ENSC 427: Communication Networks Final Project Presenation
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802.11n and 802.11g Performance Comparison in Office Size for FTP Transmission

Group 6

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Roadmap

Introduction

- WiFi and IEEE 802.11 standards
- 802.11g and 802.11n difference

Implement Details

- **case1:** Fixed distance single AP single client
- **case2:** Multi-AP Signal Interference
- **case3:** Single AP Multi-Client
- **case4:** Throughput and delay with changing distance

Simulation Results and Discussion

Conclusion

Reference

Introduction

Project Goal

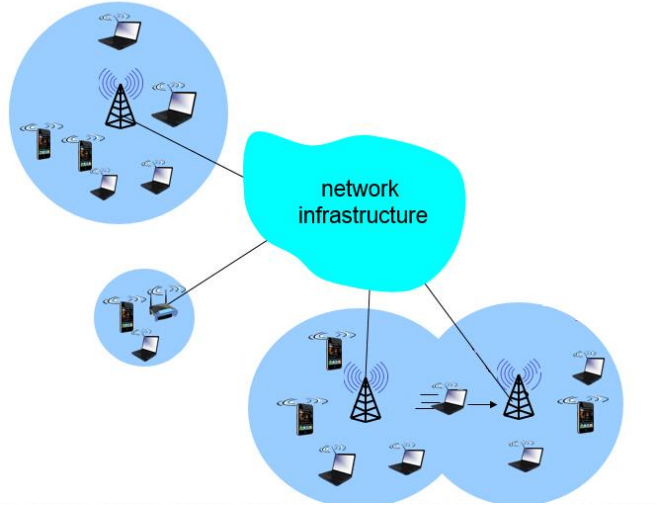
Apply Modeler to simulate the FTP transmission to analysis the performance in an office environment between 802.11g and 802.11n

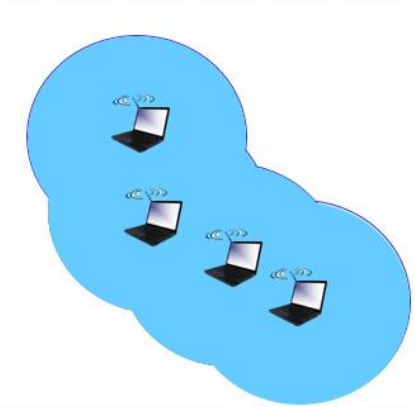
- Throughput
- End to End delay
- Distance
- Number of Clients

Introduction

WLAN and WiFi

- WiFi is wireless local area network based on IEEE 802.11 standards
- Wi-Fi is the transmission of radio signals
- Possesses with benefits including Wireless Ethernet,Extended Access, Cost Reduction, Mobility and Flexibility





Two Typical Wireless Architecture:

1. Infrastructure Mode (STAs communicate through AP)
2. Ad Hoc Mode (STAs communicate directly with one another) [3]

IEEE 802.11 standards

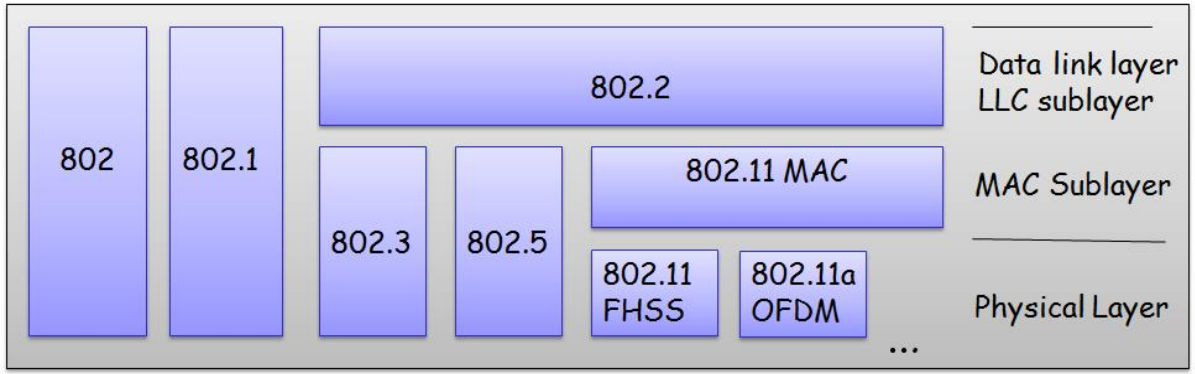
Defines physical layer and link layer for wireless local area network

- MAC Layer: CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)
- Physical Layer: modulation methods, encoding schemes and the actual transmission of radio signals through space

Services include:

Station Services (SS) : Authentication, Deauthentication, Privacy, MAC Service Data Unit (MSDU) Delivery

Distribution System Services (DSS): Association, Reassociation, Disassociation, Distribution, Integration [3]



IEEE 802.11 standards

802.11b is the first WLAN standard accepted by the market 2.4GHz

802.11a: more efficient transmission method OFDM(Orthogonal Frequency Division Multiplexing) with 5GHz

802.11g: Utilize OFDM (Orthogonal frequency-division multiplexing) modulation but 2.4Ghz

802.11n: Released in Oct. 2009 and was designed to improve 802.11g

- Better OFDM gives higher attainable raw data rate
- Untinizes MIMO technology which improves performance (split a data stream into multiple parts and transmit through separate antenna)
- Imrproved throughput and higher data rates (double the width of WLAN channel from 20Mhz to 40Mhz, trade-off: less avaiable chanel)
- Increase signal intensity to achieve a better coverage
- Other improvements include: Diversity, MIMO Power Save Mode, Reduced Inter-frame Spacing [2]

IEEE 802.11 standards[1]

Standard	Frequency band	Bandwidth	Modulation	Maximum data rate
802.11	2.4 GHz	20 MHz	DSSS, FHSS	2 Mb/s
802.11b	2.4 GHz	20 MHz	DSSS	11 Mb/s
802.11a	5 GHz	20 MHz	OFDM	54 Mb/s
802.11g	2.4 GHz	20 MHz	DSSS, OFDM	54 Mb/s
802.11n	2.4 GHz/5GHz	20 MHz, 40 MHz	OFDM	600 Mb/s
802.11ac	5 GHz	20, 40, 80, 160	OFDM	6.93 Mb/s
802.11ad	60 GHz	2.16 Ghz	SC, OFDM	6.76 Mb/s

Implement Details

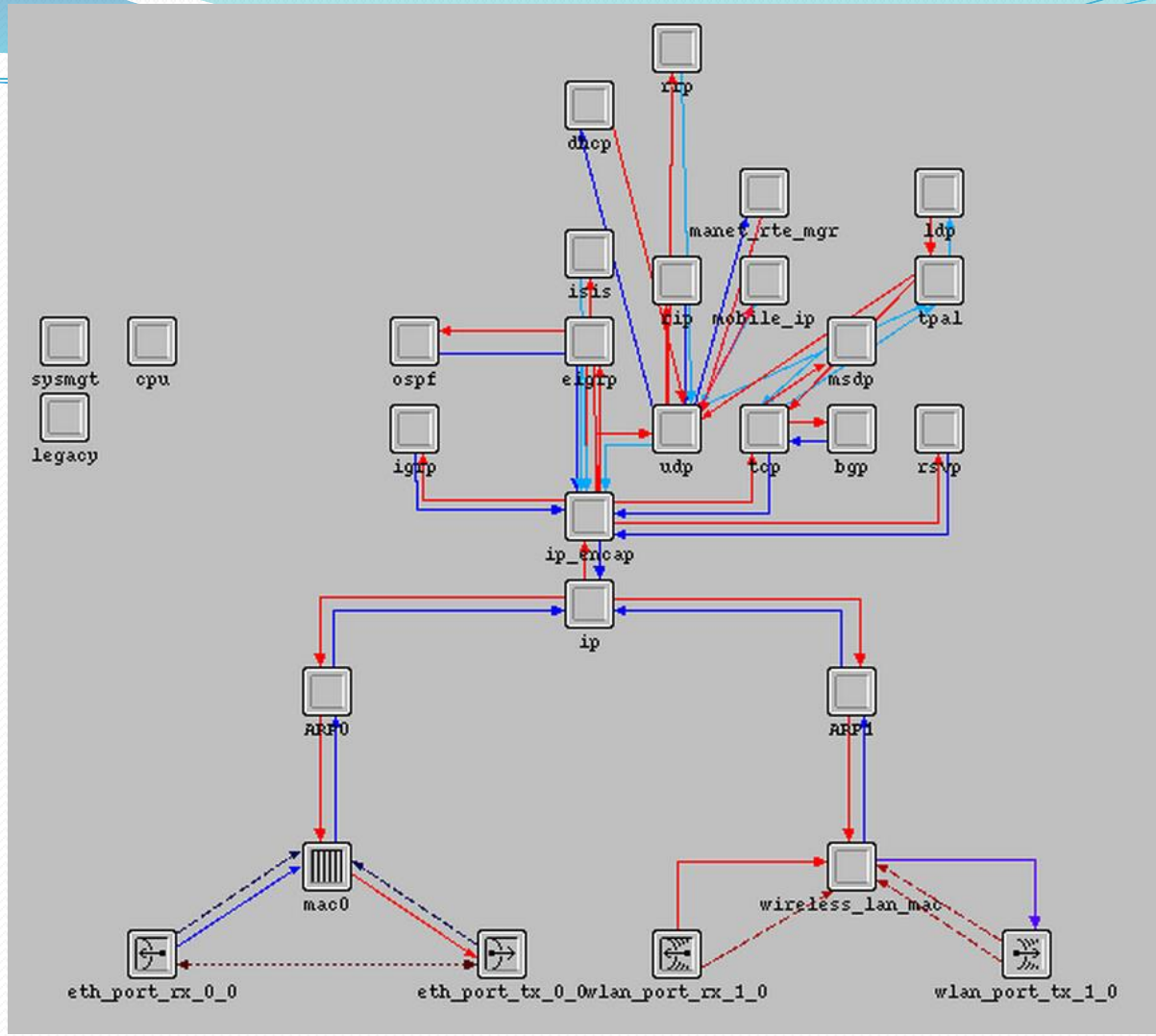
Simulation Cases:

case1: Single AP Single Client with Fixed Distance

case2: Single AP Single Client in Varying Distance

case3: Single AP Multi-Client

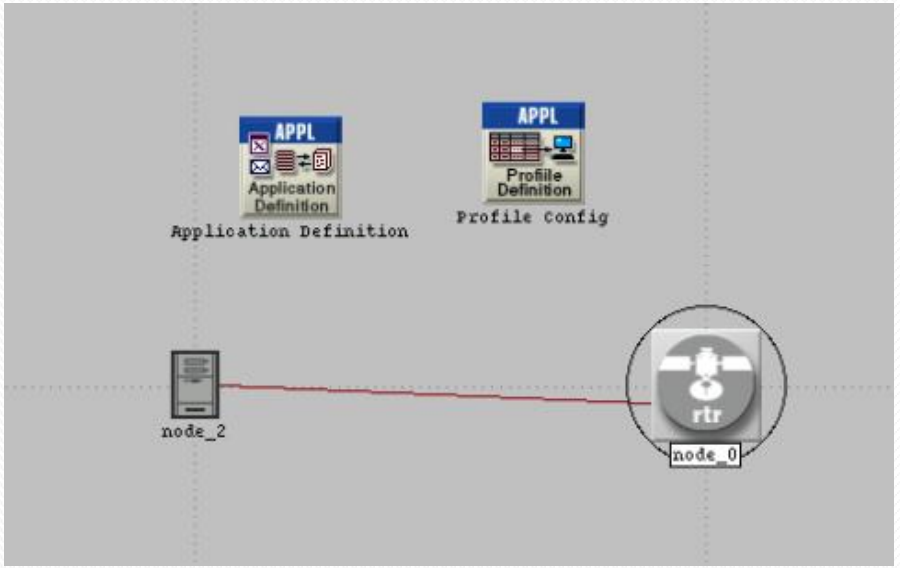
case4: Multi-AP Signal Interference



Case 1: Single AP Single Client with Fixed Distance

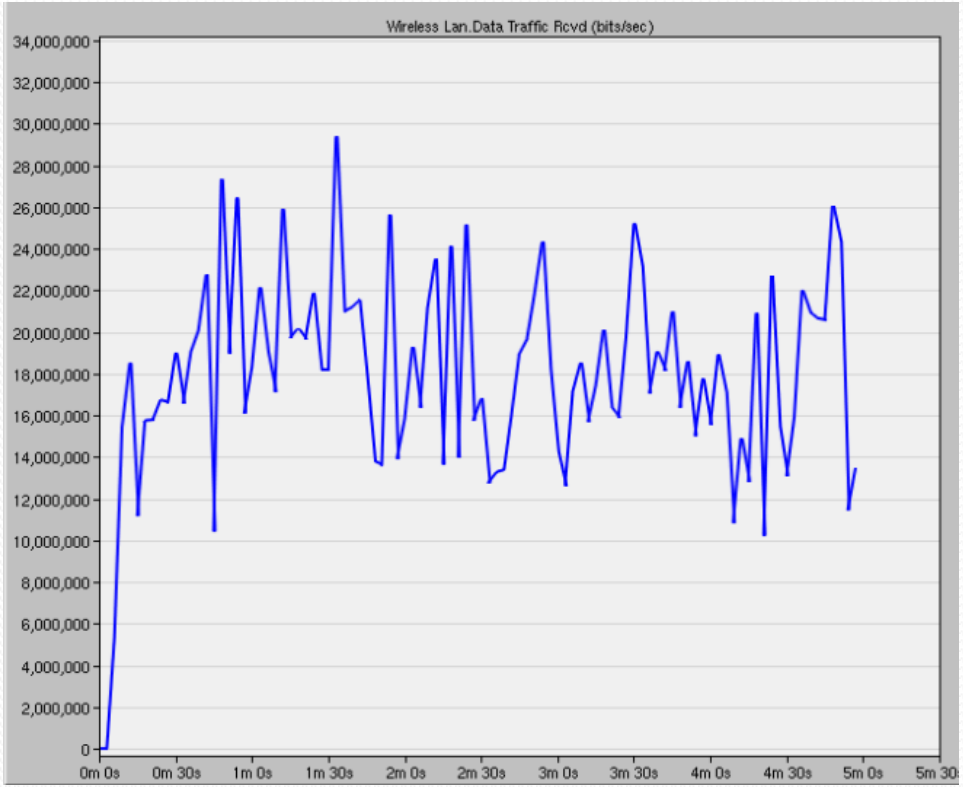
Testing environment

- Using FTP protocol to transfer 5,000,000 bytes file simutaneously.

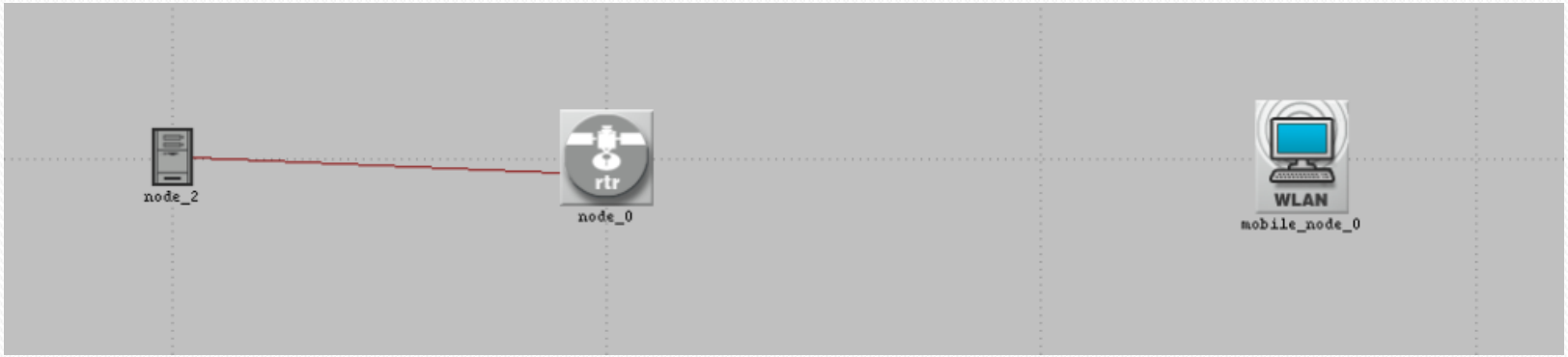


Case 1: Single AP Single Client with Fixed Distance

- TCP Congestion Control
- Throughput result will be using average for the project



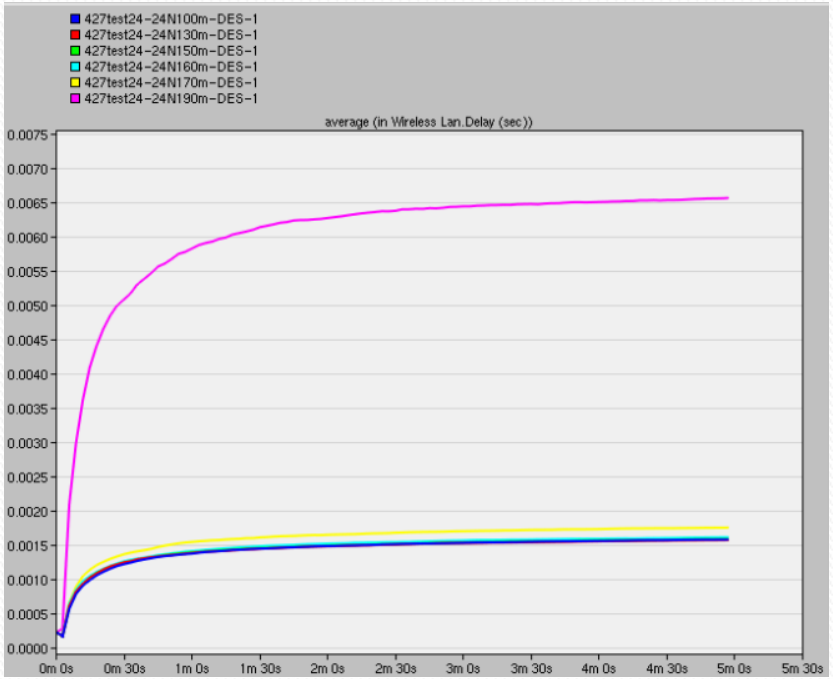
Case 2: Single AP Single Client in Varying Distance

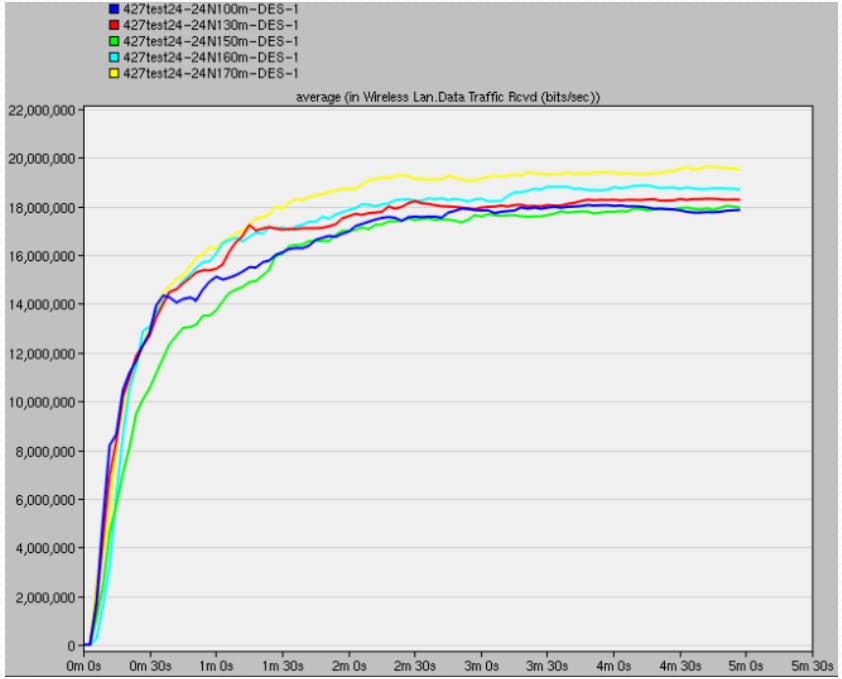


- Using case 1 as initial scenario and simulate the throughput and delay at different distance

Case 2: Throughput and Delay in varying distance

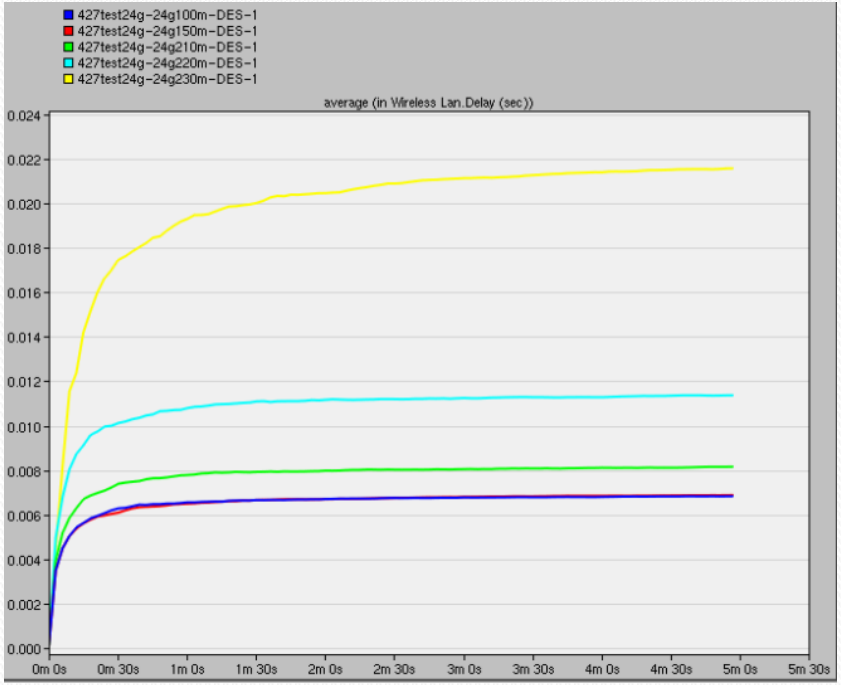
- 802.11n 2.4Ghz simulation
- Max range is 170m with 1.5ms delay and 19Mbps

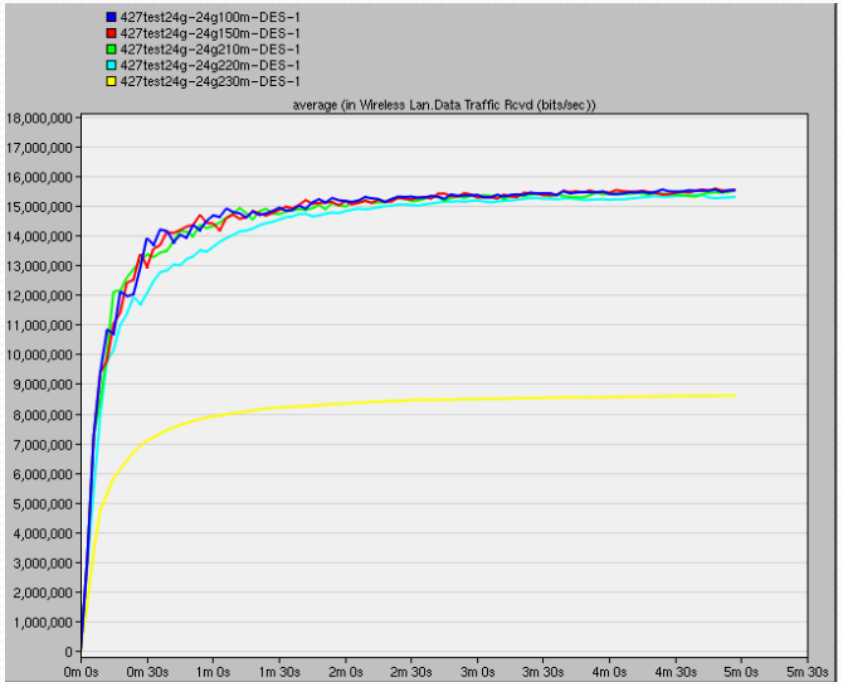




Case 2: Throughput and Delay in varying distance

- 802.11g simulation
- Max range is 220m with 7ms delay and 14Mbps





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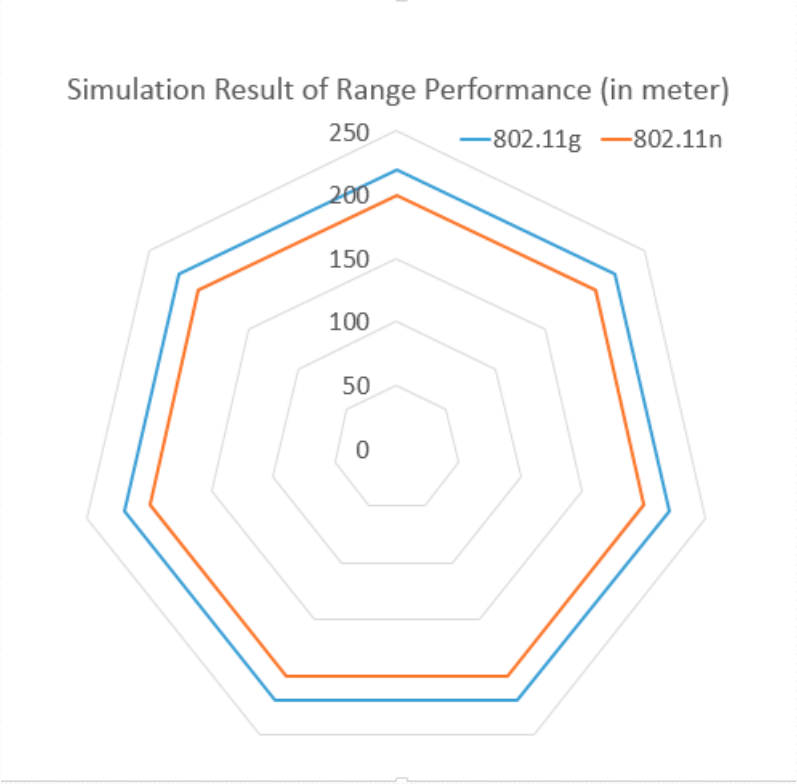
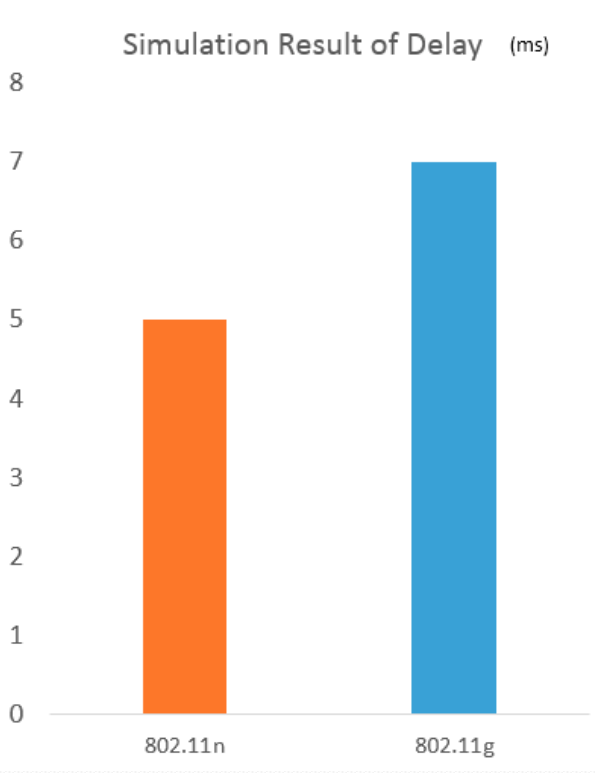
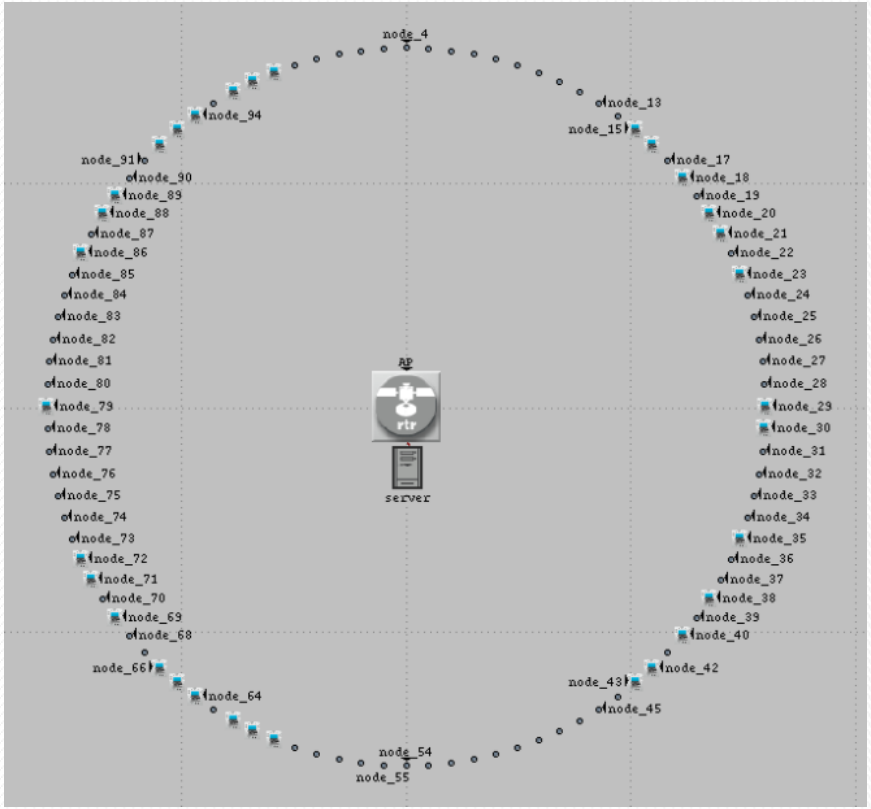




Case 3: Single AP Multi-Client

- 80m was choosen as testing distance
- 1 server connects to 1AP with 100 client
- Using FTP protocal to transfer 500,000byte file to each client



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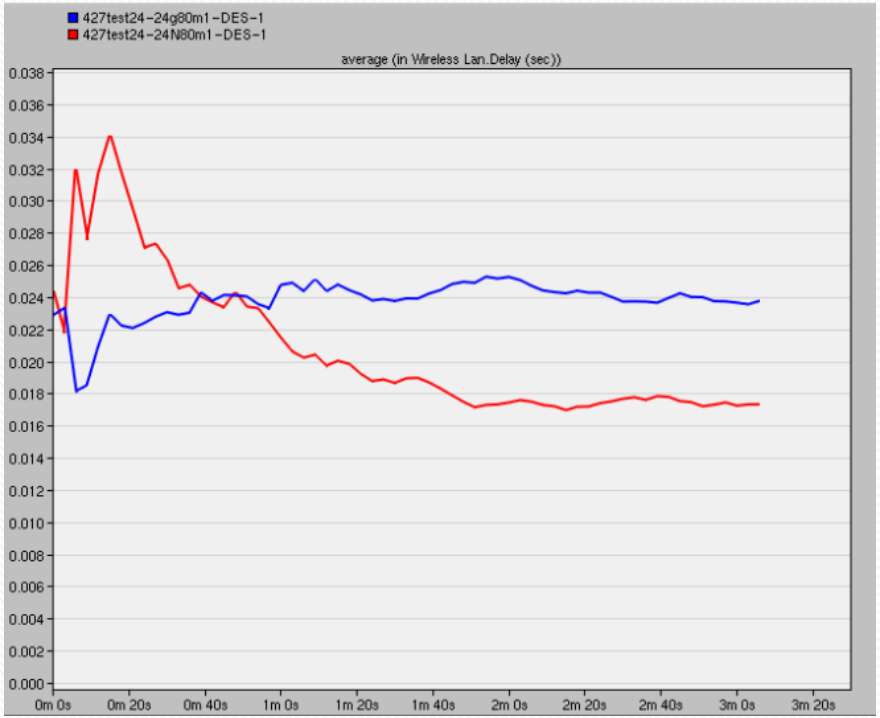
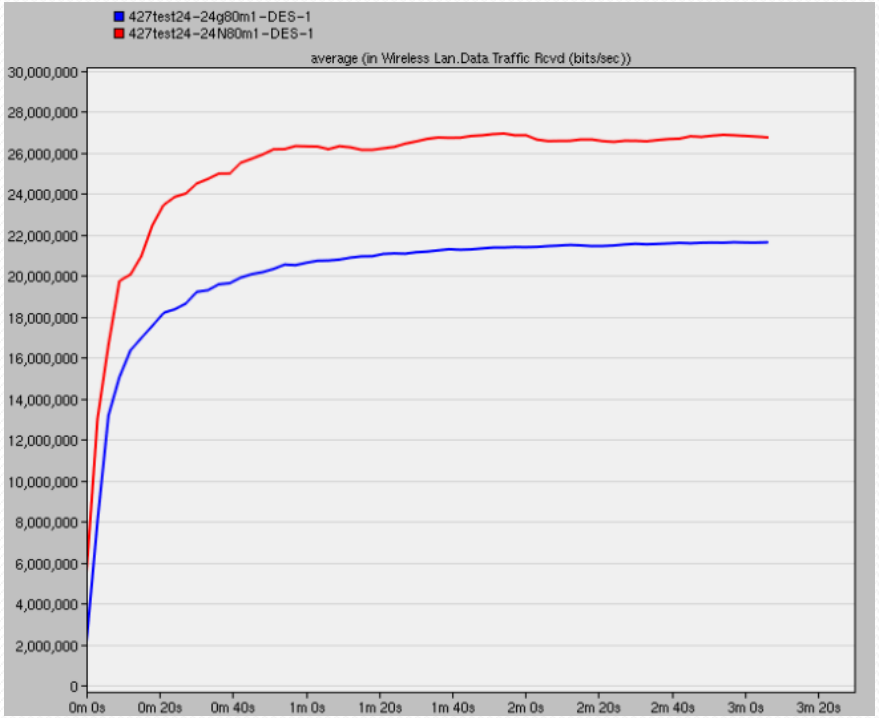
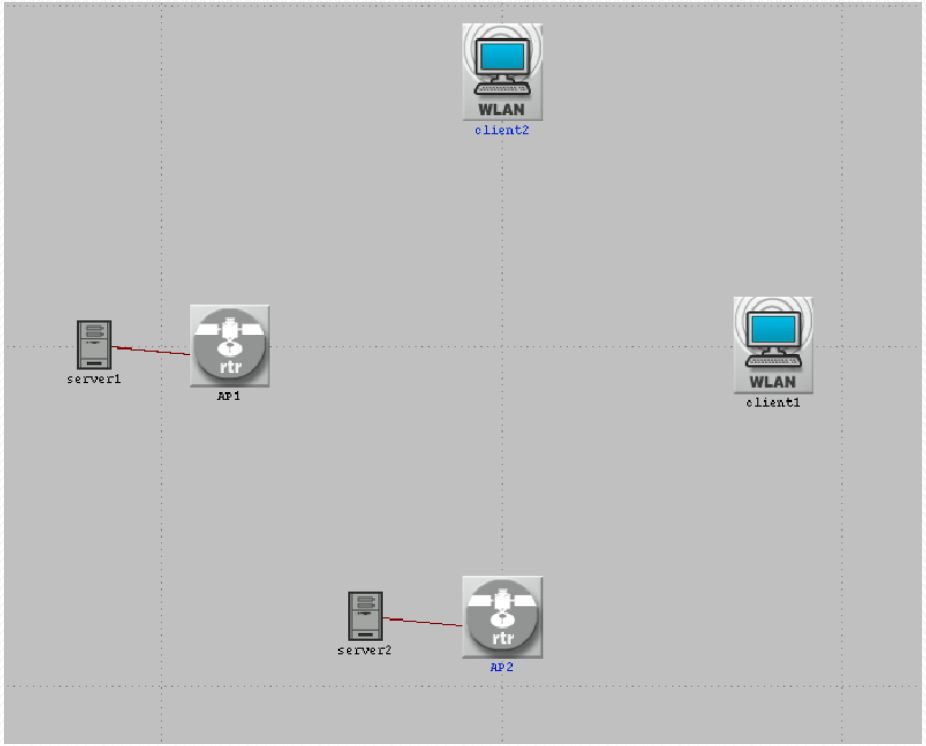




---- 802.11n ---- 802.11g

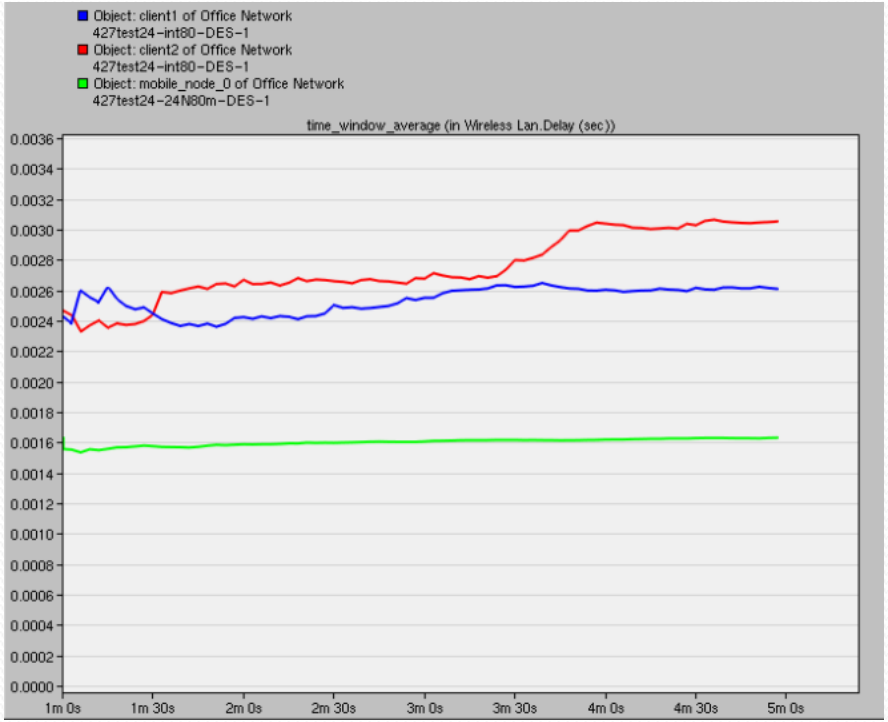
Case 4: Multi-AP Signal Interference

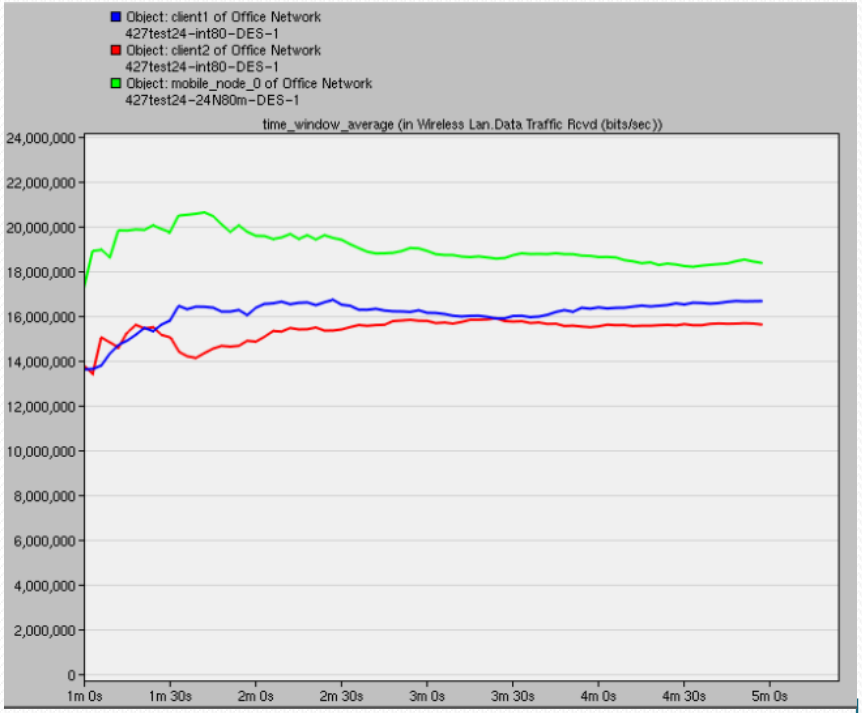
- 802.11n and 802.11g are using the CSMA in Mac layer
- In case 4, 802.11n with 2.4Ghz and 5Ghz will be simulated.
- Same application and profile setting as case1 at 80m distance



Case 4: Multi-AP Signal Interference

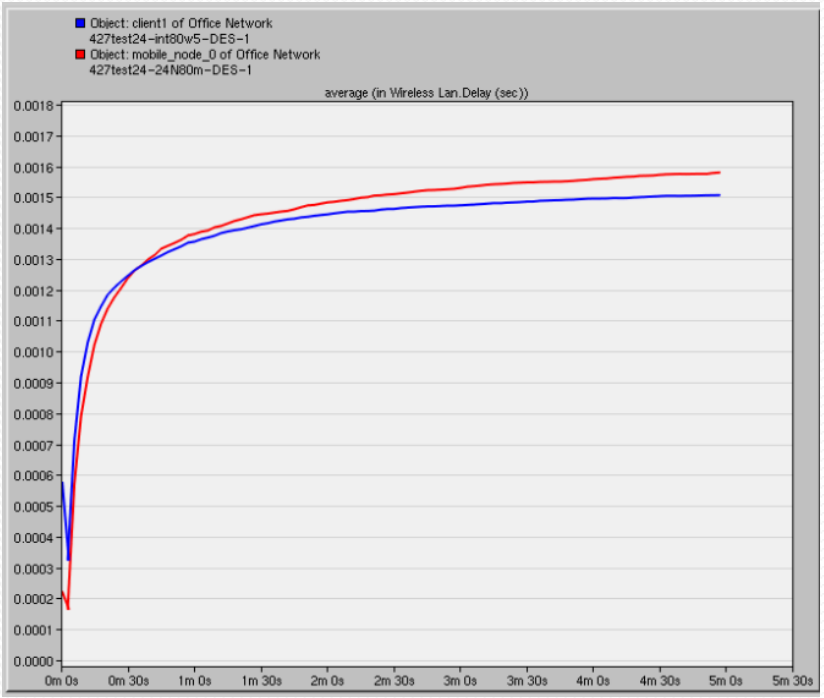
Two 802.11n 2.4Ghz APs

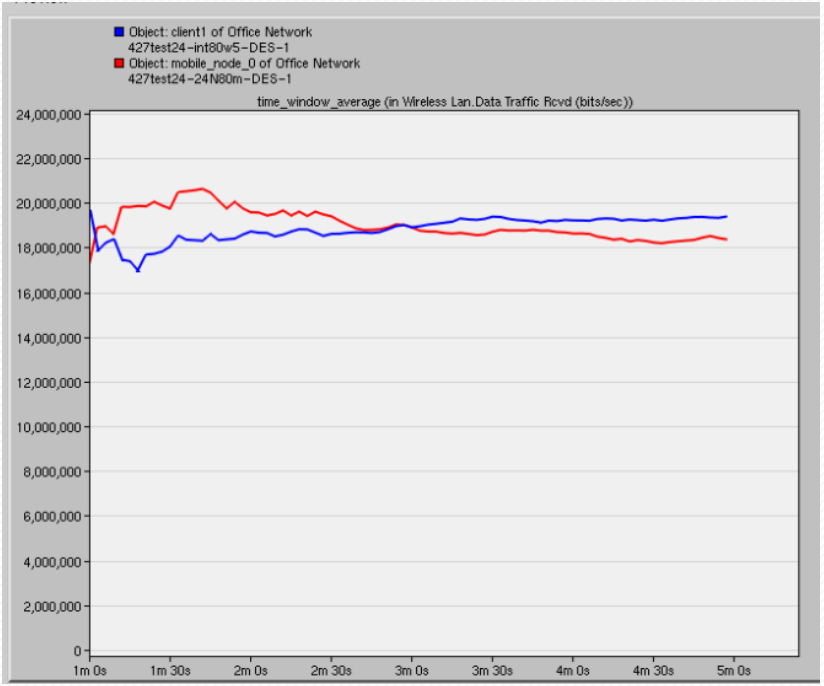




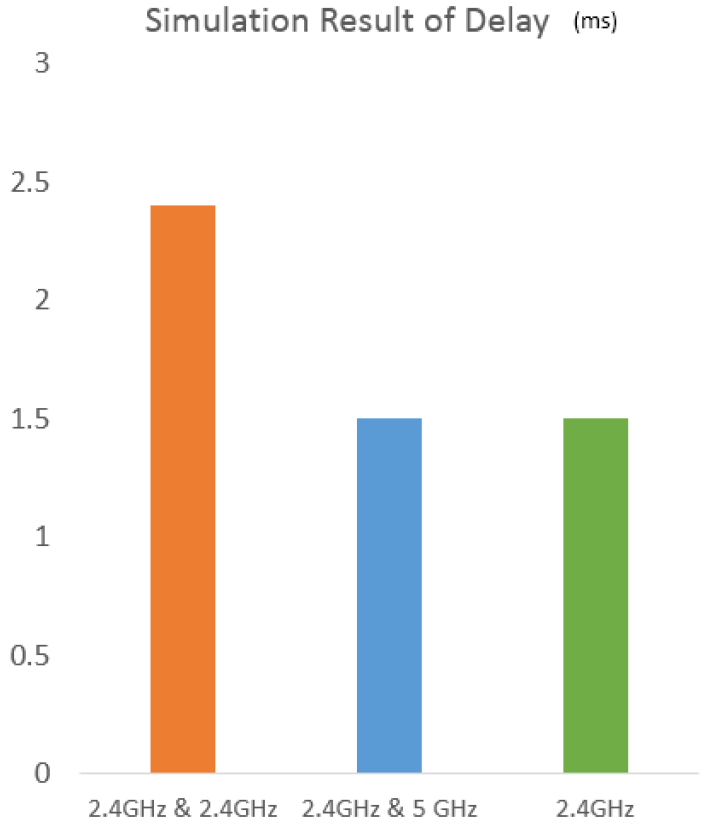
Case 4: Multi-AP Signal Interference

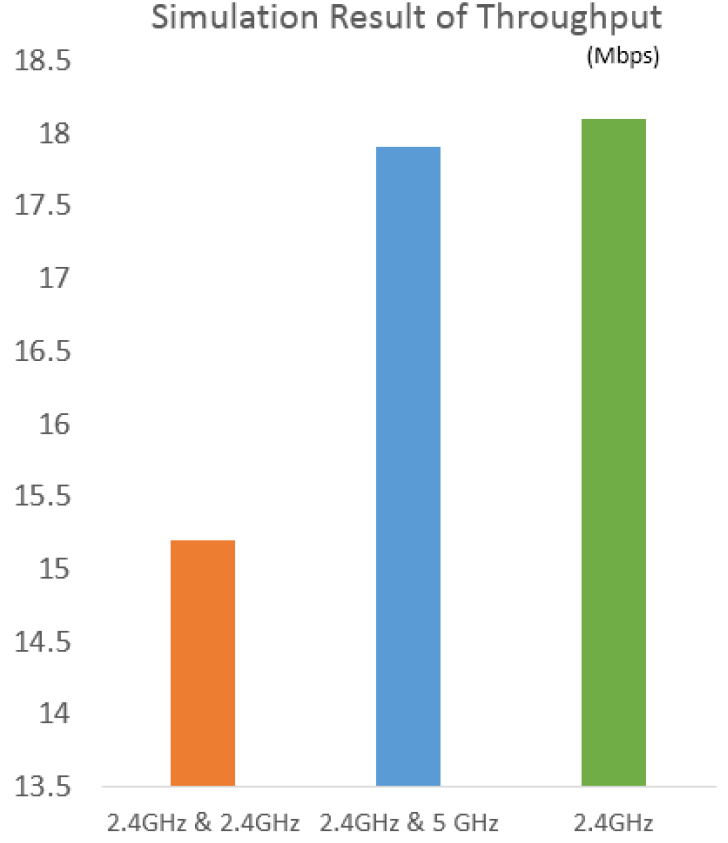
One 802.11n 2.4Ghz AP and one 802.11n 5Ghz AP





Case 4: Multi-AP Signal Interference





Simulation Result Summary

- 802.11n has better throughput and less delay but a little bit shorter range than 802.11g.
- The signal interference exists inside the 2.4Ghz; however there is no interference between 2.4Ghz and 5Ghz.
- Under Multi-client testing, 802.11n still maintains the low delay time and higher throughput than 802.11g

Conclusion

- 802.11n has significantly advantage in terms of transfer speed and delay time for the office enviornment.
- To avoid interference, pure 5Ghz is perferred in 802.11n due to less overlapping channels compare to 2.4Ghz band from other radio technologies.

Suggestion: dual radio access point could be considered due to above facts.

Future Work

- Dual-band radio router simulation
- Throughput and distance in the real office enviroment (walls, multiple APs ect.)
- The place to install the AP to result the better wireless coverage and performance.

Reference

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