ENSC 427: Communication Networks
Spring 2015

Final Project Presentation:

"A decade of advancement: comparing the performance of various applications over 802.11b & 802.11n WiFi using Riverbed Modeler"

http://www.sfu.ca/~jaridw/main.html

Team #13:

Vani Choubey (vchoubey@sfu.ca) — 301162616

Henry Hein (hhein@sfu.ca) — 301201424

Jarid Warren (jaridw@sfu.ca) — 301197954

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Roadmap

- ➔ Introduction
- ➔ Related Work
- ➔ Riverbed Model
- ➔ Simulation Results
- ➔ Conclusions
- ➔ Future Work
- ➔ References

Introduction

- Major goal: show how far we've come with 802.11 (b vs. n)
- Background:
  - 802.11b introduced in 1999 up to 11 Mb/s (we used 5.5 Mb/s), infrared in 2.4 GHz, CSMA/CA MAC
  - 802.11n introduced in 2009, MIMO up to 600 Mb/s (we used 480 Mb/s), frame aggregation, security improvements and dual bands (2.4 and 5 GHz)

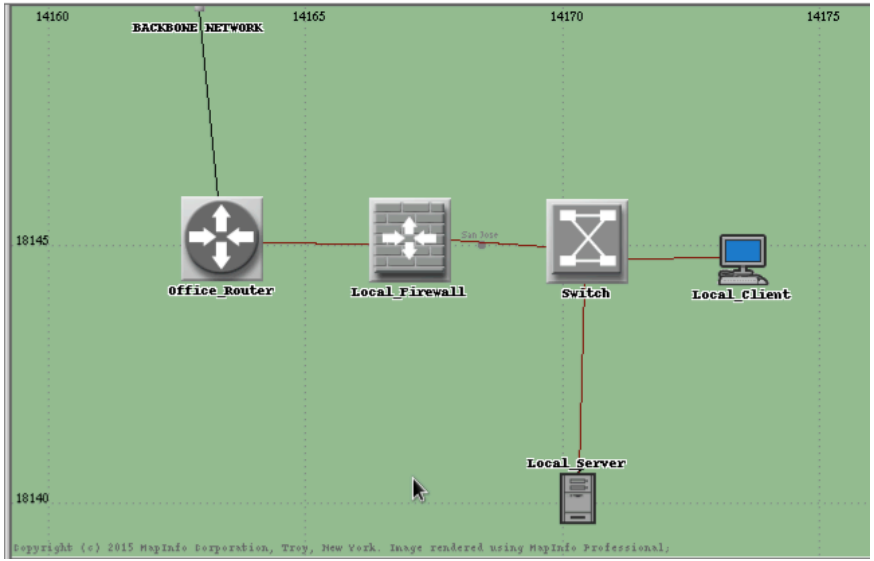
- Looked at average throughput & delay of 3 applications:
  - YouTube HD stream (HTTP) - 2009
  - VoIP (RTP) - 2004
  - FTP – 1998

Related Work

Out of Dr. Trajkovic's ENSC 427 offerings:

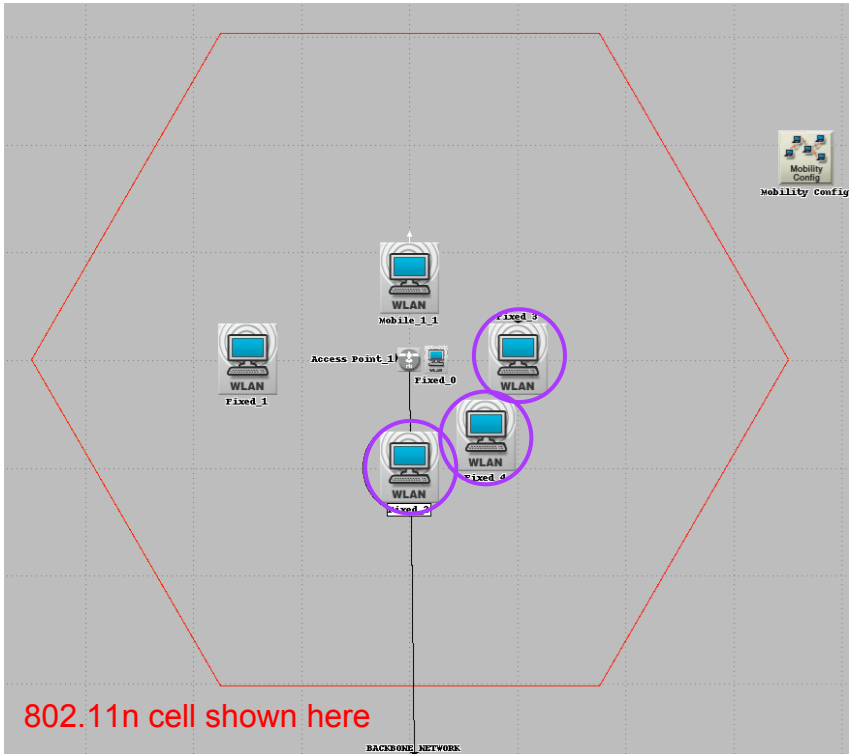
- **Spring '15:** H. Yu and C. Wen. "Comparison of 802.11g and 802.11n Standards"
- **Spring '11**: Z. Xue. "Video Streaming over the 802.11g and the 802.11n WLAN Technologies"
- **Spring '10**: Y. Hakki et al. "Comparison of the Quality of Service (QoS) of the 802.11e and the 802.11g wireless LANs"

Server Riverbed Model

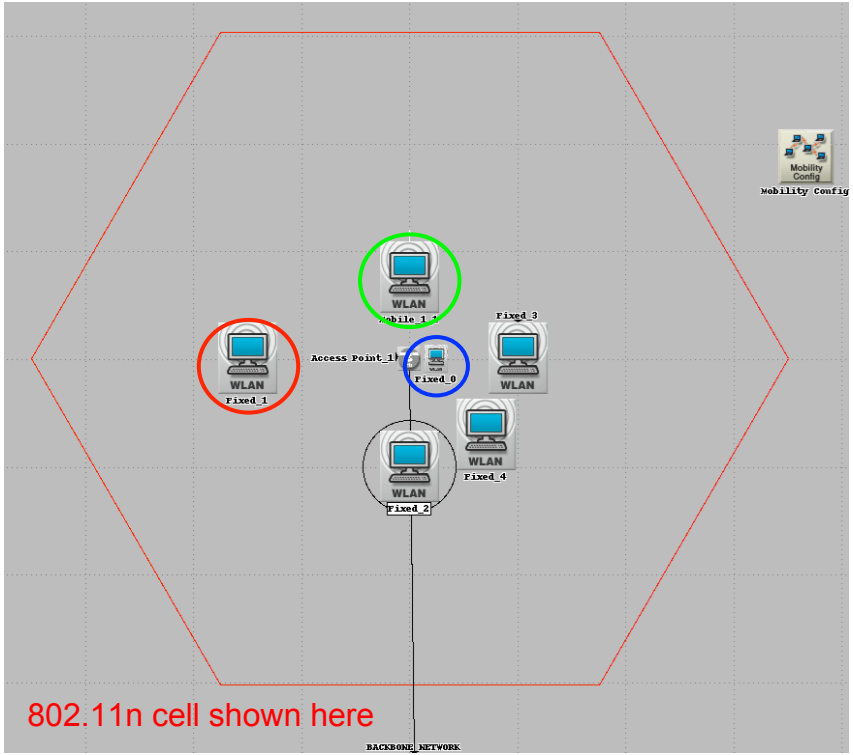


- San Jose subnet
- Local server support applications
- Sends info to client via backbone network

Client Riverbed Model

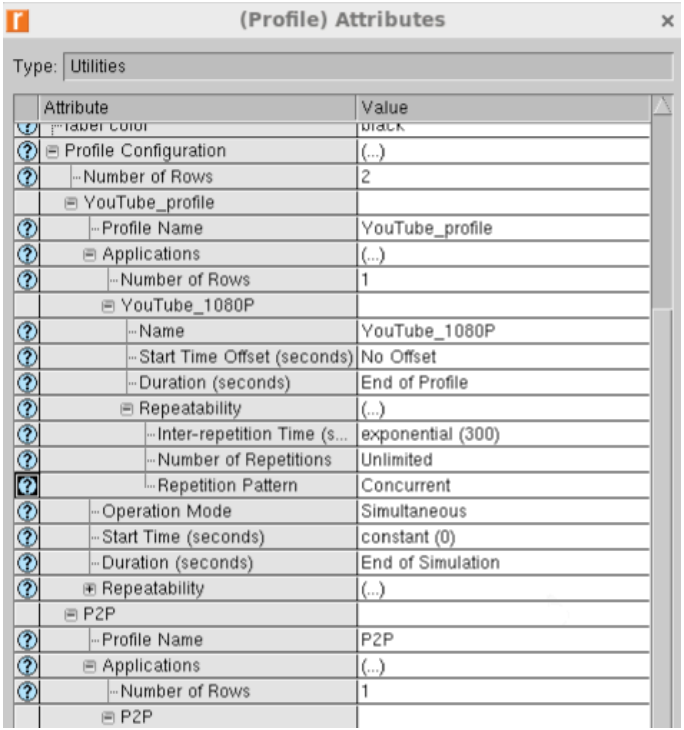


- Vancouver subnet
- 802.11b cell = 35m
  802.11n cell = 70m
- 3 workstations 10m away from router to load network (P2P traffic)

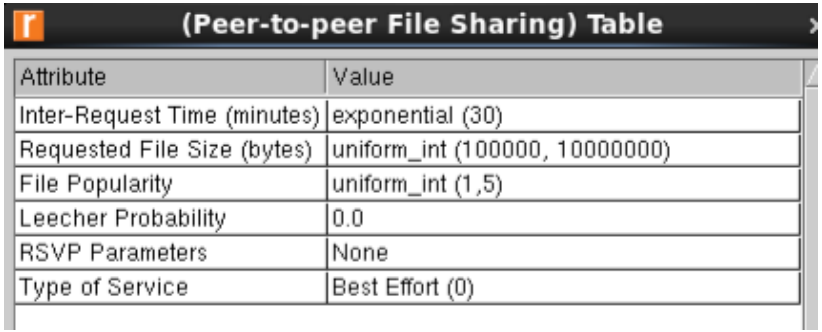


- 2 fixed nodes:
  - 5m from router
  - 15m from router
- 1 mobile node
  - 7.5m from router
  - random waypoint algorithm
  - 1.4 m/s speed

Profile Definition



P2P Model

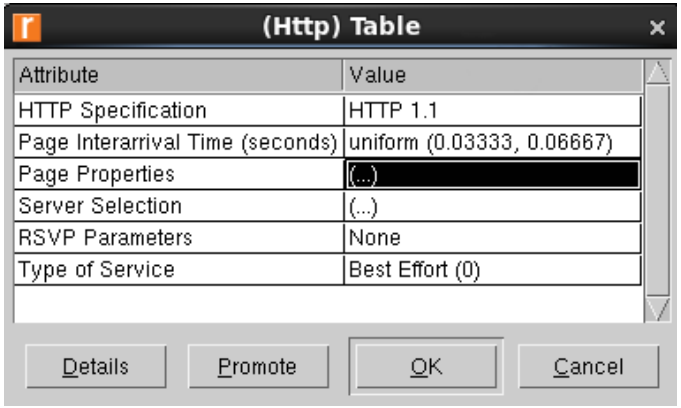


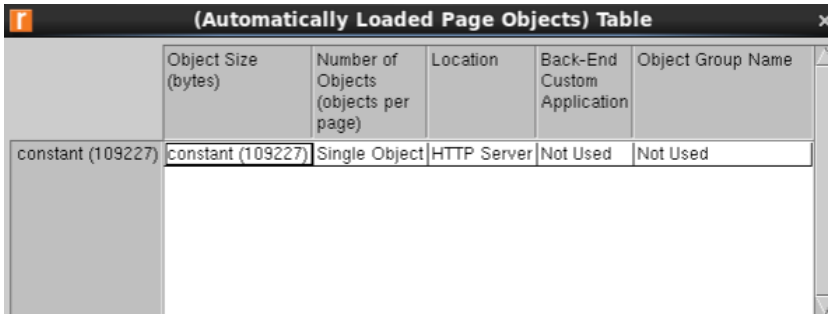
(Peer-to-peer File Sharing) Table

Attribute	Value
Inter-Request Time (minutes)	exponential (30)
Requested File Size (bytes)	uniform_int (100000, 10000000)
File Popularity	uniform_int (1,5)
Leecher Probability	0.0
RSVP Parameters	None
Type of Service	Best Effort (0)

- Default: High Traffic Setting
- File size: 0.1 MB to 10 MB (a song)

YouTube Model





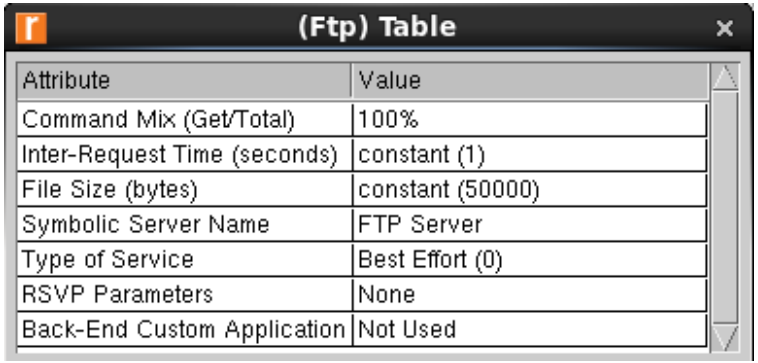
- Page Interarrival Time: 15 - 25 frames/second
- File size: ~110 kB/frame
- One object per page (Fullscreen)

VoIP Model

(Voice) Table	
Attribute	Value
Silence Length (seconds)	default
Talk Spurt Length (seconds)	default
Symbolic Destination Name	Voice Destination
Encoder Scheme	G.711 (silence)
Voice Frames per Packet	1
Type of Service	Best Effort (0)
RSVP Parameters	None
Traffic Mix (%)	All Discrete
Signaling	None

- G.711 64 Kbps Pulse Code Modulation standard
- Silence accounts for silence period during the conversation

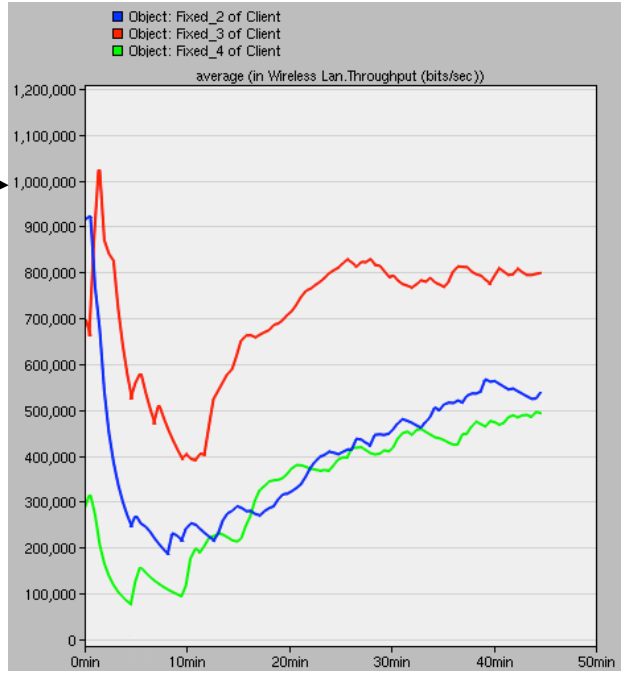
File Transfer Model



Attribute	Value
Command Mix (Get/Total)	100%
Inter-Request Time (seconds)	constant (1)
File Size (bytes)	constant (50000)
Symbolic Server Name	FTP Server
Type of Service	Best Effort (0)
RSVP Parameters	None
Back-End Custom Application	Not Used

- File Size: 50 KB (a pdf file)

P2P Traffic

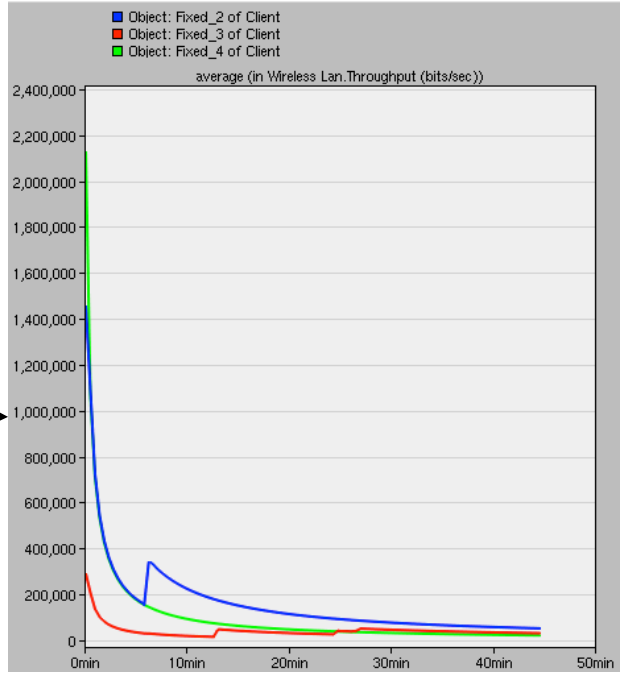


1 Mb/s

Mobile

Close

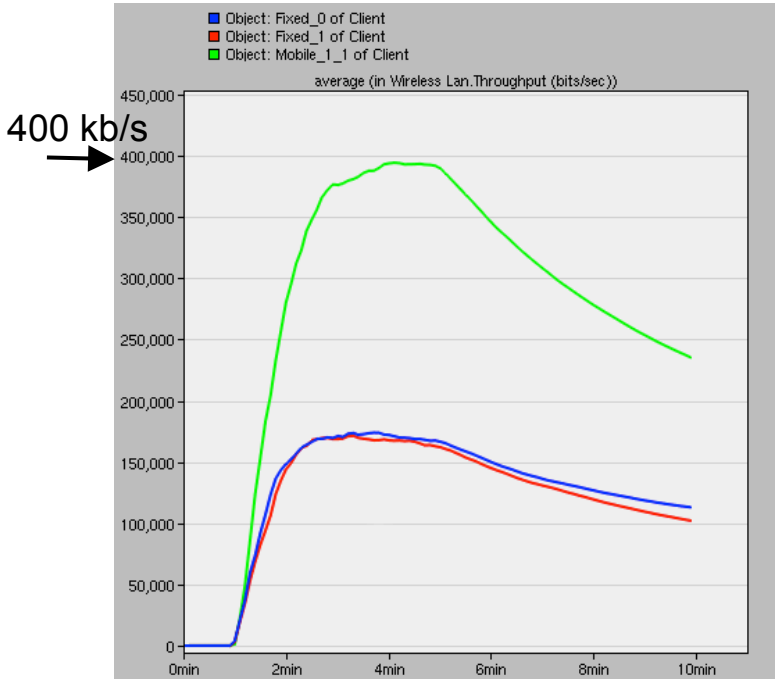
Far



1 Mb/s

802.11b vs. 802.11n average throughput (bit/sec)

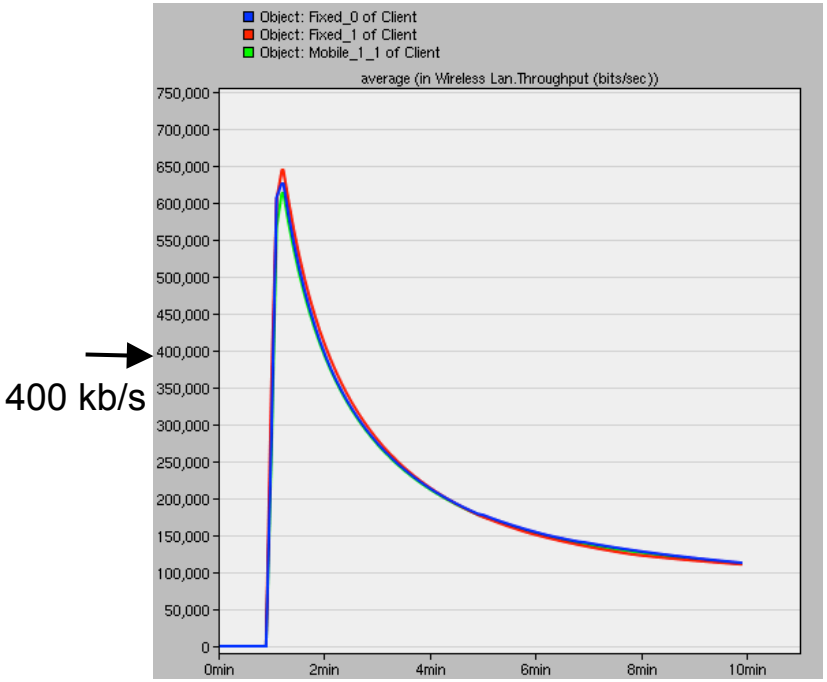
YouTube Results



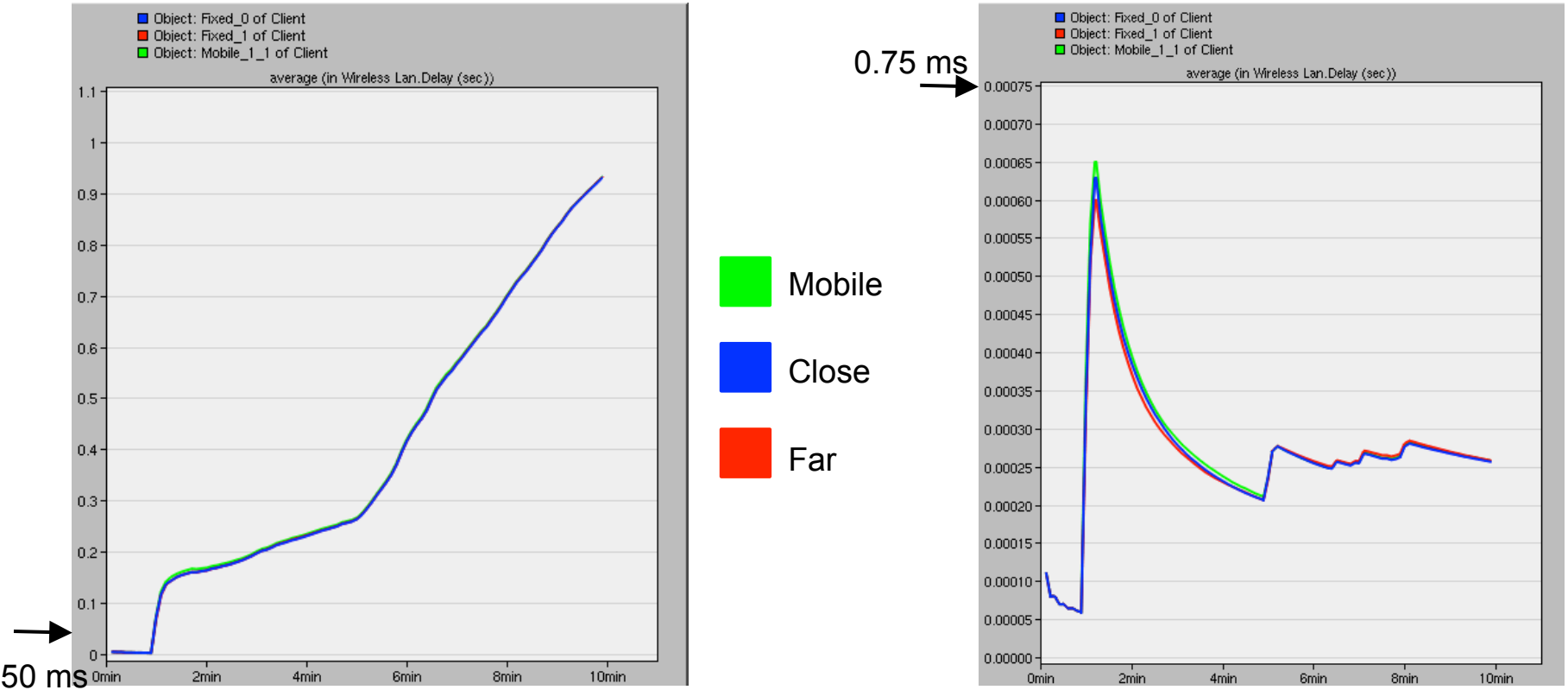
Mobile

Close

Far

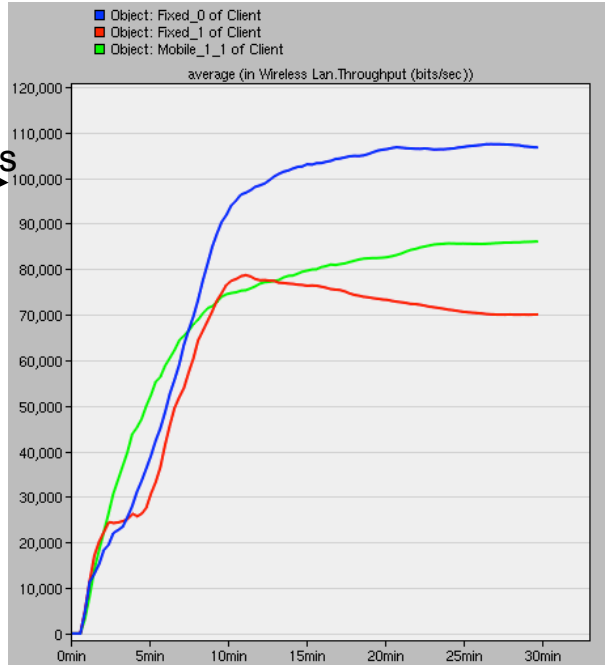


802.11b vs. 802.11n average throughput (bits/s)



802.11b vs. 802.11n average delay from server (s)

VoIP Results

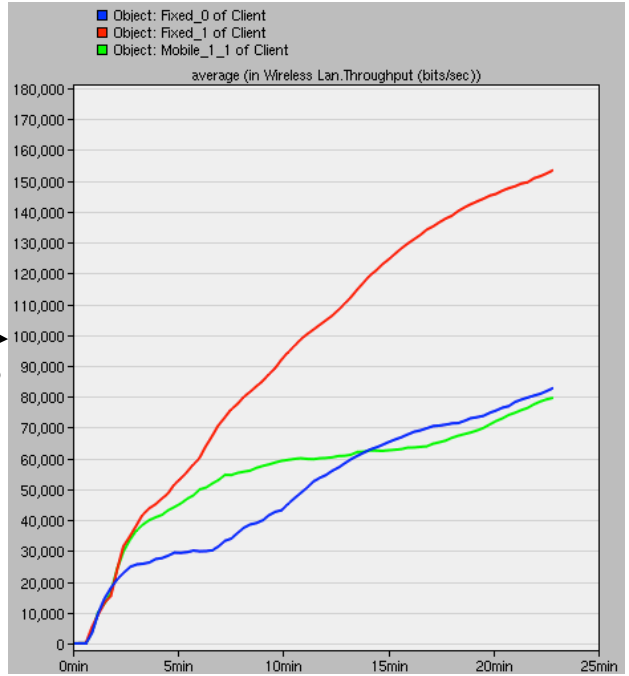


100 kb/s

Mobile

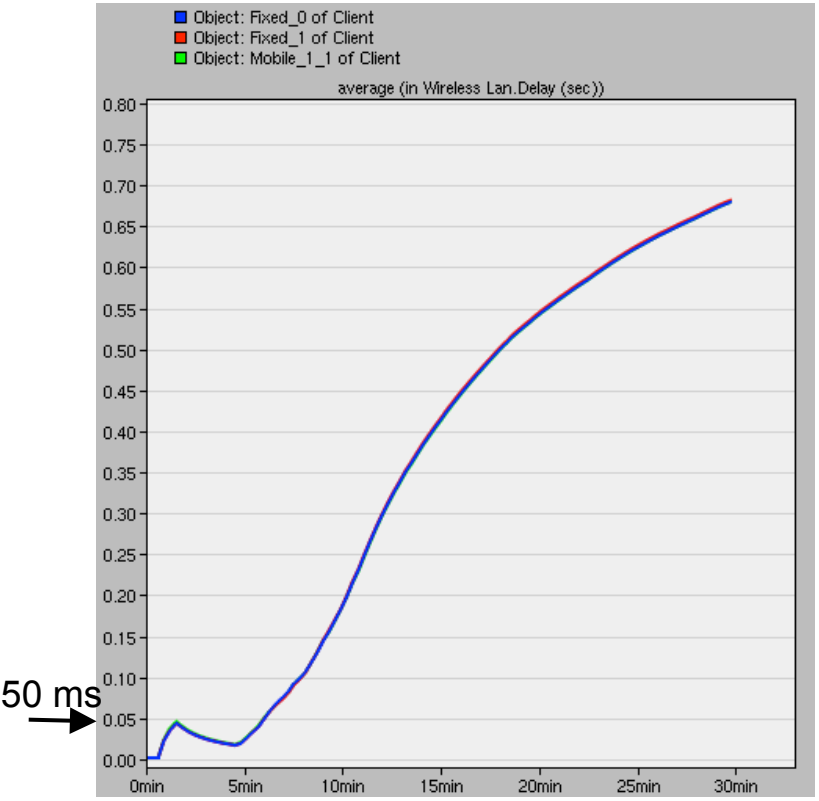
Close

Far



100 kb/s

802.11b vs. 802.11n average throughput (bits/s)



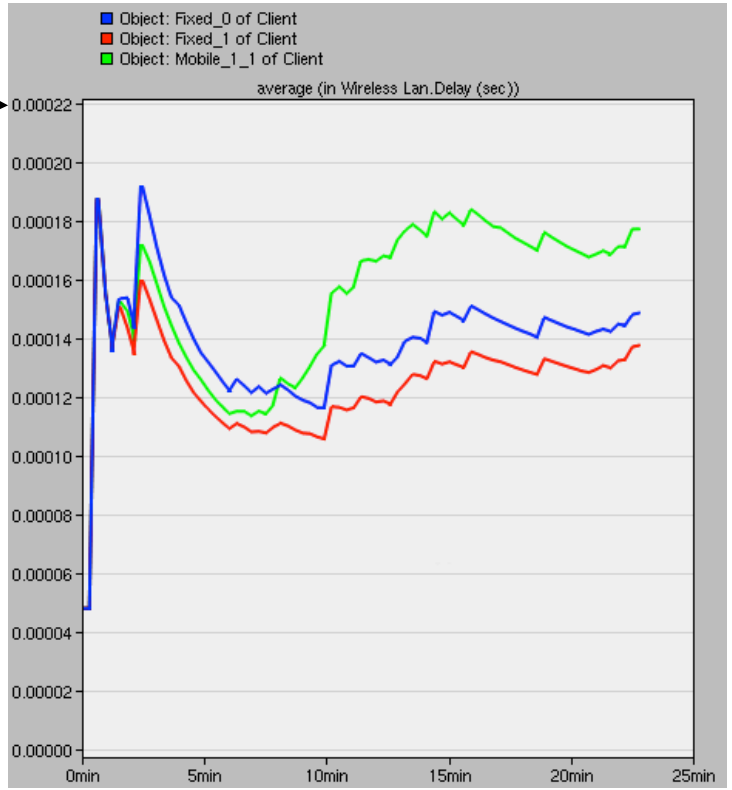
50 ms

Mobile

Close

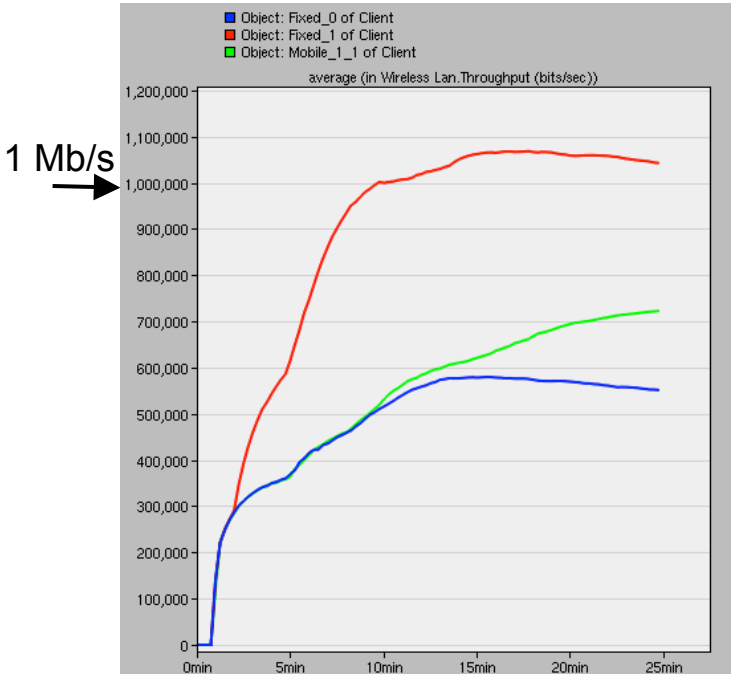
Far

0.22 ms



802.11b vs. 802.11n average delay from server (s)

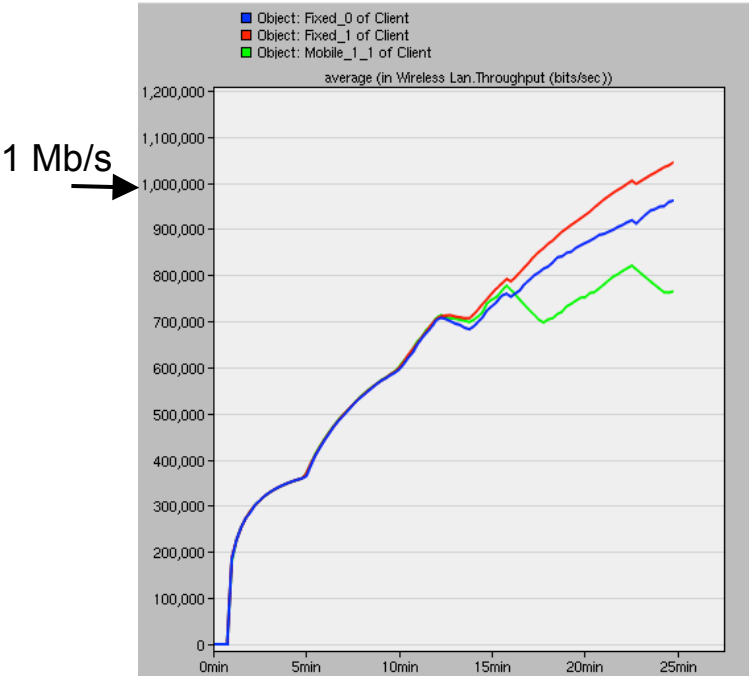
File Transfer Results



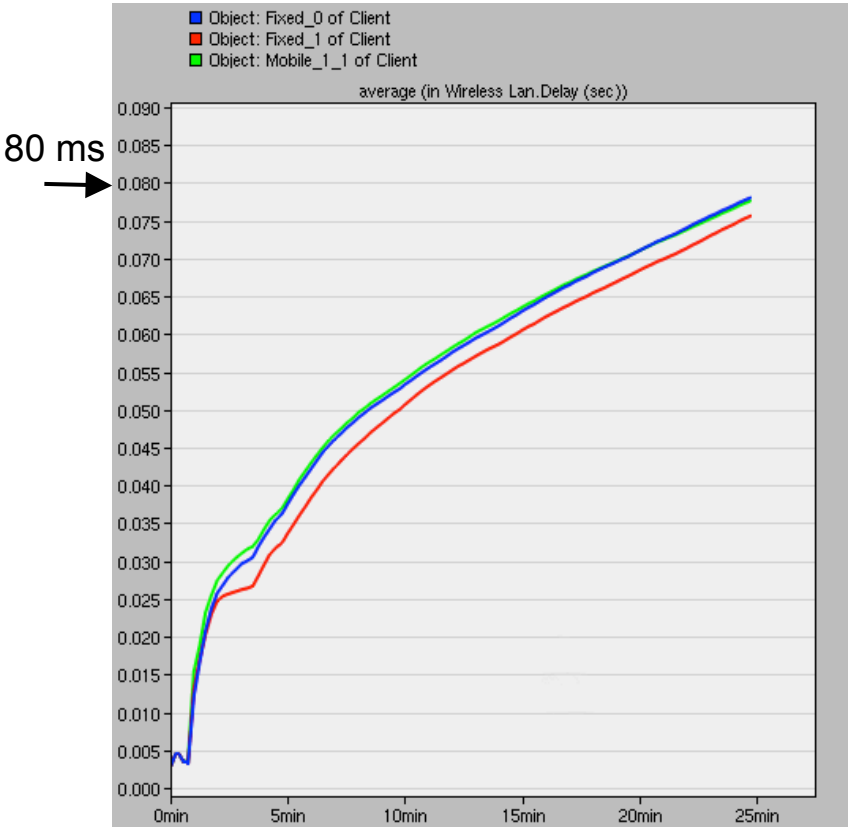
Mobile

Close

Far



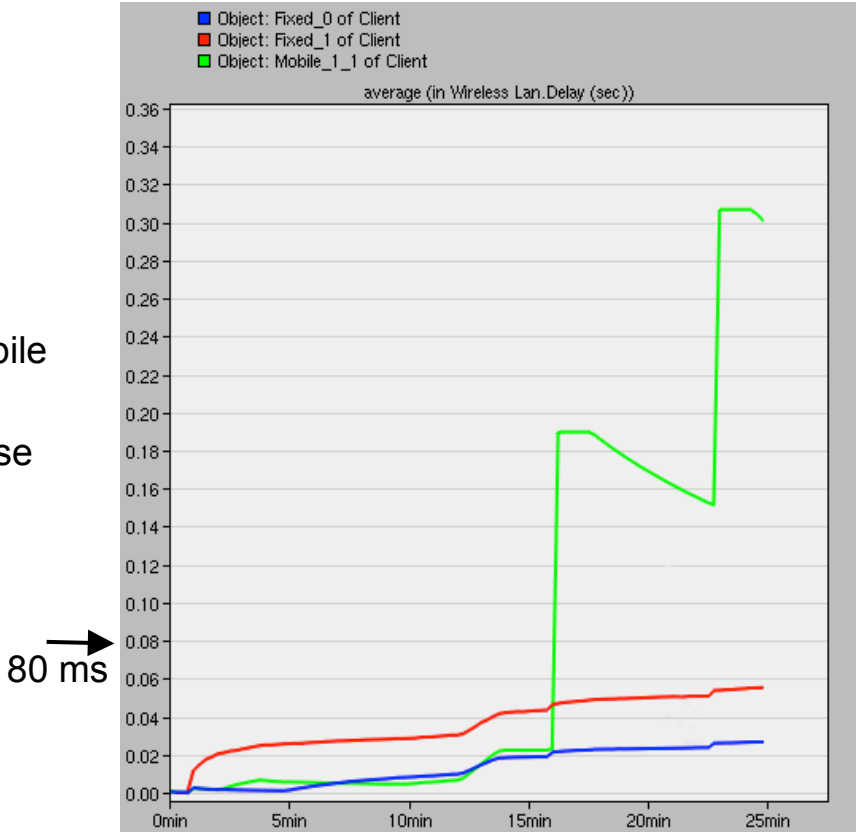
802.11b vs. 802.11n average throughput (bits/s)



Mobile

Close

Far



802.11b vs. 802.11n average delay from server (s)

Conclusions

- What did we expect?
  - 802.11n to dramatically outperform 802.11b in both average throughput and delay
  - Performance difference ↓ as app age ↑
    - ie. 802.11b handled FTP better than YouTube
  - Router distance ↓ performance ↑
    - mobile performance < fixed performance

	Average Throughput (kb/s) (max/steady-state)		Average Delay (ms) (max/steady-state)	
	802.11b	**802.11n**	**802.11b**	**802.11n**
YouTube	250/160	625/110	950+/950+	0.6/0.25
VoIP	90/90	100+/100+	680+/680+	0.16/0.16
File Transfer	750/750	900+/900+	85/60	3.5/1.5

- Average throughput comparison wasn't that different considering 802.11b was set at 5.5 Mb/s vs. 480 Mb/s for 802.11n
- Delay told the true tale, differences up to 1500x/3500x for max and steady-state respectively
- Older the application, the smaller the difference

- What about the 3 different kinds of workstations?
  - Delay had minimal dependence on mobility or distance from router
    - exception: 802.11n running FTP
  - Average throughput wasn’t as clear
    - ⅔ times being further from 802.11n router helped
    - 802.11b all over the map

Future Work

- 802.11ac update to see advancement from 2009
- WAN historical comparison analogous to LAN we did (eg. EDGE vs. LTE)
- Original plan of WiFi vs. LTE to compare performance of LAN vs. WAN

References

[1] G. R. Hiertz, D. Denteneer et al., "The IEEE 802.11 Universe," Communications Magazine, IEEE, Volume: 48, Issue: 1, January 2010. Accessed: February 15, 2015. Available: http://ieeexplore.ieee.org.proxy.lib.sfu.ca/xpl/articleDetails.jsp?arnumber=5394032&tag=1

[2] "Wireless Networking," Vicomsoft. Accessed: March 22, 2015. Available: http://www.vicomsoft.com/learning-center/wireless-networking/#3

[3] L. Phifer, "Differences between WLANs, Wi-Fi and WiMax". Accessed: February 15, 2015. Available: http://searchnetworking.techtarget.com/answer/Differences-between-WLANs-Wi-Fi-and-WiMax

[4] C. Chen, S. Sheng, and J. Yoo, “High Resolution Video Streaming over Wi-Fi, WiMAX and LTE,” Accessed: March 22, 2015. Available: http://www.sfu.ca/~cyc19/report.pdf

[5] R. Gill, T. Farah, and L. Trajkovic, “Comparison of WiMAX and ADSL Performance when Streaming Audio and Video Content,” Accessed: March 22, 2015. Available: http://www2.ensc.sfu.ca/~ljilja/papers/Opnetwork2011_farah_gill_final.pdf

[6] Riverbed Modeler’s Guide to Applications. Accessed: March 22, 2015. Available: https://webdav.sfu.ca/web/ensc/427/1151/group13/site/Reference9.pdf

Questions?