A High-Throughput Path Metric for Multi-Hop Wireless Routing

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Motivations

- Minimum hop count, the de facto standard for wired networks, should it work well for meshnet?
- If yes, why?
  - A link quality metric usually fluctuates much, causing unnecessary oscillations among routes
- If no, why?
  - On-demand routing strategy such as DSR may not need to follow such fluctuations

Speculation

- Meshnets are different from wired networks
  - Packet loss can be caused both by interference and workload (congestion)
    - Which one id more dominant?
  - Link capacity is often asymmetric
  - The interference between successive hops of multi-hop paths
- If interference is dominant, is it a good signal that there may be a good routing strategy other than the minimum hop count?

Initial experiments testbed

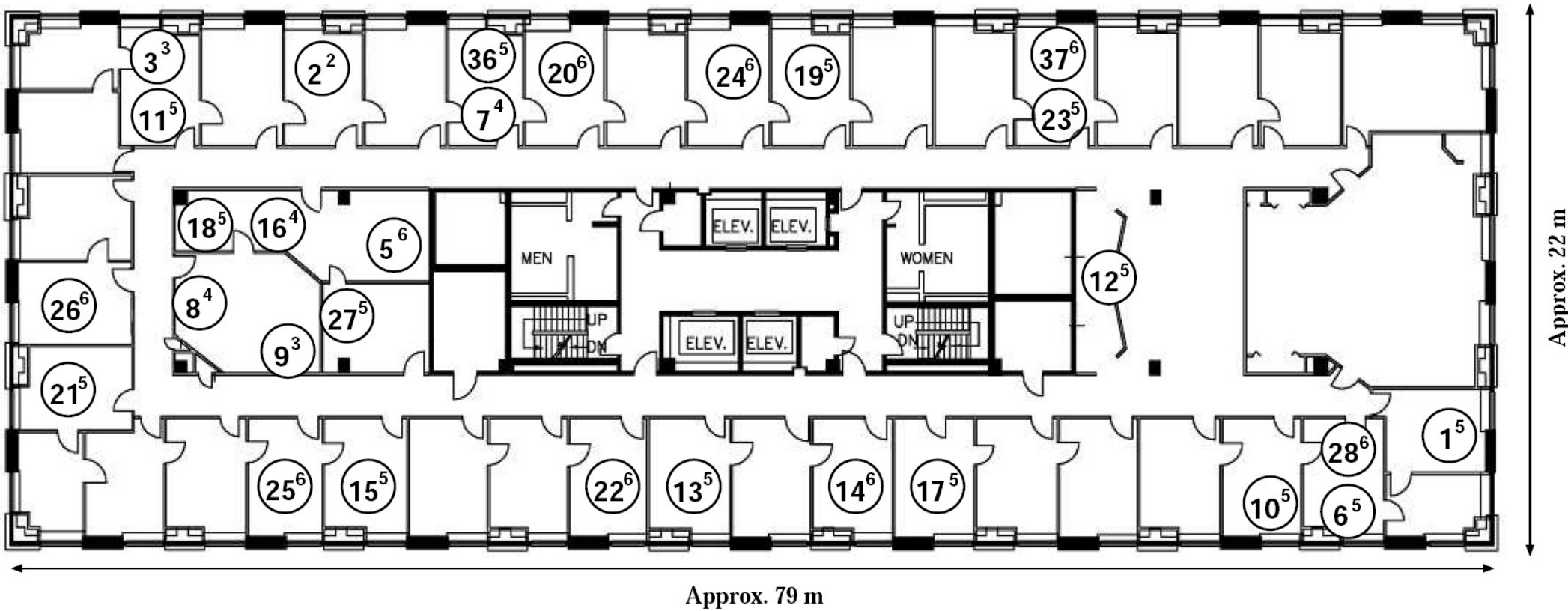
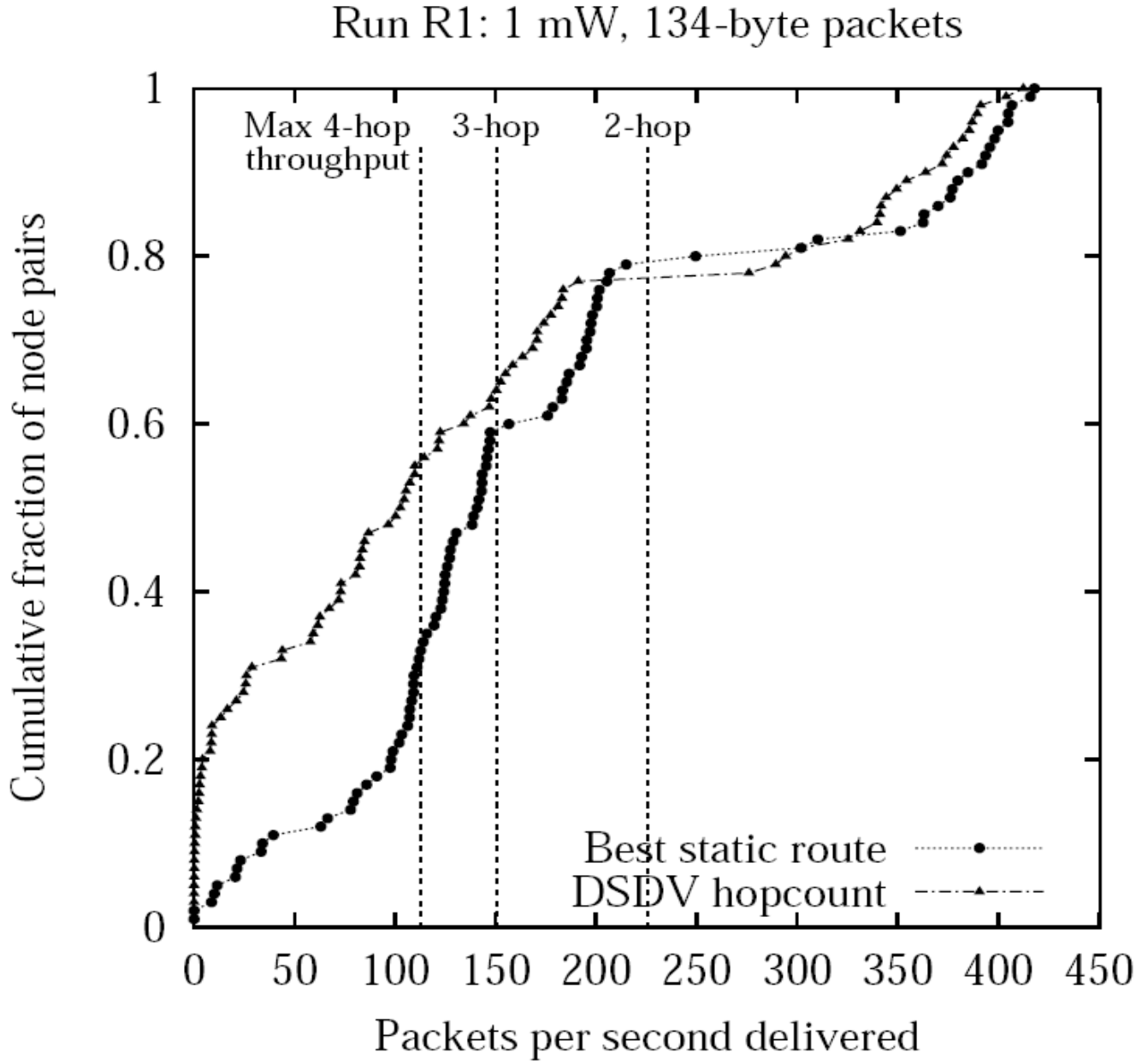


Figure 1: A map of the test-bed. Each circle is a node; the large number is the node ID, and the superscript indicates which floor of the building the node is on.

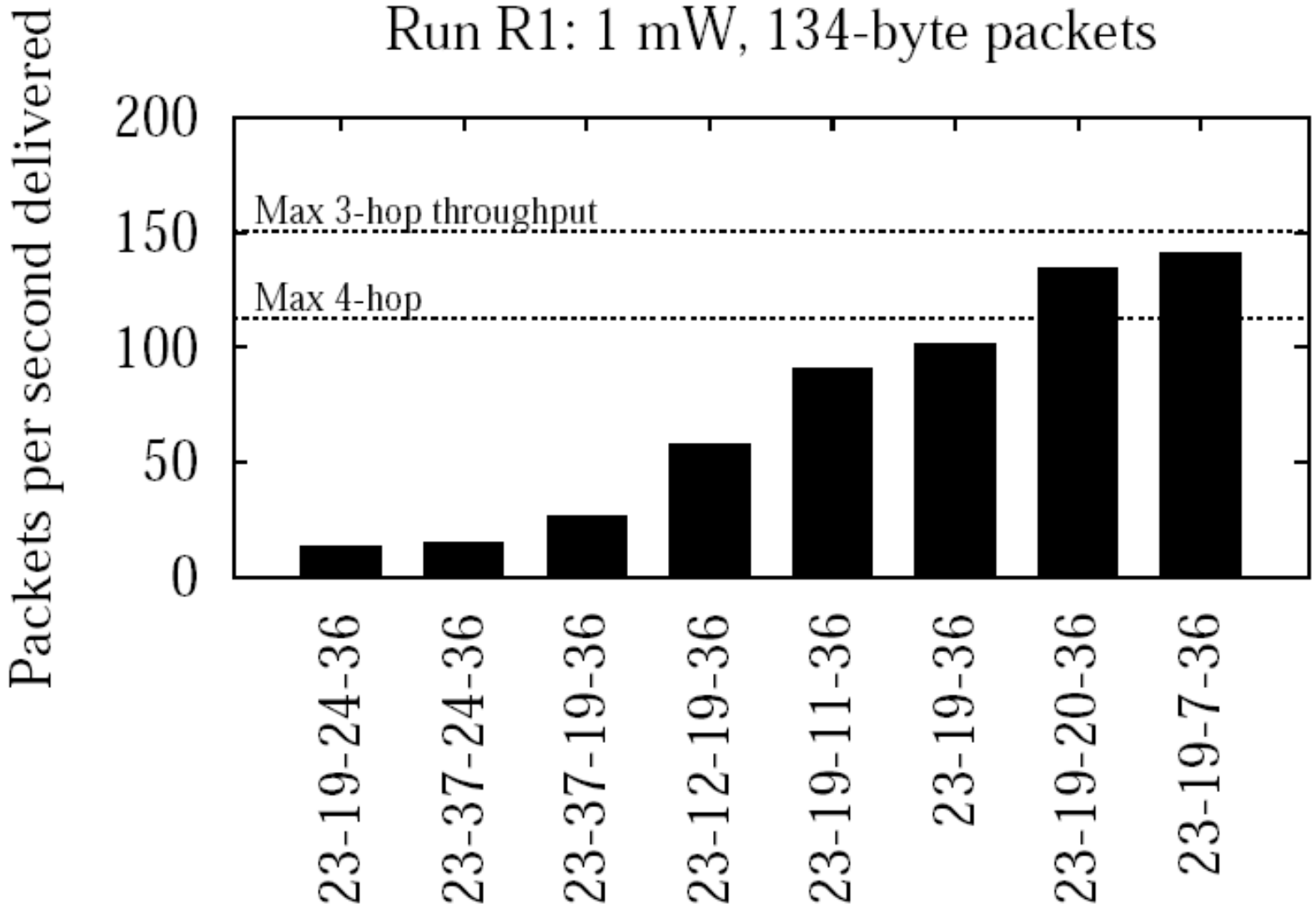
Initial experiments, traffic specs

- 802.11b cards, omni-directional, single channel
- RTS/CTS turned off
- 193 bytes per frame, 304 msec to transmit
- 451 packets per sec
- Interference unpredictable, not artificial

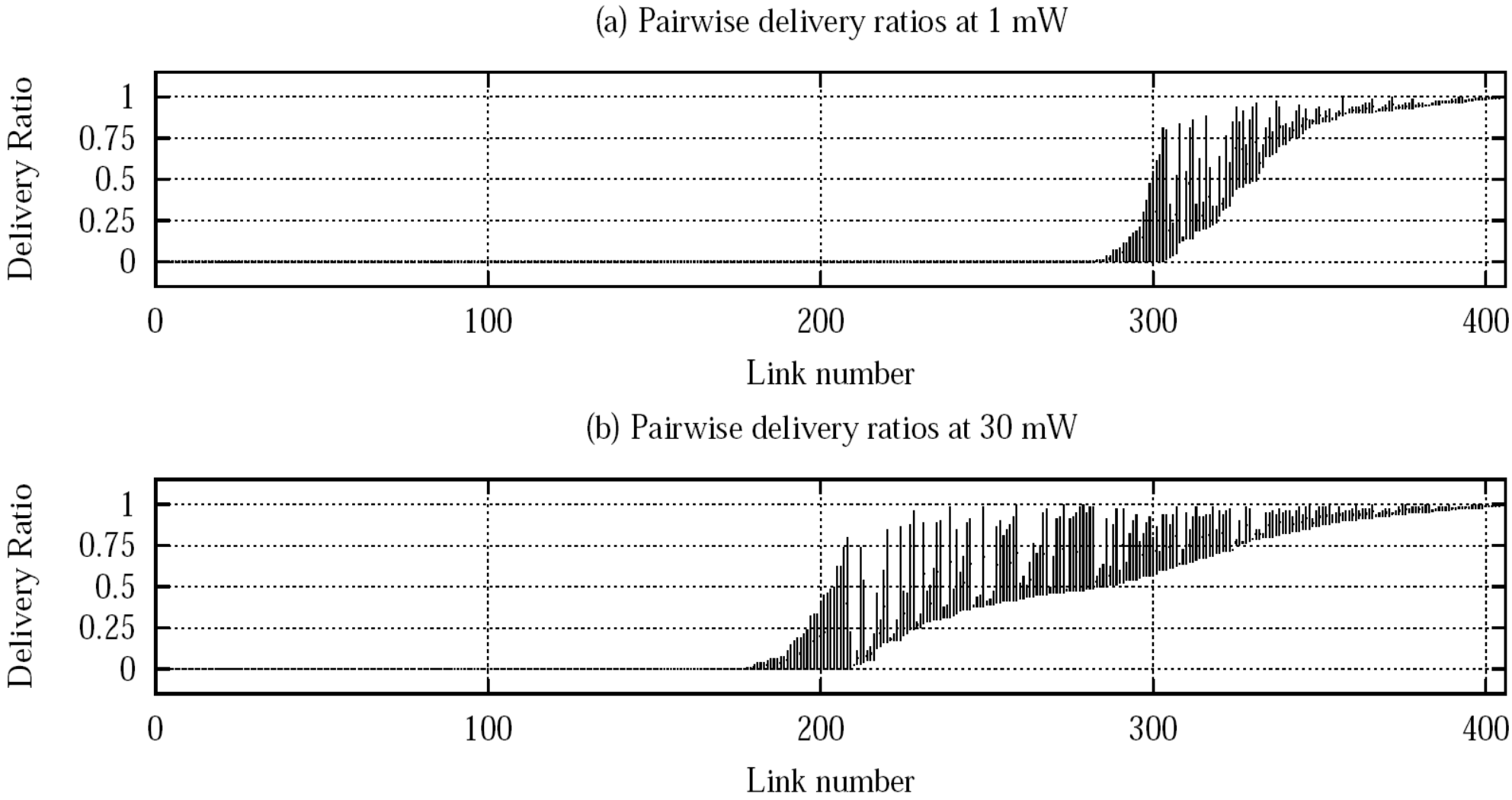
Initial experiment, results 1



Initial experiments, results 2



Initial experiments, results 3



New routing approach

- ETX: expected transmission counts over an entire path
- $$\mathrm{ETX} = \frac{1}{d_f \times d_r}$$
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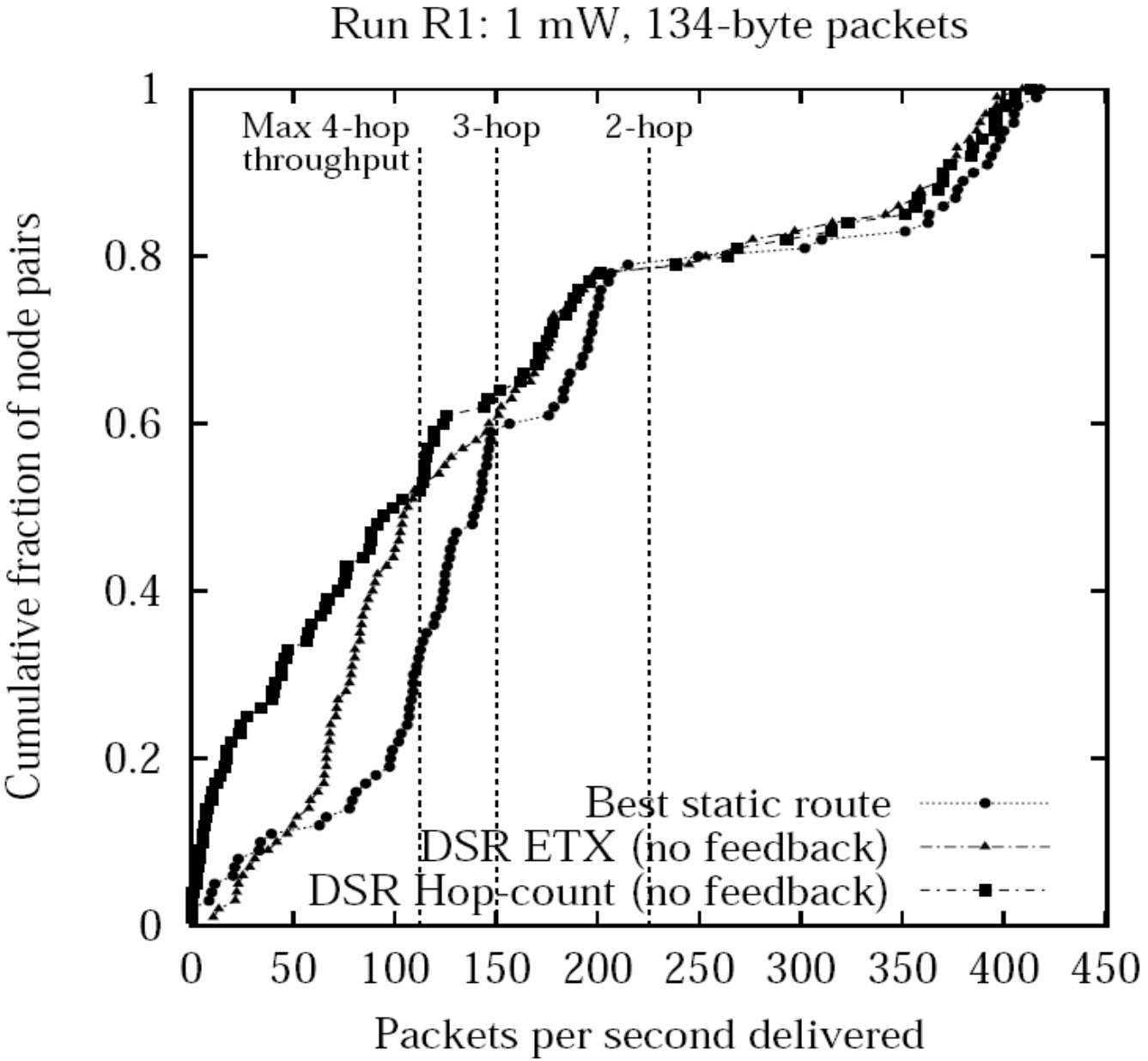
- How to measure ETX?
  - Link probe packets, broadcasting!
  - Every second in this paper
    - Synchronization discouraged by jitters

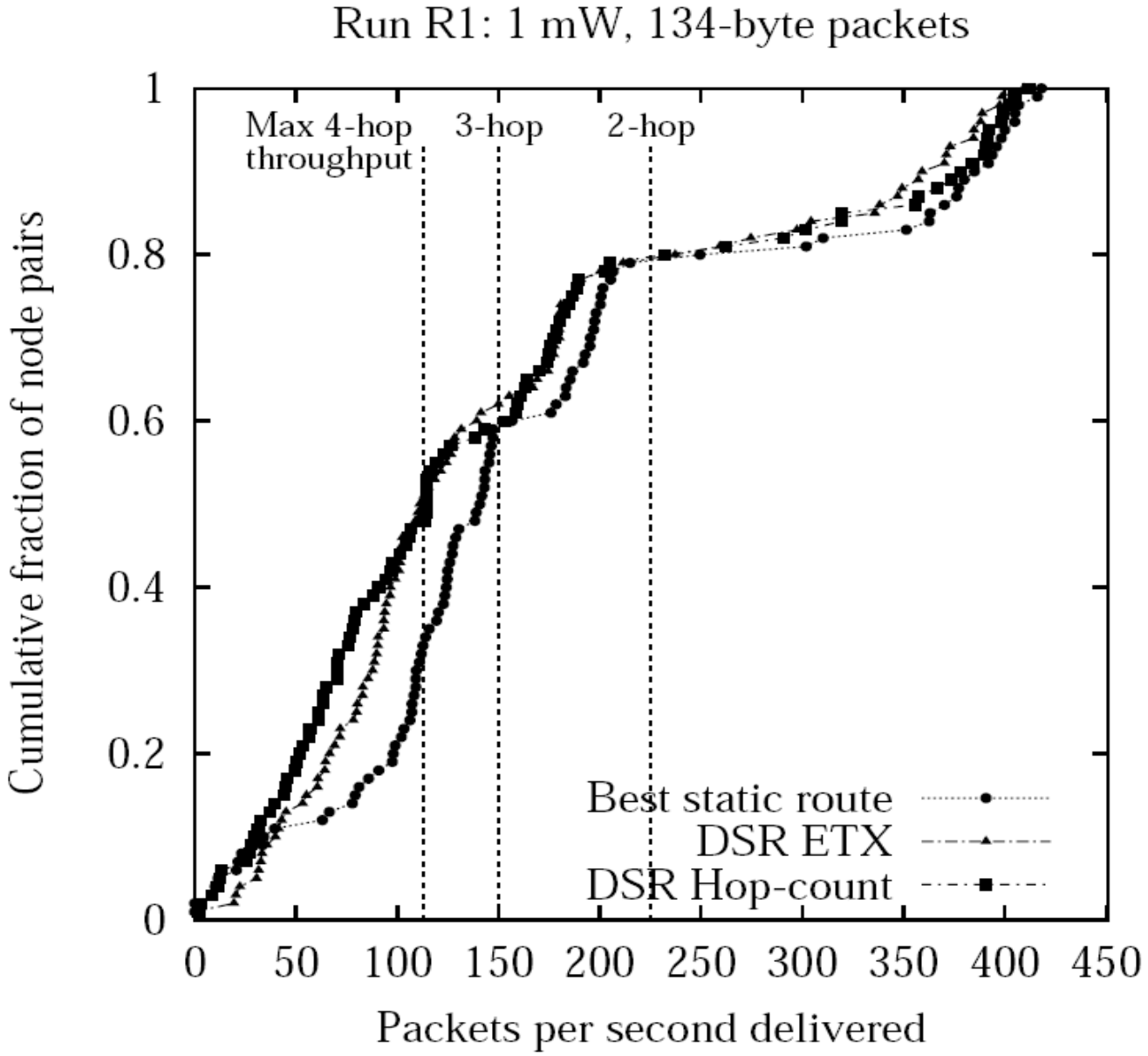
Thoughts on ETX

- ETX is a metric of delivery ratio
- Handles asymmetry
- Count link loss ratio?
- Tend to penalize routes with more hops
- Any more?

Evaluation


Run R1: 1 mW, 134-byte packets
Max 4-hop throughput
3-hop
2-hop
Cumulative fraction of node pairs
Packets per second delivered
Best static route
DSR ETX (no feedback)
DSR Hop-count (no feedback)
0
0.2
0.4
0.6
0.8
1
0
50
100
150
200
250
300
350
400
450

Evaluation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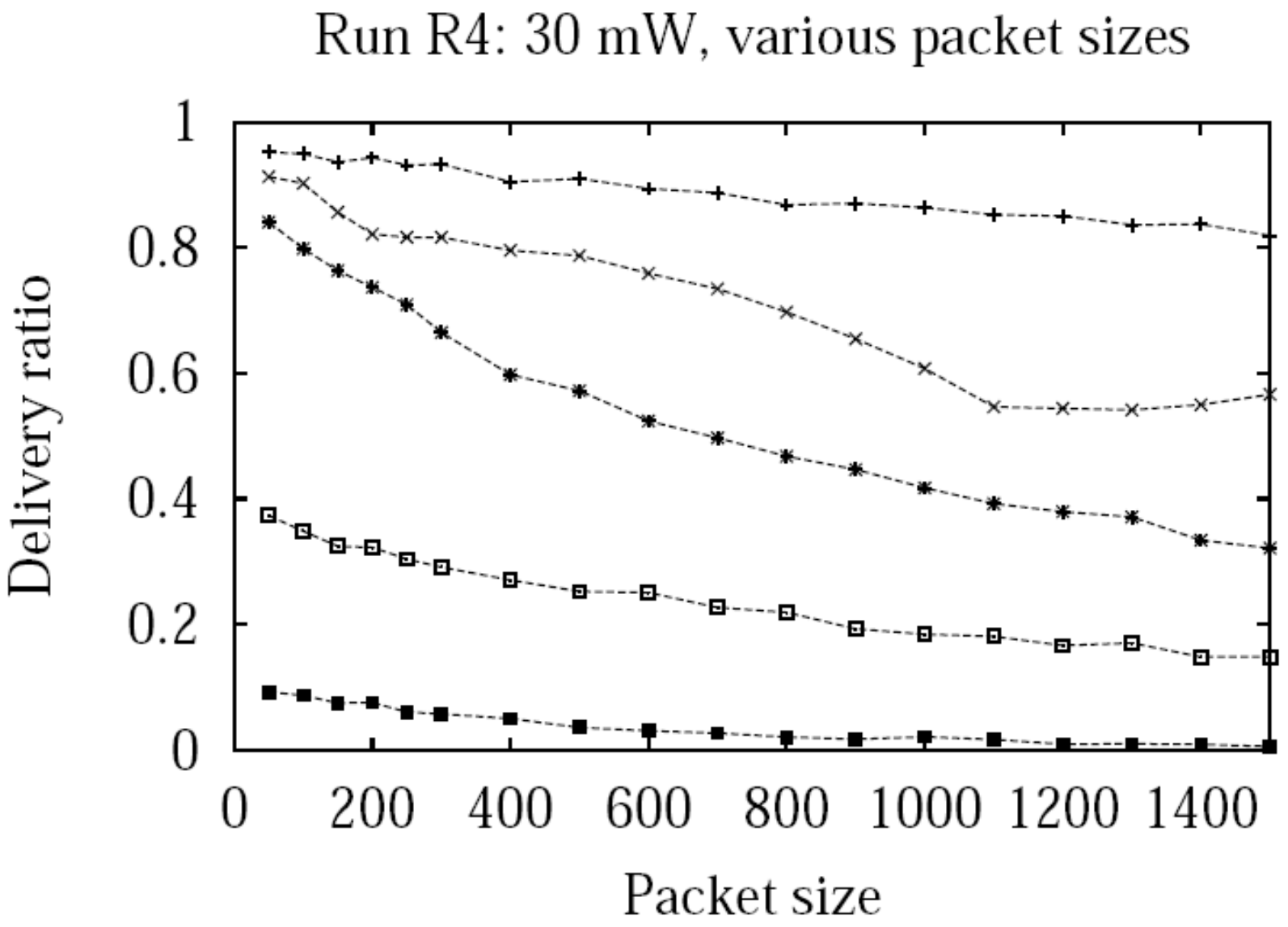
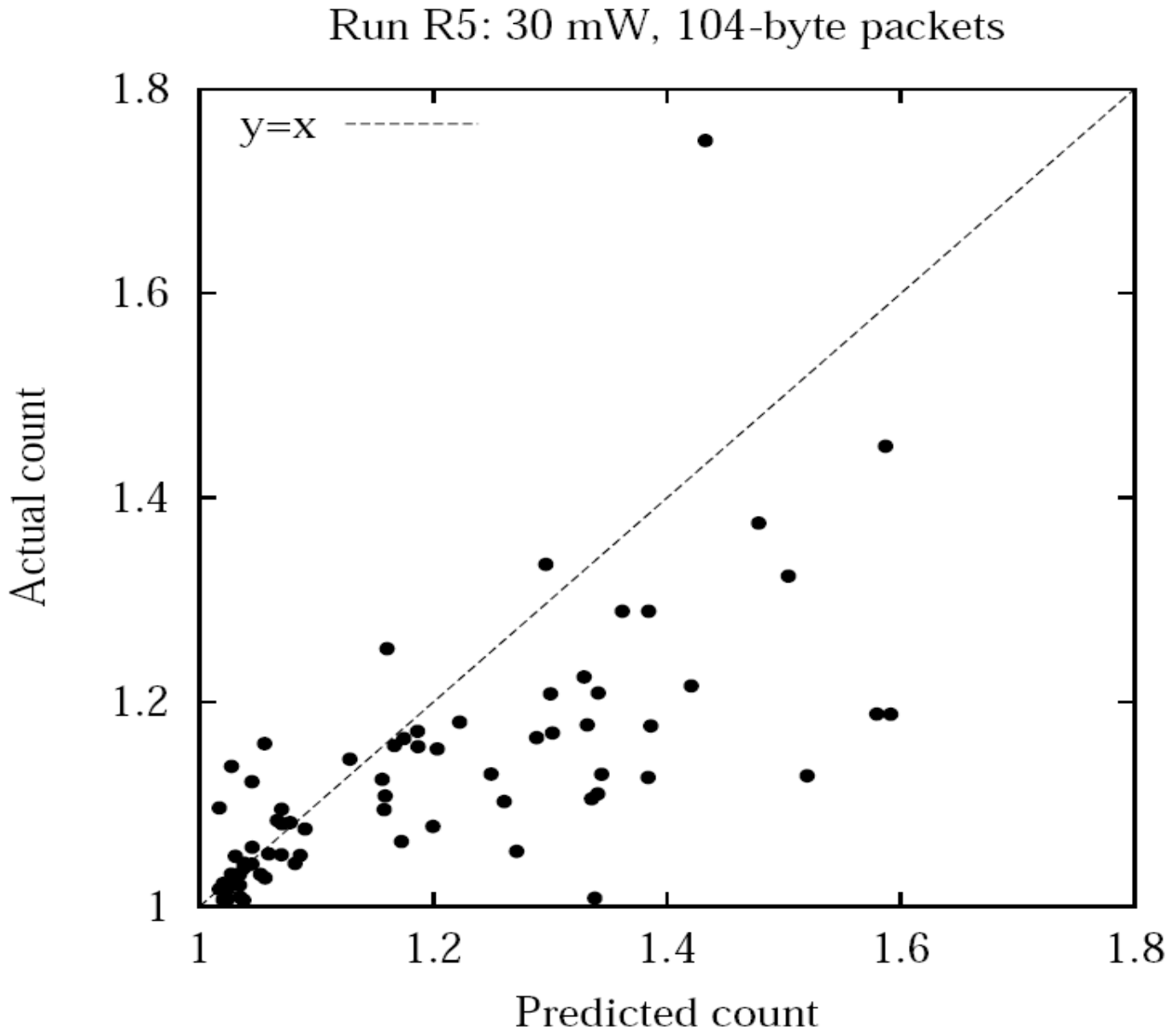

Run R4: 30 mW, various packet sizes
Delivery ratio
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000
1200
1400
Packet size

Evaluation


Run R5: 30 mW, 104-byte packets
y=x
Actual count
Predicted count
1
1.2
1.4
1.6
1.8