

White Paper



An ISL Primer

Solutions for Mixed Token Ring and Ethernet Networks and Servers



*An ISL Primer: Solutions for Mixed Token Ring and Ethernet Networks and Servers
White Paper*

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Foreword

This white paper introduces the reader to the concepts of Cisco System's *Inter-Switch Link* (ISL) and *Token Ring over Inter-Switch Link* (TRISL). It also addresses the need for extending ISL and TRISL down to the server using ZNYX Corporation's new NetBlaster ZX361-ISL Ethernet/Token Ring adapter. The white paper compares this ISL/TRISL solution to both High Speed Token Ring and a massive upgrade to Fast Ethernet.

One of the strongest features of Cisco's® Catalyst® family of network switches is its incredible flexibility in client/server connectivity. When properly configured, these switches can provide connectivity to ATM, FDDI, Ethernet, Fast Ethernet, Gigabit Ethernet, and Token Ring client workstations and servers. But until recently, this same flexibility also emphasized some important limitations of existing networking architecture.

THE NEED FOR INTER-SWITCH LINK

Due to rapid growth, mergers, restructuring, or the desire to take advantage of the latest technologies, network managers often are faced with the requirement to support two different LAN protocols within the same establishment. For example, after a merger or acquisition of another company, it is common to find one group with an Ethernet-based intranet and another with Token Ring. Combining the two networks into a single new corporate intranet or electing to gradually migrate the existing Token Ring clients to Ethernet-based switched networks poses several significant challenges for the network manager. Three of the most fundamental needs are:

- A common backbone to interconnect clients attached to either type of LAN.
- Server access via this backbone to clients attached to either LAN type.
- Faster server access and backbones for Token Ring clients.

Surprisingly, there is a simple solution. Inter-Switch Link (ISL), developed by Cisco Systems Inc., addresses these problems by carrying both the Ethernet and the Token Ring traffic within a new packet frame, and passing the traffic over a Cisco Fast Ethernet or Fast EtherChannel trunk.

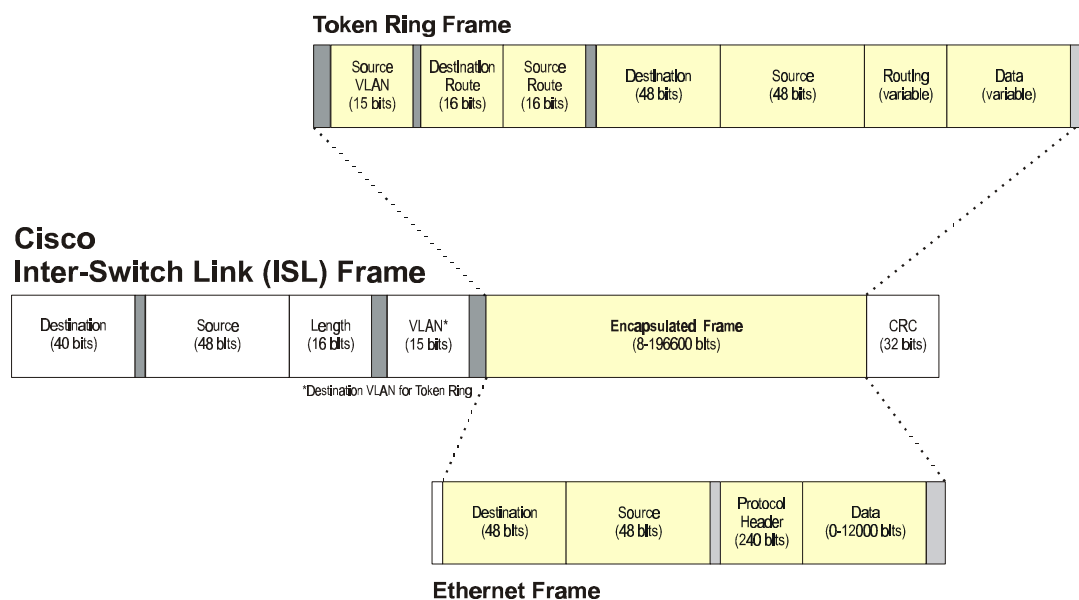


Figure 1: Constructing a Cisco Inter-Switch Link (ISL) Frame

Rather than pass just Ethernet or Token Ring frames between switches, ISL encapsulates the data into a new ISL frame. This has several benefits.

- √ It uses just one cable (a common Category 5 Fast Ethernet UTP) to interconnect the switches. There's no new wiring, and no separate cable required for each network topology!
- √ It's fast. While the Token Ring client or server is accessing the switch at its native 4 or 16 Megabits per second (Mbps), the Inter-Switch Link is capable of routing this, and other, traffic to another switch at ISL speeds of 100 Mbps or more. This high-speed link avoids the saturation normally associated with Token Ring inter-switch trunks.
- √ ISL supports Virtual LANs (VLANs), so regardless of whether the traffic is Ethernet or Token Ring, the ISL packets will be routed among the switches to the correct VLAN, bridge, subnet, client, or whatever. No routers or translational bridges are needed.
- √ Not only does ISL simultaneously transport both Ethernet and Token Ring, it does so regardless of the original frame size. Token Ring frames up to 18 Kilobytes in size are easily carried over ISL frames. And because the original Ethernet and Token Ring frames remain intact inside an ISL frame (they're only encapsulated and tagged) there is no chance for corruption or loss of information.
- √ The greatest benefit of ISL is that it does not require any significant changes to the network. Just add an ISL module to your Cisco Token Ring switch, or use the existing ISL-capable Fast EtherChannel or Fast Ethernet module already installed in your Catalyst switch, and you can join two dissimilar networks into one heterogeneous network.

PUTTING IT TOGETHER

Shown below is a typical example of how to implement Inter-Switch Link on a local area network of mixed Token Ring (the cables with a ring) and Fast Ethernet (the straight cables) topologies. By using ISL ports in the Catalyst 5505 and Catalyst 5000 switches, the Token Ring client on the right is now able to communicate with the Token Ring server on the left over one ISL link (the striped cable).

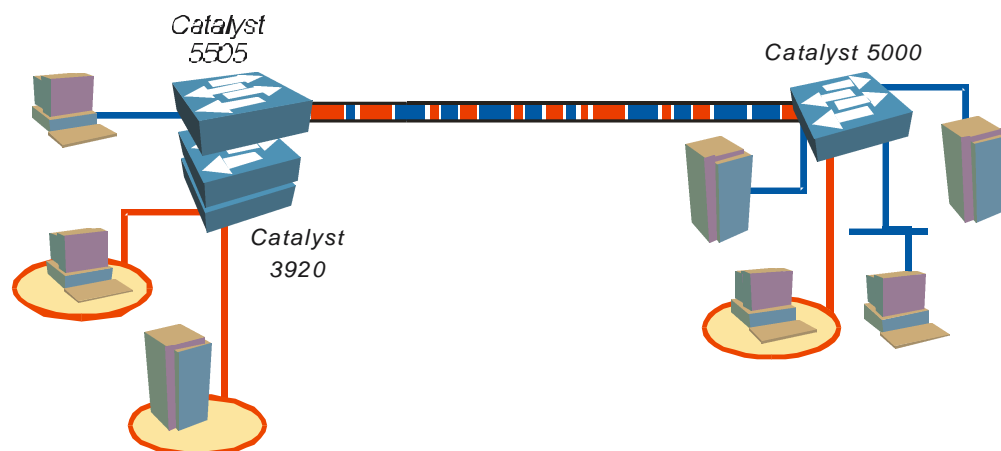


Figure 2: Using ISL to create a link between switches

Similarly, all the Fast Ethernet clients and servers (the straight cables) are able to communicate with one another because their traffic can pass over the same Inter-Switch link between the 5505 and 5000 switches.

As seen in Table 1 below, Cisco employs ISL by offering several different modules for their Catalyst family of switches. Note that any port of these Fast EtherChannel or Fast Ethernet modules can be reconfigured to support ISL.

Cisco ISL Switch Solutions	Cisco Token Ring ISL (TRISL) Switch Solutions
<i>Catalyst 5000 Series Switches with one of the following modules:</i>	<i>Catalyst 3900 Token Ring Switch with the following module:</i>
· WS-X5509 Catalyst 5500/5000 Series Supervisor Engine II TX and MII	· WS-C3900-2ISL expansion module
· WS-U5531-FETX Dual port 100BaseTX Up-link module for Supervisor III	
· WS-X5213A Catalyst 5000 Fast Ethernet switching module (10/100BaseTX, 12 interfaces)	
· WS-X5225R Catalyst 5000 24-port 10/100BaseTX Backbone Fast EtherChannel Switching Module (802.1Q/ISL, RJ-45)	
· WS-X5203 Catalyst 5000 Fast EtherChannel switching module (10/100BaseTX, 12 interfaces)	

Table 1: Cisco ISL Switch Solutions

WHAT ABOUT THE SERVER?

While Token Ring over ISL (TRISL) solves the problem of trunking different protocols between Cisco switches, it still does not address the issue of enabling a server to support both Token Ring and Ethernet clients at the same time. ZNYX, as a Cisco Enterprise Associate member, came up with the solution: a TRISL network adapter.

THE ULTIMATE SOLUTION

ZNYX's NetBlaster ZX361-ISL is a VLAN network adapter that adds a unique capability to network servers with a PCI bus. If a server is running the ZX361-ISL adapter, it can now be accessed simultaneously by both the Token Ring and the Ethernet/Fast Ethernet clients.

Because the ZX361-ISL adapter supports Cisco's Fast EtherChannel, Token Ring packets travel over a 100 Mbps to 400 Mbps (200 Mbps to 800 Mbps full duplex) bandwidth link to, and from, the server. This completely eliminates the bottleneck normally associated with 16Mbps Token Ring server connections.



Figure 3: The ZNYX NetBlaster ZX361-ISL

when combined with ZNYX's RAINlink, provides truly enterprise level support to the server.

ALL THIS AND ENTERPRISE LEVEL, TOO

The ZX361-ISL adapter offers more than just TRISL support. By employing ZNYX's revolutionary RAIN™ (Redundant Array of Independent Netports) technology, up to four ZX361-ISL adapters can be installed in a single server. These four adapters are then connected to a Fast EtherChannel module to provide an aggregate bandwidth trunk of up to 800 Mbps in full duplex mode. In addition to trunking, RAIN provides load balancing among these ports, and fast failover of under 500 milliseconds. Whenever an active network adapter, hub, switch, router, port, or cable fails, RAIN technology detects the failure, shuts down the affected link, and transfers traffic to a standby or other link. With all these features, the ZX361-ISL adapter provides a simple, more powerful method of serving multiple protocol clients while requiring virtually no change to the network. Figure 6 shows a typical installation of four ZX361-ISL adapters in one server.

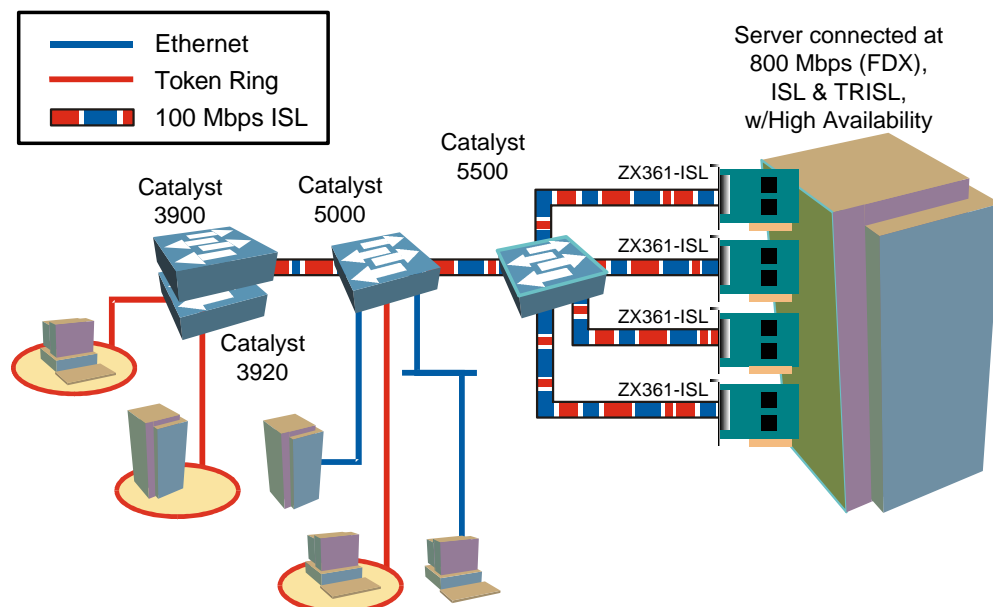


Figure 6: RAINlink allows up to four ZX361-ISL adapters to be installed in a single server. Both Ethernet and Token Ring clients benefit from an 800 Mbps Full Duplex server link with Link Aggregation, Fast Failover/Failback, and Load Balancing. A Fast EtherChannel module should be used for connecting the four ZX361-ISL adapters to the switch.

ISL ON WORKSTATIONS?

The ZX361-ISL adapter works equally well on both servers and Windows NT Workstations. Workstations that need access to both Token Ring and Ethernet servers can simply install the ZX361-ISL adapter and connect it to an ISL, Fast Ethernet, or Fast EtherChannel port in the Catalyst switch. Without the need for any routers or translational bridges, the workstation will now have full access to both protocols and any VLAN.

WHAT ABOUT HSTR, OTHER ISL ADAPTERS, OR FAST ETHERNET?

Operating over a 100 Mbps to 400 Mbps link, the ZX361-ISL adapter is a superior method of upgrading Token Ring network performance when compared to alternatives.

HSTR. High Speed Token Ring, or HSTR, has the disadvantages of cost and implementation. Virtually all Cisco customers with a mixture of Token Ring and Ethernet clients already have a switch with an ISL, Fast EtherChannel, or Fast Ethernet module that can be used for connection of the ZX361-ISL adapter.

On the other hand, HSTR requires the client purchase not only the \$204-\$350 HSTR adapter, but also a new HSTR module for their Token Ring switch. Such modules currently cost anywhere from \$940 for two ports to \$3600 for four ports. Add to that the \$556 cost of Enterprise Level software such as IP Metrics' NIC Express TR software for NT, and the cost per port for HSTR jumps to \$1230!

Features	ZNYX NetBlaster ZX361-ISL	Intel PRO/100 P1A8480	High Speed Token Ring Solutions
Cisco ISL/TRISL VLANs	Yes	ISL only	---
Cisco Fast EtherChannel	Yes	Yes	---
Simultaneous ISL + FEC	Yes	---	---
100 Mbps Ethernet	Yes	Yes	---
100 Mbps Token Ring	Yes	---	Yes
Simultaneous Ethernet + TR	Yes	---	---
Link Aggregation	800 Mbps*	Without ISL	---
Active Redundancy	Yes	Without ISL	---
Fast Failover	Yes	Varies	---
RJ-45 Connector	Yes	Yes	Yes
MII Connector	Yes	Yes	---
Use Existing Switch Ports	Yes	Yes	---

* with four adapters

But the biggest argument against choosing HSTR is that it still leaves the customer with absolutely no integration between the Fast Ethernet traffic and the Token Ring traffic. With HSTR, separate server adapters and trunks must still be used for each protocol and VLAN. An expensive router or translational bridge must also be purchased.

Other ISL Adapters. The only other adapter that offers ISL support of any kind is the Intel PRO/100 Intelligent Server Adapter. This adapter has two major drawbacks that eliminate it from use in a mixed protocol network environment.

- The Intel adapter does not support Token Ring over ISL; it only supports Ethernet or Ethernet packets encapsulated within ISL.
- The adapter does not support simultaneous ISL and Fast EtherChannel on Windows NT Servers. This means that if you desire to perform link aggregation or load balancing with multiple server adapters, you cannot serve any clients on a different VLAN over ISL.

Fast Ethernet. The most common questions about high-speed solutions for Token Ring clients address the issue of migrating Token Ring customers to Fast Ethernet. Many corporations (especially financial and government) will argue that they want to keep the existing clients on Token Ring because "it works, it's very reliable, and the client's side of the network is fast enough." A "forklift upgrade" for every client workstation to Fast Ethernet is too expensive, plus it would have a major impact upon operations both during the changeover and for some time thereafter. Further complicating the issue, in some cases even workstation and server software must be changed when switching protocols. Nevertheless, as new clients are added, or the existing Token Ring workstations are slowly upgraded with newer workstations, the fact that the computers usually come with built-in Fast Ethernet adapters makes the desire to switch very compelling. This highlights the two

most important issues of transitioning to Fast Ethernet:

- √ How do you quickly and efficiently switch a client from one protocol to another without affecting other parts of the network?
- √ How do you keep the two dissimilar networks talking to one another?

Installing the ZX361-ISL adapter in the server provides an ideal solution to these issues. When the client workstation is upgraded from Token Ring to Fast Ethernet, simply unplug the network cable from the Token Ring port on the switch and plug it into a Fast Ethernet port on the same switch or another switch. The distinct advantage of ISL is that all the Inter-Switch trunks and ISL trunks to the server are untouched, and unaffected. The same data travels over the same high-speed links through the same server NIC to the same server; just the VLANs are different. No new trunks or server NICs are required. This greatly reduces the work required by the network administrators and physical plant personnel, and keeps the networks and workgroups operating with no visible change or functional loss to the clients.

With the ZX361-ISL adapter, the overall upgrade cost is lower, “forklift” upgrades are avoided, and the existing, proven, technology and wiring are still used. Finally, the ZX361-ISL adapter adds all three Enterprise Level features, and still provides simultaneous access for the Ethernet/Fast Ethernet clients and Token Ring clients.

By extending Inter-Switch Link and Token Ring Inter-Switch Link down to both the server and the client, the ZX361-ISL adapter provides an excellent and unbeatable solution for mixed topology networks.

Glossary of Terms

ATM

Asynchronous Transfer Mode. International standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays.

Backbone

Part of a network that acts as the primary path for traffic that is most often sourced from, and destined for, other networks. Backbones are usually high speed links between network switches and/or routers.

Bridge

Device that connects and passes packets between two network segments that use the same communications protocol. Bridges operate at the data link layer (Layer 2) of the OSI reference model. In general, a bridge will filter, forward, or flood an incoming frame based on the MAC address of that frame.

Catalyst

Cisco System's family of high-performance switches. Many are stackable or modular and can handle multiple networking protocols and speeds through additional modules.

Category 5

One of five grades of UTP cabling described in the EIA/TIA-586 standard. Category 5 cabling can transmit data at speeds up to 100 Mbps.

Cisco

Cisco Systems. The world's largest provider of routers and networking switches.

Client

Node or software program (front-end device) that requests services from a server. Usually referred to as a computer or workstation.

Encapsulation

Wrapping of data inside a particular protocol header. For example, Ethernet data is wrapped in a specific Ethernet header before network transit. Also, when bridging dissimilar networks, the entire frame from one network is simply placed in the header used by the data link layer protocol of the other network. Tunneling is an architecture that is designed to provide the services necessary to implement any standard point-to-point encapsulation scheme.

Fast EtherChannel

Cisco feature used to group together multiple full-duplex 802.3 Fast Ethernet ports to provide fault-tolerant, high-speed links between switches, routers, and servers. ZNYX's ZX361-ISL adapter supports Fast EtherChannel.

Fast Ethernet

Any of a number of 100 Mbps Ethernet specifications. Fast Ethernet offers a speed increase ten times that of the 10BaseT Ethernet specification, while preserving such qualities as frame format, MAC mechanisms, and MTU. Such similarities allow the use of existing 10BaseT applications and network management tools on Fast Ethernet networks. Based on an extension to the IEEE 802.3 specification.

Fast Failover

A ZNYX RAIN feature. When using multiple NICs in the same server for link aggregation, RAIN will automatically detect when a network NIC or switch port is not working. Within 500 milliseconds, RAIN will route all traffic to the other operational ports. Upon resumption of service, RAIN will restore traffic to the disabled port.

FDDI

Fiber Distributed Data Interface. LAN standard, defined by ANSI X3T9.5, specifying a 100-Mbps token-passing network using fiber-optic cable, with transmission distances of up to 2 km. FDDI uses a dual-ring architecture to provide redundancy.

Frame

Logical grouping of information sent as a data link layer unit over a transmission medium. Often refers to the header and trailer, used for synchronization and error control, which surround the user data contained in the unit.

Gigabit Ethernet

IEEE 802.3z standard for 1000 Mbps communications over single-mode optical fiber (100Base-Lx) or multi-mode fiber (100Base-Sx). ZNYX is a member of the Gigabit Ethernet Alliance.

High-Speed Token Ring

See *HSTR*.

HSTR

100 Mbps Token Ring.

Inter-Switch Link

Cisco-proprietary protocol that maintains VLAN information as traffic flows between switches and routers.

Intranet

Networking usually contained within corporate boundaries and not extending beyond a firewall.

ISL

See *Inter-Switch Link*

LAN

Local-area network. High-speed, low-error data network covering a relatively small geographic area (up to a few thousand meters). LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area. LAN standards specify cabling and signaling at the physical and data link layers of the OSI model. Ethernet, FDDI, and Token Ring are widely used LAN technologies.

Link Aggregation

A ZNYX RAIN feature. When using multiple NICs, RAIN allows the manager to configure two or more ports into one trunk. This increases the data bandwidth up to fourfold or 800 Mbps full duplex with Fast Ethernet.

Load Balancing

A ZNYX RAIN feature. When using multiple NICs with link aggregation, RAIN will auto-

matically balance the traffic between each port by dynamically assigning each user to a different port.

Module

Plug-in devices that are installed into a Cisco Catalyst switch. Modules can provide ISL, Fast EtherChannel, Gigabit speeds, Token Ring, ATM, FDDI, supervision, and many other advanced features.

Network Adapter

A device used to connect PC servers and clients to a local area network. Also called a NIC.

NIC

Network interface card. See *Network Adapter*.

Packets

Logical grouping of information that includes a header containing control information and (usually) user data. Packets are most often used to refer to network layer units of data. The terms datagram, frame, message, and segment are also used to describe logical information groupings at various layers of the OSI reference model and in various technology circles.

Protocol

Formal description of a set of rules and conventions that govern how devices on a network exchange information.

RAIN

Redundant Array of Independent Netports. ZNYX's intranet connectivity enterprise-level technology, which provides improved network performance and reliability. RAIN, when used with multiple ZX361-ISL adapters, provides port aggregation (trunking), load balancing, and fast failover.

Router

Network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information. Occasionally called a gateway (although this definition of gateway is becoming increasingly outdated).

Saturation

When a network link suffers degraded performance due to too many user or server requests.

Server

Node or software program that provides services to clients. Usually, this is a computer designed to provide file, database, application, or web services to multiple clients over a network.

Tag

Information placed at the beginning of a packet frame to identify or route encapsulated traffic.

Token Ring

Token-passing LAN developed and supported by IBM. Token Ring runs at 4 or 16 Mbps over a ring topology. Similar to IEEE 802.5.

Translational Bridge

Bridging between networks with dissimilar MAC sublayer protocols. MAC information is translated into the format of the destination network at the bridge.

TRISL

Token Ring over Inter-Switch Link. Cisco's means of encapsulating Token Ring within ISL frames.

Trunk

Physical and logical connection between two switches across which network traffic travels. A backbone is composed of a number of trunks.

UTP

Unshielded twisted-pair. Four-pair wire medium used in a variety of networks. UTP does not require the fixed spacing between connections that is necessary with coaxial-type connections. There are five types of UTP cabling commonly used: Category 1 cabling, Category 2 cabling, Category 3 cabling, Category 4 cabling, and Category 5 cabling. Compare with STP.

Virtual LAN

VLAN. Group of devices on one or more LANs that are configured (using management software) so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. Because VLANs are based on logical instead of physical connections, they are extremely flexible.

Workstation

A client usually designated to perform intensive tasks. Usually employs a higher performance computer and operating system than the typical administrative client.

ZNYX

ZNYX Corporation, creators of the NetBlaster ZX361-ISL adapter. For more information on ZNYX, visit www.znyx.com.

ZX361-ISL

A multi-protocol, Fast Ethernet/Token Ring over ISL adapter from ZNYX.

ZNYX