

FRS IPO CONFIGURATIONS

Application Note

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Revision History

Rev	Date	Comments
1.0	13.10.2014	First version

1 About This Document

This Application Note gives some examples on how to use the Inbound Policy (IPO) configurations in FRS IP [1] with PTP [2] and HSR/PRP [3] protocols. Before looking at this Application Note, read the Inbound Policy section from the FRS Manual [1].

2 Inbound Policy Operation

The Inbound policy checks source and destination MAC addresses of all the received frames and based on the IPO configurations, it decides what kind of a treatment a frame gets.

Inbound policy operation is individual for each port and each port may include maximum 16 different inbound configurations. With IPO configuration and based on either destination or source MAC address a frame may be:

- Dropped
- Allowed to be forwarded to certain ports
- Forced to be forwarded to certain ports
- Forwarded without adding HSR tag or PRP trailer

Usually an IPO is set for certain addresses or address groups, but it is also possible to enable or disable:

- All unicast frames
- All multicast frames
- All broadcast frames

One IPO configuration register set includes the following registers:

- ETH_ADDRX_CFG
- ETH_ADDRX_FWD_ALLOW
- ETH_ADDRX_FWD_MIRROR
- ETH_ADDRX_0
- ETH_ADDRX_1
- ETH_ADDRX_2

For more information on the register content, check FRS Manual section "Inbound Registers".

3 Basic IPO configuration

In a basic example, a 3-port FRS/FES is connected to a CPU via P0, while P1 and P2 are connected to external networks (Figure 1). In normal case the FRS forwards frames based on their destination MAC address and its MAC Address table. However, with IPO configuration it is possible to limit or guide traffic based user or application requirements.

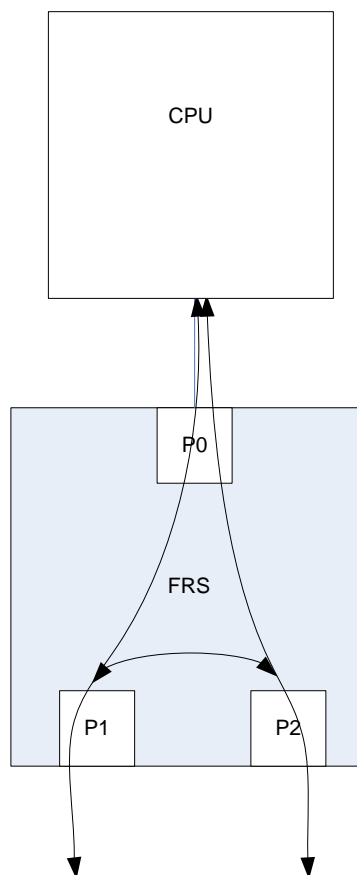


Figure 1. Example design

In some applications the user might want to cut the direct traffic between P1 and P2 as illustrated in Figure 2 on the left side design. On the other hand, the user might as well want to limit the CPU traffic as illustrated in Figure 2 on the right side design.

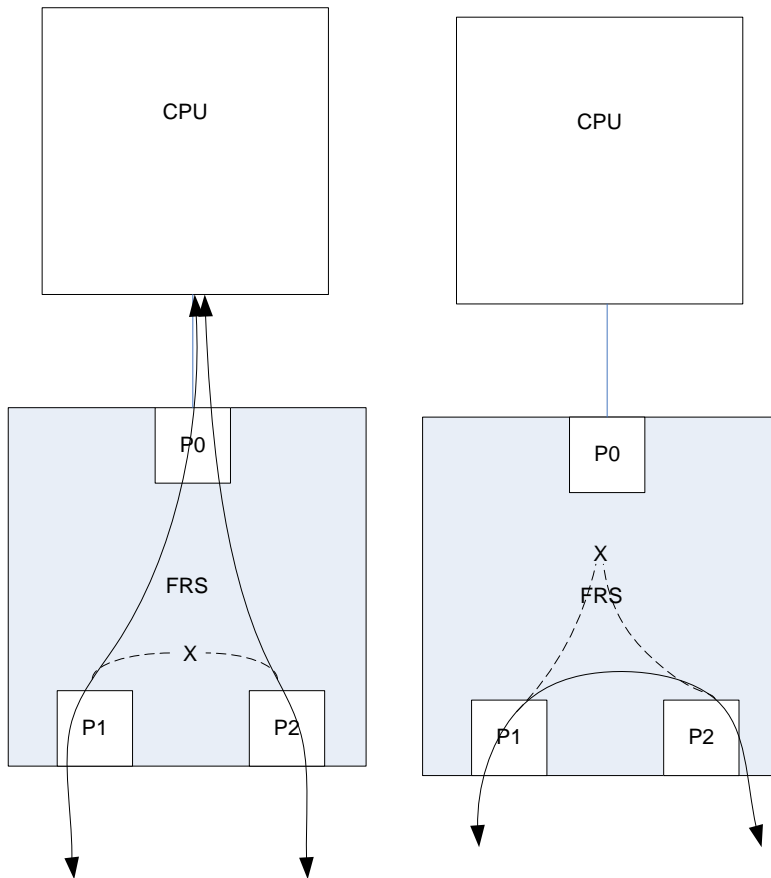


Figure 2. IPO ALLOW

These configurations use the possibility to limit/allow some traffic being forwarded to some ports. For example in the design on the left, some multicast traffic coming from P1 would in normal case be forwarded to P0 and P2, but with IPO it is possible to deny forwarding directly to P2. This is done with the following IPO settings.

- ETH_ADDRX_CFG = IPO enable, match whole destination address (could be also part of the address) = 0x00C1
- ETH_ADDRX_FWD_ALLOW = Allow forwarding to port 0 only = 0x0001
- ETH_ADDRX_FWD_MIRROR = no mirroring = 0x0000
- ETH_ADDRX_0 = Destination MAC 1st and 2nd octet
- ETH_ADDRX_1 = Destination MAC 3rd and 4th octet
- ETH_ADDRX_2 = Destination MAC 5th and 6th octet

Similarly the same setting should be set for P2.

In some other case there might be a need to deny some traffic going into the P0. Then the _ALLOW register would have the following configuration for P1

- ETH_ADDRX_FWD_ALLOW = Allow forwarding to port 2 only = 0x0004

And for P2

- ETH_ADDRX_FWD_ALLOW = Allow forwarding to port 1 only = 0x0002

On the other hand, in some use cases, there might be a need to guide some traffic into a certain port although it would not be forwarded there in a normal case. In these cases a mirroring rule is applied.

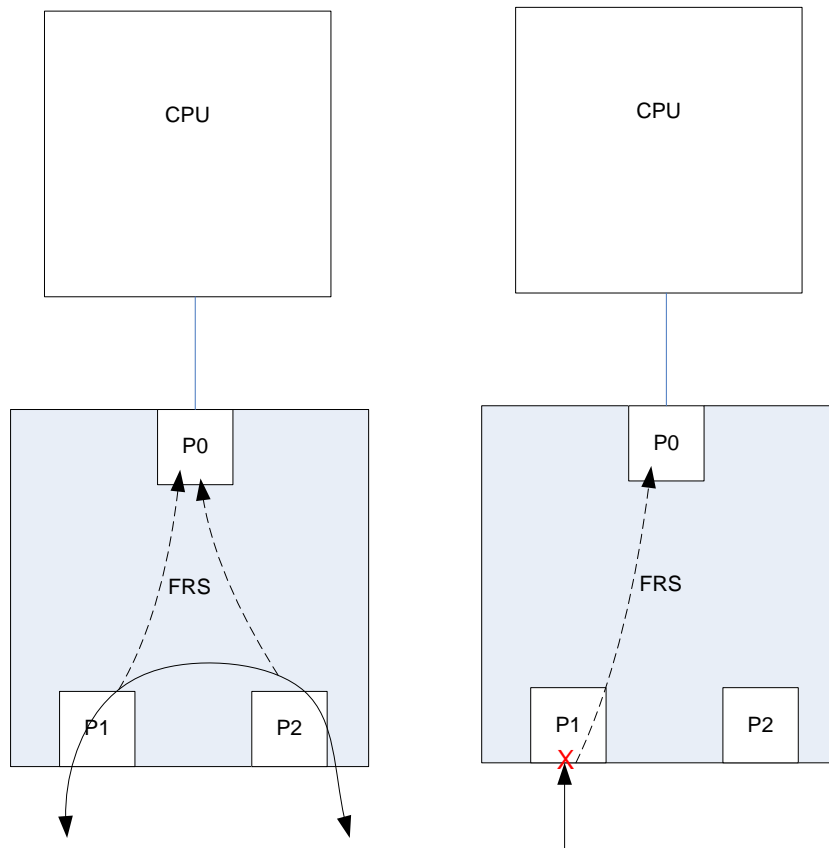


Figure 3. IPO MIRROR

Consider an example design on the left hand side in Figure 3. For some traffic the FRS would not forward packets from P1/P2 to P0 based on normal forwarding rules, but for some reason the user wants to monitor this traffic. In that case setting mirroring configuration for P1 and P2, forces packet forwarding also into the P0. The IPO setting could be as follows, for P1/P2

- ETH_ADDRX_CFG = IPO enable, match whole destination address (could be also part of the address) = 0x00C1
- ETH_ADDRX_FWD_ALLOW = Allow forwarding to all ports (or P0-P2) = 0xFFFF
- ETH_ADDRX_FWD_MIRROR = Mirror to P0 = 0x0001
- ETH_ADDRX_0 = Destination MAC 1st and 2nd octet
- ETH_ADDRX_1 = Destination MAC 3rd and 4th octet
- ETH_ADDRX_2 = Destination MAC 5th and 6th octet

The mirroring works also in case where the Port would drop the packet due to

- Port is disabled
- Port is in HSR mode, but the frame does not have an HSR tag

With the following setting it is possible to override the packet dropping and still forward it to the P0.

- ETH_ADDRX_CFG = IPO enable, match whole destination address (could be also part of the address) = 0x00C1
- ETH_ADDRX_FWD_ALLOW = Does not need to be set, since mirroring overrides allow = 0x0000
- ETH_ADDRX_FWD_MIRROR = Mirror to P0 = 0x0001
- ETH_ADDRX_0 = Destination MAC 1st and 2nd octet
- ETH_ADDRX_1 = Destination MAC 3rd and 4th octet
- ETH_ADDRX_2 = Destination MAC 5th and 6th octet

4 Inbound Policy Configuration for PTP Peer-to-Peer

The IEC62439-3 standard states that Pdelay_Req, Pdelay_Resp, PDelay_Resp_Follow_Up and Follow_Up shall not contain HSR tag. In normal case every frame going into the HSR Ring is added with an HSR tag and therefore there has to be an IPO configuration defining that these messages are sent to the HSR ring without an HSR tag. On the other hand, a message coming from the HSR ring is dropped if it does not include an HSR tag. To be able to still receive these messages an IPO configuration is needed.

Figure 4 defines an example design for PTP P2P IPO configurations. It includes a 3-port FRS of which

- Port 0 is connected to a CPU where a PTP stack is running
- Port 1 is an HSR A port
- Port 2 is an HSR B port

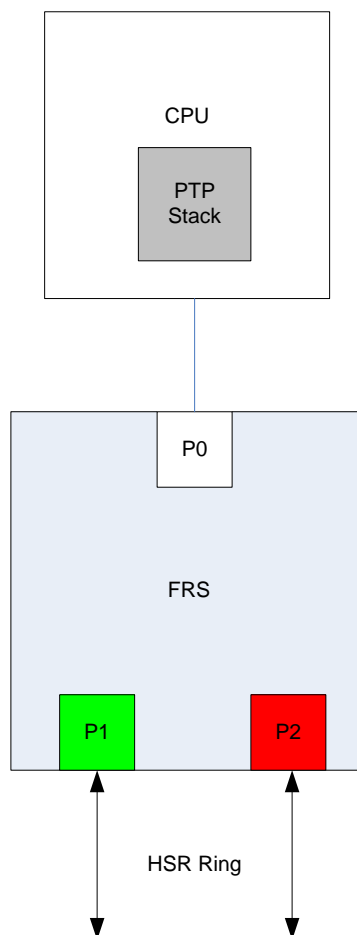


Figure 4. PTP P2P Example design

Now when a P2P delay message is sent from the CPU it is received by the Port 0. The Port 0 must apply an IPO configuration, which prevents it add the HSR tag into the frame. For this configuration the IPO registers for Port 0 shall be set as follows:

- ETH_ADDRX_CFG = IPO enable, No HSR-tag, match whole destination address = 0x04C1
- ETH_ADDRX_FWD_ALLOW = Allow forwarding to ports 1 and 2 = 0x0006
- ETH_ADDRX_FWD_MIRROR = no mirroring = 0x0000
- ETH_ADDRX_0 = P2P multicast MAC 1st and 2nd octet = 0x8001
- ETH_ADDRX_1 = P2P multicast MAC 3rd and 4th octet = 0x00C2

- ETH_ADDRX_2 = P2P multicast MAC 5th and 6th octet = 0x0E00

As the PTP P2P delay message does not include HSR tag when it is coming from the HSR ring, it would be dropped without an IPO Configuration forcing it to be forwarded. For this purpose, both P1 and P2 need to have the following IPO configuration:

- ETH_ADDRX_CFG = IPO enable, match whole destination address = 0x00C1
- ETH_ADDRX_FWD_ALLOW = Default = 0x0000
- ETH_ADDRX_FWD_MIRROR = Set mirroring to port 0 = 0x0001
- ETH_ADDRX_0 = P2P multicast MAC 1st and 2nd octet = 0x8001
- ETH_ADDRX_1 = P2P multicast MAC 3rd and 4th octet = 0x00C2
- ETH_ADDRX_2 = P2P multicast MAC 5th and 6th octet = 0x0E00

For PRP the situation is the same. Now the only difference is that the P0 IPO configuration must be set for no-PRP instead of no-HSR.

- ETH_ADDRX_CFG = IPO enable, No PRP-trailer, match whole destination address = 0x08C1

In situation where either HSR or PRP can be used, then both HSR tag and PRP trailer can be configured into the same IPO configuration.

- ETH_ADDRX_CFG = IPO enable, No HSR-tagNo PRP-trailer, match whole destination address = 0x0CC1

5 Inbound Policy Configuration for PTP

The IEC62439-3 states that Announce and Sync messages shall be included with an HSR tag when transmitted into an HSR ring. The same standard also states that DANH must receive and take into account (if arriving within certain time limit) messages coming from different paths i.e. both paths from the HSR ring. In normal case the duplicate would be dropped, but this functionality has to be overridden with IPO configuration. To enable duplicate forwarding to the P0, the IPO configuration must include mirror and allow rules.

Using again the same example design as defined in Figure 4. Now the HSR ring port P1 must have the following IPO configuration:

- ETH_ADDRX_CFG = IPO enable, match whole destination address = 0x00C1
- ETH_ADDRX_FWD_ALLOW = Allow forwarding to P0 and P2 = 0x0005
- ETH_ADDRX_FWD_MIRROR = Set mirroring to P0 = 0x0001
- ETH_ADDRX_0 = P2P multicast MAC 1st and 2nd octet = 0x1B01
- ETH_ADDRX_1 = P2P multicast MAC 3rd and 4th octet = 0x0019
- ETH_ADDRX_2 = P2P multicast MAC 5th and 6th octet = 0x0000

And for the P2, almost the same except

- ETH_ADDRX_FWD_ALLOW = Allow forwarding to P0 and P1 = 0x0003

6 Glossary

FES	Flexibilis Ethernet Switch
FRS	Flexibilis Redundant Switch
HSR	High Availability Seamless Redundancy
IPO	Inbound Policy
MAC	Media Access Controller
PRP	Parallel Redundancy Protocol
PTP	Precision Time Protocol
P2P	Peer-to-Peer

7 References

- [1] Flexibilis Redundant Switch (FRS) Manual, FRS_Manual.pdf, version 2.16
- [2] IEEE Std 1588-2008: IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems, 2008.
- [3] IEC62439-3 , “Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)”, 2010, Clause 5