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Comparison of Concepts for IP Multicast over ATM

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Comparison of Concepts for IP Multicast over ATM

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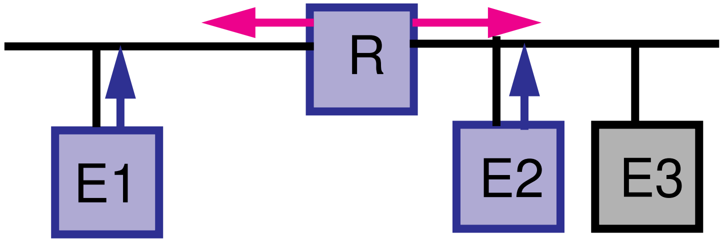
IP Multicast over ATM - Issues

- Multicast support is essential for applications such as video/audio conferencing, video distribution services (like Mbone....)
- IP multicast (group management, routing, data forwarding) is designed for shared medium LANs connected via pt-to-pt links

IGMP operation:

→ members listen to IGMP query packets
→ only 1 member of a subnet must respond



Issues:

- ATM UNI 3.0, 3.1, 4.0 knows pt.-to-multipt. VCs, but no ATM group adresses
- how to map IP group addresses onto ATM VCs?
- how to distribute IP multicast data packets over ATM VCs efficiently
    - without using broadcast
    - direct multicast or server based approach

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IP Multicast over ATM - Solutions

1. LAN Emulation
   - built in "*Broadcast and Unknown Server* (BUS)"
2. Multicast Address Resolution Server (MARS)

   address resolution:
   - MARS

   data distribution
   - VC-Mesh
   - Multicast Server (MCS)
3. Multicast server extensions of a multicast IP router (*mrouted*)

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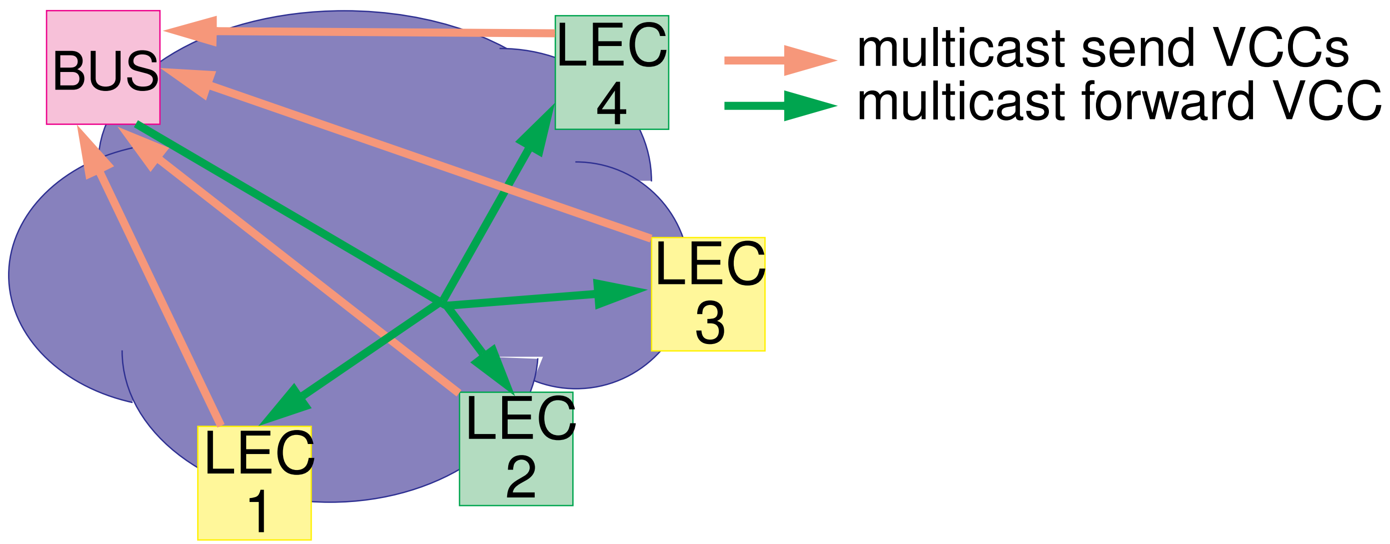
LAN Emulation



[+] no additional protocol or protocol modifcations required

[–] Broadcast and Unknown Server (BUS) broadcasts multicast packets received from the LAN Emulation Client (LEC) systems

[–] all clients receive all packets of all groups

[–] additional hop for local traffic and for non-local traffic (from a multicast router)

[–] multicast traffic is concentrated to the BUS (bottleneck), but

[+] LANE 2.0 (LNNI 2.0) allows for multiple BUSs

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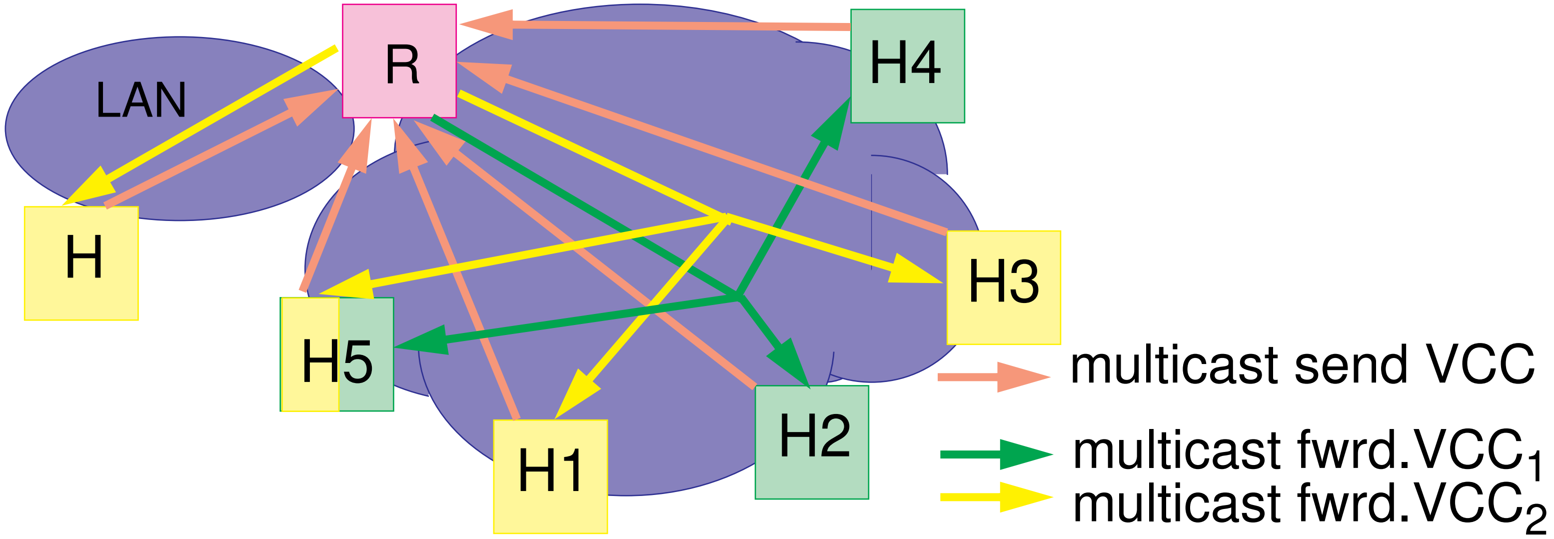
Multicast IP Router as Multicast Server



[+] separate pt.-to-multipt.-VCs per MC group -> multi-, not broadcast MC VC establishment based on IGMP packet analysis

[+] no additional protocol, minor modifications of end system implementations(all multicast packets must be sent to router)

[+] no additional hop for traffic via the multicast router because of integrated server function

[–] additional hop for local multicast traffic

[–] multicast traffic is concentrated to the multicast router

[–] group members receive copy of own data

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Multicast Address Resolution Server (MARS)

- ATM/IP end systems send special MARS PDUs
  - in order to join or to leave a group
  - and to query ATM adresses for a given group address
- multicast address resolution server (MARS) maintains a table {IP multicast adr, MCS adr, ATM adr 1, ..., ATM adr N}
- ATM target addresses are either
  - end system addresses (VC Mesh) or
  - multicast server addresses (MCS)
- the MARS server returns the list of addresses associated with requested IP multicast address (may be MCS address)
- requesting end system establishes pt.-to-multipt. VCs to the ATM end systems or pt-to-pt for a single MCS contained in the returned address list for sending multicast packets
- MARS mechanism is independent of IP, applicable to other network layer addresses

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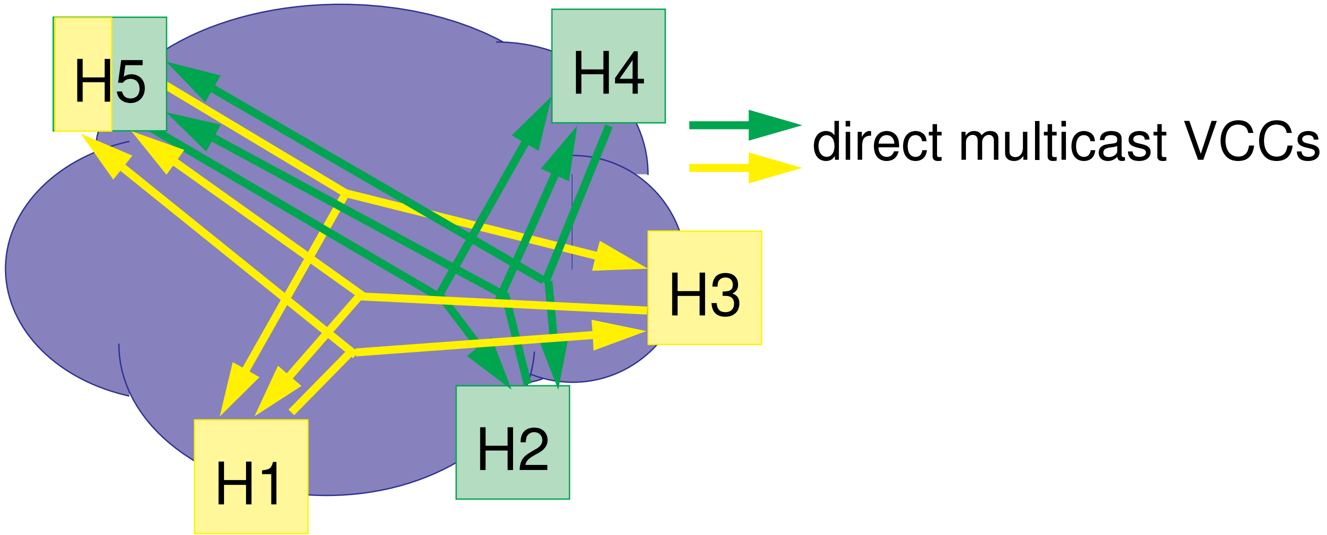
MARS - VC Mesh



[+] direct point-to-multipoint VCs as needed

[+] no additional hops for internal or external traffic

[+] multicast traffic is not concentrated to a single system

[–] n·m point-to-multipoint VCs for n senders and m groups

[–] all hosts need do be aware of group membership status, high control & signaling overhead for distribution of group information over the cluster control VC (group changes affect MC VCs on each host)

[–] new (MARS-) protocol needed in each host (clients & MARS)

[+] group members don’t receive copy of own data

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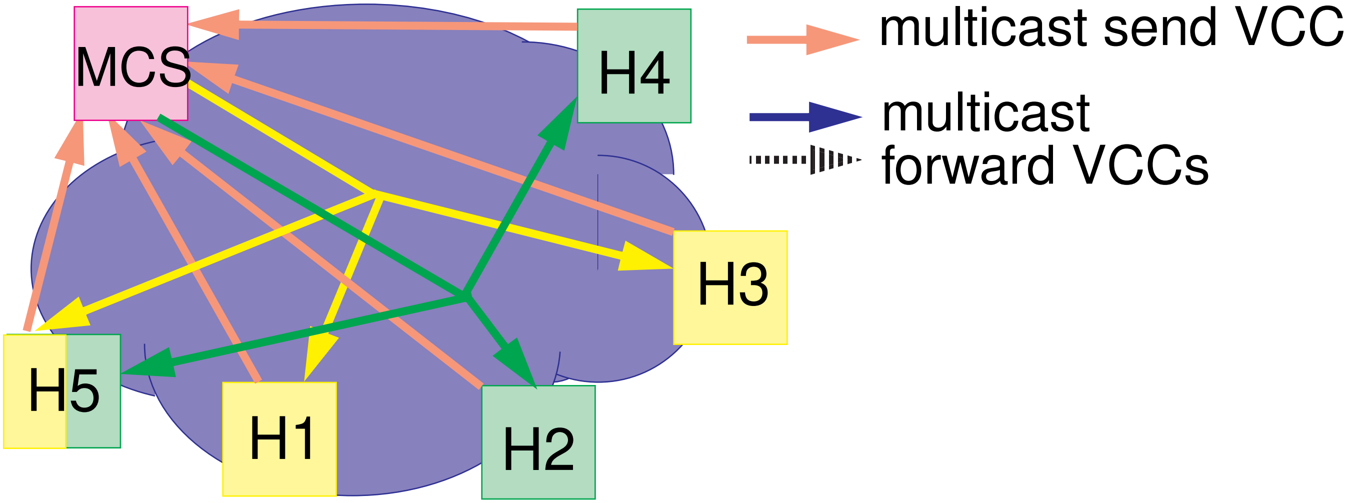
MARS - Multicast Server (MCS)



[+] separate point-to-multipoint VCs for each group (-> multicast)

[+] multicast traffic can be served by several MCSs (-> load distribution)

[–] additional hop for local traffic

[+] no additional hop for traffic via multicast router with integrated MCS

[–] additional hop for traffic from multicast router if MCS is not integrated

[–] new (MARS-) protocol needed in each host (clients & MARS)

[–] group members receive copy of own data

[–] routers receive copy of own data - potential for MC-loops

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Comparison

n groups with m members	LANE	MARS VC Mesh	MARS MCS	Multicast Router
broad- / multicast	*broadcast*	multicast	multicast	multicast
additional hops for local traffic	1	0	1	1
additional hops for external traffic	1	0	0[1]/1	0
bottleneck node	yes	no	no/yes[2]	yes
signaling overhead	low	high	low	low
required VC resources	1*(1:m)VC m*(1:1)VCs	n*m (1:m-1)VCs	n*(1:m)VCs m (1:1)VCs	n*(1:m)VCs m (1:1)VCs
implement. effort	*simple*	complex	complex	simple
QoS support	no	no	no	no

[1] MCS co-located with IP multicast router, [2] single MCS

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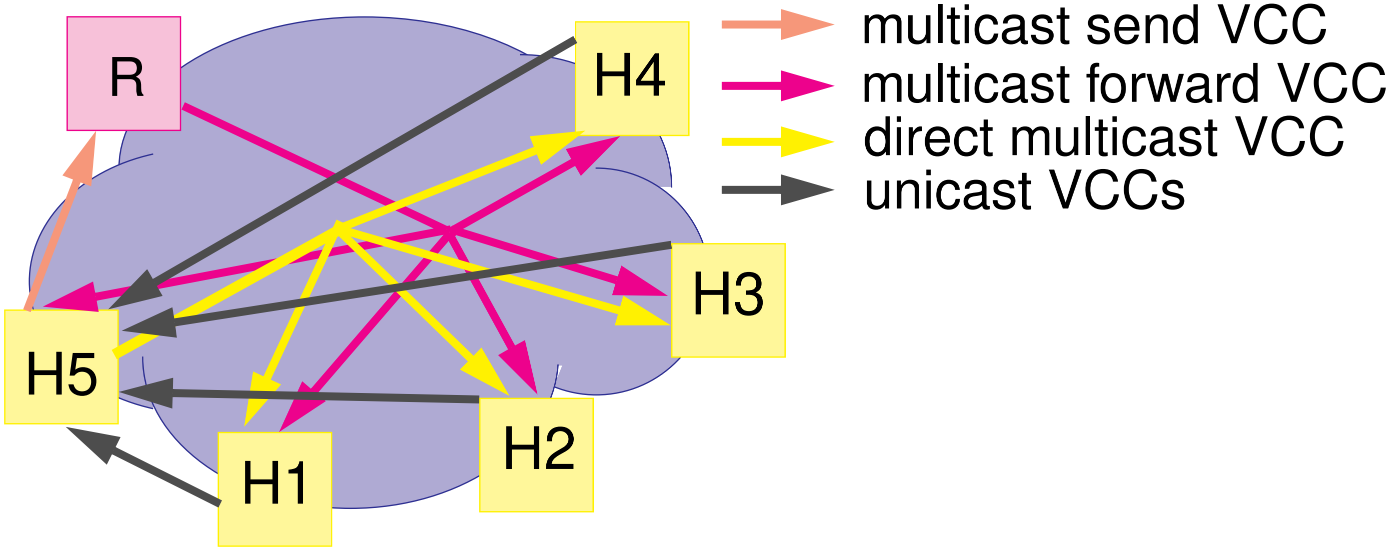
Quality-of-Service Support

- RSVP (resource reservation protocol) is required for quality-of-service support of multicast data



- Example: H5 sends data with QoS requirements
  1. H5 sends PATH msg. via multicast router or MCS to MC-group
  2. H1-4 return RESV message to H5 (pt-to-pt)
  3. H5 establishes a point-to-multipoint VC to H1-4 with appropriate quality-of-service parameters (preferably direct VCs)
- no heterogeneous QoS for ATM pt-to-multipt VCs

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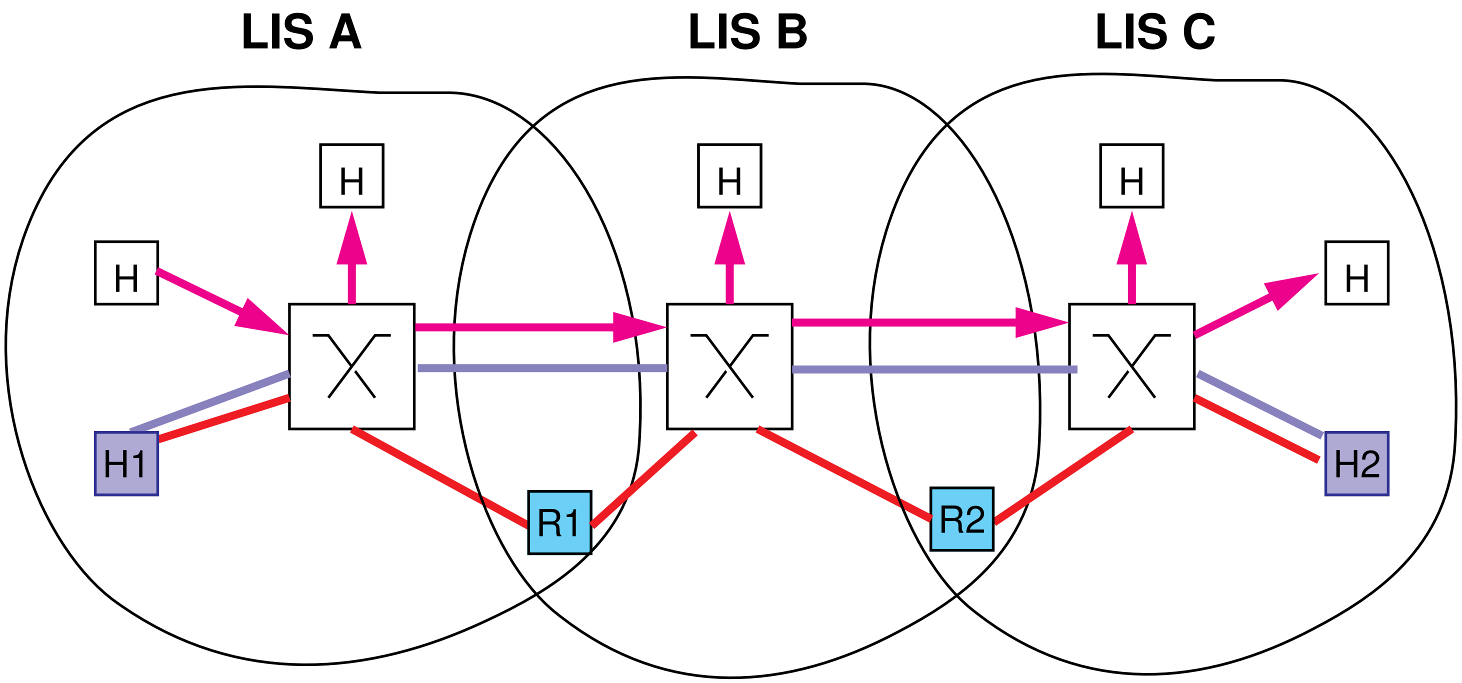
MARS and NHRP

- current MARS handles intra-LIS communication only
- Next Hop Resolution Protocol (NHRP) provides inter-LIS shortcuts for pt-to-pt only



- how to handle inter-LIS multicast with direct VCs?
  - bypassing of mrouters creates problems
  - pruning of MC-trees?

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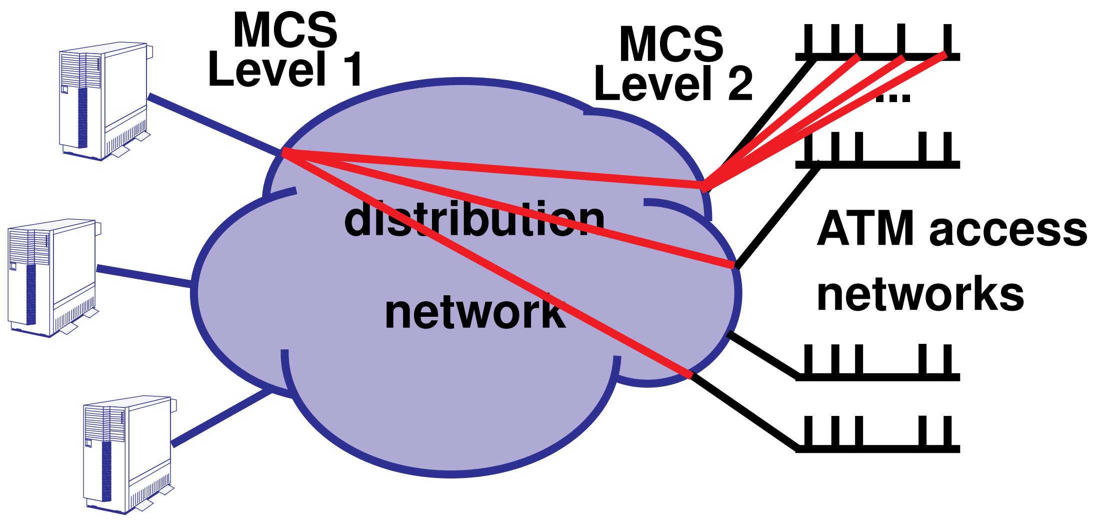
Video Server Example

characteristics:

- only a few senders - tree like communication
- potentially a large and varying number of receivers
- high-bandwidth
- soft realtime requirements



preferred solution:

- hierarchical MARS/MCS approach
- MARS extensions for leaf initiated join (UNI 4.0) needed

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Conferencing Example

characteristics:

- small number of participants (< 10)
- add/drop happens infrequently
- medium-high bandwidth
  => all 3 options feasible
- stringent realtime requirements
  => VC-Mesh
- centralized conference for
  - security, audio mixing, floor passing, ...

  => server approach

preferred solution:

- VC Mesh approach appropriate for realtime
- MCS fits in with existing conference server

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Conclusion

- IP Multicast over ATM can be implemented in four flavors:
  1. using LAN Emulation
  2. using an multicast router, extended by group management functions
  3. using MARS for address resolution and
     - a direct VC-Mesh for data
     - or a multicast server approach
- the MCS approach saves VCs and signalling overhead and is the prefered solution for “data” communication
- QoS enhanced multicasting is implemented
  - with RSVP signalling
  - MARS for MC address resolution
  - and direct pt-to-multipt. VCs (MC trees)
  - but no heterogeneous trees (so far)

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References

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