Redundancy solutions with HSR and PRP

Redundant communication is key in mission-critical applications. The need for redundancy grows with the criticality of the data being transmitted. An example of this is when the information sent contains data required for life or asset protecting functions.

To achieve redundancy in substation automation systems, Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR) are very important to consider. Organizations like IEC have identified them as preferred for substation environments.

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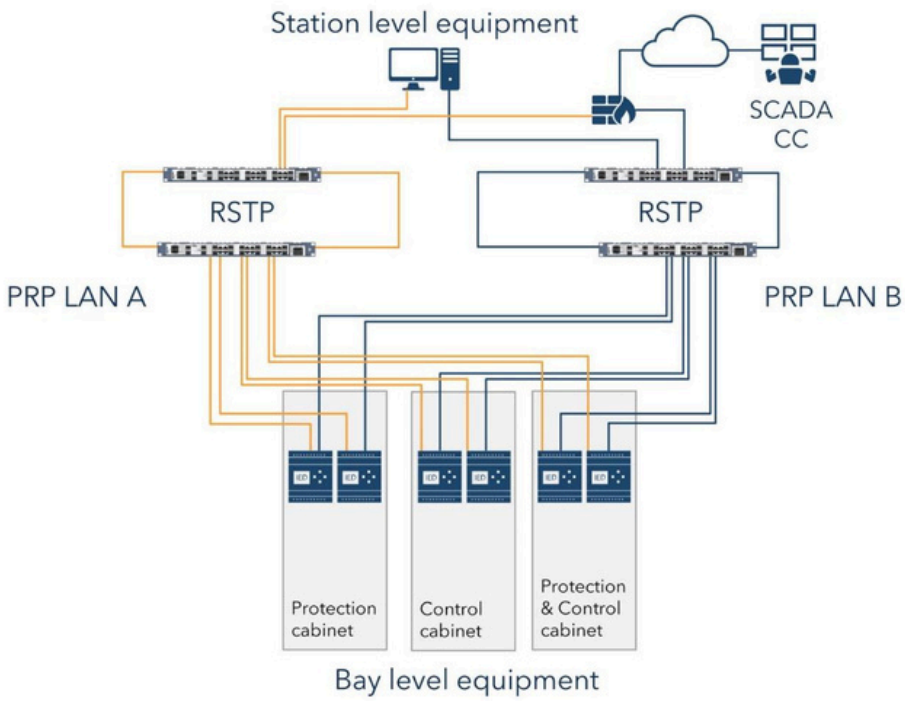
Parallel Redundancy Protocol



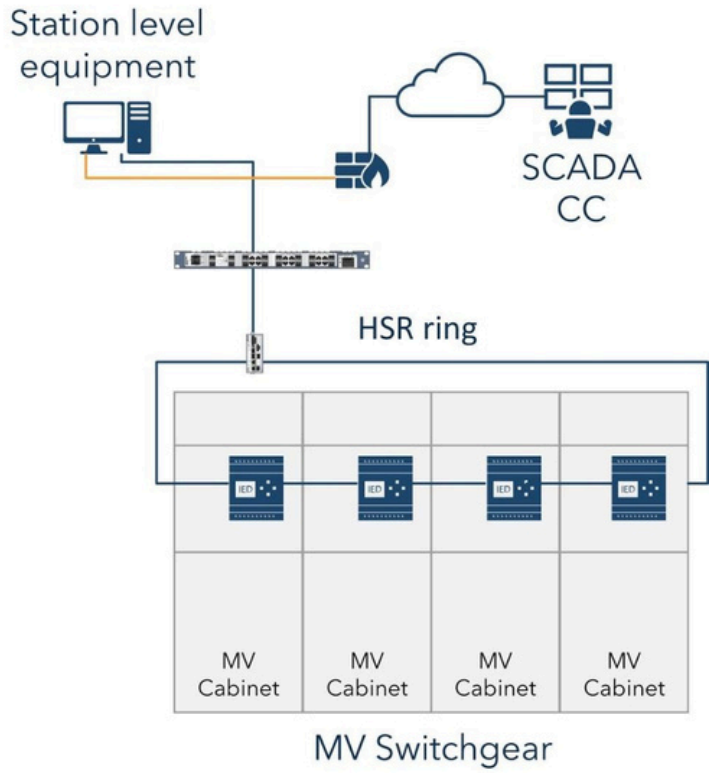
PRP, a layer 2 protocol, provides redundancy and reliability by using two independent networks (pictured in yellow and blue). Each device sends duplicate packets over both networks, ensuring continuous communication even if one network fails. Each LAN operates in parallel using RSTP (Rapid Spanning Tree Protocol).

To Implement PRP, devices are required to have two network ports and the capability to handle PRP at the software level.

The complete duplication of LANs is quite simple and offers great redundancy. It could, however, be quite expensive to build, since many devices with many ports would be required.

PRP is suitable for critical applications where high availability is essential. It ensures that communication remains uninterrupted even in the unlikely event of network failures.

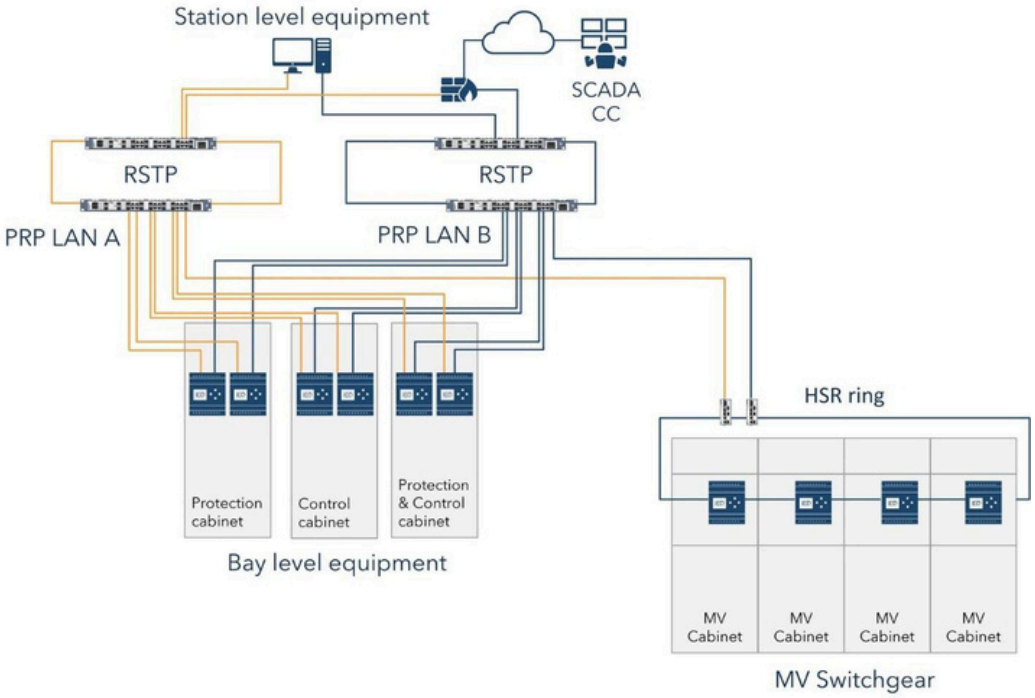
High-availability Seamless Redundancy



HSR provides zero delay failover by forming a logical ring topology where each device is connected to two other devices, creating a physical loop. This ensures that communication can continue even if a connection unexpectedly fails.

The ring topology of HSR offers some benefits over PRP, such as a reduced need for port density in switches, which simplifies installation. However, it comes at the expense of the need for HSR support in devices, and that redundancy is built to handle a single failure in the ring. In the unlikely event of multiple failures, the impact on the network will be greater than with a PRP solution. In addition, the ring solution introduces latencies in communication, which can be problematic in time-critical applications, especially when dependent on PTP/IEEE1588.

Combination of HSR and PRP



PRP and HSR serve different purposes and combining them can unlock more advanced solutions

There are several ways of combining PRP and HSR to achieve additional layers of redundancy. This example involves using an HSR ring topology to connect medium voltage switchgear and a PRP topology to connect station-level equipment. The HSR ring connects devices in a ring topology, while the PRP topology provides parallel paths for redundancy.

Redundancy Box

Redundancy Boxes (Red Box) are used to provide redundancy to end nodes that are not equipped with two network ports, commonly called Single Attached Nodes (SAN).

A RedBox bridges the HSR ring and the PRP network. It ensures that data is correctly transmitted between the two networks without duplication. The communication is handled by the RedBox by identifying and sorting telegrams based on their origin and destination.

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