

# G.8032 Ethernet Ring Protection Switching

## Feature Overview and Configuration Guide

### Introduction

This guide describes G.8032 Ethernet Ring Protection Switching (ERPS) and how to configure it.

G.8032 is an International Telecommunication Union (ITU) standard for ERPS. It prevents loops on a per-VLAN basis with networks that are wired in a simple ring topology. G.8032 Version 2 provides enhancements in support of multiple ring and ladder topologies. AlliedWare Plus™ is compliant to G.8032 Version 2 February 2012 edition.

G.8032 offers a rapid detection and recovery time if a link or node fails (in the order of 50 ms, depending on configuration).

#### List of Terms:

**ERPS**

Ethernet Ring Protection Switching.

**Major Ring**

A ring with at least two nodes and a fully closed topology.

**Sub-ring**

A partial ring that is not fully closed, and attached to a major ring, either directly, or via another sub-ring.

**R-APS**

Ring Automatic Protection Switching.

**RPL**

Ring Protection Link.

**BPR**

Block Port Reference

**FDB**

Forwarding Database

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## Products and software version that apply to this guide

This guide applies to AlliedWare Plus™ products that support ERPS, running version **5.4.7** or later.

A specific G.8032 feature license is required on every ring node in order to utilize G.8032.

To see whether your product supports ERPS, and for more information about the required licensing, see the following documents:

- The [product's Datasheet](#)
- The product's [Command Reference](#)

These documents are available from the above links on our website at [alliedtelesis.com](http://alliedtelesis.com).

Most features described in this document are supported from AlliedWare Plus 5.4.7 or later. These features are available in later releases:

- Version 5.4.7-1.1 and later support combining EPSR with G.8032 sub-rings.

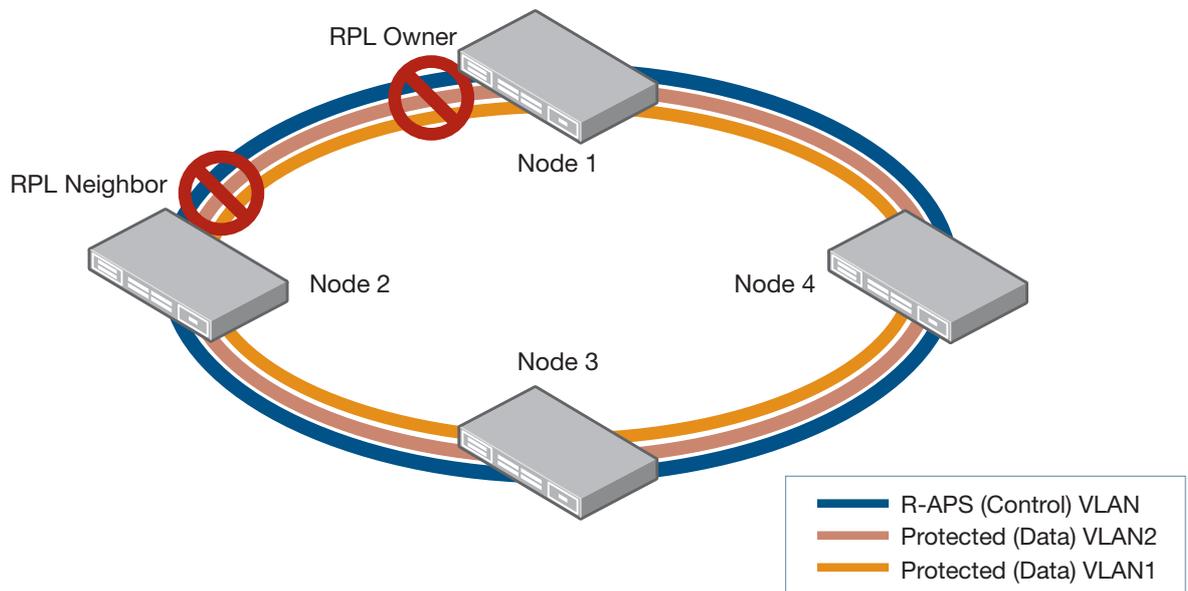
Feature support may change in later software versions. For the latest information, see the above documents.

## How ERPS Works

### ERPS components

The figure below shows a basic four node G.8032 major ring. It is called a major ring as it is fully closed in a ring topology. A ring is composed of a minimum of two nodes. The example in the figure below is a four node ring. Each node connects to the ring via two ports, also called links. One of the links in the ring is designated as a Ring Protection Link (RPL). One end of the RPL link is designated as the Owner, and the other end of the link is designated as the Neighbor.

Figure 1: Example of a Four Node ERPS Major Ring



### G.8032 Ethernet ring protection instances

Each node contains an Ethernet Ring Protection (ERP) instance. An instance is made up of:

- two ERP ring ports
- a Control VLAN that carries Ring-Automatic Protection Switching (R-APS) messages
- one or more Protected Data VLANs that the instance protects when the ring fails.

### ERP ring ports

These are the physical interface ports or interface Link Aggregation Groups (LAGs) that are used by the instance. In the major ring case, all nodes are required to have two ERP ring ports. Traditionally, these are referred to as East and West ring ports.

### R-APS channel VLAN (Control VLAN)

R-APS messages are carried over a channel. In G.8032, this channel is implemented using a VLAN. Each ERP instance uses a tag-based VLAN called the **raps-channel** for sending and receiving R-APS messages. All the nodes in the ring are required to use this raps-channel VLAN, and this VLAN must have the ERP ring ports as members. The function of the R-APS VLAN is to monitor the ring and maintain its operational functions. The R-APS VLAN carries no user data. R-APS messages flow through the ring to control its protection switching behavior.

Each node along the path will receive the R-APS message on the raps-channel VLAN and copy it for local processing. It will also attempt to forward the original version at L2 switching speed to its other ring port. If the raps-channel VLAN on the other ring port is blocked, then the R-APS message is not forwarded to the other nodes.

The raps-channel control VLAN is blocked from being forwarded to other nodes at the same place the protected data VLANs are blocked from being forwarded.

**Note:** Sub-rings without a virtual-channel are an exception which is discussed below. In this case, the raps-channel VLAN is not blocked from being forwarded even though the protected data VLANs are blocked.

The node that actually generates the R-APS messages will always send over both of its ring ports regardless of whether or not the raps-channel VLAN is being blocked on its ring port(s). Similarly, R-APS messages will be received and processed regardless of whether or not the raps-channel VLAN is being blocked on its ring port(s).

### Data-traffic VLAN (Protected Data VLAN)

Each ERP instance protects one or more data carrying VLANs (called **data-traffic**). All the nodes in the ring are required to have the same protected VLANs. The protected VLANs should have the ERP ring ports as members.

### RPL-Owner

The RPL provides the blocking of traffic under normal operating conditions, thus preventing loops. The RPL consists of an Owner on one end, and a Neighbor on the other end. It is the Owner that provides the main control for protection switching. Under normal operating conditions both ends of the RPL perform a block. However, the Owner generates R-APS No Request RPL-Blocked (NR,RB) messages continuously and is the one in charge of the RPL's blocking and forwarding states.

Under normal operation, when there are no failures, the RPL-Owner generates R-APS (NR,RB) messages. It periodically sends these, every 5 seconds, over both of its ring ports. These messages indicate which of its East or West ring ports is being blocked. Each node along the way receives the R-APS, recording the Node-id and Block Port Reference (BPR) in the message. This is used to detect a topology change.

**Note:** Configuring a G.8032 ring without an RPL-Owner is never recommended. While the G.8032 protocol can operate without an RPL-Owner, as other nodes in the ring are allowed to send R-APS messages and block traffic under both normal and failed conditions, the RPL-Owner provides predictability as to where the ring block will occur under normal conditions. The RPL-Owner is also needed for revertive operations.

## Ring failure

When a failure is detected on a ring port, known as a Signal Fail (SF), the node detecting the failure will generate an R-APS (SF) message. This message notifies the other nodes on the ring of the failure, causing a protection switch to occur. The RPL nodes remove the block on the RPL link, and all the nodes perform a Forwarding Database (FDB) flush which allows traffic to quickly return.

When a Signal Fail (SF) has been detected, the node detecting the fault will block that port for its protected VLANs, do an FDB flush for its protected VLANs, and will send out an R-APS message with a request to switch due to signal failure. It will send this R-APS(SF) message out both of its ring ports. The R-APS is first sent as a burst of three R-APS messages, and then continues to send this message every 5 seconds until the Signal Fail (SF) condition abates. Like the RPL-Owner, it will also send the R-APS message with the node-id of itself and the BPR indicating which of its ring ports is being blocked.

As the newly generated R-APS message is received by the other nodes, each node notices that the Node-id and BPR are different from what was previously received, causing it to perform an FDB flush. The R-APS message is finally received at the RPL-Owner and the RPL-Neighbor. The R-APS(SF) is also an indicator that there is a block somewhere else in the ring, and this allows the RPL-Owner and RPL-Neighbor to remove their blocks without concern for forming a loop. The RPL-Owner also notes that the Node-id and BPR received in the R-APS message is not that of itself and its RPL, so it also does an FDB flush. At this point, the ring has finished the protection switchover.

## Revertive and non-revertive operations

G.8032 also provides for revertive operations. Once the failure clears and after a waiting time of typically 5 minutes, the ring switches back to its normal mode of operation.

G.8032 also provides for a non-revertive operation, where once the failure abates, a protection switch back to the normal state does not occur. In this case, the links where the failure had occurred remain blocked and the RPL remains unblocked. A clear command, described below, is provided for you to control whether a revertive or non-revertive operation is allowed.

**Note:** When revertive operations are used, the ring will not revert back immediately. Reversion does not start until the Wait-To-Restore timer has expired, which is 5 minutes by default.

## Forced switch (FS), manual switch (MS), and clearing operations

Forced Switch (FS) is a command that can be issued to force a ring to switch. The command is issued at a given node and a given interface on the ring. This results in a block being applied at that interface (and an unblock on the opposite interface), and an R-APS Forced Switch (FS) message to flow around the ring. This will result in the RPL becoming unblocked. Any other nodes that had a block previously will also unblock when they get this message. FDB flushes also occur along the way.

To undo this operation, use the clear command at the same node. This will cause the clearing node to unblock any block it had previously applied. It will also send a R-APS No Request (NR) message, which in turn will cause the RPL to become blocked again.

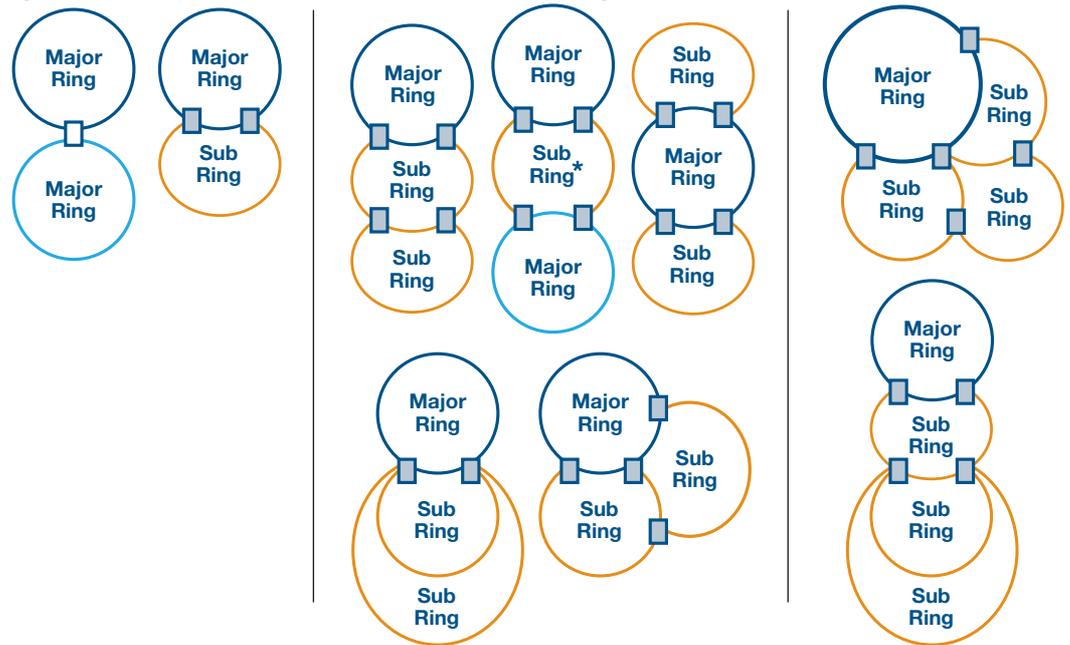
**Note:** Forced Switch (FS) commands can be issued at multiple locations along the ring. However doing so may result in the ring becoming segmented.

The Manual Switch (MS) command is nearly identical to a Forced Switch (FS) command except that only one Manual Switch (MS) command can be issued on the ring. It also has a lower priority than a Forced Switch (FS) command when a node has many requests that it needs to process at the same time.

## Sub-ring support

G.8032 Version 2 also provides support for sub-ring topologies. Sub-rings can be thought of as a partial ring in the shape of a "C" that is not fully closed. Sub-rings can be attached to a regular major ring (one that is fully closed), as well as other sub-rings where one of the sub-rings is attached to a major ring. This allows for complex ring topologies to be built as shown in the following figure:

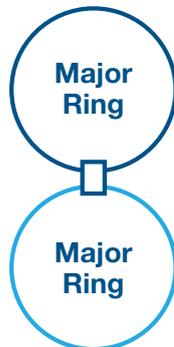
Figure 2: Examples of Various Constructed Topologies



\* Two halves of a subring connected together by a Virtual Channel

A topology that involves multiple rings requires the use of one major ring with the rest of the rings being sub-rings. There are a couple of exceptions as pictured:

- where two major rings are connected by a single node



- where two major rings are connected by a special sub-ring divided into two halves using a virtual channel



\* Two halves of a subring connected together by a Virtual Channel

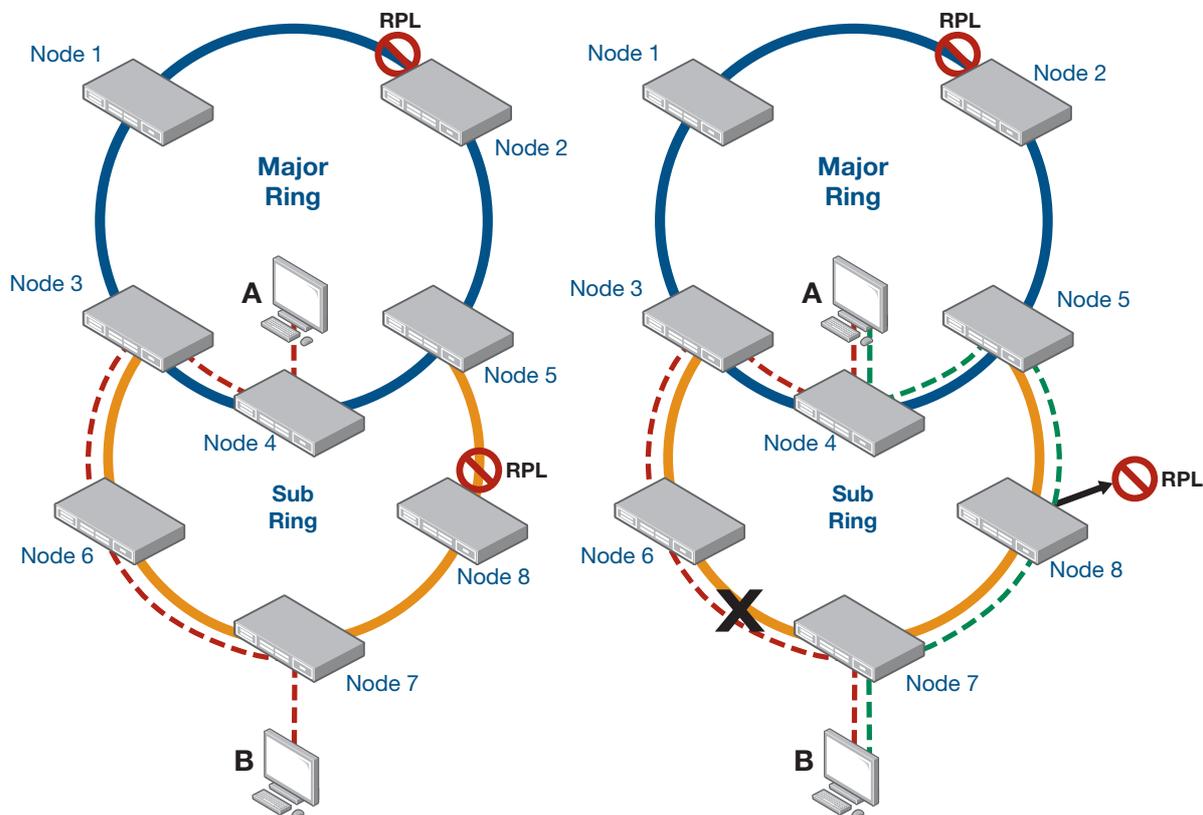
One of the differences between a sub-ring and a major ring is that the raps-channel control VLAN is not blocked anywhere along the path of the sub-ring, even though the protected data VLANs may be blocked. When configuring all the nodes in the sub-ring, the user should make sure those nodes are configured to operate as sub-rings. One exception is that when a sub-ring also uses a virtual channel, the raps-channel VLAN blocking behavior is the same as that of a major ring.

**Note:** AlliedWare Plus™ does not currently support Virtual Channel.

### Topology change notification (TCN)

When sub-rings are used and are attached to a major ring or to other sub-rings, a change in the blocking location of the sub-ring can cause a change in the "active" topology path of the data VLANs that traverse the overall network. This is illustrated in the following figure:

Figure 3: Change in the Active Topology Path



The path from A to B for the data VLANs that are being protected in the major ring and the sub-ring is shown in the red dotted line, going through nodes 4-3-6-7. When a failure occurs in the sub-ring as shown, a block is performed around the failure, while the sub-ring's RPL is opened up for traffic to flow. The new active topology of the same data VLANs has changed. The path from A to B is different as shown with the green dotted line going through nodes 4-5-8-7. However, node 4 (as well as nodes 1 and 2) in the major ring does not know about the topology change in the sub-ring and continues to forward traffic from A to B along the red dotted line.

To overcome this, the nodes in the major ring need to flush their FDB. Within the interconnected node, this requires the sub-ring ERP instance to notify the major ring ERP instance so that the latter can in turn notify all the other nodes in the major ring. Although the two instances are independent of one another, the interconnected node has knowledge of which instances are protecting the same data VLANs. The sub-ring ERP instance can determine which major ring ERP instance to notify of topology changes seen by the sub-ring.

Once the major ring ERP instance is notified of the TCN by the sub-ring ERP instance, the major ring instance will send out an R-APS message with a special Flush Event sub-code. This message will go around the major ring causing all the other ERP instances in the major ring to perform a FDB flush. After that MAC re-learning will occur and traffic along the protected data VLANs can flow properly.

It should be noted that not all situations require the entire major ring to perform a flush by using R-APS Flush Event messages. For example, if node 4 was not on the ring, then it would be sufficient to only flush node 3's and node 5's major ring ports. In this case, the sub-ring instance on node 3 can internally notify the major ring instance on node 3 to simply perform a flush. Similarly, the sub-ring instance on node 5 can internally notify the major ring instance on node 5 to perform a flush. As such, G.8032 provides the option to disable the sending of R-APS Flush Event messages on the major ring when a TCN is detected by the sub-ring.

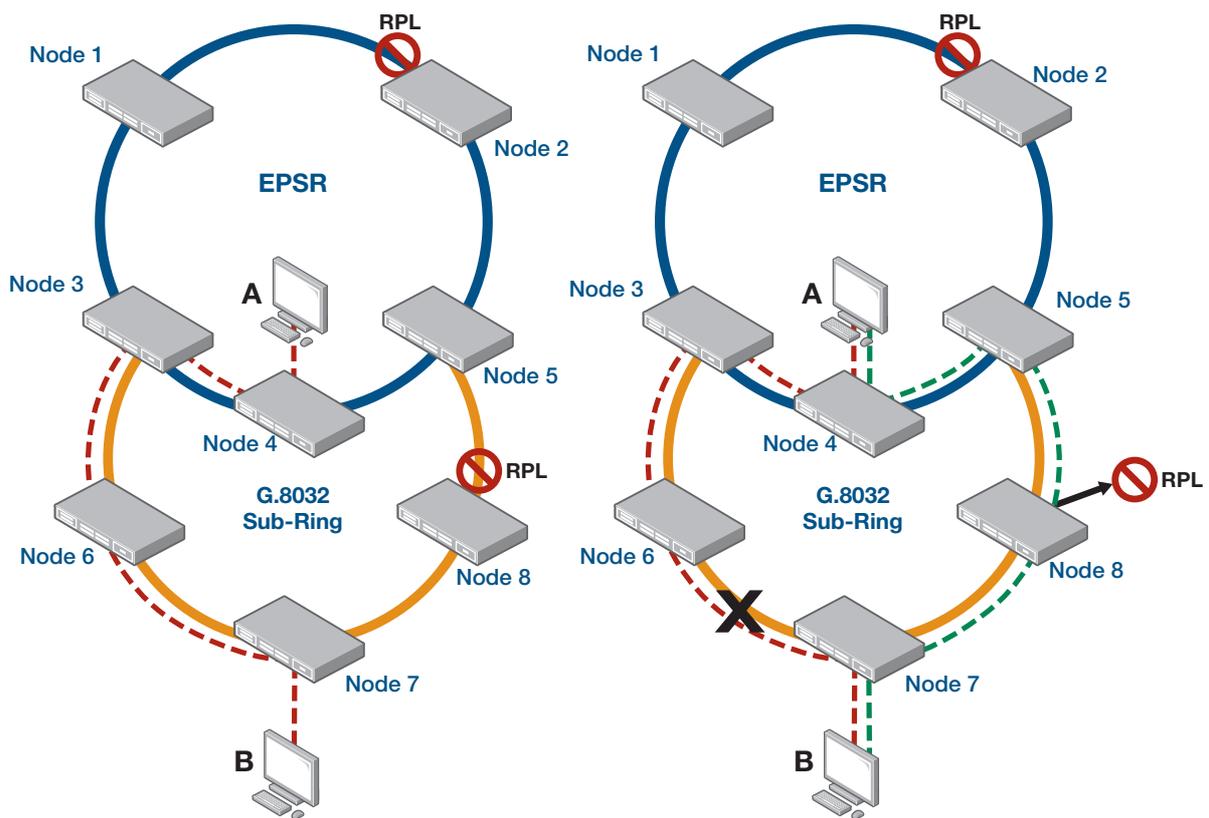
### Connecting G.8032 and EPSR

From software version 5.4.7-1.1 onwards, G.8032 can also interact with EPSR. A G.8032 sub-ring may be connected to and interact with an EPSR ring.

**Note:** NOTE: Only a G.8032 sub-ring connected to an EPSR ring is supported. A G.8032 major ring connected to an EPSR ring is not supported.

In the following diagram, a G.8032 sub-ring that is made up of nodes 3, 6, 7, 8, and 5 is connected to an EPSR ring made up of nodes 1, 2, 3, 4, and 5. The G.8032 sub-ring is protecting the same Data VLANs as the EPSR ring. In this scenario, any topology changes seen in the G.8032 sub-ring may need to be propagated to the EPSR ring. This requires EPSR on the Interconnecting node (nodes 3 and 5) to inform all the other nodes in the EPSR instance to flush their FDB using the FLUSH-FDB message.

Figure 4: Topology Change in G.8032 and EPSR



The path from A to B for the data VLANs that are being protected in the EPSR ring and the G.8032 sub-ring is shown in the red dotted line, going through nodes 4-3-6-7. When a failure occurs in the G.8032 sub-ring as shown, a block is performed around the failure, while the G.8032 sub-ring's RPL is opened up for traffic to flow. The new active topology of the same data VLANs has changed. The path from A to B is different as shown by the green dotted line going through nodes 4-5-8-7.

However, node 4 (as well as nodes 1 and 2) in the EPSR ring do not know about the topology change in the G.8032 sub-ring and node 4 continues to forward traffic from A to B along the red dotted line. To overcome this, the nodes in the EPSR ring need to flush their FDB. Within the interconnected node (nodes 3 and 5), this requires the sub-ring ERP instance to notify the EPSR ring domain instance so that EPSR in nodes 3 and 5 can perform a flush and in turn notify all the other nodes in the EPSR ring to also perform an FDB flush.

Although the G.8032 ERP instance and EPSR domain instance are independent of one another, the interconnected node has knowledge of which instances are protecting the same data VLANs. As such, the sub-ring ERP instance can determine which EPSR ring domain instance to notify of topology changes seen by the G.8032 sub-ring.

Once the EPSR ring domain instance is notified of the TCN by the G.8032 sub-ring ERP instance, the EPSR ring domain instance can send out a FLUSH-FDB message. This message will go around the EPSR ring causing all the other EPSR nodes in the EPSR ring to perform a FDB flush. After which, MAC re-learning will occur and traffic along the

protected data VLANs can flow properly along the green path. Because of added delays of the G.8032 ring informing the EPSR ring of the topology change, switchover times of the data VLANs may not meet 50ms objectives.

**Note:** Not all scenarios require the non-interconnected EPSR ring nodes to perform an FDB flush, and as such the sending of the FLUSH-FDB message is optional.

A G.8032 ERP instance detecting a topology change sends TCNs to the EPSR instance(s) that is protecting the same data VLAN(s) as the ERP instance if the EPSR instance has two ring ports and is enabled. This is called the “target EPSR instance”. Once a TCN is received by the target EPSR instance, the target EPSR instance performs an FDB Flush of its two ring ports. The target EPSR instance also performs an ARP cache flush, and sends Query Solicit, and gratARP if the VLAN is enabled for such.

To enable an EPSR instance to send out a FLUSH-FDB message after being notified by an ERP instance, use the following command:

```
awplus(config)#epsr <epsr-instance-name> topology-change g8032
```

To disable this functionality, use the following command:

```
awplus(config)#no epsr <epsr-instance-name> topology-change g8032
```

where:

**<epsr-instance-name>** identifies the EPSR ring domain instance.

**g8032** is the protocol that EPSR will allow as the trigger for the sending of an FLUSH-FDB message.

By default, the **topology-change** is disabled for the EPSR instance, and thus the target EPSR instance will not send a FLUSH-FDB message.

To see which EPSR target instances were found, use the following command:

```
awplus#show g8032 erp-instance {<erp-instance-name>|all}
```

An example of the output can be seen in the [ERPS instance](#) section. The relevant section:

```
awplus#show g8032 erp-instance all
-----
...
TTCN To Inst           : EPSR-red
TCN Flush Event         : G8032
Wait-To-Restore         : -
...
```

Once a target EPSR instance is informed of a TCN, if enabled by configuration, it will in turn send FLUSH-FDB messages out both of its ring ports. Upon receipt of a FLUSH-FDB message (not from itself), the EPSR instance performs an FDB flush on both of its ring

ports. The EPSR instance also performs an ARP cache flush, and send Query Solicit, and gratARP if the VLAN is enabled for such.

To see the EPSR configuration for topology change, use the following command:

```
awplus#show epsr {<instance-name|null>}
```

This generates the following example output:

```
awplus#show epsr testepsr2
EPSR Information
-----
Name ..... testepsr2
Mode ..... Transit
Status ..... Enabled
State ..... Links-Down
Control Vlan ..... 400
Data VLAN(s) ..... 2000,2199
First Port ..... port1.0.7
  Status ..... Down
  Direction ..... Unknown
  Is On Common Segment ..... No
  Blocking Control ..... Physical
Second Port ..... port1.0.8
  Status ..... Down
  Direction ..... Unknown
  Is On Common Segment ..... No
  Blocking Control ..... Physical
Trap ..... Enabled
Master Node ..... Unknown
Enhanced Recovery ..... Disabled
G.8032 TCN Flush Event ..... Enabled
Priority ..... 0 [superloop prevention disabled]
```

To see the EPSR counts for sending and receiving FLUSH-FDB messages, use the following command:

```
awplus#show epsr {<instance-name|null>} counters
```

This generates the following example output:

```
awplus#show epsr testepsr2 counters
EPSR Counters
-----
Name: testepsr2
Receive:                               Transmit:
Total EPSR Packets                      0      Total EPSR Packets      0
Health                                  0      Health                  0
Ring Up                                 0      Ring Up                 0
Ring Down                               0      Ring Down               0
Link Down                               0      Link Down               0
Link Forward Request                    0      Link Forward Request    0
Permit Link Forward                     0      Permit Link Forward     0
Flush FDB                               0      Flush FDB              0
Invalid EPSR Packets                     0
-----
```

## How to Configure ERPS

There are two types of node configurations:

- A standard two port node running an ERP instance with one East ring interface and one West ring interface.
- An interconnection node, which is one that joins a C-Ring to another ring. This node has two ERP instances:
  - One instance that has two ring interfaces, called East and West interfaces,
  - A second instance that only has a single ring interface, called a Terminating interface.

To configure ERPS, carry out the following steps:

1. Create a physical ring instance and configure its ports.
2. (Optionally) configure a new ERPS profile. A default one is already provided.
3. Create the ERPS instance.
4. Configure the ERPS instance's settings. These include the physical ring, raps-channel, and data-traffic VLANs.
5. Enable the ERPS instance.

### Configuring physical ring instances

Each ERP instance will be associated with two physical Ethernet ports, unless it is the terminating point of a sub-ring, in which case only one port is needed. A physical ring is effectively used as a profile to identify which Ethernet ports are to be used by one or more ERP instances. When two ports are used, they are referred to as East and West ports. When only a single port is used, it is referred to as a Terminating port.

To create an ERP physical ring profile which specifies the Ethernet ports that will be used as G.8032 ring ports, use the following command:

```
awplus(config)#g8032 physical-ring <ring-name> {east-interface
<int1> west-interface <int2>}
```

where:

**<ring-name>** is the name of the profile (up to 37 characters).

**<int>** is the name of an interface port or an aggregated interface.

The name "all" (case insensitive) is not allowed. An attempt to configure an interface port that is aggregated to a LAG will be refused.

To create an ERP physical ring profile with a Terminating interface, use the following command:

```
awplus(config)#g8032 physical-ring <ring-name> {terminating-  
interface <int>}
```

Any instances that use a physical ring profile configured with a Terminating interface will automatically be configured as a sub-ring. AlliedWare Plus™ will also treat the Terminating interface as if it were the East interface.

## Creating an ERP instance

To create an ERP instance and enter the instance mode, use the following command:

```
awplus(config)#g8032 erp-instance <instance-name>  
awplus(g8032-config-switch)#
```

The **<instance-name>** can be up to 32 characters. The instance name of "all" (case insensitive) is not allowed.

## Configuring an ERP instance

Once in the ERP instance context, the following parameters can be configured. Some of them, as noted below, can only be changed when the ERP instance is disabled. To disable an ERP instance, refer to [“Disabling an ERP instance”](#).

### Level

The CFM Level inside the R-APS messages that the ERP instance will use for sending and expects to receive. If the node receives an R-APS message with the improper level then the message will not be processed. The default level is **0**.

```
awplus(g8032-config-switch)#level <0-7>
```

This command can only be accepted when the ERP instance is disabled.

### Physical ring instance

Associate this ERP instance to a ERP physical ring instance. This is done by setting the name of the physical ring instance that was configured above. To do this, use the following command:

```
awplus(g8032-config-switch)#physical-ring <ring-name>
```

This command can only be accepted when the ERP instance is disabled.

### Profile

Associate this ERP instance to an ERP profile by the configuring the name of the ERP profile. By default the ERP instance uses a profile with the name "default-profile". To do this, use the following command:

```
awplus(g8032-config-switch)#profile name <profile-name>
```

This command can be accepted regardless of the ERP instance being disabled or enabled. Any parameters from a changed profile will take effect the next time the G.8032 state machine uses the parameters in the profile.

### RPL role

Each ERP ring port (also known as a link) has to have its role specified. The role can be specified as to whether it is an RPL or not, and if it is an RPL whether it is the Owner or Neighbor end of an RPL.

By default the RPL role of an ERP instance's link is "none". If a node has one of its ring ports set to Owner or Neighbor then "none" is automatically set on the other ring port.

To specify the RPL role of an ERP ring port, use the following command:

```
awplus(g8032-config-switch)#rpl role {owner|neighbor} {east-interface|west-interface|terminating-interface}
```

To remove an RPL role from a ring interface and put it back to the default, use the following command:

```
awplus(g8032-config-switch)#rpl role none
```

When setting the RPL role to "none", an interface need not be specified, as this command will set all the ring links to "none".

These commands can only be accepted when the ERP instance is disabled, and when an association to an ERP physical ring instance has already been made.

### Sub-ring

This command configures the mode of operation for the ERP instance as a sub-ring. By default the mode of operation is that of a major ring. To set it as a sub-ring, use the following command:

```
awplus(g8032-config-switch)#sub-ring
```

**Note:** This mode should be set for all nodes in the sub-ring as the G.8032 state machine is different from that of a major ring.

When the physical ring instance used by this ERP instance is configured for a Terminating interface, then this ERP instance will automatically be configured to be in the sub-ring mode.

This command can only be accepted when the ERP instance is disabled.

### TCN propagation

If this ERP instance is on an interconnecting node, then the ERP instance may need to be notified of a topology change that occurred in another G.8032 sub-ring attached to this

node. The former will be termed the "target" ERP instance, and the latter the "detecting" ERP instance.

The criteria for notification is:

- the detecting ERP instance is configured as a sub-ring with a Terminating interface
- it is protecting the same data VLANs as the target instance
- the target ERP instance must have two ring ports.

When the detecting ERP instance detects a topology change on its sub-ring, AlliedWare Plus™ will automatically determine which target ERP instance(s) needs to be notified. It does this by comparing the same data VLANs in the detecting ERP instance with all the other instances.

If target ERP instances are identified and these instances also have both an East and a West interface configured, then those target instances are notified. Upon notification, the target ERP instance has a couple of actions that it has to perform:

- To flush the FDB on both its East and West interfaces for the protected VLANs.
- To send out an R-APS flush event message over its East and West interfaces. The flush event message is sent around the target ring and each node on the target ring will perform an FDB flush of its protected VLANs. The sending of a R-APS flush event may not be needed in some cases and as such it is configurable.

To enable this ERP instance to send a flush event message after notification of a TCN by a detecting instance, use the following command:

```
awplus(g8032-config-switch)#topology-change {g8032}
```

where **g8032** identifies the detecting protocol that can be used to trigger FDB flush message generation.

To disable a target instance from sending a flush event message, use the following command:

```
awplus(g8032-config-switch)#no topology-change {g8032}
```

By default, the topology change is enabled. This command can be accepted regardless of the ERP instance being disabled or enabled.

### Trap (SNMP) enable

SNMP traps can be sent when a G.8032 ERP instance transitions to a new state. The following also accompanies the trap:

- Current and Previous State
- ERP instance identifier: name string

Traps can be enabled or disabled for the ERP instance, and by default traps are enabled for the instance. To enable traps for an instance, use the following command:

```
awplus(g8032-config-switch)#g8032 trap
```

### VLAN usage with G.8032

For an ERP instance, a VLAN is used for carrying an R-APS message (and the VLAN is also used to identify the instance to all the other nodes in the ring), or is used as a data VLAN that is to be protected by ERP. Use the following command to configure the VLANs:

```
awplus(g8032-config-switch)#raps-channel <vid>
awplus(g8032-config-switch)#data-traffic <vid-list>
```

If this ERP instance is not associated with a physical ring instance, then VLANs are not allowed to be configured and the attempt is denied. If this ERP instance is associated with a physical ring instance, then other ERP instances that use the same physical ring instance are checked to ensure they are not using the same VLANs. If they are, then the configuration is denied.

**vid** is a single VLAN-ID.

**vid-list** is single VLAN-ID, a range of VLAN-IDs, or a comma separated list of VLAN-IDs. For a VLAN range, specify two VLAN numbers: lowest, then highest number in the range, separated by a hyphen. For a VLAN list, specify the VLAN numbers separated by commas.

**raps-channel** is the channel that R-APS messages use for sending and receiving by this ERP instance. Only a single VLAN-id can be specified for the raps-channel and it can take on a value in the range of 2 to 4094. Any attempt to use a list or range of VLANs will be rejected. The VLAN must be a member of the ring port(s), otherwise the instance will not be allowed to be enabled. This command can only be accepted when the ERP instance is disabled.

**data-traffic** is the VLAN or VLANs that are protected by the ERP instance. Each VLAN-id can take on a value in the range of 1 to 4094. This command can be accepted regardless of the ERP instance being disabled or enabled. Data VLAN port members should be members of the ring interface(s), but this is not enforced.

**Note:** It is possible to run an ERP instance without data-traffic VLANs configured.

To remove a raps-channel VLAN from the ERP instance, use the following command:

```
awplus(g8032-config-switch)#no raps-channel
```

This command can only be accepted when the ERP instance is disabled.

To remove a data-traffic VLAN from the ERP instance, use the following command:

```
awplus(g8032-config-switch)#no data-traffic <vid-list>
```

This command can be accepted regardless of the ERP instance being disabled or enabled. When a VLAN is removed from an instance, any blocks that were in place are removed.

**Note:** The user should ensure that before the VLAN is removed from the ERP instance, it does not have a loop in its topology.

## Enabling an ERP instance

To enable an ERP instance, use the following command:

```
awplus(g8032-config-switch)#erp-instance enabled
```

When enabled, the instance is restarted back to the G8032\_ST\_INIT state. In this state, if the node has an RPL-Owner or RPL-Neighbor port, it will be blocked. Otherwise the node will block one its ring ports. The node will start sending R-APS messages. The G.8032 protocol and state machines will transition the ring into another more appropriate state.

## Configuring G.8032 instance profiles

To create a new ERP profile instance that can be used by an ERP instance, or to be put into the ERP profile instance context of an existing instance, use the following command:

```
awplus(config)#g8032 profile {<profile-name>|default-profile}
awplus(g8032-profile-config)#
```

where **profile-name** can be up to 32 characters. By default a profile with the name "default-profile" will exist in the system and is initially used by any newly created ERP instance. All the parameters in the default profile take on the default values, and can be changed as with a new profile. The name "all" (case insensitive) is not allowed.

Once in an ERP profile instance, the following commands are used to configure the parameters within the ERP profile. To configure one or more timers, use the following command:

```
awplus(g8032-profile-config)#timer {wait-to-restore {<1-12>|
default}|hold-off {<0-100>|default}|guard-timer {<1-200>|default}}
```

### Wait to restore (WTR)

This timer is used to "soak" Signal Fail (SF) abatement to ensure the signal failure abatement is not intermittent. This timer is only used by the RPL-Owner when in the revertive operation, and thus is attempting to restore the ring. It is configurable in steps of 1 to 12 minutes (default is 5 minutes).

### Hold off

This timer allows any other underlying protection schemes to recover before G.8032 reacts to its defect, giving time for the G.8032 defect to clear. One common example is when the ERP physical ring port is carried over a SONET/SDH transmission system that

itself has 50 ms recovery times. If G.8032 detects a failure, then increasing this timer to some value greater than 50 ms would allow the SONET/SDH system to recover and have the defect that G.8032 detected disappear. This prevents the need for G.8032 to try and recover. The hold off timer is configurable in 0 to 10 seconds in steps of 100 ms (default is 0 ms)

### Guard timer

This is the amount of time that an ERP instance discards most R-APS messages before being allowed to process them. It is used when a clearing condition occurs, yet at the same time older messages are still propagating around the ring with failure indications. For example, two nodes that just noticed a link failure abatement condition could start clearing and almost immediately one of them could receive an old Signal Fail (SF) indication message from the other node that was still in flight. This then causes the receiving node to react to the Signal Fail (SF) inadvertently. This timer is particularly useful where R-APS propagation time through the ring is large. Refer to ITU-T G.8032 for more information. The guard timer is configurable in 10 ms steps between 10ms and 2 seconds (default 500 ms).

**Note:** There is also a Wait To Block (WTB) timer, but this is not configurable explicitly as it is 5 seconds longer than the guard timer. The WTB timer is used when issuing clearing of Forced Switch (FS) or Manual Switch (MS) commands. It is only used by the RPL-Owner in a revertive operation as the RPL-Owner waits to block the RPL.

### Revertive or non-revertive operation

Once a failure has abated, a G.8032 ring instance will attempt to revert back to the way it was operating prior to the failure. This feature can be enabled or disabled. By default, revertive is enabled.

```
awplus(g8032-profile-config)#enable {revertive|non-revertive}
```

## Action commands for ERP instances

There are action commands available to an ERP instance. These will be performed in the privileged exec mode. The following action commands are available.

### Forced Switch (FS)

This action command attempts to forcefully cause a ring protection switch by applying a block on a specified ring port. If successful, an FDB flush is also performed if the specified port was not previously blocked. If the specified port was previously blocked, the system will keep it blocked but no FDB flush will be performed. In both cases the system will force an unblock on the other ring port if one happened to be in place. Multiple Forced Switch (FS) actions can take place along a G.8032 ring.

Care must be taken when using the **forced-switch** command, as it can only be undone by issuing a **clear** command, and not by a failure nor the clearing of a failure. If the node

where the **forced-switch** command was issued later fails, then it becomes difficult to remove the Forced Switch (FS) condition from the ring. In this situation, the operator has to go to the nodes that are adjacent to the failed node and issue a **clear** command on each one.

To apply a Forced Switch (FS), use the following command:

```
awplus#g8032 forced-switch erp-instance <instance-name> {east-
interface | west-interface | terminating-interface}
```

The **terminating-interface** must be specified if the G.8032 physical ring instance associated with the G.8032 ERP instance was also configured with **terminating-interface**.

### Manual Switch (MS)

This action command attempts to cause a ring protection switch by applying a block on a specified ring port if it is unblocked, or unblocking that ring port if it is blocked. The difference between a Manual Switch (MS) and a Forced Switch (FS) is that the Manual Switch (MS) will be ignored under various conditions. In addition, only one Manual Switch (MS) is allowed on a G.8032 ring at a time.

To apply a Manual Switch (MS), use the following command:

```
awplus#g8032 manual-switch erp-instance <instance-name> {east-
interface | west-interface | terminating-interface}
```

The **terminating-interface** must be specified if the G.8032 physical ring instance associated with the G.8032 ERP instance was also configured with **terminating-interface**.

### Clear

If a **forced-switch** or a **manual-switch** command was successfully entered before on this node and ERP instance, the **clear** command will clear the Forced Switch (FS) or Manual Switch (MS) action that took place prior.

**Note:** The **clear** command will be ignored if a **force-switch** or **manual-switch** command had not been previously entered successfully, even if the node is in the FORCED\_SWITCH or MANUAL\_SWITCH state.

Separate from a Forced Switch (FS) or Manual Switch (MS), if a switchover has already occurred and the failure causing the switchover clears, then:

- If reversion has been enabled, this command will trigger a reversion instantly without having to wait for certain timers to expire (such as WTB or WTR).
- If reversion has been disabled, this command will trigger a reversion anyway.

To clear a Forced Switch (FS) or a Manual Switch (MS), use the following command:

```
awplus#clear g8032 erp-instance <instance-name>
```

## Disabling an ERP instance

To disable an ERP instance, use the following command:

```
awplus(g8032-config-switch)#erp-instance disabled
```

When disabled, the ERP instance will no longer process incoming R-APS messages for that instance, nor send any R-APS messages. The raps-channel VLAN and any data-traffic VLANs used by this instance will be put in the forwarding state for its physical ring ports. Caution should be taken to avoid loops when disabling an ERP instance.

## Destroying an ERP instance

To destroy an ERP instance, use the following command:

```
awplus(config)#no g8032 erp-instance <instance-name>
```

When the ERP instance is destroyed, it will unblock the R-APS channel and data-traffic VLANs on both of its ring ports. It will also remove any association the ERP instance had with the ERPS profile, as well as the physical ring instance.

## Destroying a physical ring instance

To destroy the physical ring profile, use the following command:

```
awplus(config)#no g8032 physical-ring <ring-name>
```

Any attempt to destroy a physical ring profile that has ERP instances associated with it will be denied. The user is required to first remove the association.

## ERPS Show Commands

### Physical ring instance

**Command** `show g8032 physical-ring {<physical-ring-name>|all}`

This **show** command gives you information about physical ring instances:

```
Ring : R1
=====
East      : port2.0.25
West     : sa1
ERP Inst  : M1
```

Or when using a Terminating interface:

```
Ring : C1
=====
Terminating : sa2
ERP Inst    : S1
```

### Parameters explained

PARAMETER	MEANING
Ring	The name of the physical ring that was configured for this physical ring instance.
East, West, Terminating	The physical interface port or LAG of the East or West Ring interface, or the Terminating interface that was configured for this physical ring instance.
ERP Inst	A comma separated list of ERP instances by name that have been configured to use this physical ring instance, or "-" if none.

## ERPS instance

**Command** show g8032 erp-instance {<erp-instance-name>|all}>

This **show** command gives you information about the ERPS profile instance:

```

-----
Instance Name       : M1
Admin State        : enabled
G.8032 State       : IDLE
Failure of Proto-TO : false
Phy Ring           : R1 - East (port2.0.25) : West (sa1)
East Link          : Link_Unblocked
West Link          : Link_blocked
RPL Role East Link : NONE
RPL Role West Link : OWNER
CFM MEP East       : -
CFM MEP West       : -
ERP Profile        : default-profile
Level              : 0
Ring-ID            : 1
RAPS-Channel VLAN  : 900
Sub-ring           : disabled
Virtual Channel    : disabled
Data Traffic VLANs : 910,920,930,940
TCN To Inst       : -
TCN Flush Event    : G8032
Wait-To-Restore    : -
Wait-To-Block      : -
NodeID             : 0000.cd37.0c25
SNMP Traps         : enabled
-----

```

East Receiving		West Receiving	
Hold Off Timer	-	Hold Off Timer	-
Signal Fail	-	Signal Fail	-
Failure of Proto-PM	false	Failure of Proto-PM	false
Version	-	Version	-
Request	-	Request	-
RPL-Block	-	RPL-Block	-
DNF	-	DNF	-
Block Port Ref	-	Block Port Ref	-
NodeID	-	NodeID	-

```

-----

```

East Sending		West Sending	
Version	1	Version	1
Request	NR	Request	NR
RPL-Block	RB	RPL-Block	RB
DNF	1	DNF	1
Block Port Ref	1	Block Port Ref	1
NodeID	0000.cd37.0c25	NodeID	0000.cd37.0c25

```

-----

```

## Parameters explained

PARAMETER	MEANING
Instance name	The configured <erp-instance-name> for this instance.
Admin State	The configured administrative state of this instance, either enabled or disabled. When the ERP instance is disabled, all dynamic data for other parameters in this table will be shown as "-", except for the East Link or West Link which will show the last known block or unblocked state.
G.8032 State	A dynamic parameter showing the current state of the instance per the G.8032 state machine. If the ERP Instance is disabled, it will be in the INIT state.
Phy Ring	Shows the Physical Ring Instance name that this ERP Instance is associated with along with the East/West or Terminating Interface used by the Physical Ring Instance.
East Link or West Link	A dynamic variable showing whether the instance's ring port and its VLANs are blocked or not. In the special case of an interconnection node where a sub-ring terminates, both the East Link and the West Link are the same.
RPL Role East Link or West Link	Shows the configuration of the link's role.
CFM MEP East or West	Identifies the configured MEP, if any, that is being used to provide a CFM based Signal Fail indication to this instance. The MEP is identified by its direction (Up or Down), its MEP-id, and the Maintenance Domain (MD) and Maintenance Association (MA) it is associated with by name. There may be one or two MEPs for each East or one or two MEPs for each West, in which case all are shown.
ERP Profile	Identifies the ERP Profile instance that was configured for use by this ERP Ring instance.
Level	The Level that was configured for R-APS messages that are used by this ERP Ring instance.
Ring-ID	The Ring-ID that is to be used by this ERP instance.
RAPS-Channel VLAN	The VLAN-id that is configured used for sending and receiving R-APS messages for this ERP instance.
Sub-ring	Specifies whether the ring is operating as a Sub-ring or otherwise as a Major ring.
Virtual Channel	Specifies whether the sub-ring is operating with a virtual channel or not.
Data Traffic VLANs	A comma separated list of configured VLAN-ids (individually, or range) that are used for data-traffic and protected by this ERP instance.

PARAMETER	MEANING
TCN To Inst	A comma separated list of protocols and their instances that are to be notified when a Topology Change Notification occurs for this ERP instance. This only applies to a sub-ring with a Terminating interface and in which case "-" will be displayed if no target instances have been identified. Otherwise a "-" is displayed anyway. Identifies the protocol to notify. Only "G8032" will be supported initially. <instance-name> - Identifies the instance to notify for the given protocol.
TCN Flush Event	Specifies if this instance as a target instance is to send out Flush FDB messages upon TCN notifications by a detecting instance. Identifies the notifying protocol allowed. Only "G8032" will be supported initially. If no protocols have been configured then display "-".
SNMP Traps	Indicates whether SNMP traps have been enabled or disabled for this ERP instance.
Signal Fail	Indicates whether a Signal Fail condition is being received over the East or West ring interface. <signal-fail> consists of: "- " no Signal Fail is being indicated "Link" - indicates the interface port or LAG has gone operationally down. "CFM MEP <mep-id>" - indicates that a local CFM MEP has indicated a Signal Fail, and which MEP by mep-id.
Failure of Protocol	Indicates that there are defects in the receipt of an R-APS message. There are the following types: FOP-PM (Provisioning Mismatch) - "true" indicates per G.8032, that the RPL-Owner is receiving R-APS(NR,RB) messages with a node-id not of itself. In addition, since the initial implementation does not support version 1, any R-APS messages with version 1 will also indicate a FOP-PM error. The FOP-PM error can occur on an East or a West Port. FOP-TO (Time Out) - "true" indicates that a node has not received an R-APS message on any of its ring ports for 3.5 times the R-APS message interval even though one or both ring ports are capable of receiving R-APS messages (no SF, Admin Up).
Version	The version of the R-APS message that is being received or sent over the East or West ring interface. A R-APS message version of "1" corresponds to G.8032 version 2.
Request	Indicates the protection switch request being sent or received in the R-APS message. Consists of one of: NR - No Request for protection switching SF - Signal Fail MS - Manual Switch request FS - Force Switch request Event - Request a Flush to be performed. Note this is a transient condition.

PARAMETER	MEANING
RPL Block	Indicates whether the RPL is being blocked or not. consists of one of the following: "RB" - RPL Block is being applied by the RPL-Owner. "-" - No RPL Block is being applied by the RPL-Owner, or the R-APS message originated from a non-RPL-Owner.
DNF	Indicates the value of the Do Not Flush bit in the R-APS message. The value is either "0" or "1".
Block Port Ref	Block Port Reference refers to the node's East or West port that is being blocked and shows as "0" or "1" in accordance to G.8032.
Node-ID	The MAC address of this Node or the MAC address used in sending/receiving R-APS messages.
East Sending or West Sending	If this local node is not sending R-APS, then all the fields are shown as "-"
Timers	Wait-to-Restore - "Running" indicates this timer is active, otherwise is "-". Wait-to-Block - "Running" indicates this timer is active, otherwise is "-". Hold Off Timer - "Running" indicates this timer is active, otherwise is "-".

## ERPS instance statistics

**Command** `show g8032 erp-instance {<erp-instance-name>|all} statistics`

This **show** command gives you information about the ERPS profile instance statistics:

```

-----
Instance Name      : M1
Local Clear       : 0
FOP-TO           : 0
-----
  East Receiving   | West Receiving
-----|-----
RAPS NR           15 | RAPS NR           11
RAPS NR-RB        2 | RAPS NR-RB        0
RAPS SF           0 | RAPS SF           0
RAPS FS           0 | RAPS FS           0
RAPS MS           0 | RAPS MS           0
RAPS Event        0 | RAPS Event        0
Drop Guard        0 | Drop Guard        0
Drop Error        0 | Drop Error        0
Local SF          1 | Local SF          1
FOP-PM            0 | FOP-PM            0
-----
  East Sending     | West Sending
-----|-----
RAPS NR           17 | RAPS NR           17
RAPS NR-RB 20067  | RAPS NR-RB 20067
RAPS SF           10 | RAPS SF           10
RAPS FS           0 | RAPS FS           0
RAPS MS           0 | RAPS MS           0
RAPS Event        0 | RAPS Event        0
-----

```

### Parameters explained

PARAMETER	MEANING
Instance Name	The configured <erp-instance-name> for this instance.
Local clear	The number of Clear commands invoked locally.
FOP-TO	The number of Failure of Protocol Time Out events seen locally.
RAPS NR	The number of R-APS messages with a No Request (NR) being received or sent.
RAPS NR-RB	The number of R-APS messages with a No Request, RPL Blocked (NR,RB) being received or sent.
RAPS SF	The number of R-APS messages with Signal Fail (SF) being received or sent.
RAPS FS	The number of R-APS messages with Forced Switch (FS) being received or sent.
RAPS MS	The number of R-APS messages with Manual Switch (MS) being received or sent.

PARAMETER	MEANING
RAPS Event	The number of R-APS messages with Event (Flush) being received or sent.
Drop Guard	The number of R-APS messages discarded due to Guard Timer.
Drop Error	The number of R-APS messages discarded due to incorrect MAC Address (unmatched Ring-ID), incorrect version, unusable Request/State, or other invalid code point in one of the message fields.
Local SF	The number of Signal Fail events seen locally.
FOP-PM	The number of Failure of Protocol events seen locally.

To clear the ERP instance statistics, use the following command:

```
clear g8032 erp-instance {<erp-instance-name>|all} statistics
```

**Note:** It is important that the Level in an ERP instance be configured correctly because the configured Level is also carried in the R-APS message. Received R-APS messages have to have a matching Level with this ERP instance in order to be accepted and processed otherwise they are forwarded as a regular packet in accordance to G.8032. If the Level is not matched, then the R-APS messages are forwarded on the raps-channel and is not counted in any of the statistics.

## ERPS profile

**Command** `show g8032 profile {<profile-name>|default-profile|all}`

This **show** command gives you information about the ERPS Profile instance:

```
Profile : default-profile
=====
Wait-To-Restore : 5 mins
Hold Off Timer  : 0 ms
Guard Timer     : 500 ms
Wait-To-Block   : 5500 ms
Protection Type : Revertive
ERP Inst        : M1,M2,S1

Profile : prol
=====
Wait-To-Restore : 1 mins
Hold Off Timer  : 0 ms
Guard Timer     : 500 ms
Wait-To-Block   : 5500 ms
Protection Type : Revertive
ERP Inst        : S2
```

## Parameters explained

PARAMETER	MEANING
Wait-To-Restore	The configured value in <1-12> minutes.
Hold Off Timer	The configured value but shown instead in milliseconds which ranges from 0 to 10,000 (10s) in 100 ms increments.
Guard Timer	The configured value which ranges from 10 to 2000 in 10 ms increments.
Wait-To-Block	5 seconds more than the configured Guard Time. The range is 5010 to 5200.
ERP Inst	Comma separated list of ERP instances using this profile, or "-" if there are none.

## Example: Simple Network Configuration

A simple example follows for configuring a G8032 node. In this example, one R-APS VLAN and one protected data VLAN are configured for an ERP Instance called "Major" whose East port is 1.0.2 and West port is 1.0.1. The East port is configured with a role of Owner. A default G8032 profile is used by the ERP instance by default and thus is not needed in the configuration.

```
awplus(config)#vlan database
awplus(config-vlan)#vlan 100 name RAPS-1
awplus(config-vlan)#vlan 110 name DATA-1

awplus(config)#interface port1.0.1,port1.0.2
awplus(config-interface)#switchport mode trunk
awplus(config-interface)#switchport trunk allowed vlan add 100,110
awplus(config-interface)#switchport trunk native vlan none

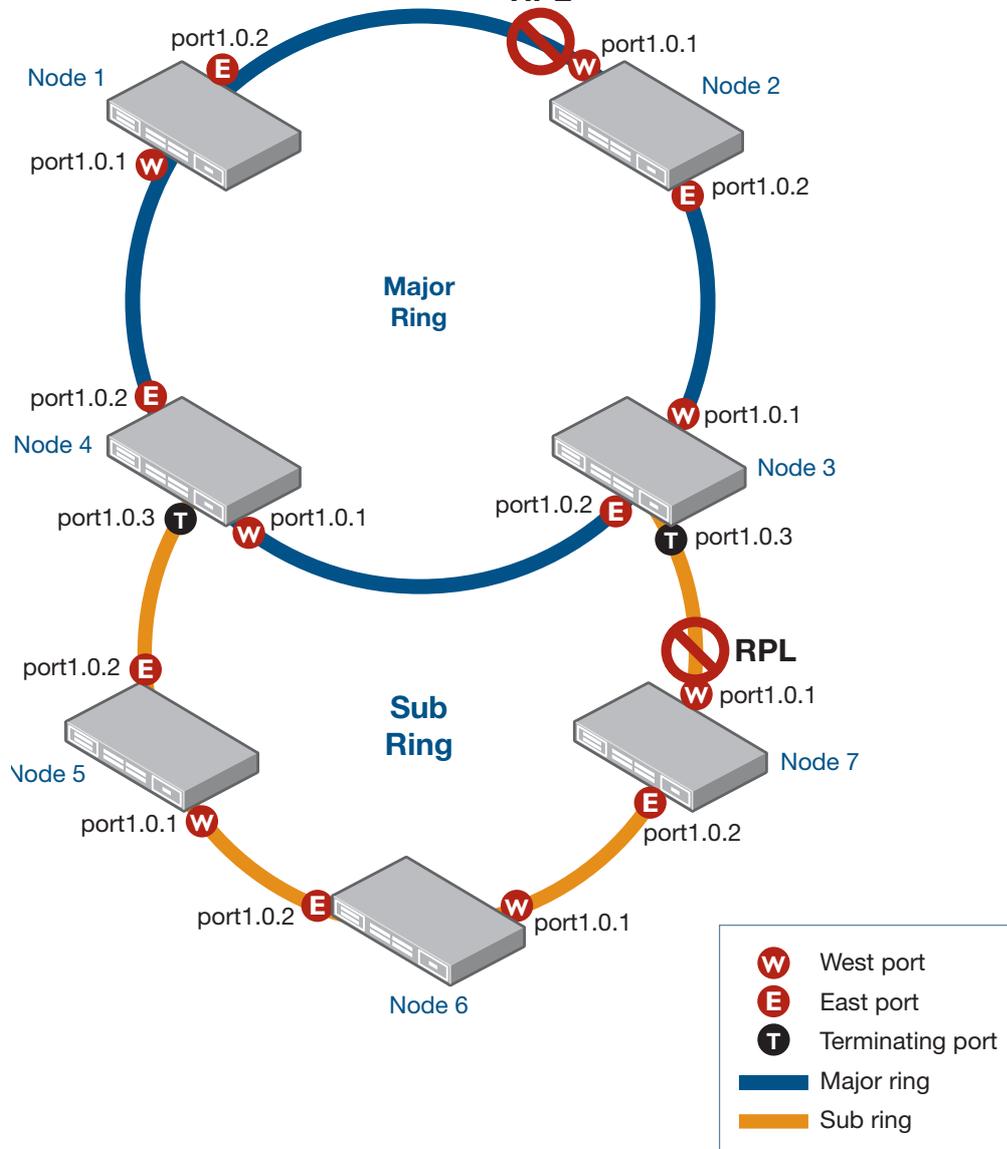
awplus(config)#g8032 physical-ring Major east-interface port1.0.2
west-interface port1.0.1

awplus(config)#g8032 erp-instance Major-1
awplus(g8032-config-switch)#physical-ring Major
awplus(g8032-config-switch)#raps-channel 100
awplus(g8032-config-switch)#rpl role owner east-interface
awplus(g8032-config-switch)#data-traffic 110
awplus(g8032-config-switch)#erp-instance enabled
```

## Example: Complex Network Configuration

A major ring and a sub-ring are used in this example. The following figure is used:

Figure 5: Example of a Complex Network with Major Ring and Sub-Ring



### Initial Configuration

1. Common VLAN configurations on all the nodes of the major ring

```
awplus(config-vlan)#vlan 100 name RAPS-1
```

```
awplus(config-vlan)#vlan 110 name DATA-1
```

2. Node 1 Configuration

```
Node-1(config)#interface port1.0.1,port1.0.2
```

```
Node-1(config-interface)#switchport mode trunk
```

```
Node-1(config-interface)#switchport trunk allowed vlan add 100,110
```

```
Node-1(config-interface)#switchport trunk native vlan none
```

```
Node-1(config)#g8032 physical-ring Major east-interface port1.0.2
```

```
west-interface port1.0.1
```

**3. Disable the RPL-Owner ports to be safe**

```
node-2(config)#interface port1.0.1
node-2(config-interface)#shutdown
node-7(config)#interface port1.0.1
node-7(config-interface)#shutdown
```

**Major Ring Configuration****4. Node 1 Configuration**

```
Node-1(config)#g8032 erp-instance Major-1
Node-1(g8032-config-switch)#physical-ring Major
Node-1(g8032-config-switch)#raps-channel 100
Node-1(g8032-config-switch)#rpl role neighbor east-interface
Node-1(g8032-config-switch)#data-traffic 110
Node-1(g8032-config-switch)#erp-instance enabled
```

**5. Node 2 Configuration**

```
Node-2(config)#interface port1.0.1,port1.0.2
Node-2(config-interface)#switchport mode trunk
Node-2(config-interface)#switchport trunk allowed vlan add 100,110
Node-2(config-interface)#switchport trunk native vlan none
Node-2(config)#g8032 physical-ring Major east-interface port1.0.2
west-interface port1.0.1
Node-2(config)#g8032 erp-instance Major-1
Node-2(g8032-config-switch)#physical-ring Major
Node-2(g8032-config-switch)#raps-channel 100
Node-2(g8032-config-switch)#rpl role owner west-interface
Node-2(g8032-config-switch)#data-traffic 110
Node-2(g8032-config-switch)#erp-instance enabled
```

**6. Node 3 Configuration**

```
Node-3(config)#interface port1.0.1,port1.0.2
Node-3(config-interface)#switchport mode trunk
Node-3(config-interface)#switchport trunk allowed vlan add 100,110
Node-3(config-interface)#switchport trunk native vlan none
Node-3(config)#g8032 physical-ring Major east-interface port1.0.2
west-interface port1.0.1
Node-3(config)#g8032 erp-instance Major-1
Node-3(g8032-config-switch)#physical-ring Major
Node-3(g8032-config-switch)#raps-channel 100
Node-3(g8032-config-switch)#data-traffic 110
Node-3(g8032-config-switch)#erp-instance enabled
```

**7. Node 4 Configuration**

```

Node-4(config)#interface port1.0.1,port1.0.2
Node-4(config-interface)#switchport mode trunk
Node-4(config-interface)#switchport trunk allowed vlan add 100,110
Node-4(config-interface)#switchport trunk native vlan none
Node-4(config)#g8032 physical-ring Major east-interface port1.0.2
west-interface port1.0.1
Node-4(config)#g8032 erp-instance Major-1
Node-4(g8032-config-switch)#physical-ring Major
Node-4(g8032-config-switch)#raps-channel 100
Node-4(g8032-config-switch)#data-traffic 110
Node-4(g8032-config-switch)#erp-instance enabled

```

**Sub-Ring Configuration****8. Common VLAN Configuration for all the nodes on the sub-ring**

```

awplus(config)#vlan database
awplus(config-vlan)#vlan 200 name RAPS-2
awplus(config-vlan)#vlan 110 name DATA-1

```

**9. Node 3 Configuration**

```

Node-3(config)#interface port1.0.3
Node-3(config-interface)#switchport mode trunk
Node-3(config-interface)#switchport trunk allowed vlan add 200,110
Node-3(config-interface)#switchport trunk native vlan none
Node-3(config)#g8032 physical-ring SubRing terminating-interface
port1.0.3
Node-3(config)#g8032 erp-instance SubRing-1
Node-3(g8032-config-switch)#physical-ring SubRing
Node-3(g8032-config-switch)#raps-channel 200
Node-3(g8032-config-switch)#rpl role neighbor terminating-
interface
Node-3(g8032-config-switch)#data-traffic 110
Node-3(g8032-config-switch)#topology-change g8032 (This is
included for illustration. This command is not needed since TCN is
enabled by default.)
Node-3(g8032-config-switch)#erp-instance enabled

```

**10. Node 4 Configuration**

```

Node-4(config)#interface port1.0.3
Node-4(config-interface)#switchport mode trunk
Node-4(config-interface)#switchport trunk allowed vlan add 200,110
Node-4(config-interface)#switchport trunk native vlan none

```

```

Node-4(config)#g8032 physical-ring SubRing terminating-interface
port1.0.3
Node-4(config)#g8032 erp-instance SubRing-1
Node-4(g8032-config-switch)#physical-ring SubRing
Node-4(g8032-config-switch)#raps-channel 200
Node-4(g8032-config-switch)#data-traffic 110
Node-4(g8032-config-switch)#topology-change g8032 (This is
included for illustration. This command is not needed since TCN is
enabled by default.)
Node-4(g8032-config-switch)#erp-instance enabled

```

### 11. Node 5 Configuration

```

Node-5(config)#interface port1.0.1,port1.0.2
Node-5(config-interface)#switchport mode trunk
Node-5(config-interface)#switchport trunk allowed vlan add 200,110
Node-5(config-interface)#switchport trunk native vlan none
Node-5(config)#g8032 physical-ring SubRing east-interface
port1.0.2 west-interface port1.0.1
Node-5(config)#g8032 erp-instance SubRing-1
Node-5(g8032-config-switch)#physical-ring SubRing
Node-5(g8032-config-switch)#raps-channel 200
Node-5(g8032-config-switch)#data-traffic 110
Node-5(g8032-config-switch)#sub-ring
Node-5(g8032-config-switch)#erp-instance enabled

```

### 12. Node 6 Configuration

```

Node-6(config)#interface port1.0.1,port1.0.2
Node-6(config-interface)#switchport mode trunk
Node-6(config-interface)#switchport trunk allowed vlan add 200,110
Node-6(config-interface)#switchport trunk native vlan none
Node-6(config)#g8032 physical-ring SubRing east-interface
port1.0.2 west-interface port1.0.1
Node-6(config)#g8032 erp-instance SubRing-1
Node-6(g8032-config-switch)#physical-ring SubRing
Node-6(g8032-config-switch)#raps-channel 200
Node-6(g8032-config-switch)#data-traffic 110
Node-6(g8032-config-switch)#sub-ring
Node-6(g8032-config-switch)#erp-instance enabled

```

### 13. Node 7 Configuration

```

Node-7(config)#interface port1.0.1,port1.0.2
Node-7(config-interface)#switchport mode trunk
Node-7(config-interface)#switchport trunk allowed vlan add 200,110

```

```
Node-7(config-interface)#switchport trunk native vlan none
Node-7(config)#g8032 physical-ring SubRing east-interface
port1.0.2 west-interface port1.0.1
Node-7(config)#g8032 erp-instance SubRing-1
Node-7(g8032-config-switch)#physical-ring SubRing
Node-7(g8032-config-switch)#raps-channel 200
Node-7(g8032-config-switch)#rpl role owner west-interface
Node-7(g8032-config-switch)#data-traffic 110
Node-7(g8032-config-switch)#sub-ring
Node-7(g8032-config-switch)#erp-instance enabled
```

#### 14. Re-enable the RPL-Owner ports.

```
node-2(config)#interface port1.0.1
node-2(config-interface)#no shutdown
node-7(config)#interface port1.0.1
node-7(config-interface)#no shutdown
```

## G.8032 Features Not Supported

- G.8032 version 1 and backwards compatibility with G.8032 version 1 is not supported.
- Virtual Channel is not supported.
- Next-neighbor FDB Flush optimization as per G.8032v2 Appendix VIII is not supported.
- Will not support Up-MEP use on a sub-ring for handling of double-faults on the Major Ring that could otherwise be fixed by the sub-ring unblocking its RPL. See G.8032v2 Appendix X.2.1
- Ring-ID configuration - G.8032 allows reuse of VLAN-id in different instances in adjoining rings (but not the same ring) as long as the Ring-ID in the MAC address is different. By not implementing the configuration of the Ring-ID, it is always x01, and different raps-channel VLANs are required per instance.
- Certain target AlliedWare Plus™ platforms may not achieve 50 ms switchover times.
- Actual switchover times will depend on the number of data VLANs that need to be protected as well as depend on the speed of each platform to process the switching.