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RPR Plug and Play Operation

Jim Kao and Necdet Uzun

AuroraNetics, Inc.

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RPR Objective #11

The 802.17 standard shall allow a new station to transit and optionally insert packets without manual configuration (plug and play)
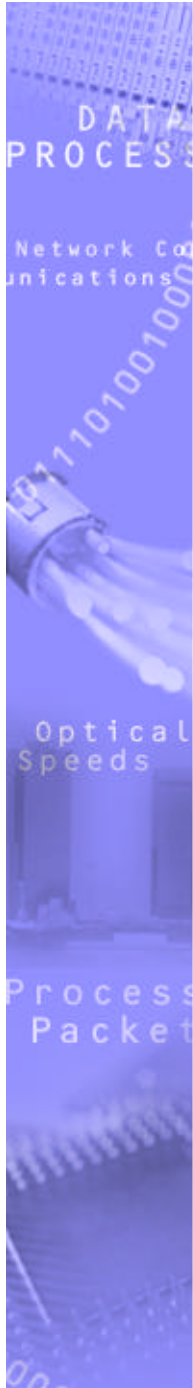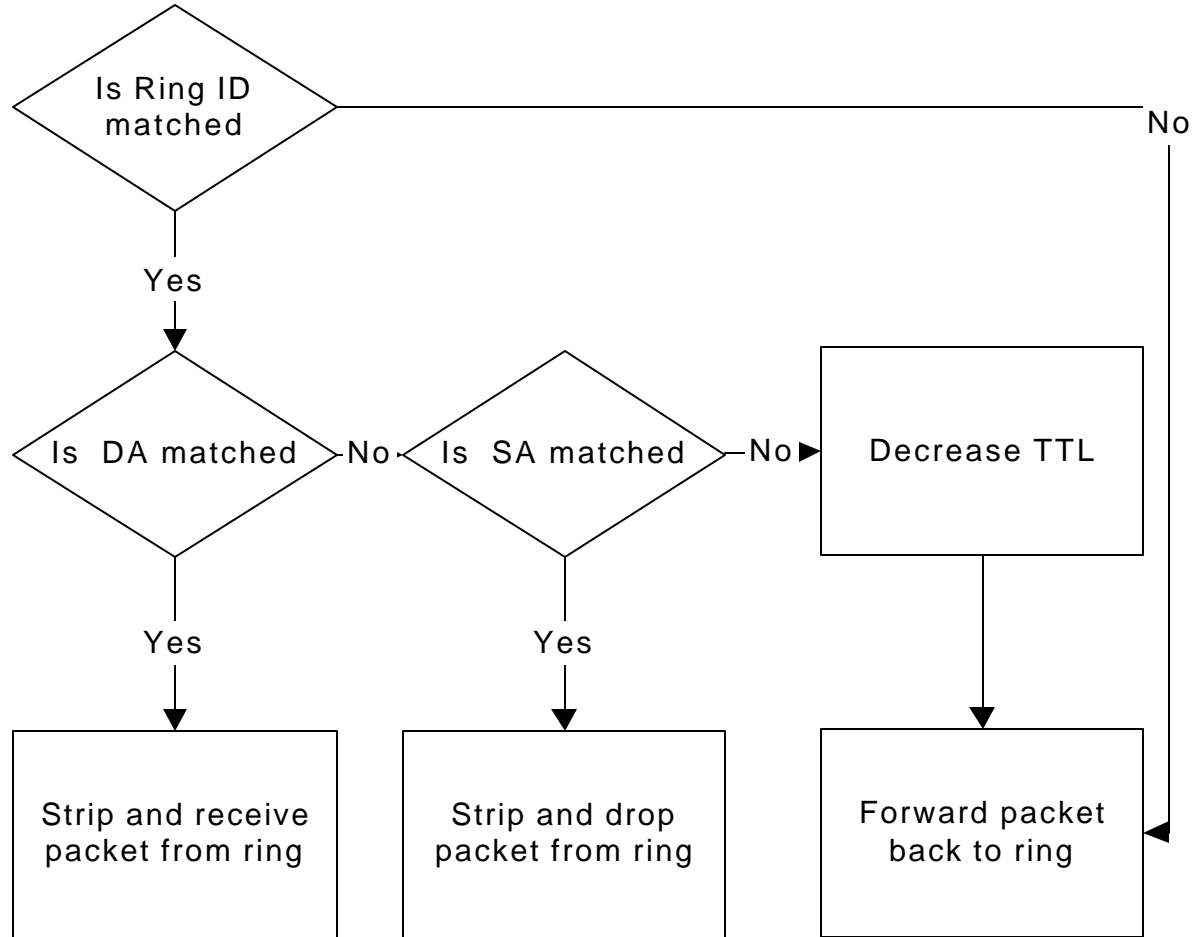
RPR Plug and Play

- A new node comes up in pass-through mode
- The new node needs to figure out its Ring ID for inner/outer ring
- The new node needs to figure out the topology of the RPR ring
- The new node then is ready

Data Packet Processing

```
        ┌─────────────────┐
        │   Is Ring ID    │────────────────────────────────────── No
        │    matched      │
        └─────────────────┘
              │ Yes
              ▼
    ┌──────────────┐        ┌──────────────┐       ┌──────────────────┐
    │ Is DA matched│── No ──│ Is SA matched│── No ─▶│   Decrease TTL   │
    └──────────────┘        └──────────────┘       └──────────────────┘
         │ Yes                   │ Yes                      │
         ▼                       ▼                          ▼
┌──────────────────┐   ┌──────────────────┐      ┌──────────────────┐
│ Strip and receive│   │  Strip and drop  │      │  Forward packet  │
│ packet from ring │   │ packet from ring │      │   back to ring   │
└──────────────────┘   └──────────────────┘      └──────────────────┘
```

Role of Ring ID in Data Processing

- Indicate source Ring ID in RPR packet header for
  - Packet stripping, receiving and transiting decisions for data traffic
  - To minimize the packet drop and packet out of sequencing during protection mode
  - Without a consistent Ring ID, RPR ring will not function properly
- Adding a new node into a RPR ring with a consistent Ring ID
  - Either requires a way to negotiate Ring ID
  - Or requires predefined Ring ID for inner/outer ring and correct cable wiring for inner and outer rings

Possible Ring ID Discovery Schemes

1. The Ring ID is locally significant, every node keeps a record of them

2. A Ring ID discovery protocol to agree on the global Ring ID
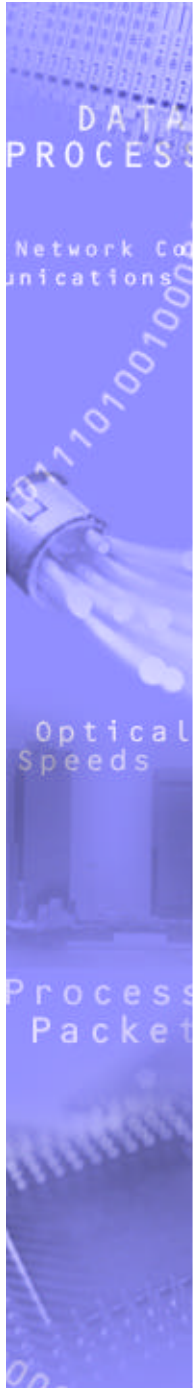
1) Ring ID is Locally Significant

- Each node assigns Ring ID locally to its MACs in a way that inner ring and outer ring get inverse of each other

- Each RPR node will not send any data packet until the first topology discovery packet is returned

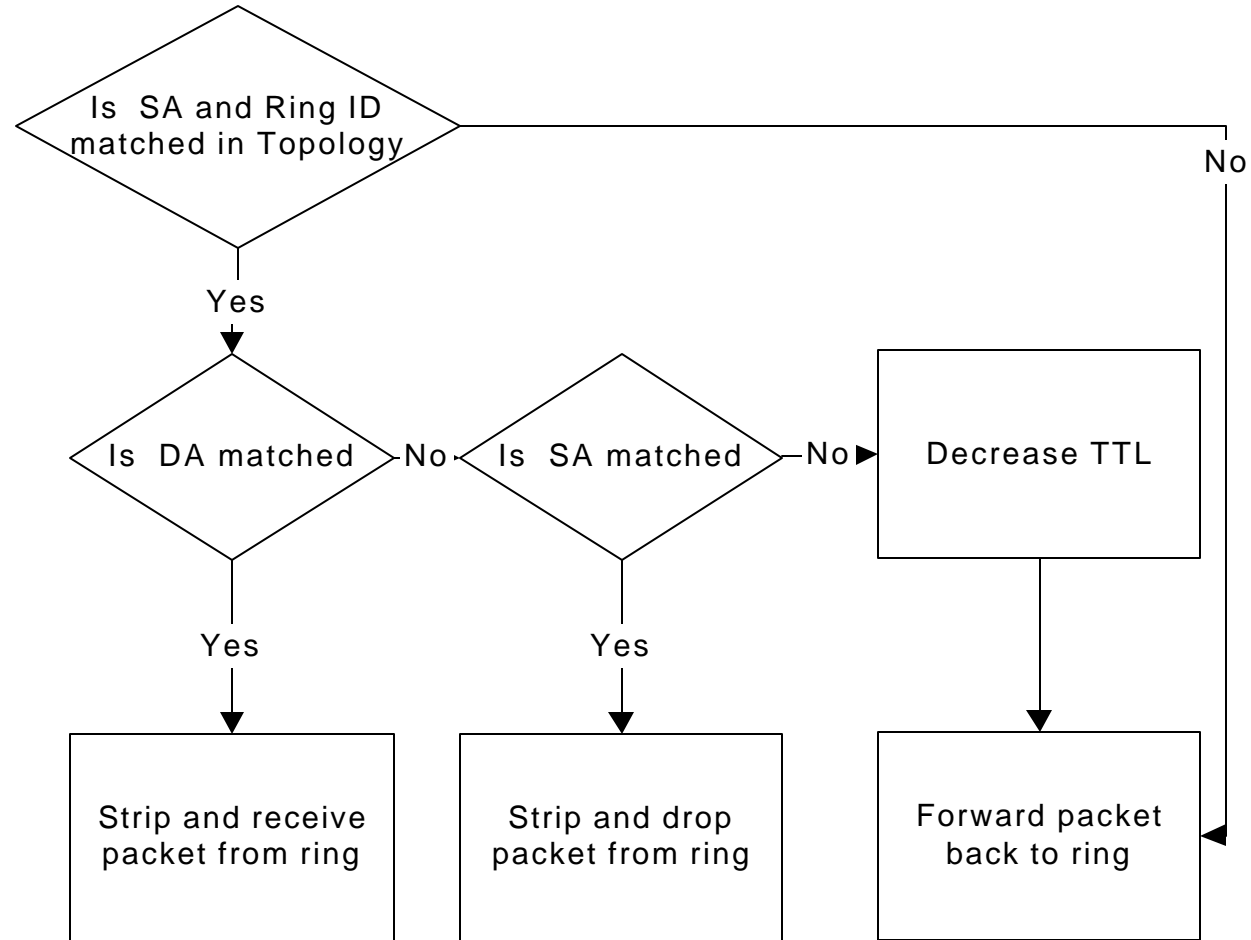- Each RPR node will bind its MAC address and Ring ID into topology discovery packet

1) Ring ID is Locally Significant(cont.)

- Each node maintain a lookup table which contains the MAC address – Ring ID pair of all nodes on the ring

- SA and Ring ID of transit packets is checked against the corresponding entry in the lookup table
  - If a match, it is not wrap traffic. Otherwise, it is a wrap traffic

- When a node receives a topology discovery packet originated from a new node, it will restart its topology discovery process

Data Packet Processing

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Is SA and Ring ID matched in Topology

No

Yes

Is DA matched — No — Is SA matched — No — Decrease TTL

Yes

Yes

Strip and receive packet from ring

Strip and drop packet from ring

Forward packet back to ring

2) Ring ID Discovery Protocol

- Init Mode
  - The initialization state, a Ring ID query packet is sent to the ring

- Active Query Mode
  - The node waits for the return of its Ring ID query packet while processing other node's query packets

- Passive Listen Mode
  - The node has received a Ring ID query from a node with a lower SA before receiving its own query packet

- Discovered Mode
  - The global Ring ID is assigned to the ring

2) Ring ID Discovery Protocol(Cont.)

- While a node is coming up, it assigns a local Ring ID to its MAC and inverse of it to its Mate
- A Ring ID query will be sent to the ring right after a RPR node joins the ring
- A node in the Discovered Mode will respond the Ring ID query by providing its Ring ID
- If there is not a node in the Discovered Mode, the Ring ID assignment of the node with the smallest MAC address will overwrite others

2) Ring ID Discovery Protocol (Cont.)

- A node in Active Query Mode will compare the original SA in Ring ID query packet with its MAC address
  - If node's MAC address is bigger than the SA, the query packet will be passed to the downstream node
  - If node's MAC address is smaller than the SA, the query packet will be dropped
- If the Ring ID query packet is circulated around the whole ring and received back by the original node, this node must have the smallest MAC address. Hence, it will assign the global Ring ID.

Ring ID Discovery State Transition

- Init Mode
  - Send the Ring ID query packet into ring
    - Enter Active Query Mode
  - Receive the Ring ID response
    - Set the Ring ID based on the Ring ID response
    - Enter Discovered Mode

- Active Query Mode
  - Receiving other Ring ID query packet with a larger MAC address
    - Drop the packet
  - Receiving other Ring ID query packet with a smaller MAC address
    - Forward the packet
    - Enter Passive Listen Mode

Ring ID Discovery State Transition(cont.)

- Receiving the Ring ID response
  - Set the Ring ID based on the Ring ID response
  - Enter Discovered Mode
- Receiving the original Ring ID query
  - Set the Ring ID
  - Broadcast the Ring ID response to both ring
  - Enter Discovered Mode
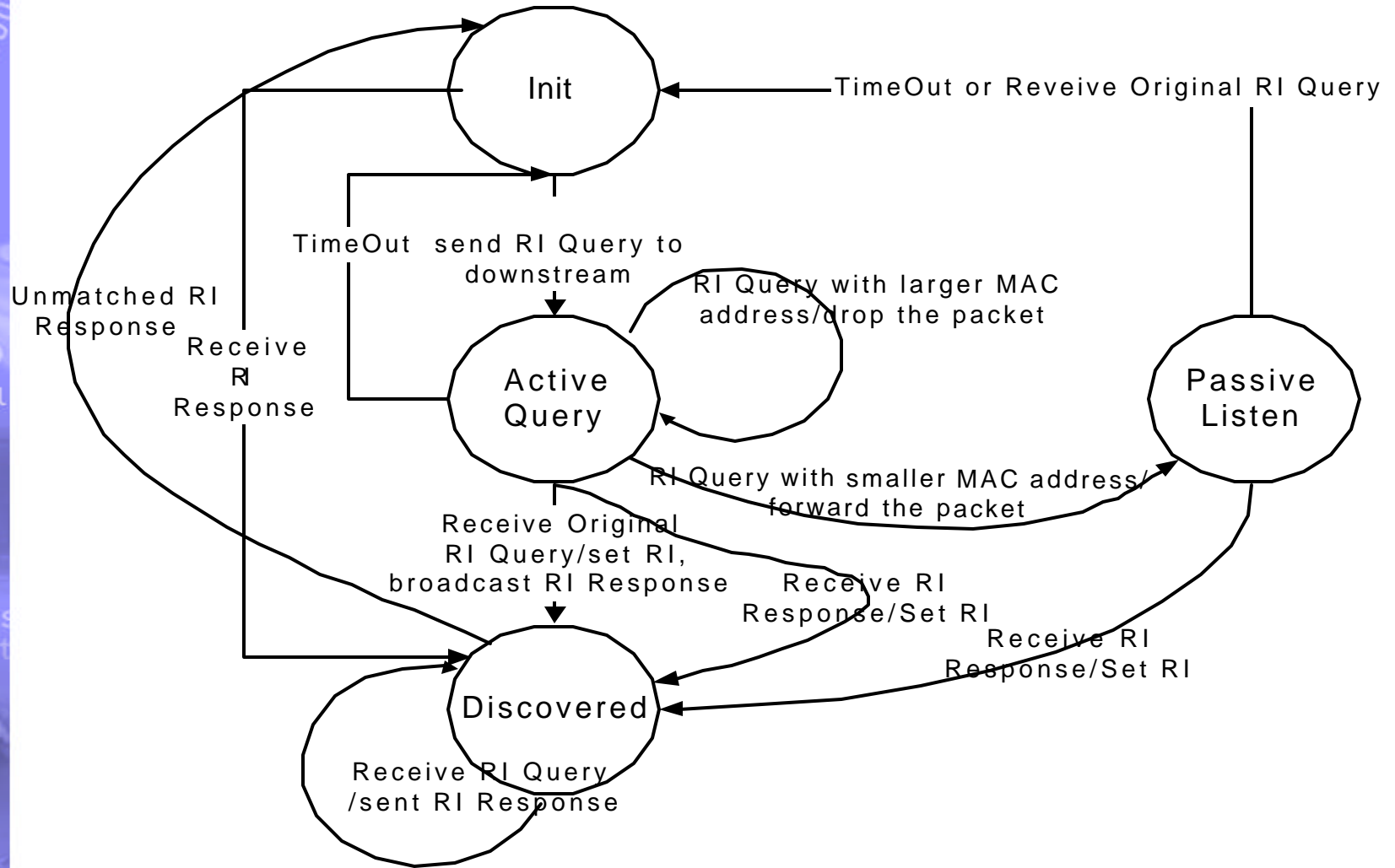- Timeout
  - Enter Init Mode

Ring ID Discovery State Transition(cont.)

- Passive Listen Mode
  - Receiving the original Ring ID query
    - Enter Init Mode
  - Receiving the Ring ID response
    - Set the Ring ID
    - Enter the Discovered Mode
  - Timeout
    - Enter Init Mode

- Discovered Mode
  - Receiving a Ring ID query
    - Sent a Ring ID response to opposite ring
  - Receiving an unmatched Ring ID response
    - Enter the Init Mode

The State Machine Transition Diagram

Init

TimeOut or Reveive Original RI Query

TimeOut   send RI Query to downstream

RI Query with larger MAC address/drop the packet

Unmatched RI Response

Receive RI Response

Active Query

Passive Listen

RI Query with smaller MAC address/ forward the packet

Receive Original RI Query/set RI, broadcast RI Response

Receive RI Response/Set RI

Receive RI Response/Set RI

Discovered

Receive RI Query /sent RI Response

Conclusion

- Two schemes are presented for RPR Plug and Play Operation

- "Ring ID is locally significant" requires hardware implementation

- "Ring ID discovery protocol" can be done in software only (recommended scheme)

- Q&A