Dr. Multicast: Harnessing IP Multicast in Data Centers

Cornell University

Pros of IP Multicast

Simple communication paradigm.

Useful in data centers:
- data replication,
- service monitors,
- load balancers,
- publish-subscribe systems.

Widely **supported**.

Cons of IP Multicast

No Policy Control
- any node can send to any group.

No Group Scalability
- NICs use small, imperfect filters.
- Switches flood all ports if state is exceeded.

No Traffic Rate Scalability
- Multicast *storms* overrun the network.

Wishlist

- **Acceptable Use Policy (AUP)**
  - Enable *control of* IP Multicast (IPMC).
- **Optimized Resource Use**
  - Use IPMC as far as it scales, then resort to another form of multicast.
  - Collapse similar groups.
- **Flow Control**
  - Limit IPMC traffic in a fair way.

Ymir Vigfusson

Hussam Abu-Libdeh

Mahesh Balakrisnan

Ken Birman

Gregory Chockler (IBM)

Yoav Tock (IBM)

1

Transparent library layer between application and network. Enforces AUP.

225.0.0.1

Dr. Multicast

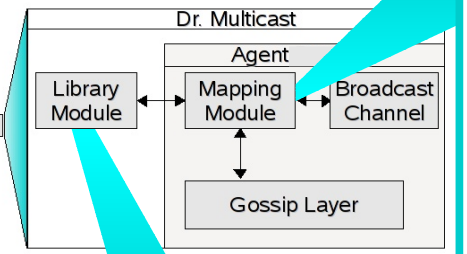
227.0.0.1 192.168.1.100 192.168.1.150

2

Logical groups are mapped to physical IPMC and/or unicast.

3

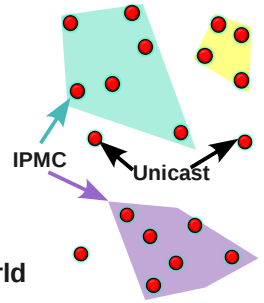
Gossip & broadcast channel ensure delivery of policy and membership changes.



Optimizing Resource Use

Global **group membership** service.

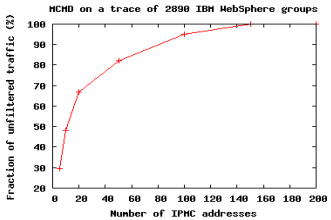
Maps **physical IPMC** to "best" groups, others use **unicast.**

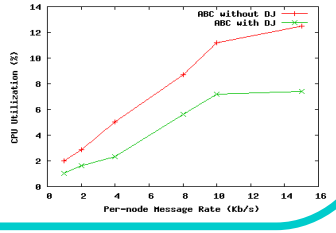


Collapses **similar groups** using the *k*-means clustering algorithm (right).

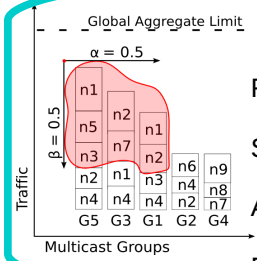
Compression opportunities in **real-world** systems, such as **IBM Websphere**:

● = **group** in a metric space.





Flow Control



Receivers **monitor** and **report** group rates.

Senders **slow down** if traffic exceeds limit.

A dynamic **subset** of senders slow down (left).

Experiments (right) indicate **fast reaction.**