High overhead: More processing and communication attempt -ts are required for a new route discovery. If the multi path routing is utilized, it needs additional effort for upholding the multi-paths regardless of the existence of alternate route.

Many packet losses: The congestion control technique attempt -ts to minimize the excess load in the network by either reduc -ing the sending rate at the sender side or by dropping the packets at the intermediate nodes or by executingboth the process. This causes increased packet loss rate orminimum throughput.

1.3 Ordered Congestion Control By Cross Layer Support In MANET Routing

We know that in MANETs crashing of the packets happen

frequently. The main causes for this to happen are as follows:

- Link collapses during transfer.
- Minimizing the packet entrance power by utilizing conditional Transfer with overwhelming Ingress. This is also named as packet sinking because of congestion near routing strategy.
- □Medium usability conflict.
- □Malevolent sinking near the recipient.

A concise explanation on introducing OCC is as given:

The congestion control methodology that was put forward is attained in stratified way. In our methodology, at firstreduce channel current near the pathway node pn_pantecedent to pathway node pn_cthat is affected by congestion. This step is voluntary and probable delay threshold at $pn_p$and functional part of buffer capability. If there is any situation of error orcrash in the functioning of the primary step, then automatically this gives rise to the functioning of the secondary step of the methodology. Coming to the secondary step the MAC layer makes the adjacent nodes pn_pattentive that are also present in that particular region. As a result the outcome of all the other adjacent nodes pn_pwill be reduced at a time, so that there will be no delay in the group of the threshold value.

Even if the affected node has not improved after thecommencement of the first steps of the methodology thenthe third step gets instigated. The procedure in this step isthat the MAC checks the inward rush of the nodes *I* neartheparticular pathway pn_pin a given period of the timespan□ □, then the nodes that are present in that particularcell $c_c$of the routing path will be intimated about theaffected node $pn_v$by the MAC. Now all the rest of thenodes have reduced their outward rush in order to makethe delay of the threshold group gets decreased. When theMAC checks the inward rush of the nodes *I* near theparticular pathway pn_pin a given period of the timespan□ □, if *I* ' □ □*I* and the affected node is not improvedthen the pathway is re-established by making a link

between the nodes $pn_p$and rpn_c, where $rpn_c$is thepathway node that is held back, which is a considerationnode for pn_c. As a result the routing information avoidsthe affected node *v pn* , that is *c pn* .

II. Congestion Control in MANET

MANET is a communication medium in daily human life

and applications areas of MANET are growing rapidly Congestion control and security are major tasks in MANET. Congestion control works very well in TCP over internet. But due to dynamic topology congestion control is a challenging task in mobile ad hoc network. Many approaches have been proposed for congestion control in MANET. Congestion control technique is the method by which the network bandwidth is distributed across multiple end to end connections. A congestion control schemeensures that the nodes place only as many packets on the wireless channel as can be delivered to the final destination. Congestion control depends on the method that how the actual control is done. Congestion can be rate based congestion control or buffer based congestion control rate based congestion control algorithms are used during routing. Main objective of any congestion control algorithm is to balance the traffic to increase throughput of the network. Also it is possible to maximize nodes transfer, packet delivery ratio, and minimizes traffic congestion, end-to-end delay and network performance can be improved.

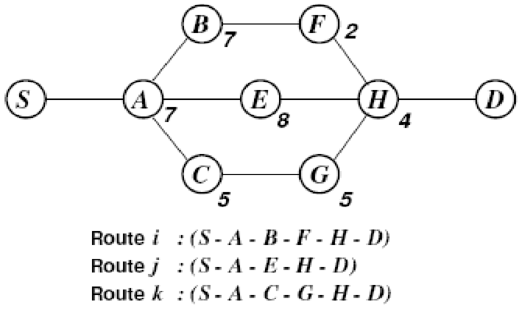
2.1 Congestion Aware Protocols In Wireless Ad Hoc Network.

2.1.1 Dynamic Load-Aware Routing in Ad hoc Networks (DLAR).

DLAR builds routes on-demand. When a route is necessary but no relation to the goal is recognized, the basis floods the ROUTE APPEAL packet to find out a route. When nodes other than the goal receive a non-duplicate ROUTE APPEAL, they build a route admission for the < basis, Goal> pair and record the preceding hop to that entry (thus, backward learning). This preceding node relation is needed later to relay the ROUTE REPLY packet back to the basis of the route.1 Nodes then attach their load relation (the number of packets buffered in their crossing point) and broadcast the ROUTE APPEAL packet. After in receipt of the primary ROUTE APPEAL packet, the goal waits for a suitable amount of time to learn all probable routes. The goal then chooses the least loaded route and sends a ROUTE REPLY packet back to the basis via thechosen route. We propose three different algorithms in formative the most excellent route. In our protocol, middle nodes cannot send a ROUTE REPLY back to the basis even when they have route relation to the goal. To use the most up-to-date load tellation when selecting routes and to decrease the overlapped routes which reason crowded bottlenecks, DLAR prohibits middle nodes from replying to ROUTE APPEALS. Throughout the lively data session, middle nodes periodically piggyback their load tellation on data packets. Goal node can thus watch the load position of the route. If the route is congested, a new and lightly loaded route is chosen to reinstate the overloaded path. Routes are hence reconstructed animatedly in advance of congestion. The procedure of building new routes is comparable to the initial route identify procedure except that the goal floods the packet to the basis of the route, in thisplace of the basis flooding to the goal. The basis, upon inreceipt of ROUTE APPEAL packets, selects the most excellent route in the same manner as the goal. The basis does not need to send a ROUTE REPLY, and plainly sends the next data packet using the newly find outed route. A node can identify a connection break by in receipt of a connection layer reply signal from the MAC protocol,3 not in receipt of inactive acknowledgments, 4 or not in receipt of hello packets for a certain period of time. When a route is disconnected, the instant upstream node of the broken connection sends a ROUTE ERROR message to the basis of the route to inform the route invalidation. Nodes along the path to the basis remove the route entry upon in receipt of this message and relay it to the basis. The basis reconstructs a route by flooding a ROUTE APPEAL when telled of a route detachment.

Route Selection Algorithms

Fig 2.1: Route Selection Algorithm in MANETs



2.2 Congestion In Mobile Ad-Hoc Networks

TCP congestion control works very well on the Internet. But MANETs show some sole properties that greatly affect the design of appropriate protocols and protocol stacks incommon, and of a congestion control mechanism inmeticulous. As it turned out, the vastly differing surroundings in a mobile ad-hoc network is highly problematic for normal TCP.

Paramount in the middle of the specific properties of MANETs is the node mobility and a shared, wireless multi-hop channel. Route changes due to node mobility as well as the inherently unreliable medium consequence in unsteady packet delivery delays and packet losses. These delays and losses must not be misinterpreted as congestion losses.

The use of a wireless multi-hop channel allows only one data transmission at a time within the meddling range of one node. Thus geographically close relations are not self-governing from every other. This influences the way network congestion obvious itself tremendously. Internet routers characteristically are devoted hosts connected by high bandwidth connections. When congestion occurs on the Internet, it is usually concentrated on one single router. In contrast, congestion in MANETs

2.3 Cross Layered Approach for congestion Control

The problem of congestion control in ad-hoc wirelessnetworks is addressed by AntonopouloC.et al. It identifies that the cause for performance degradation in wirelessnetwork isexcessive congestion. For such networks the utilization of the cross-layer design approach isadvocated. They also argued that the layered approach of the OSI/ISO model is not sufficientenough to provide substantial performance enhancement in wireless networks with dynamicnature.

Kliazovich et al. presented a Cross-layer congestion control (C3TCP) [9] scheme whichmeasures the bandwidth and delay at link layer to obtain high performance. The measurements

are stored in feedback field which are gathered hop by hop from the intermediate When an ACKis generated at the destination node the feedback included in the corresponding data packet isrepeated and thus transmitted back to the sender. C3TCP is dynamically limiting the windowsize of the sender based on the measurements. In order to keep the TCP implementationunmodified, all C3TCP logic is contained within the additional protocol module.Yu in [10] observed that in explicit link failure notification, a number of data packets and ACKsmay get lost before the state is frozen which leads to missing packets or missing ACKs after thestate is restored. These missing packets or missing ACKs will then cause timeouts or duplicateacknowledgments.

Yu presents a cross-layer information awareness scheme toovercome this byextensively using cached route information from the DSR routing protocol. Yu presented twomechanisms i.e., Early Packet Loss Notification (EPLN) and Best-Effort ACK Delivery(BEAD). EPLN notifies the TCP senders about the sequence numbers of lost packets then thesender disable the retransmission timer and retransmit the respective packets upon routereestablishment. ACK loss notifications are generated by BEAD at intermediate nodes and sendthem towards the TCP receiver. This prevents ACKs from being permanently lost. A nodeforwarding such a loss notification may send an ACK with the highest affected sequence number

to the TCP sender if it is able to do so. Otherwise the TCP receiver will retransmit an ACK withthe highest sequence number when a new route is present.

III Cross layered Routing Topology(CRT)

3.1 Congestion Control Strategy in Corss-Layered Routing Topology (CRT)

The packet dropping is a very frequent and unavoidable situation in MANETs. The reasons for this packet reducing can be classified as

- Transmission Link failure.
- Inferred Transmission due to overwhelming Packet inlet that leads Packet inlet receiving strength to short. This also can maintain as packet reducing due to congestion at routing.

The nodes participating in the routing path discovered will be partitioned into groups, and then the status of congestion will be handled in two stages

- The Status of congestion within the group
- The status of congestion between the groups

This helps to minimize the packet outlet streamlining costs.

3.1.1 Preparing node groups those participating in routing path

The nodes participating in the selected routing path will be grouped based on their packet throughput status.

In the process of root response the nodes will be grouped. The briefing of the process follows.

- In route response it group forming process will be initiated.
- First a group g_i with zero nodes will be considered.

The node that visited by response packet will be added to

the group g_i and then the average throughput $at(g_i)$ of the

nodes that are grouped will be measured. If $at(g_i) \geq \zeta_g$ (here 'ζ_g' is group level throughput threshold) then concludes a group and start preparing a new group with nodes visiting thereafter. In this process one or more groups will be generated and each group contains one or more nodes such that the average throughput $at(g)$ is greater or equal to the group level throughput threshold ζ_g. During the process of group formation the degree of inlet strength for each group will be measured. This can achieved by finding the average of the degree of inlet capacity of nodes of that group. Let consider 'dol_i' is the degree of the packet outlet at the node i. Then the degree of outlet at a group $g(i)$ of node i can be measured as follows.

$$dol_{g(i)} = \frac{\sum_{i=1}^{|g(i)|} dol_i}{|g(i)|}$$

3.2 Congestion State Prediction Algorithm (CSPA)

Congestion State Prediction Algorithm in short can refer as CSPA explored in this section. CSPA is an optimal algorithm that helps to find the state of the packet dropping under congestion. This evaluation occurs under the Mac layer with the support of physical layer and then alerts application layer.

3.2.1 Notations used in CSPA algorithm

ζ_T	Predefined threshold that represents an interval between two transmissions at one hop level
ζ_t	Actual period between last two transmissions
ζ_{et}	Elapsed time while last broadcast at one hop level
IRS_{ζ_T}	Average packet inlet receiving strength threshold observed for

	predefined interval ζ_T
∂'	Average threshold of the receiving strength
IRS_{ce}	Expected packet inlet receiving strength threshold at current interval
IRS_r	Packet Inlet receiving strength ratio
IRS_{cr}	Current packet inlet receiving strength ratio

3.2.2CSPA for determining root cause of congestion

At an event of packet receiving by node i

Physical layer determines the state of the communication signal that used to receive a packet as follows

Physical Layer sends $IRS\zeta_T$ to Mac Layer

Mac layer process to detect the root cause of packet dropping

Mac layer communicates with application layer to detect channel inference and contention state

```
if $(\zeta_t < \zeta_T)$ do
$\delta' := \frac{1}{2}\left(\frac{IRS_{cr} - IRS\zeta_T}{\zeta_t}\right) + \frac{1}{2}(\delta')$
$IRS\zeta_T := IRS_{cr}\left(\frac{\zeta_t}{\zeta_T}\right) + IRS\zeta_T\left(\frac{\zeta_T - \zeta_t}{\zeta_T}\right)$
endif
if $((\zeta_t) \neg< (\zeta_T))$ do
$\delta' := \frac{IRS_{cr} - IRS\zeta_T}{\zeta_t}$
$IRS\zeta_T := IRS_{cr}$
endif
$IRS_{ce} = IRS_{\zeta_T} + \delta'\zeta_{et}$
if $(IRS_{ce} < IRS_r)$ do
macAlert to applicationlayer:link− failure
else
MacAlert to application layer : congestion
endif
```

IV Results Discussion

In this section we look at the simulations conducted using Ns-2 simulator [48]. We carried out performance assessment using NS-2 with considerations described in table 2.

No of Hops:	225
Approximate Hop distance	300 meters
Approximate total network	1000X1000 meters
Approximate Cell Radious	100X100 meters
Physical channel bandwidth	2mbps
Mac Layer:	802.11 DCF with the option of handshaking prior to data transferring
Physical layer representation	802:11B
Performance Index	Outlet directive cost and end-to-end throughput
Max simulation time	150 Sec

Table 4.1 Parameters used in NS-2 [48] for Performance Analysis

We carried out simulations on three dissimilar routes, which are diverse in length as the number of hops. Paths and their lengths are

1. A path that contains 15 nodes
2. A path contains 40 nodes
3. A path that contains 81 nodes

The same load given to all three paths with a standard interval of 10 Sec loads given in bytes can be originated. The above table the throughput observed for the proposed CRT.

V CONCLUSION

A cross layered routing topology was discussed in this chapter. We proposed Congestion State prediction algorithm(CSPA). CSPA helps to distinguish between packet loss due to link failure and arbitrary packet loss Since the packet outlet directive is carried out at node level, current group level and all predecessor group levels in a successionThe simulation results that we observed are very impressive and promising. In future we can extend this work to maximize the power conservation in CRT to accomplish the energy efficiency.

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