An Efficient Multicast Routing Protocol for Mobile Ad-Hod Network

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ABSTRACT

Multicasting is a special case of broad cast in which the packet is sent to many recipients . Both kind of infrastructure that is Wired and infrastructure-based wireless are supported by many multicast routing protocols. Although the implementation in Mobile Ad hoc wireless networks (MANETs) is still a big issue. It appears because there is scarcity of bandwidth, Packet lifetime is short due to power constraints and dynamic topology due to the mobility of nodes. To overcome these addressed problems this protocol is proposed in which a simple, scalable, robust and energy efficient routing method for multicast environment is suggested. The proposal is for different multicasting routing protocols for mobile ad hoc networks and their deployment issues.

Keywords: **Multicasting Routing, Ad- Hoc Networks, mobile routing, routes.**

I.INTRODUCTION

In case of systems based on wireless networks, for example emergency searches, rescues, and military battlefields where sharing of information is mandatory, require rapid deployable and quick reconfigurable routing protocols, because of these reasons there are needs for multicast routing protocols.A largenumber of characteristics and challenges that should be taking into consideration when developing a multicast routing protocols, like: the dynamic of the network topology, the constraints energy, limitation of network scalability, and the different characteristics between wireless links and wired links such as limited bandwidth and poor security [1, 2, 3].Normally we consider the two types of multicast routing protocols in wireless networks.The tree-based multicast networkshows a highunstablity, for example these type is Multicast extension for Ad-Hoc On-Demand Distance Vector (MAODV)[4] and Adaptive Demand- Driven Multicast Routing protocol (ADMR)[5]. The second type is mesh-based multicast protocol. When we consider Mesh-based multicast routing protocols are more than one path may exist between a source receiver pair, Core-Assisted Mesh Protocol (CAMP) and OnDemand Multicast Routing Protocol (ODMRP)[7] are an example for these type of classification. This paper contains five parts: Section 2 describes related work on some multicast routing protocols, Section 3, describes tree-based multicast routing protocols like MAODV. The 4th section, covers a specific routing protocolslike ODMRP and patch ODMRP. Section 5, describes hybrid multicast routing protocol like AMRoute. Section 6, gives simulation results and finally Section 7 gives the conclusion of all these protocols.

We have classified the protocols that tried to pose general ideas of how applying multicast concept in MANETs. The

classification of these routing protocols will be mentioned under as shown in Figure 1.

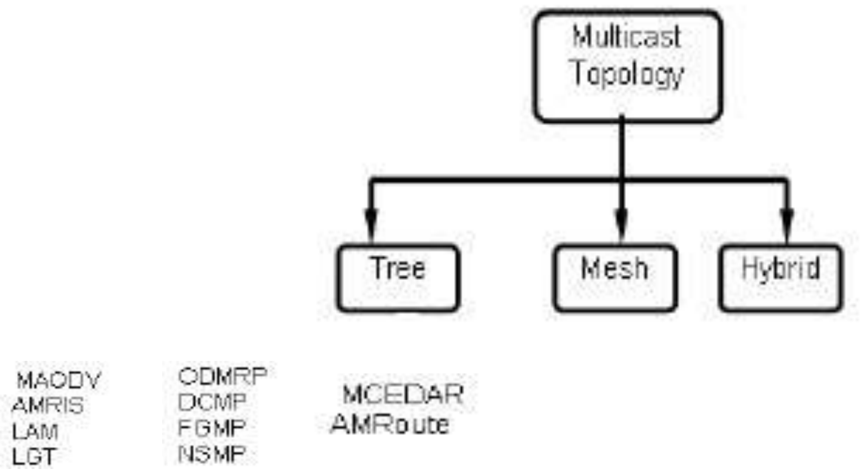


Figure 1: Multicast routing protocols in MANET

II.RELATED WORK

Multicast network supports concurrent sending for the same message from one source to multiple destinations. There is an important application in video-conferencing, distance education, co-operative work, and video on demand, replicated database updating and querying, etc. there are number of multicast routing protocols for Ad hoc networks, which are classified as either *mesh based* or *tree based*. While consideringa multicast protocol(mesh based), there may be more than one path between a pair of source and receiver, thus providing more robustness compared to tree based multicast protocols. When we consider tree based multicast protocol, it has been found there is only a single path between a pair of source and receiver, thus leading to higher multicast efficiency. The tree of multicast network can be created either from the source (*sourceinitiated*) or from a receiver (*receiver-initiated*). In case of the Ad hoc environment there is a problem of frequent path breaks due to mobility of nodes; hence efficient multicast group maintenance is necessary. Further creating these multicast group and maintaining them can be done by either *soft state approach* or *hard state approach*. Considering the first method, the multicast group membership and associated routes are refreshed periodically which necessitate flooding of control packets. Where as incase of the hard state approach, the routes are reconfigured only when a link breaks, thus making it a reactive scheme. for examples a tree based multicast protocols are Ad hoc Multicast Routing (AMRoute) [6], Ad hoc Multicast Routing protocol utilizing Increasing id-numbers (AMRIS) [12], Bandwidth Efficient Multicast Protocol [13], Multicast operation of the Ad hoc On demand Distance Vector (MAODV) routing protocol, and Multicast Core- Extraction Distributed Ad hoc Routing (MCEDAR) protocol. On the other hand the tree based concept, mesh based multicast protocols may have multiple paths between any source and receiver pairs, thus providing richer connectivity among the multicast members. The concept of OnDemand Multicast Routing Protocols [14] is based on mesh structure protocol which uses a forwarding group concept for multicast packet delivery. The members of forwarding group are only allowed to forward data packets. The rest of the multicast mesh it uses soft state approach. N case of some otherexisting mesh based multicast protocols are Forwarded Group Multicast Protocol (FGMP) [15, 16] Core-Assisted Mesh Protocol (CAMP), Neighbour Supporting Ad hoc Multicast routing Protocol (NSMP), and Location-Based Multicast Protocols like ODMRP, FGMP [15] is also based on the forwarding group concept. The large contradiction between them is that the former one is a sourceinitiated multicast protocol, while the latter one is receiverinitiated multicast protocol. In case both,Forward-group and On-demand multicast protocols use control packets flooding to form the multicast mesh, thus resulting in considerable control overhead. Location information is used to reduce the control overhead in Location based multicast protocols. For delivering the data segments to all of the nodes in the same geographical region (it is called as *member region*), a limited flooding approach is used in this protocol. A source defines a *forwarding* zone before forwarding the data packets. The data packets belonging to the that zone are forwarded only.

III.TREE-BASED MULTICASTING

A multicast routing tree is established and maintained by tree based routing protocols to deliver data from a source to receivers of a multicast group. One of the most famous treebased multicast routing protocols are the Multicast Ad hoc Ondemand Distance Vector routing protocol (MAODV).

A.*Multicast Ad-hoc On-Demand Distance Vector Routing Protocol (MAODV)*

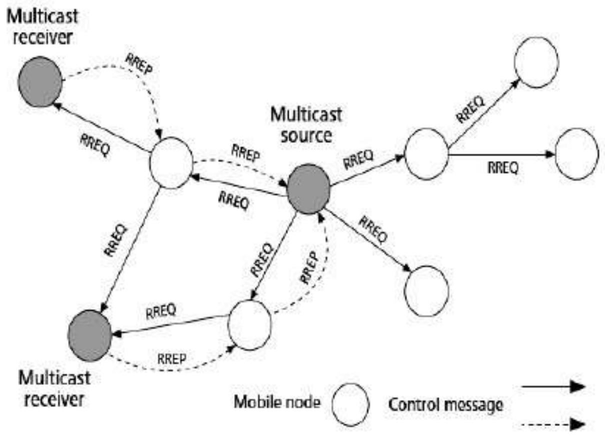


Figure 2: Path Discovery in the MAODV Protocol.

MAODV [4] can be considered as multicast extension for AODV protocol.The shared trees on-demand are used to connect multicast group members. The capability of MAODV is to provide unicast, broadcast, and multicast. It can also increase unicast routing knowledge and vice-versa. While a new member wants to join a multicast group or it has data to send to the group but does not has a route to that group, it originates a route request (RREQ) message. Response is provided through the members of the multicast group to the join RREQ. Ifa node accidently gets a join RREQ for a multicast group of which it is not a member or it receives a route RREQ and it does not have a route to that group, it rebroadcast the RREQ to its neighbours. In case it is not a join request (if) any node of the multicast group may respond.

IV.MESH-BASED MUTICASTING

A multicast routing protocolcreated on meshhave a mesh consisting of a connected component of the network containing all the receivers of a group. One such protocol of mesh-based multicast routing approaches is On-Demand Multicast Routing Protocol (ODMRP).

A.On-Demand Multicast Routing Protocol(ODMRP)

This is an on-demand mesh based multicast protocol, besides it is a multicast routing protocol, ODMRP protocol can make use of unicast technique to send multicast data packet form the sender nodes toward the receivers inthe multicasting group. It uses forwarding group concept to carry multicast data via scoped flooding. The source, in ODMRP, establishes and maintains group membership. If source wishes to send packet to a multicast group but has no route to that group, it simply broadcasts JOIN_DATA control packet to the entire network. If a node in the path receives the JOIN_DATA packet it stores source address and sequence number in its cache to detect duplicate. The objective of this is to perform necessary routing table updates for reverse path back to the source.

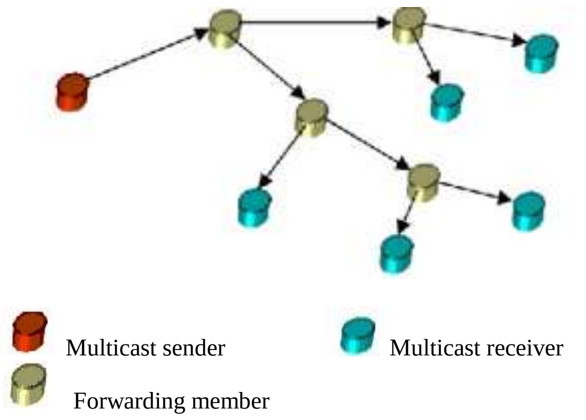


Figure 3: JOIN_DATA propagation

After getting JOIN_DATA packet a multicast receiver constructs a JOIN_TABLE and broadcasts it to its neighbours. A resolve whether it is on the way to the source by consulting earlier cached data, as soon as it gets the JOIN_TABLE. This node creates new join table and broadcasts it after considering the matched entry. Then the JOIN_TABLE starts moving with the help of forwarding group members and ultimately it reaches to the multicast source. To carry multicast data a multicast table is built on each node. With the help of this exchange the node either constructs or revises the routes from sources to receivers and forms a mesh.

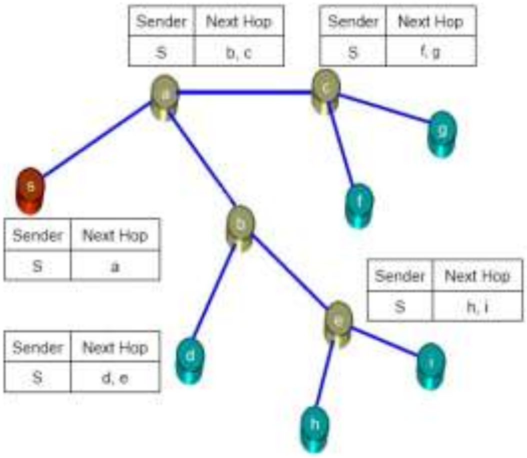
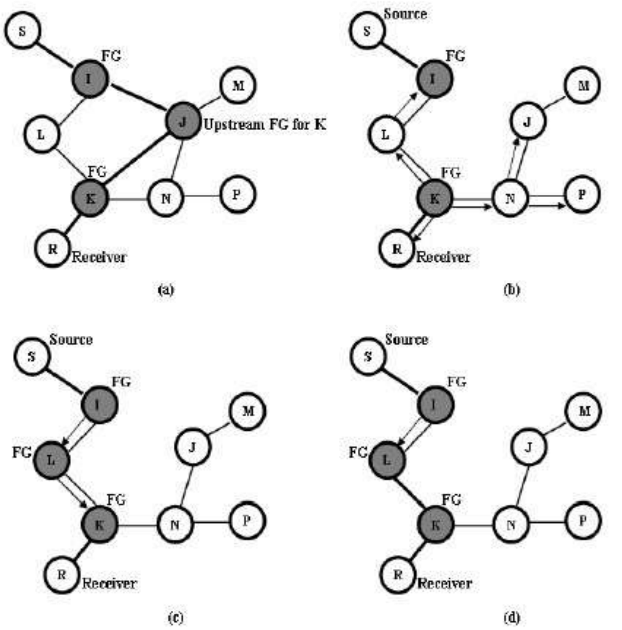


Figure 4: Multicast tables in ODMRP

B.Patch On-Demand Multicast Routing Protocol (Patch ODMRP)

Another variant of ODMRP is Patch ODMPR, which can be considered as an upper version of ODMRP protocol. Patch ODMRP works better with small networks and high mobility. It is based on the use of a local patching scheme instead of frequent mesh reconfiguration, where it copes with mobility without reducing the Join-Req interval.

In the following figure 5: the ODMRP mesh is shown in Figure 5(a), S node is the sender of the multicast group and R node is the receiver. Every ForwardingGroup node utilizes MAC layer to check for its neighbours, and comparing it with the forwarded routing table to check out if there is any unreachable node in the network. Figure 5(b) shows that the node J discovered by that node K, which is unreachable as a result of the failure of the link JK. Here K node works on the patching procedure by flooding advertisement message (ADVT), advertising the upper loss. If the node J provides supportto more than one multicast groups, then it is added in the ADVT message. The node that receives the ADVT message updates its routing table entries for the source of the ADVT. Figure 5(C) shows: a PATCH packet is generated as a reply on the ADVT and is forwarded to K node, selecting L as a temporary FG node. If K receives more than one PATCH packet, it selects the shortest path to the multicast sender. Another path is shown in Figure 5(d), K node marks L node as a new upper FG



node [9].

Figure 5: Patch ODMRP Process: (a) ODMRP protocol, (b) j node is not detected by node K, (c) PATCH packet from node I to node K and, (d) node K working last FG node.

V.HYBRID MULTICASTING

Hybrid multicast provies combination of both tree-based and mesh-based multicasting routing protocols.

A. Ad-Hoc Multicast Routing Protocol

This protocol is based on the concept of shared tree and has two faces:mesh and tree. It findsand nominate certain nodes as logical cores that areresponsible for initiating the signalling operation andmaintaining the multicast tree to the rest of the groupmembers. Response toa messages comes only from a non-core node only. This protocol does not address network dynamics and assumes the underlying unicast protocol to take care of it.

The figure 6 shows a corereceiving a JOIN_REQ packet from another core in the same multicast group. It provides a response with a JOIN_ACK. Between the two cores a new bidirectional tunnel is created, and one of them is selected as a core after the mesh merger. As soon as the mesh starts up, the core starts the tree building process. A TREE_CREATE messages is sent by the core to all nodes in the mesh, that will be received only by the multicast group nodes. Then each receiver of this message in the multicast group will forwards messages it received to all mesh links except his parent. Then the TREE_CREATE_ NAK is sent back to his parent after discarding the TREE_CREATE. If any of the member wants to leave the group, it sends a JOIN_NAK message to nodes that have connection with him.

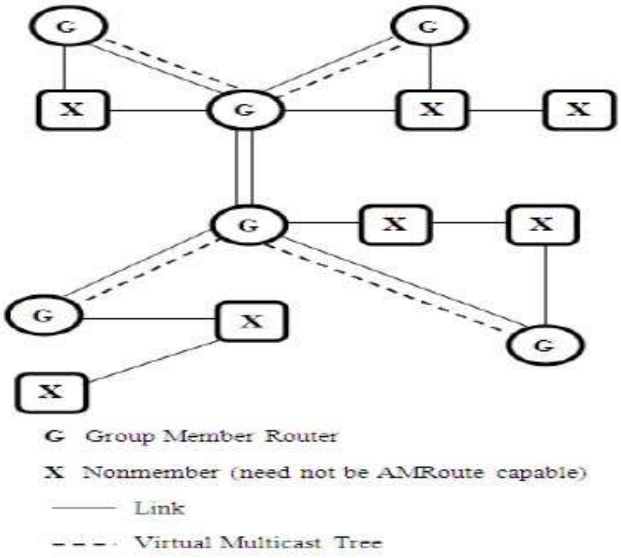


Figure 6: Virtual multicast tree formed by AMRoute

Ad-Hoc Multicast Route starts building multicast tree using a mesh link. In case of any change in the network, multicast tree in AMRoute tries to keep the multicast delivery tree unchanged. This protocol may have temporary loops and may create non optimal trees with host mobility,which is the major drawback of it.

VII.SIMULATION RESULTS

A.Mobility speed A.1. Scenarios

It is shown that each node moves constantly with the predefined speed. The directions of movement of each node were selected randomly, and when nodes reached the simulation terrain boundary, they bounced back and continued to move. The speed varies from 0 km/h to 72 km/h. twenty nodes are multicast members and five sources are transmitting packets at the rate of 2 pkt/s each,in the mobility experiment.

A.2. Results and analysis

Figure 7 shows the ratio of packet deliveryof the protocols under different speeds. The On Demand Multicast Routing Protocol gives a very good performance even in highly dynamic situations. It gives various routes with a mesh topology and the chances of packet delivery to destinations remain high even when the primary routes are unavailable. The ODMRP results in to minimal data loss and highly robust even after with path redundancy. Also, it provides effectiveness as flooding in this experiment. The least effective of the protocols with mobility was AMRoute. Although it gives great results in no-mobility, but it fails to deliver a significant number of packets even at low mobility speeds. And the delivery ratio goes further down as the mobility speed is increased. The reason behind this is the formation of loops and the creation of sub-optimal trees when mobility is present (at 72 km/h, the average hop count was nearly eight while other protocols were below four). Loops are created during the tree reconstruction phase when some nodes are forwarding data according to the stale tree and others according to the newly built tree. This occurrence is critical in protocol performance because they cause serious congestion. In some cases, nodes had up to 13.75 packets dropped per second. There are two consequences of loss of packets due to buffer overflow. First, the packet of data is dropped(in any) in the early stage of its multicast tree traversal, a large portion of tree members will not receive it, and second is if the impotant control packets (TREECREATE, JOIN-ACK, etc.) are dropped, the tree is not properly built or becomes segmented and data will not be delivered. Other reasonbehind the ineffectiveness of this protocol is its dependency on the underlying unicast protocol. It depends on the unicast protocol to set up bidirectional tunnels between group members for the multicast tree.

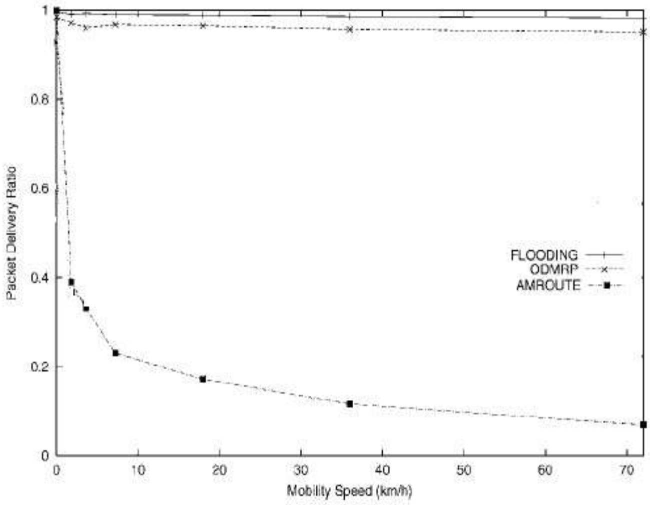


Figure 7: Packet delivery ratio as a function of mobility speed

The following figure 8 gives the number of data packets transmitted per data packet delivered as a function of mobility speed.t can be observed from the figure that AMRoute has the highest number of transmissions because of loops. Also, it is clear that protocols using mesh i.e. ODMRP transmits nearly as much data as flooding as shown in the above figure because it exploits multiple redundant routes for data delivery.

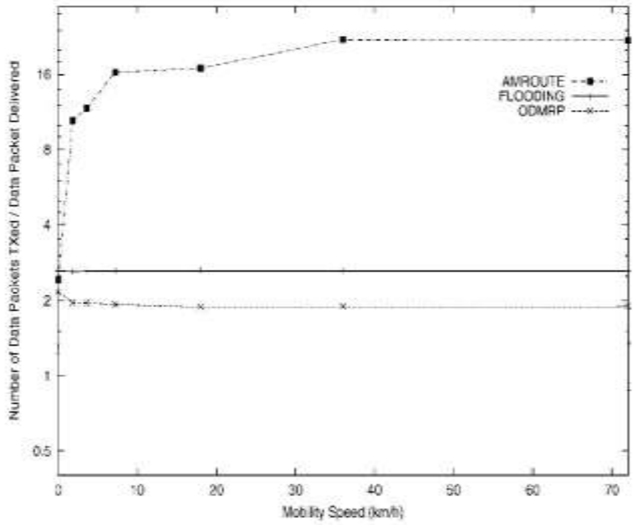


Figure 8: Number of data packets transmitted per data packet delivered as a function of mobility speed.

The overhead of control byte per data byte delivered is shown in figure 9**.** In this the header of data packet is included in control overhead.

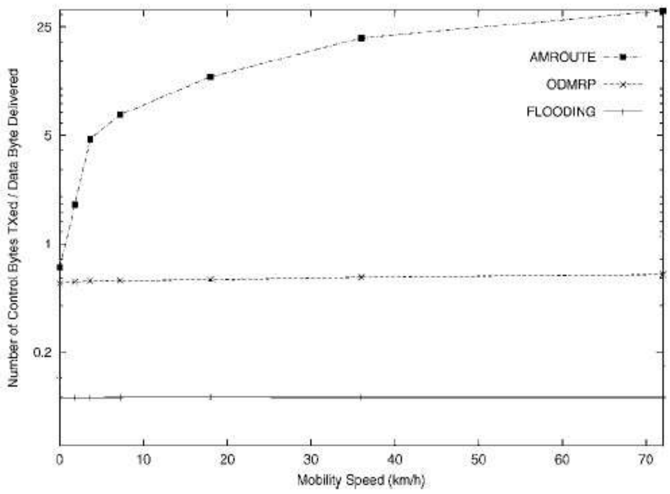


Figure 9: Number of control bytes transmitted per data byte delivered as a function of mobility speed

In case flooding of there are no control packets. Therefore, the header of packet only contributes to control overhead and this overhead does not increase with mobility. Overhead increases as speed increases in other protocols. The control overhead remains relatively constant in ODMRP because no updates are triggered by mobility. Refresh interval was set constant for the JOIN QUERY to three seconds and hence no additional overhead is required as mobility increases. AMRoute shows maximum value of ratio because of the data headers that are caught in the loops. The non-optimal tree results in having longer hops between member nodes and increasing the number of data transmissions.

Figure 10 shows the number of all packets transmitted per data packet delivered. It concludes that transmission in ODMRP more data packets on redundant paths and AMRoute has the highest value number of packet transmissions because of loops.

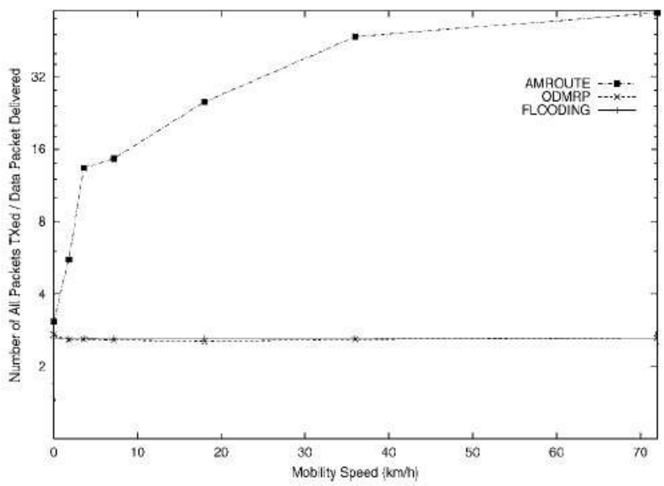


Figure 10: Number of total packets transmitted per data packet delivered as a function of mobility speed

VII.CONCLUSION

In this paper, a general view of multicast routing protocols in ad-hoc networks is given. Al most every multicast routing protocol supported by MANETstries to overcome some difficult problems which can be categorized under basic issues or considerations. Each protocols carries their own advantages and disadvantages.. Protocols based on Multicast treeare efficient and satisfy scalability issue, they have several drawbacks in ad hoc wireless networks due to mobile nature of nodes that participate during multicast session. It has bee observed that the mesh-based protocols provide more robustness against mobility and save the large size of control overhead used in tree maintenance. This type of protocolsmostly rely on frequent broadcasting, which may lead to a scalability problem when the number of sources increases. It becomes very difficult, on practical ground, to design a multicast routing protocol considering all the above mentioned issues.

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