VoIP Call Capacity

Group 2

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Introduction

- Problem Overview
- Topology and Results Summary
- Attempted Improvements
- Conclusions

Problem Statement

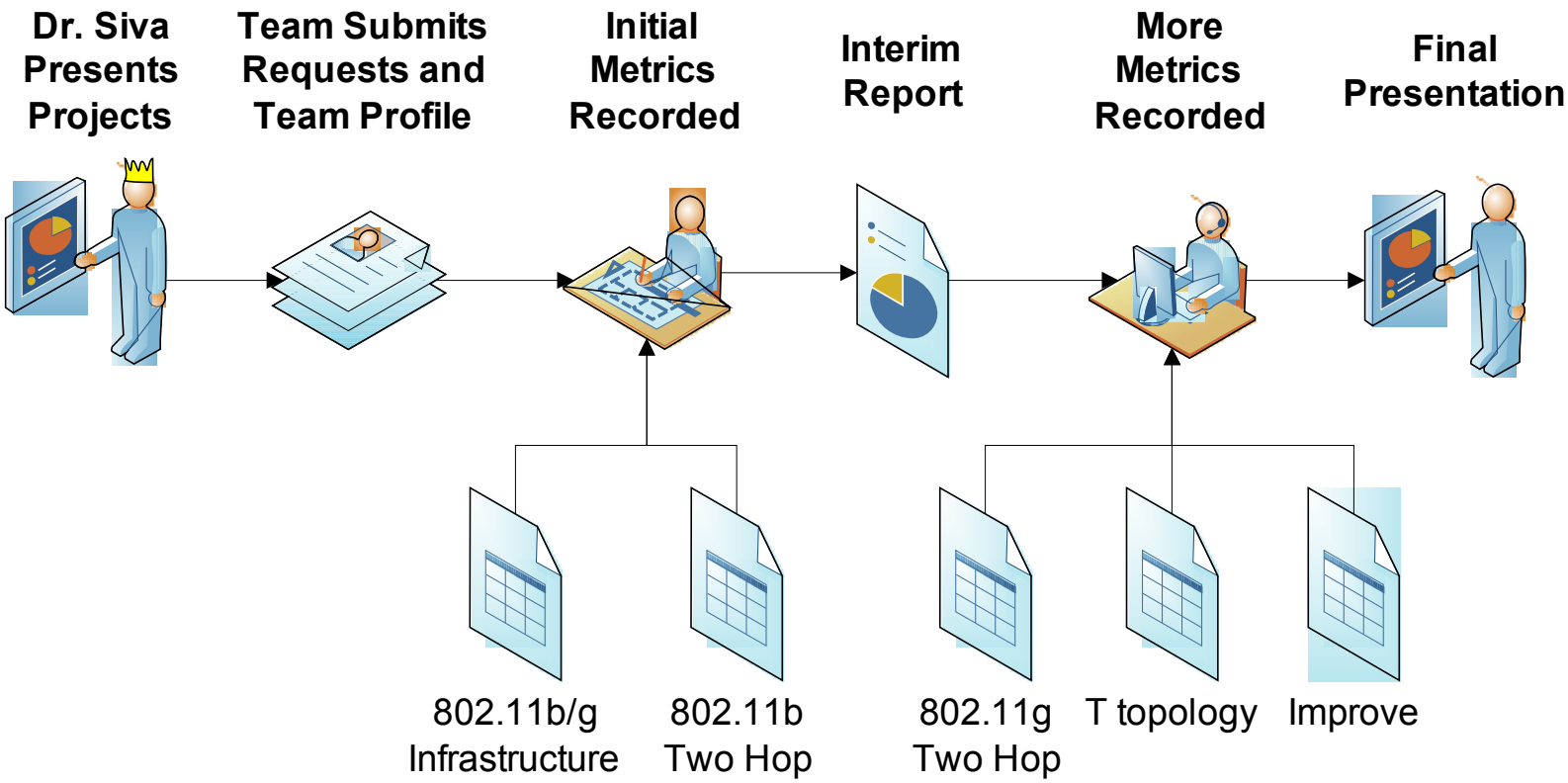
- Using open source tools, setup appropriate network topologies and measure VoIP call capacity for 802.11b and 802.11g networks

- Develop solutions to improve call capacity

Motivation

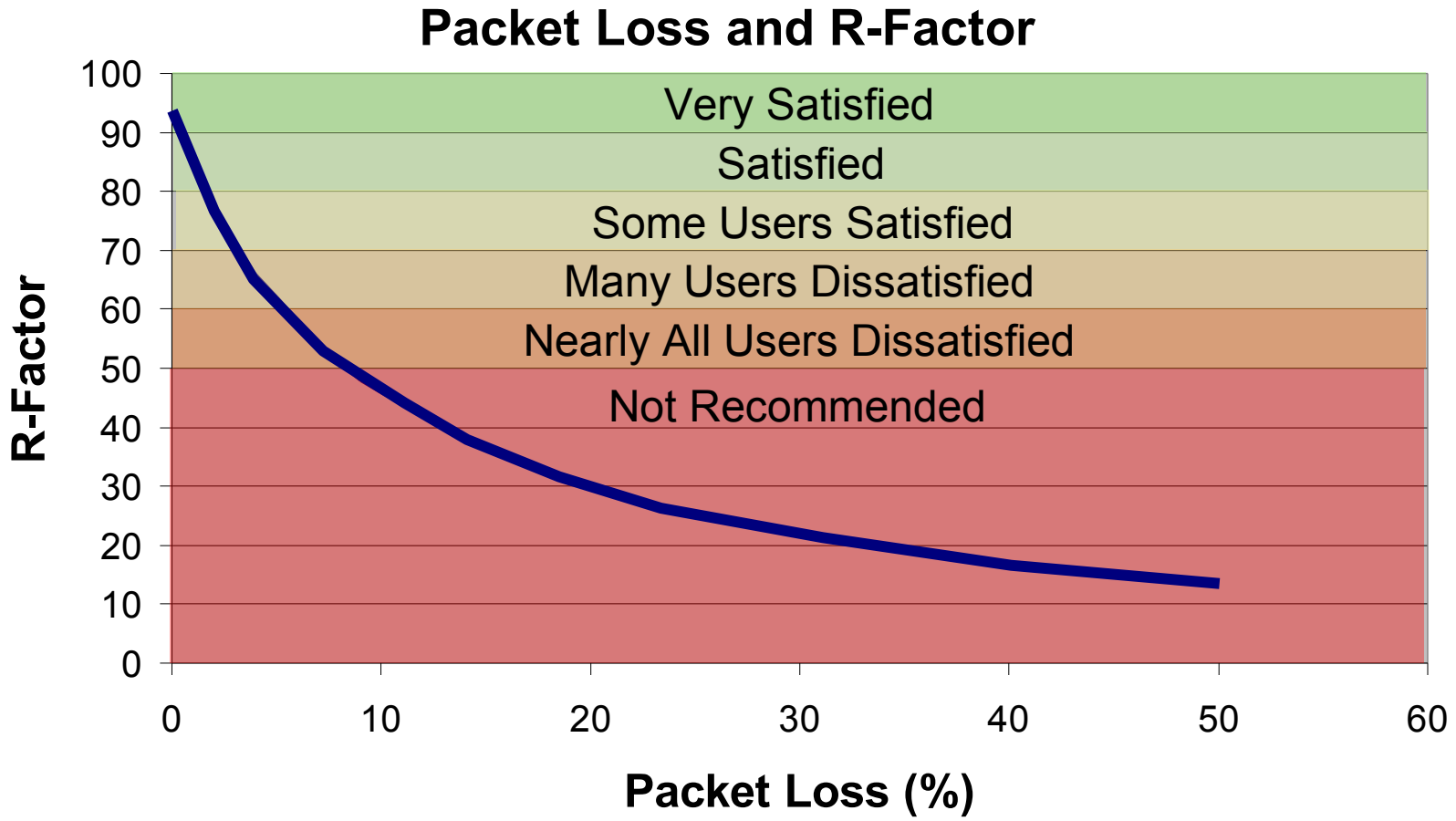
- WLANs are widely deployed
- VoIP has a promising future as the dominant voice communication method
- WLAN ad-hoc networks are ideal for communicating in disaster areas
- Important to measure the quality/capacity of VoIP traffic over WLANs

Milestones


Dr. Siva Presents Projects
Team Submits Requests and Team Profile
Initial Metrics Recorded
Interim Report
More Metrics Recorded
Final Presentation
802.11b/g Infrastructure
802.11b Two Hop
802.11g Two Hop
T topology
Improve

R-Factor

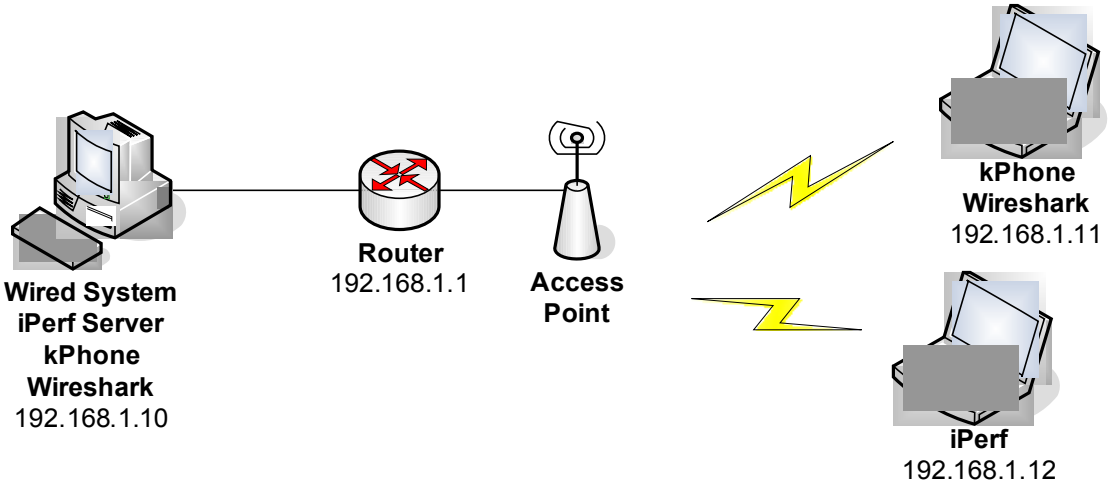
ITU Recommendation G107 Introduced E-model which outputs R-factor based on perceptual and equipment impairments in its calculation.



Topologies Overview

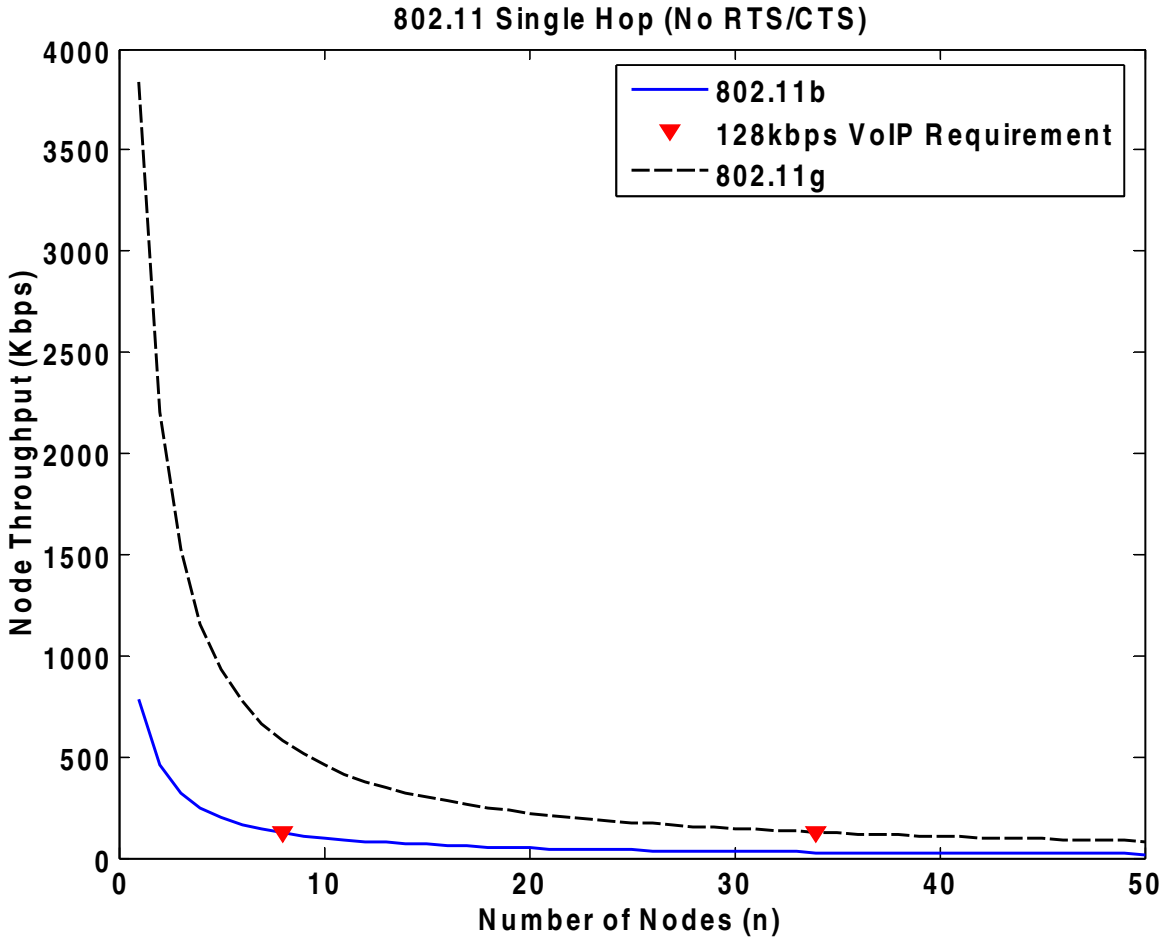
- Infrastructure
- Two Hop
- Cross Traffic T
- Two Hop with Improvements

Infrastructure



- Software: Linux, kPhone, iPerf, Wireshark
- Mix of lab and personal hardware
- Recording on *both* kPhone clients!

Theoretical Node Throughput

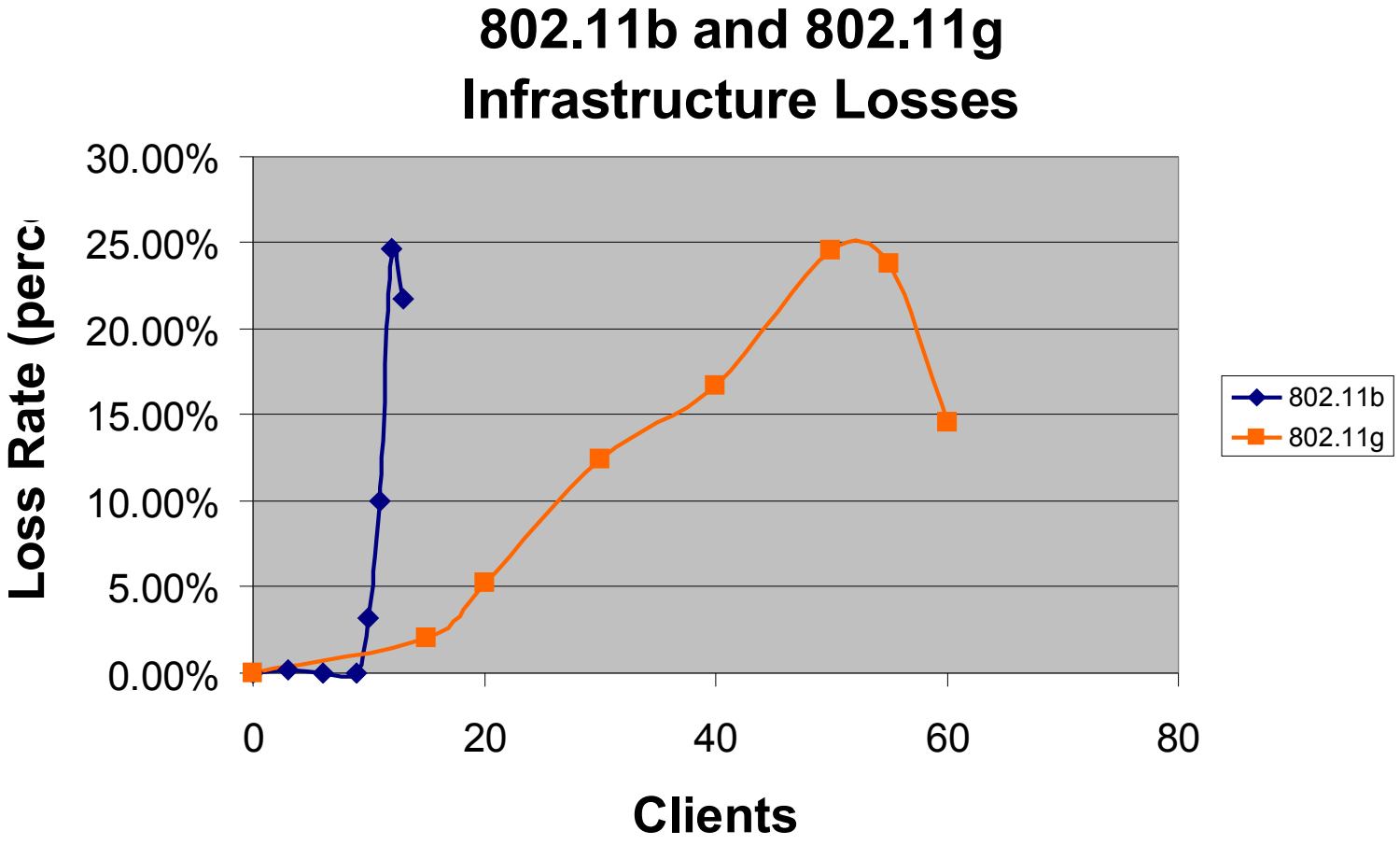


Infrastructure (Cont.)

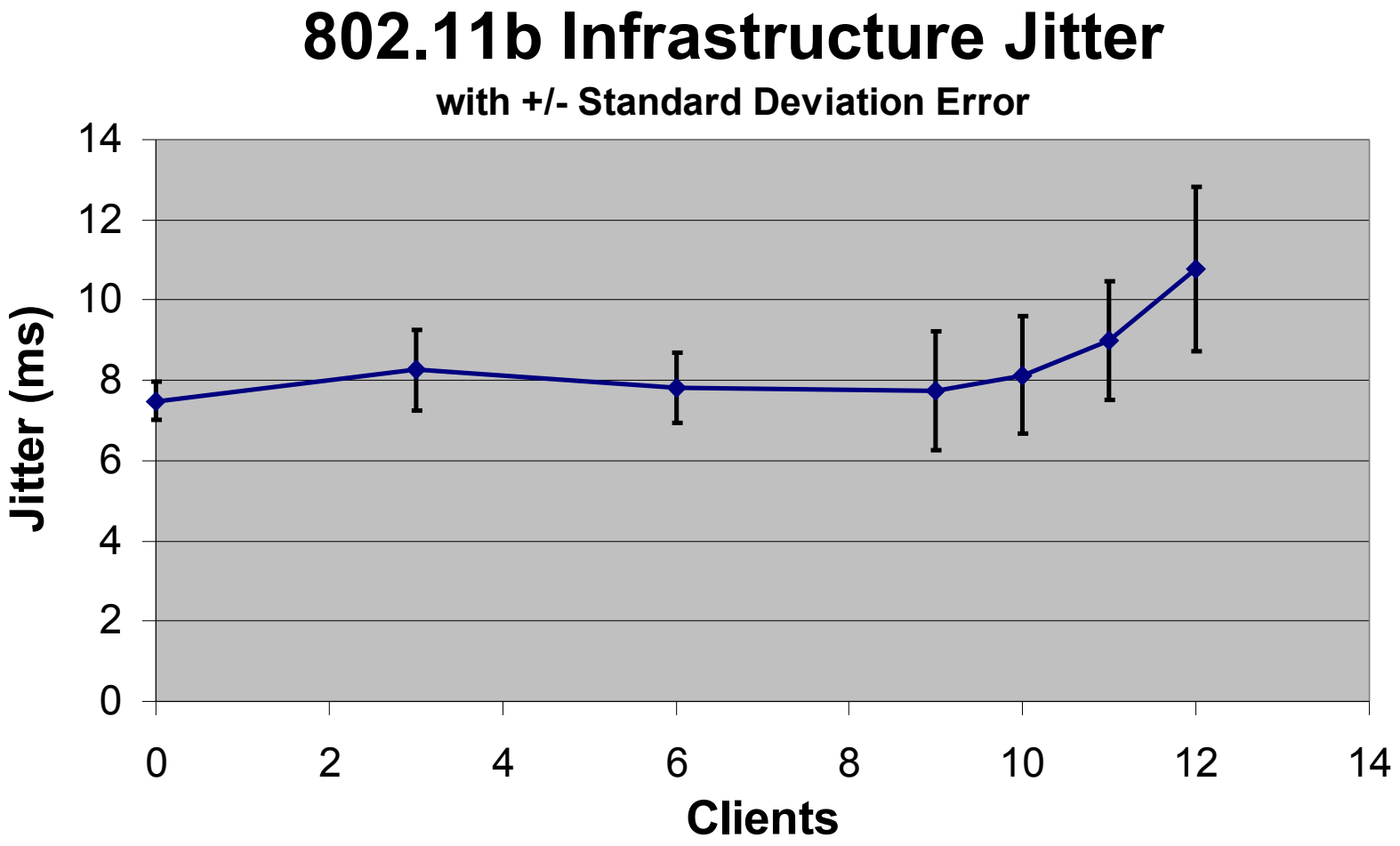
Calls Supported	802.11b	802.11g
Theoretical Max	86	422
Analytical	8	34
Measured	11	30

- Supported calls is substantially lower than expected
- Small packets and packet overhead reduce maximum calls
- Values inflated due to limited number of computers in the testbed

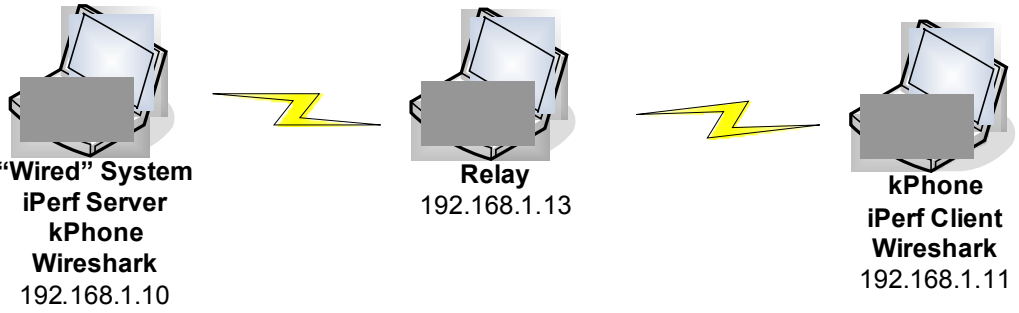
Loss Rates


802.11b and 802.11g
Infrastructure Losses
Loss Rate (perc
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0
20
40
60
80
Clients
802.11b
802.11g

Jitter


802.11b Infrastructure Jitter
with +/- Standard Deviation Error
Jitter (ms)
0
2
4
6
8
10
12
14
Clients
0
2
4
6
8
10
12
14

Linear Multi-hop



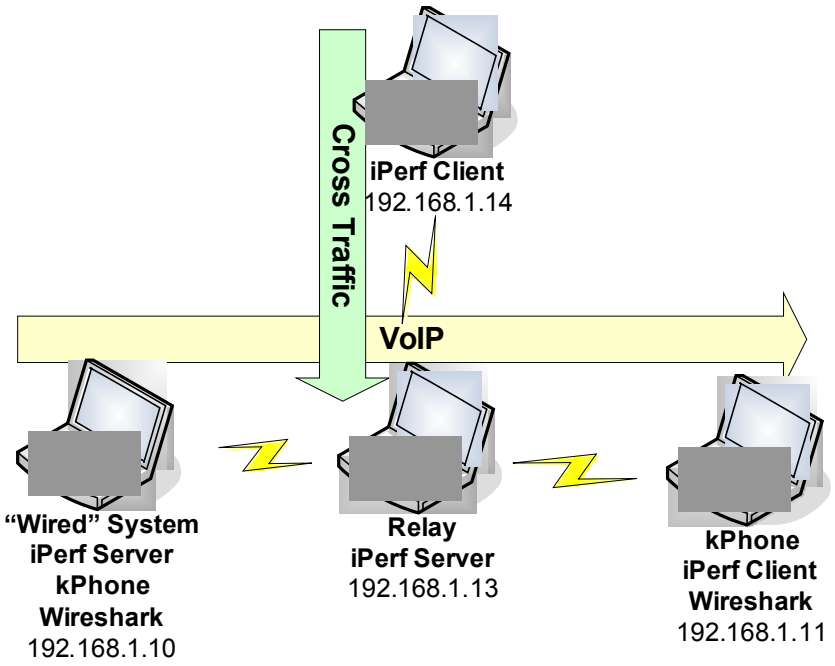
- Adhoc setup with Linux system acting as relay
- Increased contention
- Wireshark recording on endpoints (NOT in the middle!)

Linear Multi-hop (Cont.)

	802.11b	802.11g
Calls Supported	3	9

- Multiple hops reduces maximum
- Higher contention
- Excessive delay (2-5 seconds mean delay in test cases)

Cross Traffic T-Mode



- Increased contention
- Start of a grid

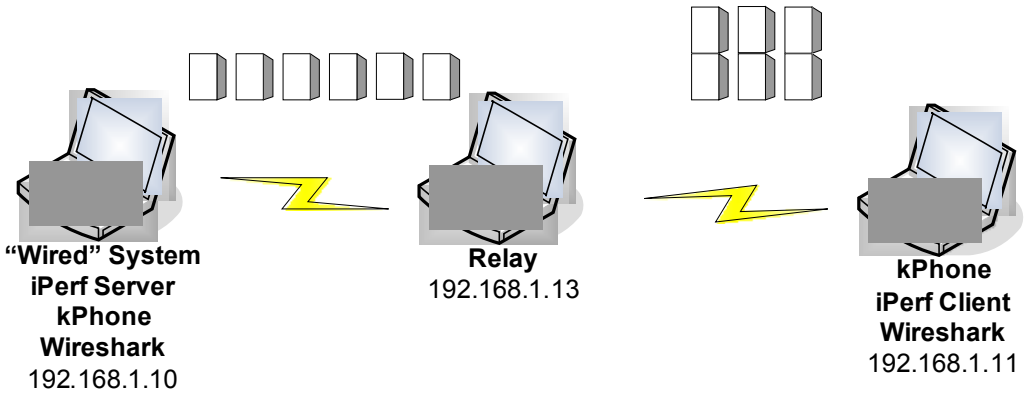
T-Mode (Cont.)

	802.11b	802.11g
Calls Supported	5	-

- Computers become overloaded in relay

Improvements

- Turn RTS/CTS on
- VoIP packet size increase
- Packet Aggregation



Improvements (Cont.)

	RTS/CTS	Double Size	Aggregate
Calls Supported	3	5	3-5

- RTS/CTS introduced extremely large delay but no improvements
- Some improvement in increased packet size
- Aggregation indicated small improvement
- Small improvements hard to measure in environment

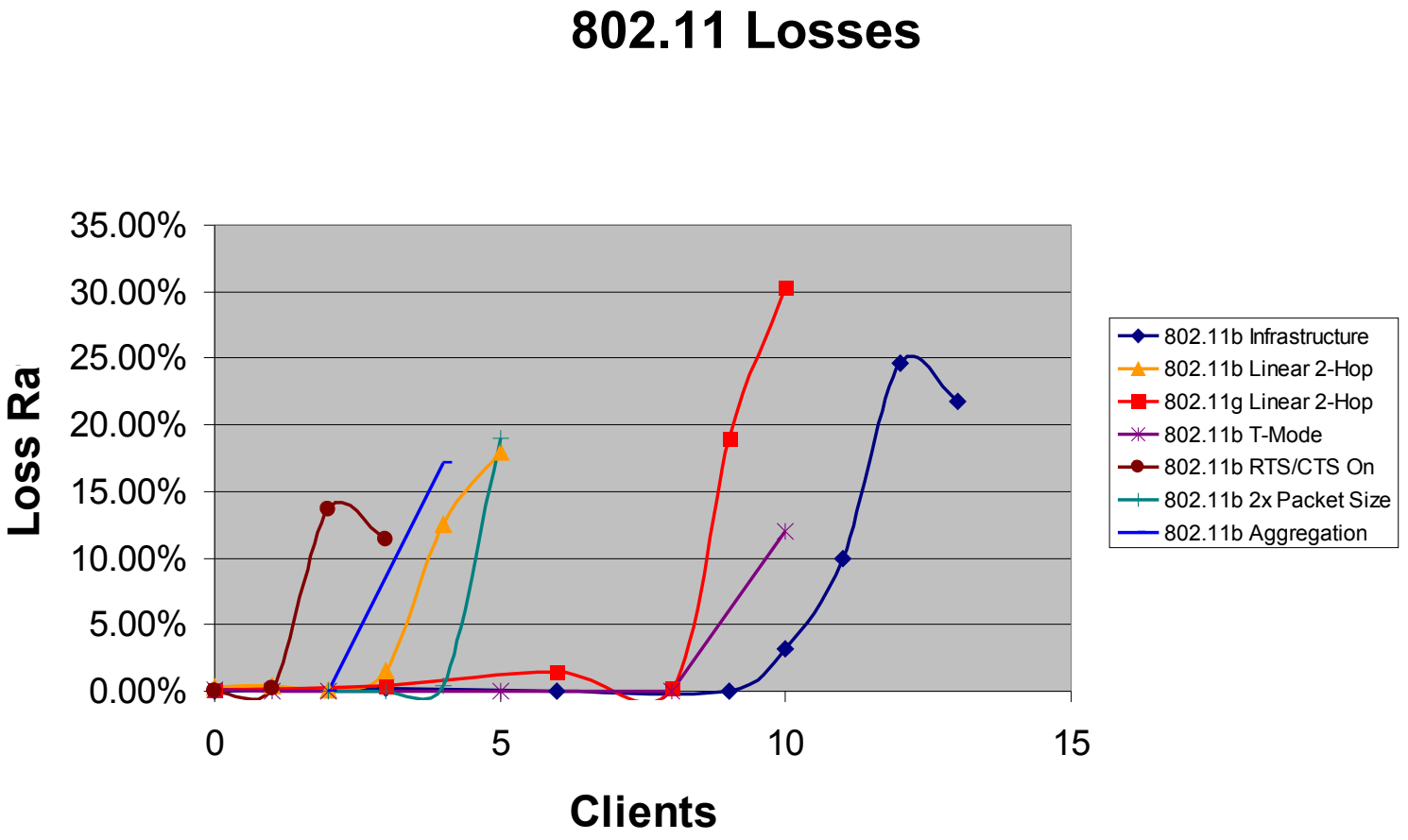
Conclusions

- WLAN characteristics result in large delay and low VoIP call capacity
- Ad-hoc networks more affected by delay, infrastructure more affected by loss
- Improvements can be made by reducing the number of packets contending at any given time

Thanks for your attention

- Feel free to ask questions!

All Losses


802.11 Losses
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Loss Ra
0
5
10
15
Clients
802.11b Infrastructure
802.11b Linear 2-Hop
802.11g Linear 2-Hop
802.11b T-Mode
802.11b RTS/CTS On
802.11b 2x Packet Size
802.11b Aggregation