Cisco − Inter−Switch Link Frame Format

Table of Contents

InterSwitch Link Frame Format

Introduction

This document provides the basic information about the InterSwitch Link (ISL) encapsulation and gives a summary of the ISL encapsulation frame fields. For information on configuring ISL encapsulation on Cisco switches, refer to the following:

- ISL/802.1q trunking configuration examples

ISL is a Cisco proprietary protocol for interconnecting multiple switches and maintaining VLAN information as traffic goes between switches. ISL provides VLAN capabilities while maintaining full wire speed performance on Ethernet links in full−duplex or half−duplex mode. ISL operates in a point−to−point environment and will support up to 1000 VLANs.

ISL and 802.1q are two types of encapsulations used to carry VLAN information over a trunk link. In ISL, the original packet is encapsulated and an additional header is added before the frame is carried over a trunk link. At the receiving end, the header is removed and the packet is forwarded to the assigned VLAN. In 802.1q, the trunking device inserts a four−byte tag into the original packet and recomputes the Frame Check Sequence (FCS) before sending the frame over the trunk link. At the receiving end, the tag is removed and the packet is forwarded to the assigned VLAN. For more information about the 802.1q mechanism, refer to the following document:

- Basic Characteristics of 802.1q Trunking

ISL Frame

The ISL frame consists of three primary fields: the encapsulation frame (original packet), which is encapsulated by the the ISL header, and the FCS at the end.

ISL Header	ENCAPSULATION FRAME	FCS

The ISL header is further expanded as shown in the following example. This expansion includes the field acronyms and the number of bits for each field.

#of bits	40	4	4	48	16	24	24	15	1	16	16	8 to 196600 bits(1 to 24575 bytes)	32
Frame field	DA	TYPE	USER	SA	LEN	AAAA03	HSA	VLAN	BPDU	INDEX	RES	ENCAP FRAME	FCS

Field Descriptions

The following section provides detailed descriptions of the ISL frame fields.

DA − Destination Address

The DA field of the ISL packet is a 40−bit destination address. This address is a multicast address and is set at "0x01−00−0C−00−00" or "0x03−00−0c−00−00." The first 40 bits of the DA field signal the receiver that the packet is in ISL format.

TYPE − Frame Type

The TYPE field consists of a four−bit code. The TYPE field indicates the type of frame that is encapsulated and could be used in the future to indicate alternative encapsulations. The following are definitions of different TYPE codes:

TYPE Code	Meaning
0000	Ethernet
0001	Token−Ring
0010	FDDI
0011	ATM

USER − User Defined Bits (TYPE Extension)

The USER field consists of a four−bit code. The USER bits are used to extend the meaning of the TYPE field. The default USER field value is "0000." For Ethernet frames, the USER field bits "0" and "1" indicate the priority of the packet as it passes through the switch. Whenever traffic can be handled in a manner that allows it to be forwarded more quickly, those packets with this bit set should take advantage of the quick path. It is not required that such paths be provided.

USER Code	Meaning
XX00	Normal Priority
XX01	Priority 1
XX10	Priority 2
XX11	Highest Priority

SA − Source Address

The SA field is the source address field of the ISL packet. It should be set to the "802.3" MAC address of the switch port transmitting the frame. It is a 48−bit value. The receiving device may ignore the SA field of the frame.

LEN − Length

The LEN field stores the actual packet size of the original packet as a 16−bit value. The LEN field represents the length of the packet in bytes excluding the DA, TYPE, USER, SA, LEN, and FCS fields. The total length of the excluded fields is 18 bytes, so the LEN field represents the total length minus 18 bytes.

AAAA03 − Subnetwork Access Protocol (SNAP) and Logical Link Control (LLC)

The AAAA03 field is an 18−bit constant value of "0xAAAA03."

HSA − High Bits of Source Address

The HSA field is a 24−bit value. This field represents the upper three bytes (the manufactures ID portion) of the SA field. It must contain the value "0x00−00−0C."

VLAN − Destination Virtual LAN ID

The VLAN field is the Virtual LAN ID of the packet. It is a 15−bit value that is used to distinguish frames on different VLANs. This field is often referred to as the "color" of the packet.

BPDU − Bridge Protocol Data Unit (BPDU) and Cisco Discovery Protocol (CDP) Indicator

The bit in the BPDU field is set for all BPDU packets that are encapsulated by the ISL frame. The BPDUs are used by the spanning tree algorithm to determine information about the topology of the network. This bit is also set for CDP packets that are encapsulated.

INDX − Index

The INDX field indicates the port index of the source of the packet as it exits the switch. It is used for diagnostic purposes only, and may be set to any value by other devices. It is a 16−bit value and is ignored in received packets.

RES − Reserved for Token Ring and Fiber Distributed Data Interface (FDDI)

The RES field is a 16−bit value. This field is used when Token Ring or FDDI packets are encapsulated with an ISL frame. In the case of Token Ring frames, the Access Control (AC) and Frame Control (FC) fields are placed here. In the case of FDDI, the FC field is placed in the Least Significant Byte (LSB) of this field (as in an FC of "0x12" would have a RES field of "0x0012"). For Ethernet packets, the RES field should be set to all zeros.

ENCAP FRAME − Encapsulated Frame

The ENCAP FRAME field is the encapsulated data packet, including its own Cyclic Redundancy Check (CRC) value, completely unmodified. The internal frame must have a CRC value that is valid once the ISL encapsulation fields are removed. The length of this field can be from one to 24575 bytes long to accommodate Ethernet, Token Ring, and FDDI frames. A receiving switch may strip off the ISL encapsulation fields, and use this ENCAP FRAME field as the frame is received (associating the appropriate VLAN and other values with the received frame as indicated for switching purposes).

FCS − Frame Check Sequence

The FCS field consists of four bytes. This sequence contains a 32−bit CRC value, which is created by the sending MAC and is recalculated by the receiving MAC to check for damaged frames. The FCS is generated over the DA, SA, Length/Type, and Data fields. When an ISL header is attached, a new FCS is calculated over the entire ISL packet and added to the end of the frame.

Note: The addition of the new FCS does not alter the original FCS that is contained within the encapsulated frame.

Frame Size

The ISL frame encapsulation is 30 bytes, and the minimum FDDI packet is 17 bytes, therefore the minimum ISL encapsulated packet for FDDI is 47 bytes. The maximum Token Ring packet is 17848 bytes. Therefore, the maximum ISL packet is 17848 plus 39 bytes of ISL header minus 1 byte for the stripped AC field, for a total of 17886 bytes. If only Ethernet packets are encapsulated, the range of ISL frame sizes are from 94 to 1548 bytes.

System Implications

The biggest implication for systems using ISL encapsulation is that the encapsulation is a total of 30 bytes and fragmentation is not required. Therefore, if the encapsulated packet is 1518 bytes long, the ISL packet will be 1548 bytes long for Ethernet. Additionally, if packets other than Ethernet packets are encapsulated, the maximum length can be greatly increased. This length change must be considered when evaluating whether a MAC can support ISL packets.

Another system implication is that ISL packets contain two FCSs. One on the internal encapsulated packet, and another covering the entire ISL packet. If the original data does not contain a valid CRC, two will have to be calculated as the packet is transmitted and the invalid CRC will not be detected until the ISL header is stripped off and the end device checks the encapsulated FCS. This typically is not a problem for switching hardware, but may be difficult for routers and Network Interface Cards (NICs).

Tools Information

For additional resources, refer to Cisco TAC Tools for LAN Technologies.

Related Information

- **ISL/802.1q Configuration Technical Tips**
- **LAN Technologies Technical Tips**
- **LAN Technologies Top Issues**

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