HAMcast

An Implementation of a System-centric Middleware Component for Universal Multicast

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Agenda

- Introduction
- Middleware Design
- Prototype Implementation
- Performance Evaluation
- Lessons learned
- Conclusion & Outlook

Introduction

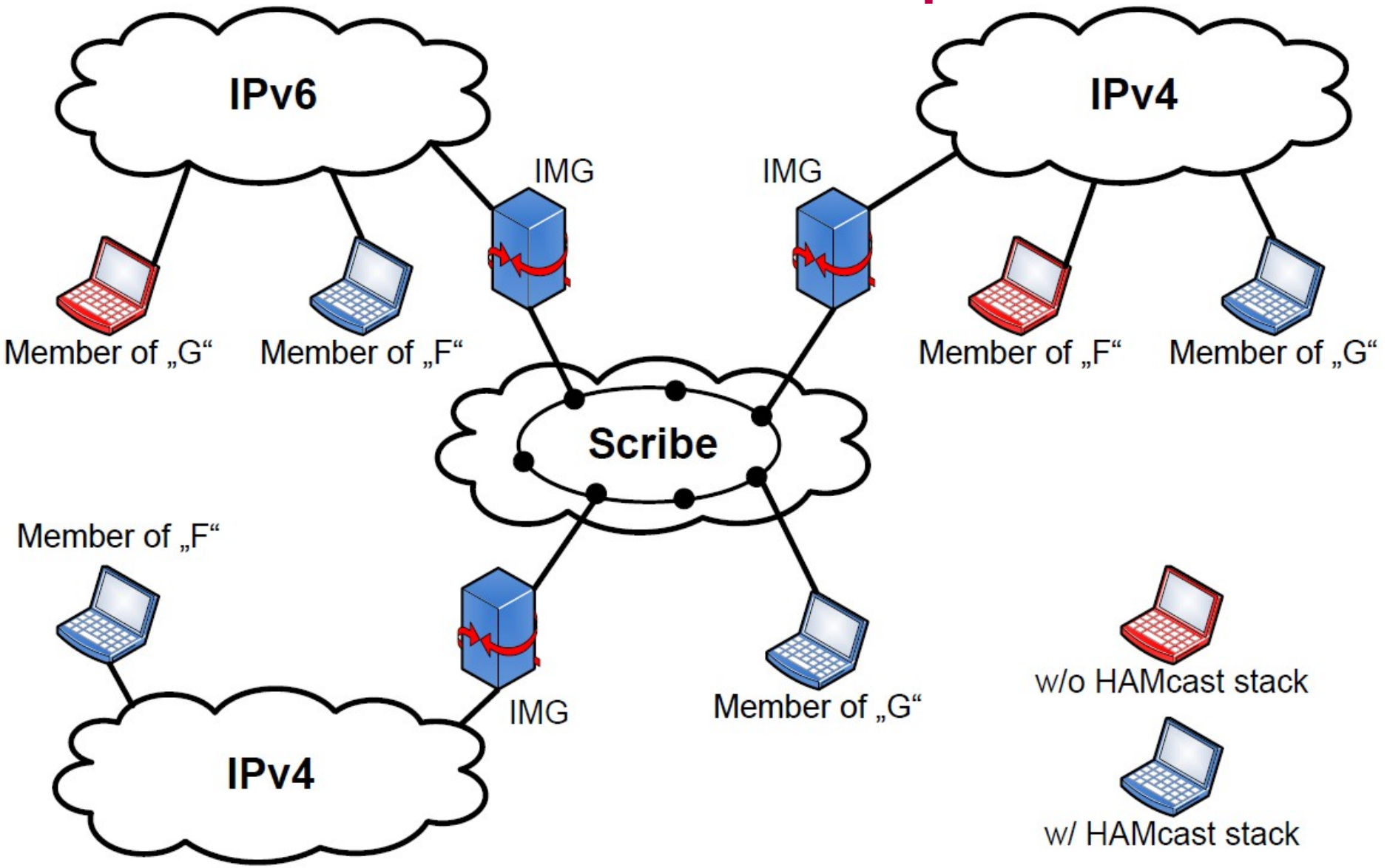
Existing Problems

- Many multicast flavours and technologies
- Heterogeneous multicast deployment
- No general API to multicast services

<draft-irtf-samrg-common-api>

- Specification of a common multicast API
- Abstract naming scheme with Loc-ID split
- Concept for integrating different multicast technologies

Network Scenario Example



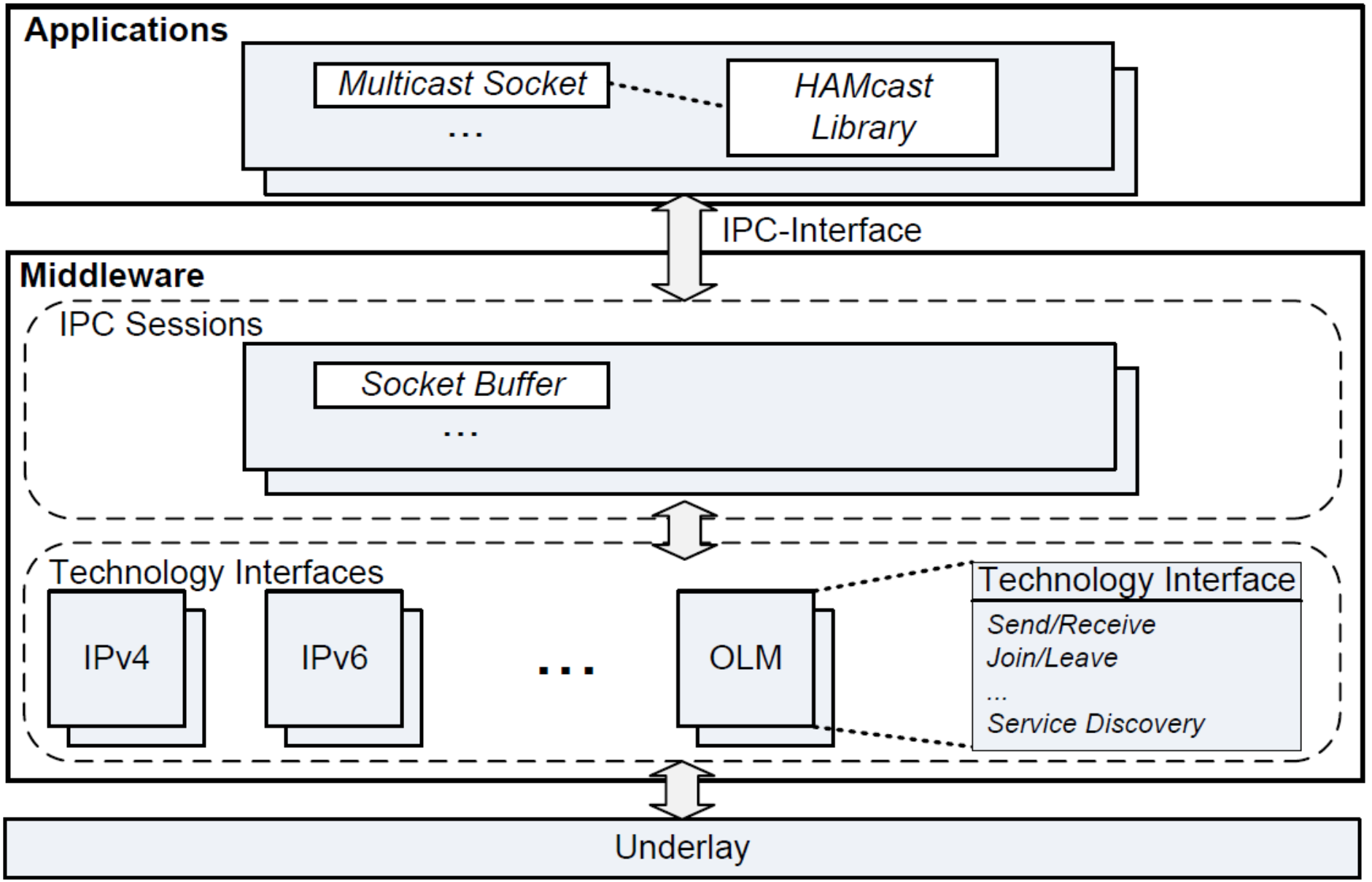
Middleware Design

- Multicast service stack for end-systems
  - Dynamic discovery and configuration of network and system environment
  - Pluggable multicast technology modules
  - Late binding of multicast technologies at runtime
- Openness to future extensions and adaption of
  - Other application programming languages
  - New network technologies
  - API library and deployed HAMcast middleware remain unchanged

HAMcast Prototype Implementation

- Middleware
  - User-space process, runs once per host
  - Implemented in C++, using *boost* library
- API available for C++ and Java, conform to:
  - *<draft-irtf-samrg-common-api>*
- Service modules
  - Multicast technology specific, currently available:
    - IPv4, IPv6, and Scribe-ALM
  - Implemented in C++ and C

Middleware Overview



IPC Interface to Applications

- Connects applications that use multicast API with the middleware process
- Based on localhost sockets and self-designed IPC protocol
  - Open protocol specification
  - Simple adoption by programming language
- Synchronous and asynchronous transfers
- Single IPC session per application

IPC Communication

- IPC session combines all calls for one application
  - Multicast traffic is handled by streams (per group)
- Asynchronous:
  - Multicast send/receive calls
- Synchronous:
  - Join/leave calls
  - Service calls (e.g., group_set, parent_set …)
  - Set/get socket options
  - Update event calls

Multicast Service Module

- Access to specific multicast technology
- Multiple instances (interfaces) possible
  - several IP interfaces or overlays
- Each module provides its own
  - Service discovery, to enable and configure module instance(s)
  - Technology dependent mapping function to translate group names (URI) to addresses (e.g., hash)

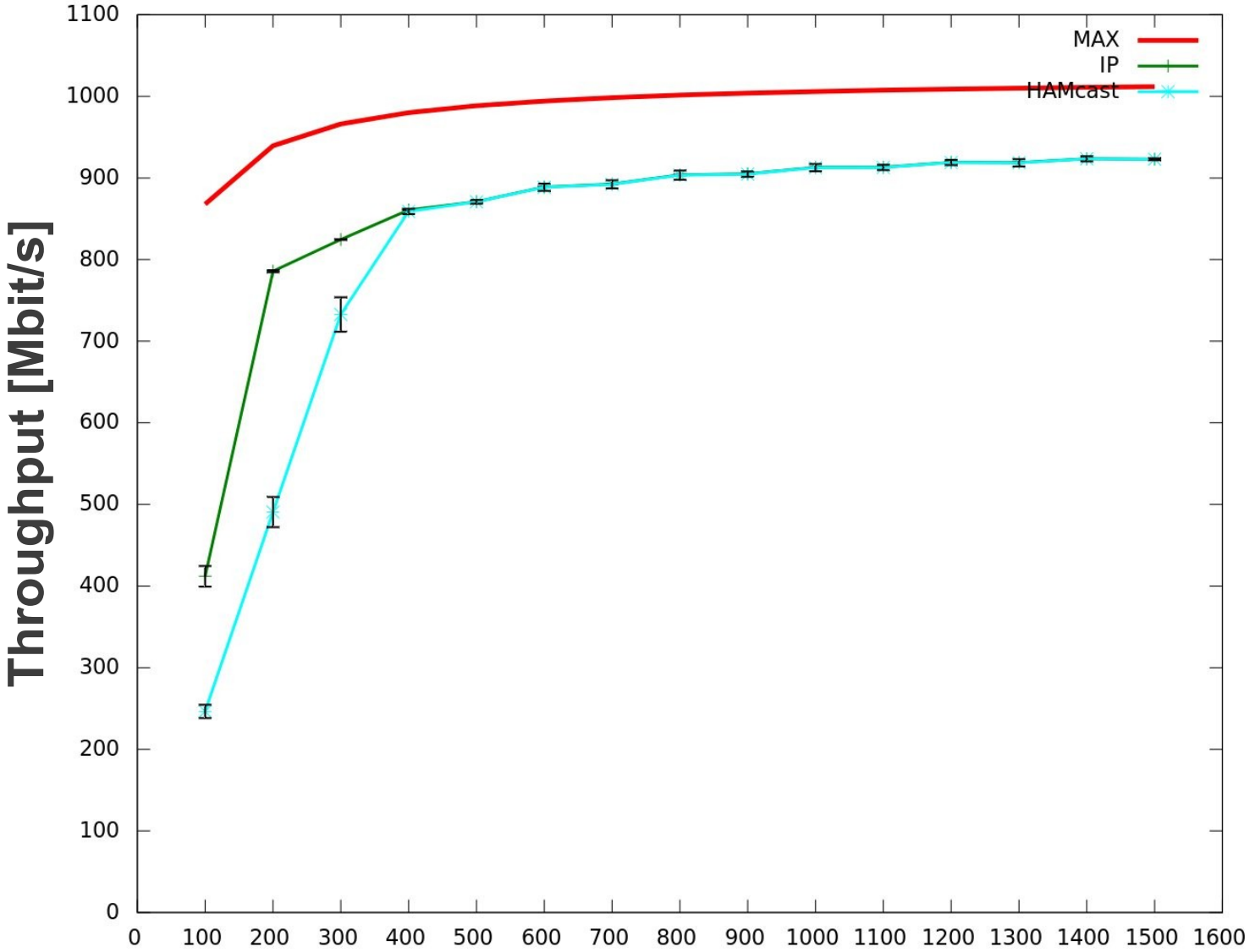
IP Service Discovery

- Investigate local system and network environment
- Passive approach:
  - Query multicast state tables
  - System calls to network card driver
  - Packet sniffing, e.g. IGMP/MLD queries or PIM messages
- Active approach:
  - Probe local network
  - Join specific groups
- React to system events
  - Device comes up or down
  - Network cable plug on/off

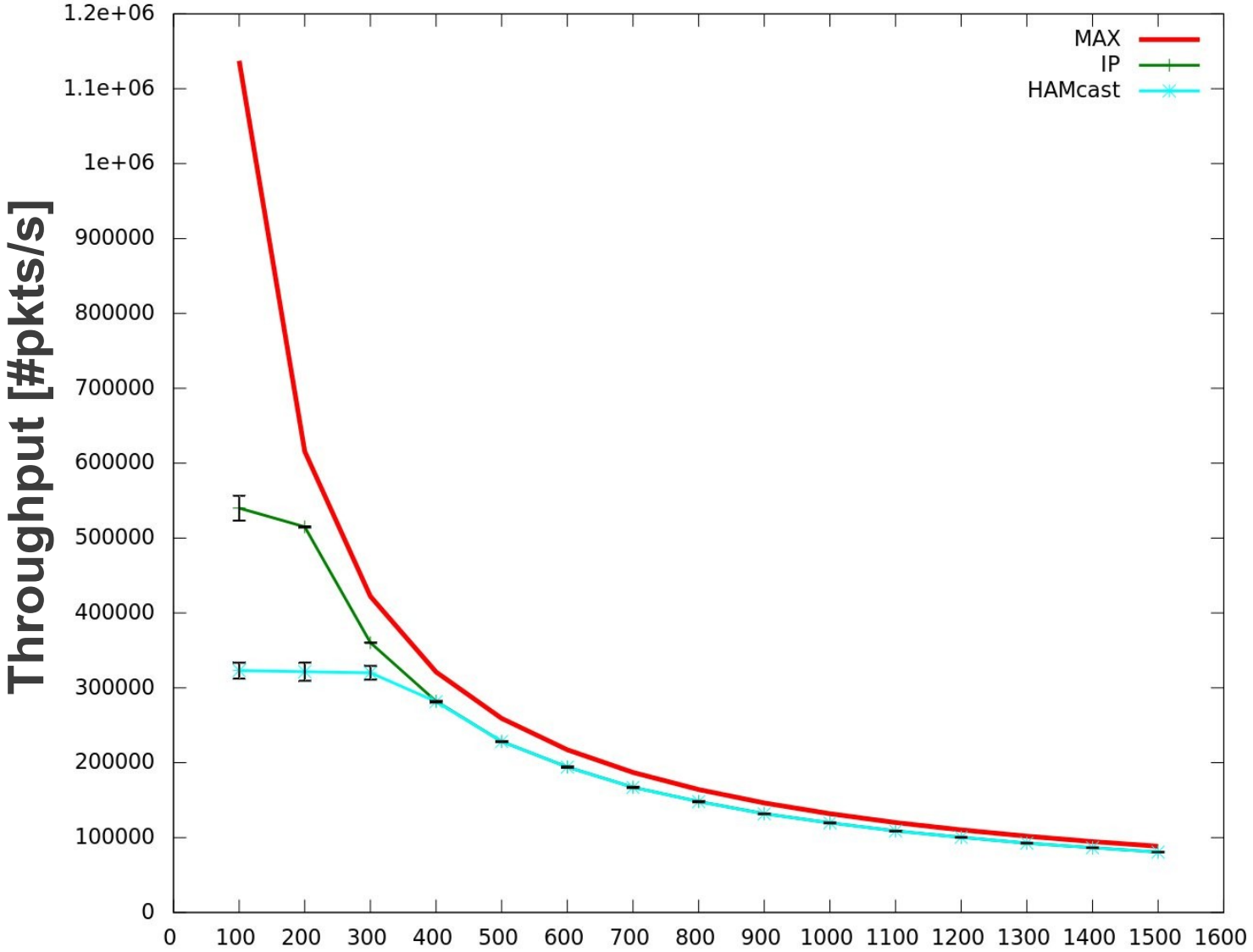
Performance Evaluation

- Measurements
  - Comparison of HAMcast middleware-stack and Linux standard IP-stack
  - Mean and std. deviation over 50 runs (60s each)
  - Analysis of different packet sizes (100–1500 B)
- Metrics
  - Throughput, and CPU usage
- Test Setup
  - Single source/receiver scenario
  - Quad-Core CPU, Ubuntu-Linux, 1Gbit network

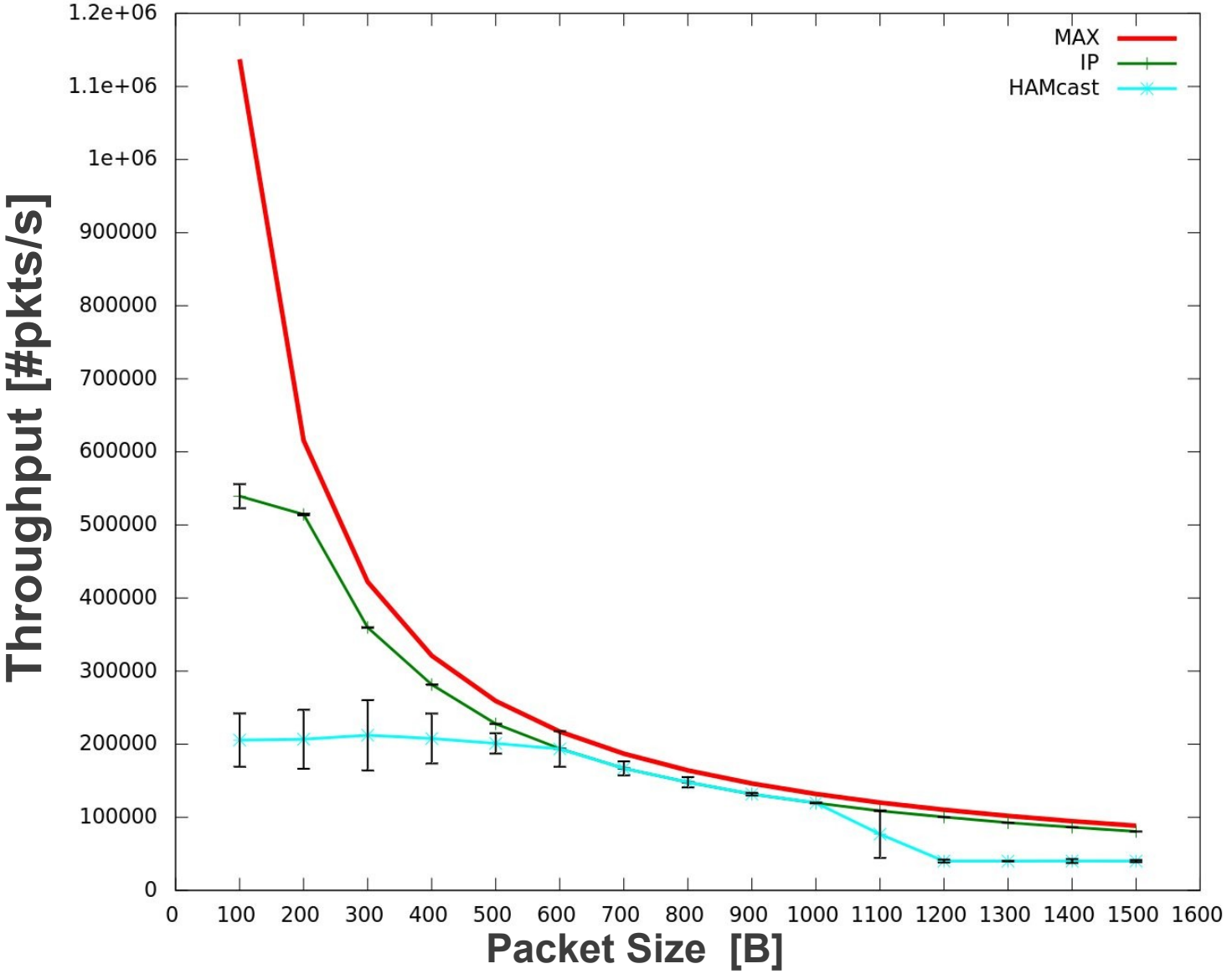
Throughput in Mbit/s (Sender)



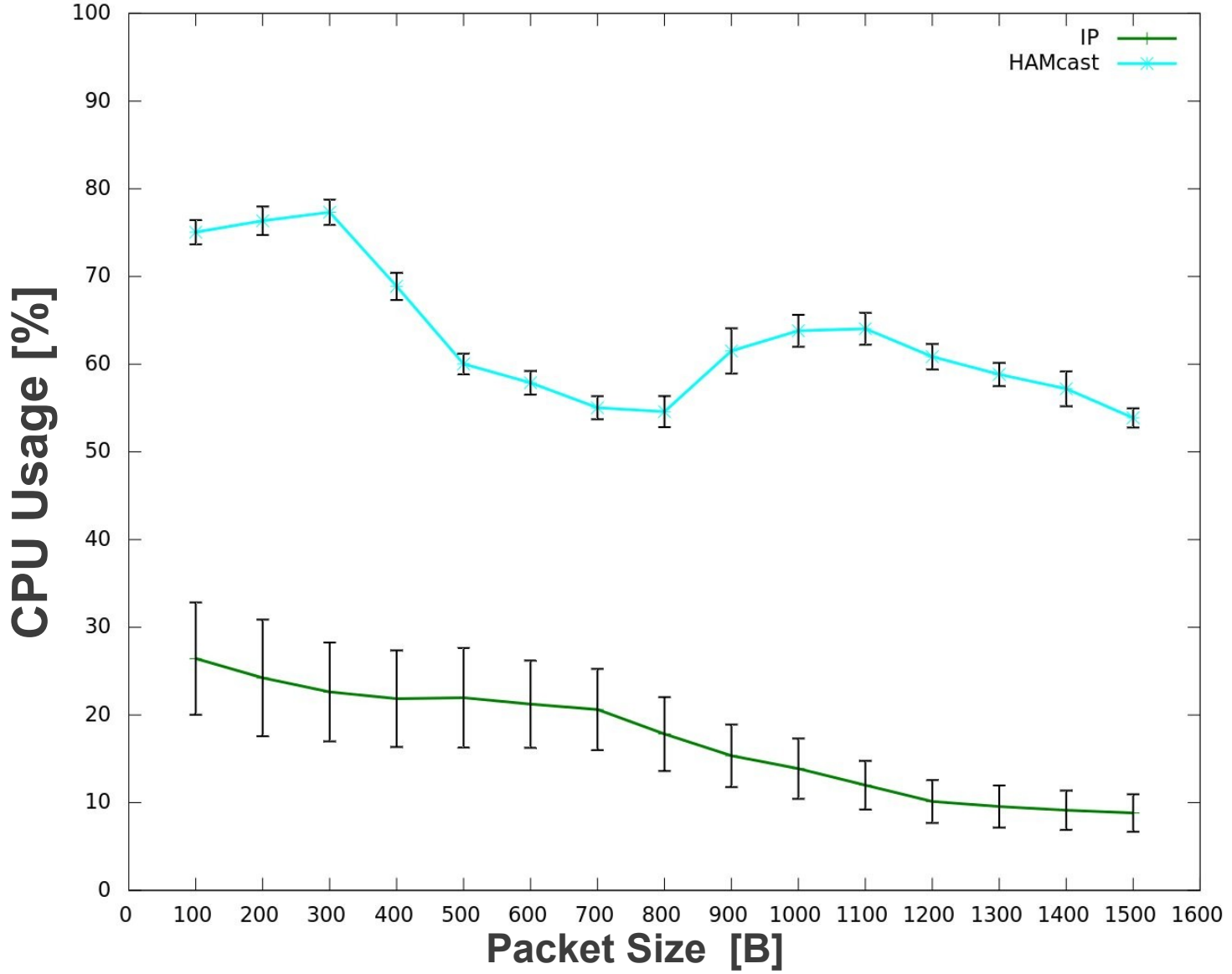
Throughput in #pkt/s (Sender)



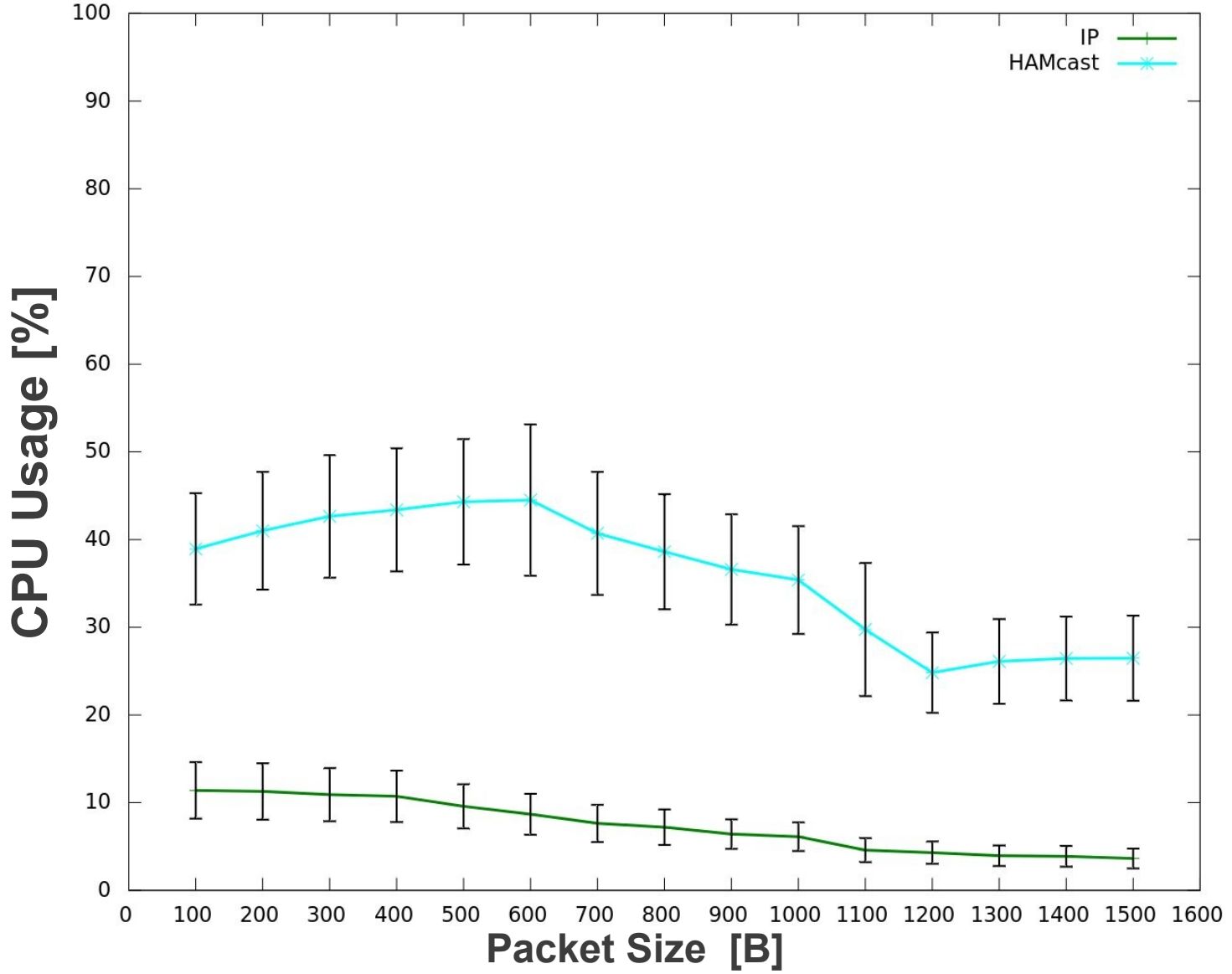
Throughput in #pkt/s (Receiver)



CPU Usage (Sender)



CPU Usage (Receiver)



Lessons Learned

- IPC communication is critical bootleneck
- IPC optimizations for send/recv calls:
  - Asynchronous transmission
  - Aggregation of successive data packets
- Further optimizations:
  - Precached name-to-address mappings
  - Middleware runs with higher priority

Conclusion & Outlook

- Middleware prototype with multicast API
  - Supports native IP and Scribe multicast
  - Provides multicast API for C++ (and Java)
  - Runs on Linux and MacOS X
- Promising performance results
- Ongoing Work:
  - Extended IMG functionalities
  - Additional technology modules (e.g., spanning multicast tunnels)

Thank you …

Questions?

- Project Website:
  - **`http://hamcast.realmv6.org`**
- Prototype Release:
  - **`Friday next week (08.04.2011)`**