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Improved Reliable Multicasting in Wireless Networks Using Busy Tone Mechanism

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ABSTRACT

Wireless adhoc Networks (WANs) have evolved as one of the most advanced field in wireless communications. They are composed of a number of static wireless routers which form an access network for end users to IP-based services.In this paper a new MAC protocol termed RMAC that supports reliable multicast for wireless ad hoc networks has been introduced. RMAC employs the busy tone mechanism to realize multicast reliability and has the three characteristics: (1) it uses a variable-length control frame to specify an order for the receivers to respond, thereby solving the problem of feedback collision (2) By extending the traditional usage of busy tone, to prevent data frame collisions in the multicast scenario; also introducing a new use of busy tone mechanism for acknowledging data frames. Additionally, the RMAC can be generalized into a comprehensive MAC protocol providing both reliable and unreliable services for all the three modes of communication: unicast, multicast, and broadcast. The evaluations of this paper shows that RMAC attains a high degree of reliability with very limited overhead. Also, by comparing RMAC with other reliable multicast MAC protocols shows that RMAC not only provides higher reliability but also results in decrease of cost. This paper focuses on using ARQ technique to implement the MAC layer reliable multicast for wireless adhoc networks where the number of one-hop multicast receivers are not very large. Examples of such adhoc networks include battlefield ad hoc networks, emergency rescuing networks etc.

Keywords: component adhoc network,multicasting, mesh networks, MAC

1. INTRODUCTION

Till date, most of the MAC protocols for wireless networks do not provide a reliable multicast service. For example, IEEE 802.11, the widely-used wireless MAC protocol today, only supports reliability for unicast with the CTS\RTS\DATA\ACK scheme.And for multicasting or broadcasting, it simply transmits the data frames. However, in recent years, the provision of multicast reliability at the MAC layer has receiving attention due to the following two observations. First, the methods solely at the network layer cannot provide highly reliable multicasting for adhoc networks in an efficient manner. So far, many network layer multicast protocols have been proposed and they can be distinguished as tree-based protocols and mesh-based protocols. However, both of these protocols encounter problems in attaining reliable multicasting.For tree-based protocols, there is acute packet loss due to the inadequate connectivity of the tree. As manifested if one node doesn't receive a multicast packet, then all its children won't receive the packet either. Mesh-based protocols, on the contrary, triumph the problem of the tree by forwarding the packets with a mesh, so that a node can receive the packets from several upstream nodes. Mesh-based protocols, however, mesh protocols are inefficient in that they instigate redundant packet transmissions;also nodes should be able to differentiate previously received packets. Therefore, to improve the upper layer performance.reliable multicast support is needed from the MAC layer.

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Second, in the context of provisioning functionality to protocol stack, the MAC layer is the best place to provide the reliability for ad hoc networks.Wireless networks are usually characterized by error-prone links, hence it is beneficial to perform local recovery at each hop. By adding local recovery at the MAC layer can highly improve the end-to-end performance of unicast wireless networks.The same effect will be produced if MAC layer type of reliability is provided for mulicasting.The reliability in multicasting is implemented by using two technologies viz. Automatic Repeat request (ARQ) and Forward Error Correction (FEC). In FEC, redundant data is transmitted for error recovery and no feedback is required from the receivers. The advantage of FEC technique is its ability to scale to a large number of receivers;and its downside is that it involves encoding/decoding overhead;additionally the sender cannot know if the full reliability has been achieved or not. Whereas, in ARQ, retransmission is mainly used for error recovery.The advantage of ARQ is that it can achieve full reliability and its downside is that it is not scalable due to the feedback implosion problem. In this paper,the focus is on using ARQ to implement the MAC layer reliable multicast where the quantity of one-hop multicast receivers isn't large enough. Examples of such adhoc networks include emergency rescue networks, battlefield ad hoc networks, sparse sensor networks, etc. In order to implement ARQ in multicast wireless ad hoc networks, two problems need to be solved: (1) how wireless channels can be reserved for multiple receivers in order to increase the successful transmissions and (2) how feedback can be collected from multiple receivers. Several existing ARQ-based multicast MAC protocols try to solve these two problems by using the IEEE 802.11 RTS/CTS/DATA/ACK methodology to the multicast scenario. However,Observing that these IEEE 802.11 based protocols are not efficient,this paper presents the RMAC protocol which solves these two problems by employing busy tone mechanism. RMAC is also generalized into a comprehensive MAC protocol providing both reliable and unreliable services to the upper layer and each service covering three modes of communications viz. unicast, multicast, and broadcasting.The evaluation's done in this paper show that RMAC achieves a high degree of reliability along with very limited overhead.

2. RELATED WORK

A communication pattern where a source host can send a message to a number of target hosts is known as Multicast (point-to-multipoint) as shown in Figure 1.1. Although this can be sent by different unicast messages, multicasting capability is much desired for a lot of reasons. Decrease in the network load is the basic advantage of multicasting. Viewing from the point of developers, multicast is very interesting, as all the complications are removed from the end-host and moved to the network. Multicast has an efficient delivery system of information, as it sends only once the message over each link in the network. Only when the destination link is split, copies of the message are created. Since the routers create an optimal distribution path, it is more complex [1]. To get the packets to the destination, a spanning tree is constructed. In many applications e.g. stock ticker application, it is required to send packets to hundreds of stations. A group of links are shared on their paths, by the packets to their destinations.

IP networks originally introduced Multicast. Many applications, for example, Internet gaming, IP teleconferencing, and Internet television need data to be sent from one or several senders to several receivers. Multicast applications involve multipoint communication/multicast whereby data is delivered from one or several sender nodes to several designated nodes. The 2 types of addresses on the Internet are unicast and multicast. Normally on the internet a host/node has only one unicast address and it can be a member in multiple multicast groups.

2.1. Multicast Support for Applications

The majority of applications in today's Internet rely on point-to- point transmission. Local area network applications traditionally used point- to-multipoint transmission. For the past some years

many new applications in the Internet are using the multicast transmission. In multicast IP, bandwidth is conserved as the networks do packet duplication only if necessary. Multicast IP also offers an alternate to unicast transmissions for many applications such as live stock quotes, network ticker tapes, shared whiteboard applications, and multiparty video-conferencing. Very importantly IP Multicast is not limited only to the Internet, as it can have a big role in large distributed commercial networks.

2.2. Reducing Network Load

For example, consider a transmission of packets to hundred stations in a stock ticker application for an organization's network. In unicast transmission for the group of stations, it will require for the packets to traverse the same links, for the periodic transmission of hundred packets. Multicast transmission is a better transmission for this type of applications, as it sends only a single packet transmission at the source and it is only duplicated at split end in the multicast delivery tree. Broadcast transmission is not ideal for this type of application as the CPU performance is affected at each end station which sees the packet and also bandwidth is wasted.

2.3. Resource Discovery

Many applications transmit packets to group members of the same network by multicast group addresses instead of broadcasts. A multicast transmission should not be limited to a single LAN since the header can limit the multicast transmission's range/scope can be limited by the Time-To-Live(TTL) field of the IP header.

2.4. Support for Data casting Applications

In a series of "audio cast" experiments conducted by the Internet Engineering Task Force (IETF) has sent live audio and video through multicast from IETF site to around the world destinations. In Data casting, the audio and video signals are compressed at the source station and sent as a set of UDP packets to a group address. An organization's requirement for parallel networks for voice, video and data is eliminated by Multicasting.

2.5. Unicast And Broadcast

Commonly data is sent from one host to another by unicast. Generally a 2-direction path is setup on a single connection/path between the sender and receiver. When the Server (host) sends data to 'computer 1' and 'computer 2' (2 hosts), 2 connections are setup. All Data has to be sent twice from the Server. The best way to send data is unicast, when different data is sent to computer 1 and computer 2. It is not a viable solution as Server load is directly related to the number of client computers. Also, when a single transfer of data would have been enough, in many cases the data travels numerous times over the same network connection.

III. PROPOSED SYSTEM

A MAC protocol called RMAC that supports reliable multicasting for wireless Adhoc networks. By the application of busy tone mechanism to achieve multicast reliability, RMAC has the following three novelties:

1. RMAC uses a variable length control frame to designate an order for the receivers to respond, which in turn solves the problem of feedback collision.
2. The RMAC extends the traditional usage of busy tone to prevent data frame collisions in the multicast scenario.
3. And, also introducing a new application of busy tone for acknowledging data frames.

To date, a reliable multicast service for wireless networks is not provided by most of the MAC protocols. For example, IEEE 802.11 the widely-used wireless MAC protocol today, only supports reliability in unicasting with the RTS/CTS/DATA/ACK scheme; and for broadcasting or multicasting , it just simply transmits the data frames once without any recovery mechanism.

For the implementation of multicast reliability, two basic technologies are used:

- Forward error correction (FEC)
- Automatic repeat request (ARQ)

The multicast routing protocol proposed in this paper can be implemented over any of these single-hop MAC layer multicast protocols. In this paper we use RMAC in our simulations as the reliable MAC layer multicast protocols.

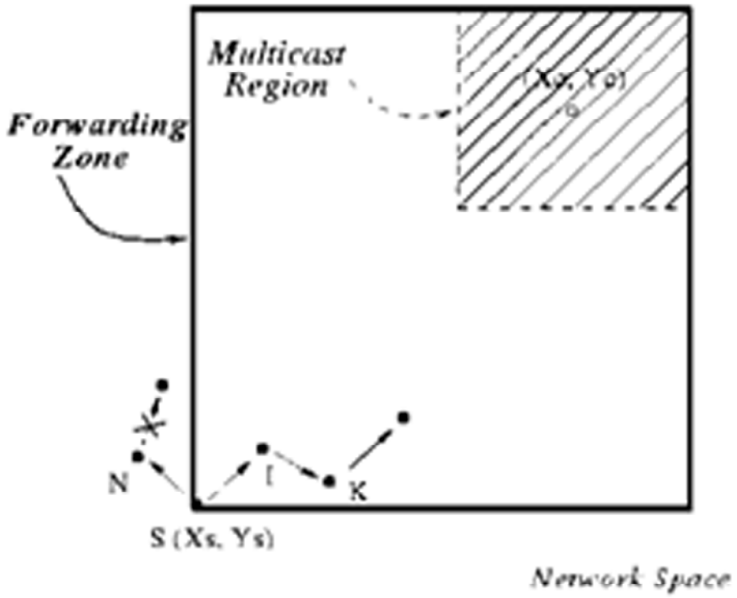

Figure 1: The first location algorithm

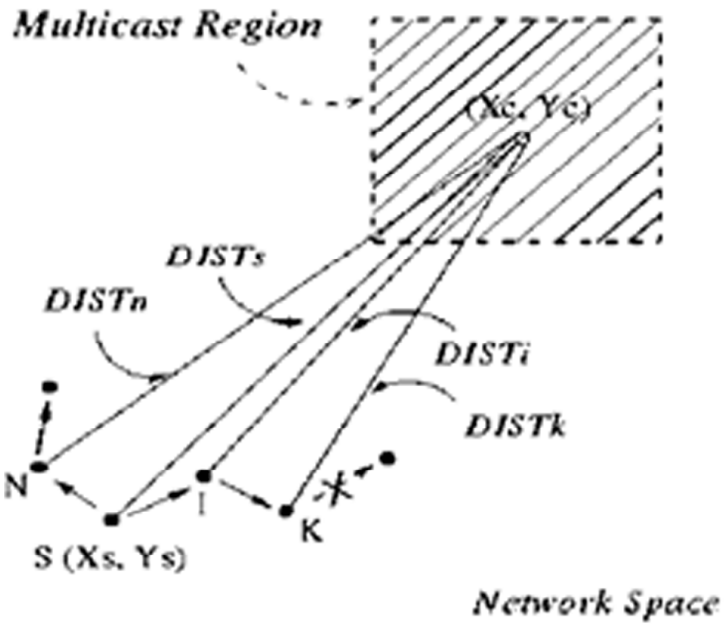

Figure 2: The second location algorithm

4. MODULE DESCRIPTION

There are many characteristics/challenges to be considered when multicast routing protocols are developed. They include, network scalability limitation, energy constraints, network topology dynamics wired and wireless links differing characteristics like limited bandwidth and poor security. A good multicast routing protocol includes characteristic shown below:

Robustness: Some data packets are dropped In Mobile Ad-Hoc Networks (MANETs) due to different reasons leading to low ratio of packet delivery. Therefore, a multicast routing protocol must be robust to withstand node mobility ensuring high packet delivery ratio.

Efficiency: The efficiency in multicasting is the ratio of total number of packets received from receivers to the total number of transmitted data and network control packets.

Control overhead: Bandwidth limitation is important in MANETs. So a multicast protocol design should lower total number of control packets transmitted to maintain a multicast group.

The prototype has several modules which are discussed one by one.

4.1. Normal Route Discovery in WMN

The route node employes the services of reactive protocol to find its neighbor.The AODV protocol i.e., it is one of the reactive protocol. In the wireless sensor network the route node first sends the root request to all the nodes in the network. In reactive protocol we just find the shortest route as we travel in the network. So which ever node accepts the request sent by the source replies by sending the response.

4.2. Routes Discovery using EMTX algorithm

Reputation based models consider interactions from past history and based on this enable nodes to identify cooperative (trusted) or uncooperative (untrusted) nodes. Nodes build their reputation from direct interaction experiences. These histories are visible to new interacting nodes through second hand reputation information. Expected transmission count (ETX), computes the expected numbers of retransmissions required for a packet to move to and from a destination. The link quality is calculated based on the number of successful packets received by the node and its neighbor within a window period.

4.3. Proposed RMAC Functionality in WMN

The RMAC protocol is a comprehensive MAC protocol that providing reliable and unreliable transmission services to the upper layer. Both of them cover three modes of communications viz. unicast, multicast, and broadcast. Hereafter, the two services are called Reliable Send and Unreliable Send services respectively. The provision of both services is due to the consideration that an MAC layer protocol should be able to

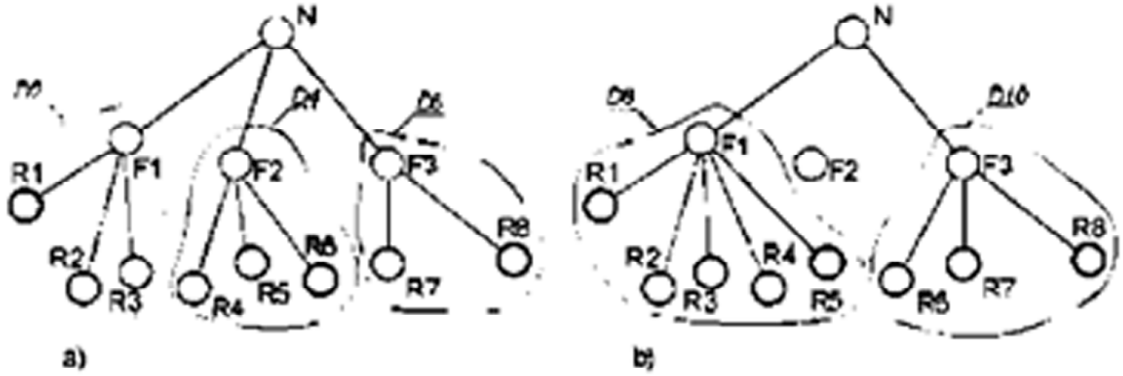

Figure 3: EMTX multi routes

support various upper layer demands. In RMAC, the data frames in Reliable Send and Unreliable Send are distinguished into “reliable data frames” and “unreliable data frames”.

In RMAC, the back off procedure is used by both Reliable Send and Unreliable Send services. It is invoked under any of the following three conditions: 1) a node has a packet to transmit, but either data or RBT channel is busy; 2) a node tries to retransmit upon a failed transmission; 3) a node completes a successful transmission or drops a frame.

4.4. ARQ and FEC association in WMN

This module to formulate the ARQ and FEC to perform some operation on the existing and proposed system to model the behavior analysis of the proposed MAC protocol performance on the different variation this protocol module deliver the high reliability and concise on the network parameters.

4.5. Compare Existing System to Proposed System Using Xgraph

In this module to compare the both system to perform the existing and proposed using xgraph approach to formulate the better performance of the whole system. Xgraph is an X-Windows application.

4.6. Qos of the proposed system

Qos of the proposed system that will provide the best quality of service along on the network dynamics and path recovery of the network status will be analyzed.

5. CONCLUSION

This paper presents a new MAC protocol for wireless ad hoc networks called RMAC that implements the reliable multicasting at the MAC layer employing the services of the busy tone mechanism. In addition, we generalize RMAC into a comprehensive protocol that supports multicast in both reliable and unreliable. Evaluation is done on RMAC and comparison is also made with BMMM, which is another example of other ARQ-based reliable multicast MAC protocols. The evaluation and comparison showed that RMAC achieves higher reliability while having very limited overhead. Multicast routing can effectively reduce transmission overhead and yet enhance multicast throughput. Open research problems include studying the performance of the proposed protocol in more realistic simulation environments as well as real-life wireless networks.

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