

CS551

Multicast Routing: IGMP

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<http://merlot.usc.edu/cs551-f12>



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- ↳ the protocol by which hosts report their multicast group memberships to neighboring routers
- ↳ version 1, the current Internet Standard, is specified in RFC-1112
- ↳ version 2: RFC 2236
- ↳ operates over broadcast LANs and point-to-point links
- ↳ occupies similar position and role as ICMP in the TCP/IP protocol stack



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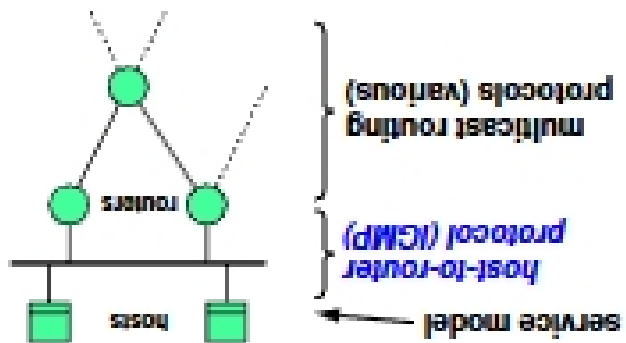
Link-layer Transmission/reception

- ↳ Transmission:
 - = an IP multicast packet is transmitted as a link-layer multicast, on those links that support multicast
 - = the link-layer destination address is determined by an algorithm specific to the type of link (next slide)
- ↳ Reception:
 - = the necessary steps are taken to receive desired multicasts on a particular link, such as modifying address reception filters on LAN interfaces
 - = multicast routers must be able to receive all IP multicasts on a link, without knowing in advance which groups will be sent to



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Components of the IP Multicast Architecture

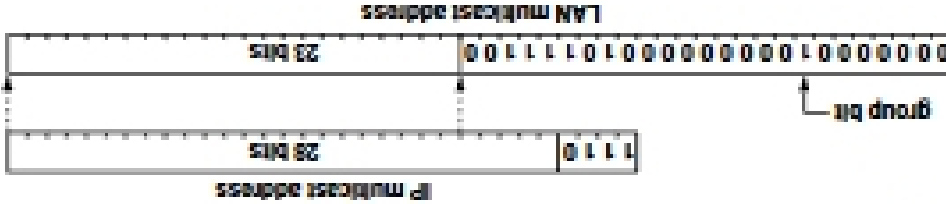


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Mapping to Link-layer Multicast Addresses

↳ for Ethernet and other LANs using 802 addresses:



↳ for point-to-point links: no mapping needed



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IGMP Version 1 Message Format

Ver's	Type	Reserved	Checksum
Group Address			

- Version : 1
- Type : 1 = Membership Query
2 = Membership Report
- Checksum : standard IP-style checksum of the IGMP message
- Group Address : group being reported (zero in Queries)



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IGMP Version 2

- changes from version 1:
 - new message and procedures to reduce "leave latency"
 - standard querier election method specified
 - version and type fields merged into a single field
- backward-compatible with version 1
- soon to appear as a Proposed Standard RFC
- widely implemented already

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IGMP Implications

- In normal case, only one report message per group present is sent in response to a query (routers need not know who all the members are, only that members exist)
- Query interval is typically 60 – 90 seconds
- IGMPv2 adds explicit leave messages
- To reduce join latency, when a host first joins a group, it sends one or two immediate reports (unsolicited responses), instead of waiting for a query

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How IGMP Works (Cont..)

The diagram shows a horizontal line representing a LAN. Below the line are several square boxes representing hosts, each labeled with the letter 'G'. Above the line are two circles representing routers, each labeled with the letter 'Q'. Vertical lines connect the routers to the LAN line. Dashed lines extend from the routers upwards.

- when a host's timer for group G expires, it sends a *Membership Report to group G*, with TTL = 1
- other members of G hear the report and stop their timers
- routers hear *all* reports, and time out nonresponding groups

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How IGMP Works

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- on each link, one router is elected the "querier"
- querier periodically sends a *Membership Query* message to the all-systems group (224.0.0.1), with TTL = 1
- on receipt, hosts start random timers (between 0 and 10 seconds) for each multicast group to which they belong

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IGMP Goal

- Determine what IP multicast groups have receivers present on the LAN
- just care about some vs. zero receivers, not how many

Approach

- designate one router as IGMP "querier"
- it asks all hosts
- get at least one response per active group
- example of *soft state* (periodically query), so occasional losses are okay

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Components of the IP Multicast Architecture

The diagram illustrates the components of the IP Multicast Architecture. It shows a 'service model' at the top, which includes a 'host-to-router protocol (IGMP)' and 'multicast routing protocols (various)'. Below this, two 'routers' are connected to each other and to a group of 'hosts'. The routers are represented by green circles, and the hosts by green squares.

Early Routing Techniques

- ↳ **Flood and prune**
 - = begin by flooding traffic to entire network
 - = prune branches with no receivers
 - = unwanted state where there are no receivers
 - examples: DVMRP, PIM-DM
- ↳ **Link-state multicast protocols**
 - = routers advertise groups for which they have receivers to entire network
 - = compute trees on demand
 - = unwanted state where there are no senders
 - examples: MOSPF

Multicast Tree Taxonomy

- ↳ Multicast routing can build different types of distribution trees
- ↳ **Source-based trees**
 - = separate shortest path tree (SPT) for each sender
 - o can have multiple senders per group
 - examples: DVMRP, MOSPF, PIM-DM, PIM-SM
- ↳ **Shared trees**
 - = single tree shared by all members
 - = shared tree rooted at group core/rendezvous point
 - examples: CBT, PIM-SM

Multicast Routing

- ↳ Multicast service model makes it hard to locate receivers
 - = anonymity
 - = dynamic join/leave
- ↳ Options so far (not very efficient)
 - = flood data packets to entire network, or tell routers about all possible groups and receivers so they can create routes (trees)

Rendezvous Options

- ↳ Specify **rendezvous** (or meeting place) to which sources send initial packets, and receivers join; requires mapping between multicast group address and meeting place
 - examples: CBT, PIM-SM

Source-based Trees

The diagram shows a network topology with several nodes and links. Two paths are highlighted: one in red and one in blue. The red path starts from a source on the right and goes through several nodes to a destination on the left. The blue path starts from a source on the left and goes through several nodes to a destination on the right. This illustrates how source-based trees create separate shortest path trees for each sender.

- = output link determined from input link, multicast address, and source address