The Hybrid Shared Tree Architecture

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Agenda

Motivation

Overview of the Hybrid Shared Tree Architecture

Construction of the Overlay Distribution Tree

Routing within the Overlay Distribution Tree

Discussion

Outlook
Motivation

There are . . .

▶ discrepancies between intra- and inter-domain deployment
  ▶ Use of hybrid overlay multicast approaches
    (draft-irtf-sam-hybrid-overlay-framework-01.txt)
▶ DHT-based routing schemes
  ▶ Typical: hash(groupaddress) defines rendezvous point + routing like PIM-SM
  ▶ Scribe distribution tree build on RP: triangular routing
▶ problems with efficient multicast mobility
  ▶ Multicast mobility PS: draft-irtf-mobopts-mmcastv6-ps-01.txt
  ▶ Mobility agnostic routing with Bi-directional PIM
The Hybrid Shared Tree Architecture

- Complement to draft-irtf-sam-hybrid-overlay-framework
- Introduce Inter-domain Multicast Gateways (IMGs)
  - Similar to Peers
  - Provide gateway functions
  - Reside between overlay and intra-domain underlay
  - Interconnect local multicast with distributed overlay peering
- Network layer multicast unchanged in end system domains
- Overlay network based on well established DHT, equipped with a new overlay routing scheme
  - Distribution tree independent of source location
  - Homogenously efficient forwarding, no RPs
- Use Pastry due to its proximity-awareness and prefix table
Architectural Overview
Constructing the Overlay Distribution Tree

- Every IMG has an overlay address: $\text{hash(IMG ID)}$
- IMGs learn about all group memberships
  - Membership updates are communicated incrementally
- Each IMG constructs a groupwise common prefix tree
  - IMGs of multicast receiver domains represent the leaves
  - Inner vertices correspond to longest common prefixes
  - Vertices on path to root share prefix with node
  - Tree will be used as bi-directional shared tree
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![Diagram of the Overlay Distribution Tree]
Routing within the Overlay Distribution Tree

- Prefix tree is a routing overlay to the DHT
- Source IMG determines its position on the tree
  - Longest common prefix
- Multicast traffic distributed to prefix neighbors
  - Only downward flow
- Underlay routing correspondence extracted from Pastry routing table
Discussion

- Unmodified layer2/3 multicast in end system domains
- HST inherits from Pastry
  - Proximity selection benefits
  - Number of overlay routing hops: \( \leq \log_2(n) \)
- Replication load on forwarders limited by size of prefix alphabet \( 2^b \)
  - Strictly predictable per packet processing costs
  - With \( g \) number of receiver domains: \( \leq \log_2(g)(2^b - 1) \)
  \[ \Rightarrow \text{Number of neighbor states: } \leq \log_2(g)(2^b - 1) \]
- No dedicated overlay nodes
  - Avoids bottlenecks and single points of failure
- In combination with Bidir-PIM: mobility-agnostic routing
  - Prefix tree will be built only receiver-based
  - HST decouples group and state management from forwarding plane
Outlook

M. Wählisch, T. C. Schmidt:  
*Between Underlay and Overlay: On Deployable, Efficient, Mobility-agnostic Group Communication Services.*  

- Protocol optimization of prefix-controlled forwarding
- Further analysis of the Hybrid Shared Tree approach
  - Large scale experiments based on PlanetLab platform
- Work of interest for SAM RG?
Intermediate vertices need to know tree position

- Overlay packets carry destination prefix

- Check if associated with destination prefix

  - Yes? Forward to next prefix neighbour(s) (routing in prefix tree + DHT)
  - No? Just forward to destination prefix (routing in DHT)