



Dynamic Address Routing (DART)

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Routing Scalability through Dynamic Addressing

- We propose a new approach to routing scalability.
- Key idea: separate node identity, and node address.
- Routing is simplified, and scalable.
- Address allocation is harder. We present a solution.
- Initial results validate the expected $O(\log N)$ scaling behavior of DART.

Current Ad Hoc Routing Layers do not Scale!

- Current protocols were designed for up to several hundred nodes.
- Reactive protocols (AODV/DSR) rely on flooding to establish routes.
- Proactive (DSDV) keeps one routing entry per node in the network!
- The Internet has scaled well so far, but was not designed for mobile, wireless terminals.

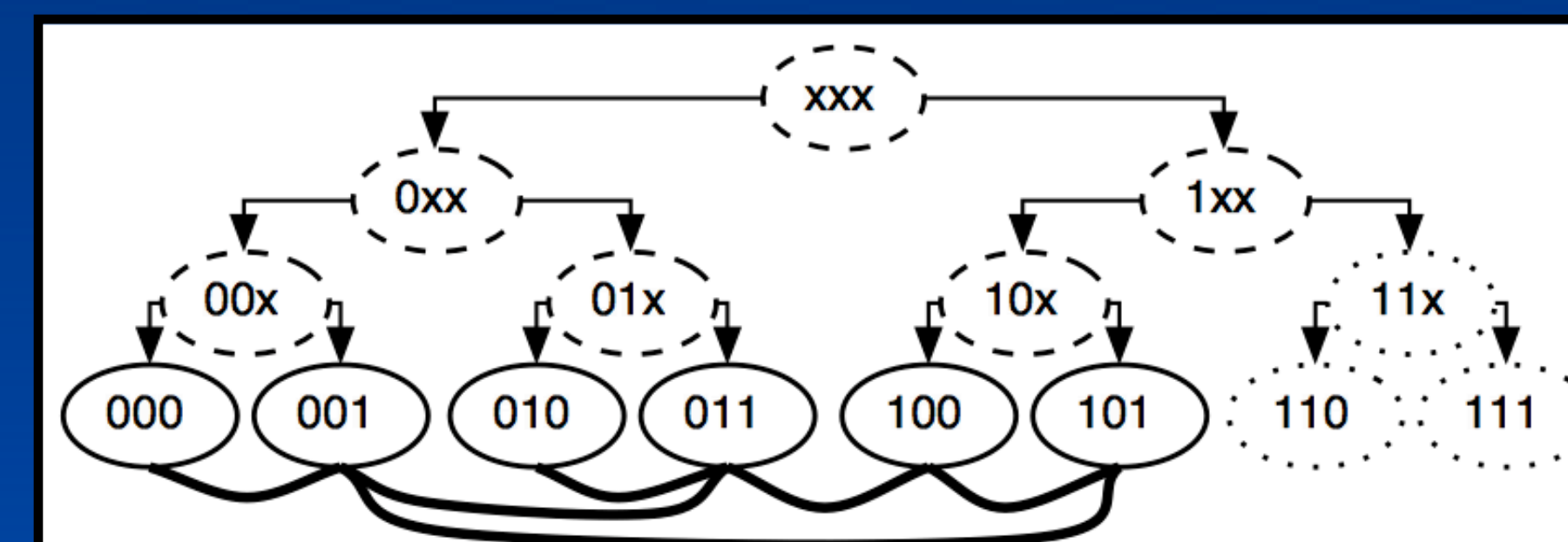


Routing by Dynamic Addressing

- Routing address and node identity are kept as two separate numbers.
- Routing **address reflects the node's location** in the network topology. Moving nodes change address.
- Nodes that have similar addresses are physically close, making route aggregation possible.
- A distributed node lookup table maps identifier to current node address.

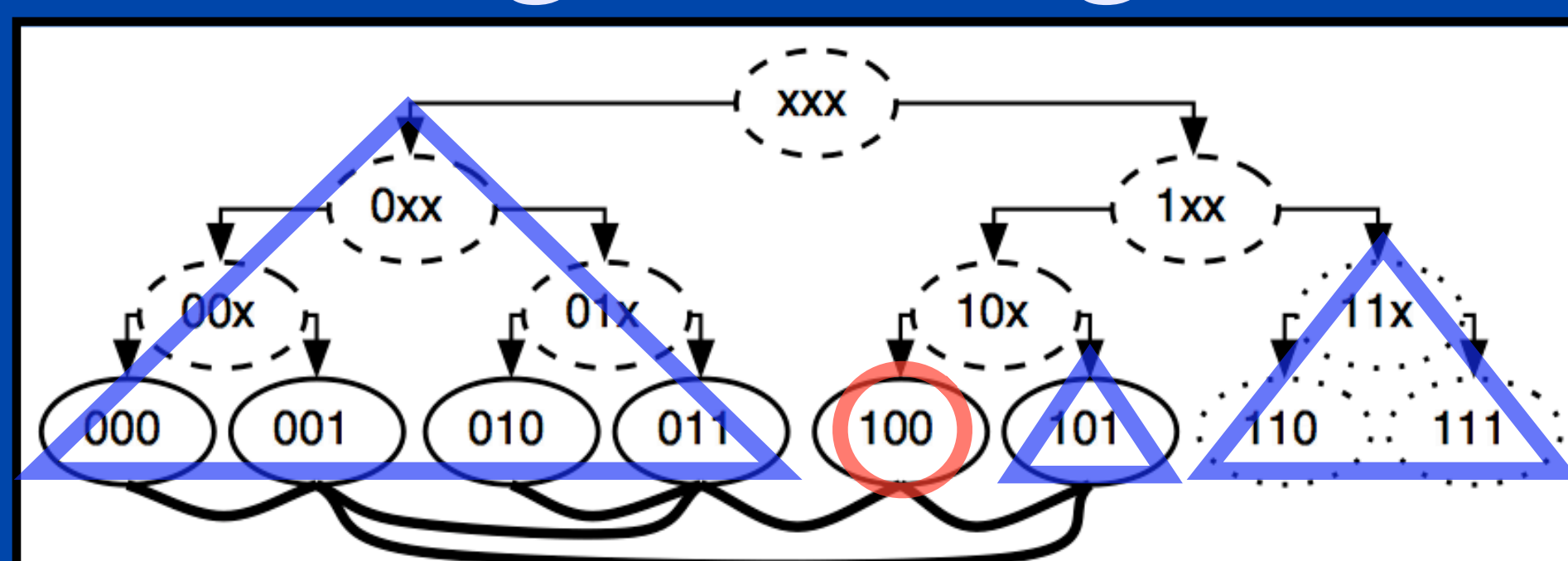
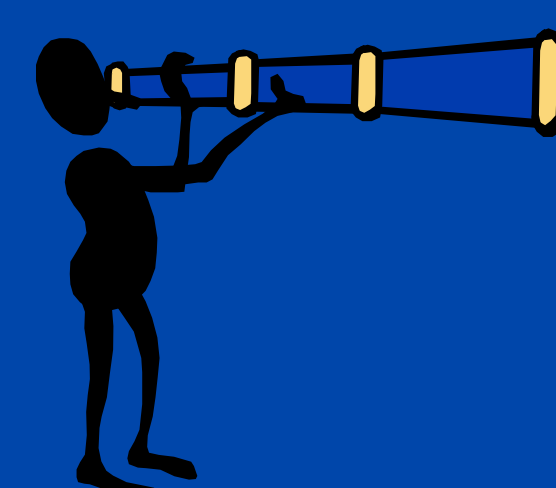


Efficient address allocation



- Routing addresses form a virtual binary tree.
- Invariant: *All nodes within any given subtree can communicate using only nodes in that subtree.*
- Nodes can figure out a valid address by listening to neighbors' periodic routing updates.

Making Routing Scale

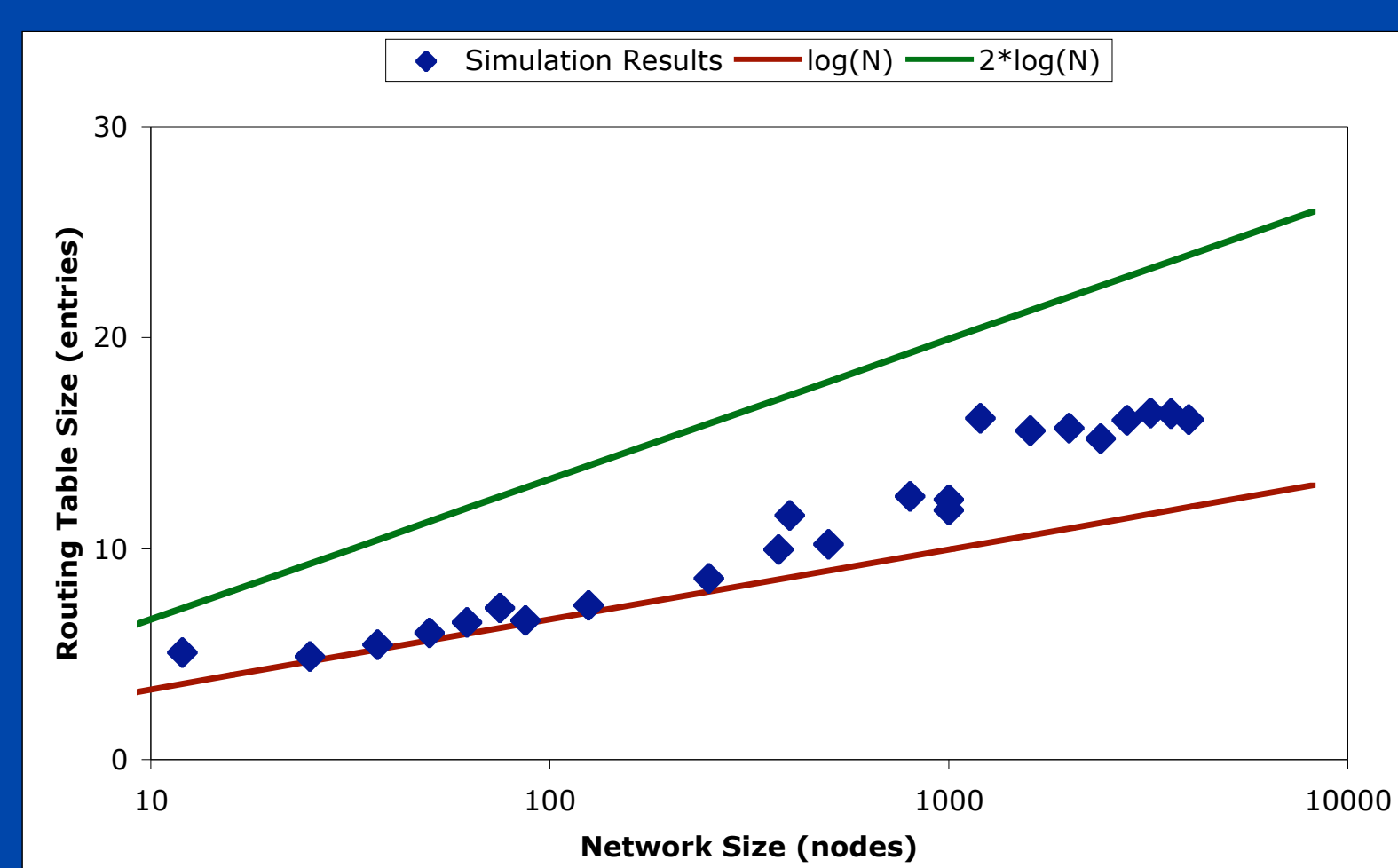


- Each node keeps **$\log N$ routing entries**.
- Routing is done by prefix; all nodes in a triangle above are covered by a single entry.

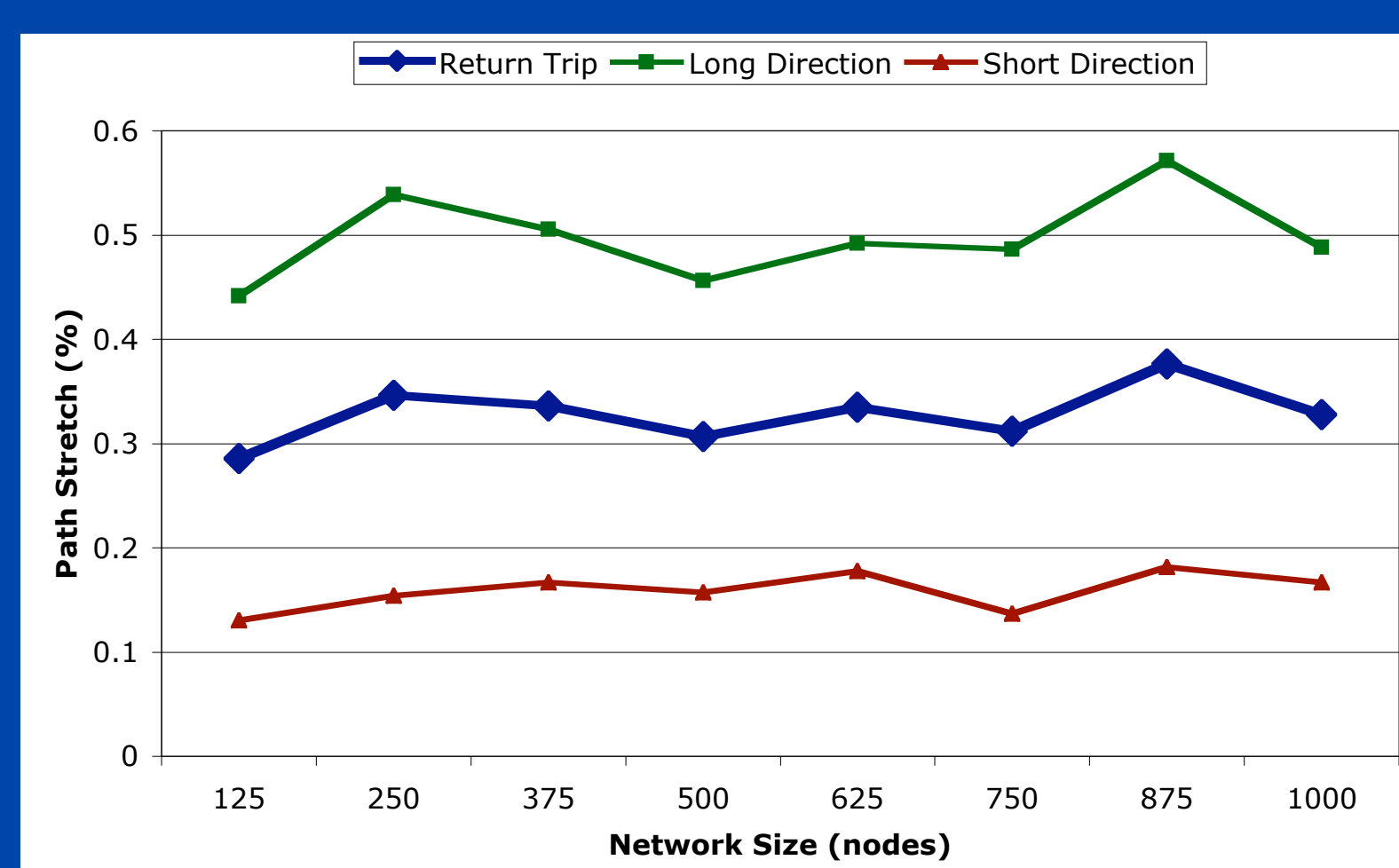
Efficient Address Lookup: ID -> Address

- Maps node identity to current routing address.
- Distributed hashtable, utilizing existing routing layer state for efficiency.
- Upon connection establishment, the current routing address of the destination is looked up in the table.
- Hierarchy of local and global lookup tables ensures locality of operations, crucial for scalability.

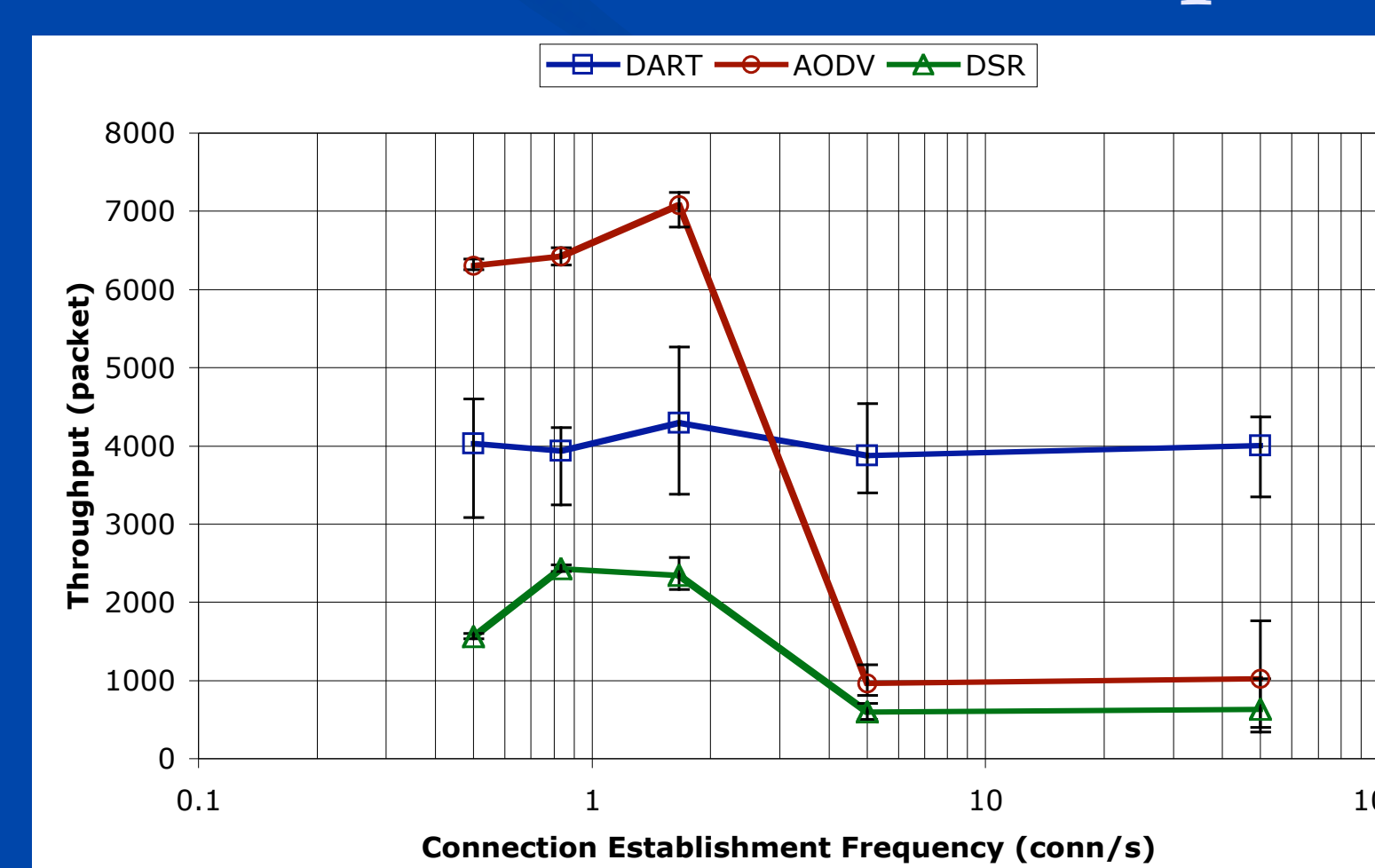
Routing Table vs. Network Size



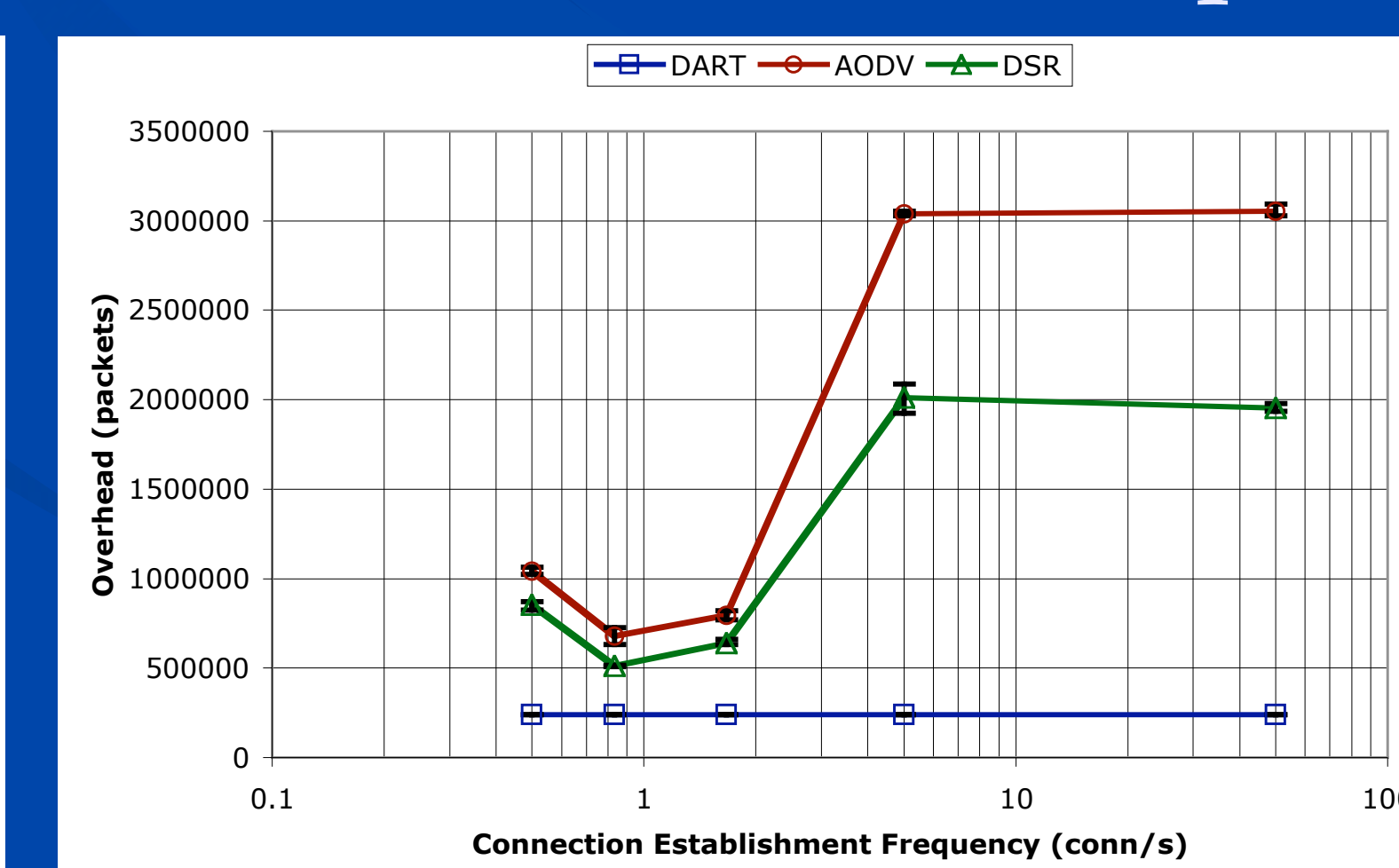
Path Stretch vs. Network Size



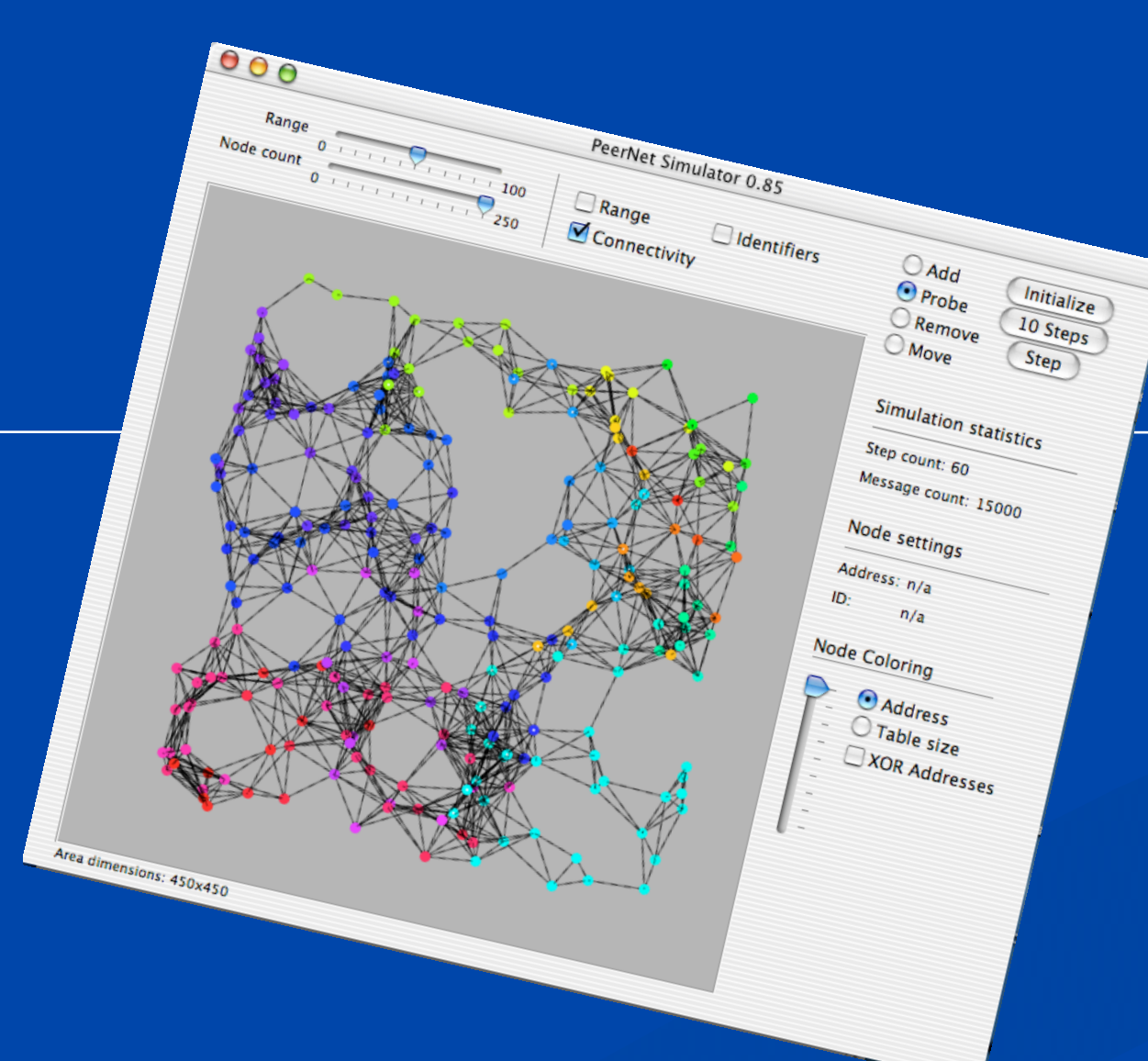
Throughput vs. Connection est. freq.



Overhead vs. Connection est. freq.



- Average **routing table size** $< 2 \cdot \log N$!
- Low **average path stretch**, 30-35%, so route aggregation is not hurting us much.



Currently ongoing work

- Address lookup service simulations.
- Linux/OS X implementations.
- Testbed of Linksys wireless routers and Compaq IPAQ wireless mobile terminals.
- Routing layer security.



Conclusion

- Dynamic Address Routing is a promising new approach to ad hoc routing.
- Simulation results show that our approach has the potential to **reliably outperform** current approaches in large networks.
- Dynamic Addressing promises to take ad hoc networking to the next level.

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