RPR Topology Discovery Proposal

Jeanne De Jaegher, Alcatel

Jason Fan, Luminous

Henry Hsiaw, NEC
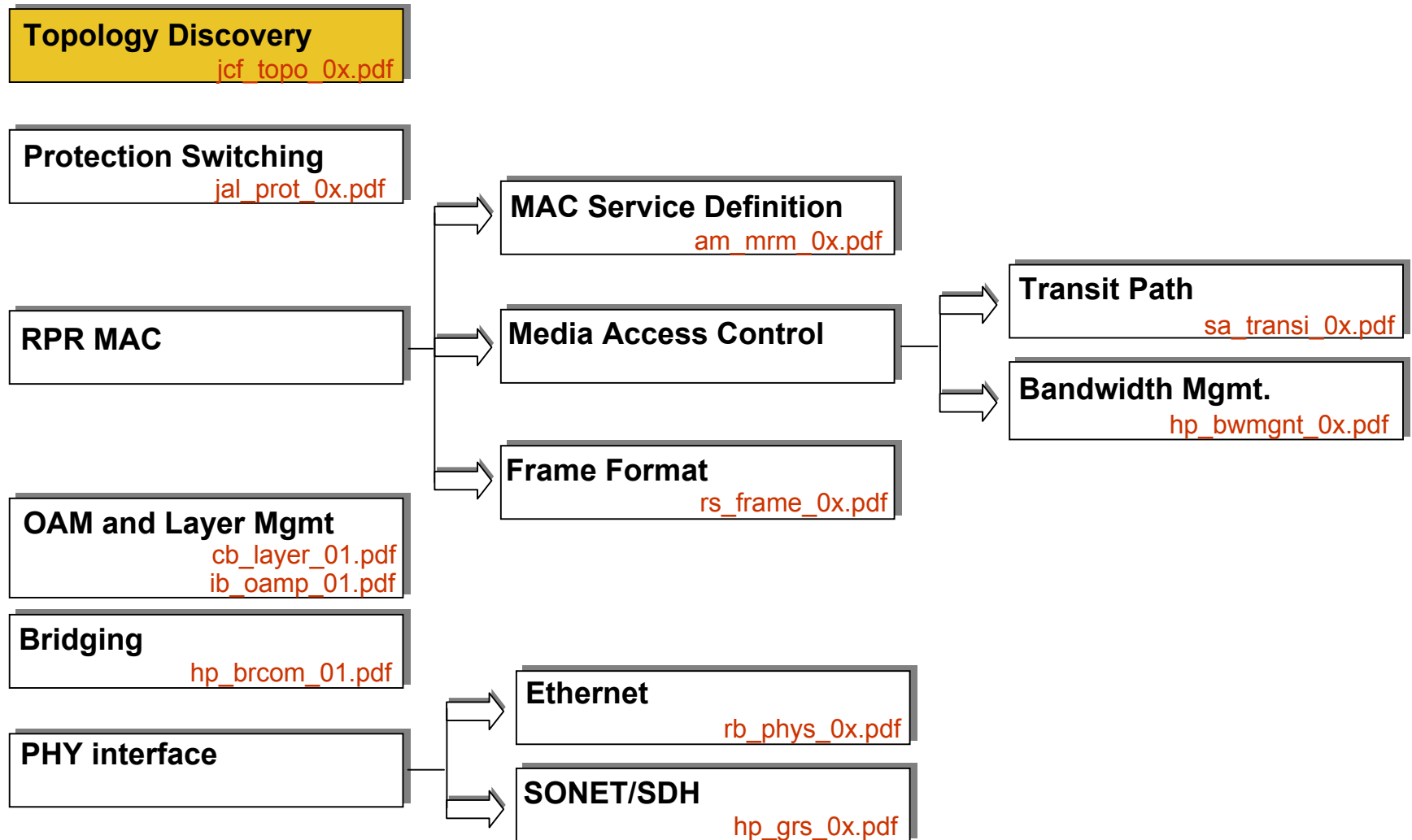
John Lemon, Lantern

Robin Olsson, Vitesse

Harry Peng, Nortel

Frederic Thepot, Dynarc

Components of a complete RPR proposal

Topology Discovery
jcf_topo_0x.pdf

Protection Switching
jal_prot_0x.pdf

RPR MAC

MAC Service Definition
am_mrm_0x.pdf

Media Access Control

Transit Path
sa_transi_0x.pdf

Bandwidth Mgmt.
hp_bwmgnt_0x.pdf

Frame Format
rs_frame_0x.pdf

OAM and Layer Mgmt
cb_layer_01.pdf
ib_oamp_01.pdf

Bridging
hp_brcom_01.pdf

PHY interface

Ethernet
rb_phys_0x.pdf

SONET/SDH
hp_grs_0x.pdf

Goals

- Scalable from 1 to 100's of stations
- Determine/validate connectivity and ordering of stations on the ring
- Ensure all stations on the ring have a uniform and current image of the topology
- Immediate reaction to changes
- Tolerant of message loss
- Operate without any master station on the ring
- Operate independently of and in the absence of any management systems

Goals, continued

- Usable with all supported topologies: multiple ringlet ring, linear (broken ring), and "star" (single station)

- Support dynamic addition and removal of stations to/from the ring

- Detect mis-cabling between stations

- Provide means of sharing additional information between stations

- Cause minimal overhead

Information Sharing

- RPR Topology Image used by other algorithms
  - Steering algorithm uses Topology Image to know when steering is needed
  - Congestion avoidance uses Topology Image to know where congestion is being experienced

Topology Discovery Triggers

- Neighbor change at any station
  - Addition or deletion of neighbor
  - Change in link status
- Detection of validation failure at any station
  - Station lacking topology image
  - Station with outdated or corrupted topology image

Image Versions

- Station_Image_Version
  - Starts at 0 (indicating no valid image)
  - Incremented upon each change in local status
  - Independent value for each station

- Ring_Image_Version
  - Checksum of all Station_Image_Versions for all known stations (including self)
 - Common value for each station

Neighbor_Hello Control Message

- Reports presence, identity, and topology version of neighbor station

- Key fields
  - Ring image version
  - Ringlet ID

- Broadcast on each ringlet with TTL = 1
  - Removed by neighbor
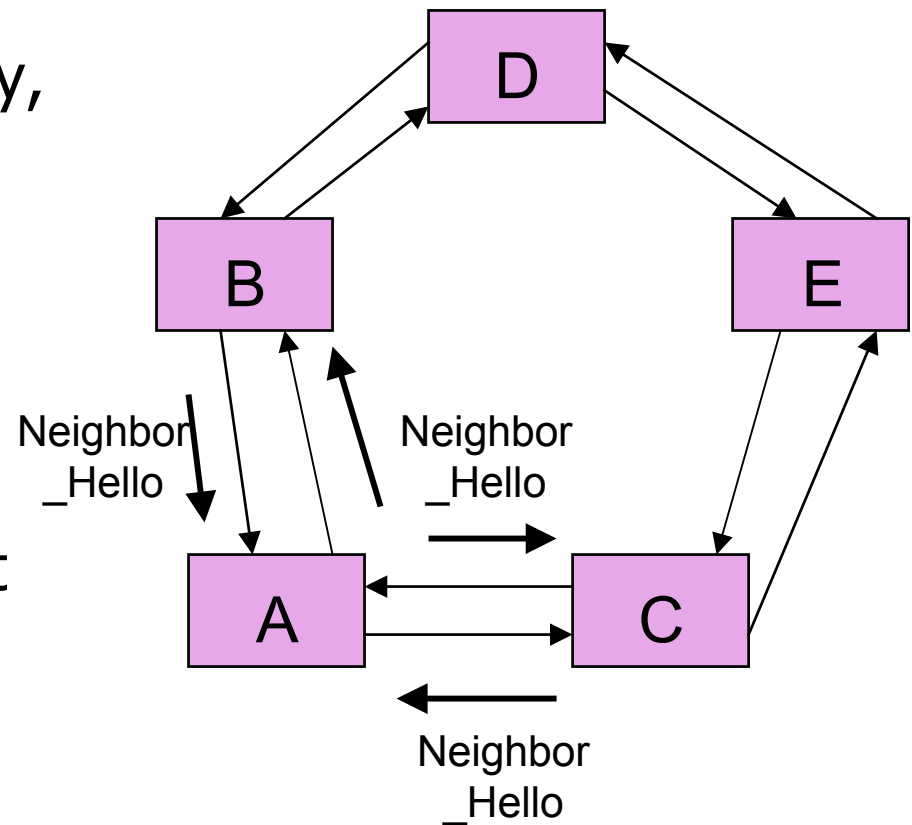
Topology_Status Control Message

- Reports changes in neighbor identity or link status
- Key fields
  - Source station image version
  - Per ringlet
    - Neighbor MAC addresses
    - Neighbor link statuses
    - Ringlet ID
- Broadcast on each ringlet with TTL = Max_Ring_Size
  - Removed by source
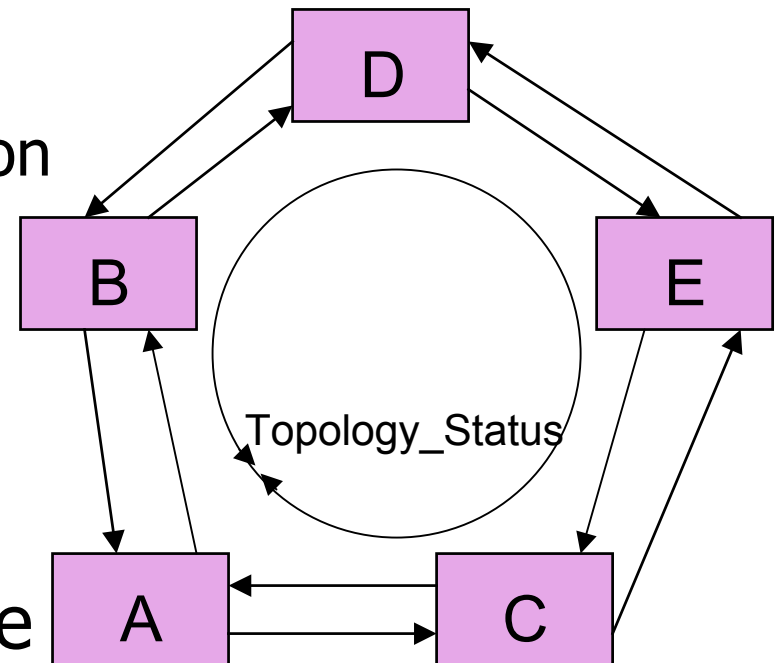
Topology_Status

Configurable Parameters

- Neighbor_Hello_Timer
- Topology_Stabilization_Timer

State Diagram
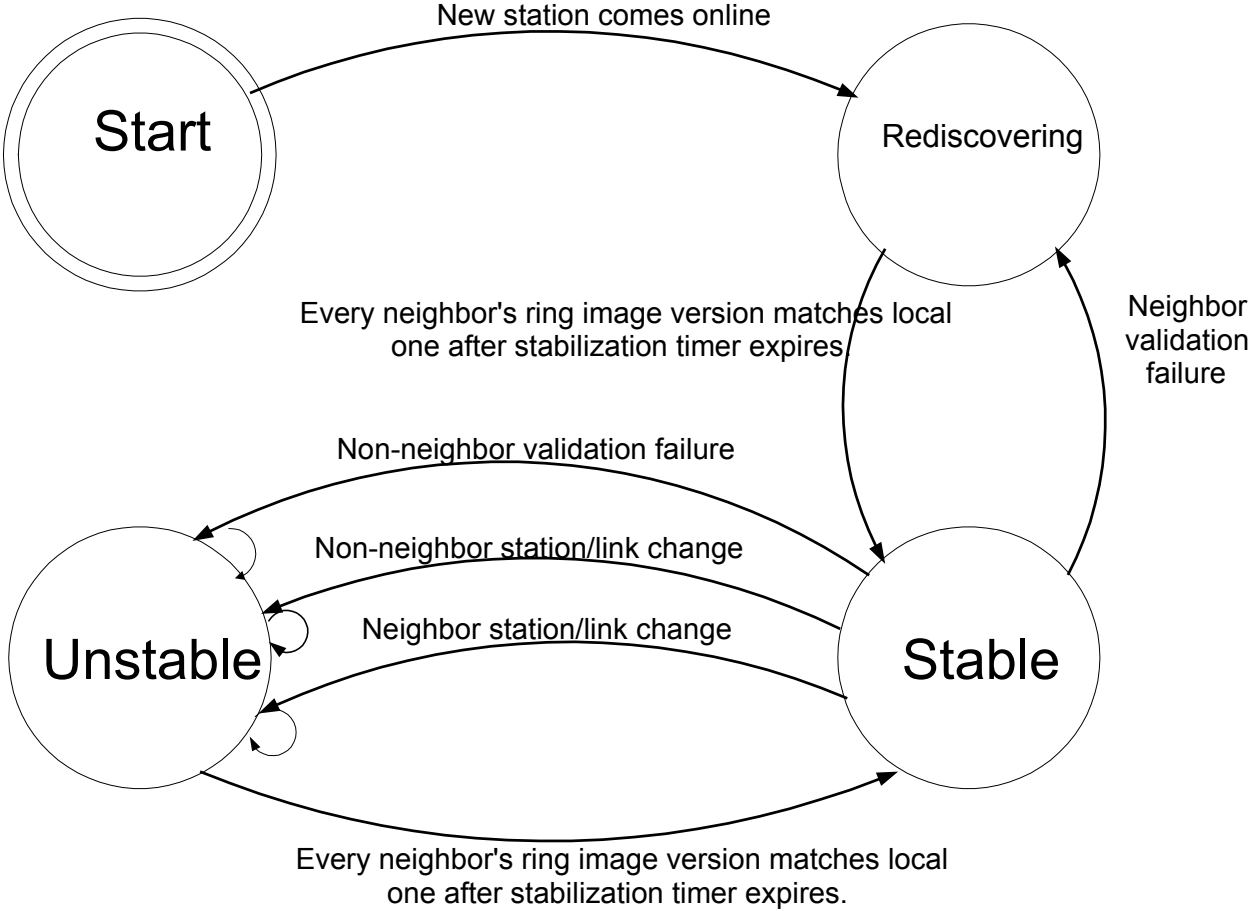
State Diagram Details, 1

- Neighbor station/link change
  - Trigger
    - No Neighbor_Hello messages in 3 Neighbor_Hello Periods (NHPs) or
    - Two successive Neighbor_Hellos from a new neighbor in 3 NHPs.
  - Action
    - Increment the local Station_Image_Version
    - Broadcast a Status_Change message
    - Replace the station information in the local topology image
    - Update the local Ring_Image_Version

State Diagram Details, 2

- Non-neighbor station/link change
  - Trigger
    - A higher Station_Image_Version is received in a Status_Change message
  - Action
    - Replace the remote station information in the local topology image
    - Update the remote Station_Image_Version
    - Update the local Ring_Image_Version

State Diagram Details, 3

- **Neighbor validation failure**
  - Trigger
    - A Ring_Image_Version in a Neighbor_Hello doesn't match the local one, or
    - the local Ring_Image_Version is 0 (a new station)
  - Action
    - Set the local and all the remote Station_Image_Versions = 0
    - Send a Status_Change message

State Diagram Details, 4

- Non-neighbor validation failure
  - Trigger
    - A Status_Change message with Station_Image_Version = 0
  - Action
    - Update the remote Station_Image_Version to 0
    - Broadcast a Status_Change message
    - Update the local Ring_Image_Version

Topology_Stabilization Timer

- Once in any of the above conditions, start the Topology_Stabilization_Timer.

- While the Topology_Stabilization timer is running, do not compare the Ring_Image_Versions.

Simulation Results

- Set up
  - 256 stations
  - 200 km circumference
  - Dual ringlet ring
  - 1 Gbps ring rate
  - Processing times for messages set to exponentially distributed times around mean of 200 usec for Neighbor_Hello and 500 usec for Topology_Status
- Scenario
  - Bring up all 256 stations at once (worst case)
- Results
  - For Neighbor_Hello_Timer of 500 msec, Topology Image complete in 1.65 seconds
  - For Neighbor_Hello_Timer of 1 sec, Topology Image complete in 3.15 seconds