ENSC427: COMMUNICATION NETWORKS

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Simulation Comparison Between LTE and WIFI in Networks

Group 1

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Roadmap

- Introduction
- Theoretical Result
- OPNET model
- Simulation result
  - HTTP, FTP
  - X-axis is in time domain; Y-axis is in bits or bytes
- Conclusion
- Future Work
- Reference

Introduction

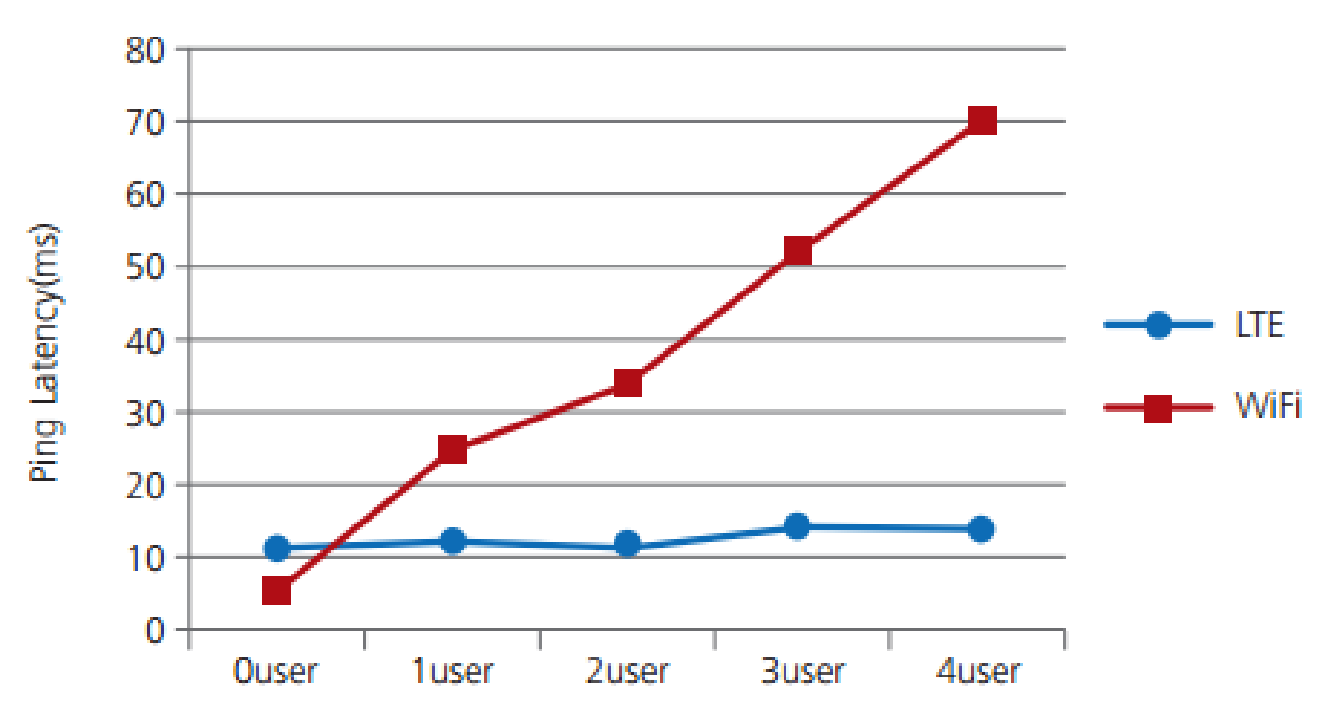
- WIFI:
  - Stands for Wireless Fidelity
  - Based on IEEE 802.11 standards
    - Ad hoc mode
    - Infrastructure mode
  - Range: 35 m(115ft)
- LTE:
  - Stands for Long Term Evolution
  - OFDMA for the downlink, SC-FDMA for uplink
  - Evolution of the GSM/UMTS standards

Introduction

- Goal
  - Build OPNET models for LTE and WIFI in simple networks with two workstations
  - Compare simulation results between WIFI and LTE with two different sample applications:
    - HTTP
      - Traffic Received, Throughput, and Delay
    - FTP
      - Traffic Received, Throughput, and Delay
  - Observe data lost between traffic received and traffic sent for one workstation in HTTP and FTP applications

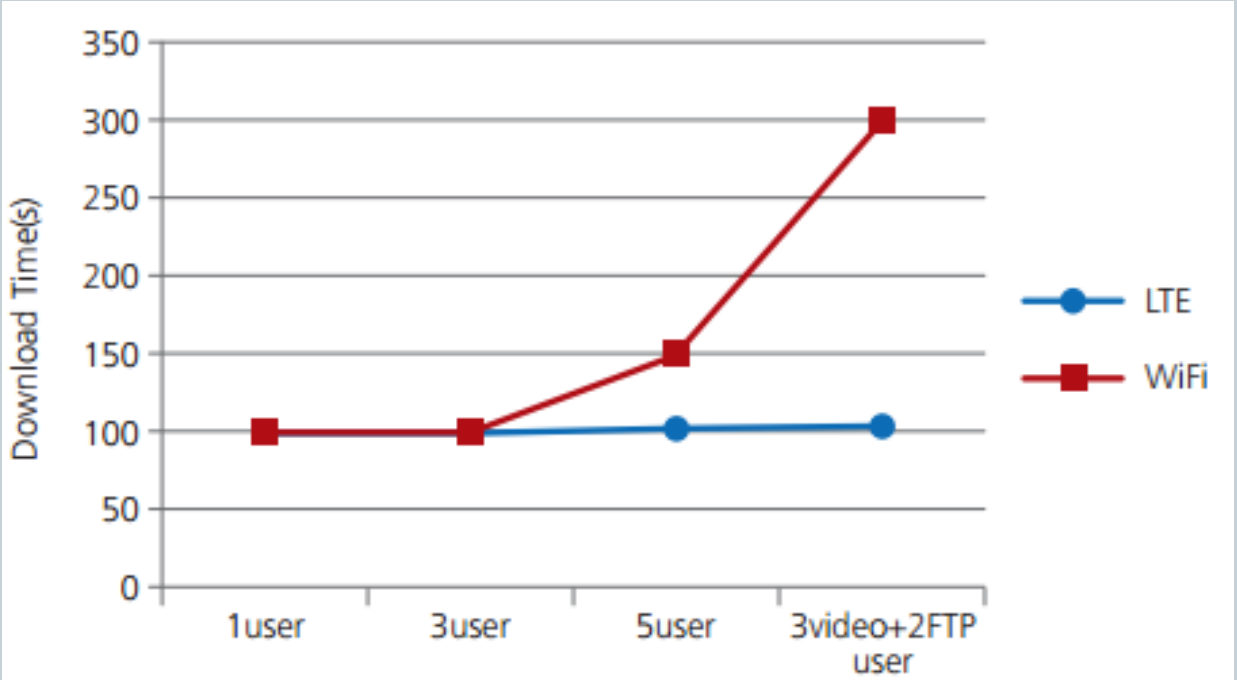
Theoretical Result

- Latency:
  - Latency on LTE is more stable than WIFI. However, the latency on WIFI increase dramatically when the number of users increase[1]



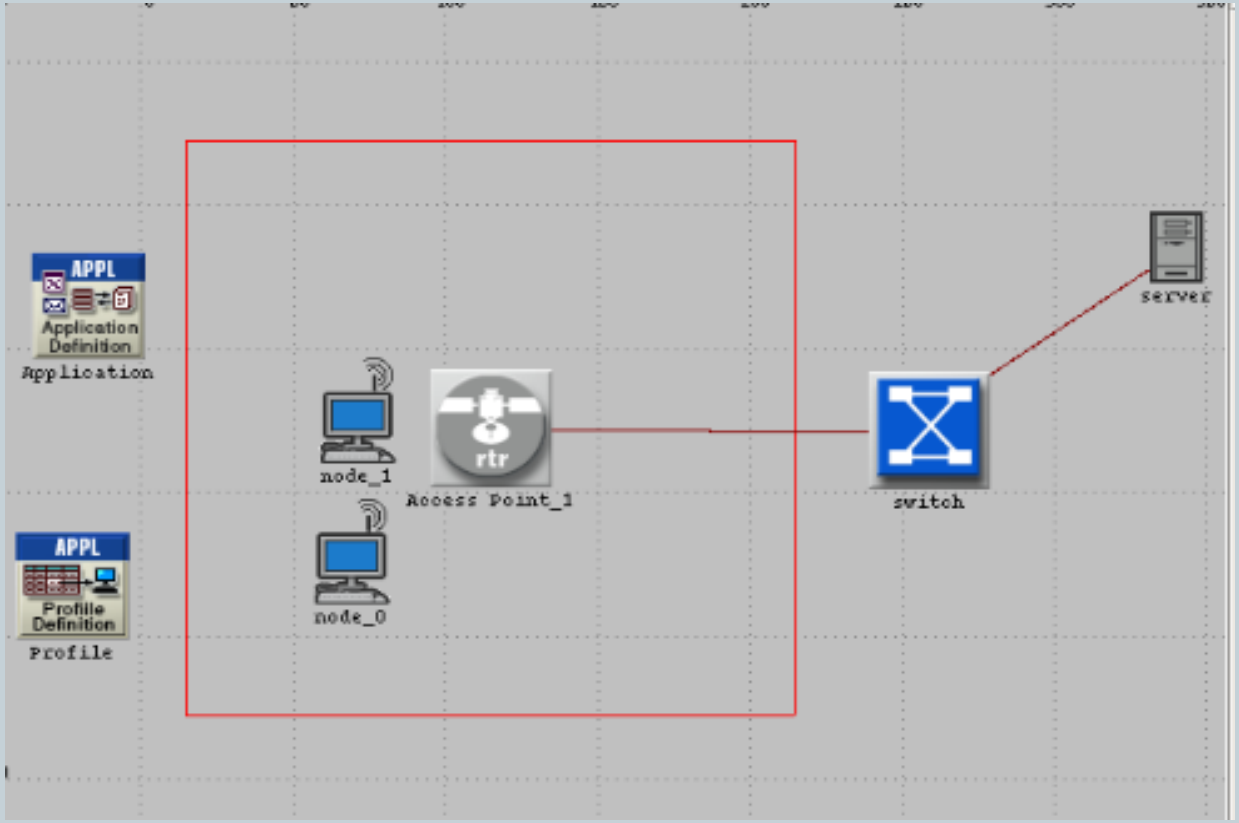
Theoretical Result

- FTP Downloading:
  - As numbers of users increases, the download time is roughly the same as single user on LTE network. However for users on WIFI network, download time increase[1]



OPNET Model

- WIFI model with one switch, one server, one router as the access point and two workstations.



OPNET Model

- WIFI Profile Setup

Type: Utilities

Attribute	Value
name	Profile
Profile Configuration	(...)
Number of Rows	1
pro1	
Profile Name	pro1
Applications	(...)
Number of Rows	1
Http app	
Name	Http app
Start Time Offset (seconds)	constant (10)
Duration (seconds)	constant (30)
Repeatability	(...)
Inter-repetition Time (s...	uniform (0, 10)
Number of Repetitions	Unlimited
Repetition Pattern	Serial
Operation Mode	Serial (Ordered)
Start Time (seconds)	uniform (100, 110)
Duration (seconds)	End of Simulation

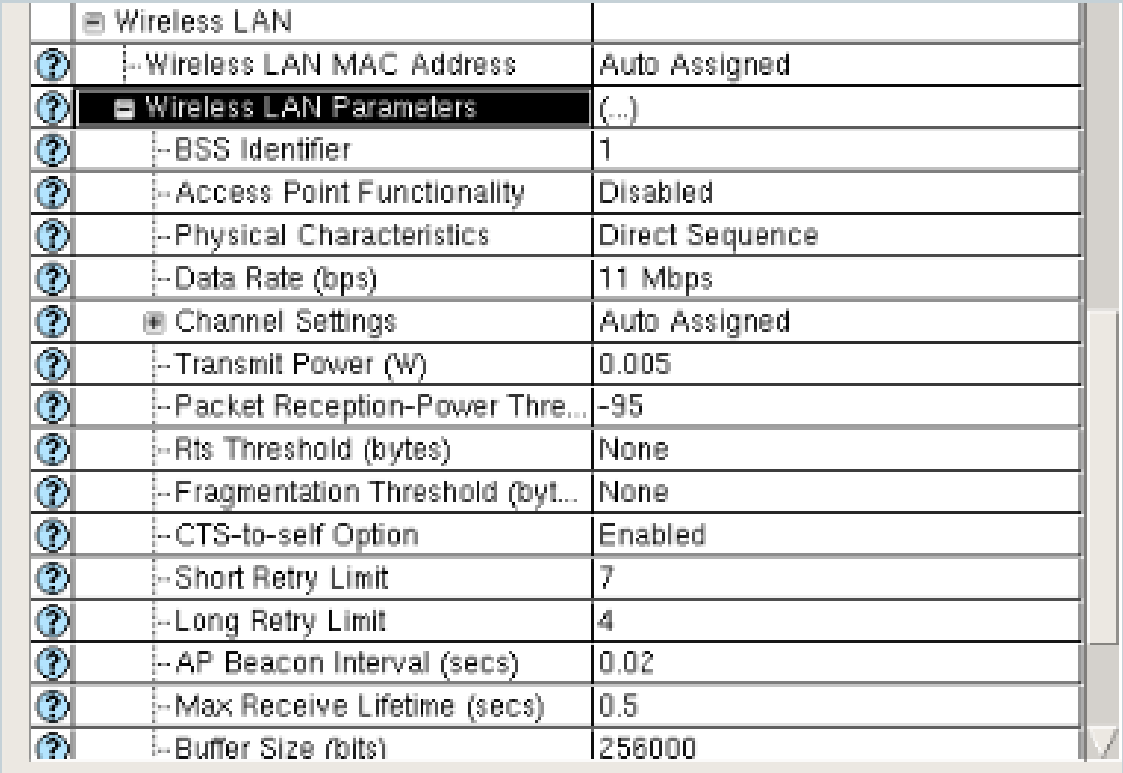
OPNET Model

- WIFI Application Configure Setup
  - FTP choosing High Load
  - HTTP using Heavy Browsing

Attribute	Value
name	Application
Application Definitions	(...)
Number of Rows	1
Http app	
Name	Http app
Description	(...)
Custom	Off
Database	Off
Email	Off
Ftp	High Load
Http	Off
Print	Off
Remote Login	Off
Video Conferencing	Off
Voice	Off
MOS	
Voice Encoder Schemes	All Schemes

OPNET Model

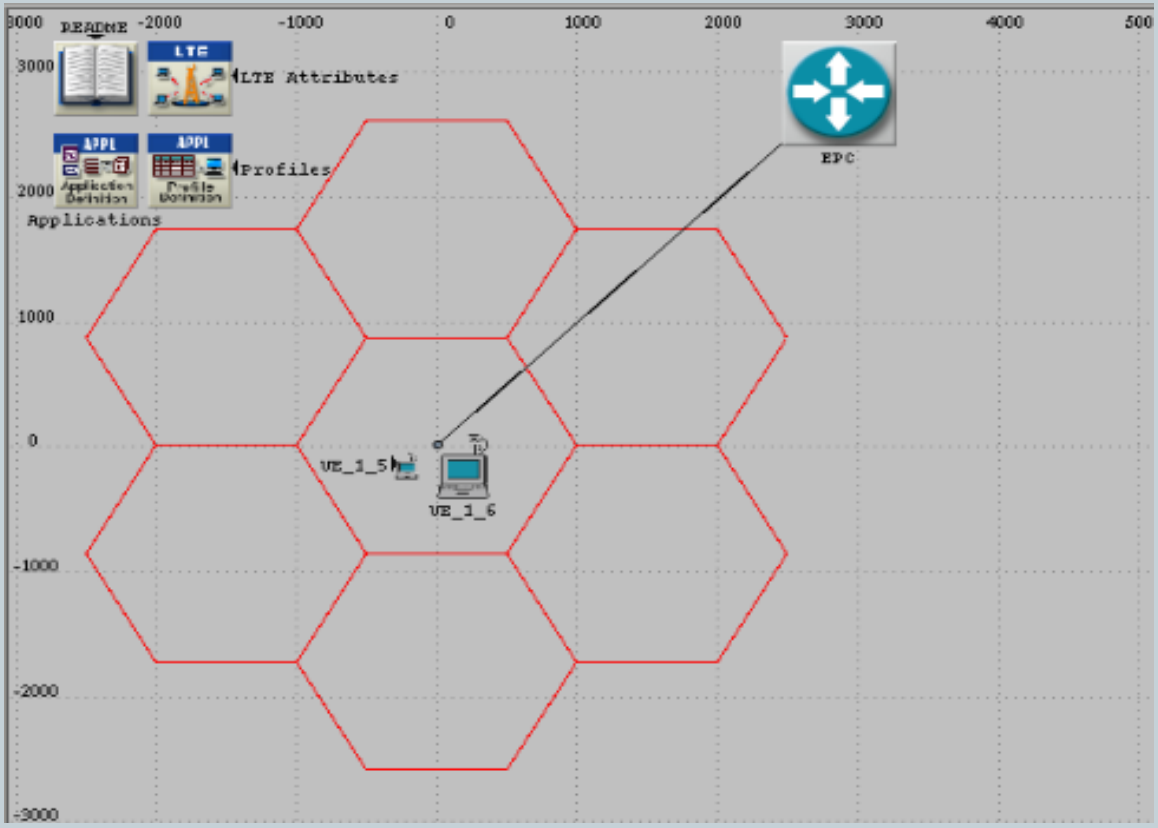
- WIFI Workstation Setup
- For Access Point, Set the Access Point Functionally to Enable



Wireless LAN	
Wireless LAN MAC Address	Auto Assigned
Wireless LAN Parameters	(...)
BSS Identifier	1
Access Point Functionality	Disabled
Physical Characteristics	Direct Sequence
Data Rate (bps)	11 Mbps
Channel Settings	Auto Assigned
Transmit Power (W)	0.005
Packet Reception-Power Thre...	-95
Rts Threshold (bytes)	None
Fragmentation Threshold (byt...	None
CTS-to-self Option	Enabled
Short Retry Limit	7
Long Retry Limit	4
AP Beacon Interval (secs)	0.02
Max Receive Lifetime (secs)	0.5
Buffer Size (bits)	256000

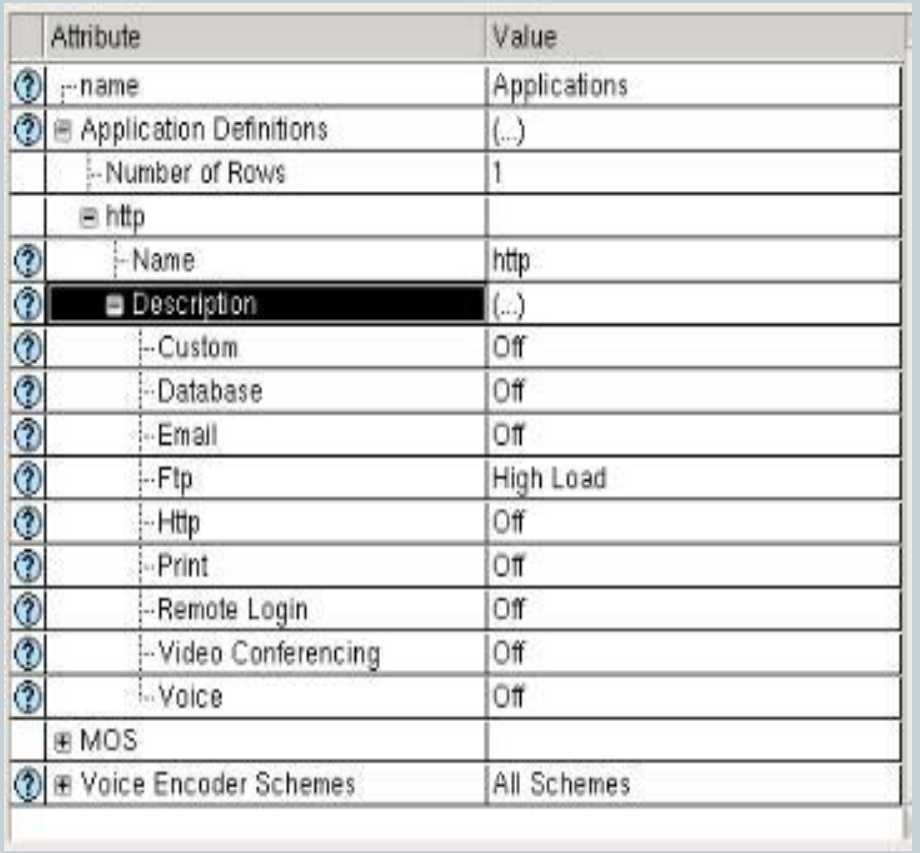
OPNET Model

- LTE model with two workstations, one access point, EPC as switch, and LTE configure application.



OPNET Model

- LTE Application Configure Setup
  - FTP choosing High Load
  - HTTP using Heavy Browsing



Attribute	Value
name	Applications
Application Definitions	(...)
Number of Rows	1
http	
Name	http
Description	(...)
Custom	Off
Database	Off
Email	Off
Ftp	High Load
Http	Off
Print	Off
Remote Login	Off
Video Conferencing	Off
Voice	Off
MOS	
Voice Encoder Schemes	All Schemes

OPNET Model

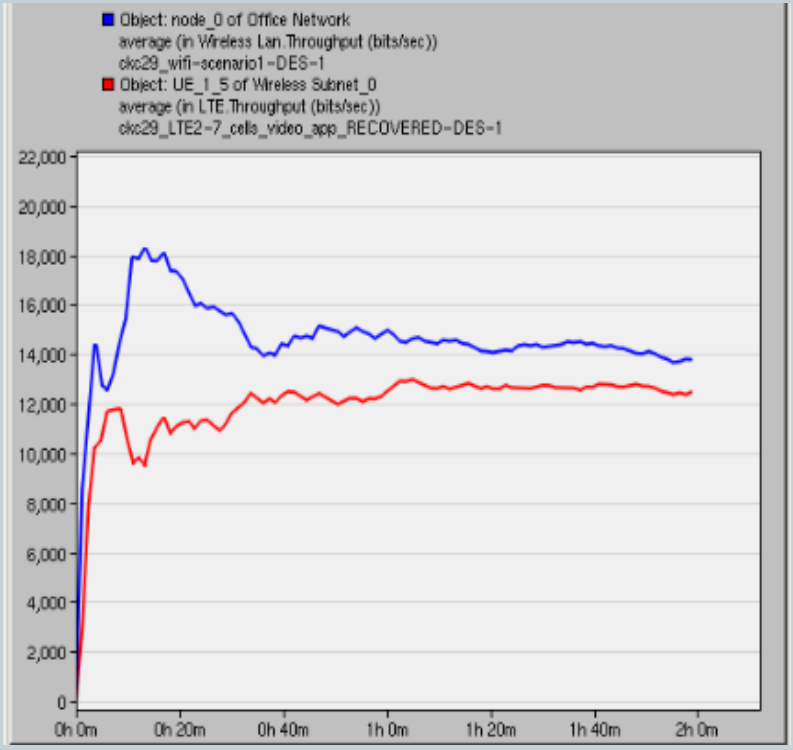
- LTE Profile and Workstation Setup

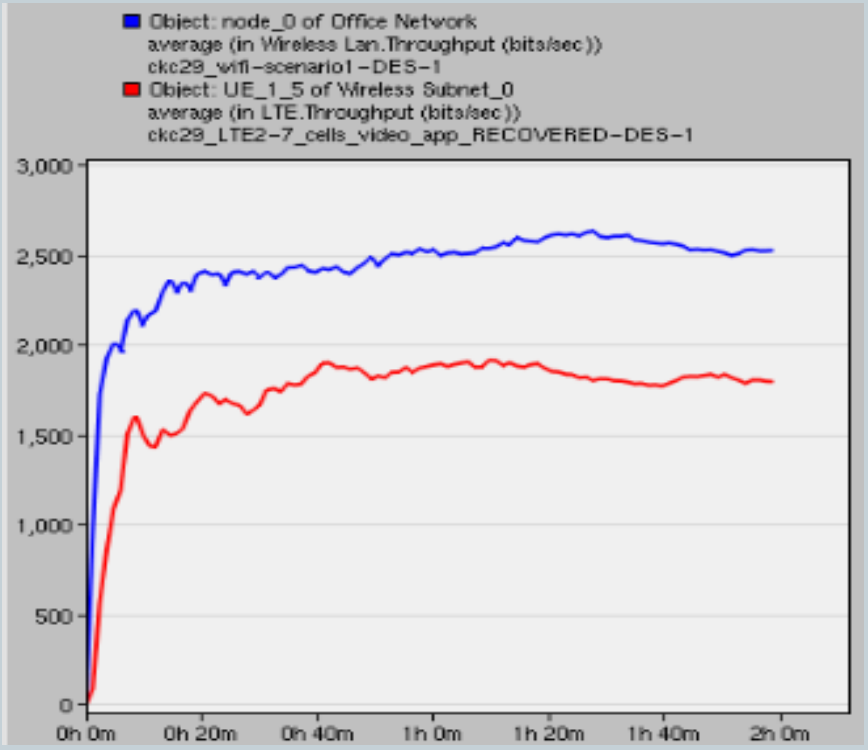
Attribute	Value
name	Profiles
Profile Configuration	(...)
Number of Rows	1
http	
Profile Name	http
Applications	(...)
Number of Rows	1
http	
Name	http
Start Time Offset (seconds)	constant (10)
Duration (seconds)	constant (30)
Repeatability	(...)
Operation Mode	Serial (Ordered)
Start Time (seconds)	uniform (100, 110)
Duration (seconds)	End of Simulation
Repeatability	Once at Start Time

Attribute	Value
AD-HOC Routing Parameters	
LTE	
PHY	
EPS Bearer Configurations	(...)
HARQ Parameters	Default
IMSI	Auto Assigned
Link Adaptation Parameters	Default
PDCP Compression	Disabled
Serving EPC ID	0
Serving eNodeB ID	1
Timers	Default
eNodeB Selection Policy	First Suitable eNodeB
Applications	
Application: ACE Tier Configura...	Unspecified
Application: Destination Prefere...	(...)
Application: Multicasting Specifi...	None
Application: RSVP Parameters	None
Application: Segment Size	64,000

Simulation Result

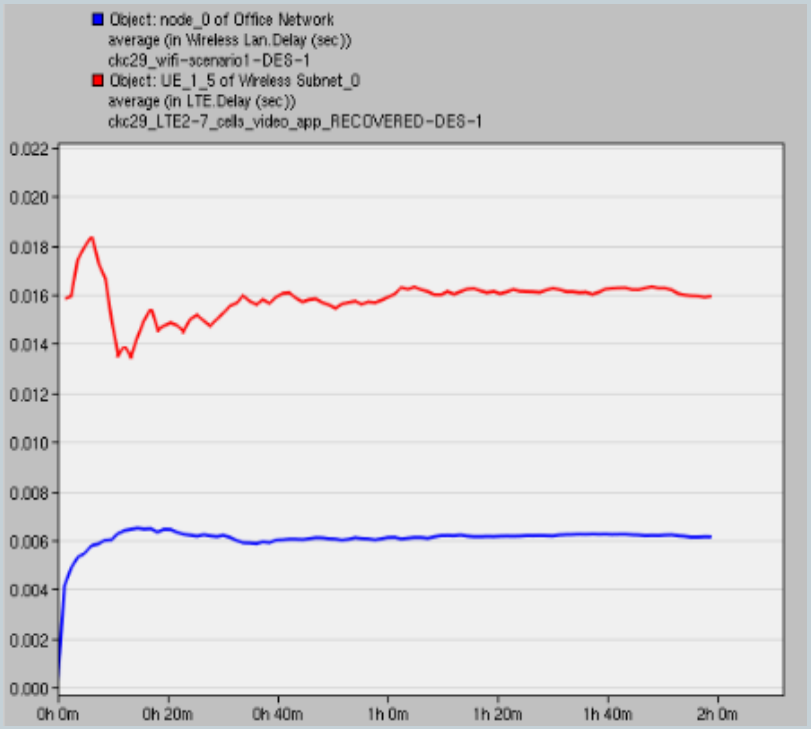
- Throughput
  - FTP: WIFI has more throughput than LTE (left figure)
  - HTTP: WIFI has more throughput than LTE (right figure)

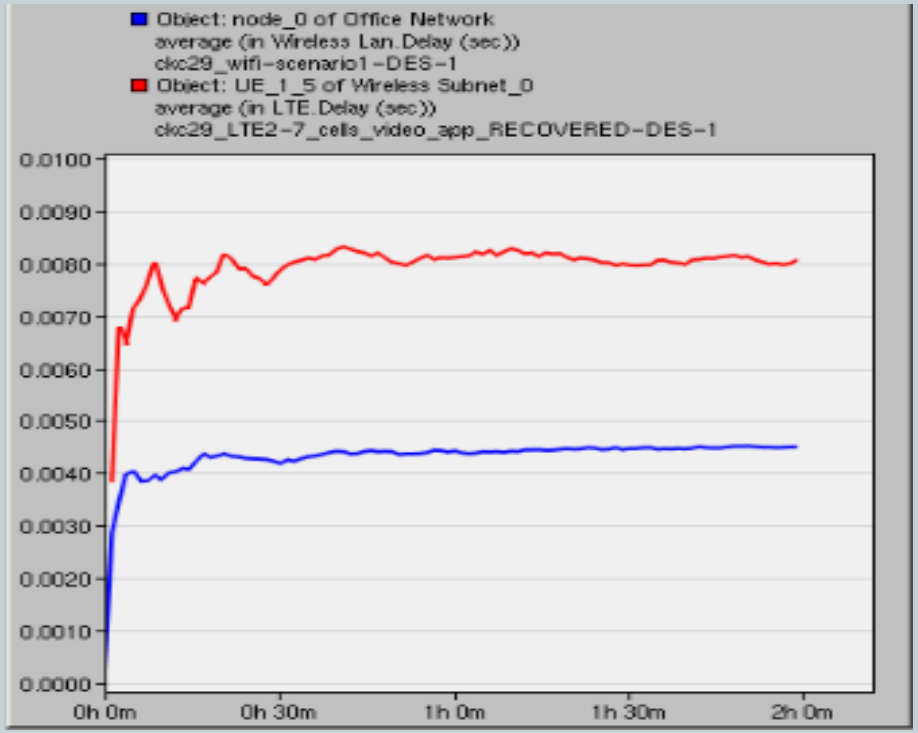




Simulation Result

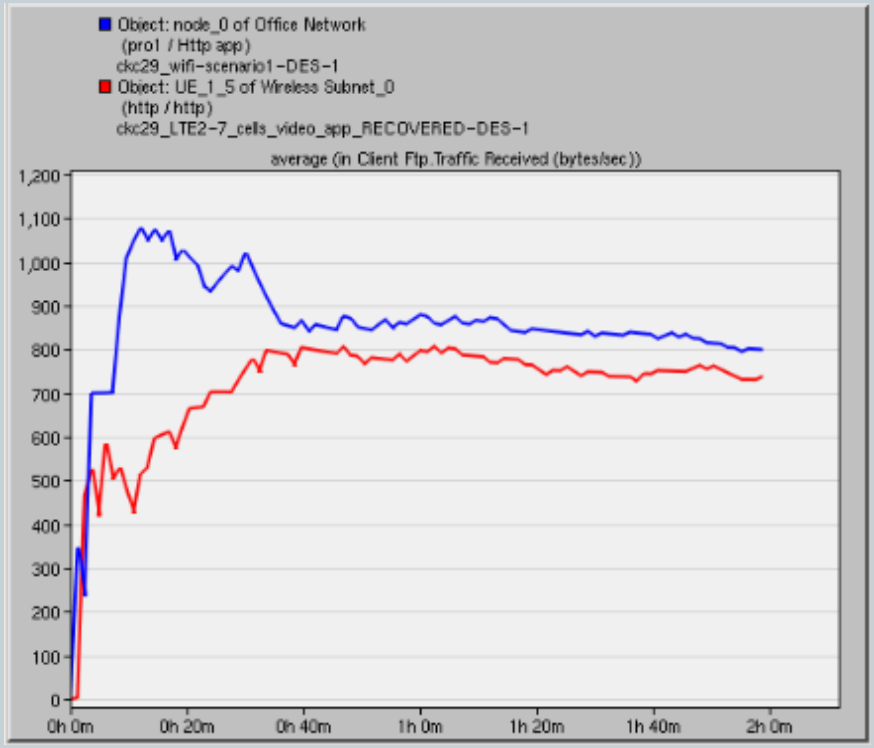
- Delay
  - FTP:LTE has more delay than WIFI (left figure)
  - HTTP: LTE has more delay (right figure)

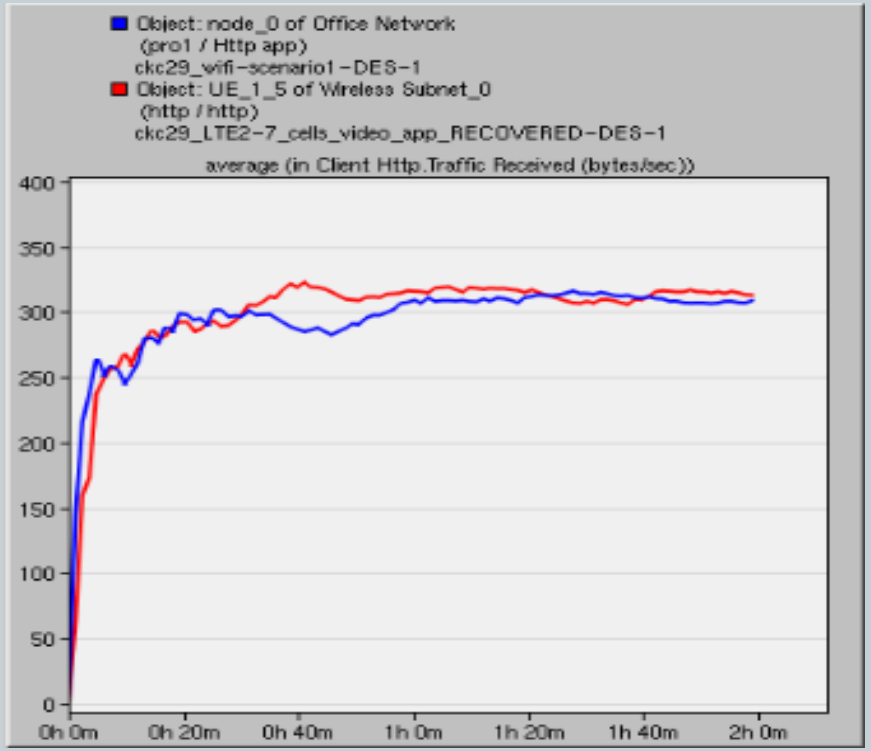




Simulation Result

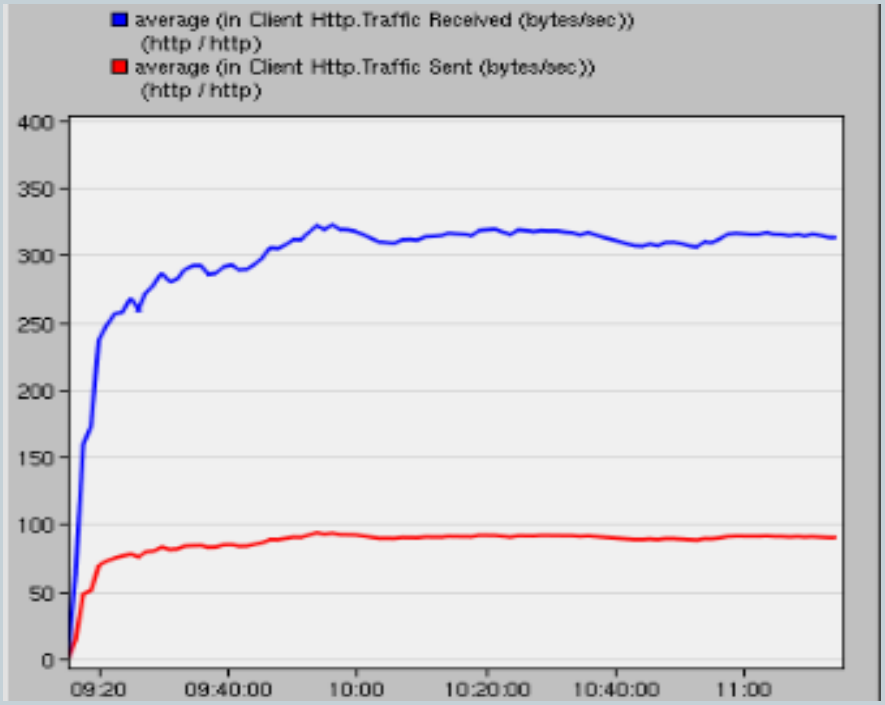
- Traffic Received in bytes
  - FTP: WIFI has more received bytes than LTE.
  - HTTP: LTE has higher received bytes (right figure)

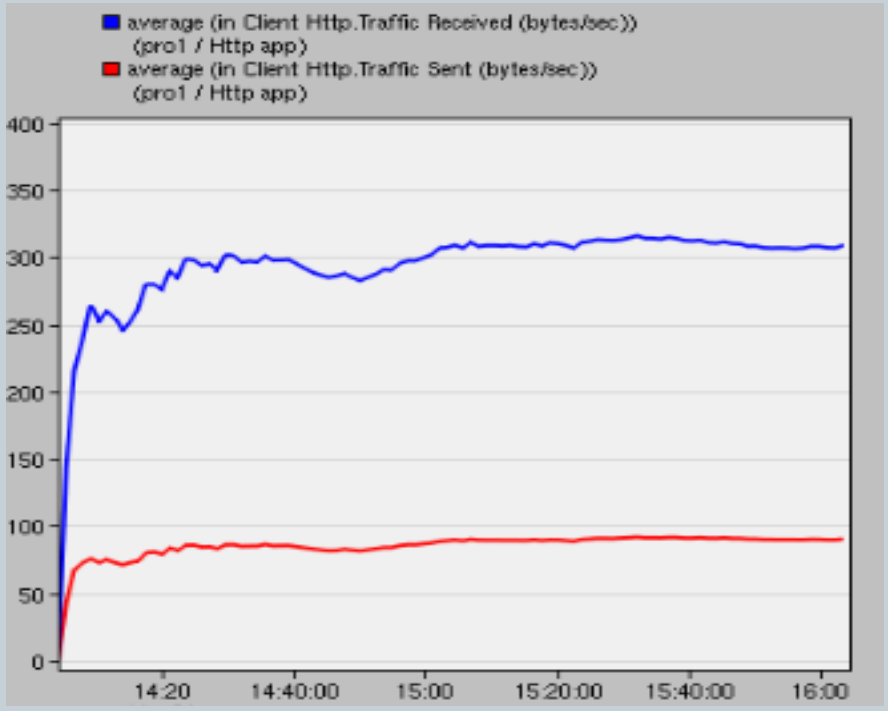




Simulation Result

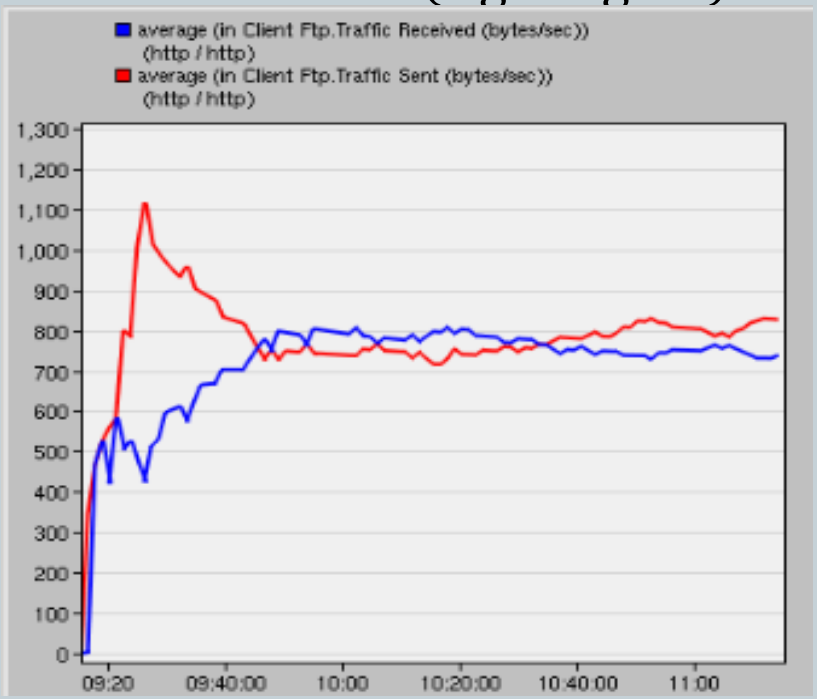
- Data Lost in HTTP
  - LTE: Average of 200 bytes difference between received and sent
  - WIFI: Average of 200 bytes difference (right figure)

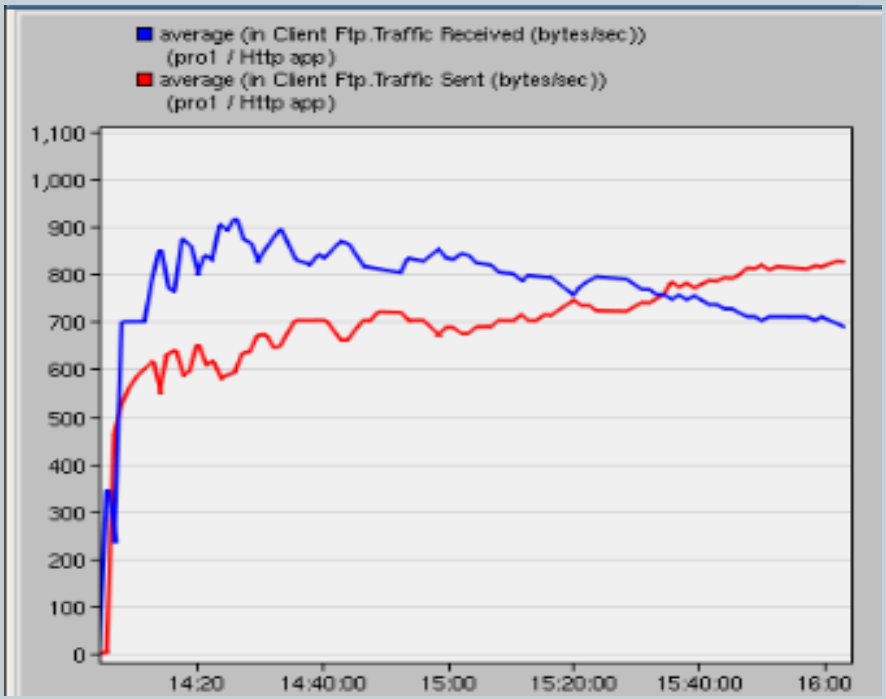




Simulation Result

- Data Lost in FTP
  - LTE: Average of 600 bytes difference (left figure)
  - WIFI: Average of 100-200 bytes difference between sent and received (right figure)





Conclusion

- FTP
  - WIFI obtains more throughputs than LTE
  - WIFI has more traffic received bytes
  - LTE has more delay
  - LTE has more data lost
- HTTP
  - WIFI obtains more throughputs than LTE
  - LTE has more traffic received byte
  - LTE has more delay
  - Both LTE and WIFI have similar bytes of data lost

Future Work

- Testing on high load video
- Testing on different number of workstations
- Comparing the different distance between the node and workstations

Questions?

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Reference

- [1] H. T. Co, "LTE Small Cell vs. WIFI," 2013. [Online]. Available: www.huawei.com/ilink/en/download/HW_323974.
- [2] Wikimedia Foundation, Inc. (2014 February, 16). Wi-Fi. [Online]. Available: http://en.wikipedia.org/wiki/Wi-Fi
- [3] Wikimedia Foundation, Inc. (2014 February, 7). LTE (telecommunication). [Online]. Available: http://en.wikipedia.org/wiki/Wi-Fi
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