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Drastic Improvements in Wireless Reliability★

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The biggest fear about wireless use in industry is its reliability. The use of Parallel Redundancy Protocol directly addresses wireless reliability concerns and is leading manufacturers to reassess their opinions about using wireless.

Figure 1. PRP in an reliable network: two redundant paths are used simultaneously. Packets
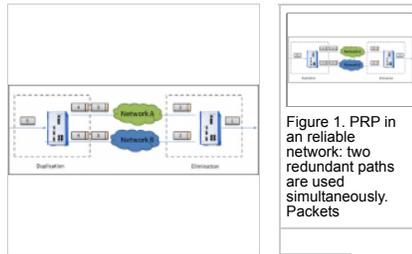
One of the most common concerns about using wireless for mission critical applications has always been—and still is—reliability. Will it work in your noisy environment? Will it be robust enough to ensure your data makes it to its destination? Can it ever provide you the assurance you need that it is stable enough?

Up until now, there have been many techniques and planning guides written to help address these concerns. However, there hasn't been an integrated, tried-and-true solution to achieve zero failover and/or zero data loss. Now, thanks in part to the integration of Parallel Redundancy Protocol (PRP), right into wireless solutions, wireless reliability concerns are quickly becoming a thing of the past.

The Use of PRP

PRP has its roots in wired industrial Ethernet networks, where redundancy techniques have long been established to ensure networks continue to operate smoothly even if individual connections fail. These techniques often involve using PRP in accordance with IEC 62439 standards. The result is seamless redundancy with delay-free and loss-free switching.

To achieve this level of uninterrupted communications, traditionally a "Redundant box" or "Red box" duplicates and transmits data packets concurrently across two different network paths. Before the duplicated packets are delivered beyond these network paths, the parallel streams are merged and duplicate packets are removed. If a single path fails, packets from the other path will be used. The application relying on this network can therefore continue to work without failure, despite serious disruptions in the network.

In wireless environments, the impact of PRP is even more significant because it can now be

integrated right into the access points and not only provides zero-failover, it can also be used to compensate for the inherent small-scale disruptions (e.g., interference) that can occur with wireless connections.

When PRP transmits packets simultaneously on two different wireless transmission paths, the effects of individual path packet losses can be eliminated. This is possible because uncorrelated packet losses are not seen by applications using PRP; a transmission fault or a receive error only occurs if both paths fail simultaneously for the exact same packet.

Beyond these benefits of PRP, jitter and latency also see dramatic improvements. When PRP is used to transmit packets simultaneously on two different transmission paths, the effects of interference or delays are nearly eliminated. As seen in Figure 3, the delay of packet 5 on Network B will never been seen by the network because the fastest packet will always be used at the point of elimination.

In practical tests, the perceptible packet loss for an application with PRP was reduced to 0.00021 percent using a PRP connection. That's a 500-fold reduction in packet loss!

Taking PRP to the Next Level

Building on the gains from standardized PRP, two additional developments make today's wireless even more practical—frequency diversification and the integration of PRP into wireless equipment.

In many countries, wireless providers are able to broadcast on several unlicensed frequencies, which likely include two popular bands—2.4 GHz and 5 GHz. Each band has different benefits and, in turn, different weaknesses. By adding frequency diversity to your PRP design, such as broadcasting one signal on 2.4 GHz and one on 5 GHz, you are almost guaranteeing another level of assurance. That's because what might typically cause unintentional signal degradation on one frequency is highly unlikely to cause interference on the other. By introducing this mix, you further enhance the dependability of data transmission in your design.

Belden further boosts the practicality and financial return of industrial wireless applications by integrating PRP capability directly into wireless access points. This means that, in many network designs, there is no longer a need for a separate "Red box" (Redundancy Box) to manage the packet duplication and merging.

Furthermore, PRP isn't exclusive to wired or wireless network designs. It can be used for completely wireless and hybrid wired/wireless designs to increase the range and scope of possible solutions.

Editor's Note: This article was contributed by Julia Santogatta, Belden's director responsible for the wireless initiatives and Dr. Tobias Heer, Belden's Head of Embedded Development.

For further reading on this topic:

- Blog: It's Time to Put Industrial Wireless on the Front Burner
- Blog: Oil Refinery Uses Industrial Wireless for Remote Monitoring
- Blog: A Quantum Leap for the Use of Wireless Communication in Automation
- Webpage: Industrial Wireless LAN Access Points, Clients and Bridges

For more information, download Belden's white paper "Parallel Redundancy Protocol Notably Improves Industrial Wireless Reliability".

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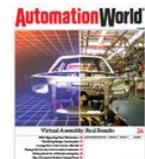
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