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# **Linux Netlabel Documentation**

***Release 6.8.0***

**The kernel development community**

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## **NETLABEL INTRODUCTION**

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August 2, 2006

### **1.1 Overview**

NetLabel is a mechanism which can be used by kernel security modules to attach security attributes to outgoing network packets generated from user space applications and read security attributes from incoming network packets. It is composed of three main components, the protocol engines, the communication layer, and the kernel security module API.

### **1.2 Protocol Engines**

The protocol engines are responsible for both applying and retrieving the network packet's security attributes. If any translation between the network security attributes and those on the host are required then the protocol engine will handle those tasks as well. Other kernel subsystems should refrain from calling the protocol engines directly, instead they should use the NetLabel kernel security module API described below.

Detailed information about each NetLabel protocol engine can be found in this directory.

### **1.3 Communication Layer**

The communication layer exists to allow NetLabel configuration and monitoring from user space. The NetLabel communication layer uses a message based protocol built on top of the Generic NETLINK transport mechanism. The exact formatting of these NetLabel messages as well as the Generic NETLINK family names can be found in the 'net/netlabel/' directory as comments in the header files as well as in 'include/net/netlabel.h'.

## **1.4 Security Module API**

The purpose of the NetLabel security module API is to provide a protocol independent interface to the underlying NetLabel protocol engines. In addition to protocol independence, the security module API is designed to be completely LSM independent which should allow multiple LSMs to leverage the same code base.

Detailed information about the NetLabel security module API can be found in the '`include/net/netlabel.h`' header file as well as the '*NetLabel Linux Security Module Interface*' file found in this directory.

## **NETLABEL CIPSO/IPV4 PROTOCOL ENGINE**

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May 17, 2006

### **2.1 Overview**

The NetLabel CIPSO/IPv4 protocol engine is based on the IETF Commercial IP Security Option (CIPSO) draft from July 16, 1992. A copy of this draft can be found in this directory (draft-ietf-cipso-ipsecurity-01.txt). While the IETF draft never made it to an RFC standard it has become a de-facto standard for labeled networking and is used in many trusted operating systems.

### **2.2 Outbound Packet Processing**

The CIPSO/IPv4 protocol engine applies the CIPSO IP option to packets by adding the CIPSO label to the socket. This causes all packets leaving the system through the socket to have the CIPSO IP option applied. The socket's CIPSO label can be changed at any point in time, however, it is recommended that it is set upon the socket's creation. The LSM can set the socket's CIPSO label by using the NetLabel security module API; if the NetLabel "domain" is configured to use CIPSO for packet labeling then a CIPSO IP option will be generated and attached to the socket.

### **2.3 Inbound Packet Processing**

The CIPSO/IPv4 protocol engine validates every CIPSO IP option it finds at the IP layer without any special handling required by the LSM. However, in order to decode and translate the CIPSO label on the packet the LSM must use the NetLabel security module API to extract the security attributes of the packet. This is typically done at the socket layer using the 'socket\_sock\_rcv\_skb()' LSM hook.

## 2.4 Label Translation

The CIPSO/IPv4 protocol engine contains a mechanism to translate CIPSO security attributes such as sensitivity level and category to values which are appropriate for the host. These mappings are defined as part of a CIPSO Domain Of Interpretation (DOI) definition and are configured through the NetLabel user space communication layer. Each DOI definition can have a different security attribute mapping table.

## 2.5 Label Translation Cache

The NetLabel system provides a framework for caching security attribute mappings from the network labels to the corresponding LSM identifiers. The CIPSO/IPv4 protocol engine supports this caching mechanism.

## NETLABEL LINUX SECURITY MODULE INTERFACE

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May 17, 2006

### 3.1 Overview

NetLabel is a mechanism which can set and retrieve security attributes from network packets. It is intended to be used by LSM developers who want to make use of a common code base for several different packet labeling protocols. The NetLabel security module API is defined in 'include/net/netlabel.h' but a brief overview is given below.

### 3.2 NetLabel Security Attributes

Since NetLabel supports multiple different packet labeling protocols and LSMs it uses the concept of security attributes to refer to the packet's security labels. The NetLabel security attributes are defined by the 'netlbl\_lsm\_secattr' structure in the NetLabel header file. Internally the NetLabel subsystem converts the security attributes to and from the correct low-level packet label depending on the NetLabel build time and run time configuration. It is up to the LSM developer to translate the NetLabel security attributes into whatever security identifiers are in use for their particular LSM.

### 3.3 NetLabel LSM Protocol Operations

These are the functions which allow the LSM developer to manipulate the labels on outgoing packets as well as read the labels on incoming packets. Functions exist to operate both on sockets as well as the sk\_buffs directly. These high level functions are translated into low level protocol operations based on how the administrator has configured the NetLabel subsystem.

## 3.4 NetLabel Label Mapping Cache Operations

Depending on the exact configuration, translation between the network packet label and the internal LSM security identifier can be time consuming. The NetLabel label mapping cache is a caching mechanism which can be used to sidestep much of this overhead once a mapping has been established. Once the LSM has received a packet, used NetLabel to decode its security attributes, and translated the security attributes into a LSM internal identifier the LSM can use the NetLabel caching functions to associate the LSM internal identifier with the network packet's label. This means that in the future when a incoming packet matches a cached value not only are the internal NetLabel translation mechanisms bypassed but the LSM translation mechanisms are bypassed as well which should result in a significant reduction in overhead.

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**CHAPTER  
FOUR**

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**DRAFT IETF CIPSO IP SECURITY**

IETF CIPSO Working Group  
16 July, 1992

COMMERCIAL IP SECURITY OPTION (CIPSO 2.2)

1. Status

This Internet Draft provides the high level specification for a<sub>u</sub>  
↳Commercial  
IP Security Option (CIPSO). This draft reflects the version as<sub>u</sub>  
↳approved by  
the CIPSO IETF Working Group. Distribution of this memo is unlimited.

This document is an Internet Draft. Internet Drafts are working<sub>u</sub>  
↳documents  
of the Internet Engineering Task Force (IETF), its Areas, and its<sub>u</sub>  
↳Working  
Groups. Note that other groups may also distribute working documents as  
Internet Drafts.

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Internet Drafts may be updated, replaced, or obsoleted by other<sub>u</sub>  
↳documents  
at any time. It is not appropriate to use Internet Drafts as reference  
material or to cite them other than as a "working draft" or "work in  
progress."

Please check the I-D abstract listing contained in each Internet Draft  
directory to learn the current status of this or any other Internet<sub>u</sub>  
↳Draft.

2. Background

Currently the Internet Protocol includes two security options. One of these options is the DoD Basic Security Option (BSO) (Type 130) which allows IP datagrams to be labeled with security classifications. This option provides sixteen security classifications and a variable number of handling restrictions. To handle additional security information, such as security categories or compartments, another security option (Type 133) exists and is referred to as the DoD Extended Security Option (ESO). The values for the fixed fields within these two options are administered by the Defense Information Systems Agency (DISA).

Computer vendors are now building commercial operating systems with mandatory access controls and multi-level security. These systems are no longer built specifically for a particular group in the defense or intelligence communities. They are generally available commercial systems for use in a variety of government and civil sector environments.

The small number of ESO format codes can not support all the possible applications of a commercial security option. The BSO and ESO were designed to only support the United States DoD. CIPSO has been designed to support multiple security policies. This Internet Draft provides the format and procedures required to support a Mandatory Access Control security policy. Support for additional security policies shall be defined in future RFCs.

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### 3. CIPSO Format

Option type: 134 (Class 0, Number 6, Copy on Fragmentation)  
 Option length: Variable

This option permits security related information to be passed between systems within a single Domain of Interpretation (DOI). A DOI is a collection of systems which agree on the meaning of particular values in the security option. An authority that has been assigned a DOI identifier will define a mapping between appropriate CIPSO field values and their human readable equivalent. This authority will distributethat  
mapping to hosts within the authority's domain. These mappings may be sensitive, therefore a DOI authority is not required to make these mappings available to anyone other than the systems that are included  
in  
 the DOI.

This option MUST be copied on fragmentation. This option appears atmost  
 once in a datagram. All multi-octet fields in the option are definedto be  
 transmitted in network byte order. The format of this option is asfollows:

+-----+	+-----+//-----+	+-----+//-----+	+-----+//-----+
10000110   LLLLLLLL   DDDDDDDDDDDD   TTTTTTTTTTTTTTTTT	+-----+//-----+	+-----+//-----+	+-----+//-----+

TYPE=134	OPTION LENGTH	DOMAIN OF INTERPRETATION	TAGS
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Figure 1. CIPSO Format

### 3.1 Type

This field is 1 octet in length. Its value is 134.

### 3.2 Length

This field is 1 octet in length. It is the total length of the option including the type and length fields. With the current IP headerlength  
 restriction of 40 octets the value of this field MUST not exceed 40.

### 3.3 Domain of Interpretation Identifier

This field is an unsigned 32 bit integer. The value 0 is reserved andMUST

not appear as the DOI identifier in any CIPSO option. Implementations should assume that the DOI identifier field is not aligned on any particular byte boundary.

To conserve space in the protocol, security levels and categories are represented by numbers rather than their ASCII equivalent. This requires

a mapping table within CIPSO hosts to map these numbers to their corresponding ASCII representations. Non-related groups of systems may

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have their own unique mappings. For example, one group of systems may use the number 5 to represent Unclassified while another group may use the number 1 to represent that same security level. The DOI identifier is used to identify which mapping was used for the values within the option.

### 3.4 Tag Types

A common format for passing security related information is necessary for interoperability. CIPSO uses sets of "tags" to contain the security

information relevant to the data in the IP packet. Each tag begins with

a tag type identifier followed by the length of the tag and ends with the

actual security information to be passed. All multi-octet fields in a tag

are defined to be transmitted in network byte order. Like the DOI identifier field in the CIPSO header, implementations should assume that

all tags, as well as fields within a tag, are not aligned on any particular

octet boundary. The tag types defined in this document contain alignment

bytes to assist alignment of some information, however alignment can not

be guaranteed if CIPSO is not the first IP option.

CIPSO tag types 0 through 127 are reserved for defining standard tag formats. Their definitions will be published in RFCs. Tag types whose identifiers are greater than 127 are defined by the DOI authority and

→may only be meaningful in certain Domains of Interpretation. For these tag types, implementations will require the DOI identifier as well as the →tag

number to determine the security policy and the format associated with the

tag. Use of tag types above 127 are restricted to closed networks.

↪ where

## interoperability

→ **Implementations**  
that support a tag type greater than 127 MUST support at least one DOI URL.

→ that requires only tag types 1 to 127

Tag type 0 is reserved. Tag types 1, 2, and 5 are defined in this Internet Draft. Types 3 and 4 are reserved for work in progress. The standard format for all current and future CIPSO tags is shown below:

//-----+-----+-----+		
TTTTTTTT	LLLLLLLL	IIIIIIIIIIIIII
TAG	TAG	TAG
TYPE	LENGTH	INFORMATION

Figure 2: Standard Tag Format

In the three tag types described in this document, the length and count restrictions are based on the current IP limitation of 40 octets for all IP options. If the IP header is later expanded, then the length and count restrictions specified in this document may increase to use the full area provided for IP options.

### 3.4.1 Tag Type Classes

Tag classes consist of tag types that have common processing requirements

and support the same security policy. The three tags defined in this Internet Draft belong to the Mandatory Access Control (MAC) Sensitivity

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class and support the MAC Sensitivity security policy.

### 3.4.2 Tag Type 1

This is referred to as the "bit-mapped" tag type. Tag type 1 is ↵  
 ↵ included in the MAC Sensitivity tag type class. The format of this tag type is ↵  
 ↵ as follows:

TAG TYPE	TAG LENGTH	ALIGNMENT OCTET	SENSITIVITY LEVEL	BIT MAP OF CATEGORIES
00000001	LLLLLLLL	00000000	LLLLLLLL	CCCCCCCCCCCCCCCC

Figure 3. Tag Type 1 Format

#### 3.4.2.1 Tag Type

This field is 1 octet in length and has a value of 1.

#### 3.4.2.2 Tag Length

This field is 1 octet in length. It is the total length of the tag ↵  
 ↵ type including the type and length fields. With the current IP header ↵  
 ↵ length restriction of 40 bytes the value within this field is between 4 and ↵  
 ↵ 34.

#### 3.4.2.3 Alignment Octet

This field is 1 octet in length and always has the value of 0. Its ↵  
 ↵ purpose

is to align the category bitmap field on an even octet boundary. This  
 ↪will speed many implementations including router implementations.

#### 3.4.2.4 Sensitivity Level

This field is 1 octet in length. Its value is from 0 to 255. The  
 ↪values are ordered with 0 being the minimum value and 255 representing the  
 ↪maximum value.

#### 3.4.2.5 Bit Map of Categories

The length of this field is variable and ranges from 0 to 30 octets. This  
 provides representation of categories 0 to 239. The ordering of the bits  
 is left to right or MSB to LSB. For example category 0 is represented by  
 the most significant bit of the first byte and category 15 is represented  
 by the least significant bit of the second byte. Figure 4 graphically shows this ordering. Bit N is binary 1 if category N is part of the label for the datagram, and bit N is binary 0 if category N is not part of the label. Except for the optimized tag 1 format described in the next section,

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minimal encoding SHOULD be used resulting in no trailing zero octets in the category bitmap.

octet 0	octet 1	octet 2	octet 3	octet 4	octet 5	
XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	. . .

bit	01234567	89111111	11112222	22222233	33333333	44444444
number		012345	67890123	45678901	23456789	01234567

Figure 4. Ordering of Bits in Tag 1 Bit Map

### 3.4.2.6 Optimized Tag 1 Format

Routers work most efficiently when processing fixed length fields. To support these routers there is an optimized form of tag type 1. The ~~format~~  
~~does not change. The only change is to the category bitmap which is~~  
~~set to~~  
~~a constant length of 10 octets. Trailing octets required to fill out~~  
~~the 10~~  
~~octets are zero filled. Ten octets, allowing for 80 categories, was~~  
~~chosen~~  
because it makes the total length of the CIPSO option 20 octets. If ~~CIPSO~~  
is the only option then the option will be full word aligned and ~~additional~~  
filler octets will not be required.

### 3.4.3 Tag Type 2

This is referred to as the "enumerated" tag type. It is used to describe large but sparsely populated sets of categories. Tag type 2 is in the MAC Sensitivity tag type class. The format of this tag type is as follows:

Figure 5. Tag Type 2 Format

### 3.4.3.1 Tag Type

This field is one octet in length and has a value of 2.

### 3.4.3.2 Tag Length

This field is 1 octet in length. It is the total length of the tag type including the type and length fields. With the current IP header length restriction of 40 bytes the value within this field is between 4 and 34.

### 3.4.3.3 Alignment Octet

This field is 1 octet in length and always has the value of 0. Its purpose is to align the category field on an even octet boundary. This will

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speed many implementations including router implementations.

### 3.4.3.4 Sensitivity Level

This field is 1 octet in length. Its value is from 0 to 255. The values are ordered with 0 being the minimum value and 255 representing the maximum value.

### 3.4.3.5 Enumerated Categories

In this tag, categories are represented by their actual value rather than by their position within a bit field. The length of each category is 2 octets. Up to 15 categories may be represented by this tag. Valid values for categories are 0 to 65534. Category 65535 is not a valid category value. The categories MUST be listed in ascending order within the tag.

### 3.4.4 Tag Type 5

This is referred to as the "range" tag type. It is used to represent labels where all categories in a range, or set of ranges, are included in the sensitivity label. Tag type 5 is in the MAC Sensitivity tag type class. The format of this tag type is as follows:

class. The format of this tag type is as follows:

Category Ranges					
Tag Type	Tag Length	Alignment Octet	Sensitivity Level		
00000101	LLLLLLLL	00000000	LLLLLLLL	Top/Bottom	Top/Bottom
					//

Figure 6. Tag Type 5 Format

### 3.4.4.1 Tag Type

This field is one octet in length and has a value of 5.

### 3.4.4.2 Tag Length

This field is 1 octet in length. It is the total length of the tag type including the type and length fields. With the current IP header, the length restriction of 40 bytes the value within this field is between 4 and 34.

#### 3.4.4.3 Alignment Octet

This field is 1 octet in length and always has the value of 0. Its purpose is to align the category range field on an even octet boundary. This will speed many implementations including router implementations.

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#### 3.4.4.4 Sensitivity Level

This field is 1 octet in length. Its value is from 0 to 255. The →  
values  
are ordered with 0 being the minimum value and 255 representing the →  
maximum  
value.

#### 3.4.4.5 Category Ranges

A category range is a 4 octet field comprised of the 2 octet index of →  
the  
highest numbered category followed by the 2 octet index of the lowest →  
numbered category. These range endpoints are inclusive within the →  
range of  
categories. All categories within a range are included in the →  
sensitivity  
label. This tag may contain a maximum of 7 category pairs. The bottom →  
category endpoint for the last pair in the tag MAY be omitted and →  
SHOULD be  
assumed to be 0. The ranges MUST be non-overlapping and be listed in →  
descending order. Valid values for categories are 0 to 65534. →  
Category  
65535 is not a valid category value.

#### 3.4.5 Minimum Requirements

A CIPSO implementation MUST be capable of generating at least tag type →  
1 in  
the non-optimized form. In addition, a CIPSO implementation MUST be →  
able  
to receive any valid tag type 1 even those using the optimized tag →  
type 1  
format.

### 4. Configuration Parameters

The configuration parameters defined below are required for all CIPSO →  
hosts,  
gateways, and routers that support multiple sensitivity labels. A →  
CIPSO

host is defined to be the origination or destination system for an IP datagram. A CIPSO gateway provides IP routing services between two or  
→more  
IP networks and may be required to perform label translations between networks. A CIPSO gateway may be an enhanced CIPSO host or it may just provide gateway services with no end system CIPSO capabilities. A  
→CIPSO  
router is a dedicated IP router that routes IP datagrams between two  
→or more  
IP networks.

An implementation of CIPSO on a host MUST have the capability to  
→reject a  
datagram for reasons that the information contained can not be  
→adequately  
protected by the receiving host or if acceptance may result in  
→violation of  
the host or network security policy. In addition, a CIPSO gateway or  
→router  
MUST be able to reject datagrams going to networks that can not provide adequate protection or may violate the network's security policy. To provide this capability the following minimal set of configuration parameters are required for CIPSO implementations:

HOST\_LABEL\_MAX - This parameter contains the maximum sensitivity label  
→that  
a CIPSO host is authorized to handle. All datagrams that have a label greater than this maximum MUST be rejected by the CIPSO host. This parameter does not apply to CIPSO gateways or routers. This parameter  
→need  
not be defined explicitly as it can be implicitly derived from the PORT\_LABEL\_MAX parameters for the associated interfaces.

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HOST\_LABEL\_MIN - This parameter contains the minimum sensitivity label  
→that  
a CIPSO host is authorized to handle. All datagrams that have a label  
→less

than this minimum MUST be rejected by the CIPSO host. This parameter does not apply to CIPSO gateways or routers. This parameter need not be explicitly defined as it can be implicitly derived from the PORT\_LABEL\_MIN parameters for the associated interfaces.

**PORT\_LABEL\_MAX** - This parameter contains the maximum sensitivity label for all datagrams that may exit a particular network interface port. All outgoing datagrams that have a label greater than this maximum MUST be rejected by the CIPSO system. The label within this parameter MUST be less than or equal to the label within the HOST\_LABEL\_MAX parameter. This parameter does not apply to CIPSO hosts that support only one network port.

**PORT\_LABEL\_MIN** - This parameter contains the minimum sensitivity label for all datagrams that may exit a particular network interface port. All outgoing datagrams that have a label less than this minimum MUST be rejected by the CIPSO system. The label within this parameter MUST be greater than or equal to the label within the HOST\_LABEL\_MIN parameter. This parameter does not apply to CIPSO hosts that support only one network port.

**PORT\_DOI** - This parameter is used to assign a DOI identifier value to a particular network interface port. All CIPSO labels within datagrams going out this port MUST use the specified DOI identifier. All CIPSO hosts and gateways MUST support either this parameter, the NET\_DOI parameter, or the HOST\_DOI parameter.

**NET\_DOI** - This parameter is used to assign a DOI identifier value to a particular IP network address. All CIPSO labels within datagrams destined for the particular IP network MUST use the specified DOI identifier. All CIPSO hosts and gateways MUST support either this parameter, the PORT\_DOI parameter, or the HOST\_DOI parameter.

**HOST\_DOI** - This parameter is used to assign a DOI identifier value to a particular IP host address. All CIPSO labels within datagrams destined for the particular IP host will use the specified DOI identifier. All CIPSO hosts and gateways MUST support either this parameter, the PORT\_DOI parameter, or the NET\_DOI parameter.

This list represents the minimal set of configuration parameters.  
↳ required  
to be compliant. Implementors are encouraged to add to this list to  
provide enhanced functionality and control. For example, many security  
policies may require both incoming and outgoing datagrams be checked.  
↳ against  
the port and host label ranges.

#### 4.1 Port Range Parameters

The labels represented by the PORT\_LABEL\_MAX and PORT\_LABEL\_MIN  
parameters  
MAY be in CIPSO or local format. Some CIPSO systems, such as routers,  
↳ may  
want to have the range parameters expressed in CIPSO format so that  
↳ incoming  
labels do not have to be converted to a local format before being  
↳ compared  
against the range. If multiple DOIs are supported by one of these  
↳ CIPSO

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systems then multiple port range parameters would be needed, one set  
↳ for  
each DOI supported on a particular port.

The port range will usually represent the total set of labels that may  
exist on the logical network accessed through the corresponding network  
interface. It may, however, represent a subset of these labels that  
↳ are  
allowed to enter the CIPSO system.

#### 4.2 Single Label CIPSO Hosts

CIPSO implementations that support only one label are not required to  
support the parameters described above. These limited implementations  
↳ are

only required to support a NET\_LABEL parameter. This parameter  
 ↪contains  
 the CIPSO label that may be inserted in datagrams that exit the host. ↪  
 ↪In  
 addition, the host MUST reject any incoming datagram that has a label  
 ↪which  
 is not equivalent to the NET\_LABEL parameter.

## 5. Handling Procedures

This section describes the processing requirements for incoming and outgoing IP datagrams. Just providing the correct CIPSO label format is not enough. Assumptions will be made by one system on how a receiving system will handle the CIPSO label. Wrong assumptions may lead to non-interoperability or even a security incident. The requirements described below represent the minimal set needed for interoperability and that provide users some level of confidence. Many other requirements could be added to increase user confidence, however at the risk of restricting creativity and limiting vendor participation.

### 5.1 Input Procedures

All datagrams received through a network port MUST have a security  
 ↪label  
 associated with them, either contained in the datagram or assigned to  
 ↪the  
 receiving port. Without this label the host, gateway, or router will  
 ↪not  
 have the information it needs to make security decisions. This  
 ↪security  
 label will be obtained from the CIPSO if the option is present in the datagram. See section 4.1.2 for handling procedures for unlabeled datagrams. This label will be compared against the PORT (if  
 ↪appropriate)  
 and HOST configuration parameters defined in section 3.

If any field within the CIPSO option, such as the DOI identifier, is  
 ↪not  
 recognized the IP datagram is discarded and an ICMP "parameter problem" (type 12) is generated and returned. The ICMP code field is set to  
 ↪"bad  
 parameter" (code 0) and the pointer is set to the start of the CIPSO  
 ↪field  
 that is unrecognized.

If the contents of the CIPSO are valid but the security label is outside of the configured host or port label range, the datagram is

discarded and an ICMP "destination unreachable" (type 3) is generated and returned. The code field of the ICMP is set to "communication with destination network administratively prohibited" (code 9) or to

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"communication with destination host administratively prohibited" (code 10). The value of the code field used is dependent upon whether the originator of the ICMP message is acting as a CIPSO host or a CIPSO gateway. The recipient of the ICMP message MUST be able to handle, ↳ either value. The same procedure is performed if a CIPSO can not be added to, ↳ an IP packet because it is too large to fit in the IP options area.

If the error is triggered by receipt of an ICMP message, the message is discarded and no response is permitted (consistent with general ICMP processing rules).

### 5.1.1 Unrecognized tag types

The default condition for any CIPSO implementation is that an unrecognized tag type MUST be treated as a "parameter problem" and handled as described in section 4.1. A CIPSO implementation MAY allow the system administrator to identify tag types that may safely be ignored. This capability is an allowable enhancement, not a requirement.

### 5.1.2 Unlabeled Packets

A network port may be configured to not require a CIPSO label for all incoming datagrams. For this configuration a CIPSO label must be assigned to that network port and associated with all unlabeled IP datagrams. This capability might be used for single level networks or networks that have CIPSO and non-CIPSO hosts and the non-CIPSO hosts all operate at the same label.

If a CIPSO option is required and none is found, the datagram is

discarded and an ICMP "parameter problem" (type 12) is generated and returned to the originator of the datagram. The code field of the ICMP is set to "option missing" (code 1) and the ICMP pointer is set to 134 (the value of the option type for the missing CIPSO option).

## 5.2 Output Procedures

A CIPSO option MUST appear only once in a datagram. Only one tag type from the MAC Sensitivity class MAY be included in a CIPSO option.

Given the current set of defined tag types, this means that CIPSO labels at first will contain only one tag.

All datagrams leaving a CIPSO system MUST meet the following condition:

$$\text{PORT\_LABEL\_MIN} \leq \text{CIPSO label} \leq \text{PORT\_LABEL\_MAX}$$

If this condition is not satisfied the datagram MUST be discarded. If the CIPSO system only supports one port, the HOST\_LABEL\_MIN and the HOST\_LABEL\_MAX parameters MAY be substituted for the PORT parameters in the above condition.

The DOI identifier to be used for all outgoing datagrams is configured by

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the administrator. If port level DOI identifier assignment is used, then the PORT\_DOI configuration parameter MUST contain the DOI identifier to use. If network level DOI assignment is used, then the NET\_DOI parameter MUST contain the DOI identifier to use. And if host level DOI assignment is employed, then the HOST\_DOI parameter MUST contain the DOI identifier to use. A CIPSO implementation need only support one level of DOI assignment.

### 5.3 DOI Processing Requirements

A CIPSO implementation MUST support at least one DOI and SHOULD support multiple DOIs. System and network administrators are cautioned to ensure that at least one DOI is common within an IP network to allow for broadcasting of IP datagrams.

CIPSO gateways MUST be capable of translating a CIPSO option from one DOI to another when forwarding datagrams between networks. For efficiency purposes this capability is only a desired feature for CIPSO routers.

### 5.4 Label of ICMP Messages

The CIPSO label to be used on all outgoing ICMP messages MUST be equivalent to the label of the datagram that caused the ICMP message. If the ICMP was generated due to a problem associated with the original CIPSO label, then the following responses are allowed:

- a. Use the CIPSO label of the original IP datagram
- b. Drop the original datagram with no return message generated

In most cases these options will have the same effect. If you can not interpret the label or if it is outside the label range of your host or interface then an ICMP message with the same label will probably not be able to exit the system.

## 6. Assignment of DOI Identifier Numbers

Requests for assignment of a DOI identifier number should be addressed to the Internet Assigned Numbers Authority (IANA).

## 7. Acknowledgements

Much of the material in this RFC is based on (and copied from) work done by Gary Winiger of Sun Microsystems and published as Commercial IP Security Option at the INTEROP 89, Commercial IPSO Workshop.

## 8. Author's Address

To submit mail for distribution to members of the IETF CIPSO Working Group, send mail to: cipso@wdl1.wdl.loral.com.

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To be added to or deleted from this distribution, send mail to:  
cipso-request@wdl1.wdl.loral.com.

## 9. References

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