Load Balancing and Congestion Control using Congestion Aware Multipath Routing Protocol (CAMRP) in Wireless Networks

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ABSTRACT: This paper deals with a network-transparent wireless Here,we propose a congestion aware multipath routing protocol called CAMRP (Congetstion Aware Multipath Routing Protocol). 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. Present Wireless Communications have got the popularity due to its randomness in the deployment and immense support and compatibility for different applications. Due to these 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 sufficent to adapt congestion and optimal link quality. Our proposed woirk deals with this problem and the simulation results using ns2 proves that our proposed work on load balancing shows better performance than the existing in terms of throughput, end-to-end delay with heavy traffic load.

***Keywords**: Congetstion Aware Routing Protocol (CARP), Congetstion Aware Multipath Routing Protocol(CAMRP) throughput , end-to-end delay*

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I. INTRODUCTION

The most of the wireless networks are approaching towards the most effective and efficient services for giving the next generation wireless technology In thsese technology era, the wireless nodes are comrised of efficient topological lins 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-relaibility as compared to the existing techniques.[2] .

With the functionalities of the wireless nodes, three types of networks are classifed:

a) Infrastructure backbone,
b) client backbone and
c) hybrid.

In the infrastructure-backbone, wireless routing topology is used to create multi-path architecture with the help of the multi-hop is able to transmit with ruoters, gateways and clients. The wirelsess routing twchniques can form auto-formation networks which enjoy the services by just relaying REQ to the wirelsess architecture. On the other hand, the hybrid technoique is a mixture of infrastructure-backbone and client-backbone as a result it enjoys the advantages of both the structures. Some of the leading challanges on the technocal point of views are categorized as: routing-optimization, efficient-load balancing, judicious transmission, self-cnfiguring-network and finally efficient manangement of mobility[3]. Earlier, metrics such as ETX, ETT, WCETT and MIC have been used but they cannot ensure the QoS and path-efficiency. Only a 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]. In wirelss network, the traffic is genarally routed through the routers to get Internet as a result, the traffic moves from clients towards the Gateways or from Gateways to the clients. Creating multi paths to choose the best path for the traffic then the load over that path will increase traffic load in turn it decreases the performance of QoS of the network [6]. Again, during the routing if the nature of traffic is not cosidered and the nature of clients then congestion inctreases heavily and it imbalances the load on the networks.[7].

The possible problems arise due to the above discussion are:

i) longer delay,
ii) lower packet-delivery fraction
iii) 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 MULTIPATH ROUTING PROTOCOL (CAMRP).

The main contributions of this paper are:

(1) We propose congestion aware LINK metric that provides loadbalancing

(2) We introduce CAMRP in which a scheme is introduced to maintain linking of nodes with some optimal path and periodically calculates the utilization queue for varous interfaces to avoid traffic in the loaded nodes.

II. METHODOLGY

Here, we propose a congestion aware multipath routing protocol called CAMRP (Congetstion Aware Multipath Routing Protocol). 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.

CARMP maintains nodes' transmissionon optimal path and improve the efficiency ofwireless mesh network. We also have computed queueu tilization of multiple interfaces on each node to avoid highly loaded nodes.We detail the proposed metric and loadbalancing scheme as follows.

A. Calculation of Congestion Aware Multipath Routing (CAMR) 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.

CAMR-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 CAMR
7. Update Rtable for CAMR
8. Check if the Current_CAMR > Other CAMR then Set a link with minimum CAMR
9. Else Load_Balance is used for current path
10. Continue step 2 to 9 untill entire newtork is working
11. Stop

The CAMR algorithm is implemented in ns2 and analysis is done using xgarph for comparing the QoS of the network with the following QoS metrics:

(i) GoodPut

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(ii) PDR

(iii) Energy Consumption

On running the above algorithms we get the following output screens:

Screen shots of ns2 Implementation

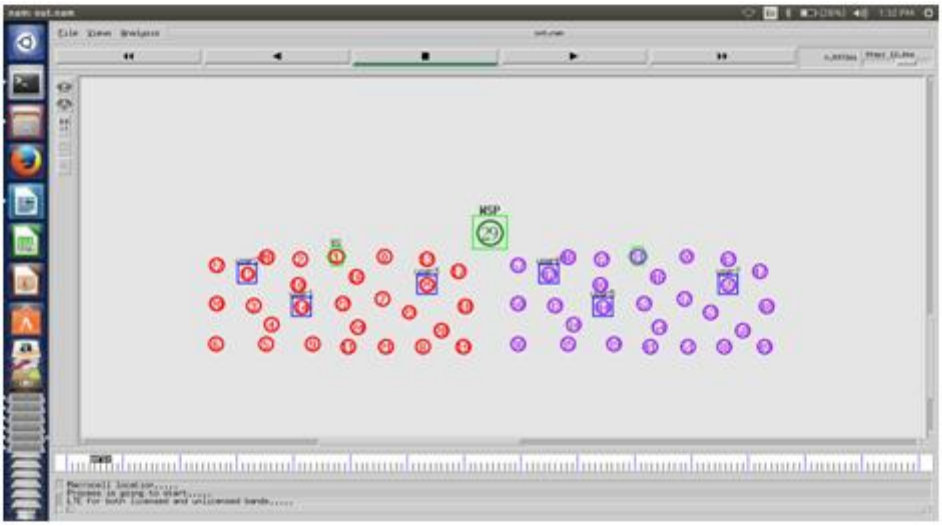

Figure-1: With Low Traffic without CAMR

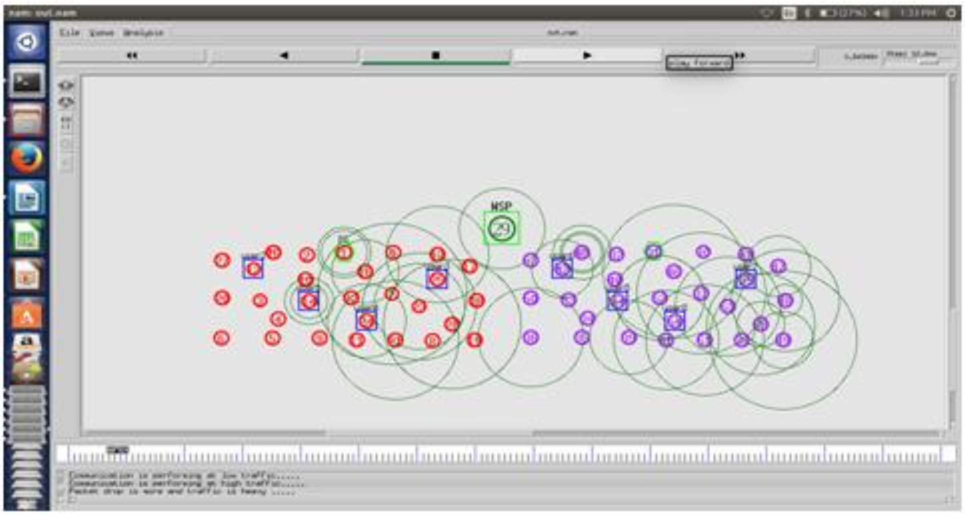

Figure-2: Trafic is approching as heavy

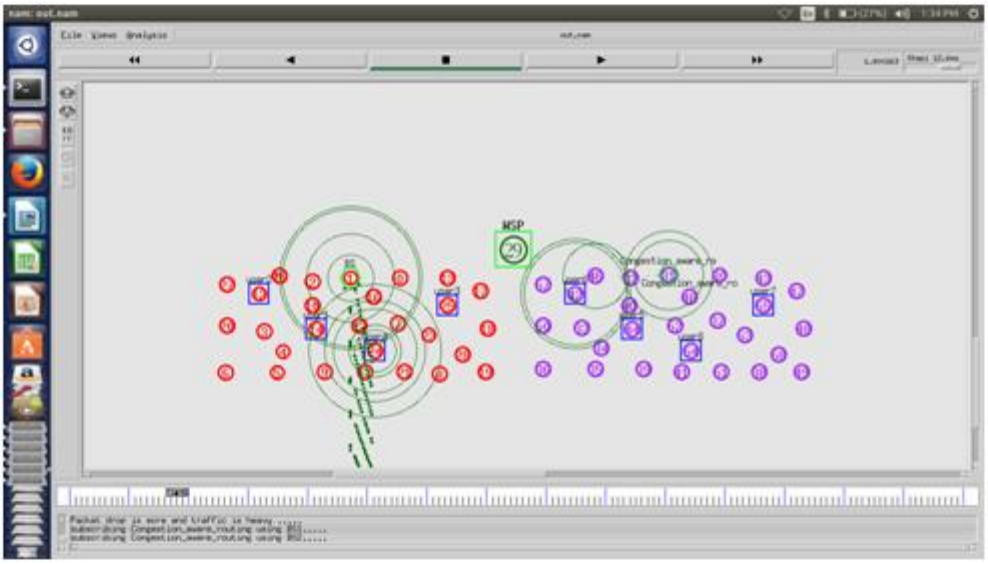

Figure-3: Trafic is heavy Congestion occure

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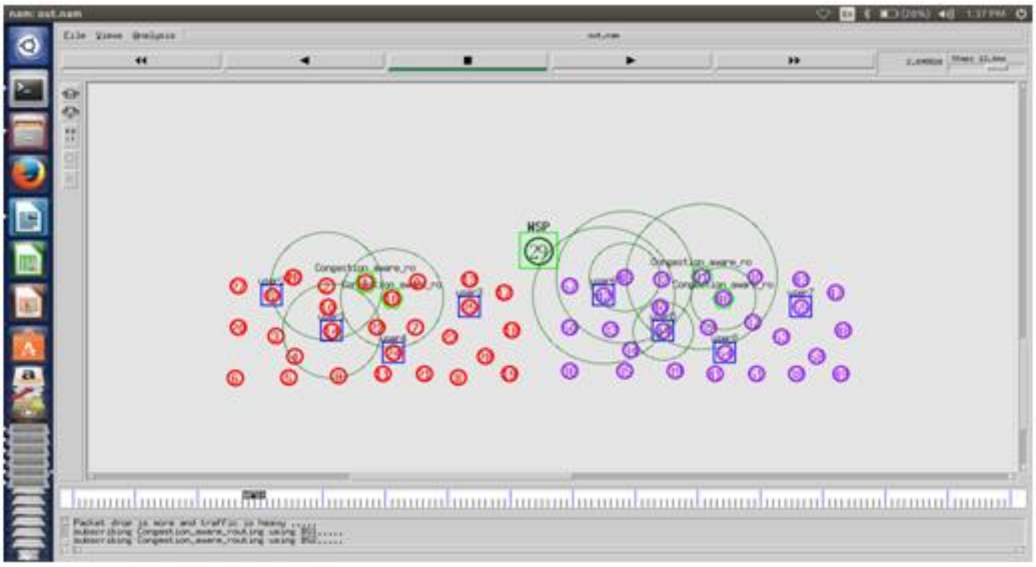
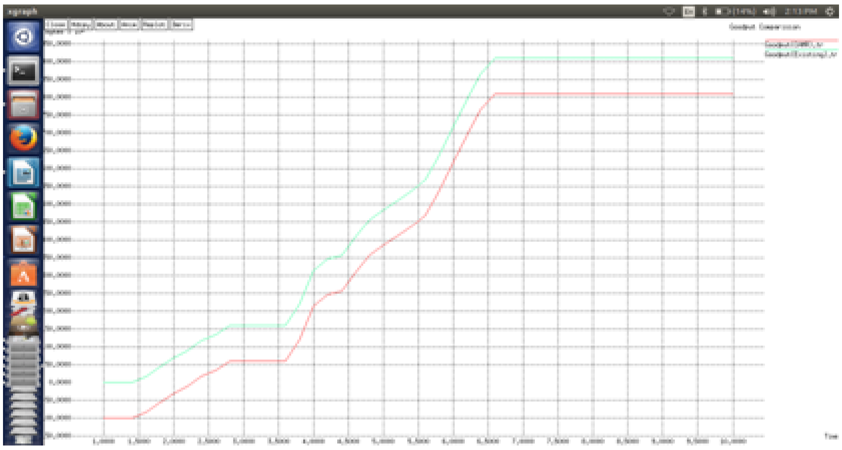
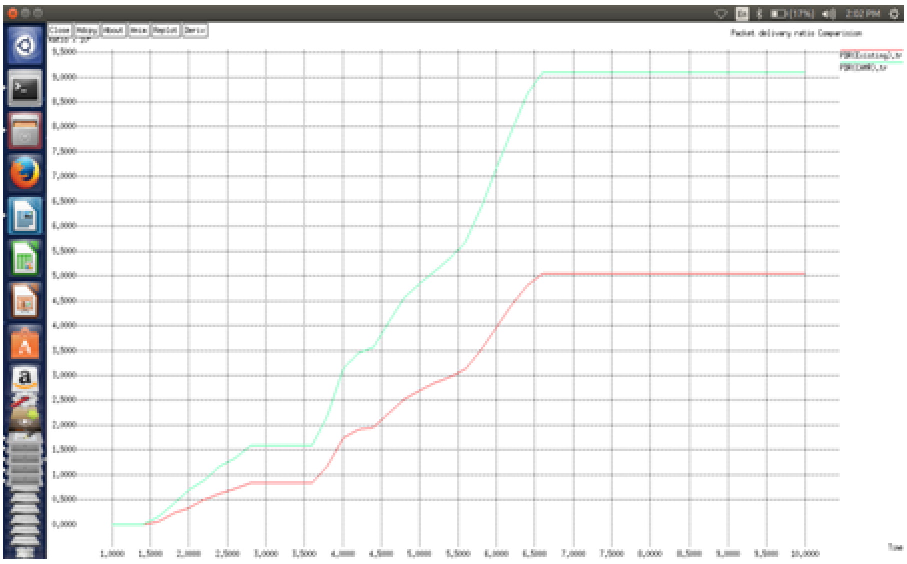


Figure-4: Trafic is heavy Congestion occured but controlled by CAMR

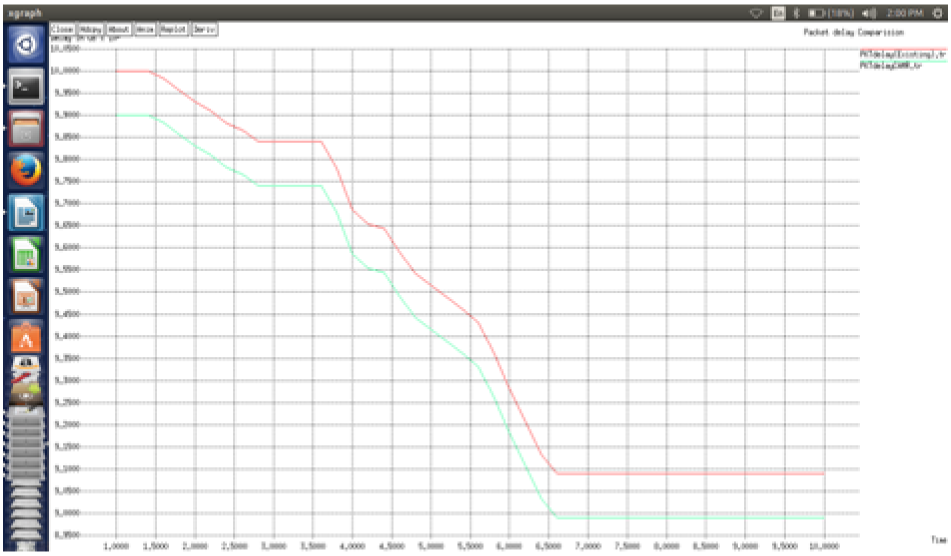
Graphical Analysis of the considered quality parameters :



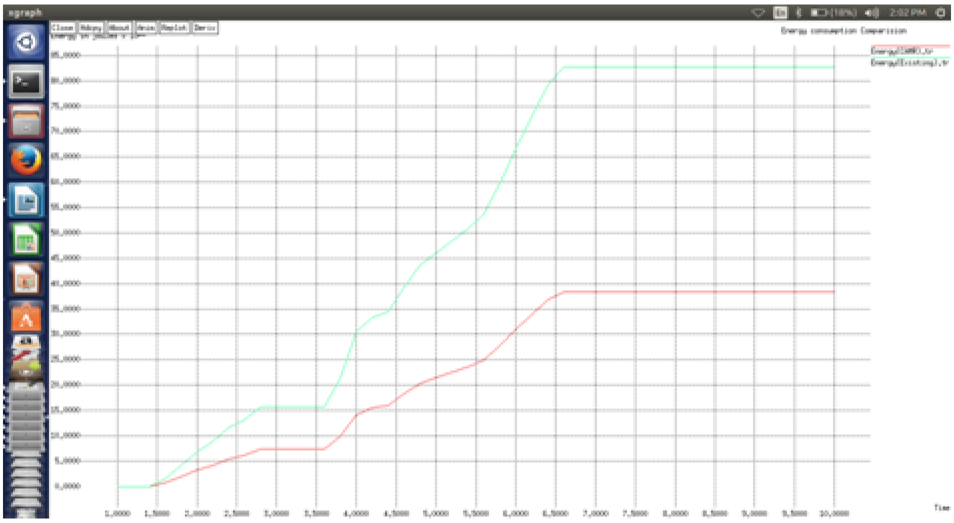
Graph-1: Good Put Comparison



Graph-2: PDR Comparison



Graph-3: Packet Delay Comparison



Graph-4: Energy Consumption Comparison

III. CONCLUSION

The CAMRP has a great potential for wireless networks, the routing finds the least congested multi-paths using the CA-mtrics 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 CA-metrics and each time performs load-balancing by using queue-utilization. The proposed technique manages transmission based on path optimaiztions and in turn achieves the greater efficiency of the networks. The performance comparisons of AOMDV and CAMRP is done using ns2 with xgraphs. The reults from the simulation clearly indiactes that CAMRP shows betterr performance with respect to the various QoS of the networks like: Goodput, Packet-delivery-ratio, Packet-delay, and energy-consumption.

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