Network Simulation and Performance Evaluation of IP Multicast Using PIM-DM in UMJaNetSim

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Abstract

The demand for multicast capabilities in IP networks is growing very rapidly. New applications that take advantage of IP Multicast are being introduced constantly. Therefore, IP Multicast is regarded as one of the most important technologies in IP networks today.

This dissertation focuses on the simulation and performance evaluation of IP Multicast using Protocol Independent Multicast – Dense Mode (PIM-DM) as the multicast routing protocol. The simulation is executed in a network simulator named UMJaNetSim, where custom components are built in order to simulate IP Multicast. First, the advantages and applications of IP Multicast, multicast addressing, Internet Group Management Protocol (IGMP), multicast forwarding algorithms, multicast routing protocols, computer simulation and objects in UMJaNetSim are studied. Next, the IGMP and PIM-DM protocols are implemented and integrated into the simulator. The simulation is carried out on point-to-point links and in a non-dynamically changing unicast routing environment. The simulated multicast applications used in the simulation environment involve only one-to-many communication pattern.

The performance of simulation of IP Multicast using PIM-DM in dense and sparse distributions of multicast membership is analyzed. These include join latency, traffic concentration and protocol overhead. It is found that membership distribution could affect the performance of IP Multicast. Simulation results show that sparsely distributed multicast members have lower join latency while densely distributed multicast members have lower traffic concentration and smaller protocol overhead.

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Abbreviations

API	Application Programming Interface
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
B-TE	Broadband Terminal Equipment
CBT	Core Based Trees
DVMRP	Distance Vector Multicast Routing Protocol
GenID	Generation Identifier
GUI	Graphical User Interface
HFC	Hybrid Fiber Coax
IANA	Internet Assigned Numbers Authority
ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
INSANE	Internet Simulated ATM Networking Environment
IP	Internet Protocol
JVM	Java Virtual Machine
LAN	Local Area Network
MBONE	Multicast Backbone
MOSPF	Multicast Extension for Open Shortest Path First
NIST	National Institute of Standards and Technology of United State
OMNET++	Objective Modular Network Test Bed in C++
OPNET	Optimised Network Engineering Tool
OSPF	Open Shortest Path First
PARSEC	Parallel Simulation Environment for Complex System
PIM-DM	Protocol Independent Multicast – Dense Mode
PIM-SM	Protocol Independent Multicast – Sparse Mode
RARP	Reverse Address Resolution Protocol
RPB	Reverse Path Broadcasting
RPF	Reverse Forwarding Path

RPM	Reverse Path Multicasting
TRPB	Truncated Reverse Path Broadcasting
TV	Television
WAN	Wide Area Network