Redundancy for Robustness: TSN .1CB

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Most recent version of the presentation

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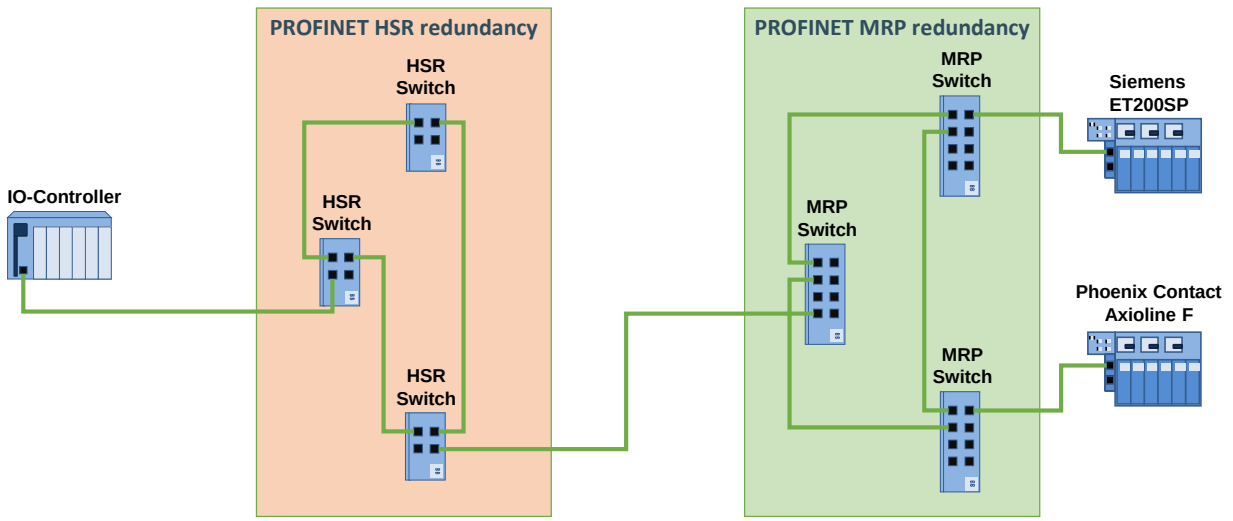
Demonstration

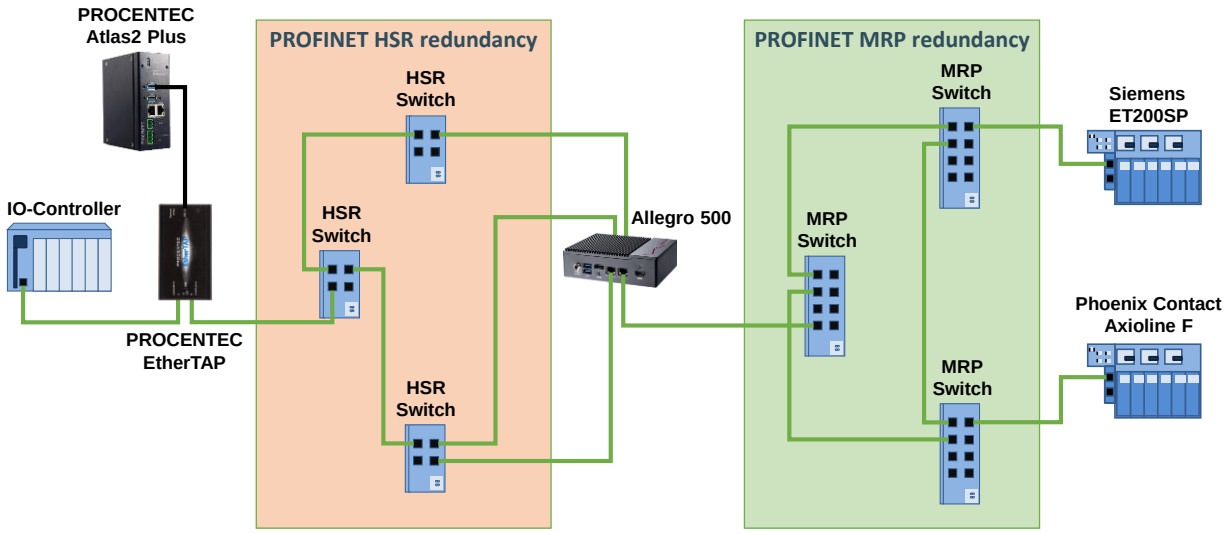
Demonstrator

- MRP and HSR redundancy
- Difference between non-seamless and seamless redundancy

Demonstrator



Demonstrator



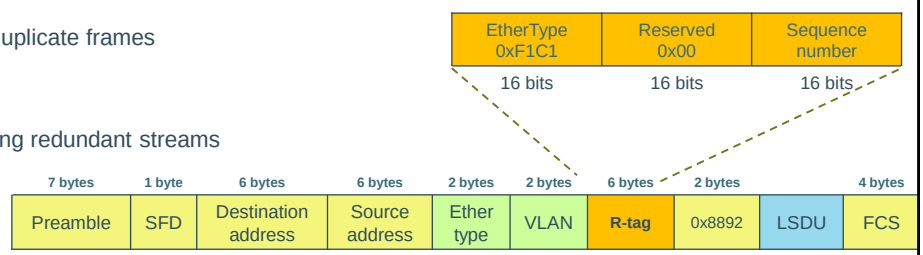
Configuration of a FRER domain

Configuration of a FRER domain

- FRER redundancy principle is based on sending TSN streams over multiple paths
- This creates following questions
  - How are streams identified?
  - How are stream replicated?
  - How are duplicates eliminated?
- An introduction is given with Relyum RELY-TSN-BRIDGE as an example

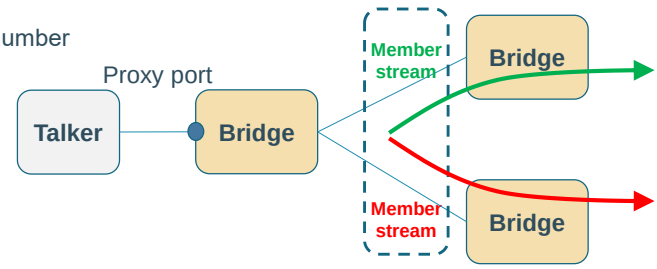
Identifying streams

- Stream that ingress a bridge are identified using:
  - Destination MAC
  - VLAN ID
  - PCP priority field
- FRER uses specific identifiers to encode/decode redundant streams
  - Sequence number
    - Part of redundancy tag
    - Identify and eliminate duplicate frames
  - Stream handler
    - Internal value in bridge
    - Link ingressing/egressing redundant streams



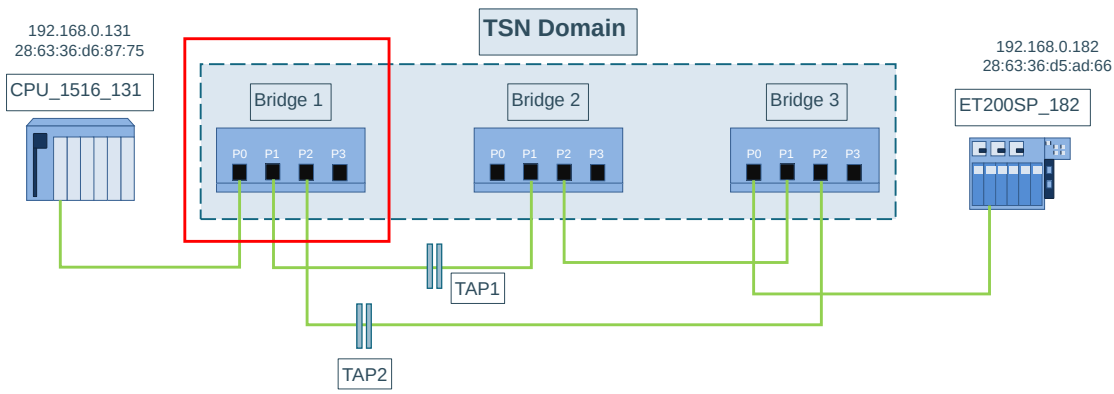
Duplicating a frame entering a FRER domain

1. Identify stream coming from talker
   - Dst. MAC
   - VLAN ID
   - PCP priority
2. Assign stream handler
3. Assign egressing ports to stream handler
4. Transmit duplicate frame on both ports
   - Sequence encoding → identical sequence number
   - VLAN translation



Network layout

- Example configuration of bridge 1 is used



Duplicating a frame entering a FRER domain

- Example configuration in RELY-TSN-BRIDGE

STREAM ID | SWITCH

	Destination MAC addr	VID	PCP	SH	PORT_0	PORT_1	PORT_2	PORT_3	INTERNAL_PORT
☐	01 : 0E : CF : 00 : 00 : 00	100	0	1	☐	☑	☑	☐	☐
☐	28 : 63 : 36 : d6 : 87 : 75	200	0	2	☑	☐	☐	☐	☐
☐	FF : FF : FF : FF : FF : FF	100	0	3	☐	☑	☑	☐	☐
☐	28 : 63 : 36 : D5 : AD : 66	100	0	4	☐	☑	☑	☐	☐
☐	28 : 63 : 36 : D6 : 87 : 75	200	6	2	☑	☐	☐	☐	☐
☐	28 : 63 : 36 : d6 : 87 : 75	200	5	2	☑	☐	☐	☐	☐

Add stream Clear all streams

FRER PARAMETERS | SWITCH

Recovery mode	Vector based recov
Recovery history	0
Recovery reset time (ms)	100

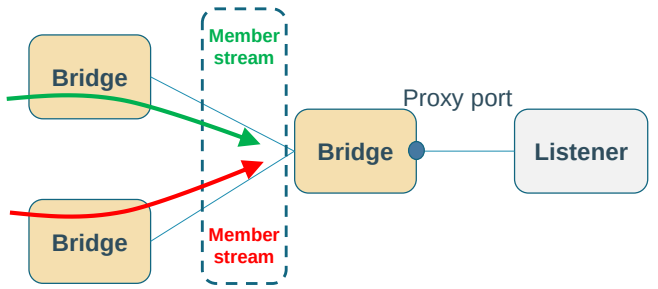
	PORT_0	PORT_1	PORT_2	PORT_3	INTERNAL_PORT
Proxy ports	☑	☐	☐	☐	☐

FRER STREAMS | SWITCH

		VLAN translation				
Enable	SH	PORT_0	PORT_1	PORT_2	PORT_3	INTERNAL_PORT
☑	1		200	200		
☑	2	0				
☑	3		200	200		
☑	4		200	200		

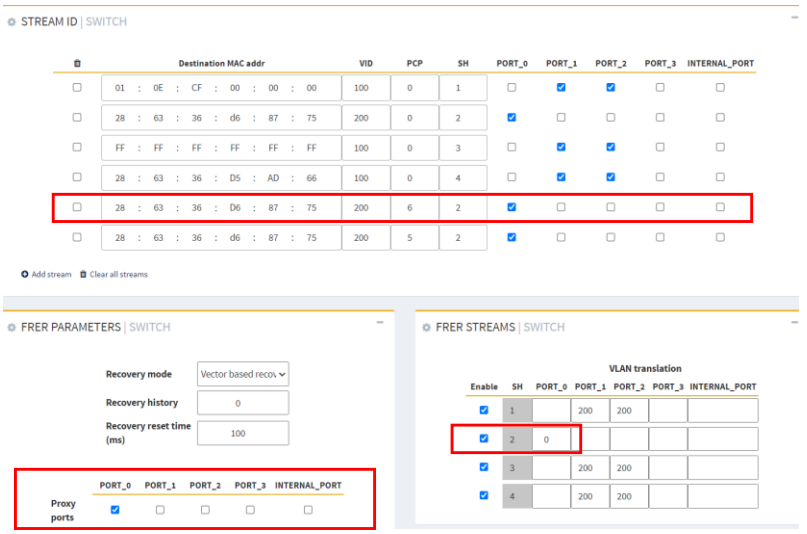
Eliminating duplicates when exiting the FRER domain

1. Identify stream coming from talker
   - Dst. MAC
   - VLAN ID
   - PCP priority
2. Assign multiple member streams to the same stream handler
3. Sequence decoding
   - Eliminate duplicates using match or vector recovery algorithm
4. If frame egresses through proxy port
   - Remove R-tag

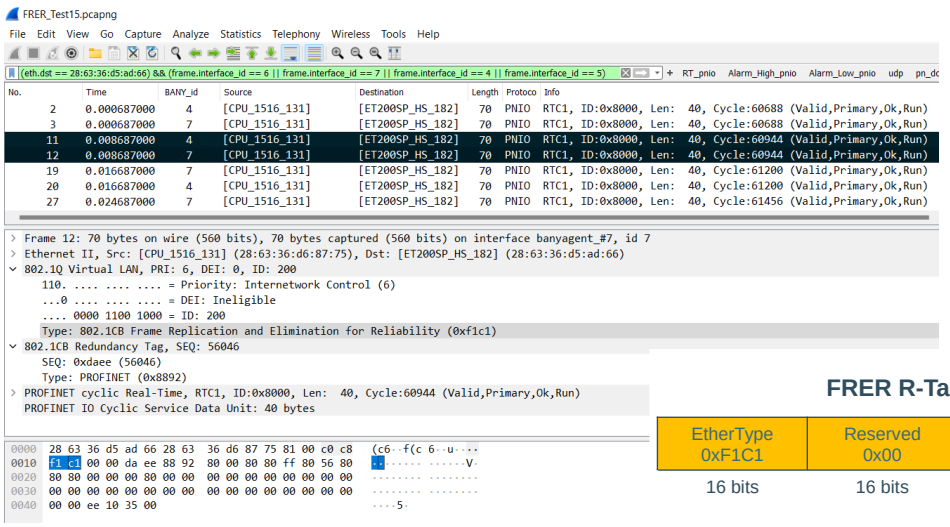


Eliminating duplicates when exiting the FRER domain

- Example configuration in RELY-TSN-BRIDGE



.pcap measurement



FRER R-Tag

EtherType 0xF1C1	Reserved 0x00	Sequence number
16 bits	16 bits	16 bits