RPR Topology Discovery Proposal

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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: 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
- Provides dynamic information needed to initiate protection

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
  - Protection can be triggered by changes reported by Status_Change messages

Topology Discovery Triggers

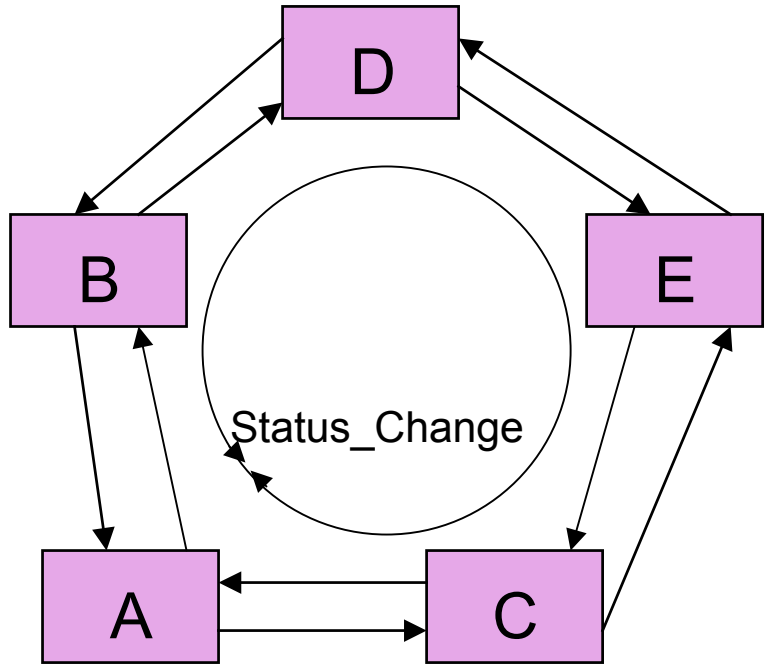
- Neighbor change at any station
  - Addition or deletion of neighbor
  - Change in link status
- Detection of validation failure at any station
  - Station lacking topology image
  - Station with outdated or corrupted topology image

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

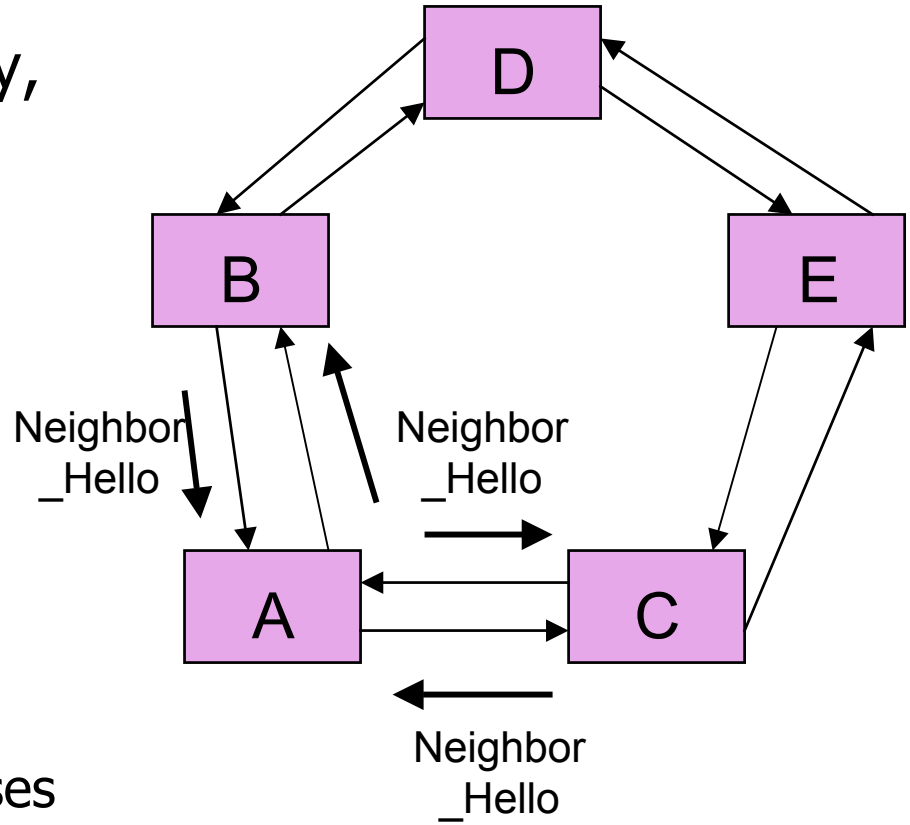
Status_Change Control Message

- Reports changes in neighbor identity or link status
- Contains
  - Source MAC address
  - Source station image version
  - Neighbor MAC addresses
  - Neighbor link statuses
  - Ring ID
- Broadcast with TTL = Max_Ring_Size
  - Removed by source
  - Sent to All_Stations broadcast MAC address



Neighbor_Hello Control Message

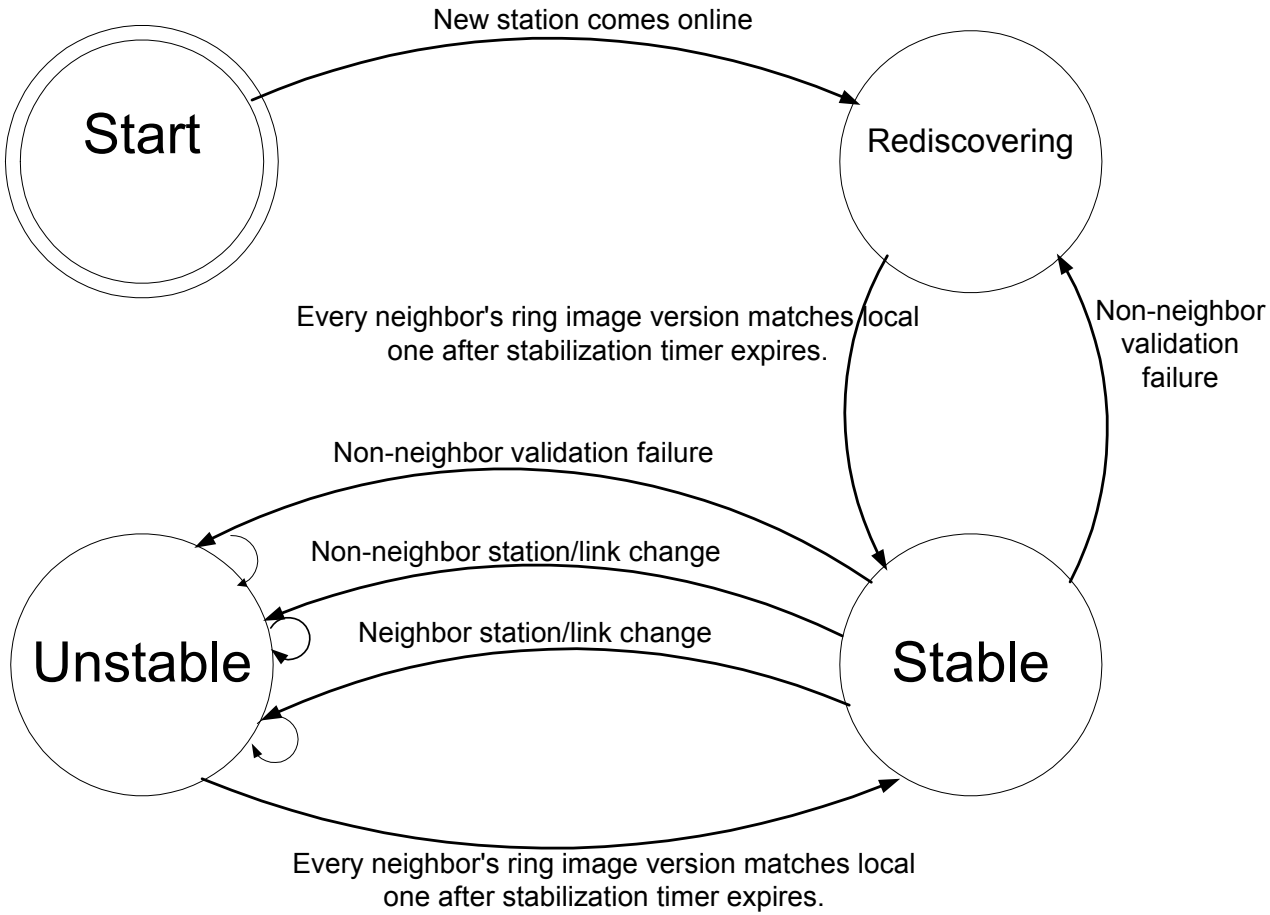
- Reports presence, identity, and topology version of neighbor station
- Contains
  - Source MAC address
  - Ring image version
  - Ring ID
- Unicast with TTL = 1
  - Removed by neighbor
  - Sent to Station_Left and Station_Right MAC addresses



Configurable Parameters

- Neighbor_Hello message period
- Topology_Stabilization time
- Hold-Off Time
- Wait To Restore timer
- Number of failed topology discovery attempts before event generated for management system

State Diagram



State Diagram Details, 1

3. Neighbor station/link change
    3. Trigger
        3. No Neighbor_Hello messages in 3 Neighbor_Hello Periods (NHPs) or
        4. Two successive Neighbor_Hellos from a new neighbor in 3 NHPs.
    4. Action
        3. Increment the local Station_Image_Version
        4. Broadcast a Status_Change message
        5. Replace the station information in the local topology image
        6. 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

5. Once in any of the above conditions, start the Topology_Stabilization_Timer.
6. While the Topology_Stabilization timer is running, do not compare the Ring_Image_Versions.

Simulation Results

- Set up
  - 256 stations
  - 200 km circumference
  - dual ring
  - 1 Gbps ring rate
- Scenario
  - Bring up all 256 stations at once
- Results