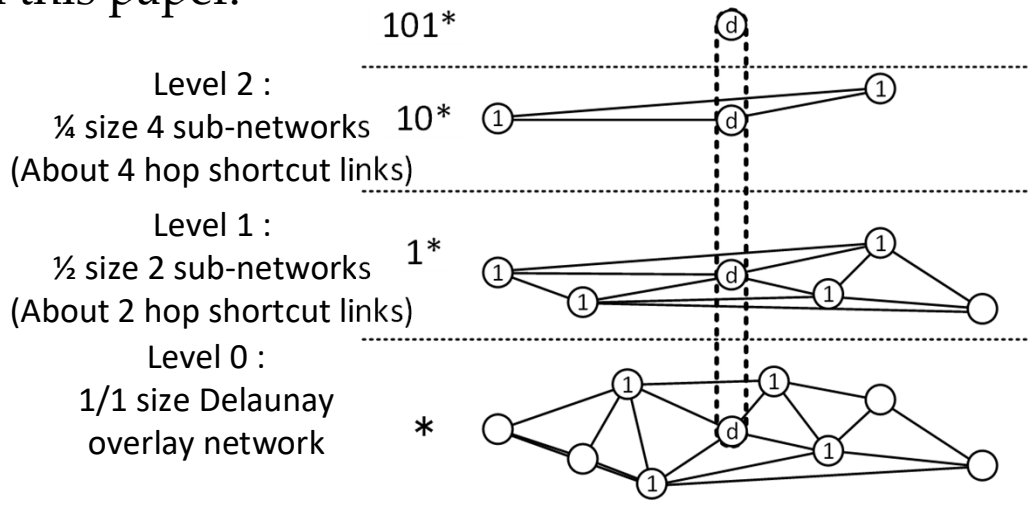
Forwarding by greedy routing

- Papers
  - Routing and decentralized construction [Ohnishi 2005]
  - Detour paths [Ohnishi 2013]

Skip Delaunay network [Tsuboi 2008]

- Introduces shortcut links
  - like Skip Graphs [Aspnes 2003]
  - Node's membership vector (MV) determines which sub-network the node joins.
    Node's MV = hash(Node's ID), in this paper.



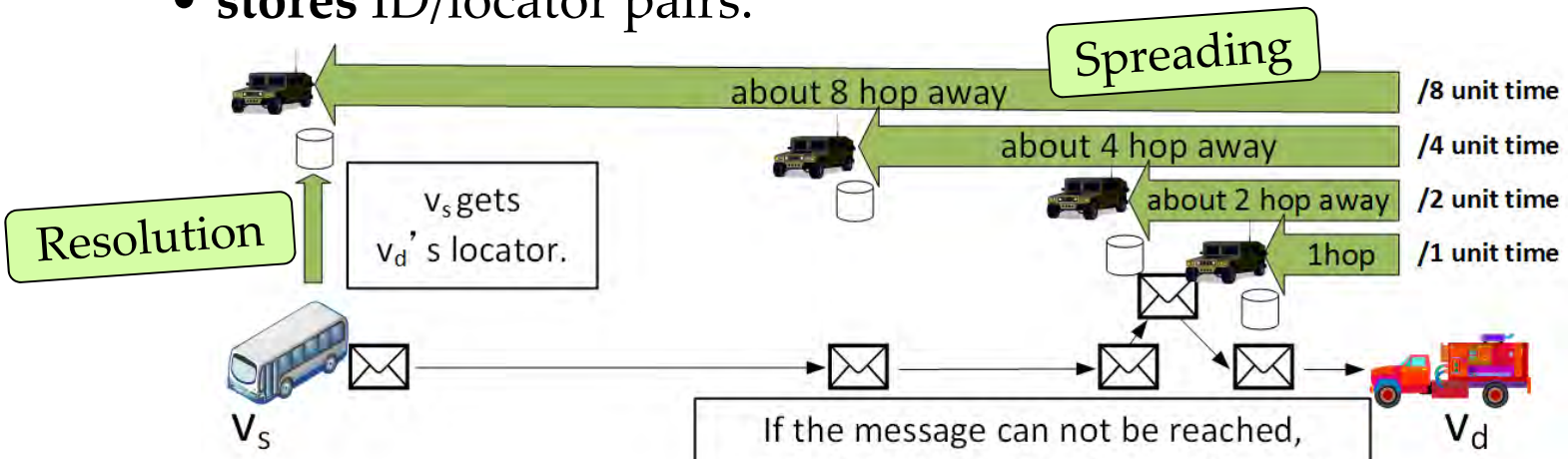


ID of node d: **101…**

- Note: Higher-level links are not physical, but virtual.
  - Communications over them can be emulated with level 0 physical multi-hop communications.
  - If long-distance physical links are available, we can utilize them.

Contribution:
ID/locator resolution mechanism

- Utilizes Skip Delaunay network as a distributed database of ID/locator pairs.
  - Each node
    - **spreads** ID/locator pairs to neighbors on all levels.
    - **stores** ID/locator pairs.



  - Scalable

n: # of nodes

- # of messages a node receives per unit time is ***O(log n)***
  - because # of msgs per level is constant, and # of levels is *O(log n)*

Evaluation

- Metrics indicating scalability
  - # of messages **received** by a node
  - # of messages **stored** on a node

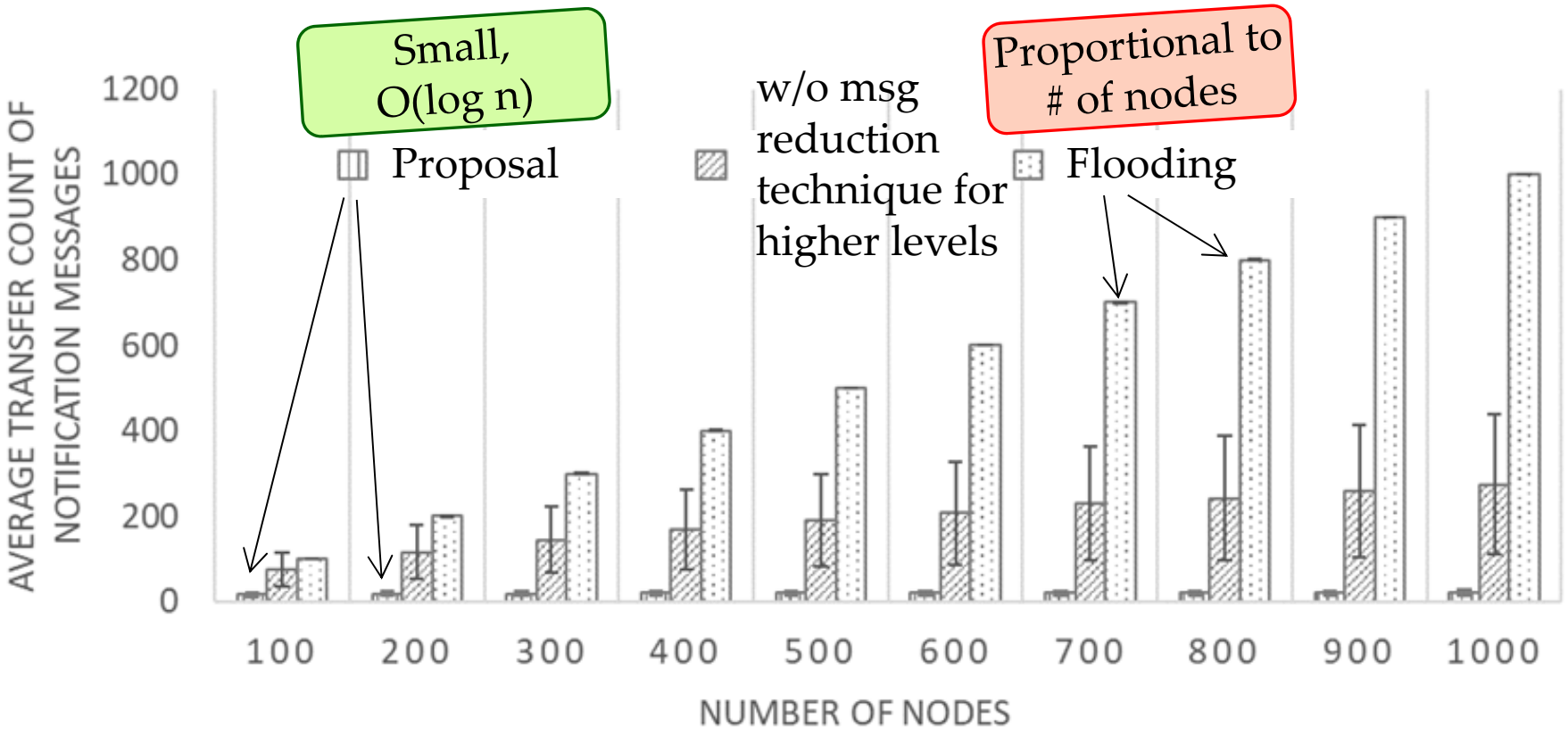
  } For DB maintenance

  - # of messages **for an ID/locator resolution**

- Simulation
  - 1.0 x 1.0 space
  - # of nodes: 100 – 1000
  - Position coordinates: uniform distribution
  - All the messages are transferred over level 0 links.

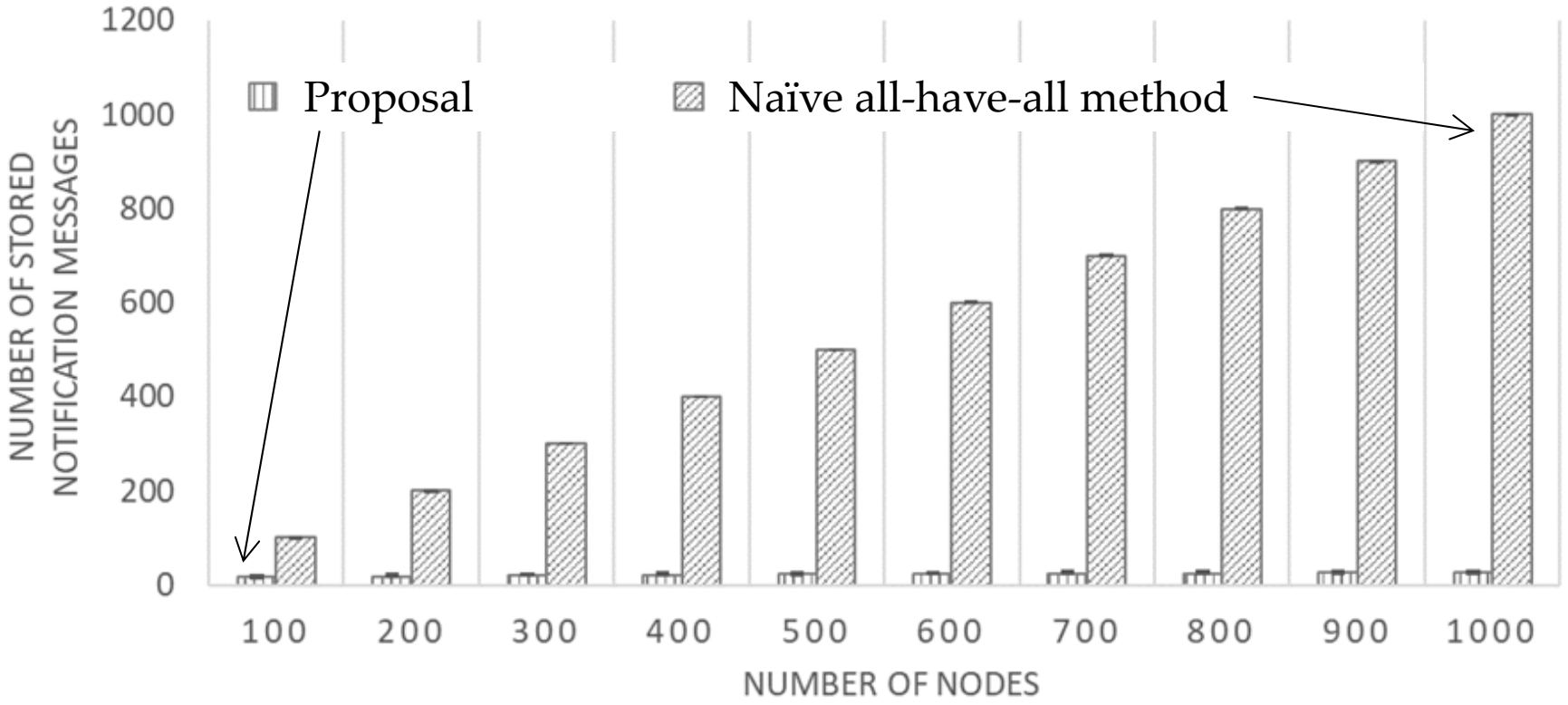
of msgs received by a node

- Much less than flooding
  - *O(log n)* *n*: # of nodes



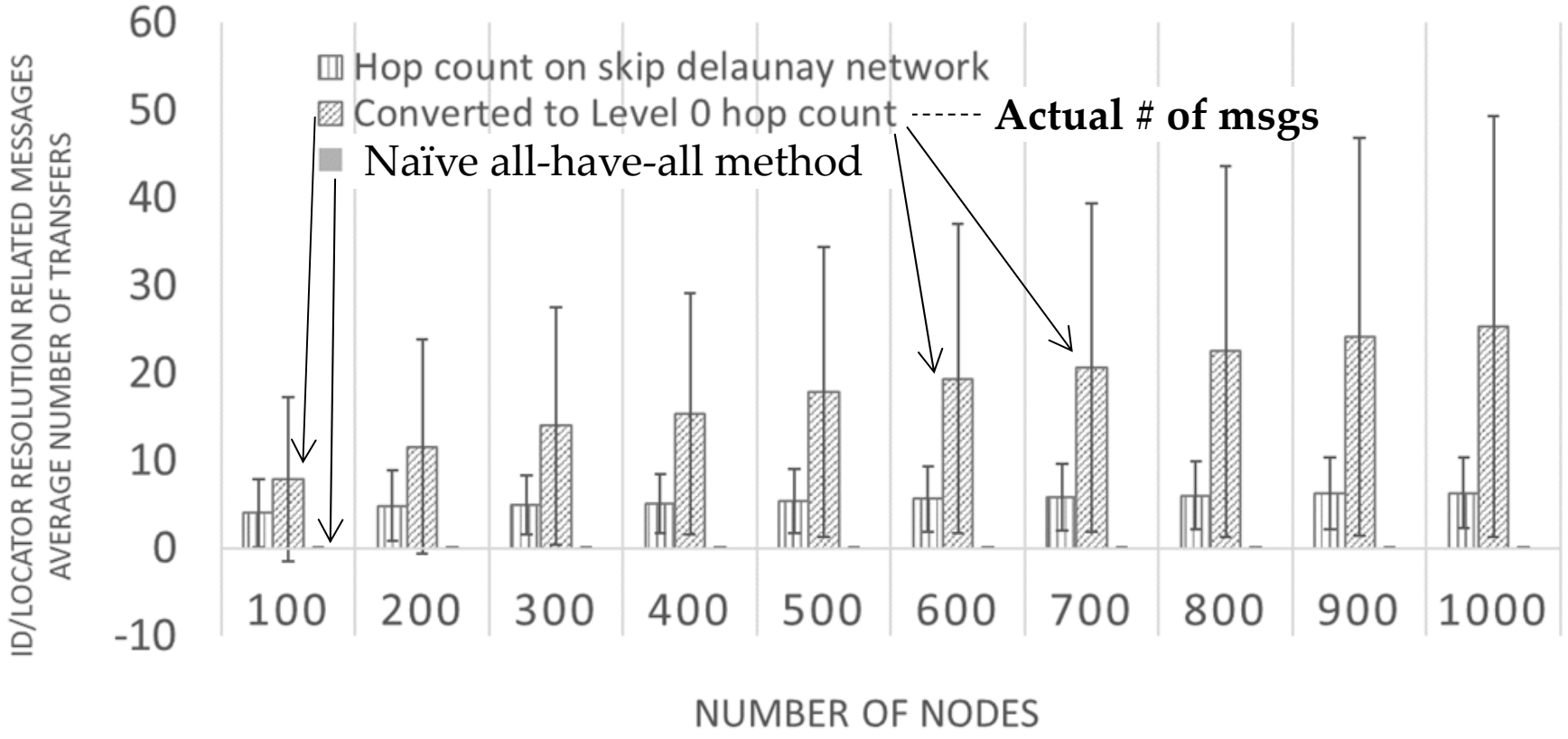
of msgs stored on a node

- Much less than naïve all-have-all method
  - *O(log n)* *n*: # of nodes



of msgs for ID/locator resolution

- Moderate
  - Much less than $O(n)$.



Summary

- InterMesh: Network of mesh networks
  - A wide-area network that does not rely on fixed infrastructure
  - For disaster situations, …
- **ID/locator resolution** mechanism for InterMesh
  - Utilizes Skip Delaunay network as a distributed DB.
  - Showed good scalability.
- Future work
  - Node movement
  - Biased distribution of nodes

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