Multicast Simulation and Modeling in OMNeT++
Agenda

1) Introduction & Motivation

2) Multicast in OMNeT++

3) Use-case example and its validation

4) Final Notes
Our Research

Formal verification and analysis of computer networks
- Reachability analysis
- Static analysis
- Simulation and modeling

Two goals
- Long-term: Variety of tools helping network administrator
- Short-term: Framework for multicast simulation

Selected resources
- ANTLR
- OMNeT++ with INET framework
- ANSA extension – our dedicated software
Basic Idea

Introduction
Contribution
Use-case
Conclusion

Real Network

Running configuration

SNMP

Suggest configuration or design changes

Create model

OMNeT++
Paper Outlines...

- Multicast
  - Goal driven by our university needs

- ANSATranslator
  - ANTLR grammar translator
  - from running config to XML

- ANSARouter
  - Enhanced compound model with multicast support

- ANSASwitch
General Multicast Architecture

Multicast distribution trees
Proposed Modules

- **Routing (IPv4 and IPv6)**
  - RIP
  - OSPFv2
  - OSPFv3
  - IGMP, MLD
  - PIM

- **Switching**
  - VLANs
  - RSTP
  - MSTP
  - TRILL

- **Quality of Service**
  - Queues (PQ, WFQ, CBWFQ)
  - Dropping algorithms (RED, WRED)
OSPFRouter and ANSARouter
Multicast in Network Layers

- NetworkLayer – IGMP Module

- NetworkLayer6 – ICMPv6 Module

![Diagram of multicast in network layers]
IGMPv2

- Comparable with RFC 2236
  - Election of IGMP Querier
  - Generating and processing of messages
  - Finite state machine
- Simplified message structure

```c
enum IGMPType
{
    IGMP_MEMBERSHIP_QUERY = 0x11;
    IGMP_MEMBERSHIP_REPORT_V1 = 0x12;
    IGMP_MEMBERSHIP_REPORT_V2 = 0x16;
    IGMP_LEAVE_GROUP = 0x17;
};

// IGMP message class
//
packet IGMPMessage
{
    short type enum(IGMPType);
    short maxRespTime;   // 1/10 s (e.g. for 10 s = 100)
    IPAddress groupAddress;
};
```
Use-Case
Different Scenarios Behavior

- **Signing on to the multicast group**
  - Membership General Query,
  - Membership Report
- **Leaving the multicast group**
  - Leave Group, Membership Specific Query
- **Timing out group membership**
  - Membership Query...after 350 s
Validation

- Cisco 2621 with IOS12.24 and Ubuntu 10.10 hosts
- Same order of message exchange but different times

```c
/* initialization of timers and variables*/
ROBUSTNESS_VARIABLE = 2; // default: 2
QUERY_INTERVAL = 125; // default: 125 s
QUERY_RESPONSE_INTERVAL = 100; // default: 100 = 10 s
QUERY_RESPONSE_INTERVAL_SEC = QUERY_RESPONSE_INTERVAL / 10; // to seconds
LAST_MEMBER_QUERY_COUNT = ROBUSTNESS_VARIABLE;
LAST_MEMBER_QUERY_INTERVAL = 10; // default: 10 = 1 s
LAST_MEMBER_QUERY_INTERVAL_SEC = LAST_MEMBER_QUERY_INTERVAL / 10; // to seconds
LAST_MEMBER_QUERIER_INTERVAL = LAST_MEMBER_QUERY_COUNT * LAST_MEMBER_QUERY_INTERVAL_SEC;
GROUP_MEMBERSHIP_INTERVAL = (ROBUSTNESS_VARIABLE * QUERY_INTERVAL) + QUERY_RESPONSE_INTERVAL_SEC;
STARTUP_QUERY_COUNT = ROBUSTNESS_VARIABLE;
STARTUP_QUERY_INTERVAL = QUERY_INTERVAL / 4;
OTHER_QUERIER_PRESENT_INTERVAL = (ROBUSTNESS_VARIABLE * QUERY_INTERVAL) + (QUERY_RESPONSE_INTERVAL_SEC / 2);
```

IGMPv2
Conclusion

- First step towards multicast support!

**Future work**
- Implementation of IGMPv3
- Create models for MLD in IPv6
- Dynamic multicast routing with PIM-DM

**Problems**
- Migration process
- Lack of backward compatibility in INET1.99.3
The End

- Thank you very much for your attention!
- Do you have any questions?