



Roofnet

Free Wireless Internet in Cambridge

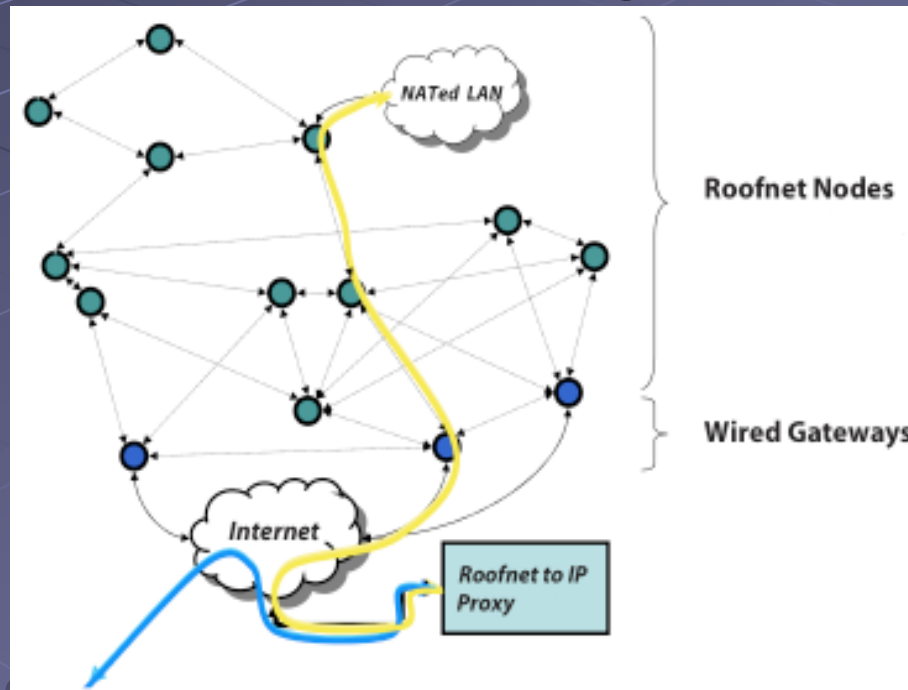
ESD 342

Presented by: Derek Rayside, Yingxia Yang
Jennifer E Underwood

Supervised by: Joel Moses

Roofnet Revisited

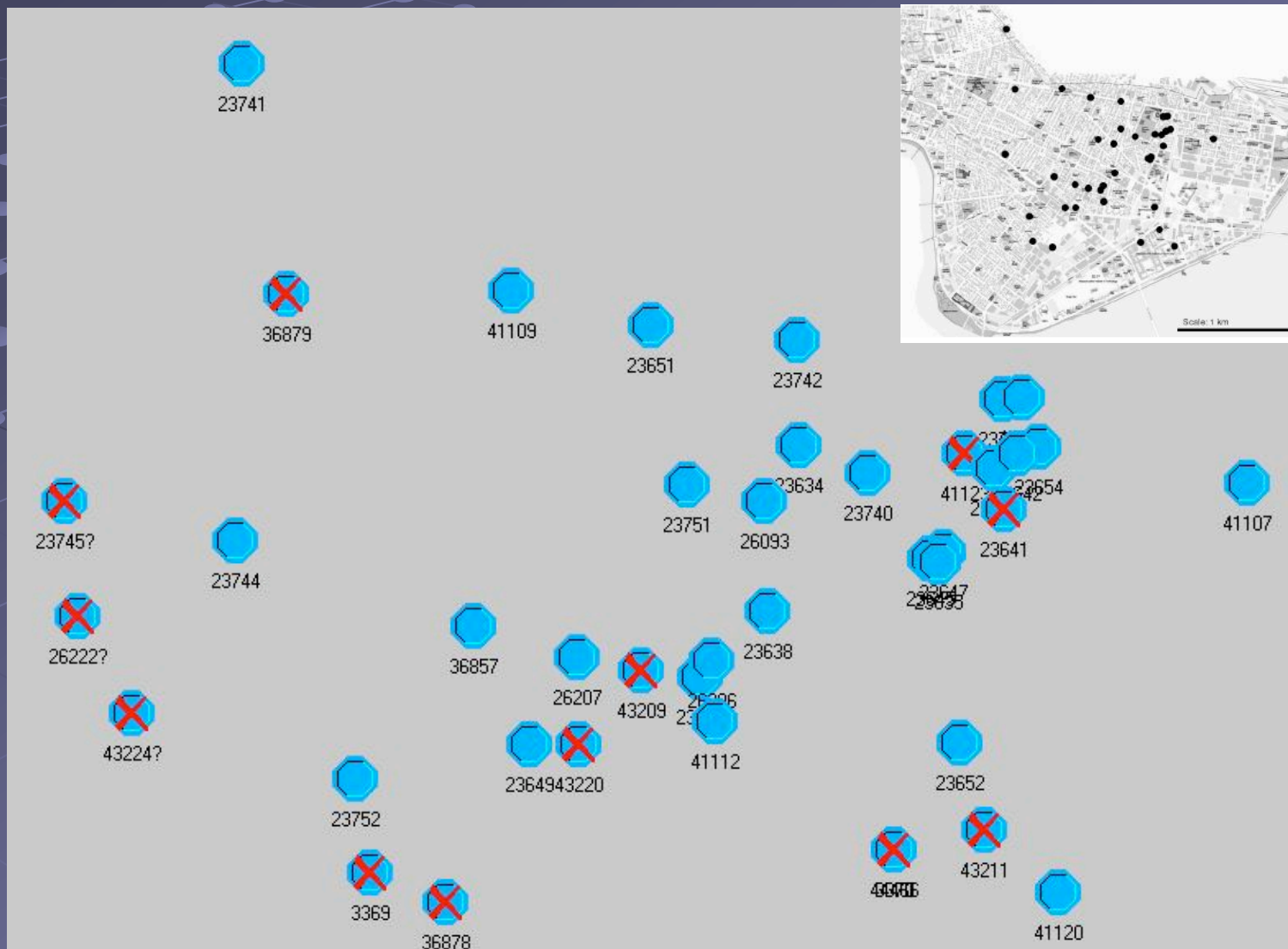
- The goal of Roofnet project is to provide broadband wireless Internet access to users in Cambridge.



Data Inconsistencies and Issues

- Coordinate data in the SIGCOMM2004 paper supplementary information:
 - Incomplete (some nodes in traffic data not in coordinate file)
 - Inconsistent (some lat-long coordinates do not match up with map in paper)
- Time stamp data not synchronized
 - Some packets arrived before they were sent
 - Couldn't calculate transmission time
 - Estimated based on s/n ratio and nominal bit rate
- Gateway nodes unclear...
- Traffic data arranged by “experiment”
 - Attempted bit rates: 1, 2, 5.5, and 11 Mbps
 - One node sends while others listen and record

Data Inconsistencies: Coordinates and Node ID

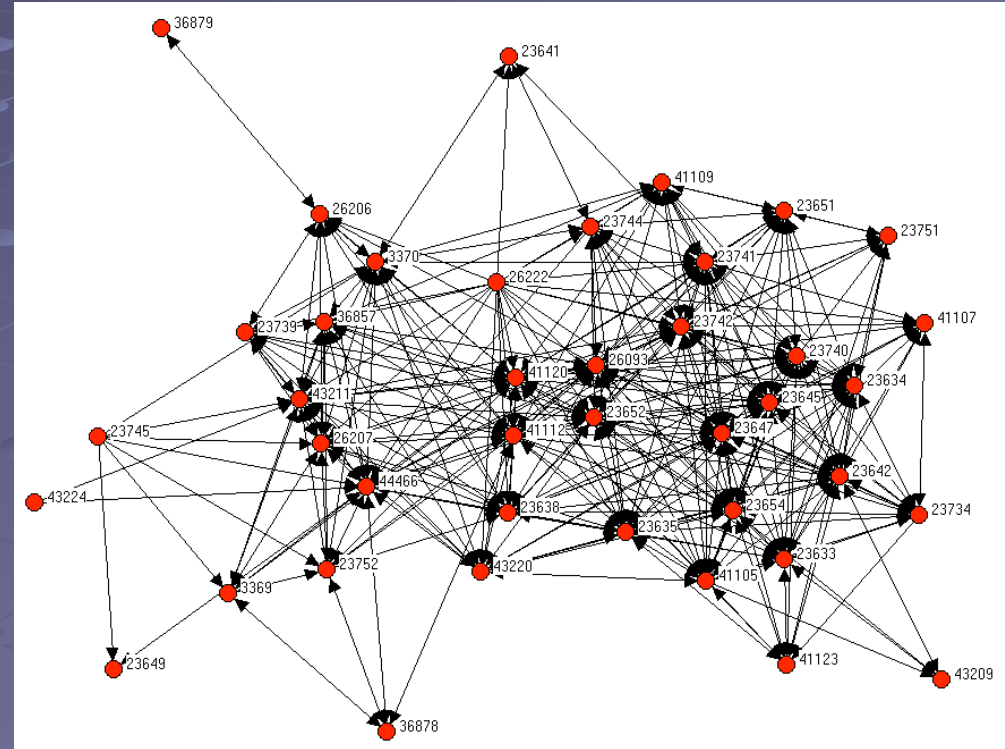


Revised Project Goals

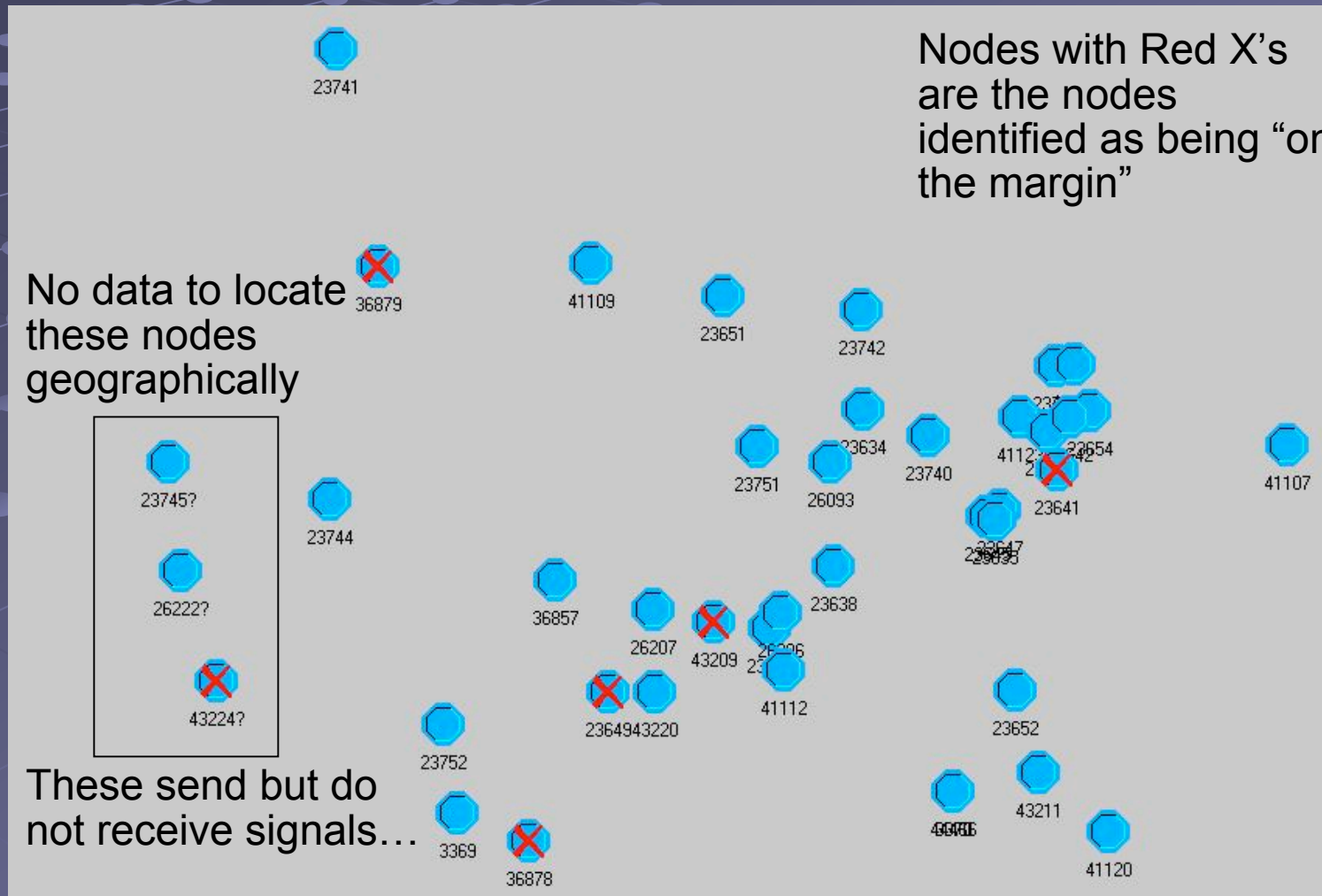
- Analyse network topological properties and variation in connectivity strengths as attempted data rate increases
 - Have analyzed for aggregate data
- Analyse performance of periphery nodes
 - Indicated as problem by Roofnet group
- Analyse robustness
 - In progress
- Analyse congestion (if time)

Periphery: where's the edge?

- Connectivity:
 - Few partners
- Bandwidth
 - Low s/n
- Geography
 - Physical distance
- All 3 are different



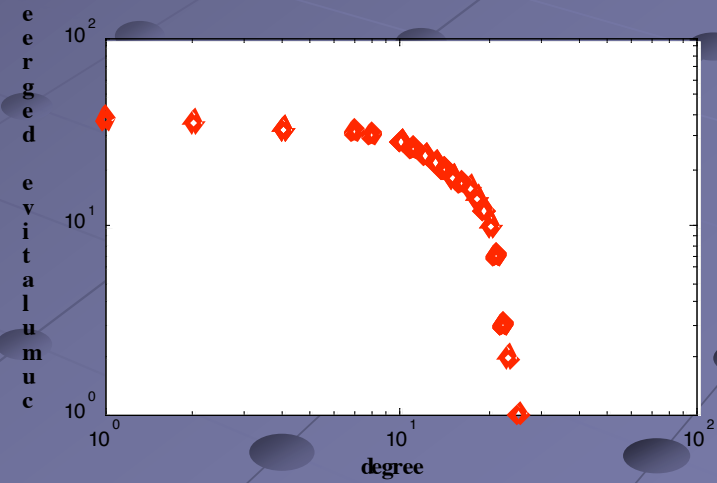
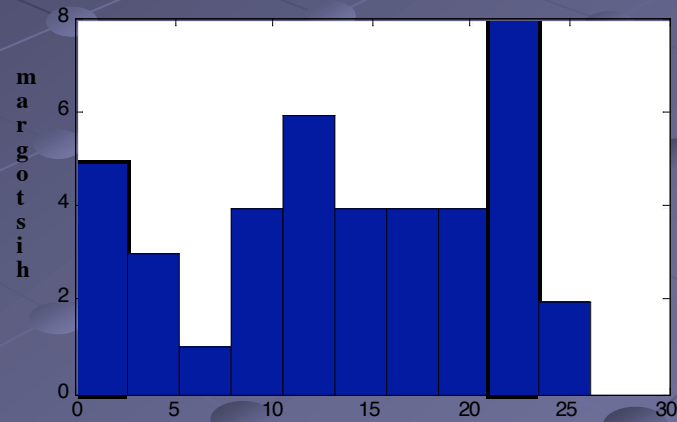
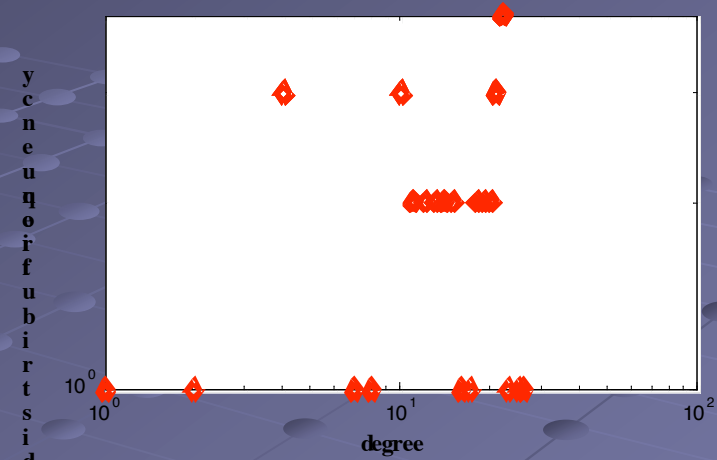
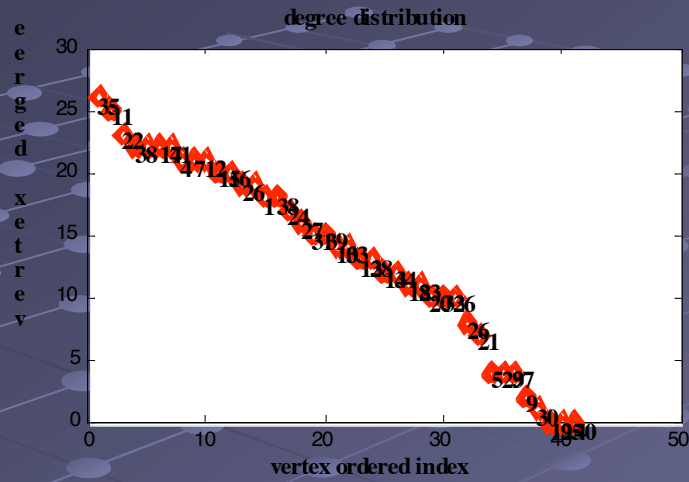
Connectivity Periphery: ≤ 4 incoming/outgoing links



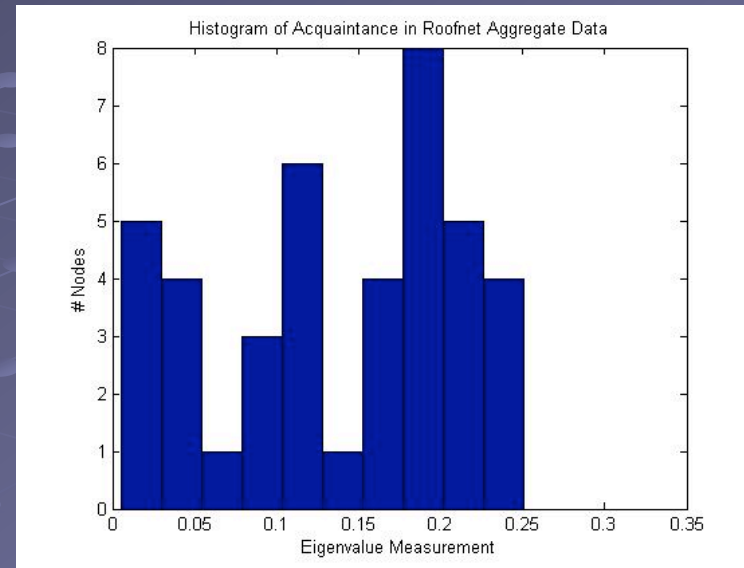
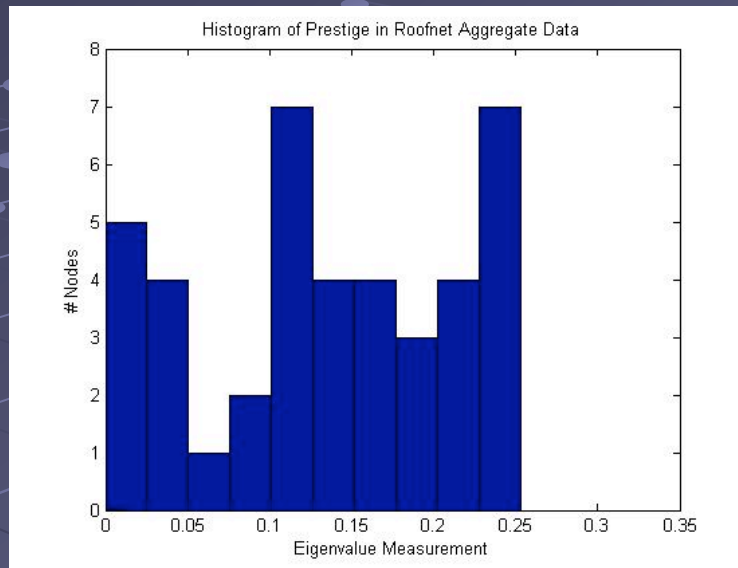
Basic Quantitative Analysis on Aggregate Data

- Nodes: 41
- Edges: 562
- Average degree: $562/41=13.7$
- Maximal out-degree = 27
- Maximal in-degree = 26
- Average path length: 0.3760
- Harmonic path length: 5.5962
- Clustering Co-efficiency: 0.5625
- Centrality:
 - Degree centrality
 - Degree centrality for out-degree: 34.063%
 - Degree centrality for in-degree: 31.500%
 - Betweenness centrality
 - Network Centralization Index = 9.19%

Degree distribution



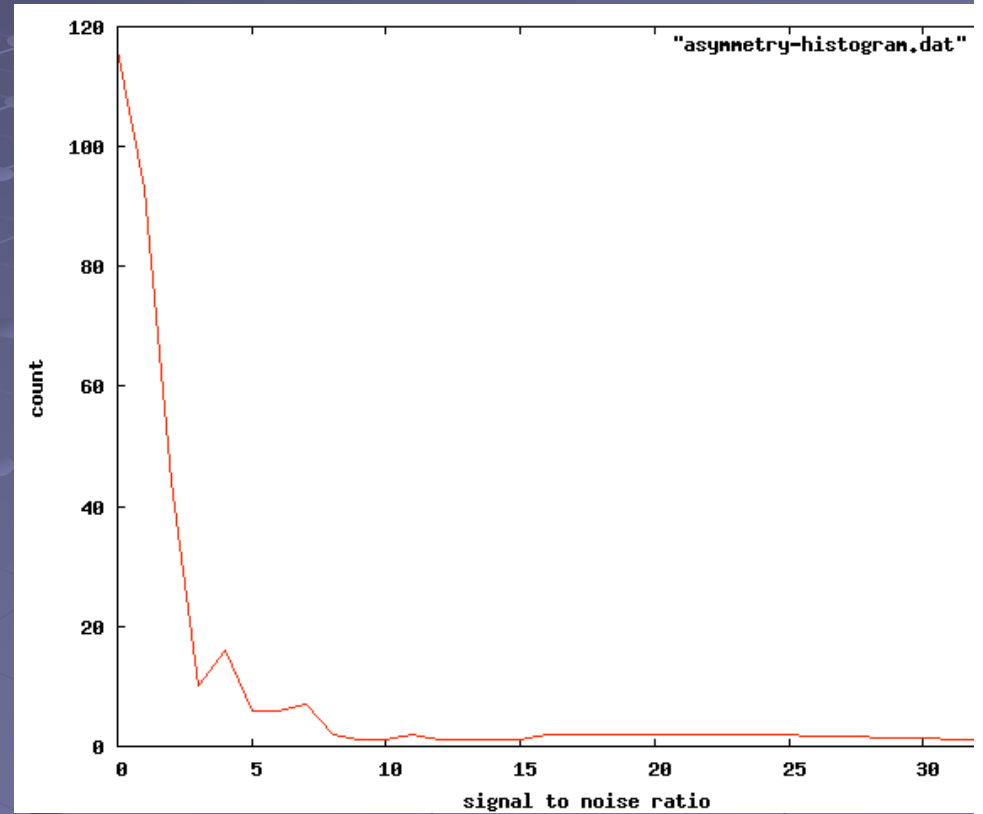
Prestige and Acquaintance



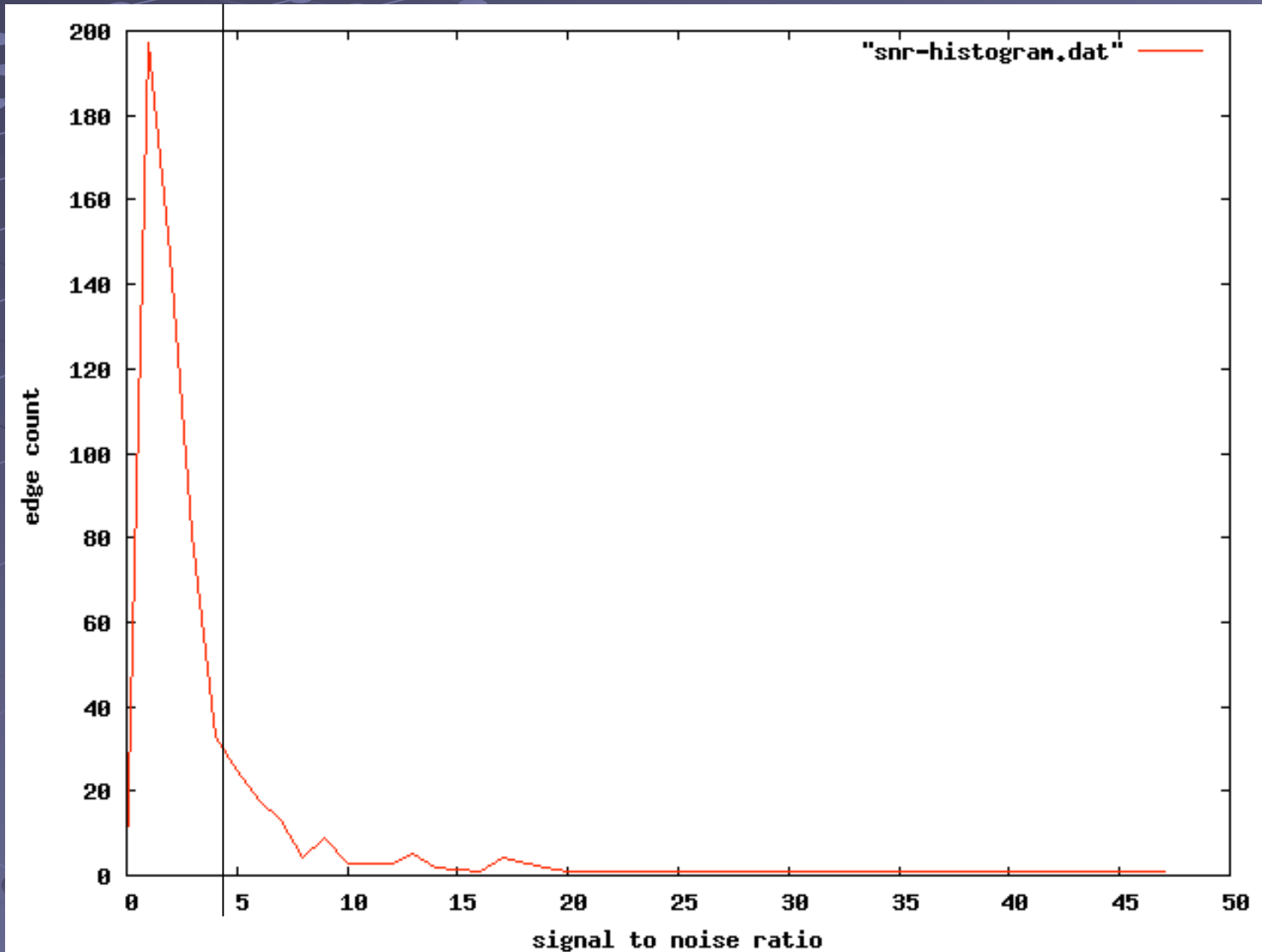
- Based on aggregate data
- Authority: not only referred to by many nodes, but also by many Hubs. (measurement: prestige)
- Hub: not only refers to many nodes, but also to many Authorities. (measurement: acquaintance)

Asymmetry

- s/n not symmetrical
- X can talk to Y
- Can Y talk to X?
- some dramatic differences
- 76 one-way edges



Most links are low quality



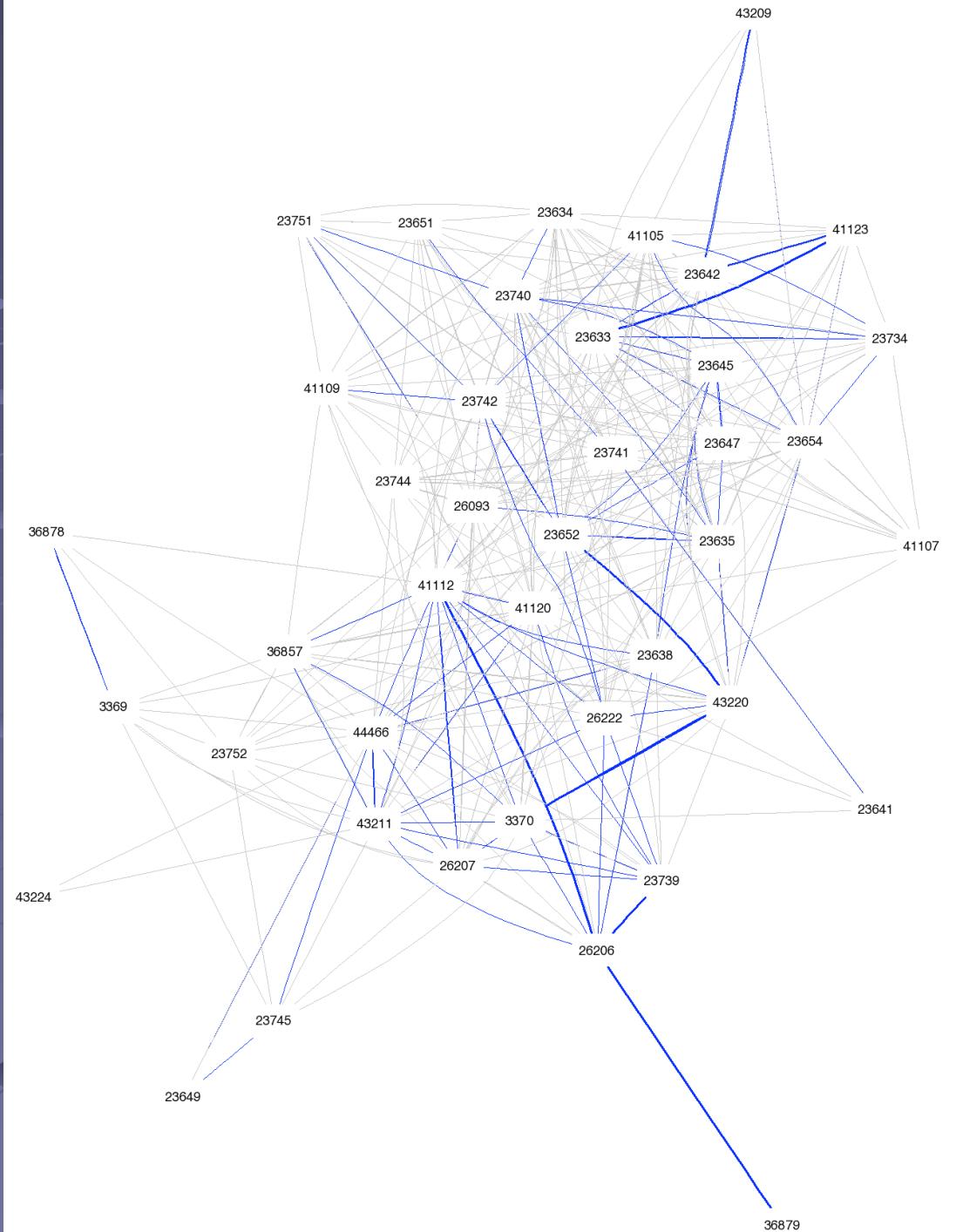
Connectivity & S/N Quality

● < 4db

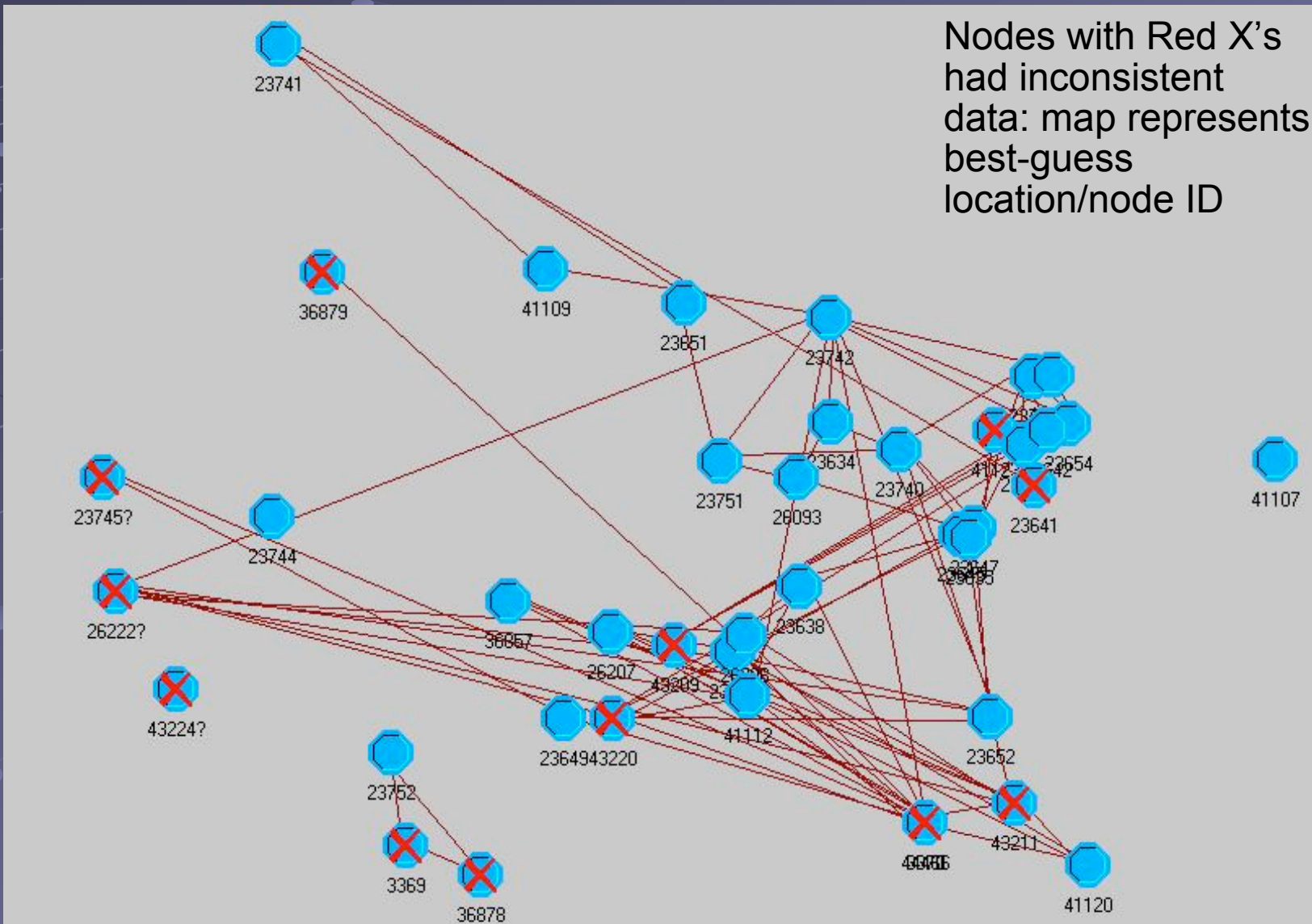
● < 20db

● > 20db

● connectivity \neq bandwidth

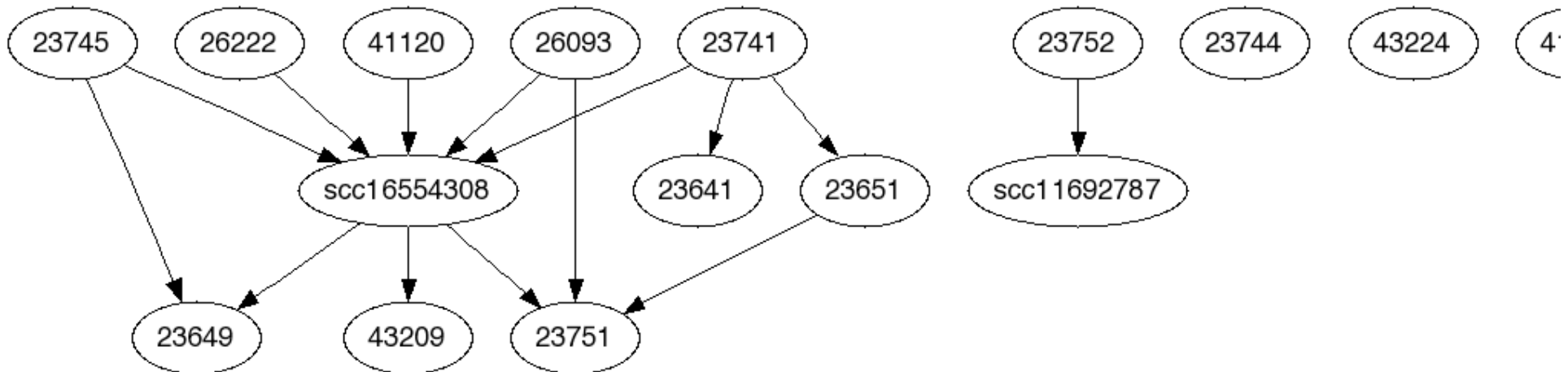
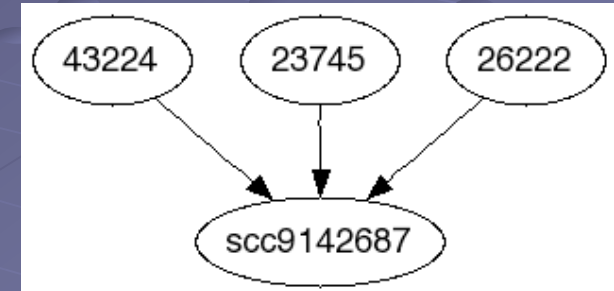


“Quality” Links: Geographical



Strongly-Connected Components

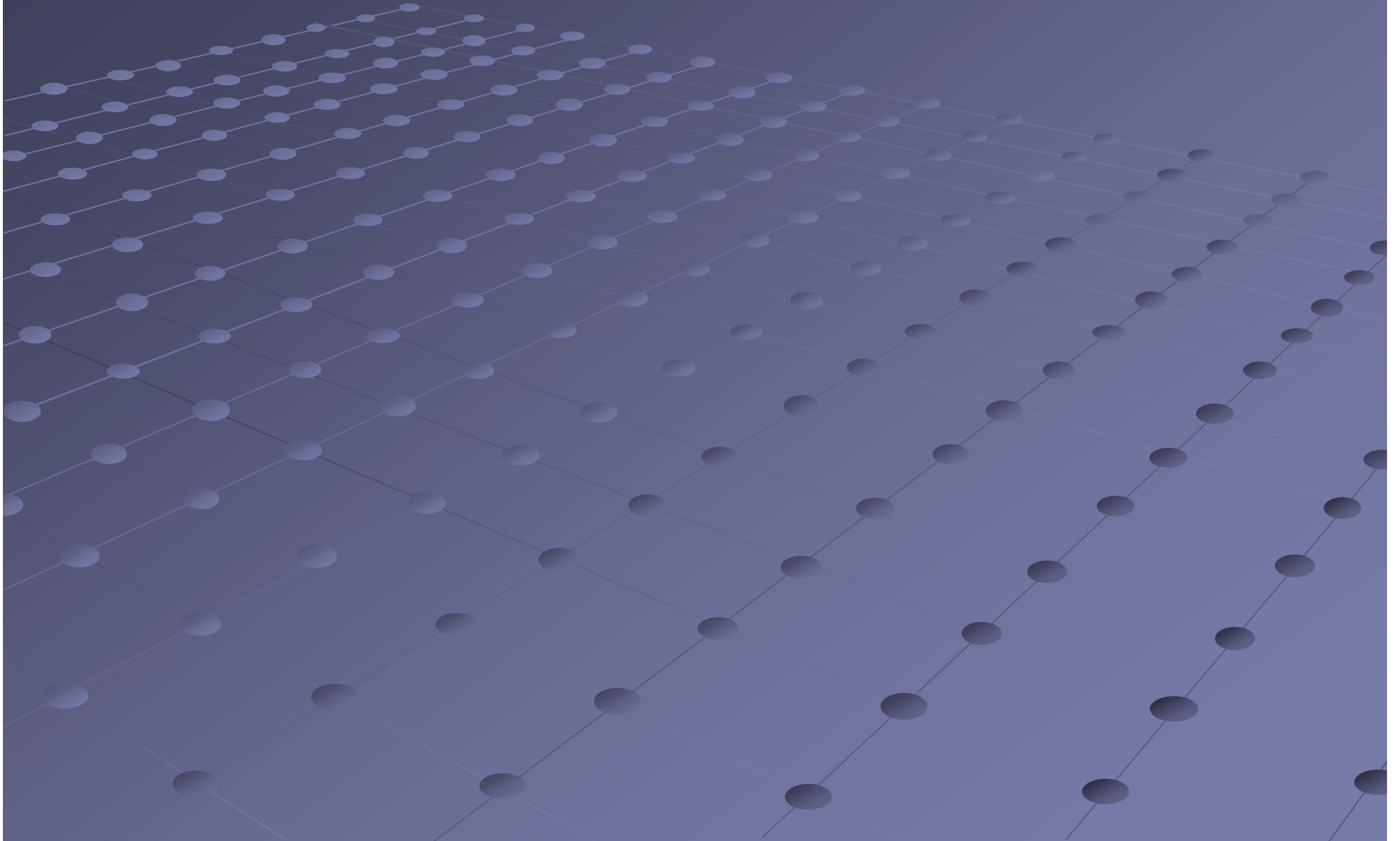
- Subgraph where every node can reach every other node
- Collapse into “meta-node”
- All links
- “Quality” links ($>4\text{db s/n}$)



Future steps

- Finish analyzing variation across experiments
- Finish robustness analysis
 - Random and targeted failed nodes
- Finish analyzing periphery nodes
- If time
 - Analyze congestion in OPNET
 - Evaluate political situation in Cambridge with regards to deploying Roofnet

Back-up Slides



3-node Motifs

Full list includes 2 motifs

MOTIF ID	NREAL	NRAND STATS	NREAL ZSCORE	NREAL PVAL	UNIQ VAL	CREAL [MILI]
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108	185	153.7+-10.1	3.08	0.000	5	56.66
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0 0 1

1 0 1

1 0 0

238	742	601.0+-13.2	10.68	0.000	10	227.26
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0 1 1

1 0 1

1 1 0

Had ALL 13 of the possible sub-graphs

Oops!

- Three nodes only sending signals without receiving any signals
 - 23745, 43224, 26222
 - Interestingly, these nodes did not appear in the coordinate data corresponding to the Roofnet SIGCOMM2004 paper...
- Nodes “on the margin” don’t have good connectivity to the network
 - Appear to be periphery nodes on this basis
 - Define as those nodes with ≤ 4 incoming/outgoing links