Extending OMNet++ INET Framework for SAM Simulation

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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

⇒ Select an existing P2P simulator (OverSim) and add extensions to network layer

⇒ Get feedback from RG and look for additional collaborators who will contribute to the needed models
Summary of OMNet++/INET/OverSim

OverSim

INET

OMNet++

- Various structured overlays
- "Simple" Topology and more realistic topologies
  - ALM
  - P2P-SIP
- TCP
- UDP
- IP
- ICMP
- OSPFv2
- ARP
- Ethernet MAC

Needed for SAM:
- Coupling of ALM with Native layer

- 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
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

- 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 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

Host joins/leaves a multicast group
Host receives a general query
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