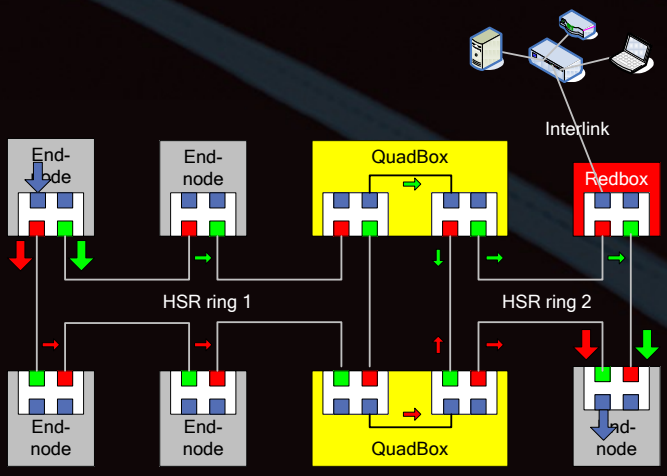
Flexibilis Ethernet Switch
High-availability Seamless Redundancy

Flexibilis Ethernet Switch with High-availability Seamless Redundancy support (FES-HSR) is a triple-speed (10Mbps/100Mbps/1Gbps) Ethernet Layer 2 switch compatible with IEC 62439-3 Clause 5.

HSR is an emerging standard providing redundancy for Ethernet networks. Typical HSR topology is a ring: source node duplicates all the frames it has to send and sends them using two different paths to their destination. If either one of the paths is broken, due to link failure or node failure, the frames are still able to reach their destination. The benefit of HSR, when compared to for example Rapid Spanning Tree Protocol (RSTP), is its zero-time recovery: single network faults in the ring will not result in any frame loss.

Originally HSR was targeted for smart grid electrical substation automation, but it can also be employed in other critical networking applications:

- Industrial automation
- Motion control
- Military communication



Typically HSR rings consists of three kinds of nodes:

- End-nodes
- QuadBoxes
- RedBoxes

End-nodes have at least two external Ethernet ports, to connect to one HSR ring. End nodes are for example IEDs (Intelligent Electronic Devices) and merging units in substation automation, cameras and other sensors.

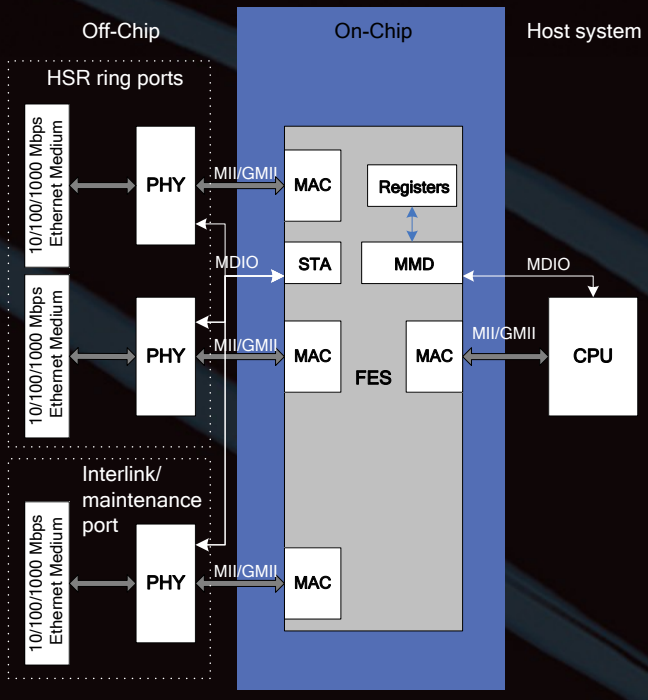
RedBox or Redundancy Box is an entity that has three external Ethernet ports. Two of the ports are connected to an HSR ring and one port is a traditional Ethernet port. RedBoxes are used to connect non-HSR nodes to HSR rings.

QuadBox or Quadruple Port Device is a device connecting two HSR rings to each other. As the QuadBox itself is a single point of failure, two QuadBoxes are typically used between HSR rings.

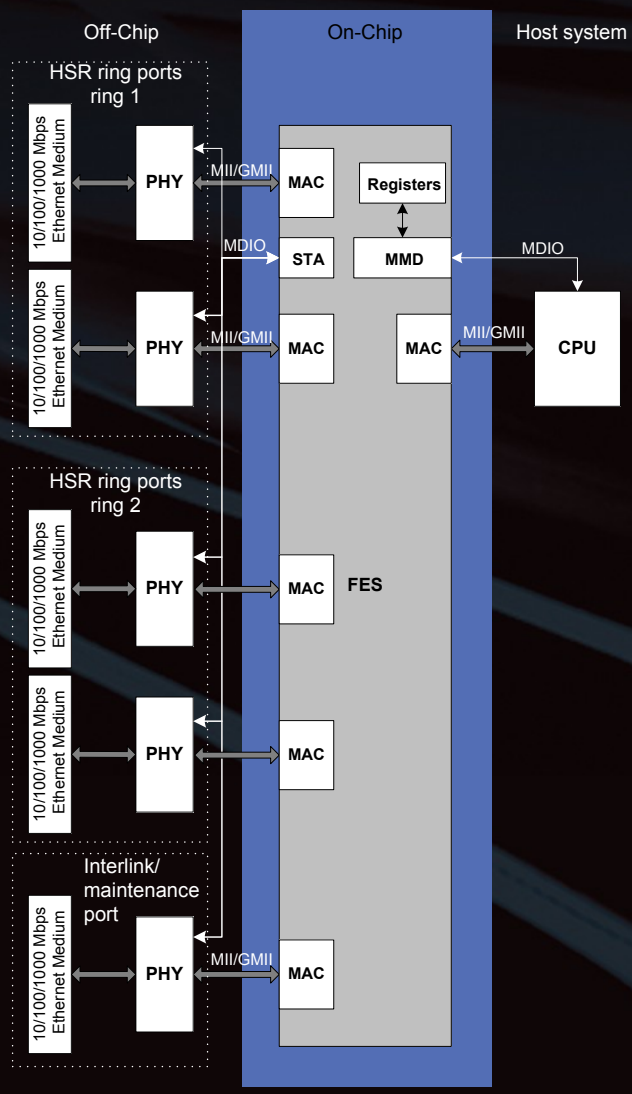
FES-HSR is available in two different configurations:

- 4-port (End-node / RedBox)
- 6-port (QuadBox)

The 4-port FES-HSR can be used to implement End-nodes and RedBoxes. Typically one of the Ethernet interfaces is internal, for the device internal CPU to be able to access the network. One external traditional Ethernet interface is provided in End-nodes, for maintenance purposes.



6-port FES-HSR can be used to implement a Quadbox. One extra traditional Ethernet port is provided to be used for RedBox-in-Quadbox functionality or as a maintenance port.



All of the ports of FES-HSR can be either copper or fiber Ethernet interfaces, or connected to other FPGA blocks. Packet forwarding takes place at wire-speed and the switching operation is non-blocking. These IP cores support the following interface options:

- MII
- GMII
- RMII
- RGMII

Precision Time Protocol

Precision Time Protocol (PTP), defined in IEEE standard 1588, enables precise synchronization of device clocks in packet based networks. Devices are automatically synchronized to the most accurate clock in the network. The protocol is used in applications such as test and measurement, power-line management, industrial automation and telecom.

HSR is typically used in applications where time synchronization is also needed. Therefore PTP support is integral part of FES-HSR. In all versions of FES-HSR there is always a transparent clock between the ring ports. In QuadBox FES-HSR there is also a boundary clock between the rings. In an End-node application FES-HSR contains an ordinary clock and in RedBox application a boundary clock.

When using Gigabit fiber Ethernet FES-HSR is able to achieve nanosecond class accuracy in clock transfer.

Standard features

- Compatible with IEC 62439-3 Clause 5 ”High-availability Seamless Redundancy (HSR)”
- HSR RedBox, HSR End-node and HSR QuadBox support
- Time and frequency synchronization using IEEE1588-2008 Precision Time Protocol
- Transparent switch functionality between HSR ring ports
- Boundary clock functionality between HSR rings in QuadBox
- Triple-speed, full-duplex operation on all ports
- Wire-speed packet forwarding
- Automatic polling of connected Ethernet PHYsical interface chips

Also available

- Evaluation package for LatticeECP3 PCI Express Solutions Board
- Open source IEEE 1588 PTP protocol stack implementation and Linux software for embedded environments
- Accelerated hardware test environment

Flexibilis Oy
Naulakatu 3
33100 Tampere
Finland
http://www.flexibilis.com/