Overview of Yallcast Dynamic Topology Configuration

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Yallcast-specific Content Protocol Stack Challenges

- Dealing with dynamic topologies
- Getting through NAT boxes

API

Application

Yallcast Tree Protocol (YTP) (framing, forwarding, sequencing)

- yTCP
- yRTP
- yRMTP
- Etc...

Yallcast ID Protocol (YIDP)

- UDP
- TCP
- IP Multicast
- IP Unicast

Sufficient generality
Tree Terminology

- Root
- Parent of C
- Child of P
- Cluster Head
- Cluster Feet
- Leaf
- Transit

Nodes: R, P, C, H, F1, F2, F3, F4, A, D, L, B
Multicast (Over Tree)
Broadcast (Over Everything)
Multicast with Mesh Repair*

*Dramatization
Unicast, and
Anycast (Over Tree and Mesh)
Tree Building Approaches

Mesh First
- Build proximal mesh
- Run classical routing algorithm over mesh
- Tree “falls out”
- AMRoute, CMU

Tree First
- Screen known members for tree neighbor validity
- Explicitly select proximal tree neighbor
- Run algorithm to detect loops
- Yallcast
Member Discovery

• Learn of other members to build topologies
  – Contact Rendezvous (initial)
  – Parent-side tree anycast or mesh anycast
discovery messages (background activity)
  – Navigate tree (as-needed foreground activity)
  – If root, broadcast “I am root” message, inform
    rendezvous
Tree Loop Detection/Prevention

• Yallcast tree may have transient loops
• Pre- and post-topology change loop detection
• Three basic mechanisms:
  – Root Path
  – Topology trace
  – Incompatible changes trace
Root Path

• Analogous to BGP AS-path
• Transmitted parent to child
  – Each member appends itself to received root path
• Discovers loops after tree change
Root Path

Flow of Root Path

R:PR:A
R:A:L R:P:H
R:P:C
R:A:D
R:P:H:B

Root Path

D
B
H
F1 F2 F3 F4
Valid Parents

P’s parent-side members

P’s child-side members
How Loops Form

“Simultaneous” changes by multiple members (e.g. P and L)
Loop Avoidance Algorithms

• Coordinated Loop Avoidance
  – Have parent, want to improve
• Emergency Loop Avoidance
  – No parent, must find one quickly
• Coordinated has stronger loop detection
• Coordinated scales better
Emergency Loop Avoidance

• Send “Root Path Trace” along new Root Path
• Root Path Trace follows path of “prospective parents”
• Last member in path, or first to discover loop, replies to initiator
Emergency Loop Avoidance: Only P Changing Parent
Emergency Loop Avoidance: P and L Changing Parent

Loop Detected!!!
Coordinated Loop Avoidance

• Send “Intent to Join” along tree from joining member to new parent
• Members along the path record intended change
• Members along the path check for and block incompatible changes
Coordinated Loop Avoidance: Only P Changing Parent
Coordinated Loop Avoidance: P and L Changing Parent

Diagram:
- Edges:
  - A to R: itj
  - R to A: itj
  - R to P: itj
  - P to R: itj
  - P to C: reject
  - P to H: accept
  - R to P: itj
  - C to R:P:C
  - H to R:P:H
  - L to A: itj
  - R:P:H to B
  - R:A:D
  - R:A:L
  - R:P:H:B

Actions:
- itj
- reject
- accept