WoMaster

White Paper

ITU-T G.8032 ERPS Technology

Part I

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ERPS (G.8032) V2 Technology White Paper

Have a solid network with Ring on it.

Ethernet Ring Protection Switching (ERPS) is a protocol defined by the International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) to prevent loops at Layer 2. With the standard number is ITU-T G.8032, and ERPS is also called G.8032. Generally, redundant links are used on a network to provide link backup and enhance network reliability. The use of redundant links, however, may produce loops, causing broadcast storms and rendering the MAC address table unstable. These can affect the network, where the communication quality is not good enough, and communication services might be interrupted.

The Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP) are often used to prevent loops. STP meets network reliability requirements but provides slow convergence. Although RSTP and MSTP make enhancements, their convergence is still at the second level.

Compared with STP, RSTP and MSTP, ERPS has the following advantages:

- **Fast network convergence**

ERPS provides advantages of traditional ring network technologies such as STP/RSTP/MSTP and optimizes detection mechanism to provide faster convergence. For example, the ERPS-enabled switch provides 50-ms convergence for broadcast packets.

- **Good compatibility**

ERPS is a standard Layer 2 loop prevention protocol issued by the ITU-T. It can be used for communication between Womaster and non-Womaster devices on a ring network.

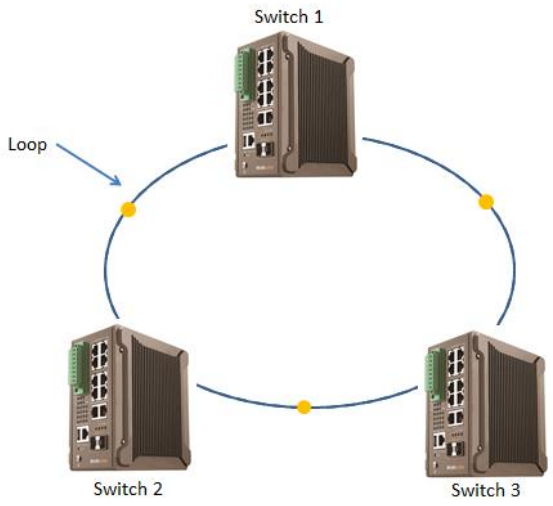
There were some basic concepts that support ERPS Ring.

- **Ring Protection Link (RPL)** – Link designated by mechanism that is blocked during Idle state to prevent loop on Bridged ring.
- **RPL Owner node** – Node connected to RPL that blocks traffic on RPL during Idle state and unblocks during Protection state.
- **RPL Neighbor node** – Node connected to RPL that blocks traffic on RPL during Idle state and unblocks during Protection state (v2).
- **Link Monitoring** – Links of ring are monitored using standard ETH CC OAM messages (CFM)
- **Signal Fail (SF**) – Signal Fail is declared when signal fail condition is detected.
- **No Request (NR)** – No Request is declared when there are no outstanding conditions (e.g., SF, etc.) on the node.
- **Ring APS (R-APS**) Messages – Protocol messages defined in Y.1731 and G.8032.
- **Automatic Protection Switching (APS) Channel -** Ring-wide VLAN used exclusively for transmission of OAM messages including R-APS messages.

G.8032 or ERPS use different timers to avoid race conditions and unnecessary switching operations.

- **Delay Timers –RPL Owner** used this to verify that the network has stabilized before blocking the RPL.
  - After SF (Signal Fail) condition – Wait-to-Restore (WTR) timer used to verify that SF is not intermittent.
  - After Force Switch/Manual Switch command – Wait-to-Block (WTB) timer used to verify that no background condition exists (v2).
  - WTB timer may be shorter than the WTR timer.
- **Guard Timer** – Used by all nodes when the state is change, it also blocks latent outdated messages from causing unnecessary state changes.
- **Hold-off Timers** – Used by underlying ETH layer to filter out intermittent link faults.
  - Faults will only be reported to the ring protection mechanism if this timer expires.

For better understanding about ERPS, the understanding about what is loop is important. A loop is a configuration where a frame travels around a network without any ending it just going back to where it started. The figure below is an example of a simple loop.

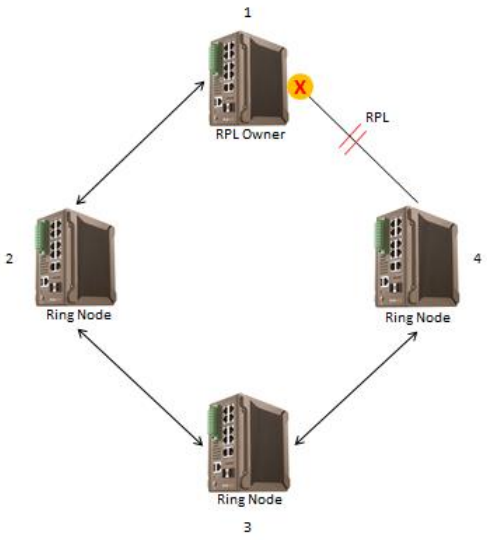


We can say that a loop avoiding protocol has not been used on switches we could see where a frame could be sent from one switch to the next. It would keep going around and eating up bandwidth. Even more, the frames passing around the loop will cause trouble with the MAC address tables, where a network will not allow packets to pass through it.

After we understand about loops, we also understand that loops are not good things for our network but we would like to have the path redundancy that a loop provides. ERPS is one way of accomplishing this. An Ethernet ring consists of switches that form a closed physical loop. Each ring switch is connected to two adjacent Ethernet ring switches. This is the simple explanation about loop that we need to avoid earlier, but since the network using ERPS on it the network can work excellent.

ERPS Principles

Normal State

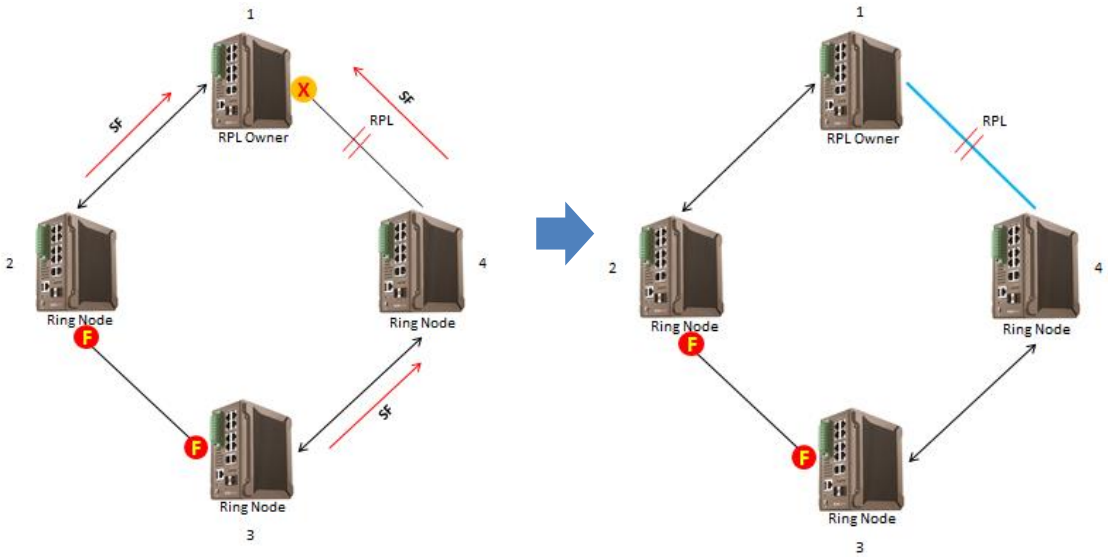


1. All nodes in a physical topology are connected to as rings.

2. ERPS blocks RPLs to prohibit formation of loops. In the figure above, the link between Node1 and Node4 is an RPL.

3. ERPS detects failures on each link between adjacent nodes.

Link Failure

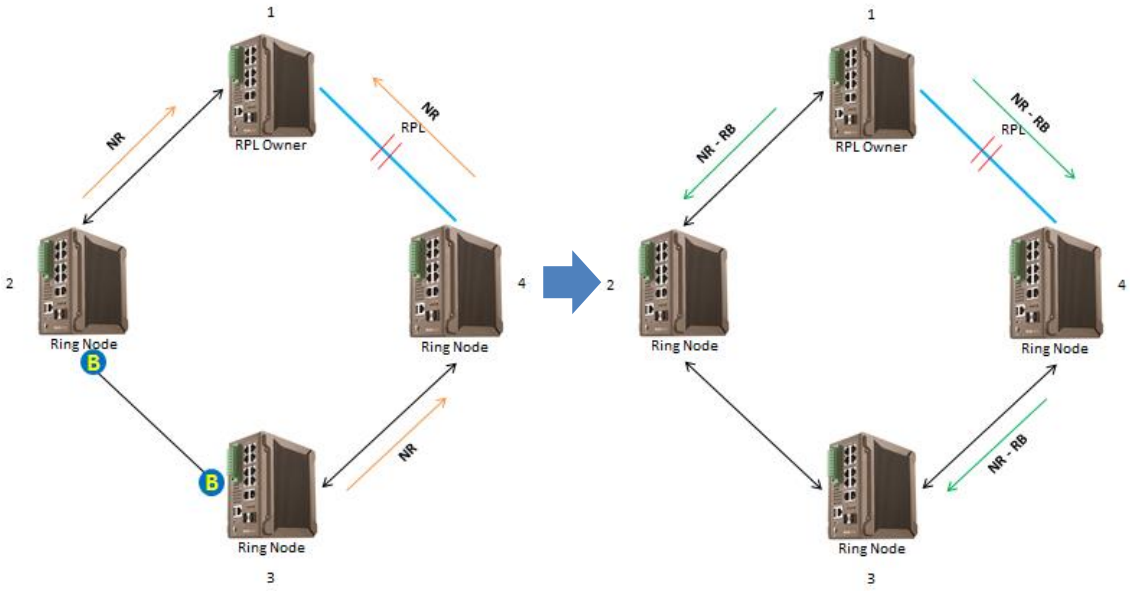


1. The nodes adjacent to a failed link block the failed link and send the R-APS(SF) message to notify other nodes in the ring of the link failure. In the figure above, the link between Node2 and Node3 fails.

2. After the hold-off timer expires, Node2 and Node3 block the failed link and send the R-APS(SF) message to other nodes in the ring.

3. The R-APS(SF) message triggers the RPL owner node to unblock the RPL port. All nodes update their MAC address entries and ARP/ND entries and the ring enters the protection state.

Failure Recovery



1. When a failed link is restored, nodes adjacent to the link are still blocked and they send the R-APS(NR) message, indicating that no local failure exists.
2. After the guard timer expires and the RPL owner node receives the first R-APS(NR) message, the RPL owner node starts the WTR timer.
3. After the WTR timer expires, the RPL owner node blocks the RPL and sends the R-APS(NR, RB) message. And the ring state is pending, while waiting for the WTR timer expires.
4. After receiving the R-APS(NR, RB) message, other nodes update their MAC address entries and ARP/ND entries, and the nodes that send the R-APS(NR) message stop periodic transmission of the message and unblock the blocked ports. The ring network is restored to the normal state which is idle state.

Benefits of adapting G.8032 v2 Ethernet Ring Protection Switching

- With G.8032 v.2 ERPS is tending to replace proprietary ring redundancy and standard Ethernet Ring Switching, as it provides stable protection of the entire Ethernet Ring from any loops**.** With the growth of the network scale, the calculation and response time in case of loop formation increases and could be from 2~120 sec to 5 minutes, and this is completely unacceptable in critical networks where the uninterrupted communication is required. Loops fatally affect network operation and service availability, thus, deploying network equipment with supported ITU-T G.8032 v2 ERPS with **less than 50ms recovery time** will significantly increase network reliability.
- G.8032 v1 standard supported single ring topology, whilst G.8032 version 2 additionally provides recovery switching for Ethernet traffic in **Multiple Ring** of conjoined Ethernet Rings by one or more interconnections which saves deployment costs by providing wide-area

multipoint connectivity with reduced number of links.

- Important to note, deploying switches supporting G.8032 v2 ERPS provides economical and highly resilient Ethernet infrastructure, as they can **interoperate with third party switches** and still guarantee fast network recovery time without any data loss.

ERPS ring is one of technology that ideal for every application, this technology currently has provided the best option. If you still want to know more, please contact us at help@womaster.eu

About Womaster

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The WoMaster brand's name distinguishes our target markets as well as symbolizes the nature sources which enforced us to become Master brand for Industrial Data Communication Market.