G.8032 Ethernet Ring Protection
Oct 4, 2011
Ethernet Ring Protection - Preliminaries

- Based on G.8032 - original version (1) in June 2008
- Currently at version 2 (+)
- Uses a single message type, R-APS that is built on the Y.1731 message structure
- Works on single (simple) rings, multiple independent rings, and laddered rings
Basic Configuration of an G.8032 Ring

- On each ring node the two ring ports are identified

- One link in the ring is identified as the *Ring Protection Link* (RPL)

- One of the switches terminating the RPL is identified as the *RPL Owner*
Ring Components

Ring Protection Link

- Normal Ring port
- RPL port on RPL Owner

A → O
C → D

RPL Owner
Basic Operation of G.8032 Ring

1. The RPL Owner blocks its RPL link

2. The RPL Owner sends an R-APS out indicating that the RPL is blocked [R-APS(NR, RB)].

3. Upon receipt all ring nodes unblock their ring ports and forward the message around the ring.

   **Steady State**

4. When a failure is detected on the ring, the nodes adjacent to the failure block their ring ports and send an indication around the ring [R-APS(SF)].

5. When the RPL Owner sees the SF, it unblocks the RPL port and makes the ring whole again.

Note: The forwarding database (FDB) is flushed at certain points during ring configuration resulting from a failure or recovery to ensure that addresses are relearned quickly.
Steady State (no failure) Ring Configuration

- **Ring Protection Link**
- **RPL Owner**
- **Blocked RPL Port**
- **RAPS Message**
  - NR (no request)
  - RB (RPL blocked)
Protection Switching Time

From G.8032:

*In an Ethernet Ring, without congestion, with all Ethernet Ring Nodes in the idle state (i.e., no detected failure, no active automatic or external command, and receiving only “NR, RB” R-APS messages), with less than 1200 km of ring fiber circumference, and fewer than 16 Ethernet Ring Nodes, the switch completion time (transfer time as defined in [ITU-T G.808.1]) for a failure on a ring link shall be less than 50 ms.*
1. **Failure!**
2. Block failed ports
3. Send R-APS message signaling failure (SF)
4. RPL Owner unblocks RPL

Ring is whole again
Recovery

1. Link recovered
2. Adjacent nodes remove SF and send NR
3. RPL Owner starts WTR timer (nominally 5 minutes)
4. WTR timer expires, RPL port is blocked
5. RPL Owner sends NR/RB
6. Other nodes unblock their ring ports
Detecting Failures

- The standard does not prescribe any specific techniques for detecting failures in the ring. The two common methods are:

  - Link failure detection - i.e. detecting a physical link defect such as disconnection or lack of light, etc.

  - Y.1731 Connectivity Check Messages (CCM) - These messages are sent across a link to check the connectivity of the link. If a node is expecting CCM messages at a particular interval and does not see a message for 3 intervals, then a failure is declared. For protection applications such as G.8032 the messages should be sent every 3.3ms (300 messages / second) in order to detect a failure in 10ms.
Multiple Rings

- In general, each ring uses a different S-Tag to identify the R-APS messages associated with the ring.

- There are two types of multi-ring configurations:
  - Independent Rings - these are rings that do not share any links
  - Laddered / Subtended Rings - this are rings that share a link
Independent Rings

- Rings that don’t share any links operate as independent G.8032 domains.
- Each ring has a S-Tag for its R-APS messages.
- Each ring has its own RPL and RPL Owner.
- There is no interaction between them, even on the interconnecting node (node D in this case)
Laddered Rings

- Laddered rings are modeled as a MAIN ring and one or more SUBTENDING rings.
- The Main ring is a fully closed ring (A-B-D-C-A).
- The Subtended ring does not include any links shared with the main ring.
- The Main ring acts as a **virtual channel** to close the Subtended ring.
  - CCM and R-APS messages are sent over the virtual channel using the S-tag of the subtended ring.
Laddered Rings

- Regardless of the failure detection used on the physical links, the Subtended Ring must use CCMs to detect the state of the virtual channel.

- A failure in the Subtended ring will unblock the RPL in the Subtended Ring.

- A single failure in the Main ring will not be seen by the Subtended ring since the Main ring will recover. A double failure in the Main ring will cause a recovery in the Subtended Ring.
Changes in G.8032 V2

- G.8032 version 2 includes several new features and several improvements to address some protocol issues.

- **Major New Features:**
  - Support for multiple instances (like MSTP)
  - Support for Force Switch and Manual Switch and Clear
  - Adds support for non-revertive recovery

- **Improvements**
  - Support for Laddered rings *without* a virtual channel (addresses problems with ring recovery in some case)
  - Avoids node isolation on recovery in some situations
  - Updates R-APS message format
  - Optimized FDB flush logic