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NS-2 SIMULATION – LAB REPORT

CS596- WIRELESS NETWORKS

INTRODUCTION:

NS (version 2) is an object-oriented, discrete event driven network simulator developed at UC Berkeley written in C++ and OTcl. NS is primarily useful for simulating local and wide area networks. NS2.29 tool is installed and used in this lab to simulate Wired2Wireless and Wireless2Wired scenarios and analyze the results obtained.

OBJECTIVE:

The main objective of this lab to learn how to install ns2 environment in Cygwin and using it to run different simulations.

These simulations help us to understand the variations in throughput and distance for different traffic direction and for different modulation techniques.

Lab 1:

- To run simulation for wired to wireless stations scenario, where the wireless station is moving away from the wired station.
- To collect the data and analyze the throughput vs distance with different modulation techniques

Lab 2:

- To run simulation for wireless to wired stations scenario and collect data.
- Analyze the throughput vs distance with different modulation techniques and compare with the Lab 1 results.

Lab 3:

- To run simulation for wireless to wired stations scenario by doubling the frequency bandwidth and increasing the traffic rate and collect the data.
- Analyze the throughput vs distance with different modulation techniques and compare with the Lab 2 results.

LAB PROCEDURE:

1. Software Installation – Basic Steps:

- Install Cygwin with all components from https://dl.dropboxusercontent.com/u/43421953/Teaching/cygwin.zip
- Install NS- 2.29 version:
  - ➢ Download ns-allinone-2.29.tar.gz from

    https://dl.dropboxusercontent.com/u/43421953/Teaching/ns-allinone-2.29.tar.gz
  - ➢ Create /opt directory
  - ➢ In /opt directory, type tar –zvxf ns-allinone-2.29.tar.gz to extract ns2 files
  - ➢ Type cd ns-allinone-2.29 and type ./install
  - ➢ Copy .bashrc from /etc/defaults/etc/skel to Home directory and modify it as follows and Save it:

    # Functions#

    #########

    export NS_HOME=/opt/ns-allinone-2.29

    exportPATH=$NS_HOME/bin:$NS_HOME/tcl8.4.11/unix:$NS_HOME/tk8.4.11/unix:$PATH

    export LD_LIBRARY_PATH=$NS_HOME/otcl-1.11:$NS_HOME/lib:

    $NS_HOME/otcl-1.8:$NS_HOME/lib:$LD_LIBRARY_PATH

    export TCL_LIBRARY=$NS_HOME/tcl8.4.11/library

  - ➢ Go to /etc/profile, open it using text editor.Add one line in the very end of that file: **. "$HOME/.bashrc"**

    This will make sure the bash starts and loads your modified .bashrc file,

    and thus your path and environment variables are initialized.
  - ➢ Restart Cygwin

- Install WiMAX module from https://dl.dropboxusercontent.com/u/43421953/Teaching/ns-2.29wimax.rar
    - ➢ Go to /opt/ns-allinone-2.29
    - ➢ Change the folder name ns-2.29 to ns-2.29-org
    - ➢ Unzip the module file ns-2.29wimax.rar to /opt/ns-allinone-2.29, under the directory of ns-2.29 (similar to the structure of ns-2.29-org)
    - ➢ Go to the folder ns-2.29 : cd ns-2.29
    - ➢ Type: make clean and make
    - ➢ Now you should have a new ns-2 simulation environment
- Install Simulation TCL script

After installing all the above components. The Cygwin screen will look as follows:

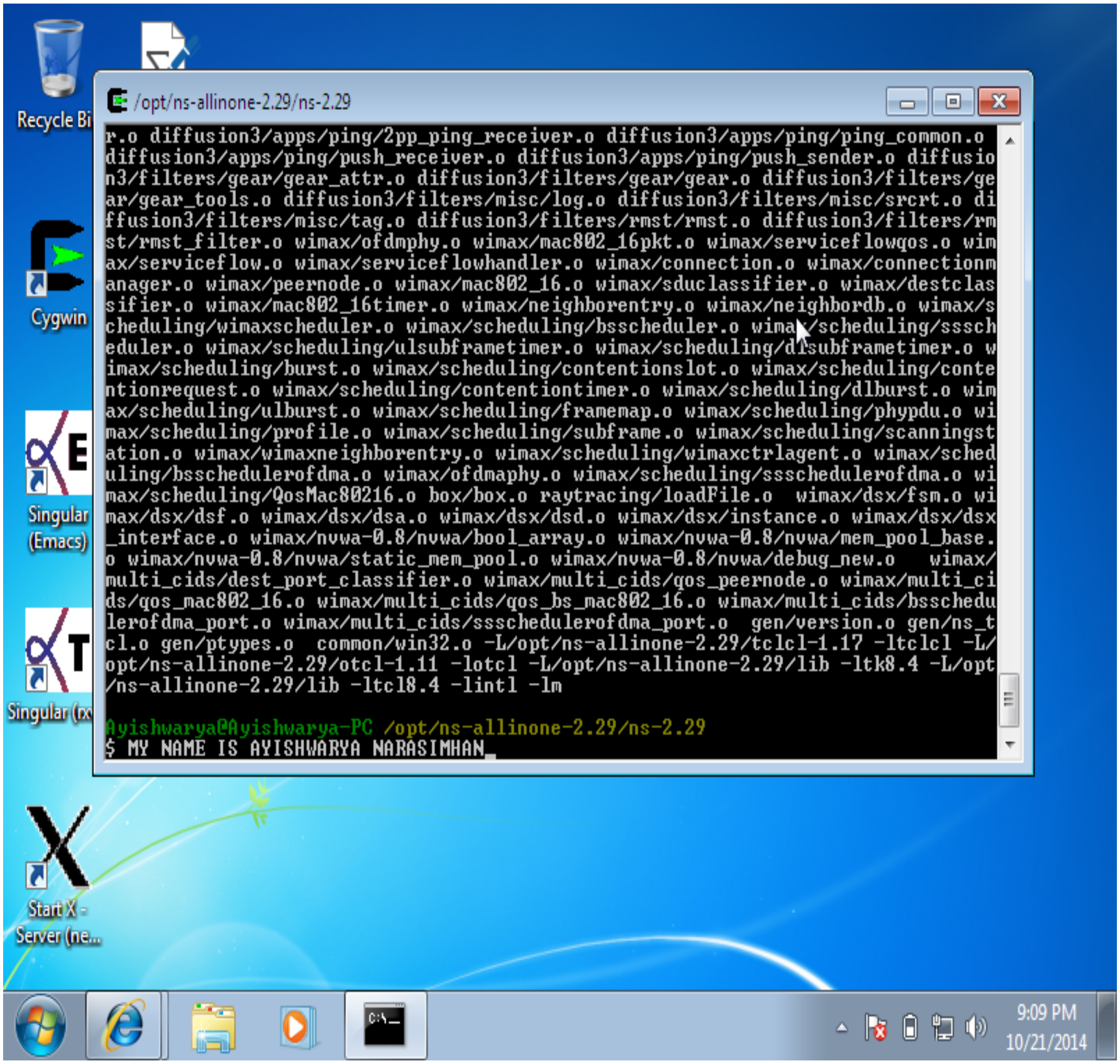

Fig 1: Screenshot of NS 2 Installation

2. Running Simulation – Steps involved:

- Open the ofdma_tput_distance.tcl file using WinEdt
- Change the traffic direction to 1(Wired to wireless) for Lab 1
- Change the traffic direction to 0(wireless to wired) for Lab 2 and Lab 3
- You may need to change the traffic_stop from 60 to 120 or higher ,because of the longer communication distance for different modulation schemes

- For Lab 3 : change the frequency bandwidth from 10Mhz to 20 MHz as follows:

  Mac/802_16 set fbandwidth_20e+6

  And also change the traffic rate to 60000000

- Set the modulation to the highest OFDM_64QAM_3_4 initially and Save the file

- Run simulation using the following command:

  $ns ofdma_tput_distance.tcl > trace.tr

  Here the output is redirected to the trace file mentioned above

- Analyze the result and collect the data using the following command:

  Lab 1: $awk –f WimaxThroughput.awk trace.tr 16387

  Lab 2: $awk –f WimaxThroughput.awk trace.tr 16386

  Lab 3: $awk –f WimaxThroughput.awk trace.tr 16386

  Here 16387 (Lab 1) & 16386(Lab 2, 3) is the ID of the connection carrying the data traffic

- Similarly continue this simulation for other modulation schemes as follows:

  - OFDM_64QAM_2_3
  - OFDM_16QAM_3_4
  - OFDM_16QAM_1_2
  - OFDM_QPSK_3_4
  - OFDM_QPSK_1_2
  - OFDM_BPSK_1_2

3. <u>Collecting Data and Plotting Graphs:</u>

- For each Lab and for every modulation technique collect the data and save it in Notepad file.

- Record it into different excel sheets by importing data from text document.

- Select the distance column and the throughput column and plot a scatter graph, with distance in the x axis and throughput in the y axis.
- Combine all the seven graphs from different sheets into one graph for each lab.
- Using the graph analyze the results obtained in the simulation.

COMPARING DATA FROM LAB 1, LAB 2 AND LAB 3:

Modulation Scheme	LAB_1 - Wired to Wireless		LAB_2 - Wireless to Wired		LAB_3 - Wireless To Wired - High frequency	
	Maximum Throughput	Range *	Maximum Throughput	Range*	Maximum Throughput	Range*
64QAM_3_4	25536	2850.03	26633.6	2250.13	54768	1750.06
64QAM_2_3	22713.6	3150.07	23408	2550.1	48608	1950.07
16QAM_3_4	16688	4250.04	17785.6	3350.15	36288	2750.06
16QAM_1_2	11088	5950.05	11648	4650.13	24080	3650.06
QPSK_3_4	8288	7350	8825.6	5750.14	17920	4550.05
QPSK_1_2	5488	8950.06	5600	6950.09	11760	5550.05
BPSK_1_2	2688	13249.9	2800	10350.1	5600	8050.05

**- The distance at which the throughput first becomes zero*

Table 1: comparing the maximum throughput Vs Distance in Lab 1, 2, 3

RESULTS & DISCUSSION:

Lab 1: Throughput Vs Distance – Wired to Wireless Station

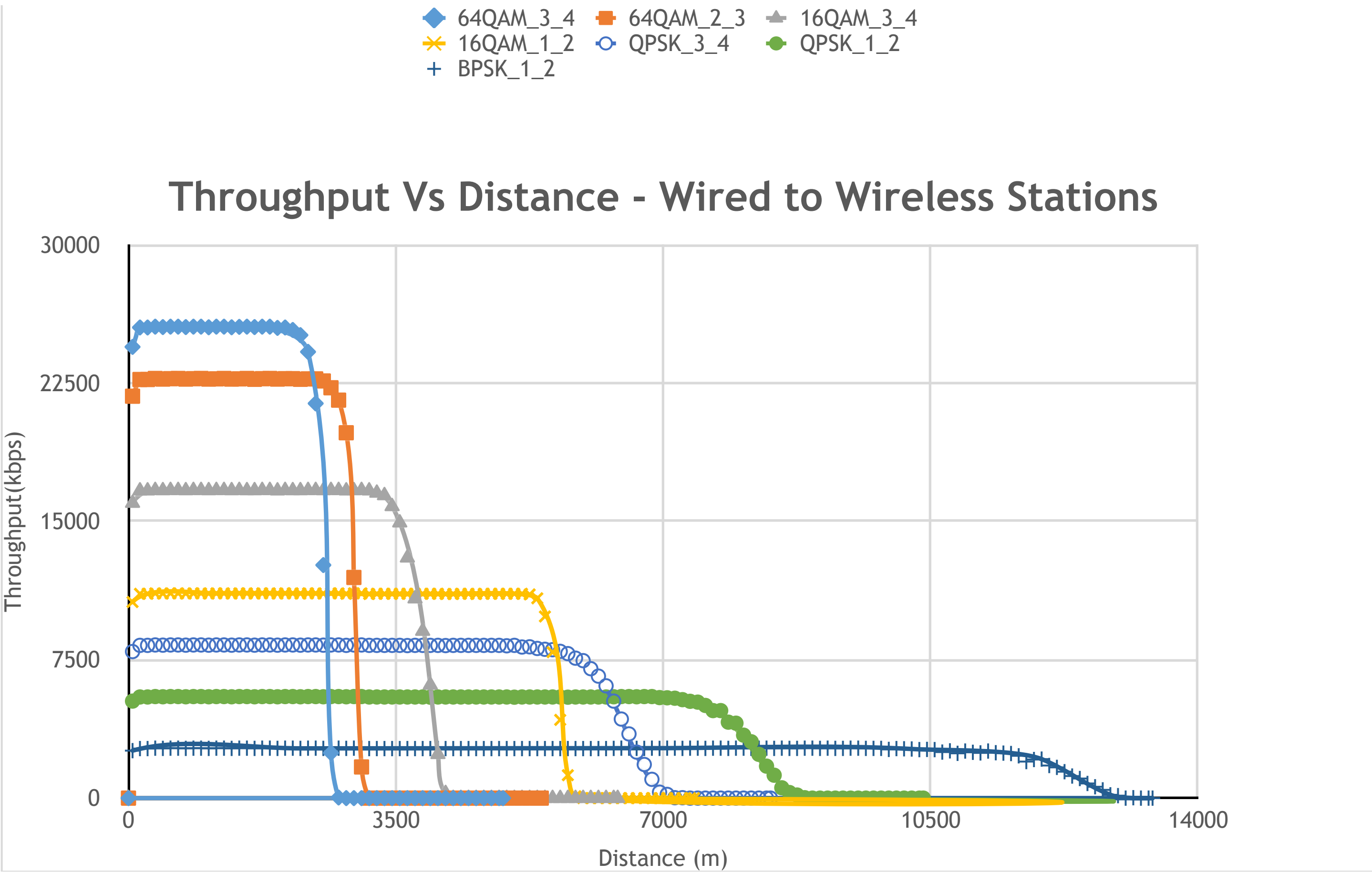

Fig 2: Wired to Wireless Stations – Throughput Vs Distance

In Lab 1, the traffic direction is from wired to wireless which is constantly moving away from the base station. The above fig 2 shows the results obtained from the ns2 simulation for lab 1 for various modulation techniques.

While running the simulation, the “traffic_stop” was gradually increased from 60(64QAM_3/4) to 140(BPSK_1/2) owing to the longer communication distance.

Presence of differences in the curves from the figure (fig 2):

From Fig2, we can see that the throughput is the maximum for 64QAM_3/4 and it gradually decreases and becomes the minimum for BPSK_1/2. But on the other hand, the distance travelled is minimum for 64QAM_3/4 and maximum for BPSK_1/2.

Reason for different throughput - distance performances:

As the modulation schemes increases from BPSK_1/2 to 64QAM_3/4, the constellation size increases. Therefore the data rate increases which in turn results in high throughput. But increase in constellation will also increase the chance of collision as the data are very close to each other. Eventually this leads to lesser communication distance.

Lab 2: Throughput Vs Distance -Wireless to Wired Stations

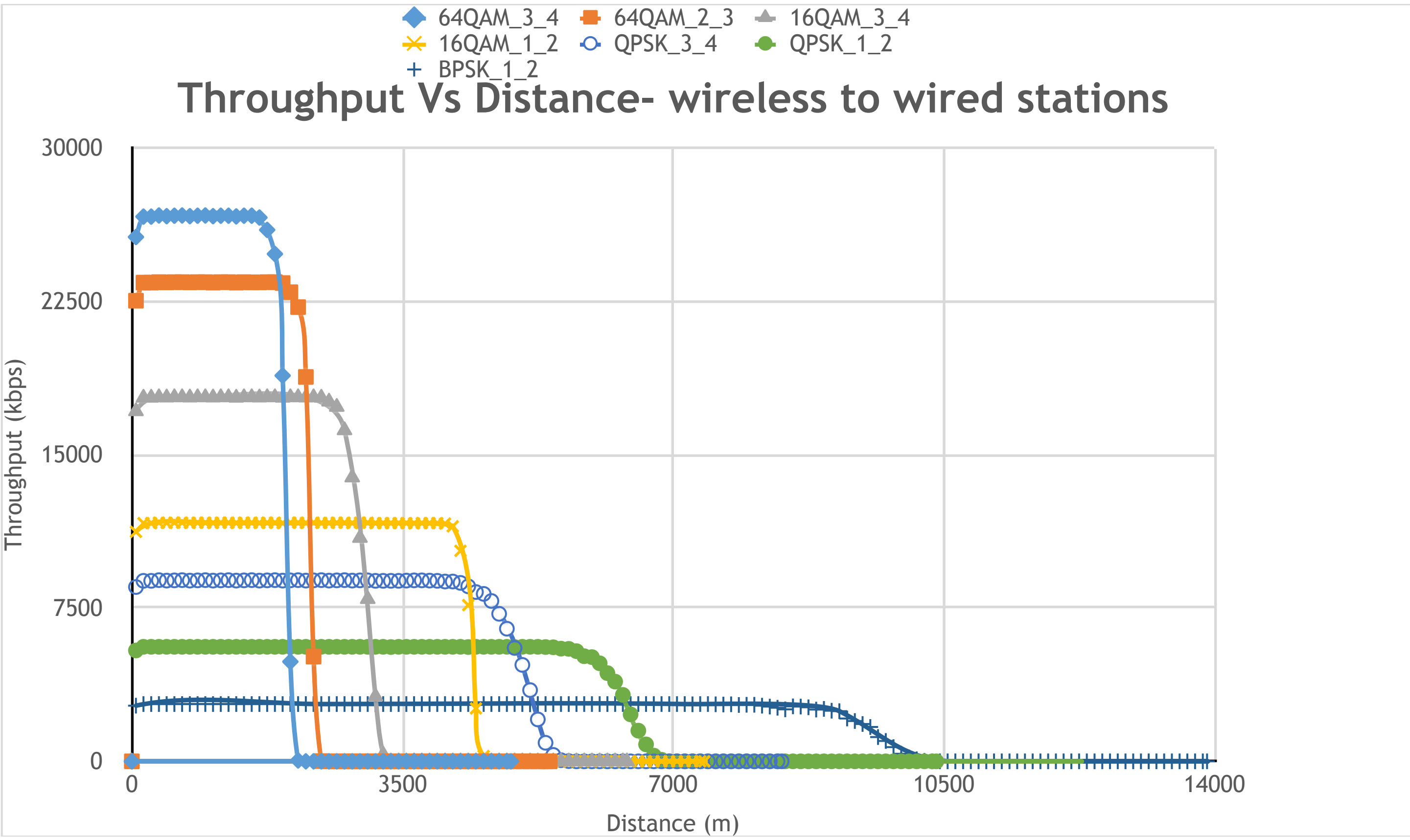

Fig 3: Wireless to Wired Stations – Throughput Vs Distance - Frequency Bandwidth: 10MHz

In this Lab 2, we change the traffic direction from wireless to wired stations (0) and perform steps similar to lab 1. The above fig 3, shows the obtained results.

Difference in result in Lab 2 vs Lab 1: Comparing the fig 2 & 3, we note there is a difference in communication distance between the 2 scenarios.

For example:

In Lab 1, for 64QAM3/4 modulation, the communication distance where the throughput becomes zero first is 2850.03.

In Lab 2, for 64QAM3/4 modulation, the communication distance where the throughput becomes zero first is 2250.13.

Thus, while comparing Fig 2 and Fig 3, we can see that for the same modulation technique, the communication distance is greater in Lab1 i.e. in wired to wireless than in Lab 2 i.e. in wireless to wired stations.

<u>Reason for larger communication distance in Lab 1 (wire2wireless):</u>

In general wired stations have dedicated resources, therefore it has better throughput compared to wireless station. Thus when the traffic direction is wireless2wire, it results in larger throughput.

However, wired stations can cover only shorter ranges compared with a wireless station. Thus, when the traffic direction is wireless2wire, the communication distance is lesser compared with that of wire2wireless station.

Lab 3: Throughput Vs Distance -Wireless to Wired Stations - High Frequency Bandwidth

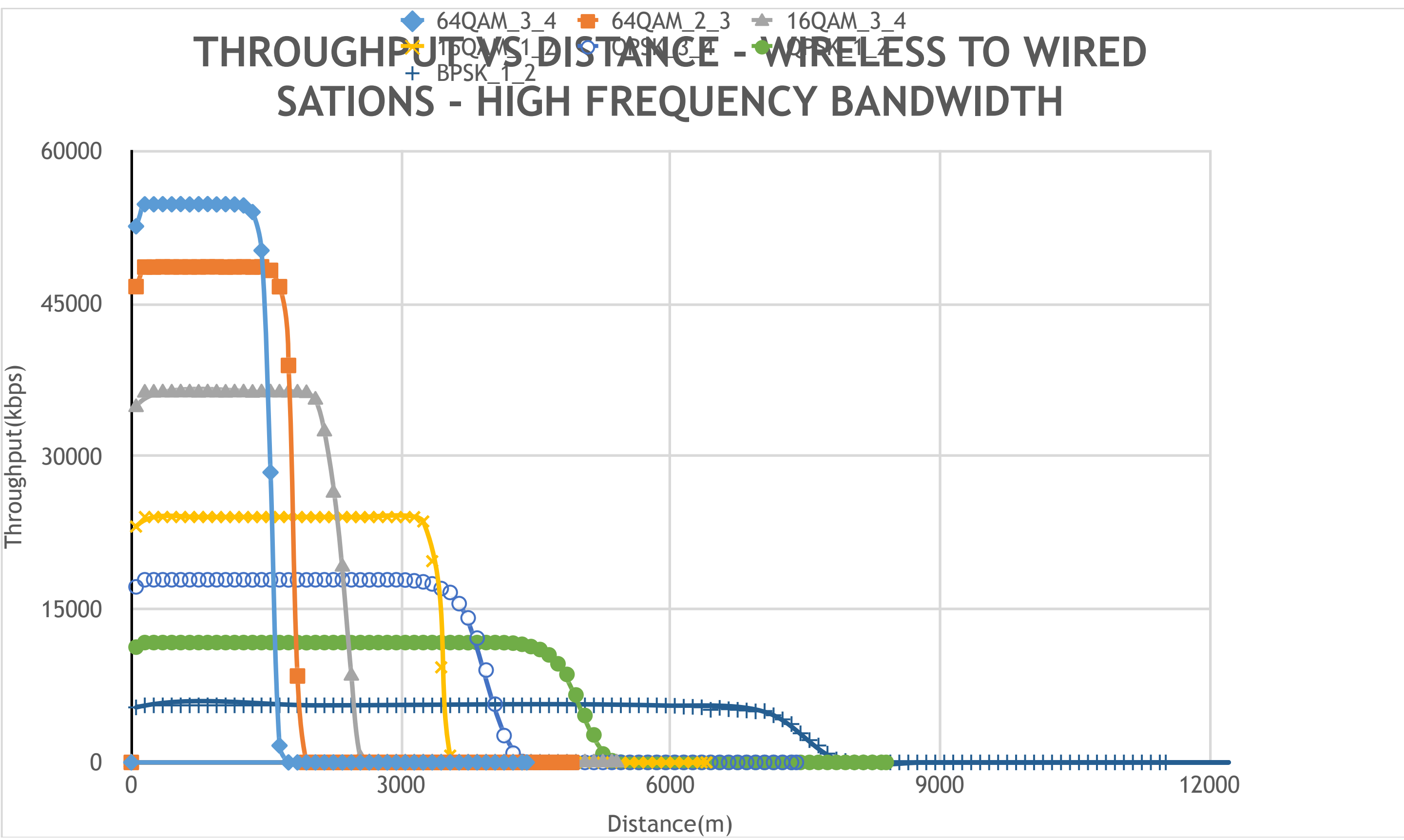

Fig 4: Wireless to Wired Stations – Throughput Vs Distance – Frequency Bandwidth: 20MHz

Fig 4 shows the results obtained for Lab 3, where the traffic rate is increased and the frequency bandwidth is doubled from 10MHz to 20MHz.

<u>Differences in the obtained results – comparing Lab 3 with Lab 2:</u>

When we compare the results obtained from Lab 3 (Fig 4) with Lab 2 (Fig 3), there is differences in both Throughput and Distance.

The throughput is almost doubled in Lab 3 from Lab 2. But on the other hand, the communication distance is lesser in Lab 3 compared to that of Lab 2.

Reason for difference in both throughput and distance performances between Lab 3 & Lab 2:

In Lab 3, since the frequency is doubled, there are more available resources. This results in increased throughput.

However, in lab 3 the traffic rate is also increased. This means that more channels want to access the resources. This eventually leads to decrease in communication distance.

CONCLUSION:

Overall the maximum throughput is obtained in lab 3(wireless2wire) followed by lab 2 (wireless2wire – high frequency) and the minimum in lab 1(wire2wireless). Longer distance is achieved in lab 1 followed by lab 2 and minimum in lab 3.

Thus using NS2 simulation the change in the performances in terms of throughput and distance in wired to wireless scenario and wireless to wired scenario were studied. Effects of increasing the frequency and traffic rate on throughput and distance were also noted.