Extending OMNet++ INET Framework for SAM Simulation

Mario Kolberg (U. Stirling)

John Buford (Avaya Labs Research)

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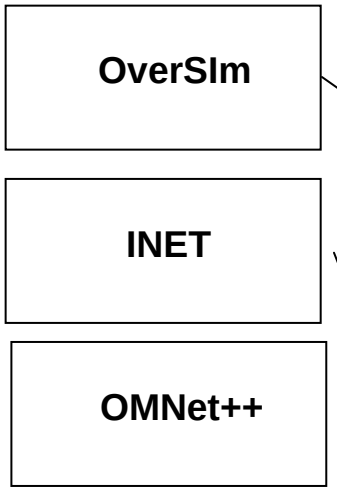
Problem Statement

- Goal: Validate hybrid overlay multicast for large scale overlays
- But existing P2P simulators …
  - Don’t scale
  - Don’t model network topology
  - Don’t have native multicast and AMT models
- $\Rightarrow$ Select an existing P2P simulator (OverSim) and add extensions to network layer
- $\Rightarrow$ Get feedback from RG and look for additional collaborators who will contribute to the needed models

Summary of OMNet++/INET/OverSim



- Various structured overlays
- “Simple” Topology and more realistic topologies
- ALM
- P2P-SIP

Needed for SAM:

- Coupling of ALM with Native layer

- TCP
- UDP
- IP
- ICMP
- OSPFv2
- ARP
- Ethernet MAC

Needed for SAM:

- IGMPv3
- MLDv2
- AMT - underway
- PIM - incomplete
- XCAST - Done

XCAST implementation in INET (work performed by Mario Kolberg)

- New elements (NED files)
  - IPXCast
  - NetworkLayerXCast
  - RouterXCast
  - TCPDumpXCast
  - UDPXCast
  - UDPXCastApp
- Minor changes to existing code
  - TCPDump
  - IPRoute
- Details and demo at next SAM interim meeting
  - M. Kolberg, J. Buford. An XCAST Multicast Implementation for the OverSim Simulator. IEEE CCNC 2010, Jan. 2010.

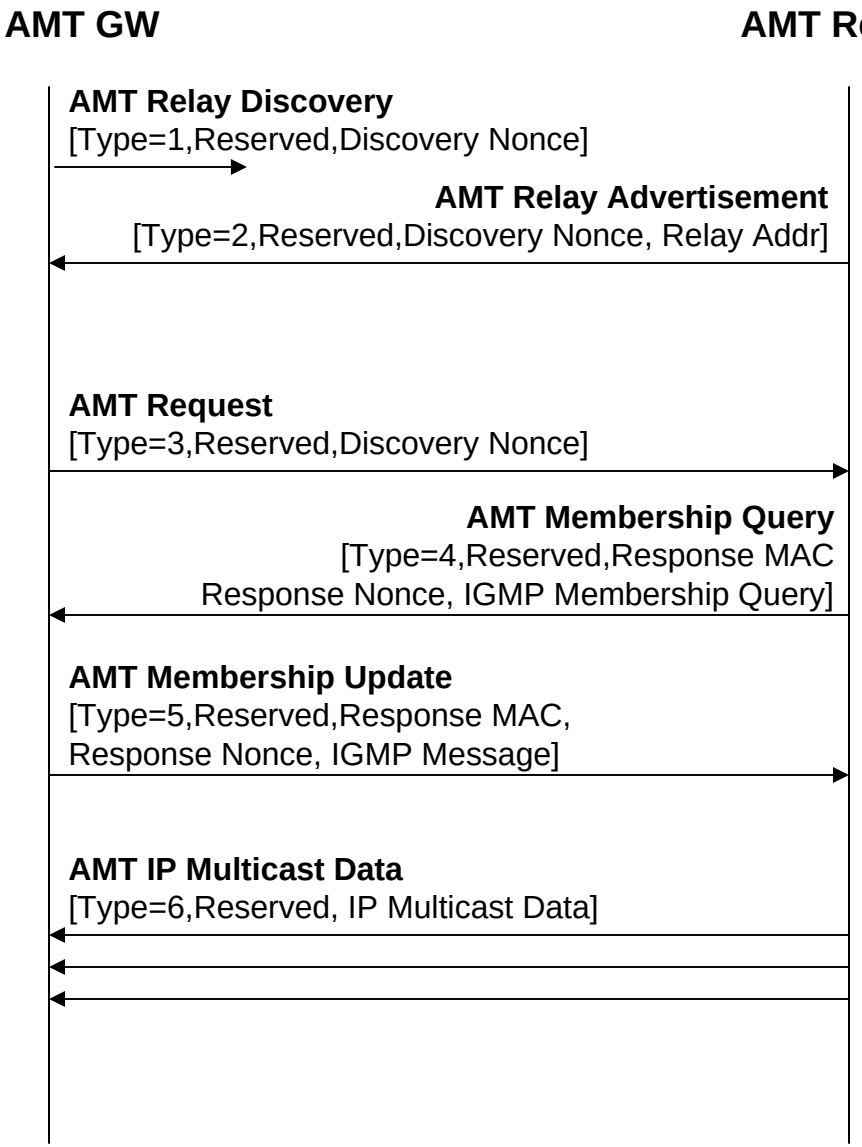
Example – XCAST message in INET (work performed by Mario Kolberg)

```
packet IPDatagramXCast
{
    short version = 4;
    short headerLength = IP_HEADER_BYTES;

    IPAddresses destAddress;
    IPAddress srcAddress;

    int transportProtocol enum(IPProtocolId) = IP_PROT_NONE;
    short timeToLive;
    int identification;
    bool moreFragments;
    bool dontFragment;
    int fragmentOffset;
    unsigned char diffServCodePoint;

    int optionCode enum(IPOption) = IPOPTION_NO_OPTION;  //#FIXME modify header length when
      options are present
                                                  //#FIXME also: the RFC says that more than one IP-Option is allowed
    IPRecordRouteOptionXCast recordRoute;
    IPTimestampOptionXCast timestampOption;
    IPSourceRoutingOptionXCast sourceRoutingOption; // optionCode determines if strict or loose source
      routing
}
```

AMT

- D. Thaler, M. Talwar, A. Aggarwal, L. Vicisano, T. Pusateri. Automatic IP Multicast Without Explicit Tunnels (AMT). Internet Draft draft-ietf-mboned-auto-multicast-09, Work in progress. June 2008.
- Used in SAM to create overlay-controlled paths between native multicast regions
- AMT highlights
  - 6 message types
  - All messages are UDP
  - AMT Gateway can be in either host or router

AMT Messaging



- Send UDP discovery packet to AMT Relay's anycast address
- Send UDP advertisement packet to AMT GW's unicast address, giving Relay Addr
- AMT Request (Initiate 3-way handshake) to either GW or Relay unicast address

INET Design for AMT

- Three AMT modules are needed:
  - AMT-GW, AMT-Router, and AMTApp.
- AMT-GW module
  - implements both the six message types to the AMT-Router.
  - Acts as an IGMP proxy on the local network.
- AMT-App module is needed for endpoint multicast apps running on the same host as the GW to participate in an AMT connection.
- AMT-Router module supports the ATM router side of the messaging to the GW, and connects to other multicast-enabled routers.

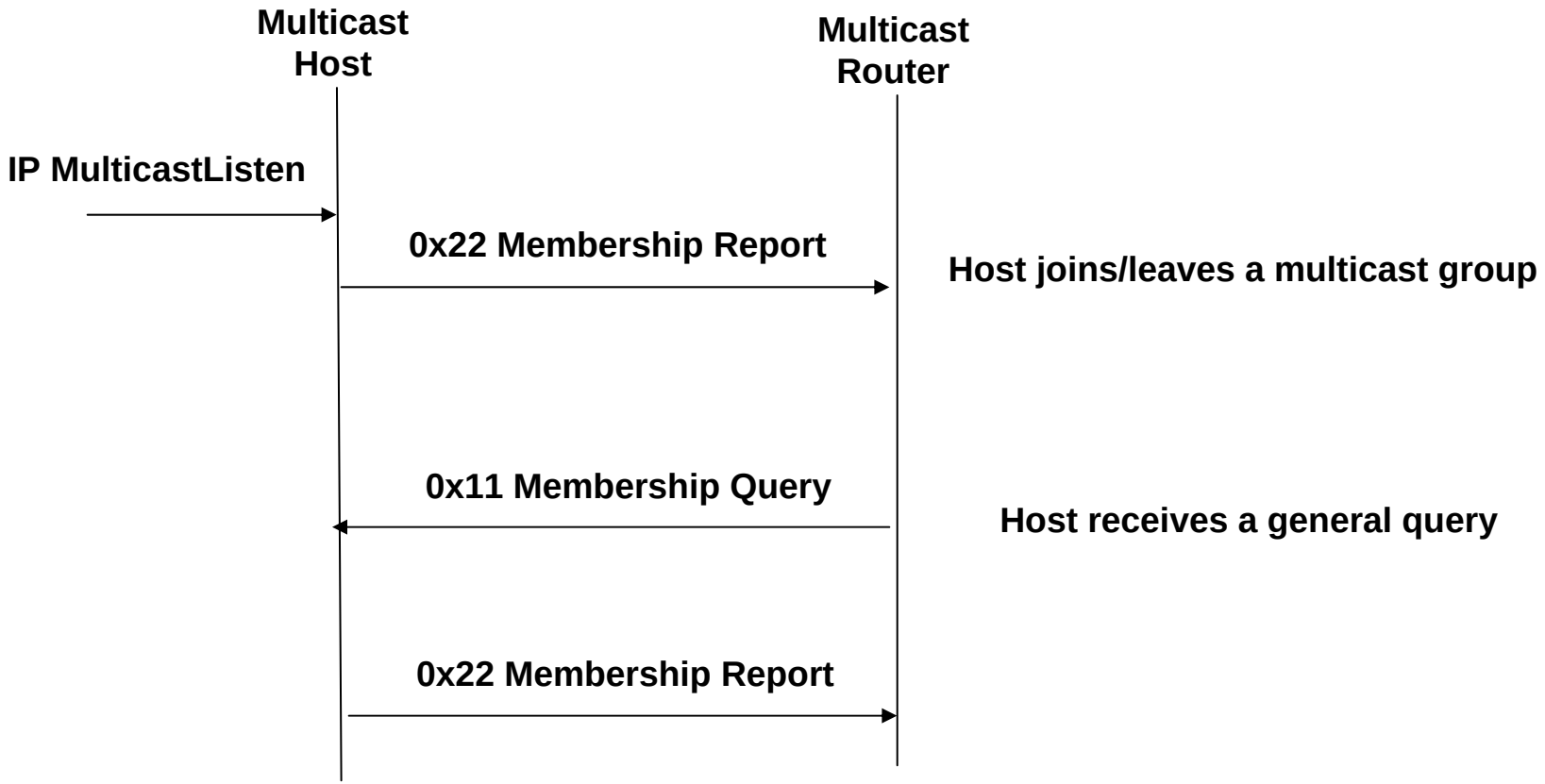
AMT Issues for INET

- AMT requires anycast addressing
  - Is anycast addressing implemented by the BGP routing mechanism?
- INET doesn’t have BGP routing
- AMT Relay anycast address is not defined in the -09 ID

IGMPv3

- Multicast reception state (RFC 3376 sec 3)
  - Per socket: (interface, multicast-address, filter-mode, source-list)
  - Per interface: (multicast-address, filter-mode, source-list)
- Message types (RFC 3376 sec 4)
  - 0x11 Membership Query
    - Type = 0x11 | Max Resp Code | Checksum | Group Address | Resv | S| QRV | QQIC | Number of Sources (N) | Source Address [1..N]
  - 0x22 v3 Membership Report (we don’t require backward compatibility to v2 and v1)
    - Type = 0x22 | Reserved | Checksum | Reserved | Number of Group Records (N) | Group Record [1..N]

Messaging Examples



Others:
Routers receive a report
Querier receives a “leave group” message

See: http://www.hep.ucl.ac.uk/~ytl/multi-cast/igmp_01.html

IGMPv3 for INET

- NED files
  - IGMPv3Interface
  - MulticastSocket
- Message types
  - MembershipQuery
  - Membership Report

PIM in INET

- PIM implementation seems to be experimental and unmaintained

Discussion

- If you are interested in collaborating on INET extensions, please contact one of the authors

Related Work

- J. Buford, M. Kolberg. Hybrid Overlay Multicast Simulation and Evaluation.IEEE CCNC 2009 (short paper). Jan. 2009.