Network Redundancy with LEH Series Ethernet Switches

Architecting Computer Networks That Are Resilient and Fault Tolerant

As computer networks have become mission-critical assets for most if not all businesses, keeping the network up and running has assumed a crucial importance. And just as there are different types of traffic that run over a computer network, there are different solutions to keeping that traffic flowing, each with its own pros and cons.

Two methods for maintaining network resiliency with the Black Box LEH family of hardened, managed Ethernet switches are the Spanning Tree Protocol (STP/RSTP) and α-Ring protocol.

Spanning Tree Protocol (STP)

The Spanning Tree Protocol (standardized as IEEE 802.1D) allows a network design to include redundant links to provide automatic backup paths if an active link fails. But STP also avoids the creation of bridge "loops" that cause broadcast storms. Without STP, Ethernet Switches with redundant links have no standardized way to keep from looping data over and over again to the other switches in the network, eventually disabling the network's ability to pass data.

For example, if the switches in Figure 1 were connected without STP, each switch would infinitely duplicate the first broadcast packet heard, until it ran out of memory. Without STP, the administrator would have to disable the redundant red links manually in order for the network to operate, and then manually reconnect them if a failure of one of the active links occurred. Spanning Tree, however, will block the redundant links until the active one becomes unusable, and then automatically fail over to the redundant link.

The idea behind a Spanning Tree topology is to allow switches to automatically discover a subset of the network topology that is loop-free, i.e., a tree. With STP turned on, the LEH switches will perform the spanning tree algorithm when they are first connected, as well as any time there is a topology change, and automatically communicate with each other in a loop-free mode. Then, should a failure of one of the active links occur, STP unblocks the redundant links to enable the network to continue transmitting traffic.

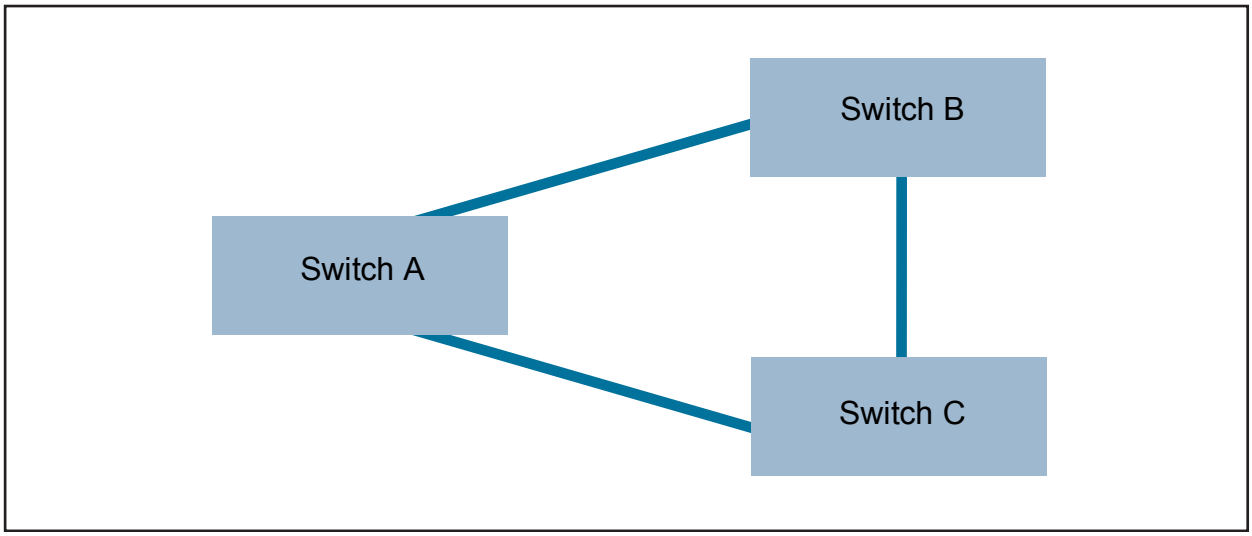


Figure 1: *Using STP in an Ethernet network.*

The α-Ring Protocol

The α-Ring protocol is a proprietary protocol designed to provide a faster network recovery time after a failure than standard STP. As the name suggests, α-Ring enables the LEH switches to be organized in a ring arrangement as shown below in Figure 2.

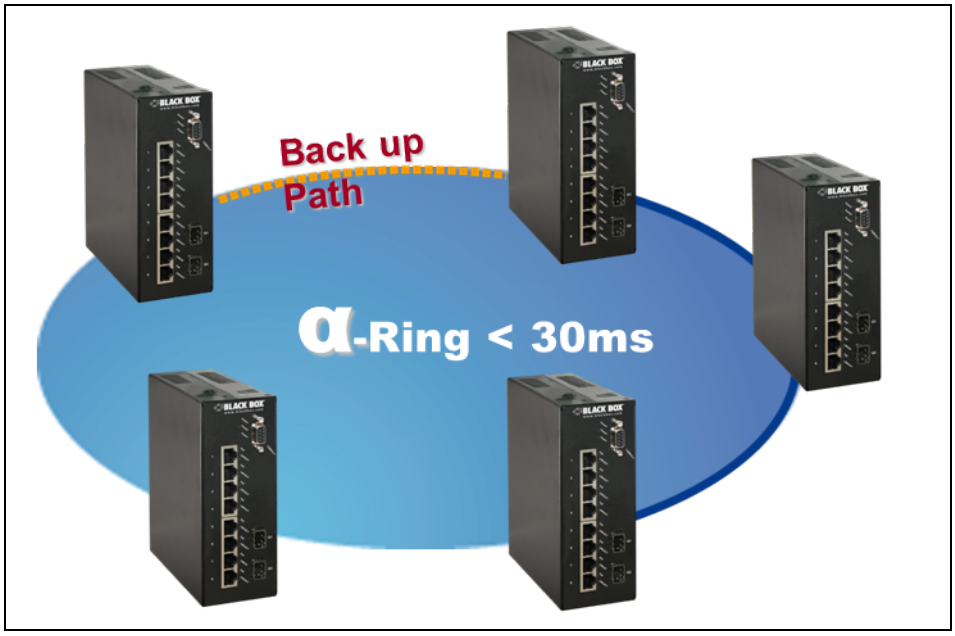


Figure 2: *When an α-Ring is formed with LEH switches, the last physical connection made in the ring is automatically selected as the backup path and is blocked during normal operation.*

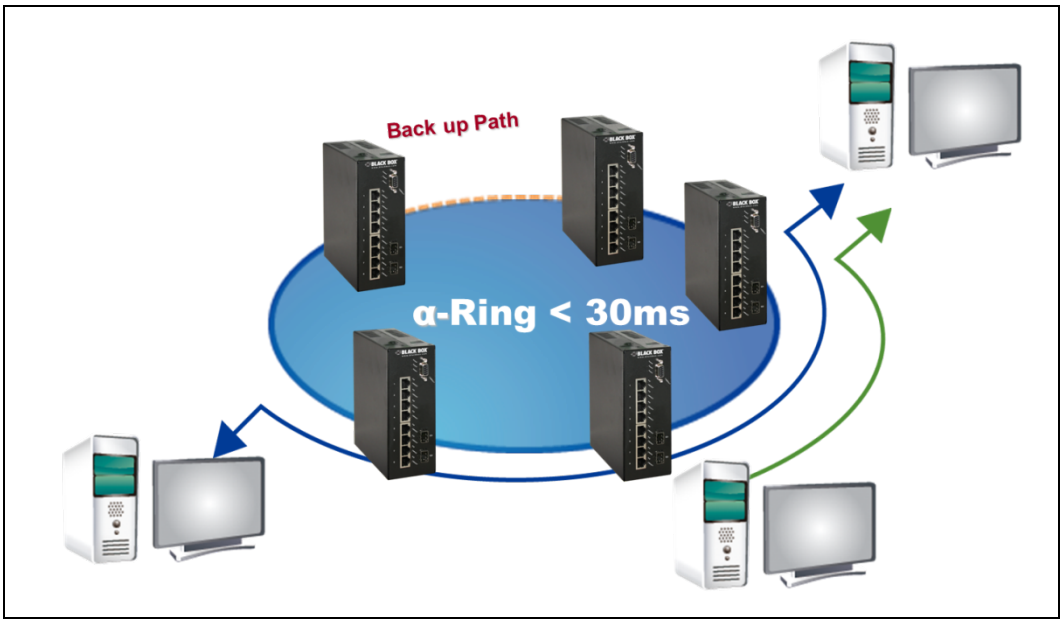


Figure 3

During normal operation, the “Back Up Path” for the α-Ring is blocked, and data follows the other links around the ring as shown in Figure 3.

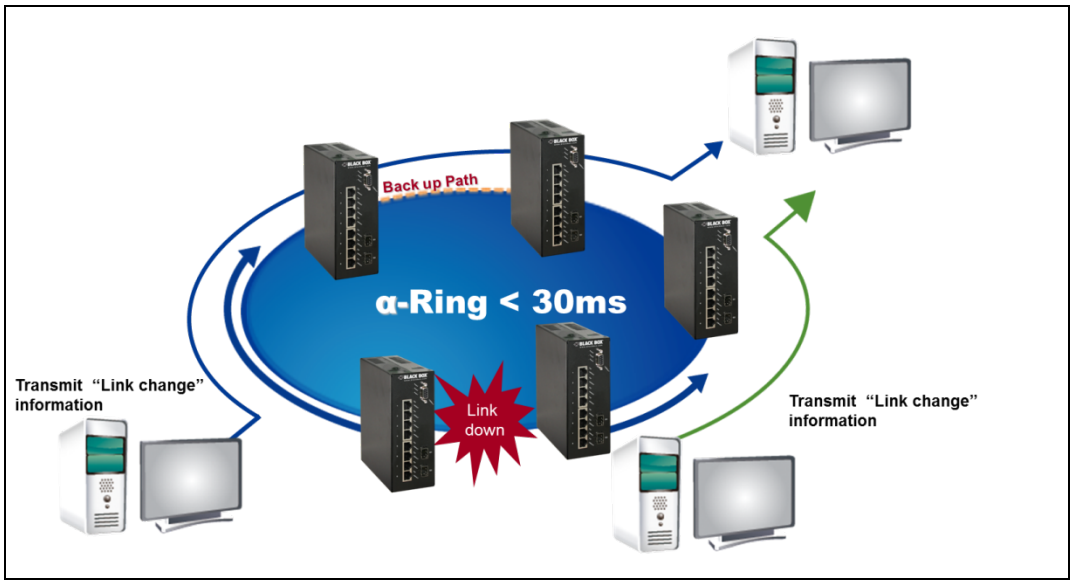


Figure 4

If, however, one of the active links fails, the α-Ring protocol unblocks the backup path to enable data to keep flowing as in Figure 4. Typical failover for α-Ring protocol is less than 30 milliseconds.

High-speed Recovery

Uninterrupted data transmission is the first priority for any business's mission-critical applications. The Black Box LEH family of switches can provide highly reliable α-Ring architecture, creating an advanced failover protocol for such applications. α-Ring creates high-speed network redundancy allowing for greater uptime by recovering from a network disconnection in less than 30 milliseconds. This means that an α-Ring setup can allow your network to recover from a disconnection with little to no data loss in the failover process.

In addition, unlike STP, α-Ring does not operate using any bandwidth-consuming packets to check the ring status. The ring port connections are monitored by each switch individually without the need for test packets to be generated and transmitted around the ring.

Ethernet Ring Protocols

Although Ethernet is usually thought of as having a star or bus topology, it's also possible to build an Ethernet network as a ring. This configuration has the advantage of providing a redundant pathway if a link goes down. A ring topology is often used in applications like traffic signals and surveillance, where long distances may make it difficult to run links in a star formation from a central switch and where downtime must be limited.

Among standardized ring protocols for Ethernet is IEEE 802.17 Resilient Packet Ring (RPR) protocol. RPR is a MAC-based protocol that can operate with Ethernet over either Ethernet PHY or SONET/SDH PHY.

Many switch vendors also offer their own proprietary Ethernet ring protocol to achieve faster convergence times after a link failure. However, these proprietary solutions typically require specialized hardware to operate and may not be compatible with other vendors' products or standardized solutions. In addition, some may consume precious bandwidth in their efforts to detect a failure in the ring.

Generally speaking, ring architectures have these advantages:

1.) They have fast failover times, typically sub-50ms.
2.) They require fewer ports. You need fewer ports to provide the same amount of resiliency as centralized switched networks with redundant paths. This results in decreased initial investment and ongoing maintenance costs.
3.) They are scalable and enable a step-by-step network rollout. More switches can be added to the ring incrementally. The full traffic does not need to traverse a main/distribution switch.
4.) They use bandwidth efficiently; dedicated paths are not rewired.
5.) They simplify traffic forecasting. You don't need to predefine paths between the switches that are connected to the ring.

α-Ring's Flexible and Scalable Network Deployment

In addition to operating independently, α-Ring can work simultaneously with another network running Spanning Tree Protocol. So if you already have an existing STP network, you can add an α-Ring of LEH switches without removing or altering the already existing STP rings. α-Ring seamlessly integrates into current STP networks, as shown in Figure 5.

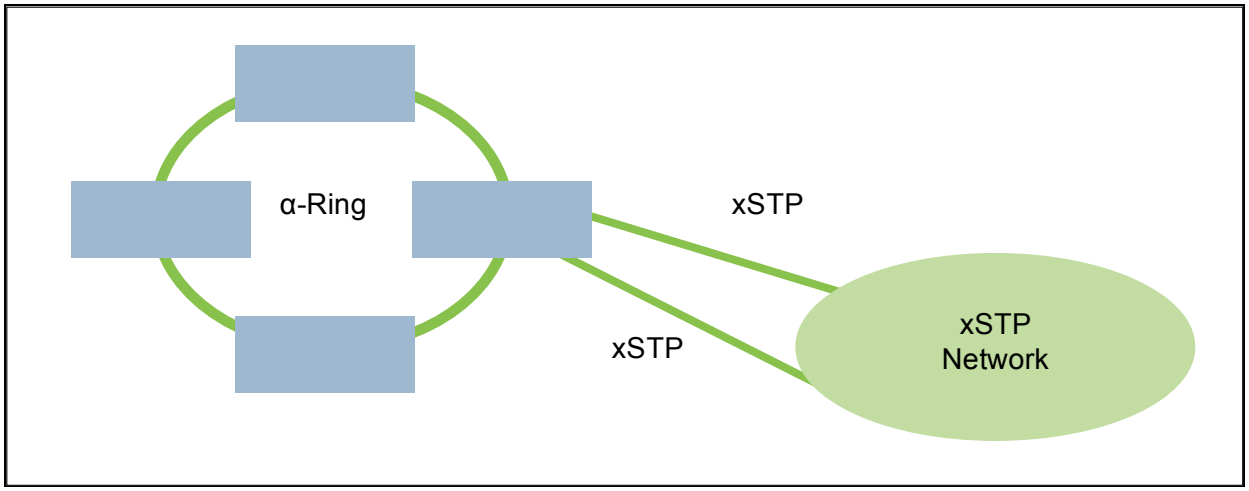


Figure 5: *α-Ring attached to an STP network*

Further, α-Ring also enables two STP networks to be connected together with redundant paths. Therefore, no matter what kind of standard network redundancy mechanism is incorporated in an individual network, α-Ring can enhance network redundancy between the two networks.

α-Ring Versus STP Sample Test Results

Below are results gathered from testing a network of LEH switches set up in an alpha-ring configuration versus one in which Spanning Tree Protocol (STP) was being used (for test configurations, see Figures 7 and 8 below).

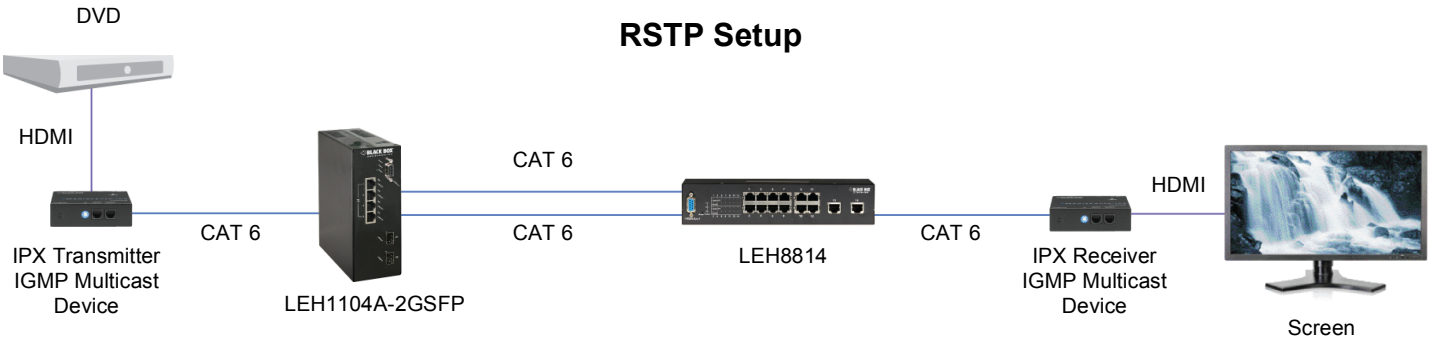


Figure 7: *The test setup for RSTP.*

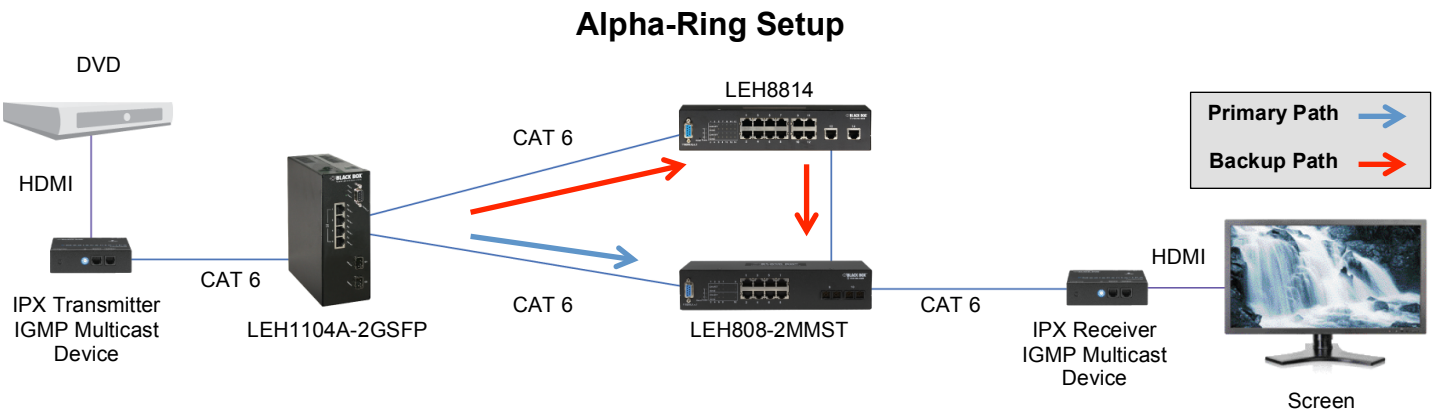


Figure 8: *The test setup for α-Ring.*

Figure 9 shows a baseline measure of each test setup with no failures in connectivity: average data speed was 95 Mbps.

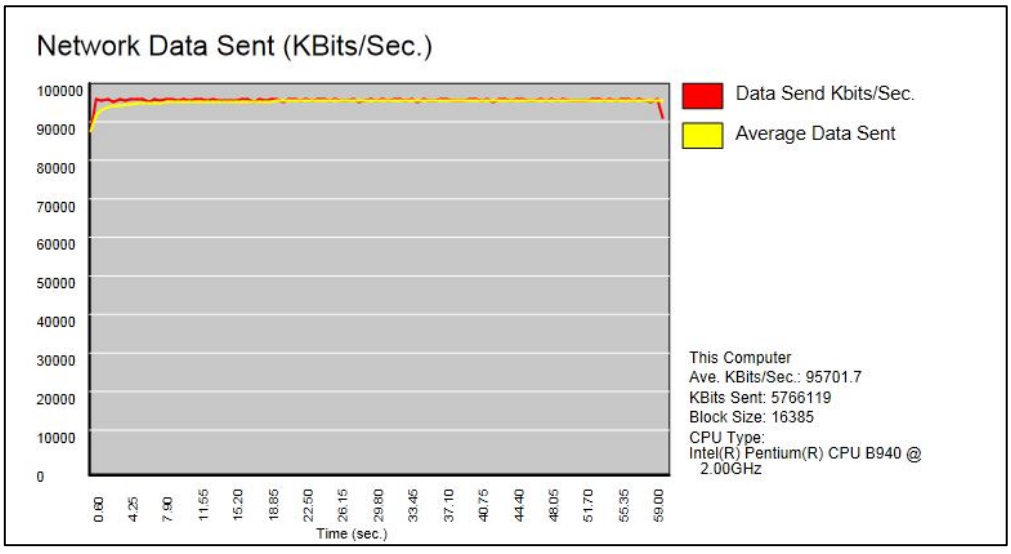
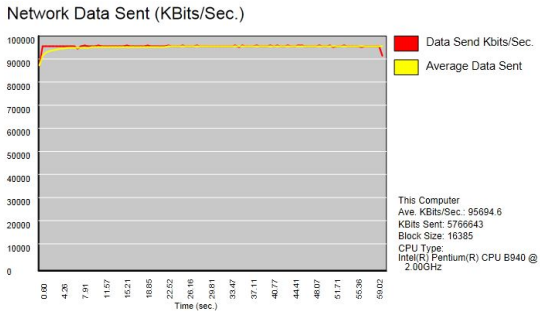
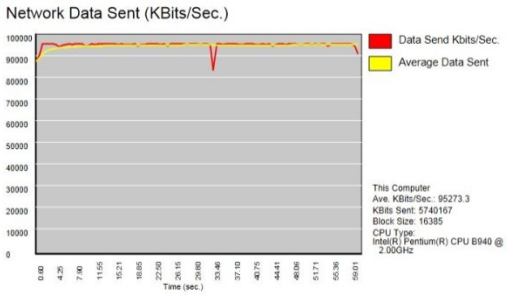


Figure 9: *Baseline test of network of LEH switches.*

Table 1 shows the same network setup configured with alpha-ring and then with STP experiencing a link failure.

Table 1: Summary Table Comparing α-Ring and STP/RSTP.

α-Ring	STP/RSTP
• **Faster Failover (15-30ms)** • **Easier setup (Auto Block /Forward Ports)** • **Auto Path** • **Ring topology** • **Works with STP/RSTP** • **Does not decrease bandwidth** 	• **Cost-based paths (Defined routes)** • **Hierarchy topology** • **Limited to a maximum of 7-hops** 

It's clear from these graphs that when α-Ring is used in the network and a link failure occurs; the network recovers much faster than with STP. Figures 10 and 11 below further illustrate this point.

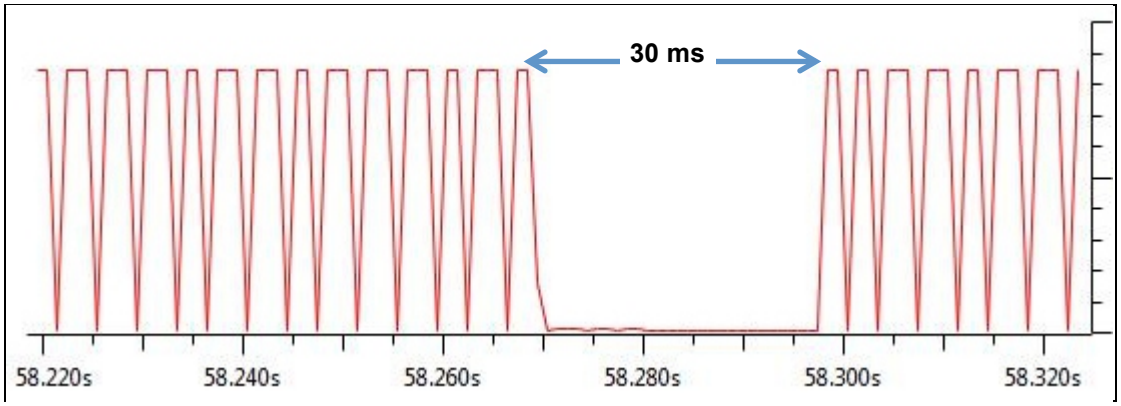


Figure 10: *In this, after a break in the ring, the alpha ring feature reconnects nodes in less than 30 milliseconds.*

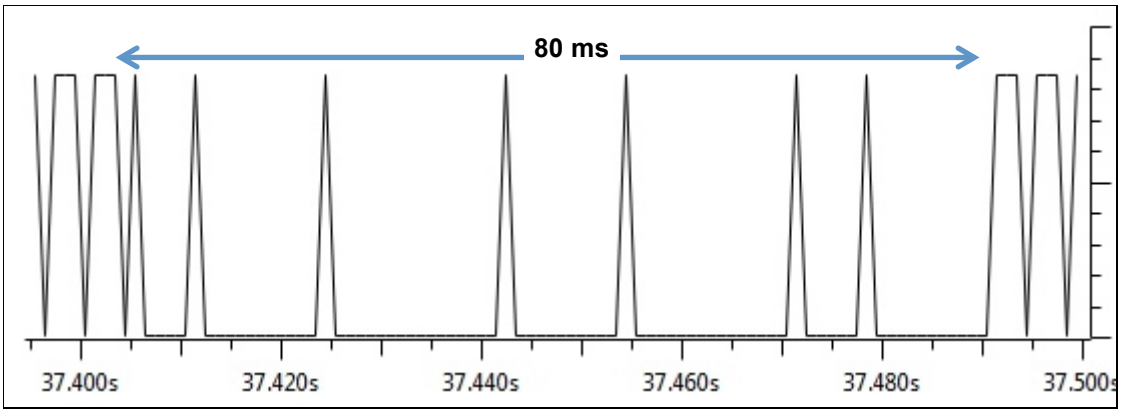


Figure 11: *Using RSTP, the nodes are reconnected in 80 milliseconds.*

About Black Box

Black Box provides an extensive range of networking and infrastructure products. You'll find everything from cabinets and racks and power and surge protection products to media converters and Ethernet switches all supported by free, live 24/7 Tech support available in 60 seconds or less.

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