ENSC 427: COMMUNICATION NETWORKS
Spring 2019
Project title: WiFi Network Design for Public Transportation System
URL: http://www.sfu.ca/~wongyauw/

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Content

1. Introduction to the project: motivation and overview (Steven)
2. Overview of related work (Steven)
3. Problem description: technical details (Jeffrey)
4. Implementation: simulation, prototype, results and analysis (even if not completed) (Hope)

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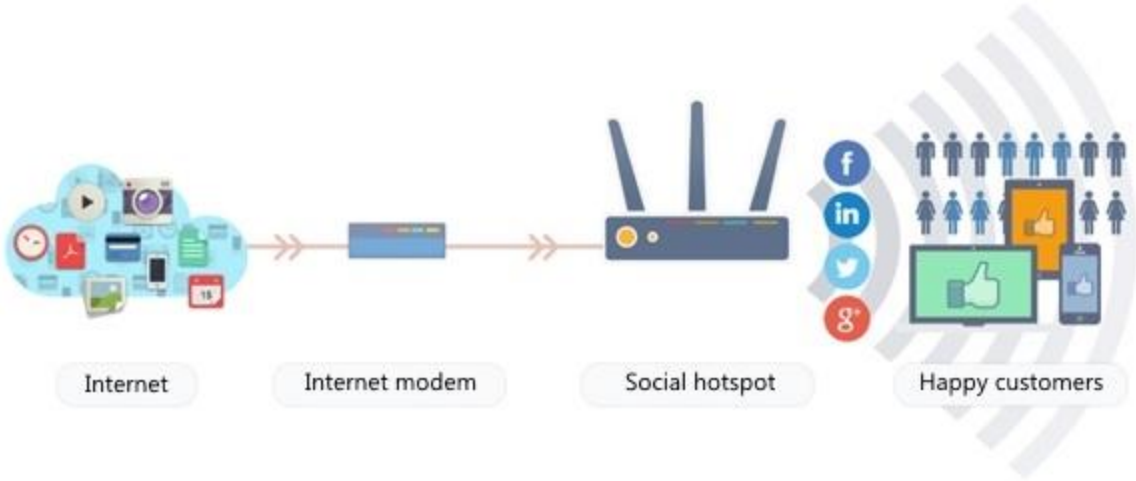
Overview



Related Work

ns-3:

Establish a router with multiple AccessPoint (to Serve large number of people - high quantity data transfer)

Simulate the occasion that when people are walking around the station/random people access the hotspot

Wireshark:

Capture the packet switch during the simulation

Technology

Wi-Fi is technology for radio wireless local area networking of devices based on the IEEE 802.11 standards.

Wi-Fi technology may be used to provide Internet access to devices that are within the range of a wireless network that is connected to the Internet.

Technology (continue)

802.11a/b/g/n/ac

Protocol	Frequency Band	Compatibility	Theoretical Rate	Actual Rate
802.11a	5 GHz	N/A	54 Mbit/s	About 22 Mbit/s
802.11b	2.4 GHz	N/A	11 Mbit/s	About 5 Mbit/s
802.11g	2.4 GHz	Compatible with 802.11b	54 Mbit/s	About 22 Mbit/s
802.11n	2.4 GHz, 5 GHz	Compatible with 802.11a/b/g	450 Mbit/s (three spatial flows)	About 80 to 220 Mbit/s
802.11ac	5 GHz	Compatible with 802.11a/n	1300 Mbit/s	250 Mbit/s to 400 Mbit/s

Technology (continue)

Protocols: rules for which both endpoints in a Wi-Fi connection agree upon to allow successful communication and interface between them.

- Transmission Control Protocol (TCP):
  - Connection-oriented
  - Reliable

- User Datagram Protocol (UDP)
  - Connectionless
  - Fast

Technology (continue)

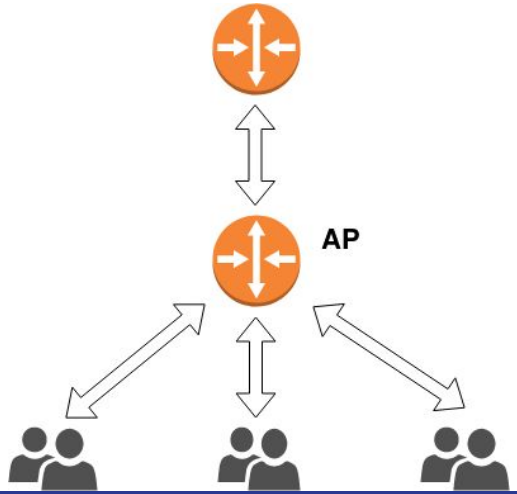
- Access Point Transmission Power
  - Omnidirectional 40 metre radius

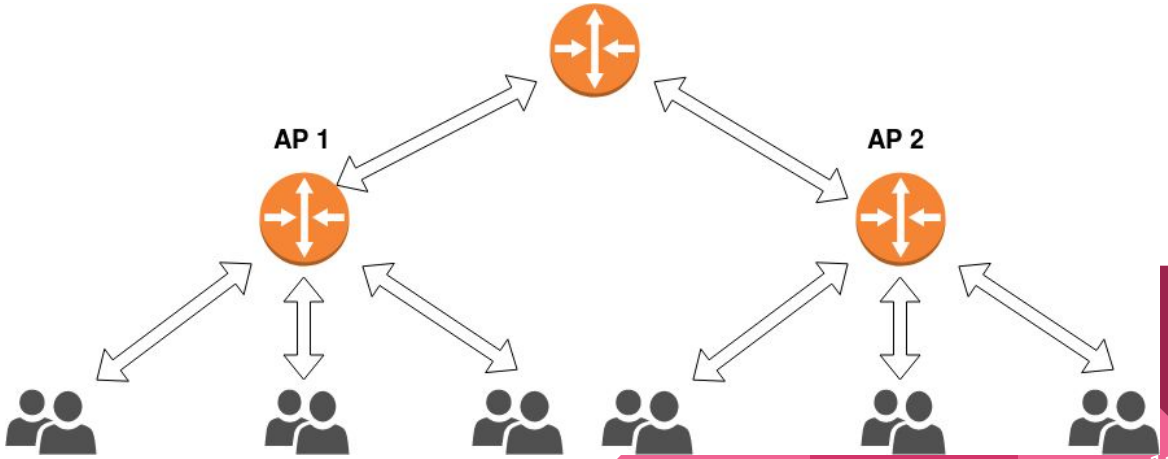
- Bus stations Size
  - Normal station: 8 metre X 10 metre
  - Terminal station: 60 metre X 60 metre

Technology (continue)

Scenarios

- 1 Access point serving for 3 user nodes.
- 2 Access points serving for 6 user nodes.





Simulation Problems

ns-3:

1. Simulate switching among Access Points.

   Solution: Directly connect the user nodes to an access point

Simulation Scenarios

- Start with third.cc
- Point to point
- WIFI: WIFI_PHY_STANDARD_80211n_5GHZ
- Packet Size: 1024KB to each user
- Use netanim to display and wireshark to display trace file

Scenario 1:

1 station

1 access points

3 users

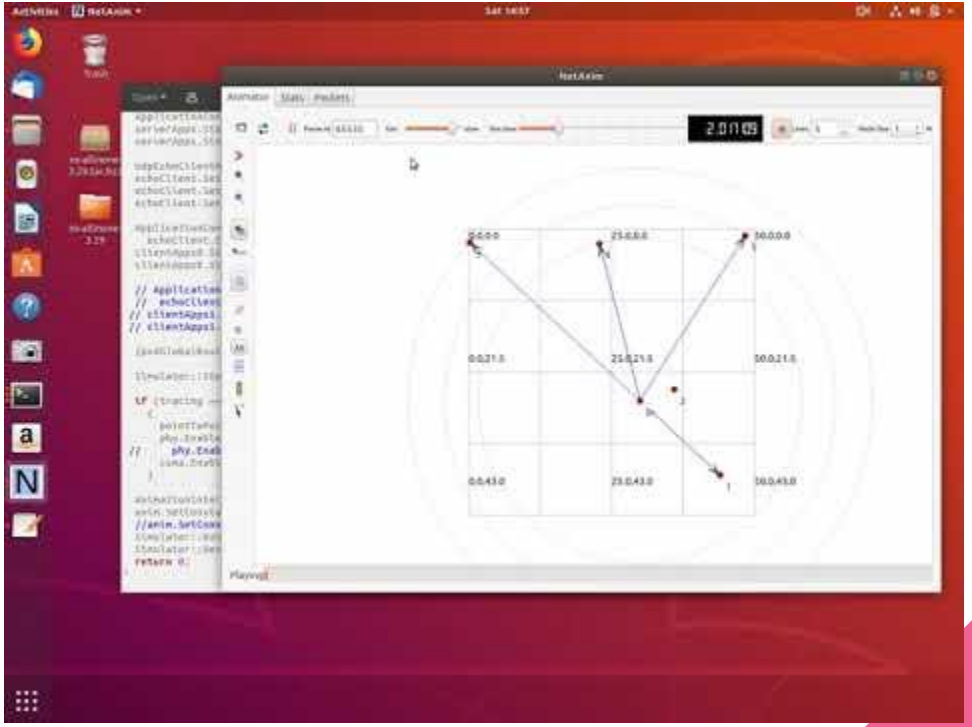
Scenario 2:

1 station

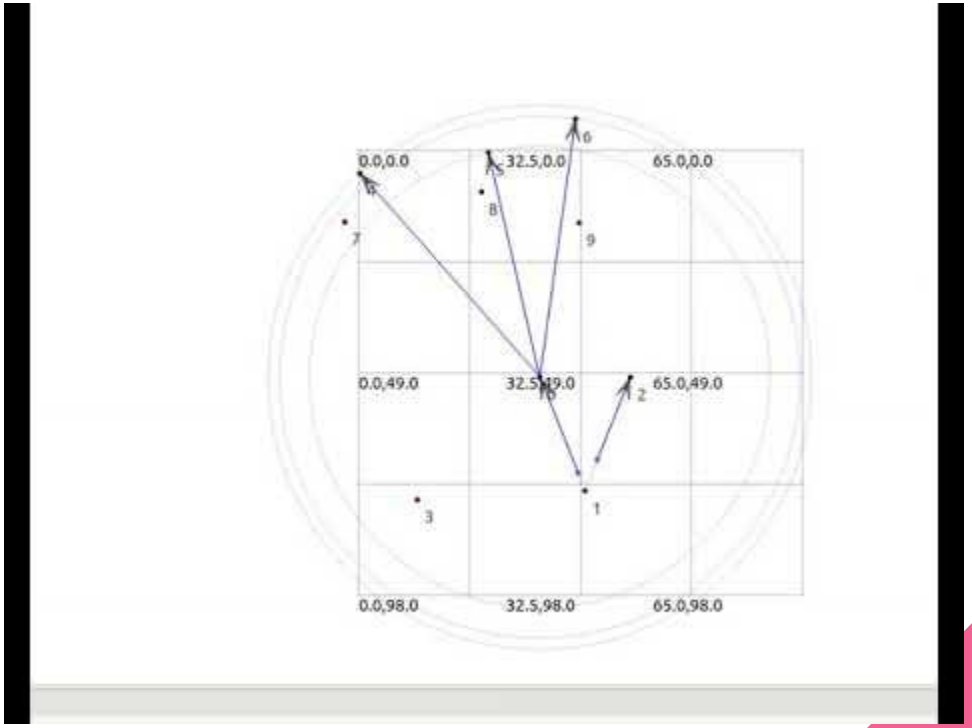
2 access points

6 users

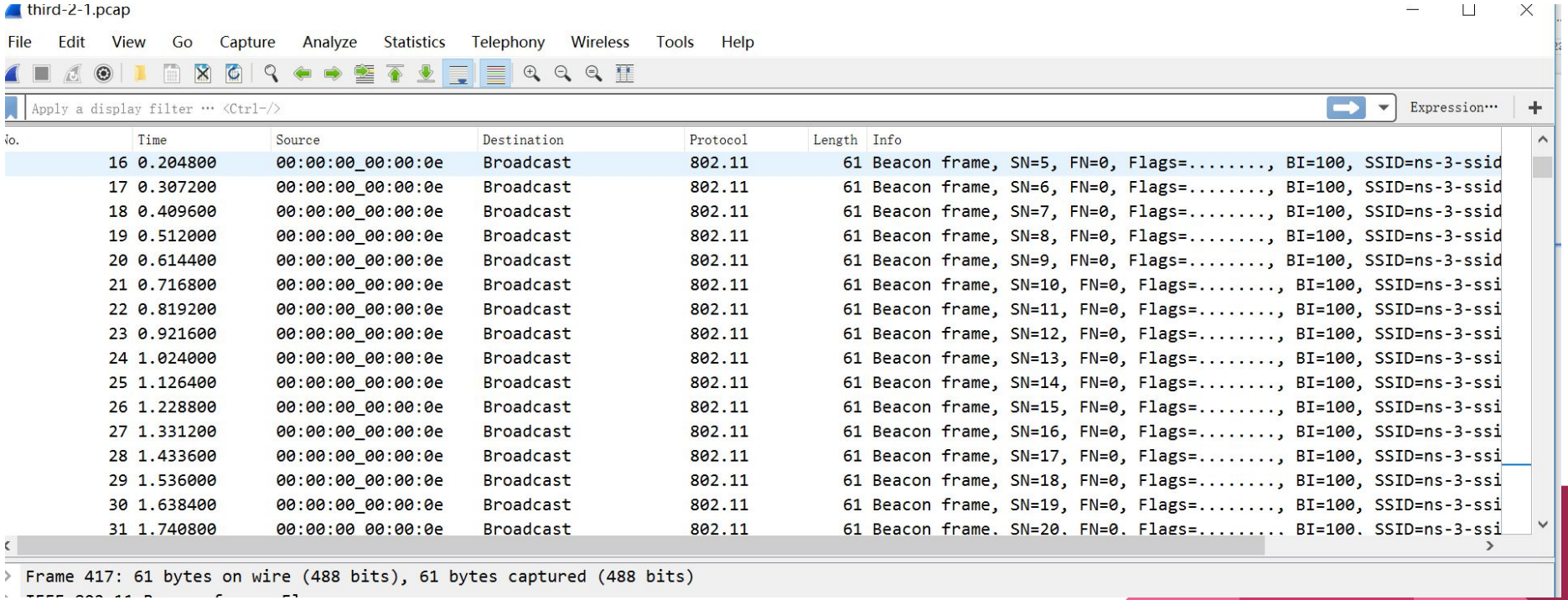
Simulation Result: One AccessPoint



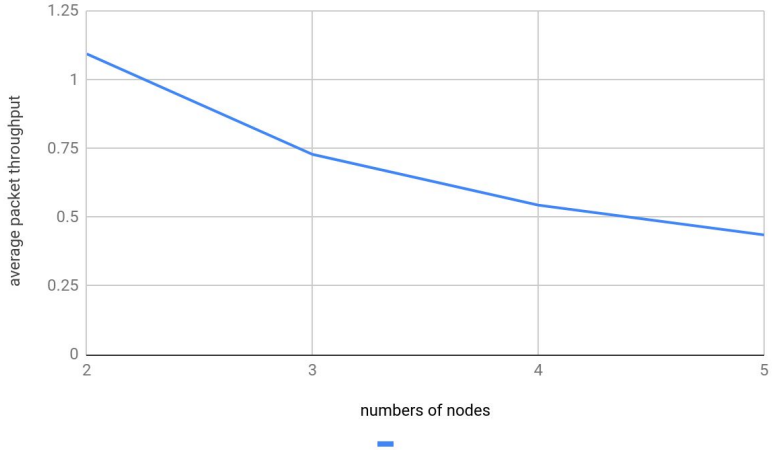
Simulation Result: Two AccessPoints



Simulation Result



Data Analysis (continue)



The throughput is decreased when there are more users connected to the access points.

Data Analysis (continue)

node number	Packet loss ratio
2	0.4924905356
3	0.6619569715
4	0.7476184566
5	0.7972395988

- Packet Loss is increase dwhen nodes are added.

Improvement of the Design

Adding Access point

AP	node	RANGE	Data rate	throughput	Lost packets	total packets	Lost ratio	average throughput
1	4	60	5.5	2.1949	48406	64454	0.745	0.548
2	4	60	5.5	2.2653	47520	64454	0.737	0.566

Lost ratio and average throughput is slightly reduced.

But still need enhancement.

Improvement of the Design

Widen the channel width

AP	node	RANGE	Data rate	throughput	Lost packets	total packets	Lost ratio	average throughput
1	4	60	5.5	2.1949	48406	64454	0.745	0.548
1	4	60	11	3.04112	41720	64454	0.647	0.760

There is a respectively enhancement.

But Lost ratio is still very high.

Improvement of the Design

Enable CTS and RTS

“RTS/CTS (**Request to Send / Clear to Send**), work as reducing frame collisions, which is introduced by the hidden node problem as well. [9] This is the optional mechanism used by the 802.11 wireless networking protocol. The difference is that modern RTS/CTS includes ACKs and does not solve the exposed node problem.[9] “

Improvement of the Design

Enable CTS and RTS

AP	node	RTS/CTS	RANGE	Data rate	throughput	Lost packets	total packets	Lost ratio	average throughput
1	4	Disabled	60	5.5	2.1949	48046	64454	0.74543084	0.548725
1	4	Enabled	60	5.5	1.74958	174422	187500	0.93025066	0.437395

- Packet loss ratio is increased and average throughput is limited.
- Idea does not work

Conclusion

This simulation firstly prove the design and capture the workflow of the bus station hotshot with bus station nodes and access nodes.

Then the simulation verifies the performance of the simple design.

- We assume the bus station is a circle with the radius of 60 meters.
- As more nodes(users) joining the wifi, the packet loss ratio goes up extremely high and throughput for each node is becoming smaller.
- The application of this design is **rejected** because of **packet loss and uninsured throughput.**

The third part of the simulation focuses on reducing the packet loss ratio.

- Adding an access point can enhance the performance slightly
- Increasing the data rate can reduce a large amount of packet loss and guarantee a more throughput.
- Adding RTS and CTS cannot reduce packet loss and it will add barriers between transmitting

Difficulties and future work

- The design still have a high rate of packet loss.
- Throughput requires to be ensured for each user when more users join the wifi

Reference

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This is the end of the presentation.
Thank you for listening.