CEG-7450-Advanced Computer Networks

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LAB-2 Experimenting with 802.11 DCF WLAN Network Performance

SUMMARY:

The purpose of the lab is to study the throughput variation when the channel conditions vary in the 802.11 DCF WLAN network. In order to achieve this, we use the ns-3 simulator. In the study on the throughput according to the packet size change and the nodes in communication, the simulations are resulted by modifying the parameters in the distributed algorithms which are written in C++ programming language.

The entire lab is worked on the NS-3 simulator which is a discrete-event network simulator. It allows generating the simulations by changing the parameters which could usually provide a different experimental scenario to understand the simulation core and models. Besides, the NS-3 simulator allows to change and identify the potential values and hence could configure the settings to generate the new simulation results. In this lab, we used the script file wifi-pcf.cc to make changes to the packet size and the node stations furthermore the NetAnim tool which is an offline animator based on the Qt toolkit is used to animate the simulation using an XML trace file collected during the simulation generated under various scenarios which are discussed in the below sections.

IMPLEMENTATION

The simulation results are carried under different scenarios by varying packet size and the transmission nodes i.e. the simulation results are generated by changing the transmission nodes from 2, 5, 10, 15 nodes and keeping the packet size constant at 1472 bytes then in the other scenario the packet size are varied from 1472, 2400, 3500, 5000 bytes by maintaining a constant node of 5 nodes. In both scenarios we modify the parameters in the C++ program by adjusting the attributes then accordingly simulation results are drawn and analysed.

TECHNICAL WORKFLOW:

1. The script we are using for simulation is wifi-pcf.cc. For a file to run we need to place the file in the scratch directory. So, we copy wifi-pcf.cc to scratch folder in /ns-allinone-3.30.1/ns-3.30.1 directory
2. We run the script using the waf command
   ./waf –run scratch/wifi-pcf
3. We run NetAnim tool from the netanim-3.108 directory inside the ns-allinone-3.30.1 folder. We start the tool using the following commands
   a. $ make clean
   b. $ qmake NetAnim.pro
   c. $ make
   d. $ ./NetAnim
4. We supply the .xml file obtained by running the ./waf command by opening the .xml file from the ns-allinone-3.30.1 folder to see the animation.

SCENARIOS AND VALIDATIONS: We change the packet size and the node station in wifi-pcf.cc to get the simulation results of the throughput change under each scenario in DCF WLAN Network.

SCENARIO 1 PACKET SIZE@ 1472 BYTES: With constant packet size at 1472 bytes we simulate 4 below results to understand the throughput by setting ***Uint32_t nWifi = 5;*** in wifi-pcf.cc. The 4 different simulation scenarios are

- 2 nodes transmitting packet size of 1472 bytes
- 5 nodes transmitting packet size of 1472 bytes
- 10 nodes transmitting packet size of 1472 bytes
- 15 nodes transmitting packet size of 1472 bytes

SCENARIO 2 NODE NUMBER@ 5: With constant number of nodes involved in the DCF WLAN Network at 5 and changing packet size we plot 4 below different simulation results by setting ***onOffHelper.SetAttribute ("PacketSize", UintegerValue(2400));***.The 5 different simulation plot properties are.

- 1472 bytes of packet size being transmitted by 5 nodes
- 2400 bytes of packet size being transmitted by 5 nodes
- 3500 bytes of packet size being transmitted by 5 nodes
- 5000 bytes of packet size being transmitted by 5 nodes

SIMULATION RESULTS

Scenario 1: Setting the packet size to 1472 bytes and changing the number of the nodes.

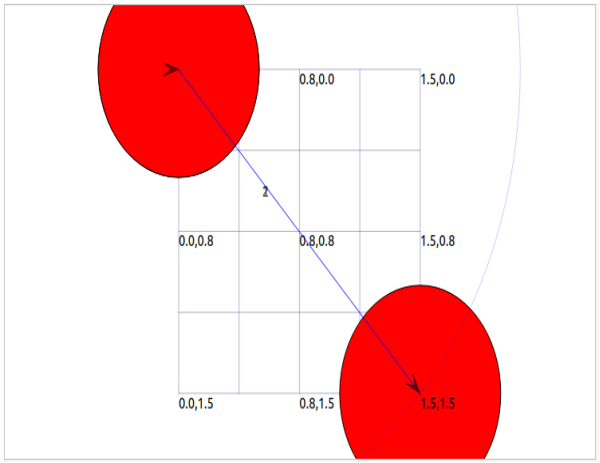

Figure 1: 2 nodes

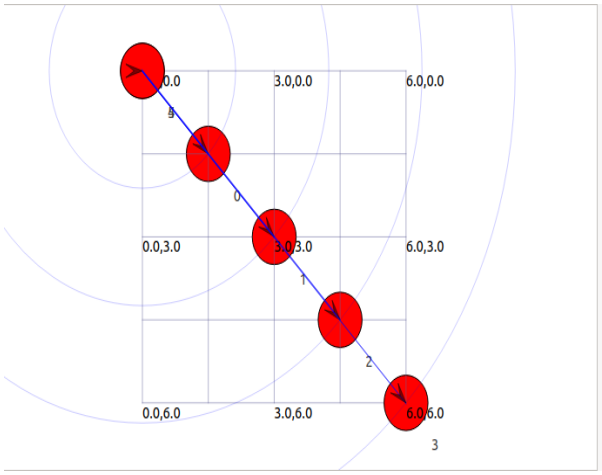

Figure 2: 5 nodes

In the above Figure 1 and Figure 2 at different nodes at 2 and 5 the throughput of the network varies very slightly i.e. from **0.998605 Mbit/s** to **0.995072 Mbit/s**. We observe that although the nodes are increased the throughput seems to decrease slightly which is expected and the ideal behaviour of the DCF WLAN Network.

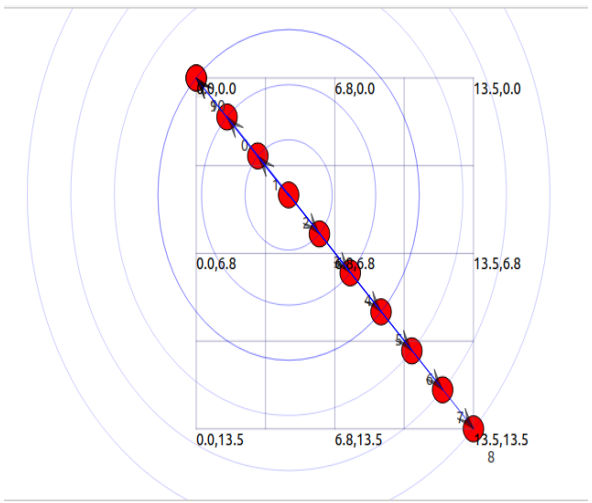

Figure 3: 10 nodes

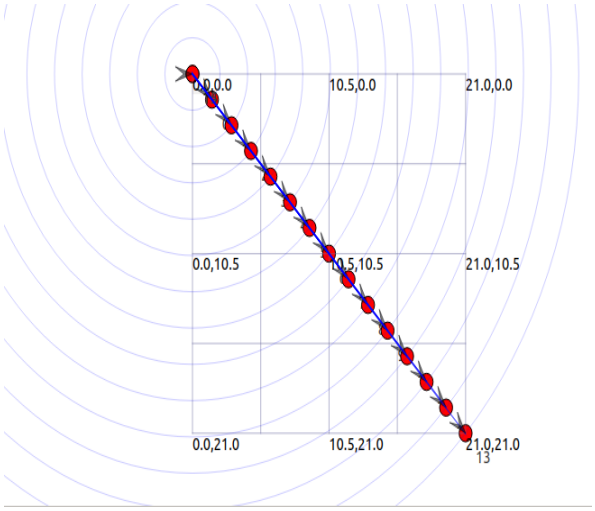

Figure 4: 15 nodes

However, in comparison to Figure 3 referring to the throughput of **0.989184 Mbit/s** at 10 nodes, 1472 packet size, and Figure 4 referring to the throughput of **0.791347 Mbit/s** at 15 nodes has much difference in the performance of the DCF WLAN Network. Thus, proving the fact that the number of nodes in the networks increases the communication among the nodes becomes difficult for the same packet size of data since every node must have the same packet synchronization among all nodes.

Throughput Simulation Results for scenario 1:

No. nodes	Packet size (bytes)	Throughput (Mbit/s)
2	1472	0.998605
5	1472	0.995072
10	1472	0.989184
15	1472	0.791347

Scenario 2: Setting the number of nodes to 5 and changing packet size.

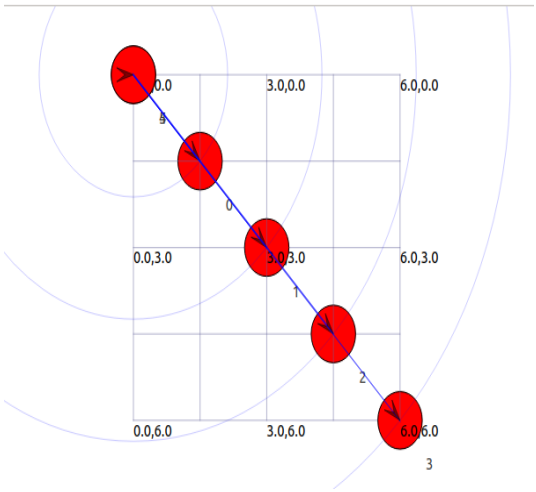

Figure 5: 1472 bytes

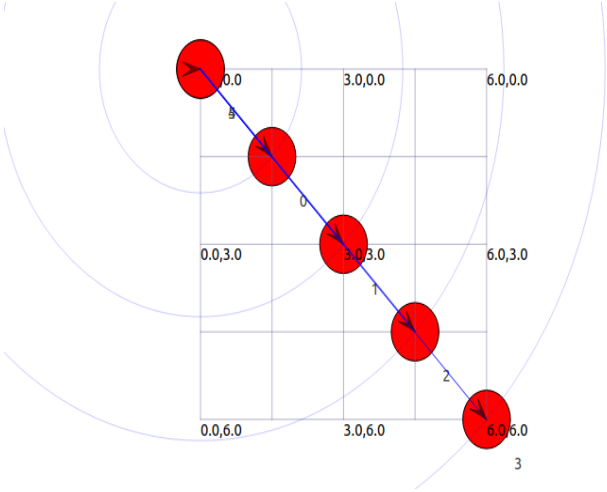

Figure 6: 2400 bytes

In Figure 5 and Figure 6 we could conclude that the increment in the packet size from 1472 bytes being transmitted among 5 nodes to packet size of 2400 bytes being transferred will increase the performance i.e. the throughput of the DCF WLAN network increased from **0.995072 Mbit/s** with 1472 bytes scenario to **0.9984 Mbit/s** in 2400 bytes of packet size transfer. It is evident that during the initial changes in the packet size at constant node size the throughput increases, however, this should be true for increased packet size case as per the theoretical evaluation which will be revealed in the below scenarios.

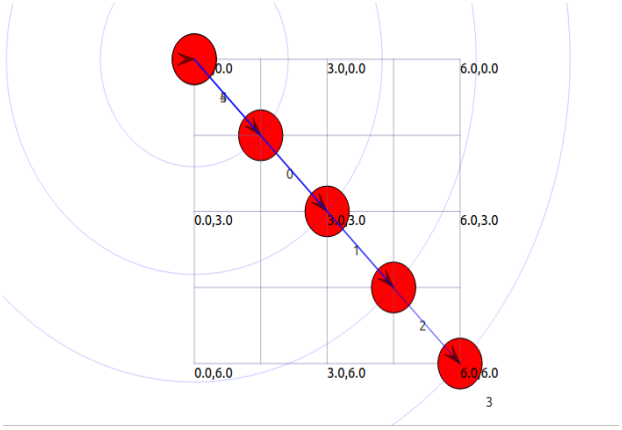

Figure 7: 3500 bytes

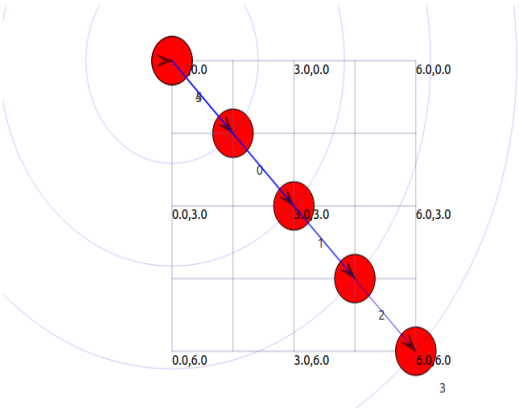

Figure 8: 5000 bytes

Similarly, in the case of Figure 7 i.e. with 3500 bytes of packet size, the throughput is **0.994 Mbit/s** and in Figure 8 with 5000 bytes of packet size with the number of nodes being 5 the throughput of **0.98 Mbit/s** in the DCF WLAN network, the throughput decreases as the packet size increases and the nodes transmitting the packets to the access points will eventually take time to reach the destination node or access point.

Throughput Simulation Results for scenario 2:

No. nodes	Packet size (bytes)	Throughput (Mbit/s)
5	1472	0.995072
5	2400	0.9984
5	3500	0.994
5	5000	0.98

CONCLUSION

This exercise helped me in understanding the behaviour of throughput of the DCF WLAN network under different scenarios like varying parameters like packet size and the number of nodes involved in the transmission of packets to the access points. The simulation results prove the theoretical fact that the throughput decreases when the number of nodes is increased and decreases when the packet size is also increased. Comparatively, the throughput declines a lot when the number of nodes transmitting the packet increases when compared to the packet size increment. Nonetheless, the DCF WLAN network doesn't consider the packet payload size i.e. packets transmitted by each node station and resulting in loophole attribute i.e. byte throughput. Thus, the fact that the DCF doesn't provide Quality of Service. The network throughput of the DCF WLAN Network can be improved when the above scenarios are being considered and respective enhancements are being made to the network protocols would improve the performance and could be used in real-world applications.