Intermediate System−to−Intermediate System (IS−IS) TLVs

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Introduction

This document explains the IS−IS Type Length Value (TLV) and its use.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

The Function of TLV

IS−IS, originally designed for Open System Interconnection (OSI) routing, uses TLV parameters to carry information in Link State Packets (LSPs). The TLVs make IS−IS extendable. IS−IS can therefore carry different kinds of information in the LSPs. As defined by ISO 10589, IS−IS supports only the Connectionless Network Protocol (CLNP). However, IS−IS was extended for IP routing in RFC 1195 with the registration of TLV 128 which contains a set of 12−octet fields to carry IP information.

In the IS−IS Protocol Data Unit (PDU), there is a fixed and a variable part of the header. The fixed part of the header contains fields that are always present, and the variable part of the header contains the TLV which permits the flexible encoding of parameters within link state records. These fields are identified by one octet of type (T), one octet of length (L) and "L" octets of value (V). The Type field indicates the type of items in

the Value field. The Length field indicates the length of the Value field. The Value field is the data portion of the packet. Not all router implementations support all TLVs, but they are required to ignore and retransmit the ignored types.

As explained by RFC 1195 , TLV 128 extends IS−IS to carry IP, in addition to Connectionless Network Service (CLNS), routing information in the same packet. DEC has also implemented an extension to IS−IS with TLV 42. This extension allows the IS−IS to hold information about DECnet Phase IV networks. In the future, a new TLV may be implemented allowing CLNS to carry IPv6 routing information.

Several routing protocols use TLVs to carry a variety of attributes. Cisco Discovery Protocol (CDP), Label Discovery Protocol (LDP), and Border Gateway Protocol (BGP) are examples of protocols that use TLVs. BGP uses TLVs to carry attributes such as Network Layer Reachability Information (NLRI), Multiple Exit Discriminator (MED), and local preference.

TLV Encoding

The variable length fields are encoded as follows:

Field	Number of Octets
Type	1
Length	1
Value	LENGTH

RFC 1142 Section 9, a revision of ISO 10589, provides detail about the packet layouts for each type of IS−IS PDU, as well as the TLVs supported for each type. The first eight octets of all IS−IS PDUs are header fields that are common to all PDU types. The TLV information is stored at the very end of the PDU. Different types of PDUs have a set of currently−defined codes. Any codes that are not recognized should be ignored and passed through unchanged.

IS−IS PDU and TLV Definitions

Definitions for IS−IS PDU types and valid code values have been established. ISO 10589 defines type codes 1 through 10. RFC 1195 defines type codes 128 through 133.

Note: TLV code 133 (Authentication Information) is specified in RFC 1195 , but Cisco uses the ISO code of 10 instead. Additionally, TLV code 4 is used for partition repair and is not supported by Cisco.

TLVs Implemented by Cisco

Cisco implements most TLVs. However, in some cases, draft or low−demand TLVs are not implemented. Below are the explanations of the popular TLVs implemented by Cisco.

TLV	Name	Description
1	Area Address	Includes the Area Addresses to which the Intermediate System is connected.
2	IIS Neighbors	Includes all the IS−ISs running interfaces to which the router is connected.
8	Padding	Primarily used in the IS−IS Hello (IIH) packets to detect the maximum

		transmission unit (MTU) inconsistencies. By default, IIH packets are padded to the fullest MTU of the interface.
10	Authentication	The information that is used to authenticate the PDU.
22	TE IIS Neighbors	Increases the maximum metric to three bytes (24 bits). Known as the Extended IS Reachability TLV, this TLV addresses a TLV 2 metric limitation. TLV 2 has a maximum metric of 63, but only six out of eight bits are used.
128	IP Int. Reachability	Provides all the known IP addresses that the given router knows about via one or more internally−originated interfaces. This information may appear multiple times.
129	Protocols Supported	Carries the Network Layer Protocol Identifiers (NLPID) for Network Layer protocols that the IS (Intermediate System) is capable. It refers to the Data Protocols that are supported. For example, IPv4 NLPID value 0xCC, CLNS NLPID value 0x81, and/or IPv6 NLPID value 0x8E will be advertised in this NLPID TLV.
130	IP Ext. Address	Provides all the known IP addresses that the given router knows about via one or more externally−originated interfaces. This information may appear multiple times.
132	IP Int. Address	The IP interface address that is used to reach the next−hop address.
134	TE Router ID	This is the Multi−Protocol Label Switching (MPLS) traffic engineering router ID.
135	TE IP Reachability	Provides a 32 bit metric and adds a bit for the "up/down" resulting from the route−leaking of L2−>L1. Known as the Extended IP Reachability TLV, this TLV addresses the issues with both TLV 128 and TLV 130.
137	Dynamic Hostname	Identifies the symbolic name of the router originating the link−state packet (LSP).
10 and 133		TLV 10 should be used for Authentication; not the TLV 133. If TLV 133 is received, it is ignored on receipt, like any other unknown TLVs. TLV 10 should be accepted for authentication

		only.

TLV Details

Name	TLV	IIH	SNP	L1 LSP	L2 LSP	Origin
Area Addresses	1	Yes	No	Yes	Yes	ISO 10589
IIS Neighbors	2	No	No	Yes	Yes	ISO 10589
ES Neighbors	3	No	No	Yes	No	ISO 10589
Part. DIS	4	No	No		Yes	ISO 10589
Prefix Neighbors	5	No	No		Yes	ISO 10589
IIS Neighbors	6	Yes	No		Yes	ISO 10589
Padding	8	Yes	No	No	No	ISO 10589
LSP Entries	9	No	Yes	No	No	ISO 10589
Authentication	10	Yes	Yes	Yes	Yes	ISO 10589
Opt. Checksum	12	Yes	Yes	Yes	Yes	draft-ietf-isis-wg-snp-checksu
LSPBufferSize	14	Yes	No			SIF-DRAFT
TE IIS Neighbors	22	No	No			draft-ietf-isis-traffic-04.txt
HMAC-MD5 Authentic	54					draft-ietf-isis-hmac-03.txt
IP Int. Reach	128	No	No	Yes	Yes	RFC 1195
Prot. Supported	129	Yes	No	Yes	Yes	RFC 1195
IP Ext. Address	130	No	No	Yes	Yes	RFC 1195
IDRPI	131	No	Yes	No	Yes	RFC 1195
IP Intf. Address	132	Yes	No	Yes	Yes	RFC 1195
Authentication	*133	No	No	No	No	RFC 1195 (illegal)
TE-Router ID	134	No	No	Yes	Yes	draft-ietf-isis-traffic-04.txt
TE IP. Reach	135	No	No			draft-ietf-isis-traffic-04.txt
Dynamic Name	137	No	No			RFC 2763
Shared Risk Link Group	138					draft-ietf-isis-gmpls-extensions-12.txt
MT-ISN	222	No	No			draft-ietf-isis-wg-multi-topol
M-Topologies	229	Yes	No			draft-ietf-isis-wg-multi-topol

IPv6 Intf. Addr.	232	Yes	No			draft−ietf−isis−ipv6−02.txt
MT IP. Reach	235	No	No			draft−ietf−isis−wg−multi−topol
3−Way hellos	240	Yes	No			draft−ietf−isis−3way−01.txt
Restart TLV	211	Yes	No	No	No	draft−shand−isis−restart−01.txt
IPv6 Reachability	236	No	No	Yes	Yes	draft−ietf−isis−ipv6−02.txt
MT IPv6 IP Reach	237	No	No	Yes	Yes	draft−ietf−isis−wg−multi−topol
p2p 3−way Adj.	240	Yes	No			draft−ietf−isis−3way−06.txt

Sub−TLVs and Traffic Engineering

Sub−TLVs use the same concepts as TLVs. The difference is that TLVs exist inside IS−IS packets, while sub−TLVs exist inside TLVs. TLVs are used to add extra information to IS−IS packets. Sub−TLVs are used to add extra information to particular TLVs. Each sub−TLV consists of three fields. A one−octet Type field, a one−octet Length field, and zero or more octets of Value. The Type field indicates the type of items in the Value field. The Length field indicates the length of the Value field in octets. Each sub−TLV can potentially hold multiple items. The number of items in a sub−TLV can be computed from the length of the whole sub−TLV, when the length of each item is known. Unknown sub−TLVs are to be ignored and skipped on receipt.

The majority of the Sub−TLVs are defined in draft−ietf−isis−traffic−04.txt and draft−ietf−isis−gmpls−extensions−12.txt.

Additionally, these sub−TLVs are part of Extended IS Reachability TLV 22, with the exception of the sub−TLV 1 which is part of Extended IP Reachability TLV 135. The sub−TLV 1 is defined in draft−martin−neal−policy−isis−admin−tags−01.txt

Below is the brief description of the Sub−TLVs:

Sub−TLV	Name	Description
1	Administration Group	This sub−TLV associates a tag with an IP prefix. Some of the examples of this 'tag' include controlling redistribution between levels and areas, different routing protocols, or on an interface.
3	Administration Group	If the link or interface has been colored (from the traffic engineering point of view), that information is carried by this TLV.
6	IPv4 Interface Address	The interface IP address that is used for the traffic engineering purposes.
8		

	IPv4 Neighbor Address	The neighbor interface IP address that is used for the traffic engineering purposes.
9	Maximum Link Bandwidth	The maximum link bandwidth of the interface in question (for the traffic engineering purposes).
10	Maximum Reservable Link Bandwidth	The maximum amount of bandwidth that can be reserved on the interface in question.
11	Unreserved Bandwidth	The amount of bandwidth which is not yet reserved on the interface.
18	Traffic Engineering Default Metric	The metric that is administratively assigned for the traffic engineering purposes.

Sub−TLV Details

Sub−TLV	TLV	Definitions	Bytes
Administrative Tag	1	ISIS_ROUTE_ADMIN_TAG	
Admin. Group (color)	3	ISIS_ADMIN_GROUP	4
Outgoing Int. Identifier	4		4
Incoming Int. Identifier	5		4
IPv4 Inter. Address	6	ISIS_INTERFACE_IP_ADDRESS	4
Interface MTU	7		2
IPv4 Neigh. Address	8	ISIS_NEIGHBOR_IP_ADDRESS	4
Maximum Link Bandwidth	9	ISIS_MAXIMUM_LINK_BW	4
Max. Reserv. Link Bandwidth	10	ISIS_MAXIMUM_LINK_RES	4
Unreserved Bandwidth	11	ISIS_CURRENT_BW_UNRESERVED	32
TE Default Metric	18	ISIS_TRAFFIC_ENGINEERING_METRIC	3
Link Protection	20		2

Type			
Int. Switch. Capability Desc.	21		variable
MT Reachable IPv4 Prefixes	117		
Max. Link. Reser. Sub Pool	*250	ISIS_MAXIMUM_LINK_RES_SUB	
Current BW UnReser. Sub Pool	*251	ISIS_CURRENT_BW_UNRESERVED_SUB	

* The Sub−TLVs 250 and 251 are part of Cisco−specific extensions in support of MPLS−TE that is documented in draft−ietf−isis−traffic−04.txt. These Sub−TLVs are used during the Guraranteed Bandwidth application under MPLS−TE.

Note: Always refer to the most recent Internet Engineering Task Force (IETF) draft. The IETF draft mentioned in this document is subject to change. It may be replaced by a more recent version or RFC, or it may expire.

Related Information

- **IS−IS Support Page**
- **Technical Support − Cisco Systems**

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