Department of Computer Science, Electrical and Space Engineering

Advanced Wireless Networks

Lab 4 - Measuring performance of an Ad Hoc network

Ameer Hamza, Otabek Sobirov

18th October 2021

Objective:

Study how the various packet size and number of stations affect wireless radio transmission and the application-level performance.

Scenario 1 – The effect of signal attenuation on communication ranges in WiFi networks

In this exercise you will explore multi-hop transmission in Ad Hoc network for different numbers of hops (Figure1).

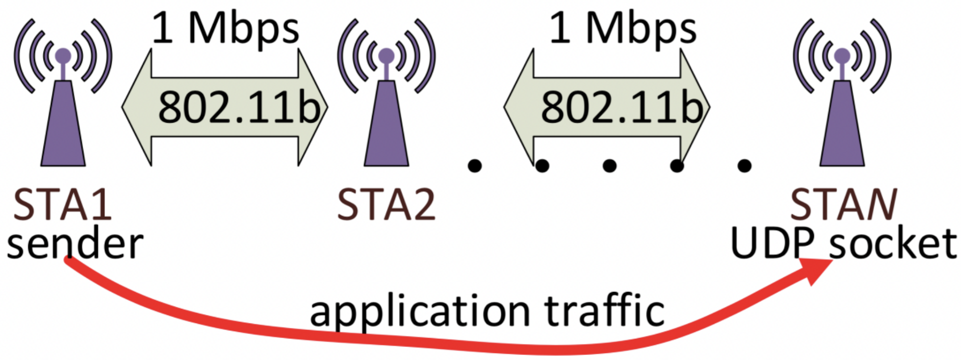

Figure 1. Topology for Scenario

Tasks:

1. Based on your experience from previous Labs, fill in missed parts for Ad hoc scenarios. Use the following settings:

• Physical mode is "DsssRate1Mbps"
• Use "ns3::ConstantRateWifiManager" for keeping bit rate constant
• The MAC settings should be set to agree with the IEEE 802.11b specification.
• Use Two-Ray Ground propagation model
• Place nodes in a line in such a way that only adjacent stations can hear each other. Keep 200m distance between nodes
• Always open socket on the last station
• Always install onOff application on the first station
• Enable routing between stations

2. Simulate scenario for different number of stations [3, 4, 5,6].

3. Also vary the UDP payload in the range {300B, 700B, 1200B}.

4. For EACH number of stations from the range run experiment with EVERY packet size. Calculate an application level throughput in bits per second.

5. Plot graphs showing the dependency of the throughput versus packet size for each number of stations.

6. Plot a graph showing the dependency of the throughput versus number of stations for packet size 1200B.

7. Compare the nominative bitrate of the physical layer and real throughputs on the application layer. Be able to explain dependencies on your plots.

8. Reflect (speculate) on how one can theoretically predict the best packet size in order to minimize transmission time for 1GB of data in an Ad Hoc multi-hop scenario.

9. Change type of traffic to TCP, i.e. uncomment corresponding part of code for the TCP socket and delete the UDP socket. Simulate scenario for 3 stations and two different lengths of packets 300B and 1200B. Calculate application level throughput for stations 3. Compare results with corresponding values for UDP traffic. Draw your conclusions

----

In this lab experiments are conducted to analyze how throughput varies with number of hops, and payload size.

Nodes	Payload (Bytes)	Throughput (Kb/s)	App. Throughput (Kb/s)
3	300	272	224.18
	700	222	203.40
	1200	311	295.25
4	300	203	167.31
	700	219	200.65
	1200	189	179.43
5	300	137	112.91
	700	134	122.77
	1200	128	121.52
6	300	107	88.19
	700	54	49.48
	1200	107	101.58

Figure 1: Throughput vs Number of hops & Payload size

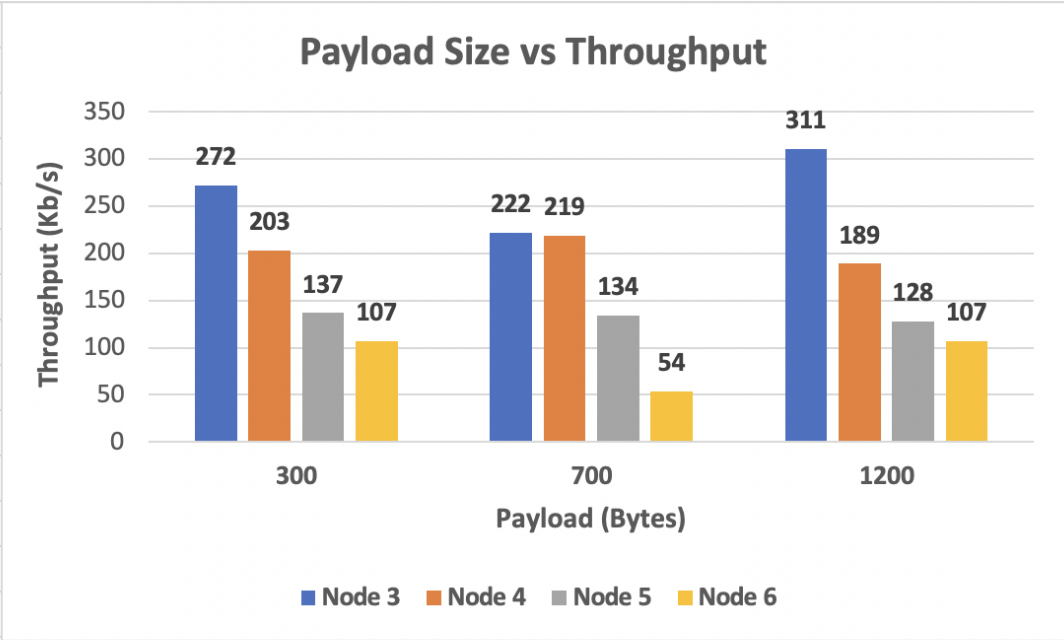

Figure 2

The graph in figure 2 shows as the number of hops (or nodes) are increased between sender and receiver, throughput decreases. This difference is much more visible when the payload size of 300 Bytes is used.

Nodes	Throughput (Kb/s)
3	311
4	189
5	128
6	107

Figure 3: Throughput comparison for payload size of 1200 bytes

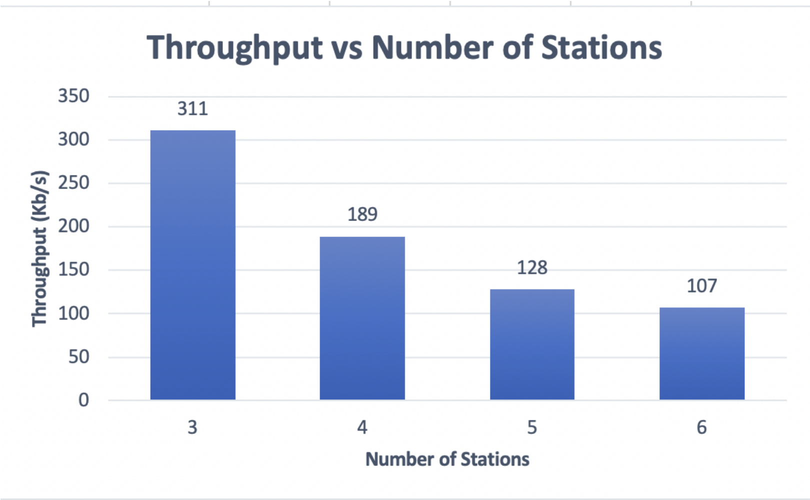

Figure 4:

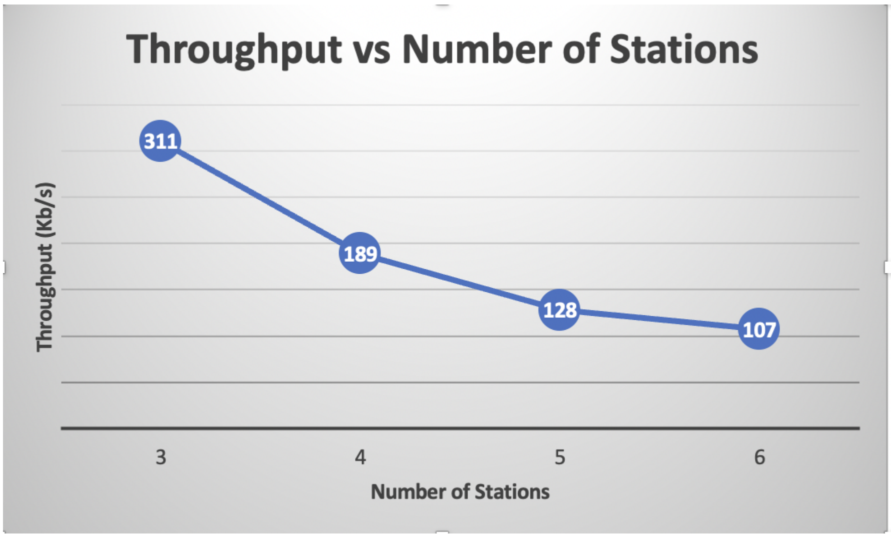

Figure 5:

Figure 4 & 5 shows that as the number of hops are increased, throughput decreases.

Task 7: The available bandwidth between 2 nodes on the physical layer is 1 Mbps (1000 Kbps), however the above figures shows that the actual throughput is much lower. The maximum throughput above is 311 Kbps. This is because as the distance between the nodes increases due to signal attenuations, collisions, interference and errors throughput decreases. Moverover, for payload size MTU value is not used, hence there is additional overhead in sending the data.

Task 8: Considering the above experimental data we can deduce that packet size and distance affect the transmission time. Generally larger packet size has higher throughput. Theoretically we can use the MTU value of the slowest link in the network to reduce the transmission time. This will avoid segmentation and hence reduce the overhead. Moreover, this will work only if the nodes are close to each other. As the distance between nodes increases it becomes extremely difficult to predict anything due to many variables.

Nodes	Payload (Bytes)	TCP		UDP	
		Throughput (Kb/s)	App. Throughput (Kb/s)	Throughput (Kb/s)	App. Throughput (Kb/s)
3	300	279	222.61	272	224.18
	1200	279	262.38	311	295.25

Figure 6:

Task 9: Figure 6 shows the comparison of application throughput between TCP and UDP. When UDP is used for transmission, application throughput is higher as compared to when TCP is used. This is because TCP has a higher header size than UDP. Moreover, TCP throughput did not change even if we changed the payload size.

https://networkengineering.stackexchange.com/a/8293