MARS and IP Multicast Router as ATM-Multicast-Server: Solutions to Provide IP Multicast Services in Local ATM Networks

Torsten Braun and Stefan Gumbrich

IBM European Networking Center, Vangerowstr. 18, D-69115 Heidelberg
E-mail: braun@heidelbg.ibm.com, Phone: +49 6221/59-4352, Fax: +49 6221 3300

1 Introduction

There are several possible approaches to support multicast communication within an ATM subnetwork. A simple one is LAN emulation, where a special server broadcasts all multicast packets to all nodes within a subnetwork. The nodes have to filter the packet depending on their group membership. Moreover, the maximum packet size is limited to the maximum packet sizes of Ethernet or Token Rings LANs.

Another approach is the use of an IP multicast router as ATM multicast server. This abstract compares the so-called multicast router approach with the Multicast Address Resolution Server (MARS) concept currently being specified within IETF IP over ATM working group.

2 Multicast Router

Within this concept, an IP multicast router is configured as a multicast server for an ATM subnetwork [3,4]. This server provides multipoint VCs for each multicast group of the local ATM subnetwork. Multicast packets received from other subnetworks or from local senders are distributed over these multipoint VCs.

Group management is based on IGMP messages. End systems send IGMP messages via a point-to-point VC to the multicast router in order to join a group. Each end system that wants to join a group has to send IGMP Host Membership Reports, since the multicast router does not forward IGMP messages. Due to this, the router knows explicitely each local member of any group.

Based on this information, the router establishes and maintains one multipoint VC per group. Multicast packets received on point-to-point VCs from a sender are forwarded via the multipoint VC of the multicast group.

3 MARS

While the approach described above is limited to IP, the MARS concept is independent of the supported network (layer 3) protocol [1]. It is basically an extension of the ATM ARP server defined in RFC1577. However, new message formats and a new protocol are defined for multicast address resolution. The MARS concept supports both a server based approach and an approach based on VC meshes.

In the VC mesh approach, a multicast sender establishes multipoint VCs based on the address information obtained from the MARS. Multicast packets within a subnetwork are sent directly from the sender to all receivers. Depending on group membership information distributed by the MARS protocol each sender maintains its own multipoint VCs.

In the server based approach, multicast packets are sent to one or more multicast server (MCS) nodes. The MCSs distribute the multicast packets to the receivers of the local subnetwork.

4 Comparison

The multicast router approach requires relatively small changes of the multicast router software in order to receive and forward multicast packets. No additional protocol is required to implement the concept. The ATM end systems have only to know the multicast router address where to send multicast packets. This can be done following different solutions:

- The router address has to be configured manually within each end system.
- If the multicast router is running on the same machine as the ATM ARP server, an end system can send all multicast packets to the configured ATM ARP server address.
- The end system extracts the IP multicast router address from the received IGMP query packets.
- Another approach is to perform address resolution for multicast packets using a RFC1577 ARP server. The ARP server must return the ATM address of the multicast router when it receives an ARP request for a multicast group. In that case the end system software must perform address resolution for multicast addresses.

A disadvantage of the multicast router approach compared to the MARS VC mesh approach is that the multicast traffic is concentrated at the router. Multicast packets sent by a sender at the local ATM end system are delayed due to the additional hop. Implementation measurements will show the magnitude of the delay in this case. The same problem occurs with MARS MCSs. In contrast to the MARS MCS approach, there are no additional hops with the multicast router concept if the sender is located on an other subnetwork.

The main problem of the MARS VC mesh concept is the intensive usage of VCs [5]. For an ATM network with n senders and m multicast groups n * m multipoint VCs must be established and maintained to realize a MARS VC mesh, while only n + m multipoint VCs are necessary for a server based approach (either multicast router or MARS MCS). Furthermore, the signalling overhead of the ATM signalling protocol and the MARS protocol grows with the number of VCs.

A problem of the MARS MCS approach are possible routing loops, when routers receive a forwarded packet from a MCS. Furthermore, group management is performed twice, namely by IGMP at IP level and by MARS at ATM level. However, there are possible optimizations to reduce IGMP traffic using MARS group management information for IGMP.

5 Conclusions

The multicast router approach performs better than the MARS MCS concept and has only one disadvantage compared to MARS VC meshes. The throughput and delay for local ATM multicast traffic is expected to be worse than for MARS VC meshes. In other scenarios the multicast router has no performance drawbacks. It has significant advantages when parameters like resource utilization and signalling overhead are investigated.

All approaches discussed above support best-effort traffic only and do not provide any quality-of-service (QoS) guarantees. Therefore, it seems reasonable to apply a server based approach for traffic without throughput and delay constraints. Traffic with certain QoS constraints should be supported by resource reservation protocols such as RSVP. RSVP signalling can also be used to establish short-cuts between ATM end systems connected to different IP subnetworks but connected via several ATM switches [2]. The establishment of short-cuts is currently under study for the MARS approach and the multicast router concept.

6 References

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