DYNAMIC PERFROMANCE OF AN ENHANCED COOPERATIVE STRATEGY FOR QOS IMPROVEMENT IN WLAN

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Abstract— In Wireless Local Area Network, wireless node will suffer due to the hidden terminal node. This hidden terminal node leads to high collision, high drop rate of packets and high delay. To avoid this hidden terminal node, wireless nodes use the control messages to know the status of the destination nodes. Another issue in the WLAN is less coverage range with lesser number of nodes. To increase the more number of users as well as the Quality of Services in the Wireless Local Area Network, a new scheme as an Enhanced Cooperative Strategy for QoS Improvement (ECQI) is proposed. This proposed Enhanced Cooperative Strategy for QoS Improvement scheme uses the cooperative nodes between the source and destination node. Source node selects the Least Hop Count (LHC) path to transmit the data. Each cooperative node will amplify and forward the data. After every data transmission, transmitter node will wait for the acknowledgment. If the acknowledgment is not received within a particular threshold time interval, cooperative node will selects an alternate path based on the Least Hop Count path. Experimental results analyze the overall network performance using the Quality of Service parameters such as throughput, delay, drop rate, delivery rate, collision probability and network efficiency. The proposed Enhanced Cooperative Strategy for QoS Improvement scheme will increase the delivery rate, throughput, network efficiency and decreases the delay, drop rate and collision probability.

Keywords- QoS ; Least Hop Count; throughput ; collision ; ECQI

I. INTRODUCTION

Busy Tone Based Cooperative Medium access control protocol (BTCM) is used in the Wireless Local Area Network [1]. This MAC protocol will use the cooperative nodes during the busy medium between the source and destination. If the source node gets a busy tone, source will transmit the data using the cooperative nodes to the destination node. This Busy Tone Cooperative Medium access control protocol reduces the drop rate. This MAC protocol will avoid the hidden terminal problems. Mostly this hidden terminal node degrades the network performance of the Wireless Local Area Network. The hidden terminal node makes high collision which in turn increases the drop rate. If the channel medium is busy, BTCM protocol uses the cooperative nodes to make the efficient communication between the source and destination. Another technique that is used for effective communication in Wireless Local Area Network is Network Coding Cooperative Communication (NCCC) to make the effective network performance [2]. Network Coding Cooperative Communication scheme uses the ACK triggering method to solve the issues occurring because of more number of the control messages. The control messages are used to know the status of the successful data transmission and channel medium. After transmitting the data, transmitted node will get the acknowledgement. Based on the acknowledgement, transmitted node will decide the successful transmission occurring between the transmitter and receiver node. ACK triggering method will force to send the acknowledgment after every data transmission which reduces the drop rate but increases the delay and control overhead.

II. METHODOLOGY

Wireless Local Area Network is connecting the wireless nodes within the limited coverage area and lesser number of users. To increase the users and coverage range of the entire network, we can apply the cooperative communication [3]. In cooperative communication, intermediate nodes act as relay nodes. These relay nodes help the cooperative communication in the Wireless Local Area Network. This cooperative communication improves the performance quality of the network, throughput and reliability in the wireless network. In cooperative communication, cooperative nodes will amplify and forward the data and also decode and forward the data. Due to the amplifying process it can boost up the data and save it from fading. This cooperative communication reduces the spatial diversity and fading in the

wireless network. Cooperative nodes can secure the data by using the decoding process. But this cooperative node uses more number of control messages to know the status of the data transmission. After transmitting the data to other cooperative nodes, first cooperative node will wait for the acknowledgement. If the data transmission fails, it will not receive any acknowledgment from the relay nodes. Cooperative nodes start the retransmission until it gets the positive acknowledgement from the respective cooperative nodes. Due to this acknowledgement and retransmission, routing overhead, traffic rate and collision probability will increase.

III. PROPOSED SCHEME

The proposed scheme is Enhanced Cooperative Strategy For Qos Improvement (ECQI) in the Wireless Local Area Network. This proposed scheme uses the cooperative communication between the wireless nodes in the WLAN. This has three different strategies to achieve the high network performance. Wireless node has multiple paths to transmit the data. Initially source node transmits the data to the destination based on less number of hop counts. Source nodes select the cooperative node whose path has lesser number of hop counts. Second step is cooperative node uses the control messages to transmit the data and waits for the acknowledgment until particular threshold limit. If the acknowledgment is not received within that particular threshold time interval, that cooperative node will select an alternate path with lesser number of hop counts between the destination nodes. This will improve the QoS requirement in the Wireless Local Area Network. This proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme starts to select the cooperative nodes between the source and destination node. After that selection, the shortest path based on the lesser number of hop counts is selected. Source node will initiate the transmission between the cooperative nodes. Each cooperative node will amplify and forward the data and waits for the acknowledgment until the threshold time interval. If the acknowledgment is received, data transmission is successful between the source and destination node. If the acknowledgment is not received, cooperative node will select an alternate path with lesser number of hop counts. That alternate shortest path makes successful transmission between the source node and destination node which will reduce the degraded network performance and increase the Quality of Services.

A. Network Architecture

This proposed Enhanced Cooperative Strategy for QoS Improvement scheme uses the independent distributed network. The subset of vertices V is denoted as S and the graph G which has no independent set is denoted as S`. S (V) is called independent set of G and every edge has connected at least at one end in the vertices and that will be a vertex cover denoted as C.

Theorem 1: A set S subset of V is an independent set of G if and only if V\S is having the covered vertices of C.

Proof: Generally Graph contains edges and vertices and this G does not have any edges and it does not have the ends. If the G has only one edge and the edge has two ends and one of the ends is covered vertices of C. i.e. At least one edge is connected to one of the vertices. Without vertices, edge will not be created in the graph G. So this G graph is an independent set and if V\S is a covering of G.

The number of vertices is maximum independent set is denoted as X and the minimum covering in the independent set of G is denoted as Y.

$$X + Y = \gamma \text{ [}\textbf{Corollary}\text{ 1]}$$

Here S has maximum independent set of G which is denoted as V\C and C has minimum covering of G and it is denoted as V/S. This has to be proved in the above theorem. V\C is an independent set and it is also called as X. V/S is a covering and it is denoted as Y.

$$\gamma - Y = V/C \leq X$$

$$\gamma - X = V/S \geq Y$$

Combining the above two equations

$$\gamma = X + Y$$

Hence these above statements states that the maximum independent set of G and the minimum covering of G is in the independent set of the graph G.

Based on the above statement, the edges and vertices are connected in the graph. In this network, each edge is connected to at least one end of the vertices V. Figure 1 shows the network architecture with vertices and edges. Each edge is connected to at least two vertices in the distributed graph.

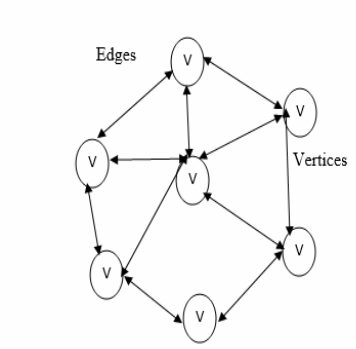

Figure 1 Network Architecture

B. *ECQI Scheme*

Figure 2 shows the ECQI [Enhanced Cooperative Strategy For Qos Improvement] scheme and it consist of source node, destination node and cooperative nodes. Source node will find the Least Hop Count (LHC) path between the source and destination node. Source node will transmit the data through the cooperative nodes to the destination node. In figure 6.2, source node has four possible paths in between the source node and destination node. In those four possible paths, source node will select the Least Hop Count (LHC) path to transmit the data. Then source node starts to transmit the data to the destination node through the cooperative nodes. Cooperative node will amplify and forward the data between the intermediate nodes. After transmitting the data, cooperative node will wait for the acknowledgment until a particular threshold time interval. If acknowledgment is not received within the particular threshold time limit, cooperative selects an alternate path with the Least Hop Count (LHC). After transmitting the data, cooperative node will get the acknowledgment. After getting the acknowledgment that transmitted data will be amplified and forwarded to the destination node. This proposed Enhanced Cooperative Strategy For Qos Improvement scheme reduces the collision probability, drop rate, delay and increases the throughput, network efficiency and delivery rate.

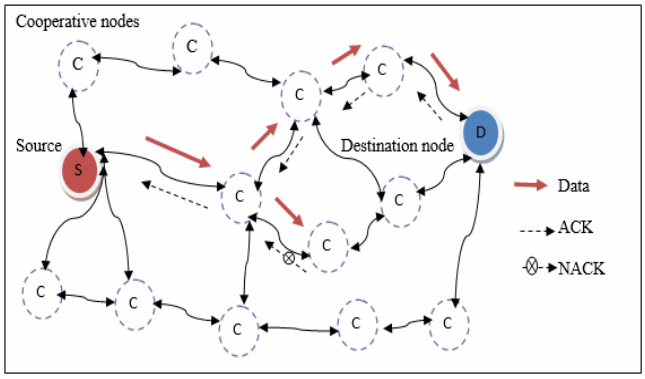

Figure 2 ECQI scheme

C. *Algorithm*

1. Create G (V, E) by theorem 1.
2. E should be connected to at least one vertex.
3. Assign S as V_1 \\ Source node
4. Assign D as Vn. \\ Destination node
5. Cn={V_2,V_3,…….., Vn} // Cooperative nodes
6. S selects LHC path // least hop count
7. S → Cn→ D
8. Cn→ "D" → Cn+1
9. Cn ← "A" ← Cn+1
10. If Cn+1 != A
11. Cn selects LHC path
12. Repeat step 8 to step 9
13. Until reaches D

The algorithm states the process of an Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme. Initially, the network will be created based on the theorem 1. It assign the source node and destination node. Remaining nodes will act as cooperative nodes which are used to amplify and forward the data. Source node selects the Least Hop Count LHC path and source node will transmit the data to the destination node through the cooperative nodes. The source will forward the data to the cooperative node and this cooperative node will amplify and forward the data to another cooperative node. After transmitting the data, cooperative node should get acknowledgment within a particular time interval. If the cooperative node does not receive the acknowledgment within the threshold time level, this cooperative node will select an alternate path with Least Hop Count (LHC). Using an alternate cooperative node the data will be transmitted to the destination node and it makes the successful transmission.

IV. RESULTS AND DISCUSSION

Experimental results analyze the performance of the proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme using the Quality of Service parameters such as routing overhead, collision probability, delay, throughput, delivery rate and network efficiency. The PHY layer and MAC layer is assigned for the Wireless Local Area Network is wireless medium and wireless channel propagation respectively. The topography size of the Wireless Local Area Network is 1000*1000meters. The simulation time for the proposed Enhanced Cooperative Strategy for QoS Improvement scheme is 200 seconds. The transport layer is using the User Datagram Protocol UDP and the data packets have constant bit rate. The data packet size is 1000 bytes per second and the queuing packet is preferred as priority queue. This has been analyzed using the Network Simulator that generates the network animation window within trace file. From the trace file we can extract the required data and plot the respective graphs using the awk file. Simulation results

performed on the existing techniques such as Busy Tone Based Cooperative Medium access control protocol (BTCM), Network Coding Cooperative Communication (NCCC) and proposed technique as an Enhanced Cooperative Strategy For Qos Improvement (ECQI) in two different stages such as stable node and mobile nodes. In stable node condition, all the nodes should act as stable nodes and the mobile condition, all the nodes in the network will act as mobile nodes.

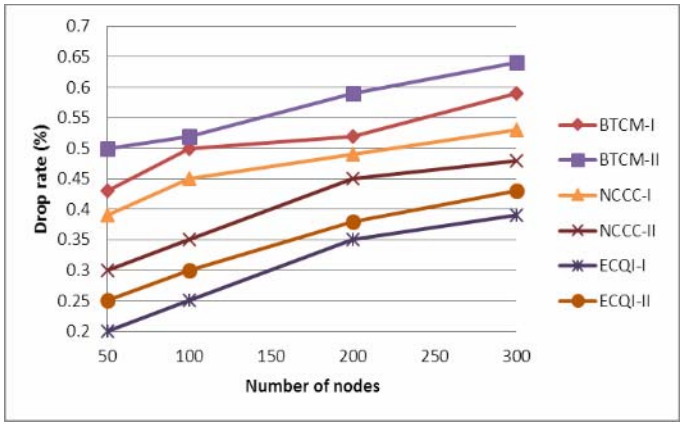

Figure 3 Drop Rate

Figure 3 shows the drop rate analysis that is defined as the ratio of number of packets received to the difference between the number of packets sent and number of packets received. The existing technique which is Busy Tone Based Cooperative Medium access control protocol (BTCM) and Network Coding Cooperative Communication (NCCC) has high drop rate due to the high collision in the network. But the proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme has low drop rate of only 39% to 43% with the help of cooperative nodes.

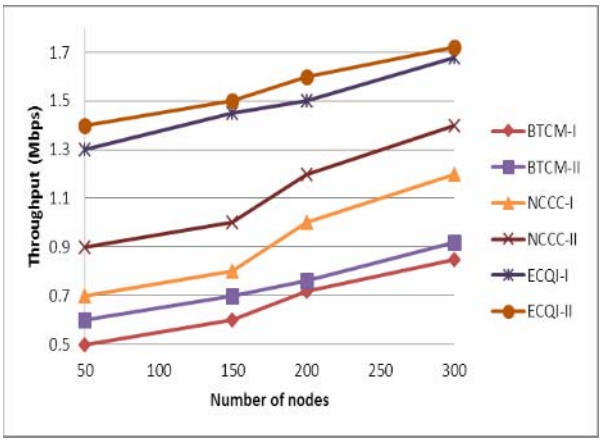

Figure 4 Throughput Analysis

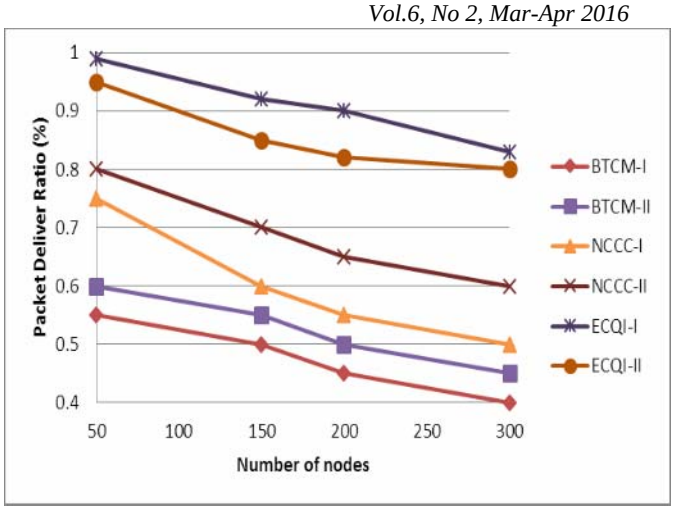

Figure 5 Packet delivery ratio

Figure 4 shows the throughput analysis and it is defined as the ratio of number of packets received to the simulation time. Throughput analysis is based on the utilization of channel bandwidth and here available channel bandwidth between the wireless nodes is 2Mbps. The existing busy tone based cooperative medium access control protocol (BTCM) and network coding cooperative communication (NCCC) techniques has low throughput. But the proposed enhanced cooperative strategy of QoS improvement scheme has high throughput of 1.72 Mbps. This cooperation node uses the least hop count (LHC) path to transmit the data.

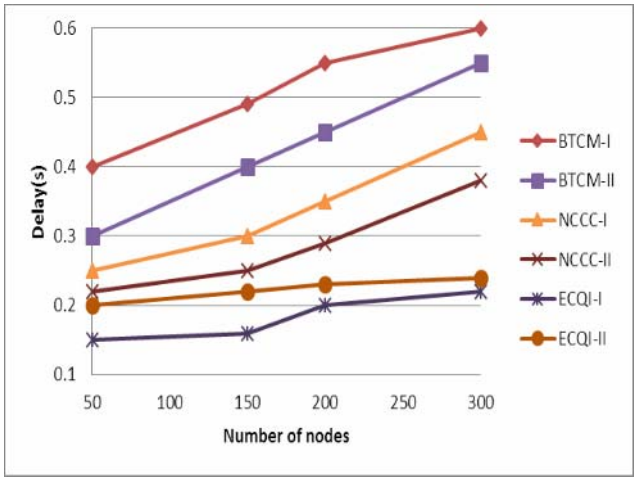

Figure 6 Delay Analysis

Figure 5 shows the packet delivery ratio analysis and it is defined as the ratio of number of packets received to the number of packets transmitted. The existing Busy Tone Based Cooperative Medium access control protocol (BTCM) and

Network Coding Cooperative Communication (NCCC) protocols has low delivery rate due to the usage of more number of control messages. The proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme has higher delivery rate of 80%. This proposed scheme achieves high delivery rate due to the cooperative nodes and it will amplify and forward the data to the destination node.

Figure 6 shows the delay analysis of the existing and proposed techniques. Delay is defined as the time taken to transmit the data from source node to destination node. The proposed Enhanced Cooperative Strategy for QoS Improvement uses the Least Hop Count (LHC) path and it has lesser number of hop counts. This will reduce the delay in the proposed Enhanced Cooperative Strategy for QoS Improvement scheme. But the existing Busy Tone Based Cooperative Medium access control protocol (BTCM) and Network Coding Cooperative Communication (NCCC) has high delay in both stable and mobile condition.

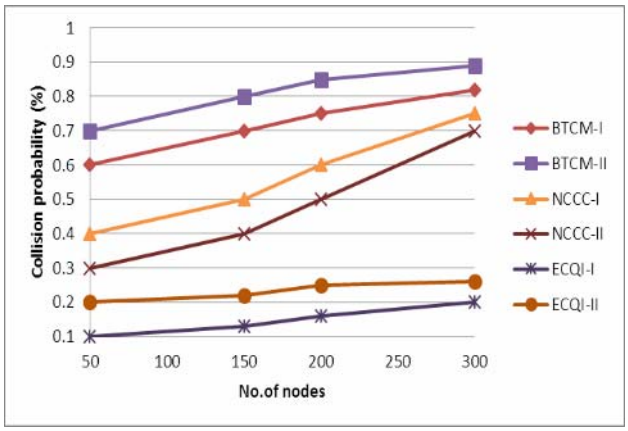

Figure 7 Collision Probability

Figure 7 shows the collision probability and it estimates the calculation based on the delay and drop rate of the Wireless Local Area Network. If the delay and drop rate is high, that achieves high collision probability. The existing Busy Tone Based Cooperative Medium access control protocol (BTCM) and Network Coding Cooperative Communication (NCCC) technique has high collision probability due to more number of control messages and hidden terminal nodes. But the proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme has less amount of collision probability in both stable and mobile conditions.

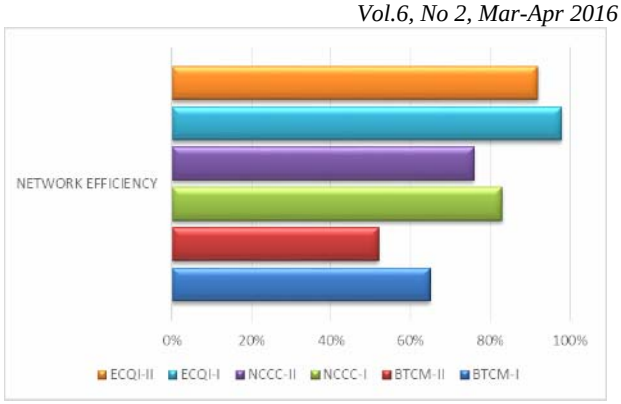

Figure 8 Network Efficiency

Figure 8 shows the network efficiency and it can be evaluated based on the network performance. Network performance is calculated based on the delivery rate and throughput analysis of the network. If these two parameters increase the performance, network efficiency has also seen an increase. The existing Busy Tone Based Cooperative Medium access control protocol (BTCM) and Network Coding Cooperative Communication (NCCC) techniques have low network performance. But the proposed Enhanced Cooperative Strategy for QoS Improvement (ECQI) scheme increase the network performance as well as delivery rate and also throughput in both stable and mobility condition.

Table 1 Comparison of network routing parameters

Parameter	BTCM	NCCC	ECQI
Number of nodes	300	300	300
Number of possible source nodes	5%	10%	15%
Number of possible destination nodes	5%	8%	20%
Number of cooperative nodes	80%	82%	65%
Average hop count	75%	65%	33%
Least hop count path	82%	76%	23%

Table 1 shows the comparison of network routing parameters with the existing techniques such as Busy Tone Based Cooperative Medium access control protocol (BTCM)

and Network Coding Cooperative Communication (NCCC) technique and proposed Enhanced Cooperative Strategy for QoS Improvement scheme (ECQI). This proposed scheme has high number of possible source node as well as destination nodes. The hop count and least hop count path between the source node and destination node is lesser compared to the existing techniques such as Busy Tone Based Cooperative Medium access control protocol (BTCM) and Network Coding Cooperative Communication (NCCC) technique.

V. CONCLUSION

The proposed Enhanced Cooperative Strategy for QoS Improvement scheme is used to increase the network performance and it makes an effective communication between the source node and destination node in the Wireless Local Area Network. The existing techniques such as Busy Tone Based Cooperative Medium access control protocol (BTCM) is used to avoid the issues occurring due to the hidden terminal node and Network Coding Cooperative Communication (NCCC) makes the cooperative communication for WLAN. But these two techniques degrade the network performance. So this proposed Enhanced Cooperative Strategy For Qos Improvement (ECQI) scheme is used to increase the network performance with the help of Quality of Service parameters such as throughput, delay, delivery rate, drop rate, collision probability and network efficiency. Simulation results analyze the performance of the proposed and existing schemes using the Quality of Service parameters. Experimental results have shown that the proposed Enhanced Cooperative Strategy For Qos Improvement (ECQI) scheme increases the throughput, delivery rate, network efficiency and decreases the delay, drop rate and collision probability. Finally, concluded that the proposed Enhanced Cooperative Strategy For Qos Improvement (ECQI) scheme has increased the Quality of Services in the Wireless Local Area Network using the cooperative nodes.

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