CONGESTION CONTROL USING EFFICIENT BANDWIDTH AWARE ROUTING SCHEME IN AD-HOC NETWORK

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ABSTRACT

Mobile Ad-hoc network is a network grouped by large number of wireless mobile nodes. These nodes are capable of moving in random fashion and at any time these nodes could join and leave the network. Additionally, the quick development of IoT causes a more noteworthy measure of data transaction while the information's are exchanged. This causes congestion especially in dense area which leads to delay in transmission also packet loss. And this may result an extreme issue where there is a more traffic huge system and high portability that authorize dynamic topology. In order to avoid this issue, we proposed the efficient Bandwidth Aware Routing Scheme. The proposed scheme settle the level of congestion in the network through bandwidth capacity monitoring and thereby cache the data. And also the calculation of availability of bandwidth as well as the bandwidth used for data transmissions must be done. Before data transmission, the residual cache also be calculated. This routing mechanism utilise the mechanism of feedback which informs about the traffic rate which helps to correct the data rate. These data rates will be modify depends upon the availability of bandwidth and the routing path queue. Using these strategies, we did simulations with the help of NS 2.35 tool where we used TCL for configuring the node and its deployment as well as mobility for data interaction. The outcomes delineates to demonstrate the strength of the proposed scheme over fundamentals in terms of Quality of Services (QoS) for Ad-hoc networks and the probability of congested node included both static as well as dynamic topologies.

Keywords: Bandwidth, Routing, Quality of Service, Data Rates, Throughput, MANET, Packet Loss.

INTRODUCTION

MANET consists of set of mobile nodes that are independent to each other and are self-configured. These nodes are free to move randomly as network change frequently. The special features of ad-hoc is that it allows easy and quick addition of new devices. Each node in MANET acts as router (1). Router's work is to forward packet between nodes in different networks. Some example of three nodes are laptop, mobile phones etc., Also MANET in IoT applications span large dynamic network that include military, conference, rescue and emergency operations. MANET now-a-days also used in VANET. When sender transmits packet to destination node for communication. This is a network each node plays an equally important role in multi hop fashion. While router paves an appropriate path for data packets transaction among source as well as destination routers within network. The design of routing protocol is a difficult procedure but various existing protocols are used which are differentiated such as hybrid, proactive and reactive protocols. Protocol list DSDV has mobile nodes that periodically updates their routing take by exchanging of information (2). In some proactive routing protocol these updates due to exchange causes overflow of message and result in network overhead.

To overcome overhead problem in proactive protocols reactive protocols are designed. Some reactive protocols are AODV and DSR for MANET. In the reactive protocols, the specific procedures such as discovery of the route as well as maintenance of the route. With the specified node behaviour, the nodes are proactive and reactive in nature when they are in outer region and destination region (3). Since a proper routing protocol don't have any issues with throughput, packet overhead as well as with packet delivery ratio, which will automatically reduce the congestion area in the network. The cache in the various level of networks rising the total latency while cluster transmission. Caching centered to briefly store detected information at cache. Computing, correspondence as well as caching either totally devour information without transmission or procedure it into a compacted data and transferred it to cloud. This system benefits enormously to lessen congestion in MANET as well as IoT situations would now be able to utilize MANET steering convention by figuring out how to alleviate the endeavors of detecting bottleneck because of protuberance of information transmitted.

Congestion is a transmission situation in which portion of subnet comprises too many packets. Congestion happens when network load is greater than network capacity (4). Congestion leads to loss of packet and reduction of bandwidth and resources on recovery of congestion. MANET congestion does not overwhelm the mobile nodes but will impact the entire area of coverage.

When routing protocols in MANET are not aware of the congestion it leads to the following problems.

1. **Delay:** This hampers the congestion detection operation. If congestion is restrictive, choose an alternate new route can be fine. But On-Demand Routing Protocol delays the routing searching process.
2. **Overhead Problem:** In process of new route discovery multipath routing is utilized. But this multipath requires huge retransmission attempts that may end up in network overhead.
3. **Packet Loss Increment:** In attempt to minimize network load, congestion control techniques either reduces transmission rate or drop packet at intermediate nods or execute both the process. Any of these causes packet loss rate increase, thus resulting in minimum throughput.

In this paper, the new routing scheme that can cache information in queue and thus control congestion. Our principal contributions are as:

a. The scheme alters existing routing protocol as per available bandwidth in order to fine tune the sending rate if the network is close to congestion.
b. The propounded routing mechanism modifies route request and route reply messages of existing routing protocol by mapping bandwidth and queue size of path in it.
c. It is important to bestow the QoS to the routing. The metric used for route selection is bandwidth and queue size.
d. The result of implementing above step as propounded routing mechanism shows that is outstands in comparison with other techniques used for packet loss.

LITERATURE REVIEW

In this composition, routing as divided into two groups. They are congestion aware routing as well as adaptive routing. With their uses the cross layer MAC as well as rate control protocols were reviewed.

Congestion Aware Routing (CoAR) utilizes selection of an alternative parent to alternate congestion during route establishment phase in the network. Selection best alternative node is done by combining multiple routing matrices and selected parent route doesn't change. For selection CoAR adopts a mechanism base current queue and observation of present and past traffic (5). We cannot change the selected route until the nodes intermediate between source and destination changes their location/link. CoAR based on cross layer Mac protocol is a number of protocols defined before focussed on designing strategies for 'single' layer. In this paper, we take an alternative approach i.e., cross layer design for MAC protocol. In this approach a per-flow notation of important treatment for channel access and end-to-end throughput fairness is achieved.

CL-MAC scheduling is based on structure of flow setup packets and effectively handles multi-packet; multi-hop and multi-flow traffic patterns (6). This protocol utilizes routing information for transmit purpose under condition of multiple multi-hop flows. CL-MACs consider pending packets in layer buffer and set up requests from neighbour. This makes CL-MAC to take care of scheduled decisions reflecting current network status and optimize its mechanism(7). In all our experiment CL-MAC exponentially reduces end-to-end latency and average energy consumed while substantially increasing delivery ratio.

Suburah *et al.* presents cross layer on QoS route. It is used for congestion and route stability. This protocol works on physical and Mac layer (8). Route based protocol scheme, congestion can be avoided taking transmission rate into account. In this end, network status is shared between communicating nodes so that if any congestion occurs in intermediate node then sender node will reduce its transmission rate so that congestion will be avoided.

Some of them are:

i. SoundaraRajan et al stated a congestion strategic approach, called congestion mitigation based on multi - hop load, balance and rate (MLBRCC). By this technique the transmission rate is changed according to the network condition by sender. These mechanisms also require integrated rate control that helps by able to take advantage of accurate measurements in collision avoidance.
ii. Tuan Anh Le et al. has formulated a multi-path protocol that could really avoid congested and energy-consuming paths based on power-consciousness and congestion control. This algorithm calculates energy for host transmitter as well as receptor. This energy-conscious congestion management communicates traffic from most clogged route to less compensated track and distributes energy from higher cost right path to lower cost record.
iii. Sankaranarayan et al . implemented congestion identification and routing control protocol for early detection. This technique's main aim is to provide possible solutions when congestion occurs. This technique produces components they would be:
    a. Discovery route
    b. An appropriate indicator of congestion
iv. Dynamic congestion detection and control routing is a methodology to mitigate congestion by setting free route congestion also at initial route relatively concentrated. Within the whole algorithm, CFS preconfigure all congestion-free pathways at one or two hop peers.

Explain the proposed method for identifying a route between sender and receiver in Bandwidth Conscious Routing Strategy. We need bandwidth value in this algorithm to be suitable for data exchange(9). This bandwidth value can be achieved through analysis of available bandwidth and residual queue size. Subsequent steps were worked on to incorporate this algorithm as a function in AODV in:

1. It is important to test the capacity of all nodes along the route, that they can have bandwidth-related knowledge of available resources.
2. In terms of residual bandwidth, we have to acknowledge source node regarding network conditions. This helps to change its sending rate to the source node.
3. If any broken route is identified in the network then it will be repaired immediately by the route recovery process.

To accommodate their features in AODV the packet forward needs to be changed. For example, it is important to properly add QoS to packet format by introducing new filled such as RREQ and RREP. Since fields do bandwidth information there (10). The approach that improves this methodology and makes it distinct from the system already described is that of implementing adaptive feedback process (11). This additional feature makes it easy to find the current state of the network, link capacity by source node, and change its data rate there. Checking all nodes along the path knows about their usable bandwidth is a restriction that must be met before implementing the above stated characteristic.

PHASE-1: CALCULATION OF RESIDUAL BANDWIDTH

Each node in a network is calculated by its residual bandwidth at the initial phase. It happens in two steps:

a. In this phase residual bandwidth is determined by transmitting request between two adjacent Ni and Nj nodes. Such nodes then save the transmission time value and the transmission message costs.

b. In this second stage, residual bandwidth values already saved are summed in order to notify the source node about the residual bandwidth current. With both of these data rates can be changed to avoid congestion.

1. Source node to Residual bandwidth:

The first step in finding residual bandwidth is by sending "Hello" message to identify one hop neighbour. Thus "Hello" message consists of two HELLO INTERVAL variables also ALLOWED HELLO LOSS. To maintain connectivity to neighbouring nodes. Each node will circulate its message of control to its neighbour. Those messages are stored in the routing table as an entry. But if, within a specific time interval, a sender node has no replay as control packets.

2. ACK in Residual bandwidth at source node:

Estimation of the bandwidth is usually performed in the sender node. The residual bandwidth between 2 connected nodes is assumed to be proportional to a maximum throughput. HELLO Ack packet records the packet receiving time(Tr) when sent by sender nodes. Now measure residual bandwidth. PH and PH-ACK together with RTS and CTS requests represent size of HELLO and HELLO Ack. Total message sent by HELLO and time received by HELLO Ack is called as round trip time (T). Is listed as $T = T_r – T_s$. The routing table update also measures the delay between sender and receiver nodes at the initiator otherwise the packet will be lost. Also can be found by this residual bandwidth. Additionally, residual queue size is extracted to evaluate correct route by measuring queue size and bandwidth. It helps add additional data to the queue and increases the usage of the bandwidth.

PHASE II – BW ALLOCATION FEEDBACK FORWARDING BASED

This process makes use of a theory to create a suitable path. This route is built for packet transmission based on available bandwidth. In this step the route request packet (RREQ) is considered to contain minimum necessary bandwidth compared to the retransmitted packet from the destination node. This takes up a condition that is less than residual bandwidth transmission of data packets occurs only if the requested bandwidth used by source node. Suitable routing is found in this way, and congestion is therefore avoided. This process also gives importance to the intermediate node through information, whether or not these intermediate nodes are a part of the transmission.

1. Sending packets from source:

In this routing technique the path is assigned based on the necessity of the source. Source indicates minimum bandwidth requested. This requested minimum bandwidth is called Bandwidth-oriented Route Request. Once a node receives a packet of this request a reverse route is generated along with a session I d and a retransmission. Session I d is a unique I d that helps to identify flow, and this is increased whenever new Route Request RREQ is generated. This process is carried out automatically before the request hits the destination node.

2. **Bandwidth request at intermediate node:**

First thing any node does is, it extracts header from packets and either checks that it has route to destination route, then the node is called intermediate node. The node compares the bandwidth value demanded for each node by the sender with the residual bandwidth. If only this requested bandwidth is less than the residual data packets are further transmitted. In this case it is necessary to take into account another condition, which is that the bandwidth of the next link is greater than the previous link. Keeping this into account as paths to destination have several routes of the same size, links with higher bandwidth are selected for packet transmission as this leads to avoidance of congestion.

3. **Bandwidth request at destination node:**

If a node is received at the destination node then in this case two calculations are performed. They are I end-to - end residual bandwidth while weighted average value is given as IBMres(t) is given by IBWres (ti-1) as well as weighted average value of last bandwidth. Assume the α is real residual bandwidth weighting. This α in this Bandwidth Route Request technique is standardized to 0.8 or 80 per cent. While α is current residual weighted bandwidth, previous average weighted value is given by (1-2), this value is set to 0.2. This approach harnesses the high priority exploration strategy. Therefore, the existing residual bandwidth is given high priority. This influences current bandwidth value. Next calculation is estimation of the appropriate bandwidth (BWcon) to be consumed. Source node estimates that. This estimate is essential because it helps to check whether each node on path can satisfy the bandwidth condition requested from the source node. For this measurement of consumed bandwidth, intraflow interference often called mutual interference must be taken into account. Hop count (HC) is the parameter used for calculating mutual interference.

HC is then quantified considering node distance from source to destination. Highest Hop count (HCmax) is always taken into consideration. Now consumed BW is totalized as BWcon = HCmax * BEreq where source node demands BWreq. Finally, destination compares consumed bandwidth and end-to - end and residual BW and produces results for data rate adjustment. If BW > residual BW is consumed, it will inform BWavl / HCmax of rising the data rate to the source node.

B. Destination Bandwidth Feedback:

Bandwidth based route replay (BRREQ) packet is transmitted back from destination node to source node in this phase. But all measurement relating to bandwidth is possible after mmm. These nodes have to check a condition for these packets to pass through intermediate node. The state as the residual current bandwidth is greater than the residual bandwidth. The current residual BW is drawn from the header of the packet. The sense of it here is that both the forwarding process and the forwarding of feedback are the same and each node checks the routing table's reverse path entry. Each node uses packet headers to check whether they are the desired receiver.

i. There's end-to - end contact
ii. Last to last delay is reduced
iii. Loss of the packets will decrease
iv. Enhance the delivery ratio for packets
v. The caching, processing and connectivity consequences

In performance matrices the impact of caching, computing, and communication is identified. Caching is the realistic way to reduce Contact costs. This process of caching reuses the sensed data and information that is stored as cache. The Packet Delivery Ratio (PDR) can be considered as measurement matrices used to measure the received packet ratio to total packet sending. Implementation of smart caching strategy involves the process of reducing contact costs. This technique helps in many other metrics as well as in reducing the contact costs. They are

i. Eliminate duplicate data transmission
ii. Reduce amount of consumed bandwidth
iii. Decrease packet drops
iv. Increase PDR ratio

CCC's main goal is to optimize throughput by reducing garbage data, as network throughput is a key factor in determining network efficiency and quality. Eliminating redundant data accomplished by caching helps by using smart computing functions to reduce the size of the data packet.

The key point is the CCC policy also reduces energy consumption. This technique has its application in the cyber world. CCC strategy model also considers caching mainly, and then data is shared in aggregated and de-duplicated format. The cost of sending a little on this wireless network is 50 nano joules, as usual.

RESULT AND ANALYSIS:

By comparing the parameters and their results of the proposed scheme with the DRA and WRA, simulation setup, working of the proposed algorithm and simulation results are discussed. Network Simulator 2.35 is used to test the performance of proposed scheme. (2.35 NS). Residual bandwidth is also measured and calculated which is then shared with the layers. Simulation scenarios are of two types.

In the first scenario we see about the random deployment of static nodes and in the second scenario we consider mobility. The output is contrasted with DRA and without WRA by adjusting the node speed and the data rate.

A. Simulation Network of proposed Method:

To simulate it consists randomly of up to 50 nodes. It initially sends 10 nodes, and eventually expands them to a total of 50 nodes. The number of statics simulations as well as topologies for the mobile network were carried out. The proposed system function is contrasted in simulation with current DRA process.

B. Average end-to end delay:

This graph illustrate average end to end delay with data rate and the proposed scheme.

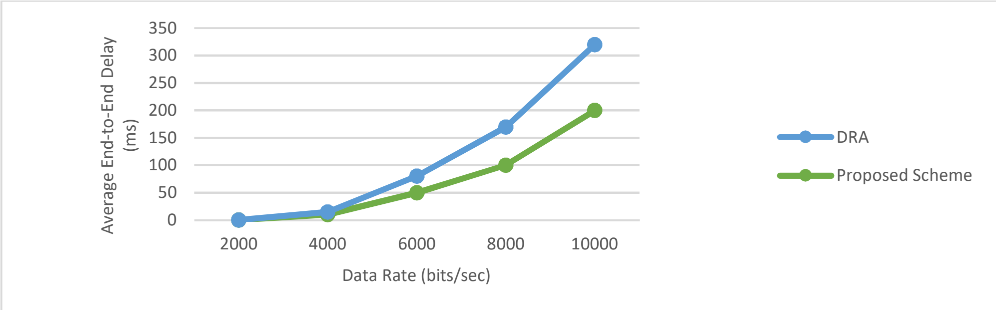

Fig 1: Average End-to-End Delay difference for DRA and the proposed scheme

C. Packet delivery Ratio

In DRA, loss of packets is higher when data rate increases. The packet loss in the new scheme is smaller as compared with DRA. DRA fails in the usability aspect, because it stores the data prior to forwarding. But in the proposed scheme, after Dis-connectivity, it provides a fast route restored between mobile nodes. For DRA the packet delivery ratio is 55 percent whereas for the proposed scheme it is 80 percent.

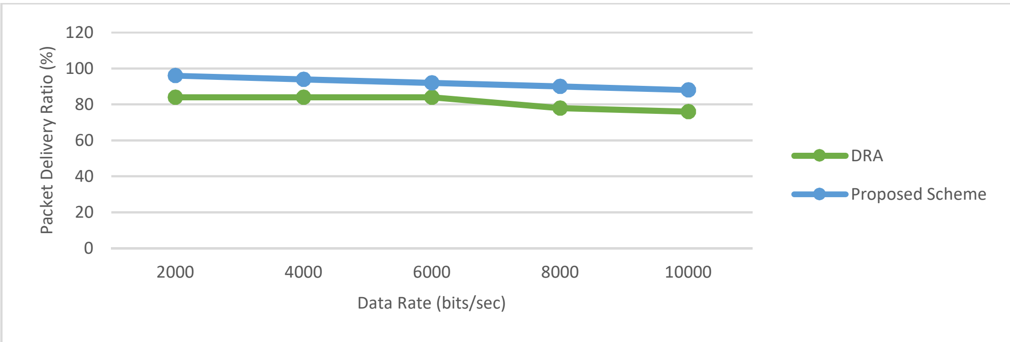

Fig 2: Packet Delivery Ratio difference for DRA and the proposed scheme

D. Throughput:

The graph below shows the output with respect to DRA for the proposed scheme, and the data rate range varies from 60 to 460 bits per second. As the output is reversed to the congestion of the network, the proposed scheme achieves high data-rate efficiency.

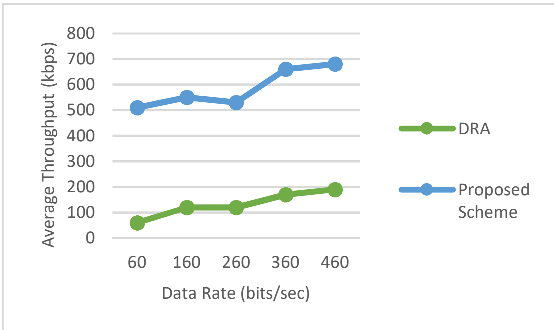

Fig 3: Average Throughput difference for DRA and the proposed scheme

E. Packet loss:

In DRA system, when the data rate is increased, the data is stored in queue resulting in loss of packets. Although it adapts the mechanism of rate adjustment, congestion occurs because of the capacity of the connection. A parameter which results in less data loss than DRA is taken as a means of avoiding congestion in the proposed scheme link capacity. For static topology, 54% of the loss occurs in the proposed DRA where only 90% of the loss occurs. In the case of dynamic topology, DRA is 31 percent and proposed method is 21 percent where node speed is 8 m / sec.

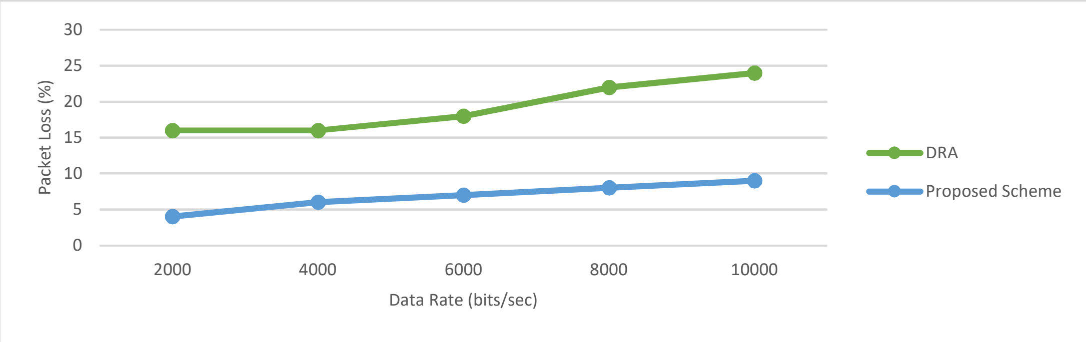

Fig 4: Packet Loss difference for DRA and the proposed scheme

F. Congestion level at node (Probablity):

Congestion affects the level of nodes that will drop packets and result in loss of information.

$Pr_{c} = 1 - (K - 1 / L - 1) / (K / L)$

CONCUSION:

In the proposed scheme, the residual bandwidth and residual queue size is used to cache the information. Congestion is managed by the residual bandwidth that re-establishes the broken links by adopting caching, computing and communication capabilities. When the hello message is not received at the neighbour then the path break is identified. The effect of the proposed scheme is measured using NS 2.35. C language and Perl scripts are used to get results of the scheme being proposed. Using the function, the results are analysed.

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