Case Study

RELY-PCIe: the solution for high-availability and sub-microsecond synchronization in Broadcasting

This success case shows how a single device supports synchronization and seamless failover in complex Broadcasting architectures that combine audio/video data with other management and service information. This device overcomes the complexity of implementing Parallel Redundant Protocol PRP and IEEE 1588 synchronization in any commercial server or workstation.

Customer Snapshot

- BROADCASTING PUBLIC ENTITY
- Activity: broadcasting of TV channels and radio channels on digital terrestrial television, digital terrestrial radio and subscription television.
- Region: national coverage

The Challenge

- Implementation of a zero-packet-loss network
- Support of AES 67 Media PTP Synchronization Profile
- Management of different types of traffic through VLANs

The Solution

- RELY-SYNC-HSR/PRP-PCIe NIC that converts a commercial server in a Dual Attached Node (DAN) of a PRP network and integrates IEEE 1588 support and VLAN management in the same device.

Key benefit

- DAN and Redbox functionality for HSR/PRP networks
- Flexible IEEE 1588 – PTP implementation
- Advanced L2 switching features: VLAN, Port mask, Frame limit, etc.
- Ethernet network drivers available for most OS (Linux, Windows, VxWorks, etc.)

The Broadcasting Public Entity had to renew its infrastructure for the radio headend system.

The main function of a headend is receiving and encoding the live audio from the radio stations to a compressed format such as AAC, and then multiplexing multiple streams to one package. This package is then transmitted over the air to digital radio receivers, for distribution to end-users. Based on this architecture, the company has been successfully operating such services since mid-90s.

However, in the last years, the technology has moved from dedicated equipment and physical cabling between them to a highly software and IP based solution. This new scenario brings Broadcasting operators new challenges as they need to keep everything tightly synchronized over multiple separate sites to maintain seamless failover and redundancy.

Key part of the project has been to design and implement a highly robust and redundant network to ensure no single point of failure and high availability. Traditionally such redundancy in broadcast applications has been defined and implemented using the SMPTE 2022-7 standard, a very simple method to create redundancy, that only works for audio (or other media) using the RTP - Real-time Transport Protocol.

It is based on sending the same packet out on two physical network interfaces. The identification in this case is done by inspecting the header of the RTP packet itself, which contains sequence numbers and other identifiers. As there is no extra information added to the packets (like other protocol's RCT), the receiver can easily identify them and select which ones are identical and which can be ignored.

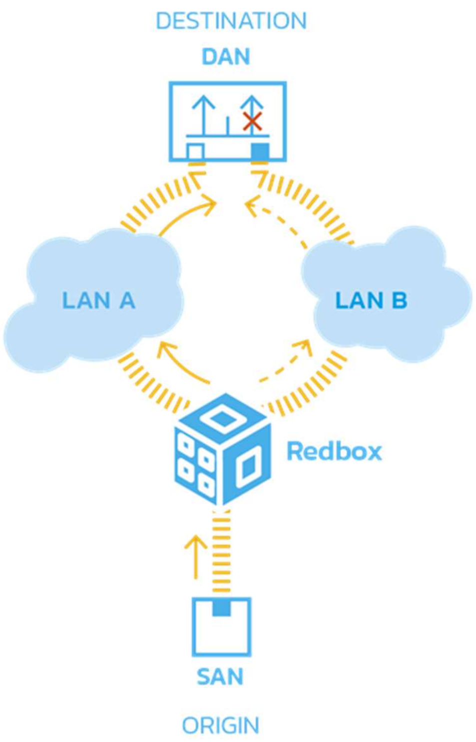

Figure a. Parallel Redundant Protocol

This allows parallel transmission of real-time media (video and/or audio) over two separate networks, with automatic reassembly and failover in the receiver.

However, this method does only work on RTP packets transmitted using UDP uni- or multicast, which becomes a problem, since, in this type of systems, the media is only a small part of the chain and full redundancy is also mandatory in terms of synchronization (PTP), control (e.g. HTTP, SSH), monitoring (SNMP, ilo/idrac) and distribution (EDI) of the final product.

The challenge of redundancy and synchronization has been already approached in many other sectors. In particular, in power substation applications, where zero-packet-loss networks are required, this particular needs have already largely been solved adopting the "IEC 62439: Industrial communication networks - High availability automation networks"- standard.

IEC 62439 proposes PRP in Clause 3 (IEC 62439-3). The basic functionality of this protocol is summarized in Figure a. The redundancy is supported in the PRP capable nodes (DANs) by two network interfaces. Each interface is connected to different standard Ethernet networks (LAN A and LAN B). Any non-redundant nodes (SANs) can be attached in a redundant way using a RedBox as depicted in the Figure.

Additionally, the customer wanted to avoid any special adaptations of the operating system and/or the broadcast software to implement the functionality. Since standard servers are used for most of the functions, RELY-PCIe card was a perfect solution as it transparently converts.

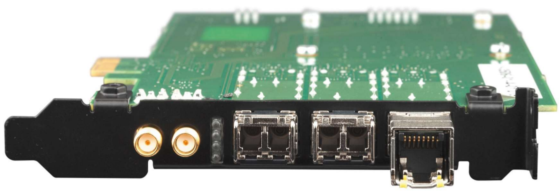

Figure b. RELY-PCIe NIC

standard Ethernet traffic to and from PRP. This card is offered to the operating system as standard NIC card. This approaches ensures driver compatibility with most of the OS available in the market (Linux, Windows, VxWorks, etc.). This feature means significant savings in terms of software integration and cards' configuration for connecting to the network. It also simplifies any future upgrade to the latest technology available in the market, thanks to a solution independent and decoupled from the broadcasting software and hardware.

Figure c shows the architecture defined for the new audio headend of the Broadcasting Public Entity. In this new architecture, RELY-PCIe cards have been installed in the following devices:

- DAB MUX: based on Dell R440 servers running Ubuntu with RELY-PCIe NIC. It receives audio from the network (from the AoIP boxes), encodes and combines it with metadata and package them together. This package is then sent using IP to the transmitters on the hilltops throughout the country, where it is converted to radio signals that are broadcasted in the air. The format inside the IP packets sent to the transmitters is called "EDI".

- Config Clients: which are Windows or Linux desktop machines with a web browser for setup/configuration/management/monitor of the system, also with a RELY-PCIe card installed on each.

A total of 35 RELY-PCIe cards have been installed in the devices located in the different sites of the network.

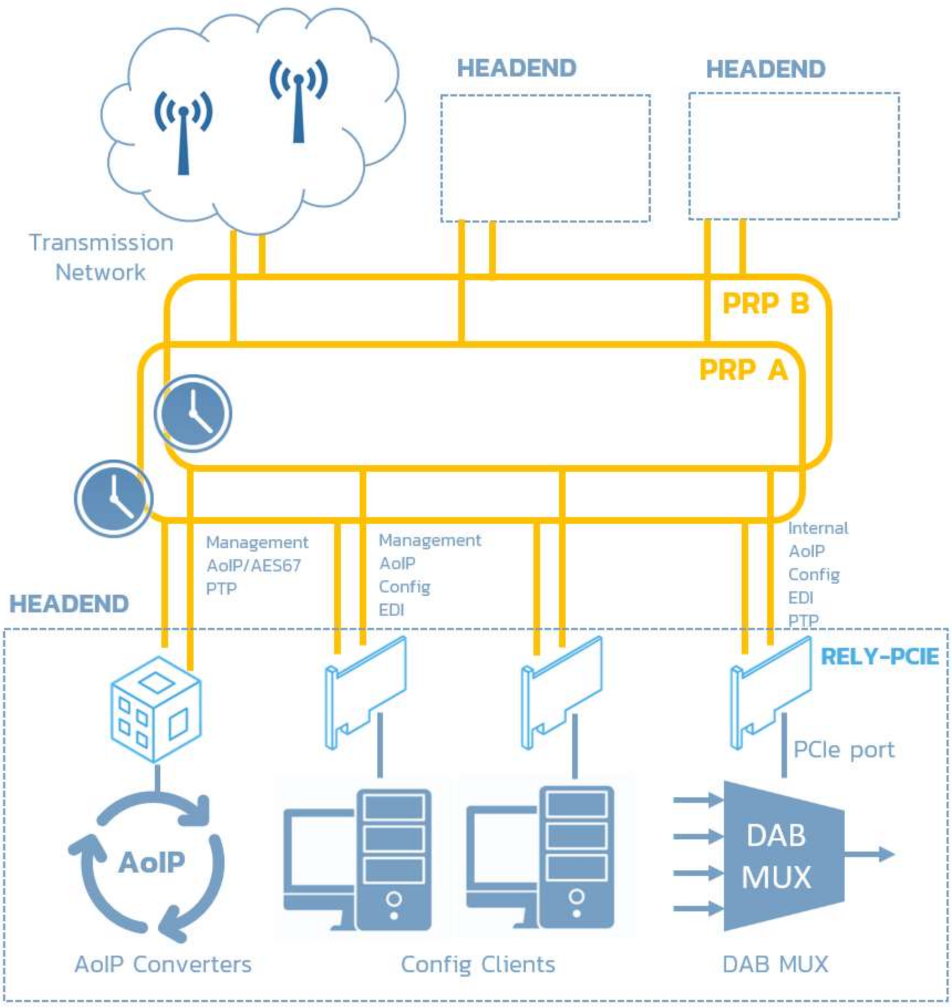

Figure c. Audio Broadcasting architecture

VLAN Management	
VLAN 1	Management
VLAN 2	Config
VLAN 3	Internal
VLAN 4	AoIP
VLAN 5	EDI
VLAN 6	PTP – IEEE 1588

Figure d. VLAN assignment

These devices manage different type of traffic by using multiple VLANs assigned to each traffic (see table in Figure d).

Apart from simplifying the implementation of a complex time-aware high-availability network, RELY-PCIe provides advanced tool for configuration, monitoring and diagnosis of the behaviour of the PCIe card and the network.

In terms of configuration, RELY-PCIe embeds a user-friendly web server (see Figure e) for configuring all the synchronization, redundancy and layer-2 switching features supported by the card, no software installation being required in the user's workstation.

Additionally, a configuration management tool allows to remotely deploy a pre-defined configuration in multiple devices connected to the network, which saves significant time during commissioning.

The Web Manager embedded in the device provides different tools for monitoring the behaviour of the system. Among others, the following elements can be supervised from the GUI tool:

- SNMP v1, v2c, v3 status

- Internal logger for services: configuration service, PTP, NTP, SNMP, etc.

- System parameters monitor: CPU, Memory, Temperature

- Network nodes table based on HSR/PRP supervision frames

- Network statistics per port

The above tools in combination with the ability of remotely update/upgrade the device through a secured connection, gives end-users a complete control of the network operation.

Moreover, apart from these high level features that can be managed through a user-friendly interface, the device can be configured trough the Command Line Interface (CLI).

Finally, if required by the application the device can be upgraded to accomplish other Edge computing tasks, targeting not only the on-board CPU, but the FPGA as well.

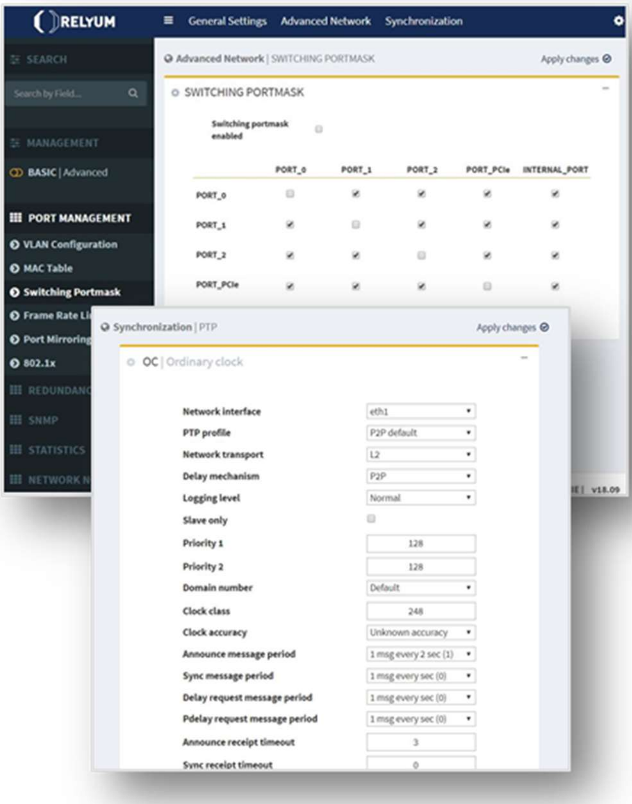

Figure e. RELY-PCIe Web Manager