COMP 6461 : Computer Network + Protocol NS3 Project Report

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Abstract

This report describes the work that was done for the ns3 project of the computer network and protocol course. The report is organized as follows. First is the introduction where a brief description of the wireless networking. Second is the description of the project. Third is the implementation section, where in more detail the implementation of the project is presented. Fourth is the results section where the produced graphs and results are discussed. Finally there is the concludion.

i. Introduction

A wireless network is any type of computer network that uses wireless data connections for connecting network nodes. Wireless networking is a method by which homes, telecommunications networks and enterprise installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless networks based on the IEEE 802.11 standard, better known as WLAN (Wireless Local Area Network). The most widely use standard for wireless networks was IEEE 802.11b. IEEE 802.11b wireless networking specification that extends throughput up to 11Mbit/s using the same 2.4GHz band. It uses the same CSMA/CA media access method, which means that nodes listen the channel and transmit when it is idle. Collision detection cannot occur, so if a collision happens, the node that has not received an ACK after back off time transmits again. Due to the CSMA/CA protocol overhead, in practice the maximum 802.11b throughput that an application achieves is about 5.9 Mbit/s using TCP and 7.1 Mbit/s using UDP. 802.11b is used in a point-to-multipoint configuration, wherein an access point communicates via an omnidirectional antenna with mobile clients within the range of the access point.

ii. Project Description

The project is to write a simulation using the NS3 network simulator to gain insight in a network and its properties, and how they influence performance.

NS3 is a free open-source software project for network simulations targeted at research and education. The simulator would be written from scratch, using the C++ programming language. In this project the Wifi IEEE 802.11b is simulated using the infrastructure topology, meaning one access point and different number of station nodes.

A. Objective

The objective of this project is to observe and simulate the different of parameters of the wifi network are changed in order to obtain the different results in network performance. The simulation focuses on the measurement of throughput of the connection where the number of mobile user changes on the same AP, one of the mobile user move to another AP under the same switch and then the user move to another AP under a different switch. The main question being answered is: what is the average of throughput and delay when the location and number of mobile user changed and what happens as the user moves such as will there be any service discontinuity and will there any packet lose?

B. Hypothesis

When more nodes connect to the same AP and transmitting data, the average throughput is expected to go down earlier than for lower data rates.

When the mobile user move to another AP under the same switch which means all of the stations in the two APs belong to the same IP subnet. So the mobile user may keep its IP address and all of its ongoing TCP connections. As the mobile user wanders away from AP1, it detects a weakening signal from AP1 and starts to scan for a stronger signal. The mobile user receives beacon frames from AP2. So when the signal becomes weak, the

throughput will decease and a stronger signal it received its throughput will increase back.

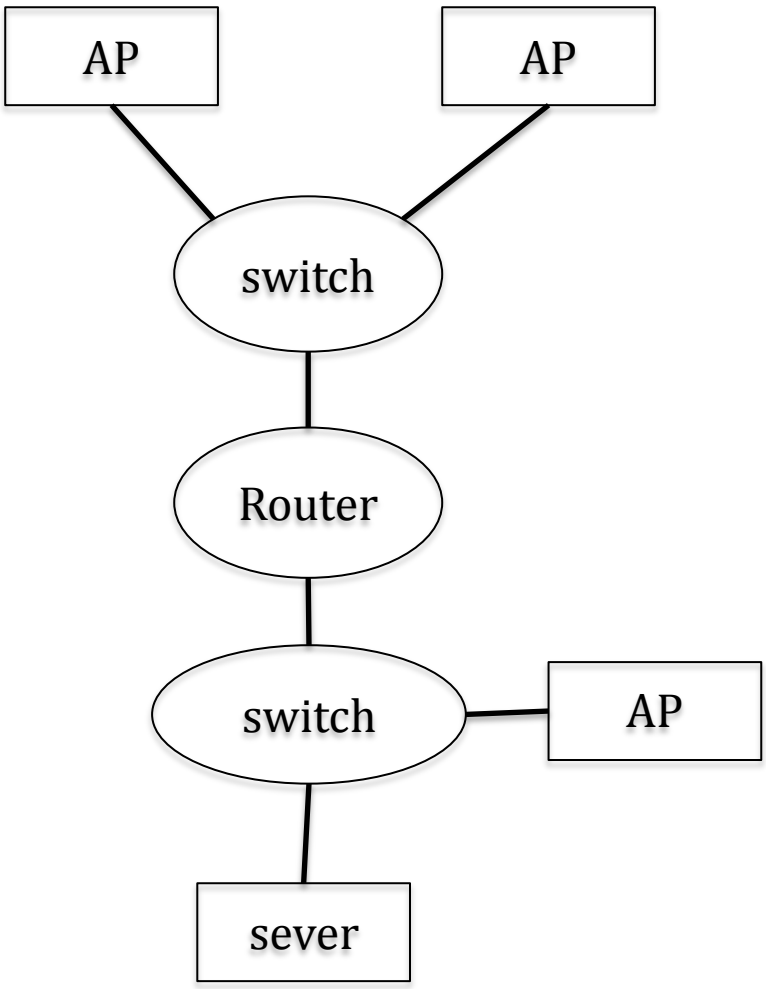
When the mobile user move to another AP under the different switch but still in the same router. So the stations in the two APs belong to the different IP subnet. That means the mobile user changes its IP address and it will discontinue the TCP connections for a little time. So the throughput will decease at the beginning, and then the packets will loss and the throughput cannot be detected, finally, when a stronger signal it received its throughput will increase back.

iii. Implementation

The simulations of the scenario described in section II-B are performed with NS3.

A. Topology overview

The network topology consists of three access points and each of them has a set of N stations connected to it through a wireless connection. In addition, there are two switches connect to a same router. Two of the three access points connected to a switch and the switch in turn is connected to a router which connects to another router which connects to another switch which attached the sever and another AP. All of this connection through a CSMA channel. One particular user would like to access a sever in the same network to get packet. And the number of the station in the same AP will change and the location of the particular user will change later to another two APs. The topology is shown in fig1.



B. Script description

The NS3 installation contains some example scripts. The simulation script for this project is based on the third.cc found in the tutorial examples.

First the nodes include sever, switch, router, AP and station are created with the NodeContainer class and use "Create" to set different number for them. Then use CsmaHelper to create channel for different nodes and set attributes to this channel. Then the YansWifiPhyHelper and Yans WifiChannelHelper are used to create and install wifi devices on ApNodes. For the WiFi channel, the default channel configuration of YansWifiChannelHelper is used.

The access points are assigned a constant position using the ConstantPositionMobilityModel, while the connecting

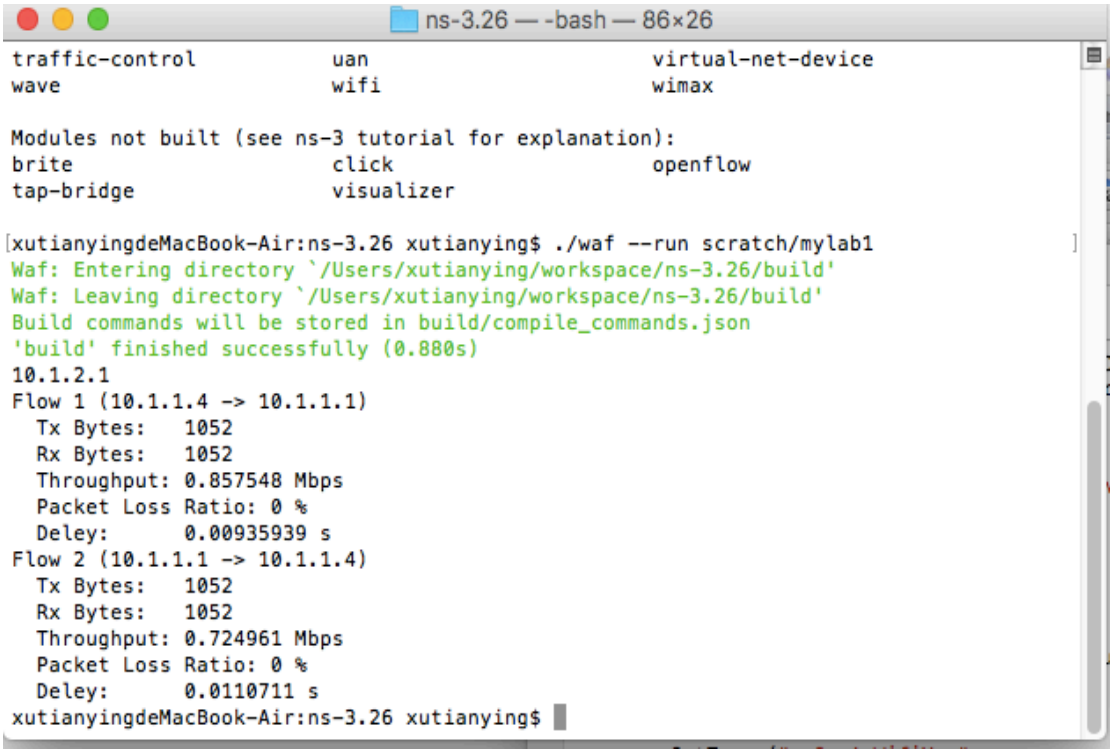
nodes are assigned the RandomWalk2dMobilityModel to simulate movement during simulation. The bound of the random movements is a predefined rectangle with the access point being in the center. Then we need use InternetStackHelper to add internet stack to the terminals.

After the movement models, the IP addresses are assigned and the application are loaded onto the stations. Using Ipv4AddressHelper to set the IP addresses of router. Then use ApplicationContainer to create application to send packets between nodes.

To get the throughput of the simulation a tool called Flow Monitor is used. Flow Monitor's goal is to provide a flexible system to measure the performance of the simulated network nodes, resulting in an overview of each flow of traffic between network nodes. The throughput equation used by the flomonitor is as shown in equation 1 where "duration" is equal to the running time of the application in the simulation.

Throughput=(rxBytes*8.0)/(duration*1024*1024)Mbps (1)

The FlowMonitor is set up to give the output directly after running any individual simulation. This output is shown in fig.2.

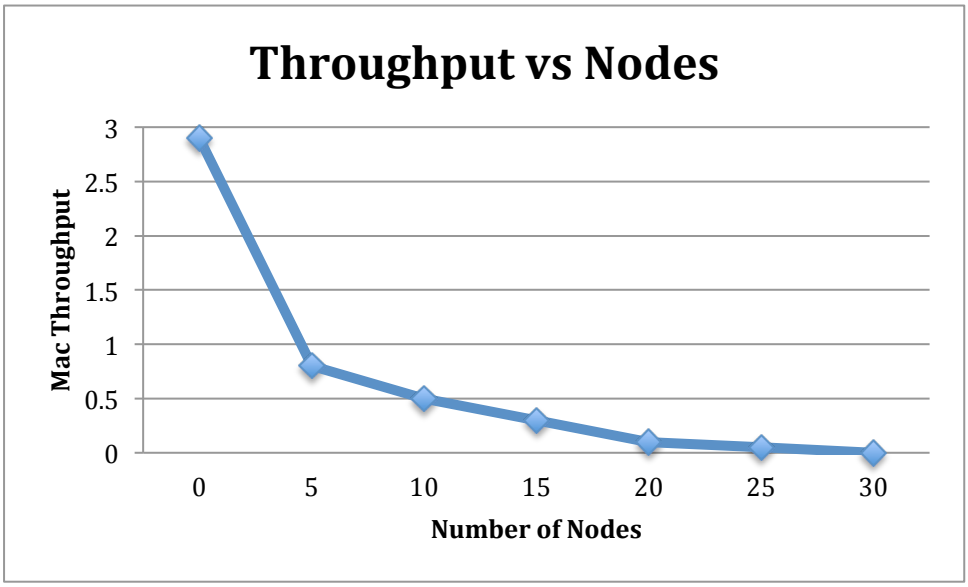


C. Run the simulation

In order to run this project, copy the file script into the scratch directory and use waf to build. To avoid any confusion about what you are executing, do the renaming to file suggested above. It runs the first simulation with a mobile user in an AP with some certain number of users. Then change the number of user in the same AP. Recording the throughput changes and organize them into a form.

iv. Results

In the first scenario, nodes are steadily increased per simulation starting form 2 nodes and ending at 30 nodes. As far as the MAC Throughput is concerned, it is observed that as the number of nodes increases that throughput decreases exponentially. Since the nodes increase the total bandwidth needs to be shared, the throughput is decreasing exponentially.



In the second scenario, the particular user moves in the same IP subnet. As the user wanders away from AP1, it detects a weakening signal from AP1 and starts to scan for a stronger signal. The user receives beacon frames from AP2(which in many corporate and university settings will have the same SSID as AP1). The user then disassociates with AP1 and associates with AP2, while keeping its IP address and maintaining its ongoing TCP sessions. The switch is "self-learning" and can handles occasional moves. The switch has an entry in its forwarding table that pairs users ' MAC address with the outgoing switch interface through which user can be reached. If the user is initially in AP1, then a datagram destined to user will be directed to user via AP1. Once the user associates with AP2, however, its frames should be directed to AP2. The solution is for AP2 to send a broadcast Ethernet frame with user's source address to the switch just after the new association. When the switch receives the frame, it updates its forwarding table, allowing H1 to be reached via AP2. So the throughput of user will decrease at the beginning and then increase when it feel a strong signal from AP2.

In the third scenario, the particular user moves in another IP subnet. It will change the IP address since the different

switches connect with same router. So when the user moves the throughput of the connection will decrease and becomes zero since the packer is loss and the TCP service discontinue. And then the throughput will increase since it gets a new IP address.

v. Conclusion

From the results we conclude:

(1)Throughput decreases exponentially as the number of users in the same AP increases

(2) Throughput will decreases when the particular user move to another AP in the same switch and when it received a strong signal from another AP, its throughput will increase back. In addition it will not change its IP address.

(3) Throughput will decreases when the particular user move to another AP in the different switch and its service will discontinue for a little time since it cannot sense the channel and then its throughput will increase back. And it will change its IP address.

References

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