Congestion Control using Congestion Aware Protocol in Wireless Networks tested with Standard QoS

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Abstract : ***This paper addresses the problem of congestion with a network-transparent wireless, where we propose a congestion aware protocol. The protocol computes its various routing paths and used some congestion aware metrics. The work performs with load balancing by a pooling scheme with proper queue utilization of variable interfaces of a node. The load balancing technique constantly maintains optimal data transmission using optimal path searching by managing traffic in all the way through congested area. The wireless communications generally have the popularity for its efficient randomness its deployment and compatibility for different applications. The problem of network congestion arises and in turn it results lower throughput and longer delay. In many recent research works, routing protocols dealing with these problems are designed but they are not sufficient to adapt congestion and optimal link quality. In this work, we tried to give solution to the above problem and the simulation is done with ns2. The simulated results proved that the work done here is better than the existing in terms of the QoS like throughput, end-to-end delay and energy spending.***

Index Terms - Load balance, Congestion, Congestion Aware Protocol(CAP), throughput , end-to-end delay, energy-spending

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I. INTRODUCTION

Wireless networks are really approaching towards the era where technologies are providing the most effective and efficient services unmatched with the technologies we had a decade ago. The wireless nodes are comprised of efficient topological links among the wireless nodes to get the maximum connectivity and nodes are capable of dynamic auto-configuration and auto-organization. These are now used for smart home, smart device control community-network, bulding automation etc.[1]. The advancement of this technology brings cost-effectiveness, convenient-deployment, robustness, wider-coverage, easy-and-low-cost maintenance, higher-reliability as compared to the existing techniques.[2] .

In the wireless communications, the infrastructure-backbone uses the wireless routing topology for multi-path architecture. The wireless routing techniques can form auto-formation networks which enjoy the services by just relaying REQ to the wireless architecture. Again, the hybrid technique is another way to get a mixture of infrastructure-backbone and client-backbone as a result it enjoys the advantages of both the structures. Here the challenges are : routing-optimization, efficient-load balancing, judicious transmission, self-configuring-network and finally efficient management of mobility[3]. The communication metrics such as ETX, ETT, WCETT and MIC have been used but they cannot ensure the QoS. The shortest path routing is done using hop-count as a result the above metrics might lead to less-efficient load-balance and less-efficient network. [5]. The traffic is generally routed through the routers and the traffic moves from clients towards the Gateways or from Gateways to the clients. The best path for the traffic exaggerate the load over that path which in turn increases the traffic load and as a result the performance of QoS of the network diminishes [6]. Again, during the routing if the nature of traffic is not considered and the nature of clients then congestion increases heavily and it imbalances the load on the networks.[7].

On going into the minutes of the work it is found that the possible problems arise due to the above discussions. They are: longer delay, lower packet-delivery fraction, higher routing overhead. To remove these problems load balancing technique is used. Efficient load balancing can improve QoS of networks by avoiding traffic in the congested area. For the purpose efficient routing protocol needs to design for the wireless networks so that networks achieve load-balancing. This paper deals with load-balancing in wireless-networks and introduces a protocol CONGESTION AWARE PROTOCOL (CAP).

The main contributions of this paper are: i) congestion aware LINK metric that provides load balancing and (ii) We introduce CAP in which a scheme is introduced to maintain linking of nodes with some optimal path and periodically calculates the utilization queue for various interfaces to avoid traffic in the loaded nodes..

II. METHODOLOGY

Here, we propose a congestion aware protocol called CAP. The protocol computes multiple paths using proposed congestion aware metric and performs load balancing by a pooling scheme with proper queue utilization of variable interfaces of a node. However, the effective load balancing technique constantly maintains optimal data transmission using optimal path by managing traffic in all the way through congested area.

CAP maintains nodes' transmission on optimal path and improve the efficiency of wireless mesh network. We also have computed queue utilization of multiple interfaces on each node to avoid highly loaded nodes. We detail the proposed metric and load balancing scheme as follows.

A. Calculation of Congestion Awareness Metric

To Balance the loads in the network clusters the cluster heads are managed with metric: Link-cost and Round Trip Time (RTT) instead of the traditional calculation of Expected Transmission Time (ETT) and link-quality the reason is that our is compatible with multiple Radio-Frequency environments.

The following is the relationfor calculating the wireless links cost:

$W_{INK\ COST} = \{CA_{OVERHEAD} + P_{OVERHEAD} + B_{TEST\ FRAME}\}\ X\ \{1 - E_{RATE}\}^{-1}$

where, $W_{INK\ COST}$ = Wireless-Link-Cost, $CA_{OVERHEAD}$ = Channel Access-Overhaed,
$P_{OVERHEAD}$ = Protocol-Overhaed, $B_{TEST\ FRAME}$ = Bits in test-frame and E_{RATE} = Error-rate.

B. Queue Utilization calulation

The load balance is monitored by using route request procedure which guarantees the efficient path selection without going into the congetsed area. If a node starts communicating to a node and does not have information regarding that node, it initiates a REQ procedure to find the route by broadcasting RREQ (Route Request) message, every immediate node wil receive the message including all others but those will respond first, so before broadcasting RREQ again the immediate nodes which qualify will response. The decision will be made on the basis of the value of the queue utilization, i.e it checks for the threshold of the queue utilization. If in case a neighbouring node fails in queue utiliztion threshold value then it drops the RREQ. In doing so the overloade nodes are avoided on craeting the path for the links. Since every nodes will calculate the threshold value for the queue utilization before making the links with the requesting node, hence load balancing achieves during linking with multi-path. The process will continue using nodes' own current utilization and their neighbours. To achieve load balancing efficiently the intermediate node calculates queue-utilization value by using the relation[14]:

queue_ultilization= Sum of [interface_queue's] / n

C. Load Balancing Scheme

When the load on a path increases, the link efficiency of the initial optimal path decreases for this reason we need a scheme to calculate the paths dynamically with specific intervals so that the every time the path created will be based on the current value of the link-cost for the nodes. Doing so whenever, we find minimum metric cost from other possible path then the path will be considered as the optimal otherwise it updates the link cost and accordingly the link changes the path to search the next optimal path based on the minimum link cost. The AOMDV computes multiple paths based on the calculated value and choose the optimal path. The traffic size is based on the load and is balanced by distributing the tyraffic across the network.

III. CAP ALGORITHM:

1. Begin: 2. Star selecting a suitable path to destination 3. Check if the path-link is best with minimum Queue_UTL then send RREP 4. Else Broadcast RREP to all available interfaces 5. Check if the Queue_UTL> threshold then Drop PKT 6. Else Broadcast RREP to all the neighborhood nodes and calculate Congetstion_Awareness 7. Update Rtable for Congetstion_Awareness 8. Check if the Current_Congetstion_Awareness > Other Congetstion_Awareness then Set a link with minimum Congetstion_Awareness 9. Else Load_Balance is used for current path 10. Continue step 2 to 9 untill entire newtork is working 11. Stop

The CAP algorithm is implemented in ns2 and analysis is done using xgarph for comparing the QoS of the network with the following QoS metrics: i) Throughput, (ii) PDR, (iii) Energy Spending. On running the above algorithms we get the following output screens:

IV. SCREEN SHOTS OF THE NS-2 RUN OUTPUT

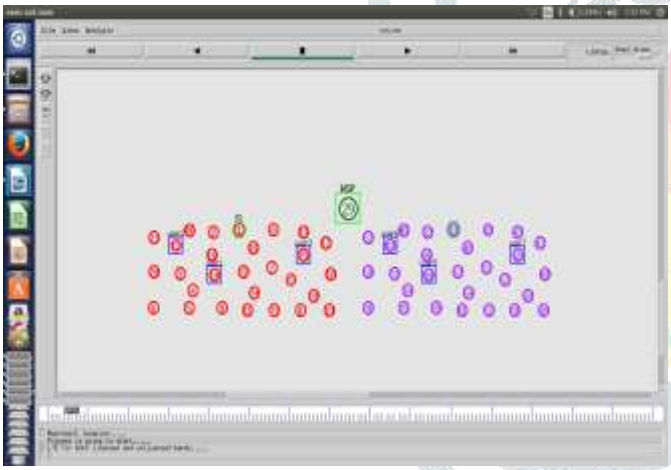


Figure-1: With Low Traffic without CAMR

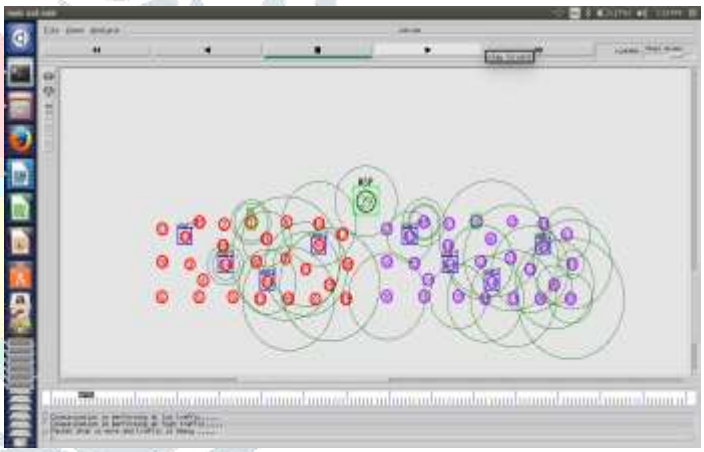


Figure-2: Trafic is approching as heavy

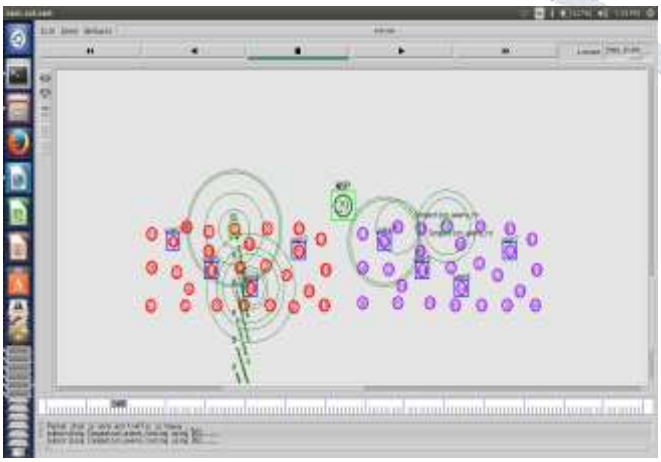


Figure-3: Trafic is heavy Congestion occure

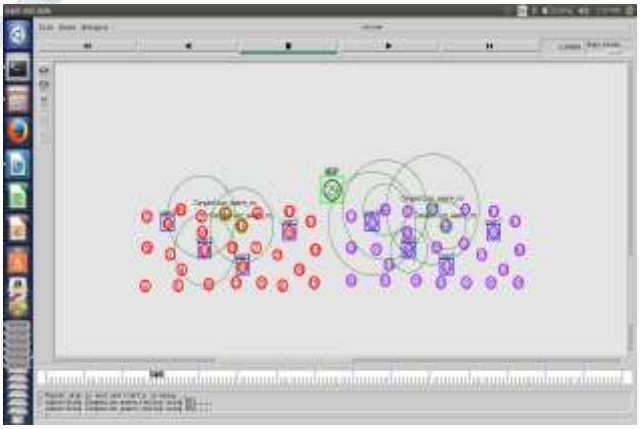
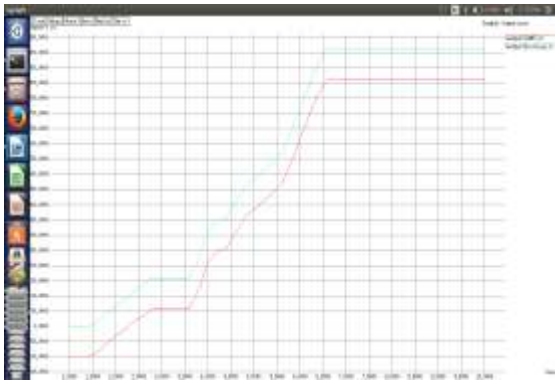
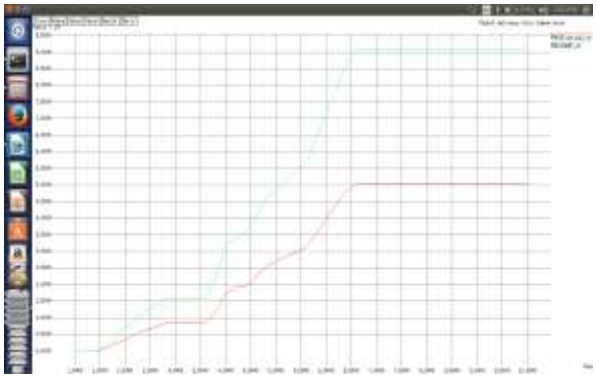


Figure-4: Trafic is heavy Congestion occurred but controlled by CAP

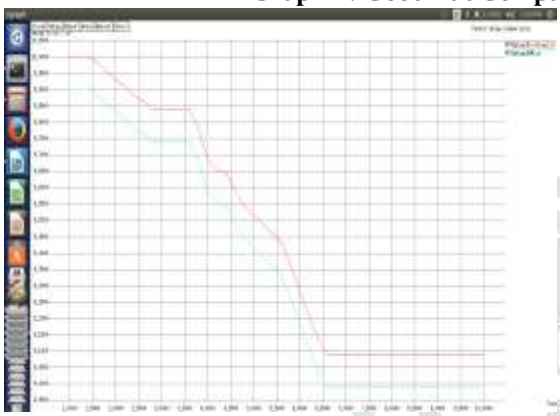
V. GRAPHICAL ANALYSIS OF THE CONSIDERED QUALITY PARAMETERS :



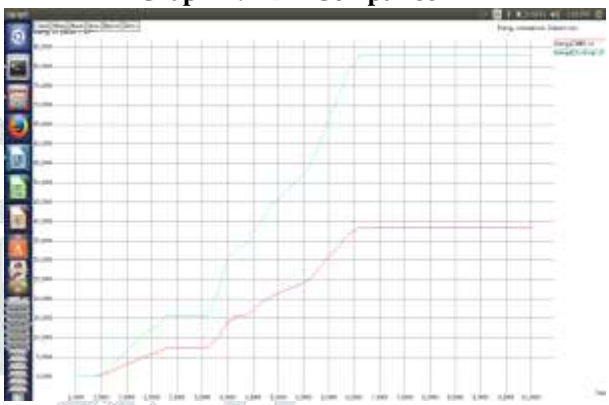
Graph-1: Good Put Comparison



Graph-2: PDR Comparison



Graph-3: Packet Delay Comparison



Graph-4: Energy Consumption Comparison

VI. CONCLUSION

The CAP has a great potential for wireless networks, the routing finds the least congested multi-paths using the Congestion_Awareness-metrics and checks the load before utilizing the resources as result optimal usage of the network is achieved. This paper deals with the routing protocol in which it calculates efficient link-path with the use of Congestion_Awareness-metrics and each time performs load-balancing by using queue-utilization. The proposed technique manages transmission based on path optimizations and in turn achieves the greater efficiency of the networks. The performance comparisons of AOMDV and CAP is done using ns2 with xgraphs. The reults from the simulation clearly indicates that CAP shows better performance with respect to the various QoS of the networks like: throughput, Packet-delivery-ratio, Packet-delay, and energy-consumption.

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