

# Redundant Recovery X-Ring

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## Network redundancy

Network redundant recovery time is critical when having a failure in the communication link. Longer recovery time may result in serious impact to business. IEEE published two protocols: **Spanning tree protocol (STP) (IEEE 802.1D)** and **Rapid spanning tree protocol (RSTP)(IEEE 802.1w)**.

However, STP and RSTP have recovery time longer than 3 seconds, which is not acceptable in application of industrial automation, transportation automation, video surveillance, and some critical needs. Therefore, in addition to standard features of STP and RSTP, LCSI industrial managed switches also have proprietary X-Ring to optimize the network redundancy with a much faster recovery time less than 20ms.

## Recovery Time

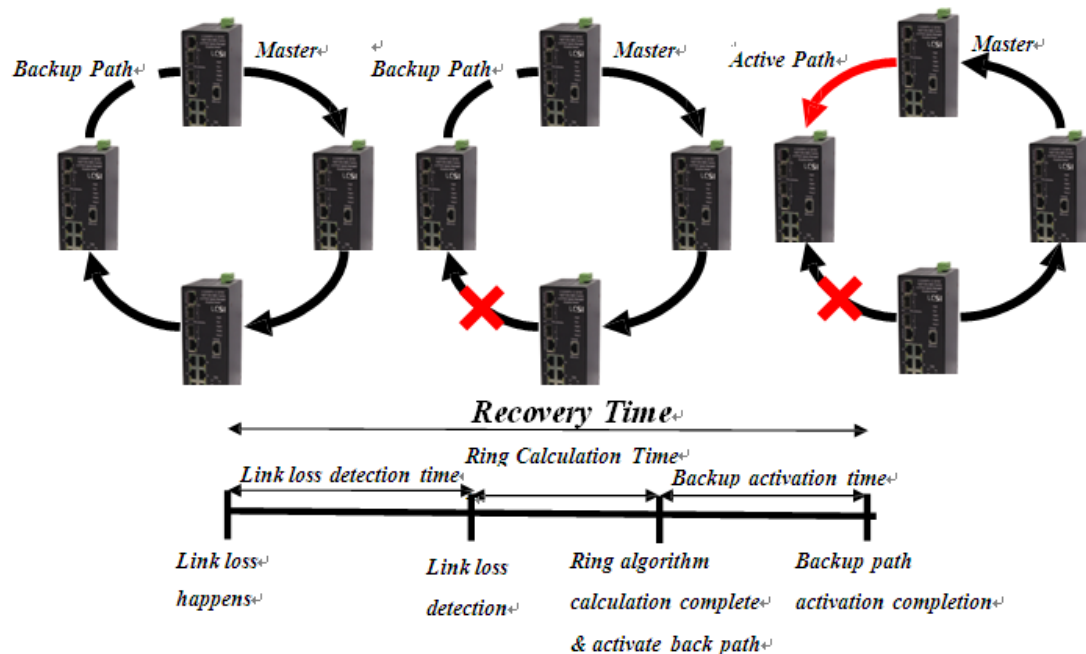
Network recovery time is the time it takes to recover the network after connection failure. The faster the recovery time the better. Generally, Spanning tree protocol (STP) provides network recovery time from 10 to 50 sec, and Rapid spanning tree protocol (RSTP) is from 3 to 5 sec. In some industrial network applications, even a few seconds of downtime could cause a huge loss in revenue of production line. The X-Ring protocol can help the network system recover from network connection failure within 20 ms or less, and make the network system more reliable

**Recovery Time = Link loss detection time + Ring Calculation Time + Backup active time.**

**Link loss detection time:** From link loss to CPU awareness. CPU must know that the link loss event happens while the link fault happens. CPU can know the event from the physical layer notification event. The CPU can also send a detection packet to detect a link loss event.

**Ring calculation time:** From CPU awareness of loss event to ring algorithm calculation completion. A different ring algorithm will take different time to calculate new topology; the more nodes in the ring, the more time needed.

**Backup active time:** From ring algorithm calculation completion to new topology establishment completion. After the CPU calculates ring topology, new topology needs to be established. It takes more time with complex topology.

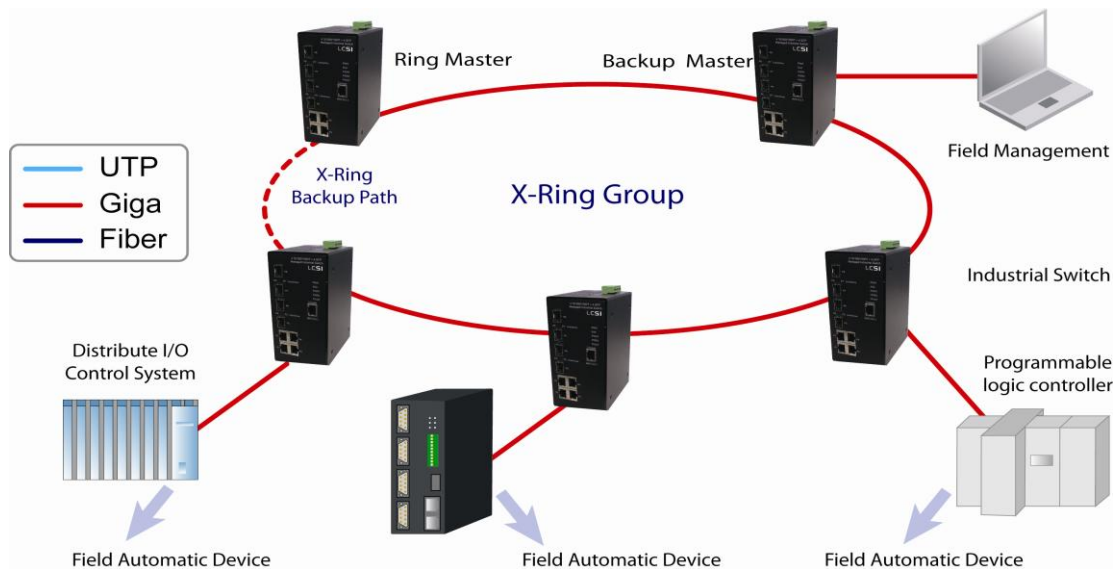


# X-Ring Application Diagrams

The following diagrams are samples of several X-Ring applications from simple single ring to complex coupling ring or dual homing

## 1. Basic X-Ring Diagram

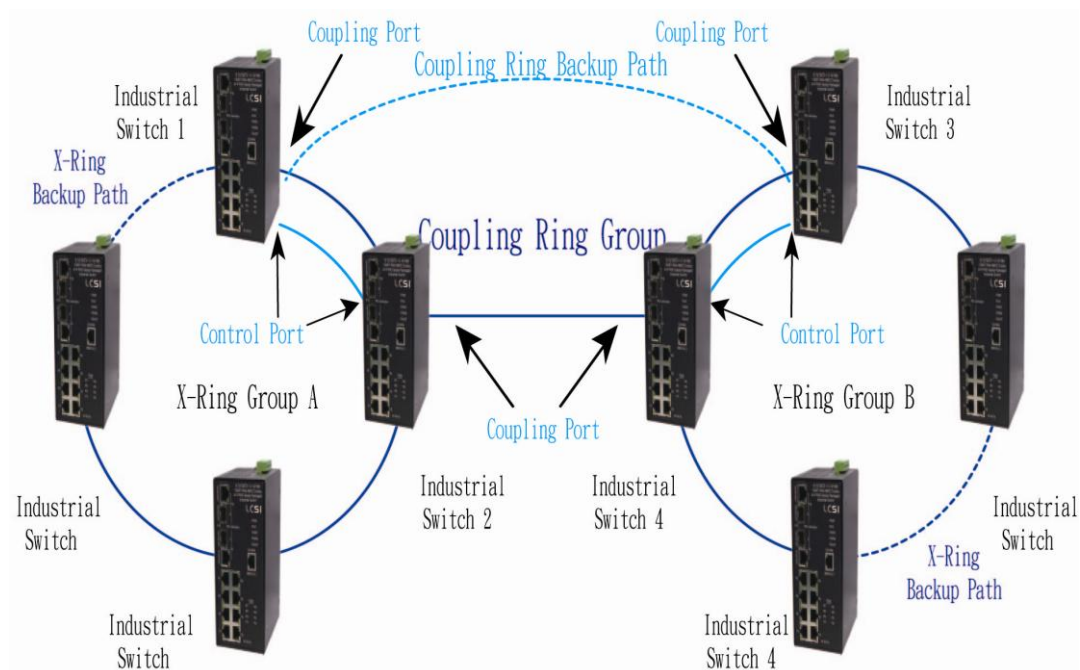
It is only allowed to have one Ring Master existing and several backup masters in an X-Ring Topology. If any other switch enables Ring Master in the same X-Ring Topology, the switch with the lowest MAC address will be the actual Ring Master and the other will be Backup Master.



## 2. Couple Ring Diagram

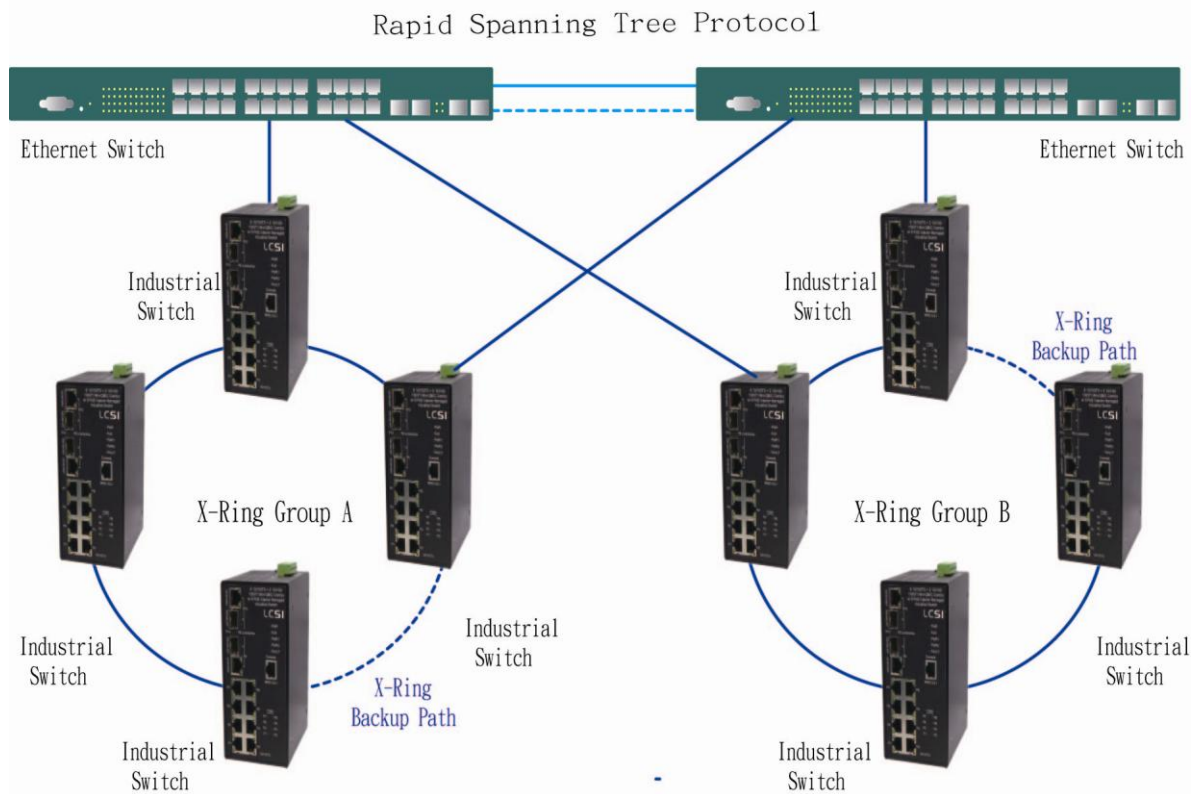
In a network, it may have more than one X-Ring group. By using **couple** ring, it can ensure the communication between two rings have very high resilient capability. To enable the Coupling Ring function, select two Switches( A, B ) in the X-Ring Group at left-hand side and another two in the X-Ring Group at right-hand side. Then assign the appropriate Coupling ports in each switch and link two groups together. Next, by assigning control ports, the four switches to form the Coupling Ring Group and software will automatically select the switch with lowest MAC address number as the Coupling master switch. The Coupling master switch has

the rights to negotiate and command to other switches in Coupling Ring.



### 3. Dual Homing diagram

Dual Homing function is the redundant mechanism between X-Ring group and upper level/core switch. Dual Homing application provides an advanced redundancy network solution by connecting switches running in different redundant protocols (e.g. RSTP and X-Ring). System administrator should assign two ports to be the Dual Homing backup port. The following figure is a sample of Dual Homing application.



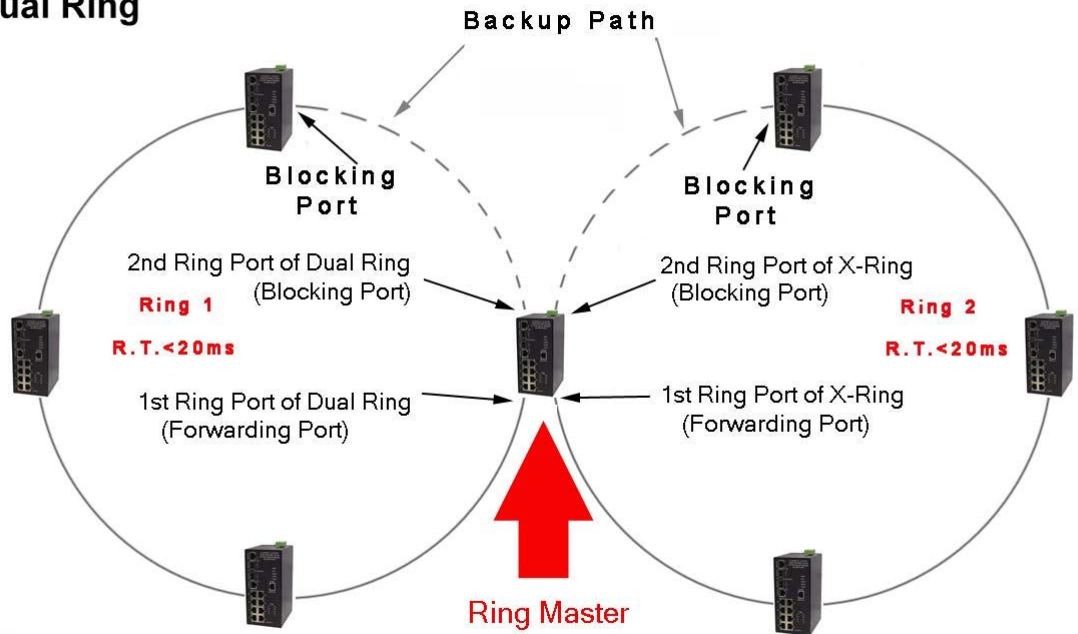
In Dual Homing application architecture, the upper level switches need to enable the Rapid Spanning Tree protocol. Dual Homing recovery time is dependent on the upper level switches' configuration and performance.

## Dual Ring Application

Dual ring is an advanced function that supports backup connection to ensure redundant transmission. If the connection fails, the system will recover from within 20 milliseconds. Apart from that, Dual Ring only needs one unit (and only the one located in the middle) to be configured as the Ring Master switch to deploy the dual ring.

Dual Ring

## Dual Ring



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