School of
Applied Computing

Network Simulation

NetSim

Exercise 3

Faculty of Architecture, Computing and Engineering

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3. Study how the Data Rate of a Wireless LAN (IEEE 802.11b) network varies as the distance between the Access Point and the wireless nodes is varied

3.1 Theory:

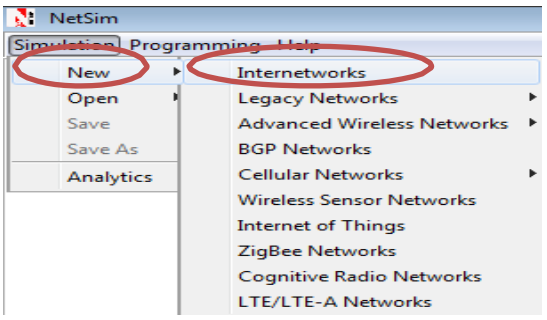
In most of the WLAN products on the market based on the IEEE 802.11b technology the transmitter is designed as a Direct Sequence Spread Spectrum Phase Shift Keying (DSSS PSK) modulator, which is capable of handling data rates of up to 11 Mbps. The system implements various modulation modes for every transmission rate, which are Different Binary Phase Shift Keying (DPSK) for 1 Mbps, Different Quaternary Phase Shift Keying (DQPSK) for 2 Mbps and Complementary Code Keying (CCK) for 5.5 Mbps and 11 Mbps.

Large Scale Fading represents Receiver Signal Strength or path loss over a large area as a function of distance. The statistics of large scale fading provides a way of computing estimated signal power or path loss as a function of distance and modulation modes vary depends on the Receiver Signal Strength.

3.2 Procedure:

Please navigate through the below given path to,

Go to Simulation → New → Internetworks



Sample Inputs:

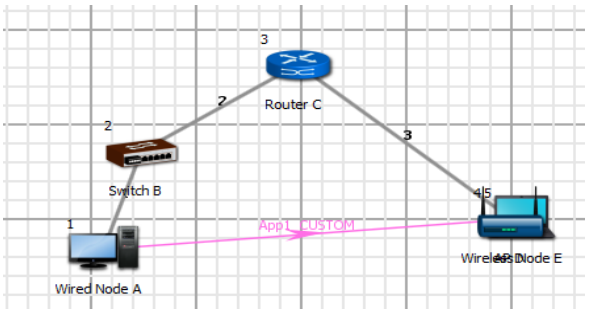
Follow the steps given in the different samples to arrive at the objective.

In Sample 1,

- Total no of APs (Access Points) used: 1
- Total no of Wireless Nodes used: 1
- Total no of Routers used: 1

- Total no of Switches used: 1
- Total no of Wired Nodes used: 1

The AP, Wireless Nodes, Router, Switch and Wired Nodes are interconnected as shown:



Also edit the following properties of Wireless Node E:

Wireless Node E Properties	
X/Lat	355
Y/Lon	150
Interface_Wireless properties	
RTS Threshold(bytes)	2347
Retry Limit(DataLink_Layer)	7
Rate _Adaptation	GENERIC

Edit all link properties as shown:

Wireless Link Properties	
Channel Characteristics	Fading only
Path Loss Exponent	2.5
Fading Figure	1.0

Wired Link Properties	
Uplink Speed (Mbps)	100
Downlink Speed (Mbps)	100
Uplink BER	0
Downlink BER	0

Also edit the following properties of Wired Node A:

Wired Node A Properties	
TCP	Disabled

Set the properties of Access Point as follows:

Access Point Properties	
X/Lat	350
Y/Lon	150
Interface_Wireless properties	
Buffer Size(MB)	5
RTS Threshold(bytes)	2347
Retry Limit	7

Click and drop the Application, set properties and run the simulation.

Application Properties	
Application Type	Custom
Source_Id	1
Destination_Id	5
Packet Size	
Distribution	Constant
Value (bytes)	1460
Packet Inter Arrival Time	
Distribution	Constant
Value (micro secs)	900

Simulation Time - 10 Sec

(**Note:** *The Simulation Time can be selected only after the following two tasks,*

- *Set the properties for all the devices and links.*
- *Click on Run Simulation button***.**

Upon completion of the experiment, ‗Save‖ the metrics result for comparison by using Export to Excel . Save the excel file in any user defined location.

- **Sample 2**: Distance from Wireless Node E to Access Point is 10m.
- **Sample 3**: Distance from Wireless Node E to Access Point is 15m.

……. And so on till 55 meter distance.

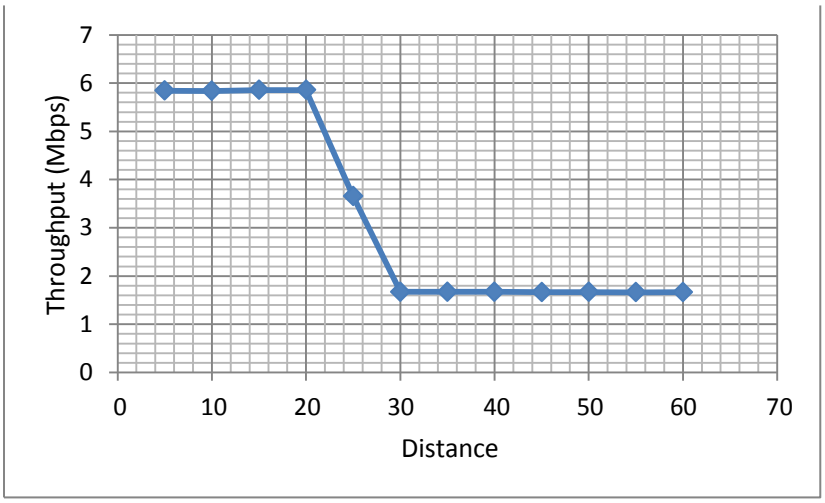
3.3 Output:

Go to Application Metrics and obtain Throughput value for all the samples from the saved Excel files and make a comparison chart as shown. Use Excel ‗Insert →Chart‖ option and then select chart type as ‗Line chart‖.

Comparison Chart:

Distance (m)	Throughput (Mbps)
5	5.843504
10	5.837664
15	5.85752
20	5.85635
25	3.65467
30	1.67024
35	1.69907
40	1.69907
45	1.66556
50	1.66790
55	1.65972
60	1.66323

3.4 Inference



*** All the above plots highly depend upon the placement of nodes in the simulation environment. So, note that even if the placement is slightly different, the same set of values will not be got but one would notice a similar trend.

We notice that as the distance increases, the throughput decreases. This is because the underlying data rate depends on the received power at the receiver. Received power is directly proportional to (1 / distance).

In 802.11b, four data rates, 1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps, are supported. The rate is decided based on the received power and the errors in the channel. Note a higher data rate does not necessarily yield a higher throughput since packets may get errored. Only when the channel conditions are good, does a higher data rate give a higher throughput. In a realistic WLAN environment, the channel condition can vary due to pathloss, fading, and shadowing. In NetSim to accommodate different channel conditions, rate adaptation is commonly employed. The **rate adaptation algorithms dynamically adjusts the modulation mode and data rate to optimize performance when channel condition changes**. So, when NetSim detects that the number of errors in the channels are high, it automatically drops down to a lower rate.

In addition, one must note that WLAN involves ACK packets after data transmission. These additional packet transmission lead to reduced Application throughput of 5.5 Mbps (at 1 – 20 mts range) even though the PHY layer data rate is 11 Mbps.