Overview of Yallcast Dynamic Topology Configuration

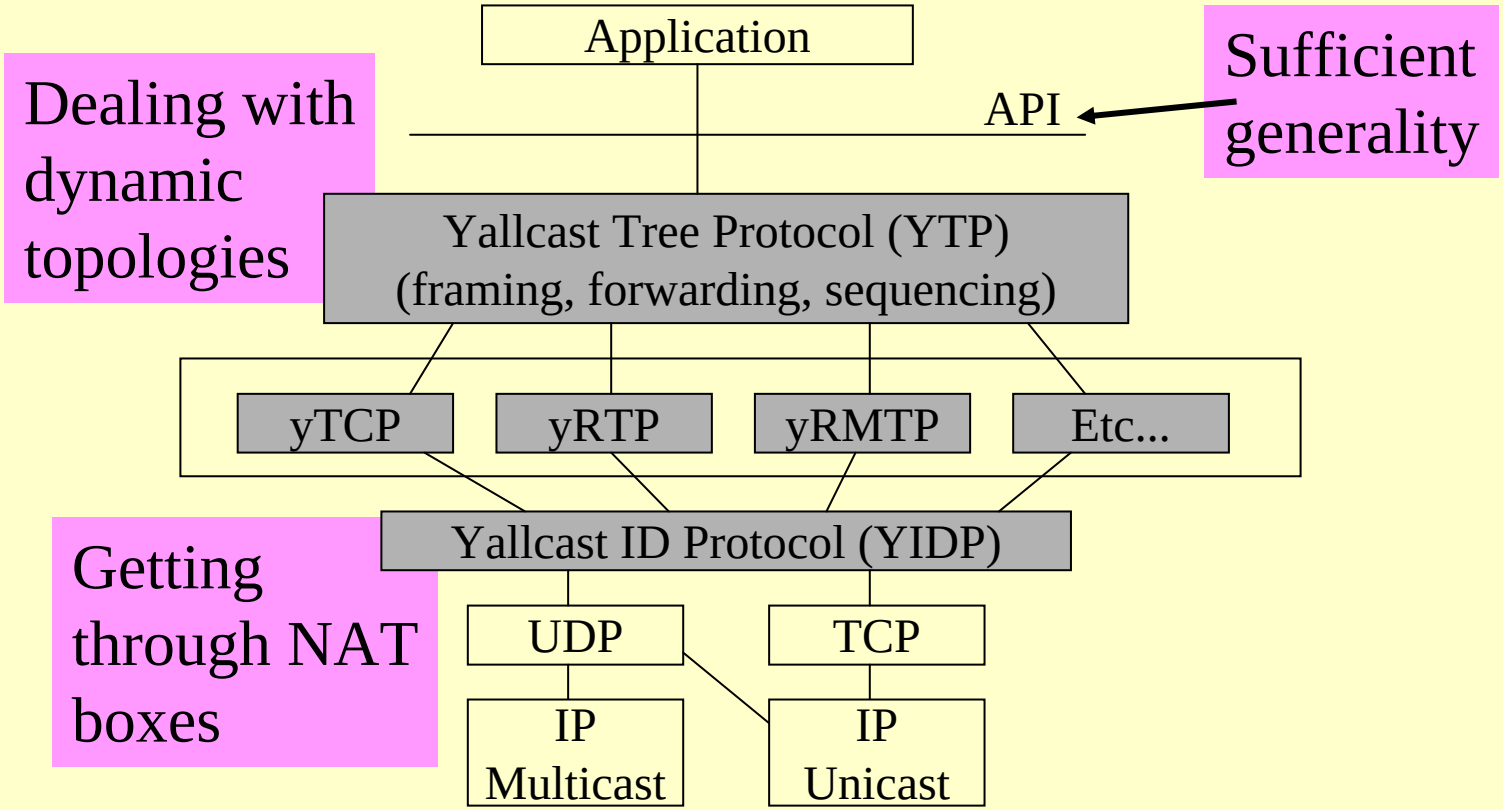
Paul Francis

NTT PF Labs

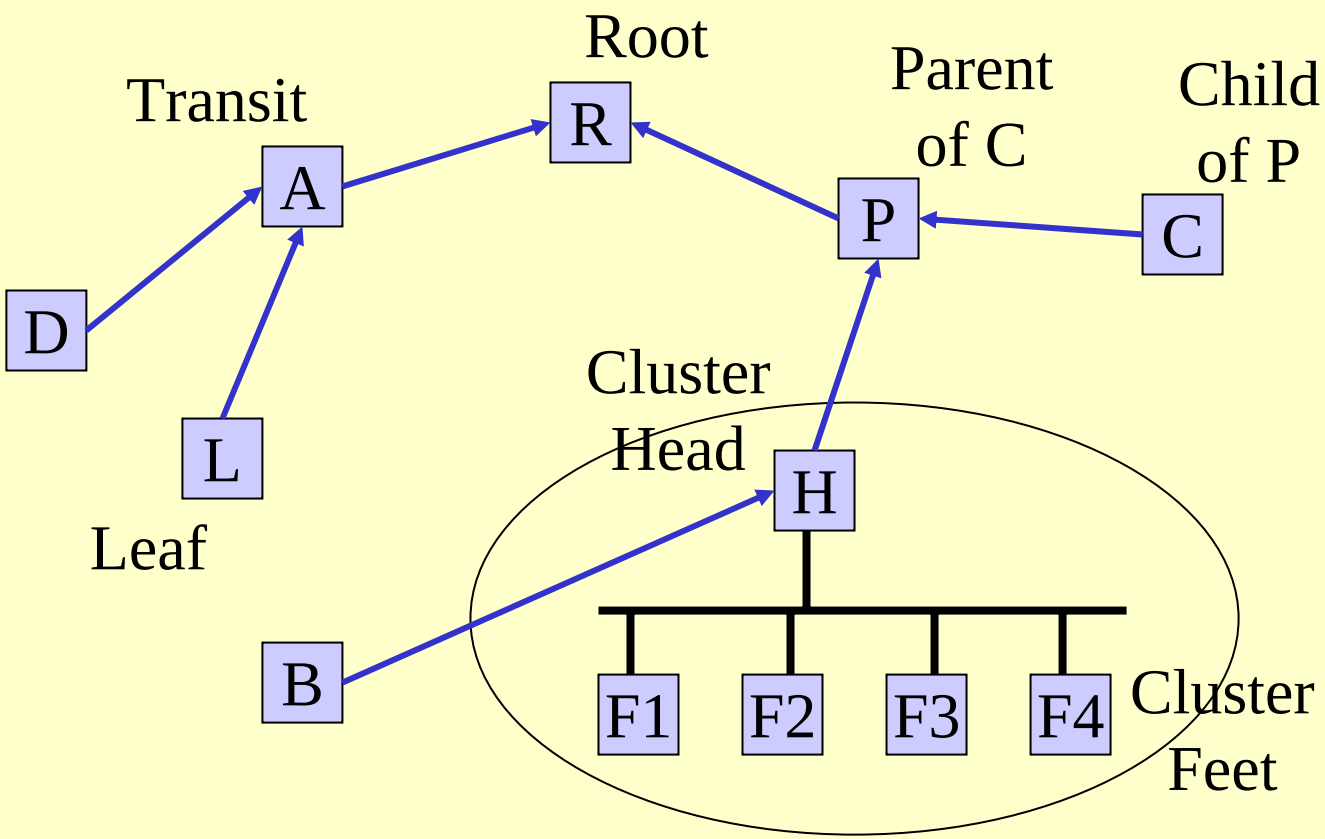
francis@slab.ntt.co.jp

www.yallcast.com

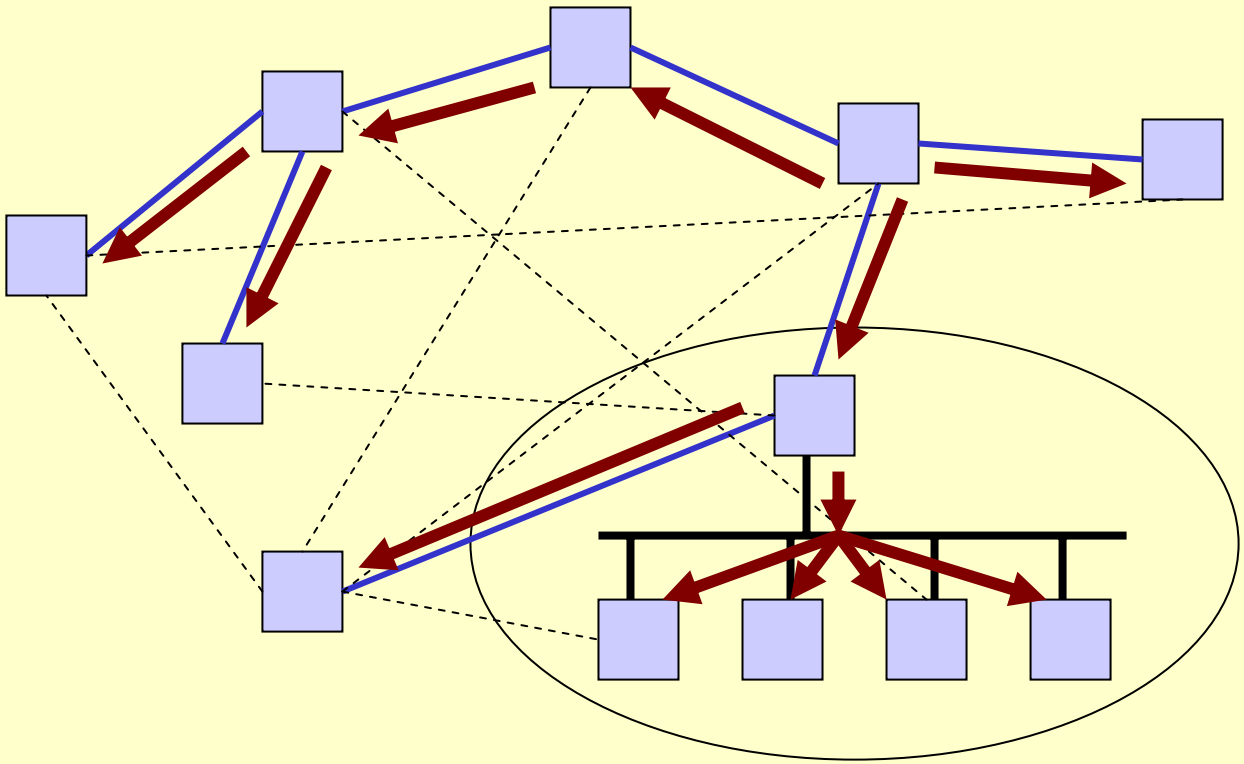
Yallcast-specific Content Protocol Stack Challenges



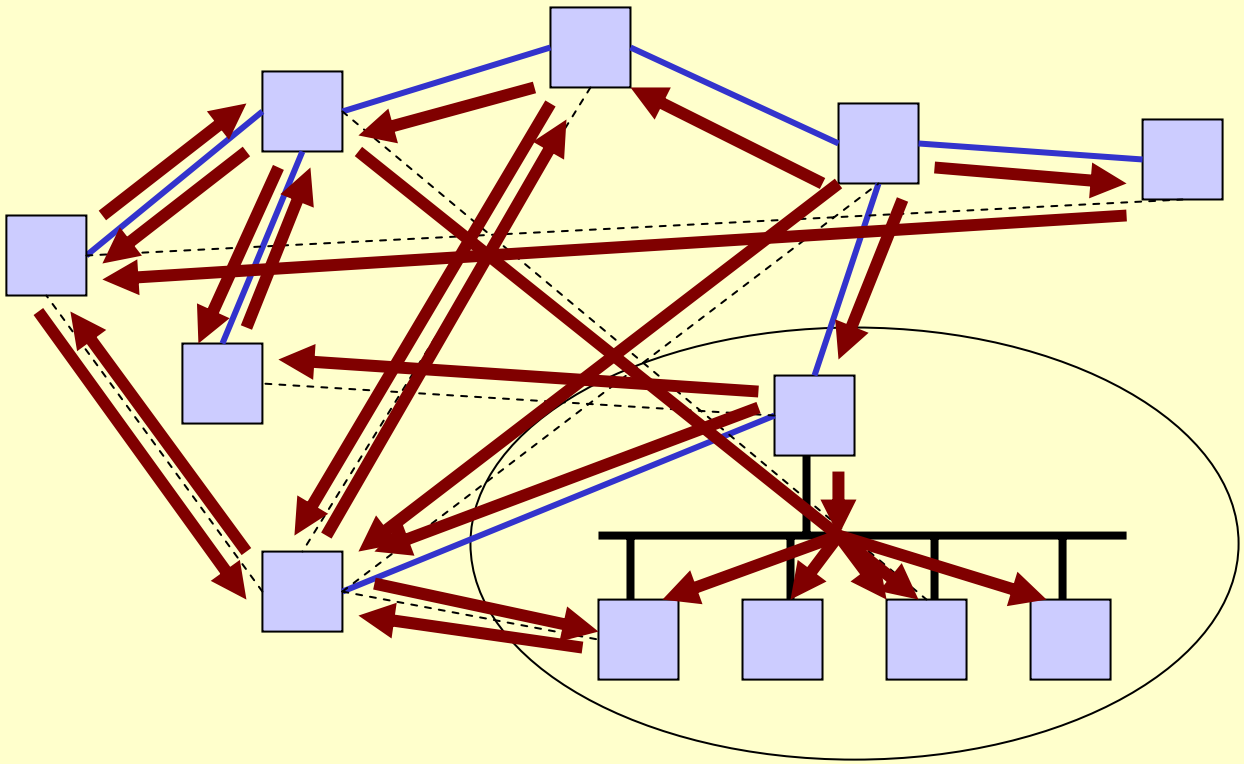
Tree Terminology



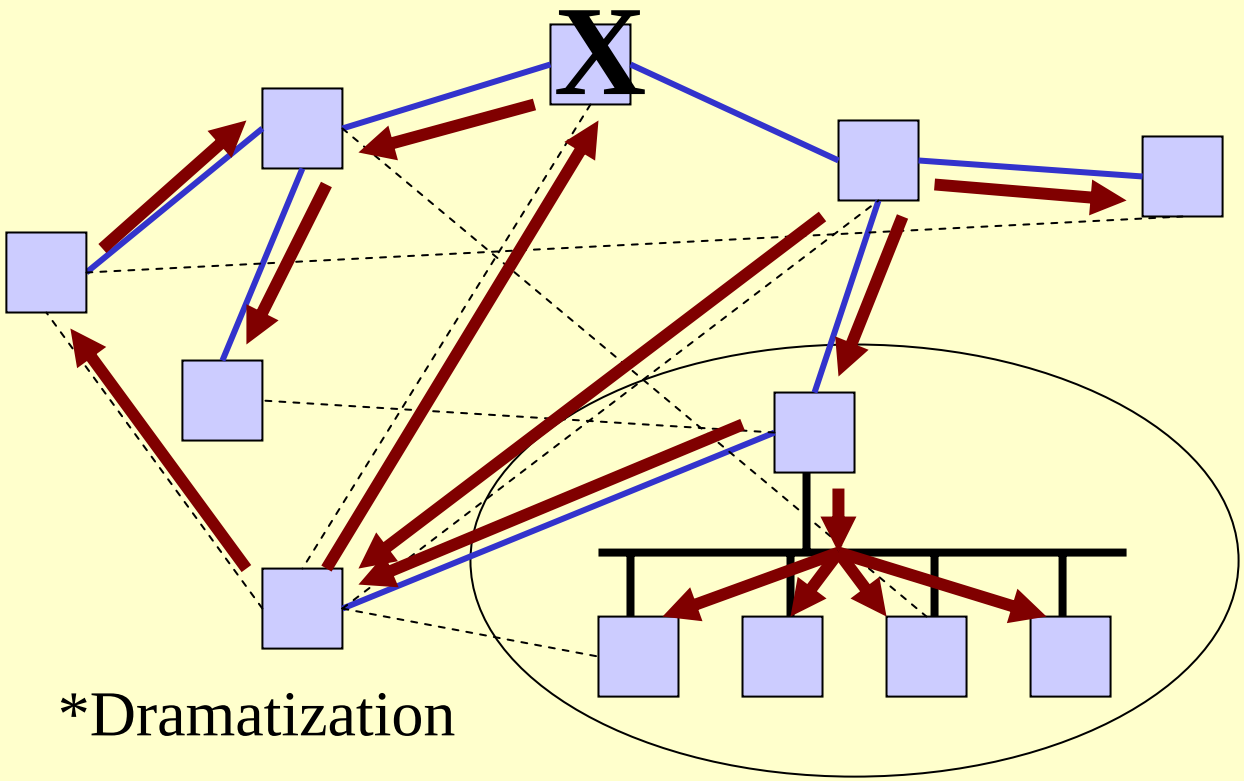
Multicast (Over Tree)



Broadcast (Over Everything)

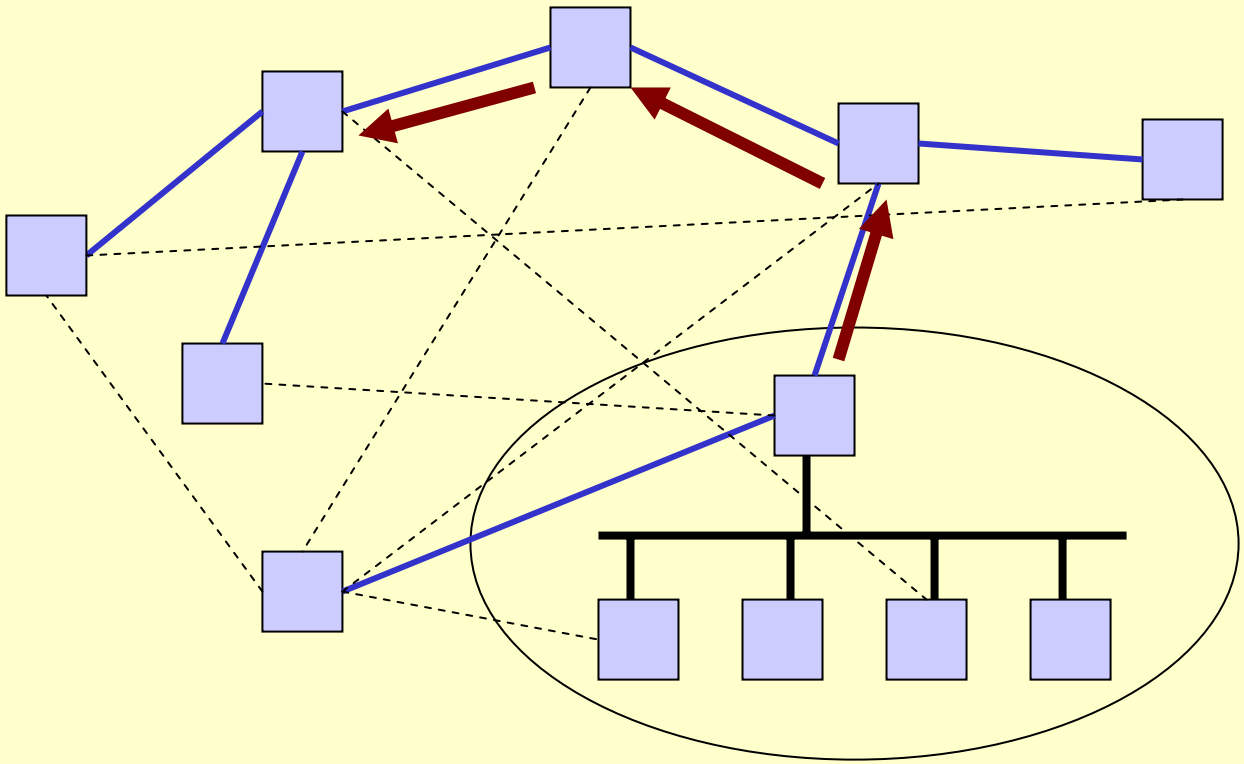


Multicast with Mesh Repair*



*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

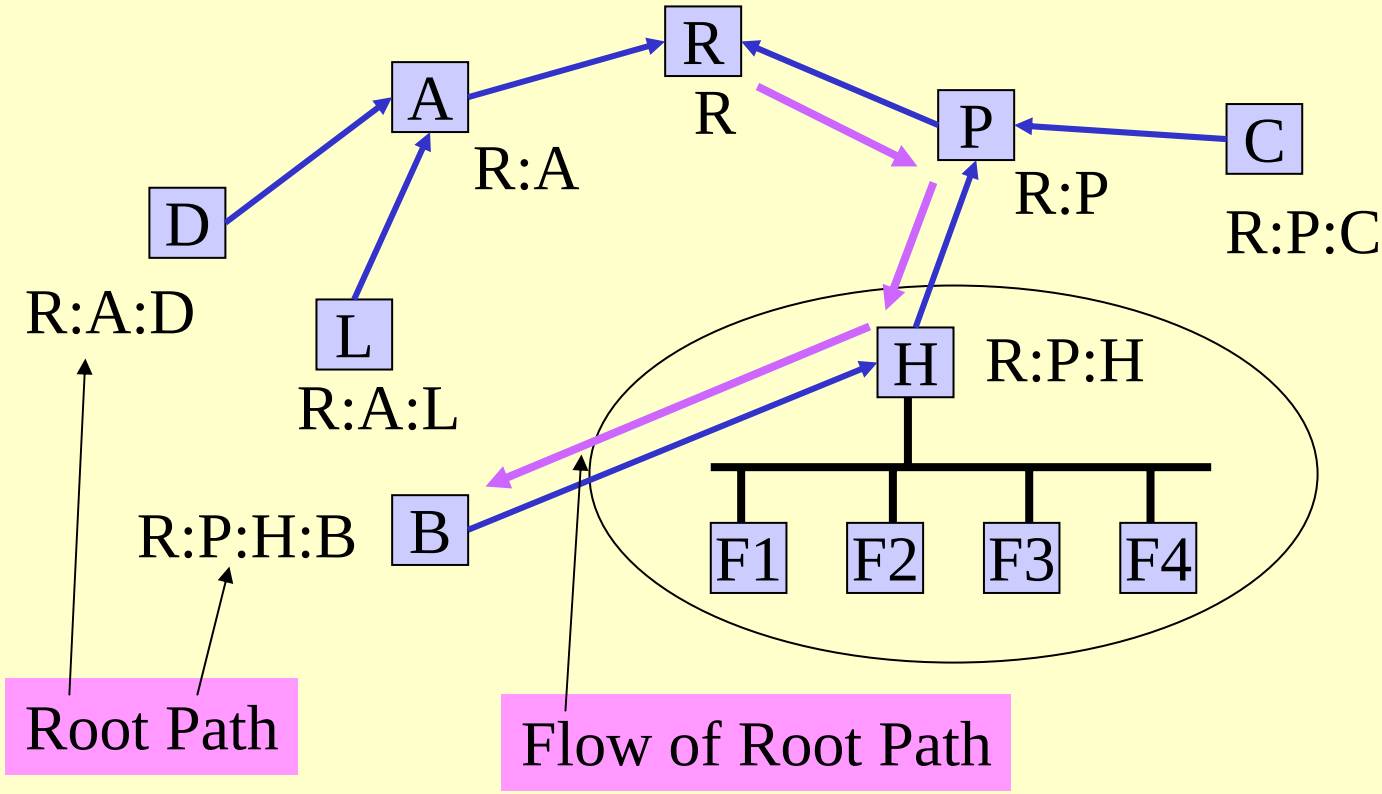
Tree Loop Detection/Prevention

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

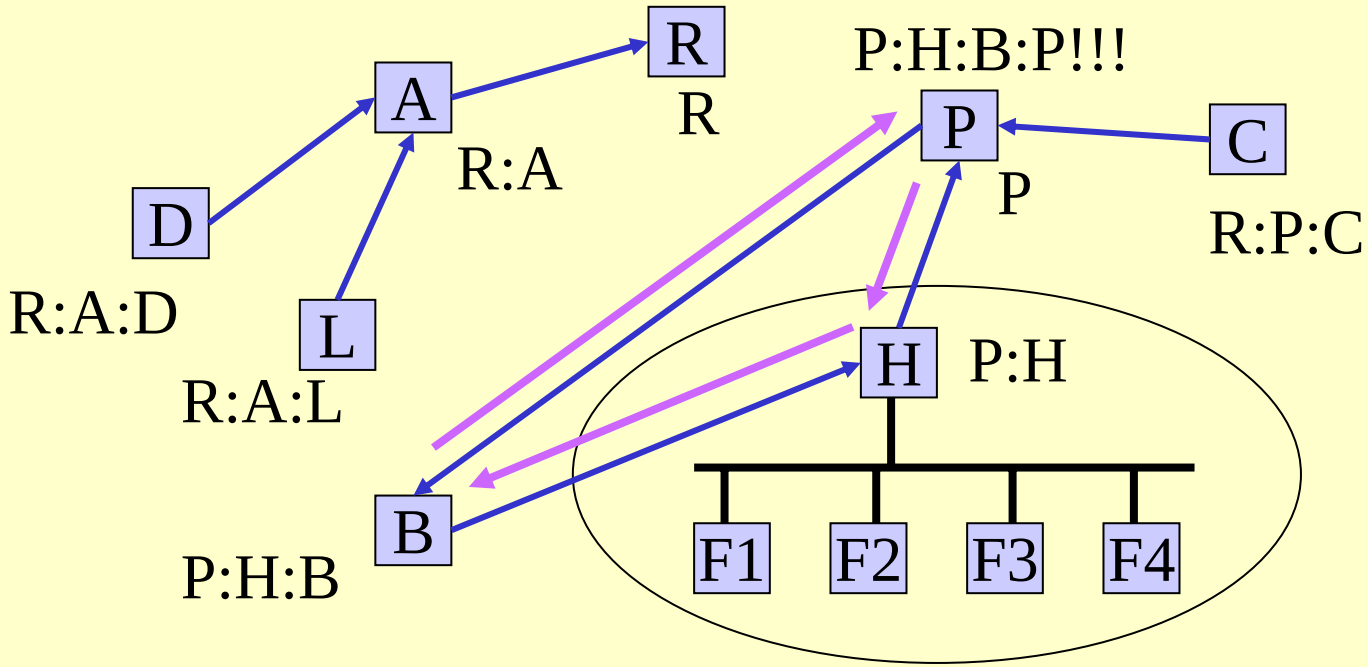
Root Path

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

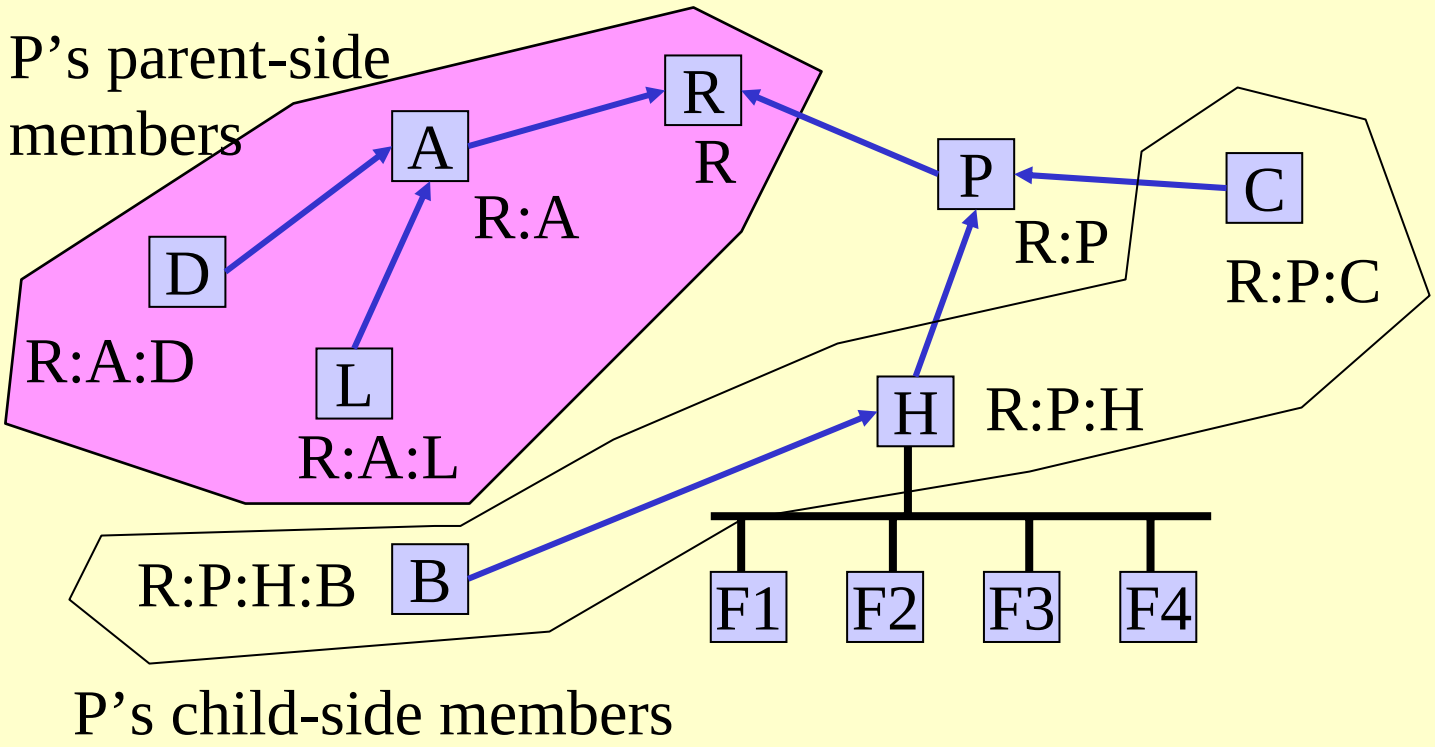
Root Path


R
R
A
R:A
P
R:P
C
R:P:C
D
R:A:D
L
R:A:L
H
R:P:H
B
R:P:H:B
F1
F2
F3
F4
Root Path
Flow of Root Path

Root Path Loop Detection

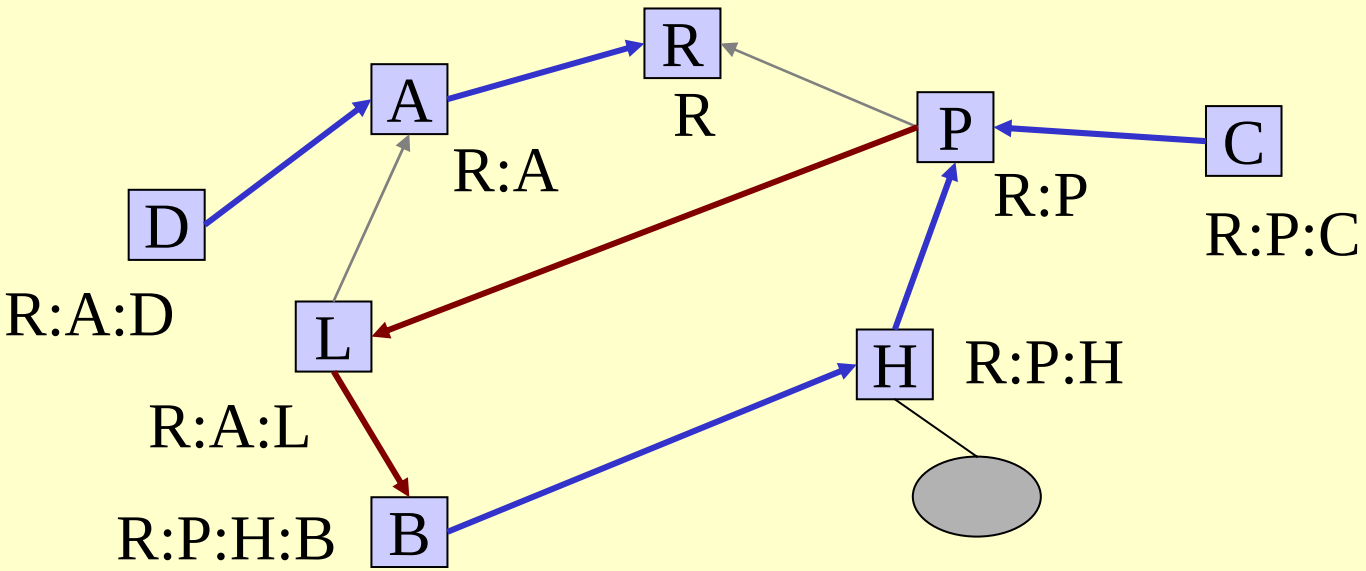


Valid Parents



How Loops Form

"Simultaneous" changes by multiple members (e.g. P and L)



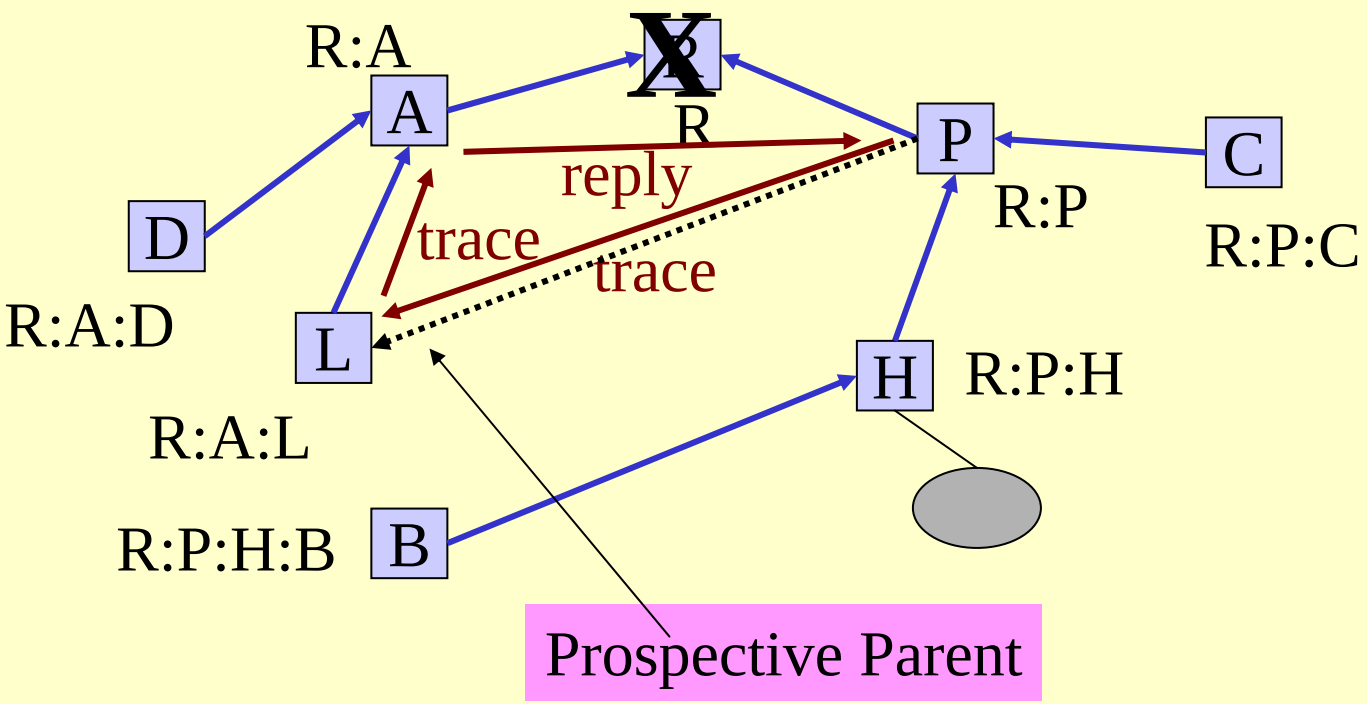
Loop Avoidance Algorithms

- 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

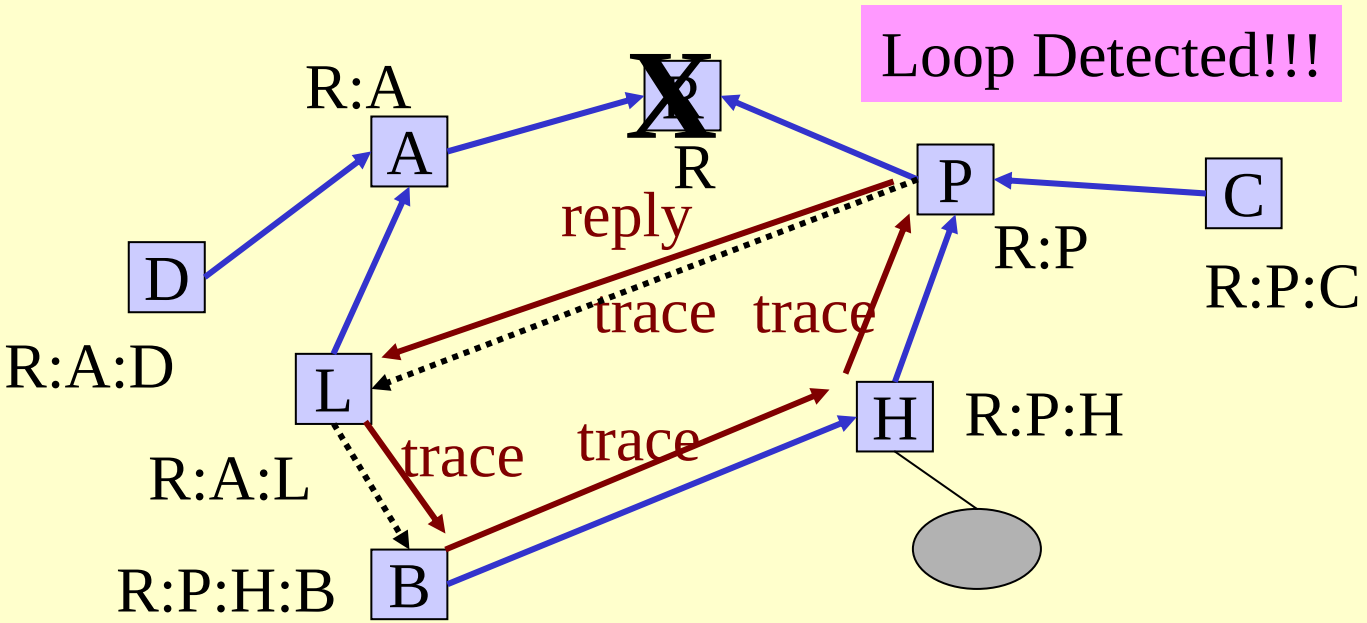
Emergency Loop Avoidance

- 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



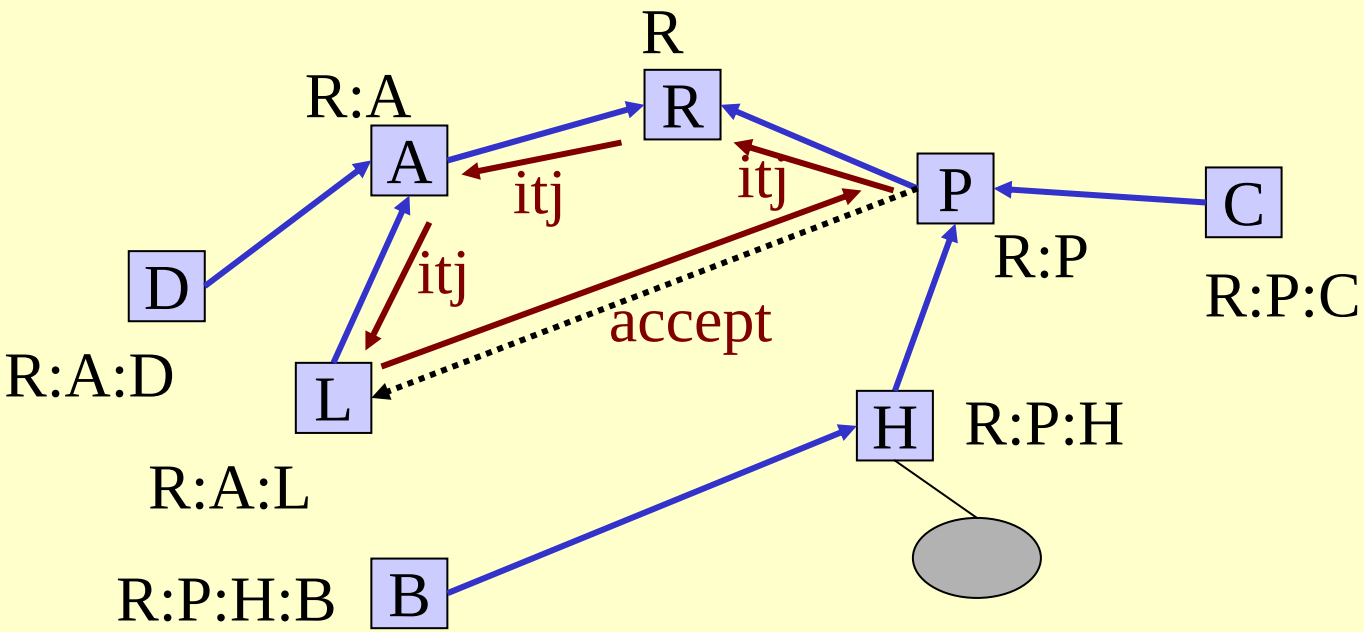
Emergency Loop Avoidance: P and L Changing Parent



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