H∀Mcast: A High-Throughput Middleware for a Universal Future Internet Multicast Service

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Outline

1. Introduction
2. Architecture
3. Prototype
4. Evaluation
5. Conclusion

Motivation

- Network nodes are equipped with enhanced resources
  - advanced endsystem intelligence
  - support for complex operations
- This offers new service deployment options
- For example hybrid group communication
  - combine native IP and overlay multicast
  - endsystems participate in routing and forwarding

Objectives

- Decouple application development from service deployment
- Universal service access through standardized APIs
- Adaptive service instantiation at runtime, depending on local network environment and node capabilities
- Provide incremental deployment and service evolution
- H∀Mcast exemplary implements a universal multicast service

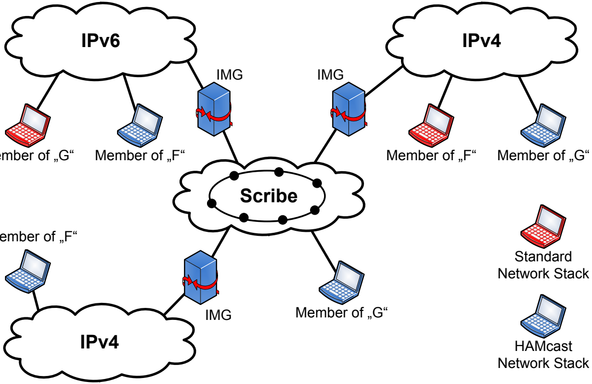
Issues for Future Internet Services

- Globally available network services rely on:
  - uniform deployment within networks and endsystems
  - widely available (standardized) service APIs
- Requires support by vendors of hardware and operating systems
- Multicast specific issues:
  - Divergent deployment states of multicast technologies
  - Incompatible APIs for various multicast flavors
  - Conflicting incentives for usage and deployment

H∀Mcast Architecture

- System oriented multi service architecture
- Building blocks for new services:
  - technology transparent, universal service API
  - extended middleware functionality on endsystems
  - evolutionary, incremental service deployment
- H∀Mcast multicast service consists of:
  - an abstract naming scheme based on URIs (LocID split)
  - the common multicast API, conforms to IRTF draft [1]
  - a middleware component for endsystems
  - Interdomain Multicast Gateways (IMGs)

Incremental Deployment Scenario



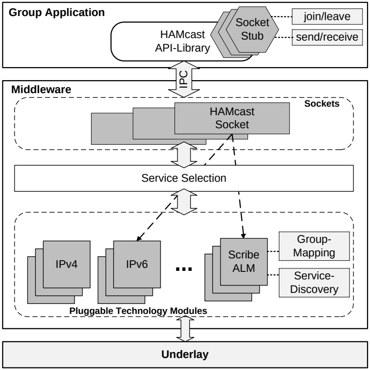
- IMGs inter-connect heterogeneous multicast domains
- Group members (F, G) independent of domain or technology
- Coexistence of standard and H∀Mcast network stack

Overview

- Prototype implementation to demonstrate concepts of the H∀Mcast architecture
- Utilizes hybrid group communication to provide a universal multicast service
- Late binding of multicast technology at runtime
- Implemented in C/C++ including *boost* library
- Multi OS support, currently runs on Linux and Mac OS

Components

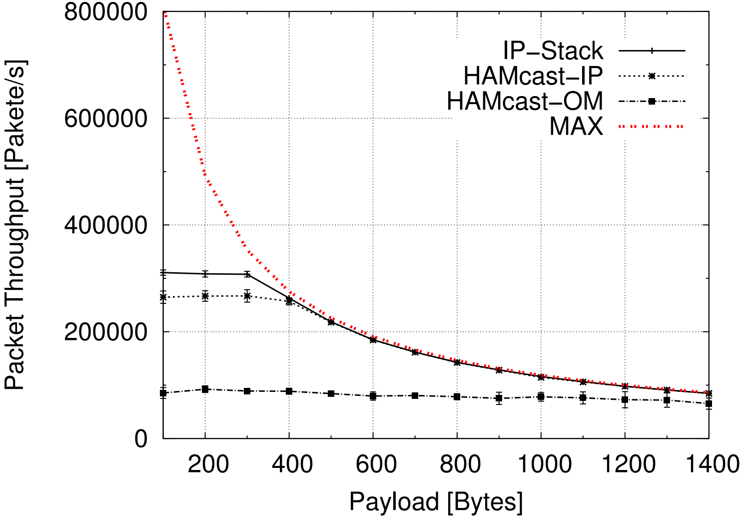
- Common multicast API
  - Transparent multicast calls
  - Implemented as client library
- Middleware Component
  - User space daemon
  - Instantiated once per host
- Service Modules
  - Implement specific technology
  - e.g. IP multicast, Scribe



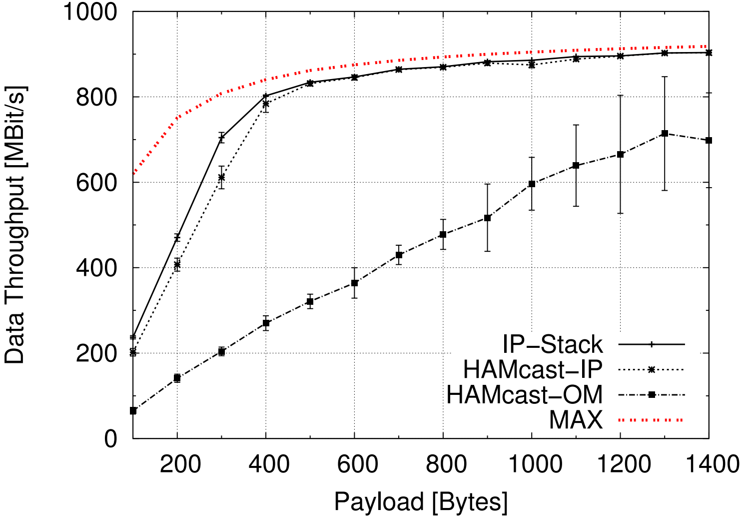
Evaluation

- Analyzing system performance of H∀Mcast prototype
- Single sender-receiver scenario
- Hardware:
  - Hosts with QuadCore CPU, 8 GB RAM
  - Network link with bandwidth of 1 Gbit/s
- Comparison of H∀Mcast-IP, H∀Mcast-OM and IP multicast
- Metrics: throughput, loss and CPU usage
- Packet payload size from 100 to 1400 Bytes

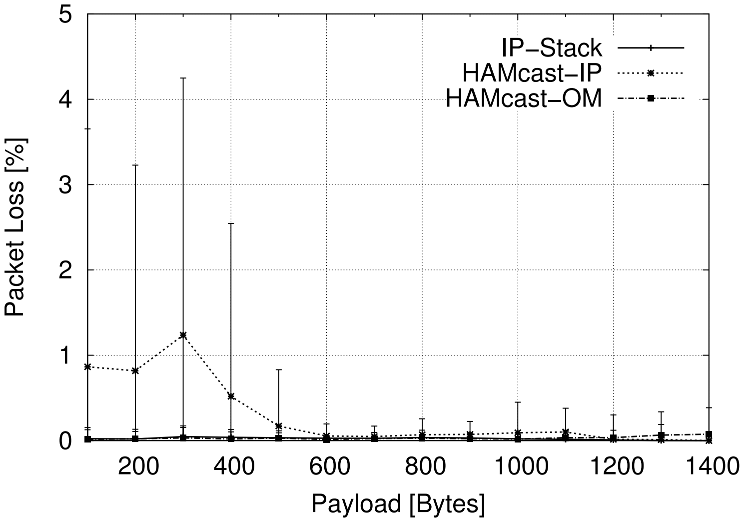
Packet Throughput



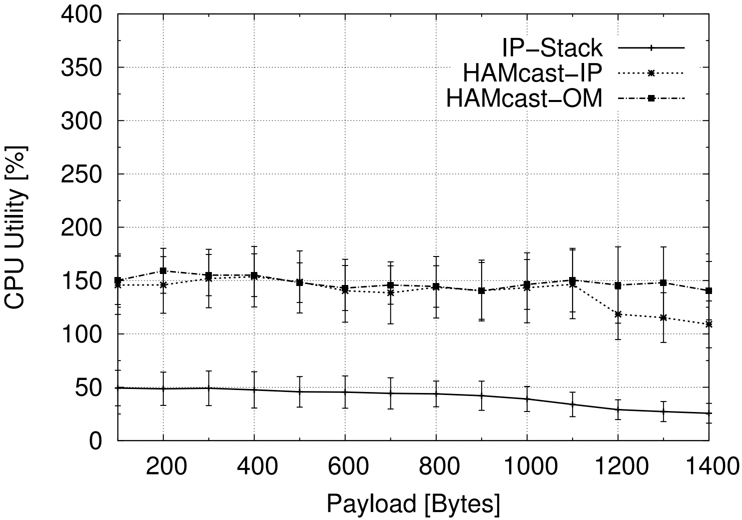
Data Throughput



Packet Loss


Packet Loss [%]
Payload [Bytes]
IP–Stack
HAMcast–IP
HAMcast–OM
0
1
2
3
4
5
200
400
600
800
1000
1200
1400

CPU Utility



IP–Stack
HAMcast–IP
HAMcast–OM
CPU Utility [%]
0
50
100
150
200
250
300
350
400
200
400
600
800
1000
1200
1400
Payload [Bytes]

Conclusion

- Prototype demonstrates feasibility of H∀Mcast architecture
- Design enables extension and integration of new features
- Promising evaluation results verify prototype performance
- First deployment of prototype enables a hybrid group communication service in G-Lab testbed environment
- Active participation in IRTF SAM RG:
  - Standardization of common multicast API
  - Cooperation within research community
- Further information and download of prototype at: `http://hamcast.realmv6.org`
- Visit demo presentation here at EuroView

End of Talk

Thank you for your attention.
Questions?

References I

- M. Waehlisch, T. Schmidt, and S. Venaas, "A Common API for Transparent Hybrid Multicast," IETF, Internet-Draft – work in progress 02, July 2011.
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- M. Wählisch, T. C. Schmidt, and G. Wittenburg, "On Predictable Large-Scale Data Delivery in Prefix-based Virtualized Content Networks," *Computer Networks*, 2011, accepted for Publication.

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- T. Schmidt, M. Waehlisch, and S. Krishnan, "Base Deployment for Multicast Listener Support in Proxy Mobile IPv6 (PMIPv6) Domains," IETF, RFC 6224, April 2011.