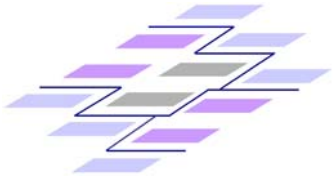


Scalable Adaptive Multicast (SAM) Research Group
www.samrg.org

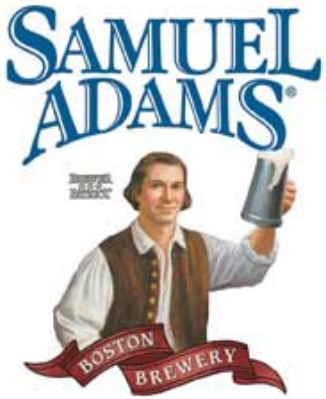
Chairs:

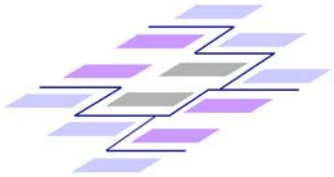
John Buford

Jeremy Mineweaser

July 13, 2006 - IETF 66

Introducing … “SAM”





Scalable
Adaptive
Multicast
RG

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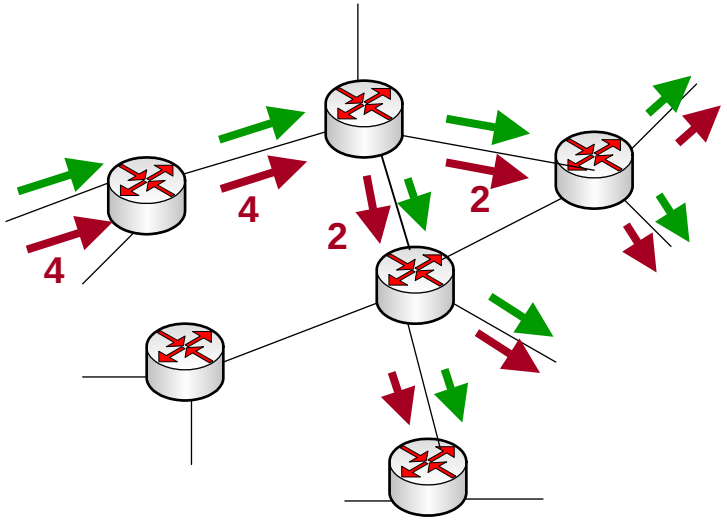
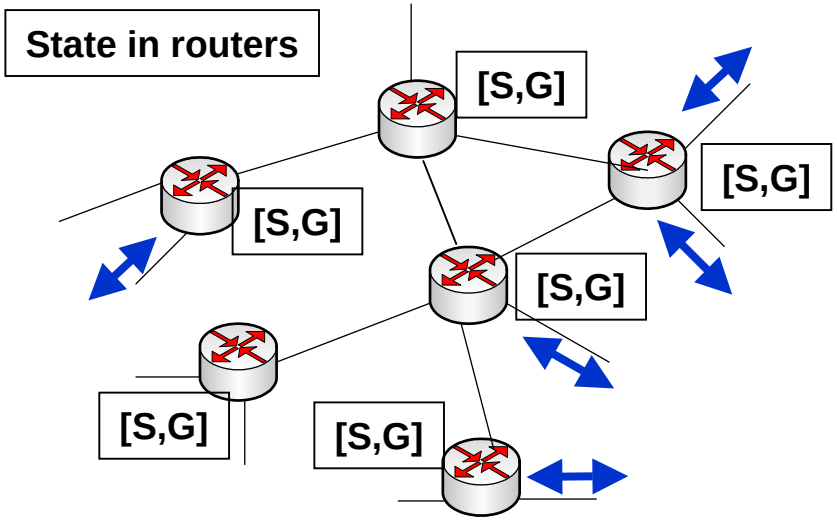
Agenda

- Brief review of IP multicast
- Application layer and overlay multicast approaches
- Hybrid approach
- Goal: SAM Framework
- RG Workplan

Short Review of IP Multicast





IP multicast data packets

IP unicast data packets

IGMP join/leave/query packets

- Sender(s) send to multicast group address
- Receivers join the multicast group by messages to nearest router
- Routers forward data packets
- One-to-many and many-to-many paths

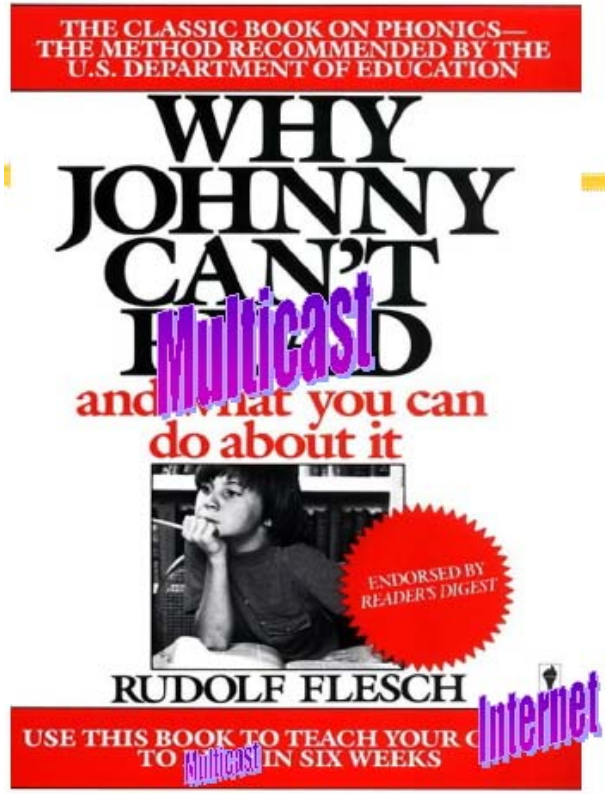
- Some related RFCs
  - RFC 3973 PIM-DM
  - RFC 3376 IGMP v3
  - RFC 2189 CBT
  - RFC 1075 DVRMP
- Active WGs:
  - PIM, SSM, MSEC, RMT

Why do we need IP Multicast?

- Multicast achieves bandwidth savings over unicast
- Bandwidth savings proportional to group size (Chuang-Sirbu scaling law)
  - Group of 10 => 33% BW savings
  - Group of 1000 => 70% BW savings
  - Conferencing applications are particularly efficient
- Important applications (e.g., real-time streaming) are difficult or impossible without it

Many possible applications but slow deployment

- Deployment issues:
  - Business model
  - Global deployment requirement
- Scaling issues
  - Number of available group addresses
  - Router state vs. many small groups

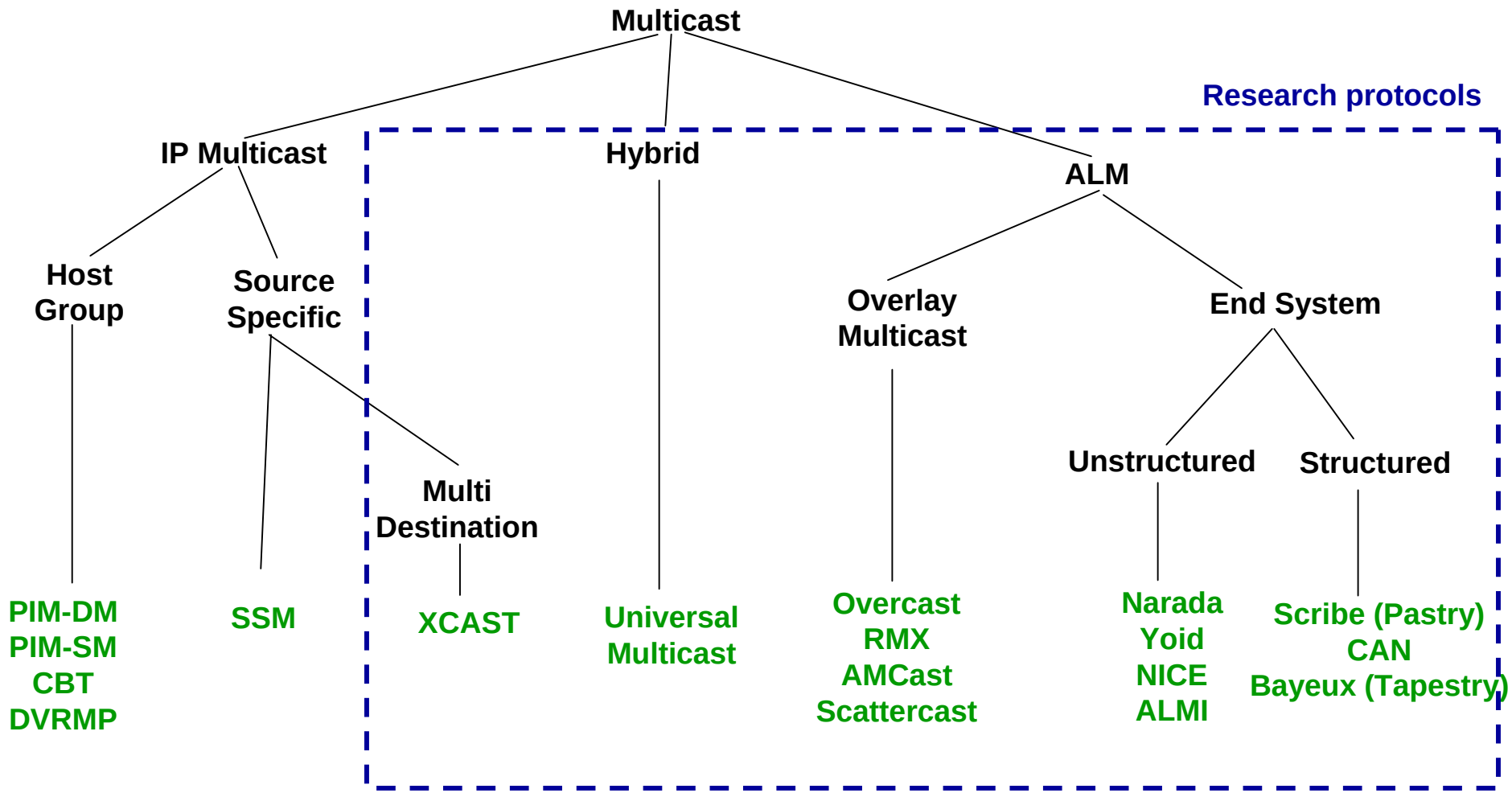


Mostafa Ammar. Why Johnny Can't Multicast Lessons about the Evolution of the Internet. Keynote - NOSDAV 03.

RG Goal: Enabling the Benefits of Multicast

- Offer flexible and incremental deployment options
  - Not all end-points may have network infrastructure support
  - Enable growth of multicast applications
- Address other dimensions
  - Highly dynamic group membership
  - Millions of small groups
  - Concatenated VPNs
  - Mobile networks

Taxomony


Multicast
Research protocols
IP Multicast
Hybrid
ALM
Host Group
Source Specific
Multi Destination
Overlay Multicast
End System
Unstructured
Structured
PIM-DM
PIM-SM
CBT
DVRMP
SSM
XCAST
Universal Multicast
Overcast
RMX
AMCast
Scattercast
Narada
Yoid
NICE
ALMI
Scribe (Pastry)
CAN
Bayeux (Tapestry)

Application Layer Multicast

Application Layer Multicast

- Multicast is controlled only by participating end-hosts without explicit support of intermediate routers or proxies
- A rendezvous point (RP) is registered in a public directory
- Each node has application software for connecting to multicast sessions
- Various ways to join the multicast tree

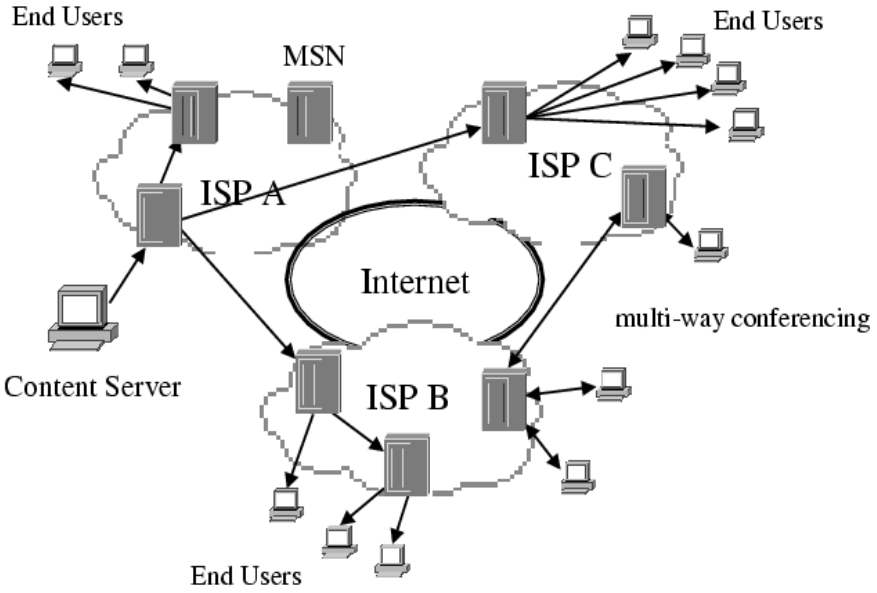
Application Layer Multicast

- Advantages
  - Scalability
    - Routers do not need to maintain per-group state
    - End systems do, but they participate in very few groups
  - Leverage solutions for unicast congestion control and reliability
- Disadvantages
  - Inefficient trees lead to longer latency
  - Dependent on host resources and availability
  - Doesn’t leverage native infrastructure support where it exists

Overlay Multicast

Overlay Multicast

- Basic idea
  - Construct a backbone overlay by deploying special intermediate proxies
  - Proxies create multicast trees among themselves
  - End hosts communicate with proxies via unicast or native multicast
- Examples
  - Overcast, RMX, OMNI, Scattercast, Amcast



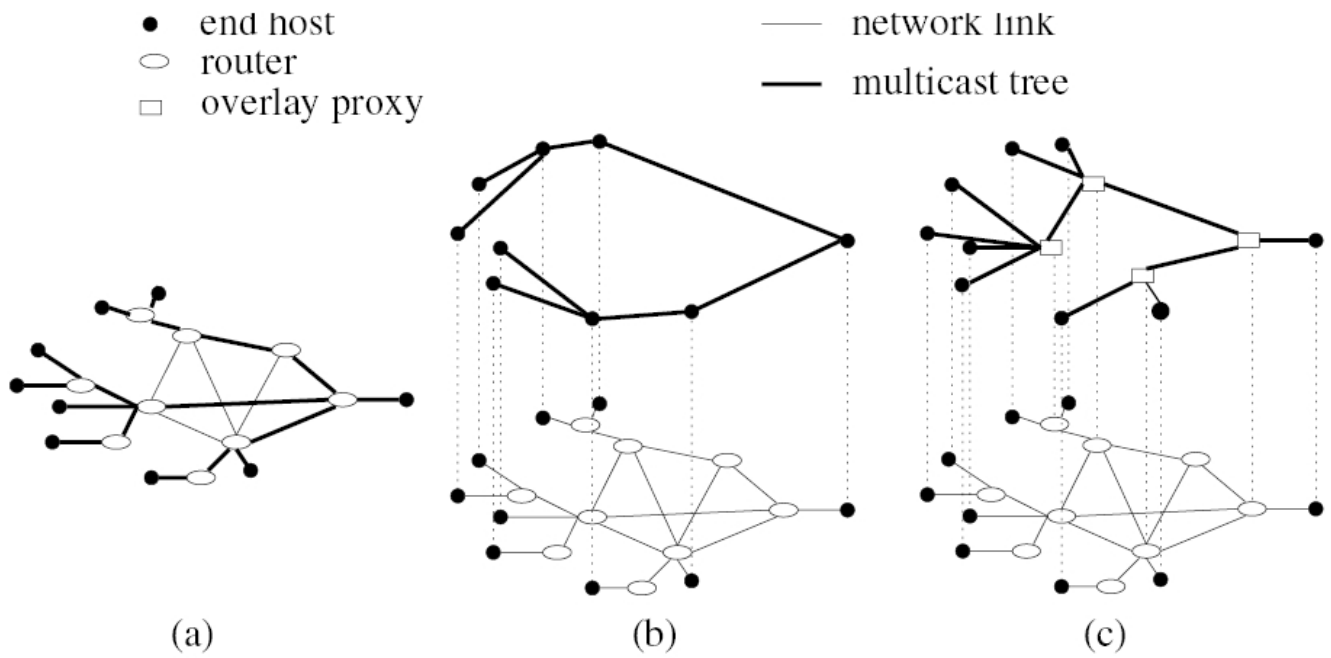
Sherlia Y. Shi and Jonathan S. Turner, Multicast Routing and Bandwidth Dimensioning in Overlay Networks *IEEE Journal on Selected Areas in Communications*, Vol.20, No.8. October 2002.

Overlay Multicast

- Advantages
  - Doesn’t require router upgrade
  - Performance can approach native multicast
- Disadvantages
  - Requires infrastructure deployment and provisioning
  - Faces inter-provider interoperability issues

ALM vs OM

- OM has better performance than ALM and simpler deployment than native multicast
- But requires wide deployment to provide service through out network



IP Multicast **ALM** **OM**

L. Lao, J.-H. Cui, M. Gerla and D. Maggiorini. A Comparative Study of Multicast Protocols: Top, Bottom, or In the Middle? in *Proceedings of 8th IEEE Global Internet Symposium (GI'05)* in conjunction with IEEE INFOCOM'05, Miami, Florida, March 2005.

Hybrid

Hybrid Approaches

- Basic idea
  - Combine islands of IP multicast deployment with application level multicast
  - Transition between multiple multicast mechanisms to optimize performance

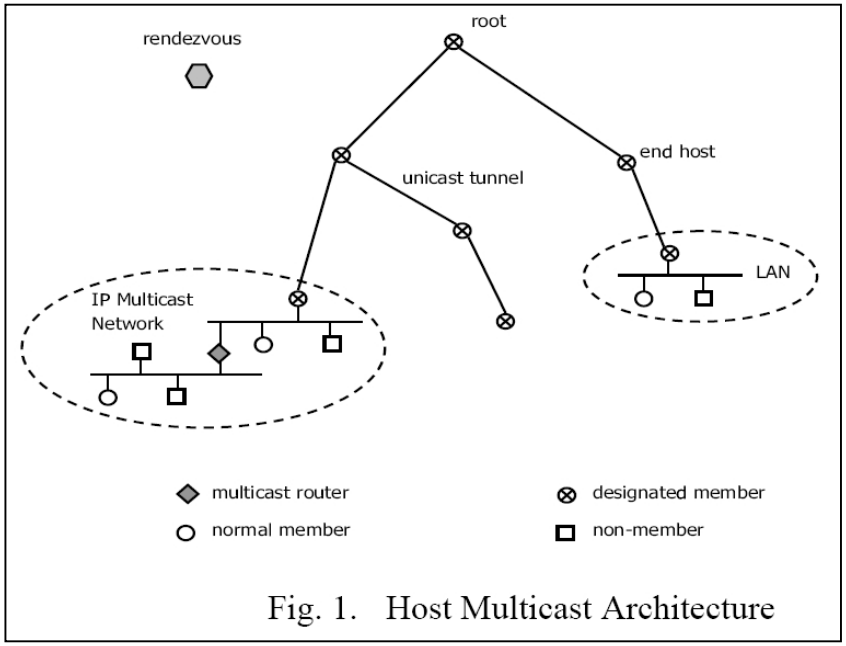


Fig. 1. Host Multicast Architecture

B. Zhang, S. Jamin, and L. Zhang. Universal IP multicast delivery. In *Proc. of the Int'l Workshop on Networked Group Communication (NGC)*, Oct. 2002

Hybrid Approaches

- Advantages
  - Provides capability despite partial IP multicast availability
  - Enables multicast mechanisms tuned to network characteristics (e.g. link intermittency)
- Disadvantages
  - Complexity and performance loss due to
    - Mapping different join/leave and routing protocols
    - Brokering different group management mechanisms
  - Application sensitivity to performance variations

Goal: A Unified Framework

- Basic idea
  - Enables interoperability of different multicast protocols based on network, traffic, and group properties
  - Dynamically transition between protocols/mechanisms to optimize performance
- Some challenges
  - Understanding multicast support by region is a type of topology awareness
  - Trees that cross regions require mapping between different protocols
    - Tree construction, group membership, loop detection, etc.

What is the RG doing?

- First meeting IETF66
  - 2 IDs
  - Presentations on GIG and survey of ALM/OM systems
- What's our work plan
  - Problem statement and driving scenarios
  - Requirements for SAM Framework
  - Survey of ALM/OM/Hybrid technologies and performance metrics
- Meeting schedule
  - Meeting at Workshop on Peer-to-Peer Multicasting, Jan 2007
    - Part of IEEE Consumer Communications and Networking Conference
  - One other networking conference in 2007, venue under discussion
- Further information
  - Website: www.samrg.org, Mailing lists: sam@irtf.org
  - Biblio on website