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Architecture for real time and best effort traffic in mobile ad-hoc network (MANET)

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Abstract
Applications proposed for wireless Ad-hoc networks include both Real and Non-Real Time applications. The Access Control module is used to admit or reject a new Real Time flow request depending upon bandwidth availability along the route. The Rate Policing Protocol is used to reduce the flow rate of Best Effort traffic in order to make room for new Real Time flows. The bandwidth availability along a route is provided through demo packets to the network layer, which, in turn, finds a suitable route for Real Time applications. Our paper focuses on an architecture that consist of an Ad-hoc Routing Protocol for route repair and route setup, a bandwidth Allocation and Reservation Scheme for Real Time traffic, and a MAC layer protocol that provides traffic differentiation.

Keywords: rate policing protocol, bandwidth allocation and reservation scheme, admission control, local route repair

Introduction

Wireless networking and multimedia content are two rapidly emerging technological trends. Among kinds of MANET, multi-hop ad-hoc networks provide a flexible means of communication when there is small or no infrastructure or the current infrastructure is inconvenient or expensive to use [1]. The fast spread of small Wi-Fi computer systems has enabled the layout and deployment of Wi-Fi MANET. Typical applications proposed for such networks include both actual Time and Non- actual Time packages [2]. Real Time programs are bandwidth hungry, throughput demanding and put off touchy. For example, a conversational audio/video conferencing will not sustain performance degradation in phrases of throughput or delay. An architecture is required that can give an appropriate treatment to both Real & Non-Real Time program as per their requirements [3].
Our proposed designing architecture uses AODV) protocol for route setup and route repair [4]. It unearths the shortest path for Non-real Time packages and the shortest course with required bandwidth for real Time packages. A Bandwidth Allocation and Reservation Scheme is formulated to give sufficient bandwidth to Real Time application flows while leaving some space for Best Effort traffic flows. We assume that the highest bandwidth allocation for Real Time traffic is megabyte/sec. out of the total channel capacity [5]. The rest is for Best Effort traffic. The traffic differentiation property of the IEEE 802.1 le MAC protocol gives preference and more transmission time to Real Time flows [6]. It maintains 8 different queues. Each queue is for different priority traffic. A statistics packet classifier classifies every incoming packet and puts it in to suitable queue [7]. The preference is given to maximum priority flow along with more transmission time during transmission.
An Admission managing module [2] will admit or refuse the new request depending upon bandwidth availability. The Rate Policing Protocol [2] will decrease the flow rate of Best Effort traffic on demand in terms to make room for new Real Time flows. In terms to provide the existing bandwidth information, the nearest nodes exchange data packets with each other. Once the necessary route is creating, the soft bandwidth reservation is made alongside the route [8]. Due to the unstable topology of the MANET, the underlie routes are broken. Our architecture presents the idea of Local Route Repair. In Local Route Repair, the route repair is initiated through the upstream node of the damaged link as opposed to the source node. We assume the Ad Hoc network as a composition of heterogeneous mobile nodes with different transmission ranges, processing powers and buffer spaces [9].

Architecture

Our proposed architecture is supposed to be a complete framework for both Real Time and Best Effort traffic. It includes AODV Protocol for route setup and route repair, Bandwidth Allocation and Reservation Policy for allocating and reserving appropriate bandwidth for the Real (actual) Time traffic flows, MAC layer protocol IEEE 802.11 for traffic differentiation, Local Route Repair mechanism to locally repair a broken route, Admission Control to admit or refuse a latest Real Time flow depending upon bandwidth availability and a Rate Policing protocol to remove the Best Effort traffic flow rate when desired.
The current 802.11 MAC protocols (802.11 anetc.) have not any means of differentiating visitors streams or assets. All data is treated equally. As an outcome, no consideration can be made for the service needed of the traffic on the channel. For example, low priority bursts traffic may choke out a long running critical video feed.
The Extended Share Coordination Program (ESCP) is using in MAC protocols 802.1le to support eight traffic classes (TC). Each TC starts a reverse off after finding the packets being

idle for AIFS, which is likewise known as a rivalry Window. Inside a station, the eight TC's have independent transmission queues. They behave as virtual stations. The (TC) Transmit Opportunity is given to the TC with highest precedence and the others go into reverse as if the collision at the medium passed off. This TXOP gives pinnacle priority and more transmission time to Real Time packets, thus dropping starting to end interruption.

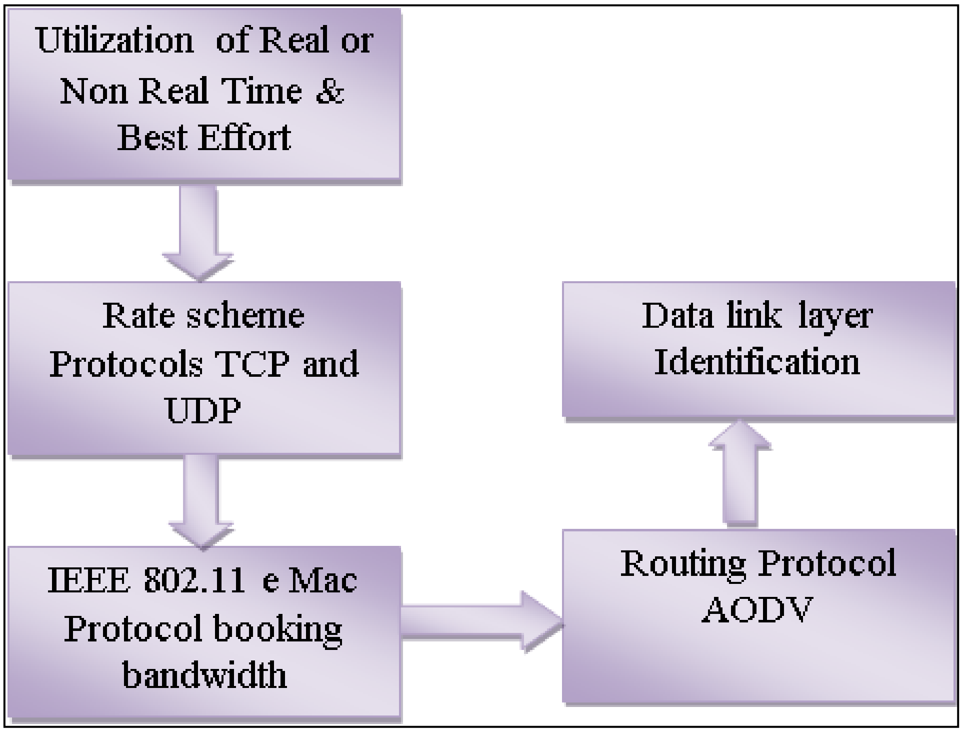

Fig 1: Structure component

Reservation and Allocation of bandwidth system

We have already mentioned that our proposed architecture supports two types of traffic classes Best Effort & Real Time. In our Reservation Scheme, we assume that the maximum bandwidth allotment for Real Time traffic is M bps, where M could be a user-defined parameter. If the bandwidth consumption of Real Time applications reaches M, the new requests are simply denied. We restrict the bandwidth consumption for Real Time flows in terms to reduce the congestion on the path. We assume that every mobile node knows the bandwidth availability to itself and its neighbors. This could be determined with the help of data packet exchange. The data packets contain the neighbor information along with their consumption and availability of bandwidth along a route. The decision for accepting or rejecting a new Real Time program request depends upon the bandwidth availability along the path. A (RRM) Reservation Request message, which carries the flow route, packet length, traffic class and flow rate information is sent along the route of the new flow. Each node that receives this message performs admittance manage using its available bandwidth information. If admittance manage succeeds, a soft bandwidth reservation is made and the reservation request is sent to the next hop. If admittance msanages fails at some node, the flow is rejected and the reservation is down using explicit messages or timeouts.

Using of Rate Policing protocol to decrease the rate of Best Effort flows if new Real Time request arrives and the bandwidth portion dedicated for the traffic of Real Time that is not completely utilized. This means that if the channel capacity used by Real Time program flows is less than M bps, and the rest of the packet of data is occupied by Best Effort traffic flows, the price Policing protocol will decrease the Best Effort flow rate to accommodate new Real Time request.

Discovery process of route

Through a path discovery system, the source node broadcasts a (RREQ) route request packet to its pals. If any of the pals has a course to the destination spot, it replies to the query with a data reply packet [10]. In any other case, the pals rebroadcast the direction query packet. Eventually, some question packets attain to the destination.

Generate route message error

Whilst the hyperlink inside the route between node A and node 10 breaks the upstream node i.e. node four that is affected by the ruin generates and proclaims a RERR message. The RERR message subsequently finally ends up in supply node [11]. A After getting the RERR note, node one will produce a new RREQ note.

Repair AODV source route

Whilst a link break in an energetic path occurs, the node upstream of the ruin determines whether any of its associates use that hyperlink to attain the destination. If, it creates a direction blunders (RERR) packet. Once a supply node getting the RERR, it invalidates the listed routes [12]. If it determines it nevertheless desires any of the invalidated routes, it re-initiates route discovery for that direction.

Route maintenance stage

After backup routes are set up in the route discovery phase, it may be impossible to use backup routes anymore due to moving nodes. If we use wrong backup routes without any verifying, it may cause not only data loss and wastes of unnecessary resources [13]. Thus it is desirable to eliminate wrong backup routes from the route cache quickly in order to maintain stable backup routes. It is possible to check up the established backup route periodically.

The route setup method

The MANET protocol chosen here is AODV [14, 15]. AODV is a clean on-demand protocol in Ad-hoc system and using a broadcast (i.e. flooding) path discovery process. It depends upon dynamically establishing routing table records. The reason for selecting AODV is that its route discovery mechanism matches the bandwidth calculation scheme very well and is worthy for bandwidth constrained routing.

When a Real Time application running on a mobile node wants to transfer its data packets to a destination, it makes a route request to that destination along with the required bandwidth. The AODV RREQ message is generated and broadcast to the neighbors. The source node keeps an entry for this traffic flow in the type a triplet <Session-ID, Source-address, Destination address>. The RREQ message will be extended to carry a QoS object, which contains the requested QoS parameters. As every intermediate node receives this message along the route, it checks its bandwidth availability. If the requested bandwidth is available, it also makes a similar entry for the flow and rebroadcasts the RREQ message to its neighbors. If a node doesn't have such bandwidth availability, it simply rejects the RREQ message. This process repeats at each intermediate node along the route till RREQ reaches the end point. During the RREQ propagation, every intermediate node also contains the information about its upstream node. When the RREQ message reaches the end users, it indicates that a route meeting the required bandwidth has been found. The destination replies back by generating and sending the RREP information back to the source in the reverse direction. As every intermediate node along the pathgetting the message of RREP, it keeps the downstream neighbor sending the RREP information. Now every intermediate node has its upstream and downstream neighbor information along the route. When an intermediate node getting the message of RREP, it reserves the required bandwidth for Real Time flow. When the RREP information reaches the source, the route has been established and the required bandwidth has been reserved along the route.

Fig 2 provides an example of the route setup. Assume that node (E) is the source and node (A) is the destination. Source node (E) generates and broadcasts the RREQ message along with the QoS object extension containing the bandwidth requirement in Fig 2 [X].

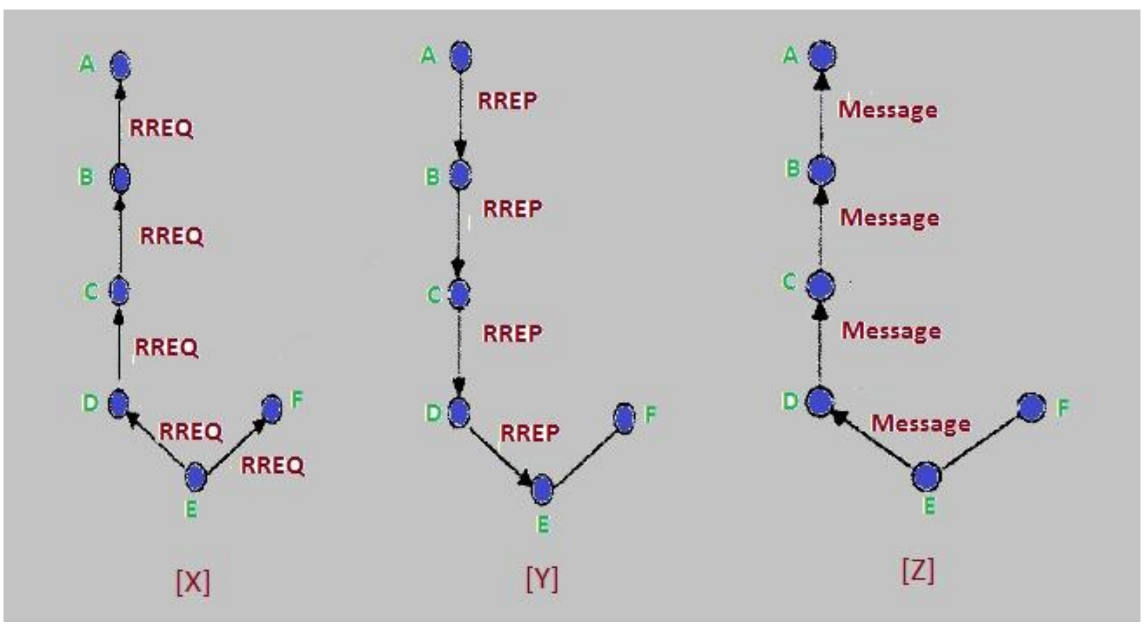

Fig 2: Route Setup

Assume that each link in the network has sufficient bandwidth required by the source hop, so a node does not drop RREQ packet. A node drops the messages of RREQ if it's not provided with the requested bandwidth along the path. As each node gets the message of RREQ, it broadcasts it to its neighbors. When the RREQ comes the destination node (A), it replies to the source (E) in the reverse direction by generating messages of RREP in Fig 2 [Y]. As all nodes receive the messages of RREP along the route, it reserves the requested bandwidth. When this RREP message reaches the source node (E), the route is established and the messages are sanded along the route in Fig 2 [Z].

The path Setup Time is set earlier than the supply node initiates the path discovery method. If the route isn't always set up during this term, the supply node reinitiates the path discovery. Different timer, called direction lifetime is

refreshed with the passage of real Time utility packets along the path.
In case of Best Effort traffic request, the source node generates and pronounces the messages of RREQ without QoS object extension. Every node gets and announces the message of RREQ to its buddies. If an intermediate node has the clean enough direction to the specified destination, it responds by using producing the messages of RREP, otherwise the destination node plays the identical assignment. Once the route is setup, the statistics packets will be sent over the route.

Local route repair

In place of sending an errors message to the supply node, the upstream node attempts to repair the broken link itself, information facts packets can be lost and the hyperlink can be repaired without the supply node (and different upstream nodes) being disturbed. For short routes, local repair may not have any extensive performance advantages. A node upstream of a link break that tries to restore the route does so by way of broadcasting a RREQ with a TTL set to the last known distance to the destination, plus an increment value. This TTL cost is used in order that simplest the maximum recent whereabouts of the destination might be searched, which prevents flooding the complete network. The upstream node locations the series number of the destination, incremented by means of one, into the RREQ. This prevents nodes further upstream at the course from replying to the RREQ, which might form a loop.
The nodes in a MANET are changing their positions with the way of time. This movement might break an established route and might create delay for delay sensitive Real Time programs. This delay could be reduced with the help of Local Route Repair mechanism. We imagine that the Ad Hoc network is composed of heterogeneous mobile nodes with different transmission ranges, processing speeds and buffer spaces. Fig 4 demonstrates this mechanism.

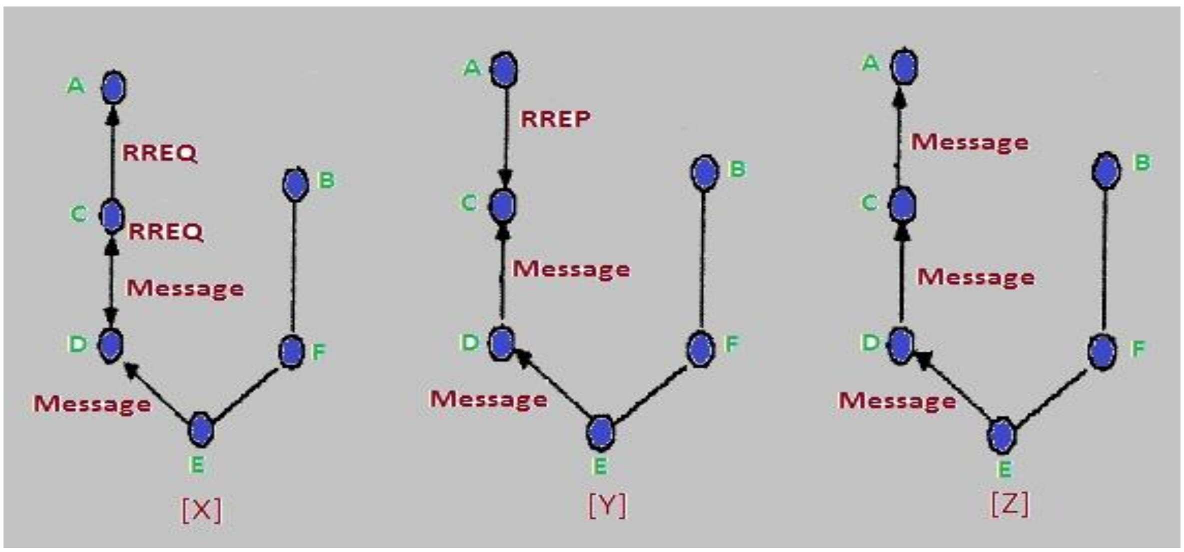

Fig 3: Local route repair

Suppose sometimes later, some of the nodes (B, A) change their positions and the route is broken. Node (B) moves from the neighborhood of (C) to the neighborhood of (F) and node (A) comes in to the neighborhood y of (C). The upstream node of the damaged link (C) detects that the link is broken and initiates the Repair of Local route of the damaged route. Before initiating the local repair, the node (C) checks its buffer space and the flow rate of the incoming Real Time packets. It calculates the time in which the buffer will be filled up with the data messages of the flow. It then compares this time with the period of a new timer called Local Repair Time. If the buffer filling time is higher than the Local Repair Time, it broadcasts the message of RREQ with the QoS object to its neighbors to perform route repair. This is to prevent the packet loss when the buffer is filled up, while the local repair is done. If the Local Repair Time is higher than the time in which the buffer will be filled up, the node (C) sends the message of RERR to the source node (E) to reinitiate the route discovery method. The source then proceeds as described in Fig 2 [X]. In case of Best Effort traffic route breakage, the similar procedure will be applied without the QoS object extension.
Assume that the local repair is applicable in this situation. The node (C) broadcasts the RREQ message to its neighbors for route setup in Fig 3 [X]. Now the destination node (A) is the neighbor of node (B) after this node movement. The source node is often not informed of the route breakage and continues to transfer its Real Time packets in Fig 4 [X]. The node initiating the Local Repair buffers the packets till the route is repaired in Fig 4 [X]. When the upstream node of the route-repairing node (D) receives this RREQ from (C), it will come to know that the route has been broken and the Local Repair is in progress. It will not broadcast the RREQ further along the broken route in Fig 4 [X]. When node (A) receives this RREQ message, it replies by sending RREP message to the node (C). Now the partial paths from (C) to (A) have been established in Fig 4 [Y]. Once the route is established between (A) and (C), the packets, which were stored in the buffer of node (C), are transmitted along this new route in Fig 4 [Z].

Conclusion

A Multi- Precedence traffic Architecture has been proposed for MANET. An Ad Hoc on demand distance vector (AODV) Protocol is used or route setup and route repair. A Bandwidth allotment and Reservation Scheme is formulated to allocate required bandwidth to Real Time application flows. Soft bandwidth guarantees are provided. A MAC layer Protocol is introduced that provides traffic differentiation. The concept of Local Route Repair is also introduced. Admission Control helps in deciding the receiving or elimination of new Real Time application requests depending upon bandwidth availability along the route. The Rate Policing protocol is utilized to reduce the Best Effort traffic flow rate on demand. This architecture is supposed to be more appropriate for, Real Time and Best Effort traffic flows. The simulation result of this architecture is in progress in NS2 simulator and it is expected to provide better outcomes.

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