Cross Layered Congestion Tolerance for Wireless Ad hoc Networks

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Abstract - ***In mobile ad hoc networks (MANETs), when data packets are being sent from the origin to the destination, congestion can take place in any intermediary node often due to inadequacy in resources. Congestion will lead to waste of resource utilization time, long delay, and high packet loss. The fundamental objective of congestion control is to better utilization of the network resources available and maintain such that the load is below the capacity. Packet drop in routing is mainly because of link crash as well as clogging. A lot of existing clogging controls remedies do not have the capability to differentiate between packet loss because of link failure and packet loss caused by clogging. Thus, these remedies aim inside action towards packet drop because of link failure, which is an unnecessary hassle and concludes with of energy solutions. The other limitation in many of the obtainable solutions is the use of energy as well as resources to determine clogging state, degree of clogging as well as notifying the source node regarding blocking in routing path.The proposed work mainly focuses on avoiding the congestion through tolerant scheduling in ad hoc networks***.

Index terms : Cross-layer design, MANETS, Ad-hoc networks, clogging, optimization, tolerance, wireless network.

1.INRODUCTION

In recent years, communication protocols are well designed and optimized due the emerging wireless network technologies. Strict layering principles are followed by Protocol architectures, which ensure efficient implementations, interoperability and fast deployment. However, due to the specific challenges posed by wireless nature of the transmission links lack of coordination between layers limits the performance of such architectures.

To overcome such limitations, cross-layer design has been proposed [1]. Its core idea is to maintain the functionalities associated to the original layers, but to allow coordination, interaction and joint optimization of protocols crossing different layers. Wireless multi hop networks work much below their capacity, due to the weak coordination among transmitting nodes.

Cross layer back pressure architecture, XPRESS is designed to reach the capacity of a wireless multi hop network. XPRESS rather than an aggregation of poorly coordinated wireless routers, converts a mesh network into a wireless switch. Using a throughput-optimal backpressure algorithm, transmissions over the network are scheduled. As it was originally proposed in the theory, implementation and evaluation of backpressure scheduling are done over a TDMA MAC protocol. The congestion control scheme is implemented to ensure that the network operates within the capacity region.

The ad hoc network provides several advantages, including convenient service coverage, low cost and simple network maintenance. Congestion occurs in a network if the number of packets being transmitted through the network is greater than the number of packets that the network can manage [3]. Thus, network clogging can cause packet loss, severely increase the delay and reduce network throughput. Clogging control refers to mechanisms and techniques that can either prevent or remove congestion. The aim of congestion control is to minimize the buffer overflow and delays caused by network congestion and hence enable the better performance of the network [7].

In wired networks, clogging control is employed at the transport layer and is always designed separately from the tasks of other layers. However, such clogging control methods do not apply directly to ad hoc networks, which involve special confronts like route failures due to node mobility, power constraints, and limited wireless bandwidth and limited buffer size. This shows that as the number of packets is being transmitted through a network, network clogging should result in loss of energy and bandwidth, re-routing instability, high packet loss rate, and retransmission of lost packets. However, packet losses and delays need not necessarily be caused by network clogging, but these can be mistaken as congestion losses [8].

2. RELATED WORK

Was Yung Yi et al [12] projected several metrics for clogging aware routing. Xiaoqin Chen et al [2] presented metrics to measure data-rate, MAC transparency as well as buffer delay, which enables the identity as well as deal the blocking assertion area in the system. Tom Goff et al., [5] reviewed a group of algorithms that leads to distinctive path utilization when the characteristic of a path available transforms out to be presumed. A cross-layer hop-by-hop clogging restraint scheme proposed by Xuyang et al., [6] to enhance TCP efficiency in multi hop wireless systems. Duc et al.[13] projected that recent strategies for routing are not pliable to clogging.

The existing versions aim at detecting clogged mishaps in routing the path. A link problem is established due to the packet deficiencies. Generating initiatives to handle the packet losses that result in link failure are inefficient. One other exclusive strategy is regularizing the outflow whatever nodes contributing in routing. In most of the instances congestion handling is done at hip level. Henceforth outflow regularization at every node of the system requires the procedure of extravagant wealth. Throughout this document we discuss that it is significant to determine the cause for packet loss. Therefore, we can prevent the clogging regularization procedure via outflow regularization using the level of link failure. Additionally, we maintain the spat that hop level blocking regulation only, is not enough when the hop levels are incapable to normalize as well. The outflow load can handle the blocking by using the equivalent sources as in spring level outflow regularization designs. In this case we project a cross layer dependent clogging control routing protocol that consists of Clogging detection as well as clogging control systems.

3. CLOGGING DETECTION WITH MINIMAL ENERGY CONSUMPTION

3.1 Quantifying levels of clogging at the Transmit hop level node

Contrary to established systems, nodes in the wireless ad hoc system display a high level of heterogeneity regarding both hardware as well as software designs. The heterogeneity of the exchange hop nodes can show maximum retransmission counts, different radio range, also barrier capability [9]. Therefore the degree of transmission load, packet drop occurrence, also the degree of buffer conservation of relay hop standard node is a minimal combination to choose the degree of clogging. The use of these three persistent values aids, to decouple the clogging, determines procedure from other MAC layer events.

The level of network load, packet drop level as well as degree of load procedure together incorporate a scope to envisage the blocking because of the improper ratio inside collision as well as retransmission count. Whenever retransmissions in contrast with collision rate are considerably lower than an outflow delay of the transmitting hop node will enhance proportionally, which produces clogging as well as shown as clogging because of buffer overflow.

3.2 Quantifying levels of clogging at the Route level traffic

The level of clogging at every relay hop collectively assists to recognize the degree of clogging at route level traffic from provider to target node. Every relay hop level node obtains the degree of clogging from its neighbor node in the structure. As the destiny node, which is a final node of the routing path does not release the emptiness position. Therefore the destination node leads to evaluate the degree of clogging at route level traffic [10]. The interrupted enhancements of clogging condition at every relay hop standard node to its heir in routing gateway are considerably energy consuming procedure. Thus to protect the energy, the clogging improvement approach concerns two restricted activities, which ensues:

1. Level of blockading $l_b(n_i)$ at transmit hop level node n_i will be forwarded to its successorn_{i+1}, iff the node level clogging threshold$l_d(\tau)$ is lesser than '$l_b(n_i)$ '. Hence the energy maintains due to conditional transmission.
2. If $l_b(n_i)$ is greater than the level of blockading at path level traffic $l_b(rp)$ that acquired by node $n_i$from its entryway initiator h_{i-1} then it updates the $l_b(rp)$else it persists same, therefore energy is conserved due to prevention of $l_b(rp)$ update.

4. CROSS LAYERED MODEL FOR CONGESTION CONTROL

The packet dipping usually happens in Manets. The causes of this packet dipping are as under

- Link failure during transmission.
- Inferred Transmission because of weighing down Inflow that prospects inflow balancing capability to low. This can also declare as packet dropping because of blocking at routing.

The clogging control is often considered in two phases by altering over the zonal head with the system portioned into Cells as ensues

- The status of clogging at intra Group level
- The status of clogging at inter Group level

This assists in minimization of source standard outflow balancing cost as well as balances the power utilization.

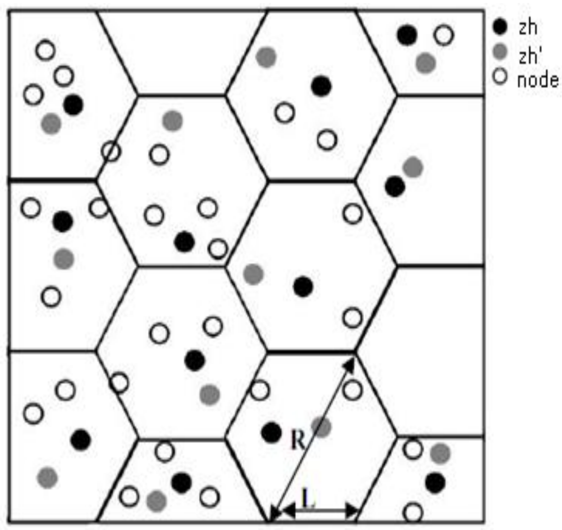

Fig.1. General Overview of the network.

4.1 Nodes in a Network and Network events under projected topology

The system is to be cleaved into Cells. For every Cluster i where $i = 1 \dots |Z|$; (|Z| is entirely the amount of cells) Select Group-head for every Group i. Find spread load threshold ξ_n for every Group i. By using ξ_n Of every Group, spread load threshold for the entire system can be determined.

4.2 Cleaving the network into Groups

With the information of the provided node, the region is split into equivalence partitions. Hexagon is mainly chased for the zonal shape as it covers a maximum surface and reveals the enhancement of interacting with neighbors as they have near spherical form of the sender. The accessibility of small, affordable low power GPS recipient produces it feasible to use position-based in MANETs. The interaction range of node represents as R also t.side of the hexagon as L. Considering that the nodes must be capable of correspond with one another the R as well as L are associated as $L = R/2$.

Every Group has a Group attributes (zid), Group Header (zh) as well as a Group Leader Backup (zh'). The zh node provides, in sequence about each of the nodes in a Group with their positions as well as IDs. Furthermore, sustain information about the zh of the neighboring Cells as revealed in the fig 1. The zh' node preserves a copy of the information stored at the zh so that it is not misplaced when the zh node is off or touching the Group. By defining the coordinates of a node location, nodes can execute self-mapping algorithm of their current regions onto the current Group and also measure its zid. Fig 1. displays the general summary of the system architecture.

4.3 Choosing Group Heads

Group heads are selected under the pressure of the Pursuing metrics:

i. Node positions: A node that is closer to the center with a position p more likely to act as a Group head.
ii. Ideal energy available: A node with greater energy e more probably acts as a Group head.
iii. Computational ability: The node whose computational ability c is high is more possible to act as a Group Head.
iv. Low mobility: A node with mobility m which is low is preferred for selection as a Group head.

Each node of the Group broadcasts its (p, e, c, m). The node that acknowledged itself as the most optimal in (p, e, c, m) metrics, announces itself as Group head zh. The next ideal node in order claims itself as reserve Group head zh'.

4.4 Sharing of Information at Intra zone level [between Nodes in the group and group head]

For each node n that is a subset to Group Z verifies the Inflow load and shares degree of inflow load dil_n with Group head. Once $ndil_k$ received from each node k of the Group i, the Group head zh calculates the degree of inflow load at Group level $zdil_i$.

$$zdil_{z_i} = \sum_{k=1}^{zn_i} ndil_k \Big/ zn_i$$

4.5 Information sharing at inter-zone level [between Group heads]

A group head receives $zdil$ of its hierarchical counterpart zones, and transmits the same along with that zone's $zdil$ to its hierarchical counter parts. This transmission occurs in broadcasting approach [13]. Then the source zone head measures the network level degree of ingress load dil and update origin node. So that origin node can regulate its degree of Egress load such that the Egress load is not producing congestion.

4.6 Group level Congestion Evaluation Algorithm (GCEA)

Group Level Clogging Evaluation and Handling Algorithm abbreviated as GCEA is presented in this section. GCEA is an optimum algorithm that helps in locating the packet dipping under clogging. This valuation occurs under Mac layer which thus alerts the network layer.

4.7 Group Level Load Balancing Egress regularization Algorithm (GLLBERA)

This consequence occurs if Mac-layer alert specifies the clogging circumstance. Once the routing topology [4] receives an alert from the Mac layer about the blocking at a node i, it alerts the fellow citizen node which is the origin node s for conflict node i. Therefore s evaluates it's dil_s by comparing with $zdil$ of Z_c (Group of the node s). If dil_s is more in magnitude than $zdil_{z_c}$the variant between dil_s and $zdil_{s_z}$ should be either greater or equal to the outflow threshold ε then node s regularizes the outflow load by manipulating its buffer timeBT_s such that $ndil_s \geq zdil_{s_z} + \varepsilon_{s_z}$

Here ε can be calculated with the following equation

$$\varepsilon_j = \sum_{k=1}^{zn_j} zdil_j - dil_k \Big/ zn_j$$

In case if the node s not able to normalize its outflow so that disagreement node i terminates blocking then it alerts the zh_{s_z}(Group-head of the $Z_c, s \epsilon Z_c$) subsequent that event zh_{z_c}alerts all the nodes in the network building that all nodes in the upstream of the source node to way out load using the above stated slant. Then all nodes update their $ndil$ and send to Group-headzh_{z_c} , then Group-head zh_{z_c} calculates $zdil$ and confirms the integrity of the $zdil$ by evaluation with dil. $zil_{z_c} \geq dil + \bar{\varepsilon}$ concludes that clogging at contention node maintained by outflow regularization at current Group level. If $zdil_{z_c} < dil + \bar{\varepsilon}$ then GCEA will be started at Z_p , which is adjacent upstream Group to Z_c in transmissible. In this process Group head of the Z_c firstly alerts the Group head of the counterpart Z_p then zh_{z_p} alerts all nodes that belong toZ_p, of the route path. The above procedure of outflow regularization at Group level can be referred as GLLBENA (Group Level Load Balancing Egress Normalization Algorithm). Hence the nodes belong to Z_p regularize their outflow load by utilizing GLLBENA and alert Group-head about their efficient degree of inflow load $ndil$. Then zh_{z_p} measures $zdil_{z_p}$ and verifies the result of $zdil_{z_c} \geq dil + \bar{\varepsilon}$. True indicates the elimination or minimization of clogging at the Group due to the outflow regularization at Group Z_p, if false then Group head of the Z_p performs the act of alerting all other Group heads using a broadcasting[11] instrument about the clogging at the adjacent Group in downstream of the hereditary. Hence all Cells in the upstream side of the Z_p apply GLLBERA and the Cells in downstream side of the Z_p fill in their $zdil$. Then all Cells broadcasts $zdil$ to resource Group. Hence the source Group evaluates the dil. Basing on the dil, the source node regularize its outflow load.

The representations used in Algorithm:

i: Node that being affected by emptiness
s : source node of the i.
Z_c: Current Group where i, $s \epsilon Z_c$
Z_p: Immediate Group to Z_c in upstream side of the pecking order.
$\{n_{u1}, n_{u2}, \dots, n_{uk}\} Z_c$: All upstream nodes to s.
$\{n_{d1}, n_{d2}, \dots, n_{dk}\} Z_c$: All downstream nodes to s.
$\{Z_s, Z_{u1}, Z_{u2,\dots,} Z_{uk}\}$: Set of upstream Cells to Z_p in routing path, hereZ_s is a Group that contains the root node of the routing path
$\{Z_{d1,} Z_{d2,\dots,} Z_{dm,\dots,}\}$: Set of downstream Cells to Z_p in routing path, here Z_T is a Group that contain destination node of the routing path
ε: Group level outflow threshold
$\bar{\varepsilon}$: Network level Outflow threshold

Algorithm:

Mac layer alerts about the blocking at the node of Group Z_c to routing topology, hence the following steps to execute in sequence

$$\varepsilon_{Z_c} = \frac{\sum_{k=1}^{zn_{Z_c}} zdil_{Z_c} - dil_k}{zn_{Z_c}}$$

complete following at node s

If $ndil_s > zdil_{Z_c}$ and $ndil_s - zdil_{Z_c} \geq \varepsilon_{Z_c}$ begin

$BT_s = BT_s + bt$

Note: Value of buffer threshold bt should be certain such that $dil_s \geq zdil_{Z_c} + \varepsilon_{Z_c}$

Return.

Endif

S sends alert to zh_{z_c} about conflict node i.

zh_{z_c} alerts all nodes that belongs to GroupZ_c

$\{n_{u1}, n_{u2}, \dots, n_{uk}\} Z_c$ Updates their $ndil$ by applying GLLBERA recursively and alerts zh_{z_c}

$\{n_{d1}, n_{d2}, \dots, n_{dk}\} Z_c$ measures their $ndil$ and alerts zh_{z_c}

zh_{z_c} Measures $zdil$ as fallows

$$zdil_{Z_c} = \frac{\sum_{k=1}^{zn_{Z_c}} ndil_k}{zn_{Z_c}}$$

If $zdil_{Z_c} > dil$ and $\left(zdil_{Z_c} - dil\right) \geq \bar{\varepsilon}$ begin

Alert: blocking at contention node handles at current Group Z_c Level.

Return.

Endif

zh_{z_c} Alerts zh_{z_p}

zh_{z_p} Alerts all nodes that belong to GroupZ_p

For each node $n \in Z_p$ begin

If $ndil_n > zdil_{Z_p}$ and $ndil_n - zdil_{Z_p} \geq \varepsilon_{Z_p}$begin

$BT_n = BT_n + bt$

Note: Value of barrier threshold bt should be decided such that $dil_n \geq zdil_{Z_c} + \varepsilon_{Z_c}$

Endif

Find dil_n and send dil_n to zh_{Z_p}

End-of-for each

zh_{Z_p} measures $zdil_{Z_p}$

If $zdil_{Z_p} > dil_{Z_p}$ and $zdil_{Z_p} - dil \geq \bar{\varepsilon}$ begin

Alert: Outflow regularization at Z_p leads to overcome clogging situation at contention Group.

Return;

Endif

zh_{z_p} alerts all Group heads in network regarding clogging contention Group.

For each Group Z in $\{Z_s, Z_{u1}, Z_{u2}, \ldots\ldots, Z_{uk}$ begin

zh_z alerts all nodes that belong to Group Z

For each node $n \in Z$ begin

If $ndil_n > zdil_z$ and $ndil_n - zdil_z \geq \varepsilon_z$ begin

$BT_n = BT_n + bt$

[Note: Barrier threshold value bt should be understood such that $dil_n \geq zdil_z + \varepsilon_z$]

Endif

Find dil_n and send dil_n to zh_z

End-of-foreach

zh_z measures $zdil_z$ and broadcast towards source Group.

End-of-foreach

For each Group z in $\{Z_{d1}, Z_{d2}, \ldots, Z_{dm} \ldots Z_T\}$ begin

For each node n belong to Group z begin

Determine $ndil_n$ and sends to zh_z

End-of-foreach

zh_z measures $zdil_z$ as

$$zdil_z = \frac{\sum_{k=1}^{zn_z} ndil_k}{zn_z}$$

zh_z sends $zdil_z$ to source Group via propagation [11]

End-of-foreach

Z_s measures dil as

$$dil = \frac{\sum_{i=1}^{|Z|} zdil_i}{|Z|}$$

Hence a source node S of Group Z_s, which is starting node of the routing path normalize it's outflow load to direction-finding path

5. SIMULATIONS AND RESULT DISCUSSION

In this segment we discuss the result acquired from simulation conducted using a simulation model developed by using MXML. We evaluated performance using Madhoc. Thus, it provides outflow balancing cost as well as balances the power utilization. Here in this graph it represents the degree of Egress calculated at the inter zone level. The plotting in the graph shows how buffer delay is maintained and congestion is controlled

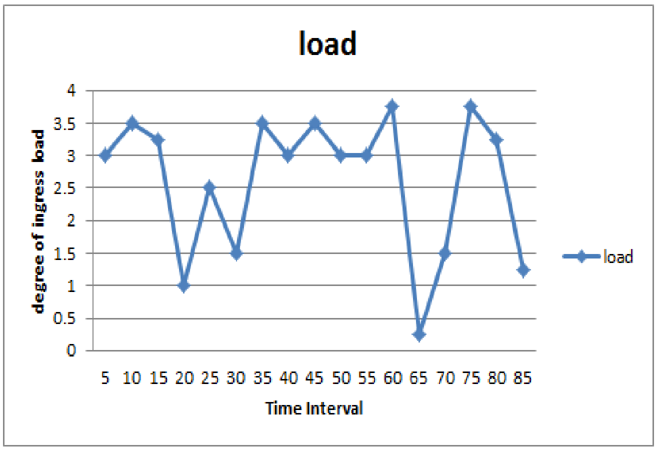

Fig.2 Graph representing the load in the Network

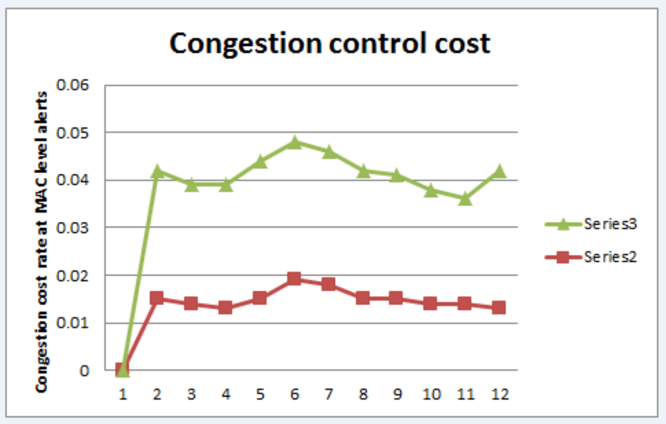

Fig.3 Graph representing the Congestion control cost in cases of Energy and Band width

6 CONCLUSION

This manuscript discussed about proposed "Hierarchical Cross layered blocking Detection and Control Routing Topology" in short referred as "Clogging Detection and have power over with Control seaplane Functionality

Further research steps stemming out of this paper include the following. First, unique features in our algorithm for practical implementations need to be further leveraged. Second, we will extend the results to network with more general interference models and/or node mobility. Third, scheduling problem is always a challenging problem for ad hoc network, and continued exploration of distributed scheduling protocols will further enhance the performance gain from cross-layer design involving link layer. Fourth, we will formally quantify the interesting observation that channel variations, in fact, help mitigate the overall system's degradation due to suboptimal design in one layer.

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BIOGRAPHIES

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