Chapter 48

Open Systems Interconnection (OSI)

Introduction

The OSI Network Layer consists of two network services:

- Connection-Oriented Network Service (CONS)
- Connectionless mode Network Service (CLNS)

The following routing protocols are part of the OSI Network Layer:

- End System to Intermediate System routing exchange protocol (ESIS)
- Intermediate System to Intermediate System routing exchange protocol (ISIS)
- Inter-Domain Routing Protocol (IDRP)

This chapter addresses the implementation of CLNS, ESIS, and ISIS. It does not address the implementation of CONS or IDRP.

ISO NSAP (Network Service Access Point) Addresses

ISO addresses defined in ISO 8348-Add2 for IS-IS can be thought of as a sequence of variable bytes up to 20 bytes long. The addresses are divided into several separate parts depending on the interpretation of the addresses specified for the routing domain.

Source and destination addresses for Protocol Data Units (PDUs) are preceded by an address length indicating the length of the corresponding address field.

For example, the OSI network specifies the following NSAP format:

- 5 bytes of Domain part
- 2 bytes of area address
- 6 bytes of System ID and
- 1 byte of system selector

In the context of ES-IS and IS-IS, NSAP addresses are interpreted as:

- n bytes of area address (variable)
- 6 bytes of system ID
- 1 byte selector
- NSAP Address Representation

Dotted hexadecimal notation is used in commands to represent NSAP addresses. In this format, NSAP addresses are represented as:

- ww.xxxx.xxxx.xxxx.xxxx.xxxx.xxxx.yyyy.yyyy.yyyy.zz.
- ww: domain part
- xx: area part
- yy: system ID part
- zz: selector part

where all “ww”, “xx”, “yy” and “zz” are hexadecimal bytes.

Note that the area part of the address is of variable length. Therefore the whole NSAP address has a variable length of not less than 8 bytes (1 byte for the domain part, 6 bytes for the system ID, and a 1 byte for the selector part).

An NSAP address is interpreted as: 1 byte for the domain part, a variable number of bytes for the area part, 6 bytes of system ID part, and 1 byte selector. Refer to examples in the following table.

Table 48-1: Interpreting NSAP addresses

NSAP Address Example	Interpretation
47.0004.004D.0003.4300.2233.1177.00	Domain part: 47 Area part: 0004.004D.0003 Area address: 47.0004.004d.0003 System ID: 4300.2233.1177 Selector: 00
47.0004.4300.2233.1177.00	Domain part: 47 Area part: 0004 Area address: 47.0004 System ID: 4300.2233.1177 Selector: 00 - selector part
47.2233.1177.00	An invalid NSAP address (too short)
47.0004.004D.0003.1272.3320.1111.1134.4300.2233.1177.00	An invalid NSAP address (too long)

An NSAP address prefix may be used to define which addresses can be accessed via a specified route. The prefix consists of the first *n* bytes of the NSAP address. These “reachable addresses” must be defined in the Reachable Address Database. A reachable address, therefore, defines a group of NSAP addresses with the same prefix that are able to be reached via a specified route.

ISO on the Router

ISO have published a range of standards and reports relating to OSI. Not all of the standards and reports are mandatory, and this section outlines the mandatory as well as the optional standards and reports supported by the router.

Mandatory CLNS Standards

All mandatory parts of the ISO standards for Connectionless Mode Network Service (CLNS) have been implemented. Relevant standards are:

ISO 8473-1: CLNS Protocol Specification

The protocol in this standard may be used between Network entities in end systems, between Network entities in intermediate systems, or between a Network entity in an end system and a Network entity in an intermediate system. In an end system, the router provides the connectionless-mode network service defined in CCITT Rec. X.213 and ISO/IEC 8248.

ISO 8473-2: CLNS over ISO 8802 Subnetworks

This standard specifies the way in which the underlying service assumed by the protocol defined in ISO/IEC 8473-1 is provided. The service is provided by a subnetwork that conforms to ISO/IEC 8802 through the operation of a SubNetwork Dependent Convergence Function (SNDCF). The SNDCF function is described in ISO/IEC 8648. The SNDCF specified in the ISO standard may be used with any ISO/IEC 8802 compliant subnetwork that provides the Logical Link Control Sublayer Interface service defined by ISO/IEC 8802-2.

ISO 8348: Network Service Definition

This standard defines the boundary layer service provided by the Network Layer to the Transport Layer. It provides definitions of how the layers interact and support each other.

Section 2 of this standard – Definition of the Connection-Mode Service – is not supported.

ISO 8343/Add2: Network Layer (NSAP) Addressing using preferred binary encoding

This standard defines the OSI Network Service.

ISO 8648: Internal Organisation of the Network Layer

This standard defines the internal organisation of the Network Layer.

ISO TR 9575: OSI Routing Framework

This Technical Report describes the framework, concepts, and terminology used in OSI routing protocols.

ISO TR 9577: Protocol Identification in the Network Layer

This Technical Report describes how to discriminate between multiple network-layer protocols running on the same medium.

Optional Sections of CLNS Standards

The following optional sections of CLNS have also been implemented.

Lifetime Control

The PDU lifetime control function assesses whether a received PDU's assigned lifetime has expired. If its lifetime has expired, the PDU is discarded. If its lifetime has not expired, the PDU may be forwarded.

Segmentation

Segmentation is performed when the length of a PDU is greater than the maximum data unit size supported by the underlying service to be used to transmit the PDU.

Reassembly

Reassembly reconstructs PDUs that were fragmented by the segmentation process.

Error Reporting

When a PDU is discarded, Error Reporting attempts to return an Error Report PDU to the source network entity of the discarded PDU.

ECHO

Echo request and Echo response is invoked by Network Layer Management to obtain information about the dynamic state of the Network Layer with respect to the reachability of specific network entities. This process clarifies the characteristics of the path or paths that can be created between network entities through the operation of Network Layer routing functions.

Route Recording

Route Recording records the path taken by a PDU as it traverses a series of intermediate systems.

Quality of Service

The quality of service maintenance function provides information to network entities in intermediate systems. The information may be used to make routing decisions where such decisions affect the overall quality of service provided to network users.

Basic Congestion Notification

Intermediate systems may inform the destination network entity of congestion through the use of a flag in the QoS maintenance parameter in the options part of the PDU header. This allows network users to take appropriate action when congestion is experienced within the network service provider.

The following optional parts of CLNS are **not** supported:

- Security
- Source Routing
- Priority
- TRACE

Mandatory ESIS Standards

All mandatory parts of the End System to Intermediate System routing exchange protocol (ESIS) have been implemented. ESIS is defined in:

ISO 9542: End System to Intermediate System Routing Exchange Protocol (ESIS)

This standard specifies a protocol used by Network Layer entities operating ISO 8473 in End Systems (ES) and Intermediate Systems (IS) to maintain routing information.

The protocol specified in this standard relies upon the provision of a connectionless-mode underlying service.

Optional Sections of ESIS Standards

The following optional sections of ESIS have been implemented.

Route Redirection

Route redirection information allows Intermediate Systems to inform End Systems of (potentially) better paths to use when forwarding NPDUs to a particular destination.

Setable Timers

There are two types of setable timer: the Configuration Timer and the Holding Timer. The Configuration Timer determines how often a system reports its availability to other systems on the same subnetwork. The Holding Timer determines how long configuration and route redirection information is maintained. Both timers may be set using commands.

Mandatory ISIS Standards

All mandatory sections of the Intermediate System to Intermediate System intra-domain routing protocol (ISIS) have been implemented. These parts are defined by the following documents:

ISO 10589: Intermediate System to Intermediate System Intra-Domain Routing Protocol (ISIS)

This standard specifies a protocol used by Network Layer entities operating the protocol specified by ISO 8473 in Intermediate Systems to maintain routing information. The information is used for the purpose of routing PDUs within a single routing domain.

The protocol specified in this standard relies upon the provision of a connectionless-mode underlying service.

Optional Sections of ISIS Standards

The following optional sections of ISIS have been implemented:

Optional Decision Metrics

ISIS defines four routing metrics. The four metrics correspond to the four possible orthogonal qualities of service. While the default metric is mandatory, the other metrics (delay, expense, and error) are optional.

The following optional section of ISIS is **not** supported:

- The stronger form of authentication defined in "draft-ietf-isis-hmac-00.txt - IS-IS HMAC-MD5 Authentication"

Layer 2 protocols supporting CLNS

CLNS is supported over the following Layer 2 protocols:

- Ethernet
- PPP

CLNS is not supported over the following Layer 2 protocols:

- X25T
- FR
- ISO 7776 LAPB
- IP/GRE Tunnelling

CLNS circuits over dial-up PPP interfaces

To disable ESIS and ISIS on a CLNS circuit, use these settings:

```
ESIS=OFF ISIS=OFF
```

A CLNS circuit added on a dial-up PPP interface should use static routing and should not have ESIS or ISIS enabled. This is due to the "chatty" nature of ESIS and ISIS, which would keep the dial-up interface open continuously.

SNMP

A MIB for managing the operation of the IS-IS and ES-IS protocols has been implemented under the Allied Telesyn Enterprise MIB. The MIB is based on a draft revision of an IETF MIB dated September 1992 and titled "*Integrated IS-IS Management Information Base*". Several additions have been made to this MIB to provide a more complete IS-IS and ES-IS management system.

Configuration Examples

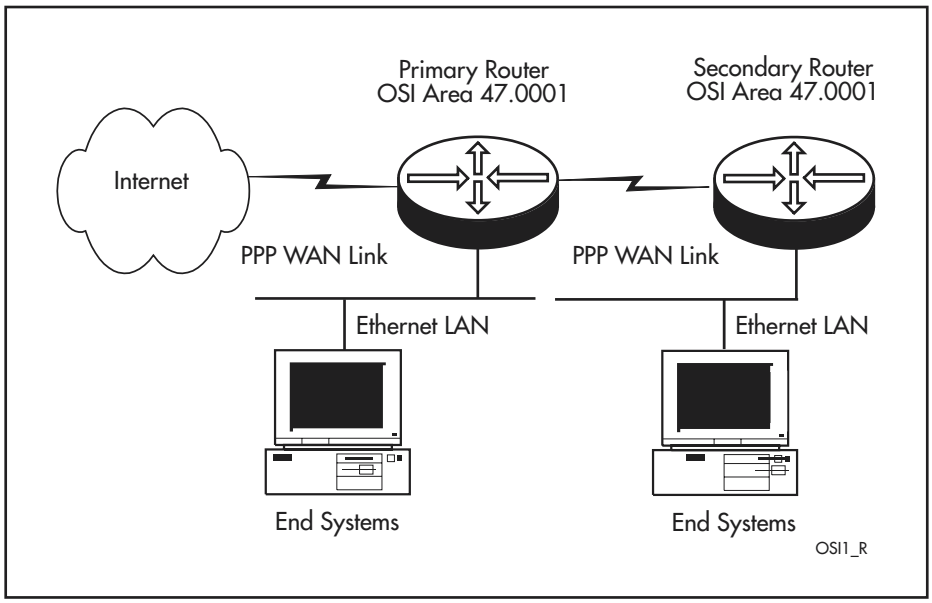
This section presents two examples of the application of OSI. The examples are indicative only; circuits can be added or altered to meet network requirements.

Example 1: Two routers and one OSI area.

The example includes one Ethernet onto a LAN, and two WAN links (one to another router, the other link to the Internet). Both routers are in the same OSI area (Figure 48-1 on page 48-8).

The WAN links can use PPP interface links of any PPP type.

Figure 48-1: Two routers and one OSI area.



To configure the primary router

Perform these steps on the primary router. In this example the primary router is the router with a WAN link to the Internet.

1. **Create the WAN links.**

   Create the WAN link to the secondary router.

   ```
   CREATE PPP=0 OVER=syn0
   ```

   Create the WAN link to the Internet.

   ```
   CREATE PPP=1 OVER=syn1
   ```

2. **Enable an OSI area.**

   ```
   ENA CLNS AREA=47.0001
   ```

3. **Add the local LAN circuit to the OSI area.**

   ```
   ADD CLNS CIRC=1 INT=eth0
   ```

4. **Add the remote office WAN circuit to the OSI area.**

   ```
   ADD CLNS CIRC=2 INT=ppp0
   ```

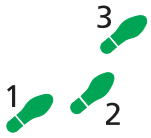
5. **Connect to the uplink WAN to the Internet.**

```
ADD CLNS CIRC=3 INT=ppp0
```

The OSI network now functions. However, you may improve security by limiting sent and received traffic to level 2.

6. **Limit sent and received traffic to level 2.**

```
SET CLNS CIRC=3 L2 ONLY=YES
```



To configure the secondary router

Perform these steps on the secondary router. In this example the secondary router is the router without a WAN link to the Internet.

1. **Create the WAN links.**

   Create the WAN link to the primary router.

```
CREATE PPP=0 OVER=syn0
```

2. **Enable the OSI CLNS area.**

```
ENA CLNS AREA=47.0001
```

3. **Add the local LAN to the OSI area.**

```
ADD CLNS CIRC=1 INT=eth0
```

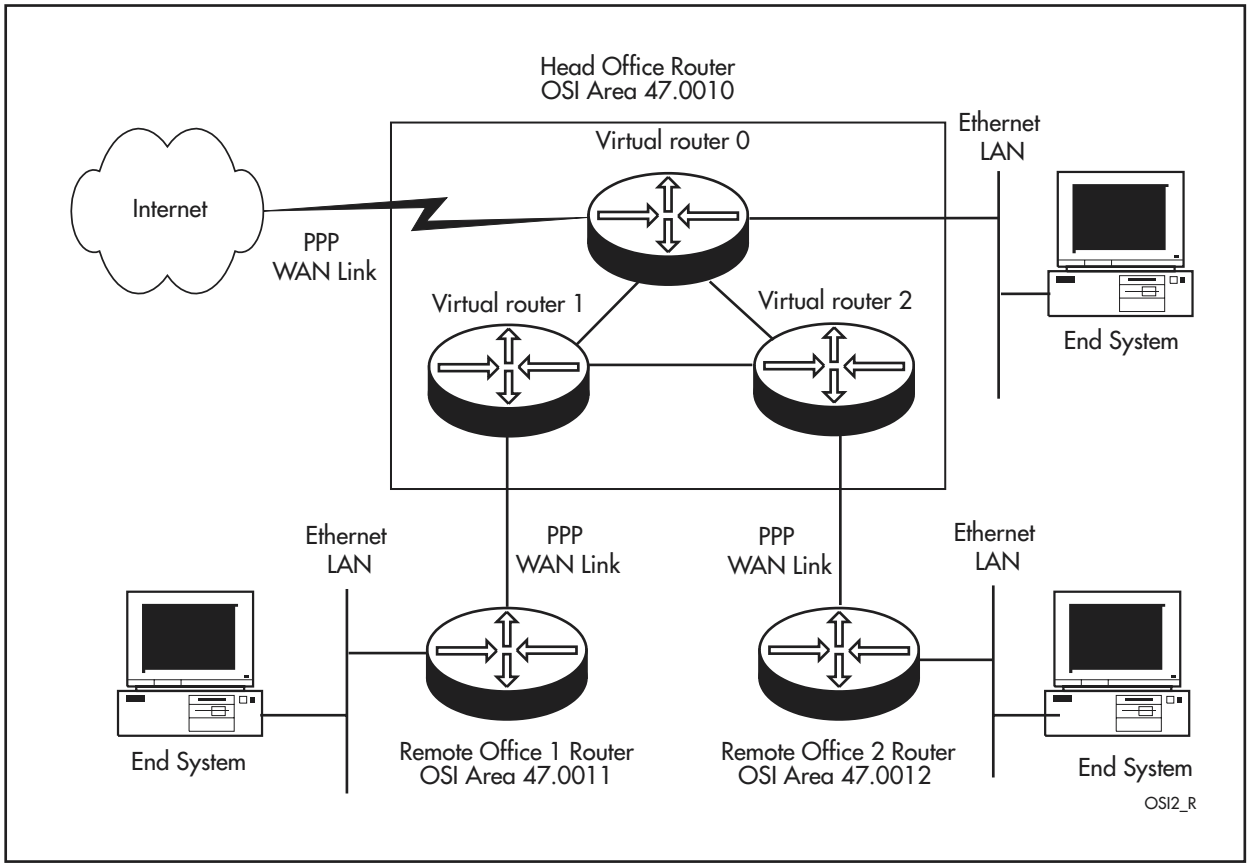
4. **Add the remote LAN to the OSI area.**

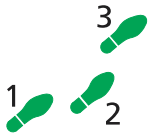
```
ADD CLNS CIRC=2 INT=ppp0
```

Example 2: Three virtual routers and three OSI areas.

The example shows how to configure a router with three virtual CLNS routers, with each virtual router in a different OSI area. A typical scenario might be where a single head office router is connected via WAN links to two remote office routers (Figure 48-2). The WAN links in this example use PPP over a synchronous interface, but could be any type of PPP.

Figure 48-2: Three virtual routers and three OSI areas.





To configure the head office router

1. **Create the WAN links.**

```
CREATE PPP=0 OVER=syn0
CREATE PPP=1 OVER=syn1
CREATE PPP=2 OVER=syn2
```

2. **Create the head office virtual router.**

   Enable an OSI area.

```
ENA CLNS=0 AREA=47.0010
```

   Add a circuit to the head office LAN.

```
ADD CLNS=0 CIRC=1 INT=eth0
```

   Add a circuit for the head office WAN uplink.

```
ADD CLNS=0 CIRC=2 INT=ppp0
```

3. **Create a virtual router for remote office 1.**

   Enable an OSI area.

   ```
   ENA CLNS=1 AREA=47.0011
   ```

   Add a circuit for the WAN link to remote office 1.

   ```
   ADD CLNS=1 CIRC=1 INT=ppp1
   ```

4. **Create a virtual router for remote office 2.**

   Enable an OSI area.

   ```
   ENA CLNS=2 AREA=47.0012
   ```

   Add a circuit for the WAN link to remote office 2.

   ```
   ADD CLNS=2 CIRC=1 INT=ppp2
   ```

5. **Connect the head office virtual router to the remote office virtual routers.**

   Connect the head office router to the remote office 1 router.

   ```
   ADD CLNS=0 CIRC=3 INT=virt1
   ```

   Connect the head office router to the remote office 2 router.

   ```
   ADD CLNS=0 CIRC=4 INT=virt2
   ```

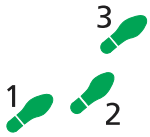
6. **Connect the remote office virtual routers to the head office virtual router.**

   ```
   ADD CLNS=1 CIRC=2 INT=virt0
   ADD CLNS=2 CIRC=2 INT=virt0
   ```

The virtual router network now functions. However, you may reduce the number of hops by connecting the remote offices.

7. **Connect the remote offices.**

   ```
   ADD CLNS=1 CIRC=3 INT=virt2
   ADD CLNS=2 CIRC=3 INT=virt1
   ```



To configure the remote office routers

Perform these steps on both remote office routers.

1. **Create the WAN links.**

   ```
   CREATE PPP=0 OVER=syn0
   ```

2. **Enable the OSI CLNS area.**

   At remote office 1, enable an OSI area.

   ```
   ENA CLNS AREA=47.0011
   ```

   At remote office 2, enable an OSI area.

   ```
   ENA CLNS AREA=47.0012
   ```

3. **Add the local LAN to the OSI area.**

   ```
   ADD CLNS CIRC=1 INT=eth0
   ```

4. **Add the WAN link to the head office.**

   ```
   ADD CLNS CIRC=2 INT=ppp0
   ```

Command Reference

This section describes the commands available to configure and monitor OSI on the router.

The shortest valid command is denoted by capital letters in the Syntax section. See "Conventions" on page xcv of Preface in the front of this manual for details of the conventions used to describe command syntax. See Appendix A, Messages, for a complete list of error messages and their meanings.

add clns adjacency

Syntax

```
ADD CLNS[=virtual-router-id] ADJacency=nsap-system-id
   CIRCuit=circ-id [ETHernetaddress=macadd]
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-system-id* is the system ID part of an NSAP address.
- *circ-id* is an integer from 1 to 255.
- *macadd* is an Ethernet MAC address in dashed hexadecimal notation.

Description

This command adds a static end system adjacency entry to the adjacency database of the specified CLNS virtual router.

The CLNS parameter specifies which virtual router the adjacency is to be added to. The default is 0.

The ADJACENCY parameter specifies the system ID of the end system that is adjacent to the router.

The CIRCUIT parameter specifies the circuit over which the adjacent end system can be reached. The circuit must be over either a PPP or Ethernet interface. The circuit must not be over a virtual interface.

The ETHERNETADDRESS parameter specifies the ethernet MAC address of the adjacent end system if it is reached from the router via a broadcast interface (such as Ethernet). The ETHERNETADDRESS parameter should not be present if the circuit is not over an Ethernet interface.

Examples

To add a static adjacency with system ID 1d2b.345a.975d, reachable over circuit 1 with MAC address 00-00-cd-00-0d-01, to CLNS virtual router zero, use the command:

```
add clns adj=1d2b.345a.975d circ=1 eth=00-00-cd-00-0d-01
```

Related Commands

delete clns adjacency
purge clns
show clns adjacency

add clns area

Syntax

```
ADD CLNS[=virtual-router-id] AREa=nsap-area-address
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-area-address* is an OSI NSAP area address.

Description

This command adds an area NSAP address to a CLNS virtual router.

The CLNS parameter specifies the identity number of the virtual router that the area address is to be added to. The default is 0.

The AREA parameter specifies the NSAP area address that is to be added to the virtual router. The area address should be no more than 13 bytes long.

Examples

To add an area NSAP address of 47.12ac.5689.1235.acdb to the CLNS virtual router with identifier 0, use the command:

```
add clns=0 are=47.12ac.5689.1235.acdb
```

Related Commands

delete clns area
enable clns
show clns area

add clns circuit

Syntax

```
ADD CLNS[=virtual-router-id] CIRCuit=circ-id
   INTerface=interface [IIHpint=1..65535]
   [L1DEFmetricval=1..63] [L1DELmetricval=0..63]
   [L1EXPmetricval=0..63] [L1ERRmetricval=0..63]
   [L2DEFmetricval=1..63] [L2DELmetricval=0..63]
   [L2EXPmetricval=0..63] [L2ERRmetricval=0..63]
   [ISIS={ON|OFF|YES|NO|TRue|FALse}] [L2Only={ON|OFF|YES|
   NO|TRue|FALse}] [L1Priority=1..127] [L2Priority=1..127]
   [ESIS={ON|OFF|YES|NO|TRue|FALse}] [ISConfint=1..65535]
   [POrt=port] [VLantag=1..4094]
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.
- *interface* is a valid interface name.
- *port* is the port number on a VLAN that this circuit runs over.

Description

This command adds a circuit to a CLNS virtual router.

The CLNS parameter specifies the CLNS virtual router the interface is to be added to. The default is 0.

The CIRCUIT parameter specifies an identifier for the circuit.

The INTERFACE parameter specifies the interface that provides the circuit for the CLNS virtual router. The interface type VIRT specifies a virtual point to point interface to another CLNS virtual router. VIRTn specifies an interface to CLNS virtual router n. In order for packets to be passed between the two virtual routers via this circuit an equivalent virtual circuit must be added to the peer virtual router. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- virtual interface (e.g. virt9)

The interface must already exist. To see a list of all currently available interfaces, use the **show interface** command on page 7-66 of Chapter 7, Interfaces.

The IIHPINT parameter specifies the period in seconds between IIH PDUs. It is also used as the period between ISH PDUs when polling the ES configuration. The default is 10.

The L1DEFMETRICVAL parameter specifies the value for the L1 default metric. The default is 20.

The L1DELMETRICVAL parameter specifies the value for the L1 delay metric. The default is 20.

The L1EXPMETRICVAL parameter specifies the value for the L1 expense metric. The default is 20.

The L1ERRMETRICVAL parameter specifies the value for the L1 error metric. The default is 20.

The L2DEFMETRICVAL parameter specifies the value for the L2 default metric. The default is 20.

The L2DELMETRICVAL parameter specifies the value for the L2 delay metric. The default is 20.

The L2EXPMETRICVAL parameter specifies the value for the L2 expense metric. The default is 20.

The L2ERRMETRICVAL parameter specifies the value for the L2 error metric. The default is 20.

The ISIS parameter specifies whether ISIS PDUs are transmitted and received on this interface. The default is YES.

The L2ONLY parameter specifies whether the interface is to be used for level 2 ISIS PDUs. If YES, level 2 ISIS PDUs are transmitted on the interface; level 1 ISIS PDUs are discarded. The default is NO.

The L1PRIORITY parameter specifies priority for the router becoming the LAN L1 Designated Intermediate System for a broadcast interface. This parameter can be specified only for a broadcast interface. The default is 64.

The L2PRIORITY parameter specifies priority for the router becoming the LAN L2 Designated Intermediate System for a broadcast interface. This parameter can be specified only for a broadcast interface. The default is 64.

The ESIS parameter specifies whether ES-IS packets are to be sent and received over this circuit. If the circuit connects the router to an End System (or in the case of a broadcast circuit, a number of End Systems), this parameter should be set to ON. If there are no End Systems on the circuit, this parameter may be set to OFF. The default is ON.

The ISCONFINT parameter specifies the value for the IS configuration timer. It determines how often an Intermediate System reports configuration information to End Systems. The default is 10.

The PORT parameter specifies the port on the VLAN over which the circuit is to be created. Packets are transmitted and received on this port. The PORT parameter can be used when the interface is a VLAN and the VLANTAG parameter is not specified. This port must be a member of that VLAN. There is no default.

The VLANTAG parameter specifies the Ethernet Virtual LAN (VLAN) to be used by the circuit. This parameter can be used for an Ethernet interface only. There is no default.

Examples

To add a circuit, with identifier 5, that uses interface eth0 to CLNS virtual router 0, use the command:

```
add clns=0 circ=5 int=eth0
```

To add a circuit, with identifier 5, that uses interface vlan2 to CLNS virtual router 0, and the port number is port 7 on that VLAN, use the command:

```
add clns=0 circ=5 int=vlan2 po=7
```

Related Commands

delete clns circuit
disable clns circuit
enable clns circuit
purge clns
set clns circuit
show clns ra

add clns ra

Syntax

```
ADD CLNS[=virtual-router-id] RA=nsap-prefix
   CIRCuit=circ-id SOURCE={NONE|EXPLICIT}]
   [ETHernetaddress=macadd] [DEFMetricval=1..63]
   [DEFMType={INTernal|EXTERNAL}] [DELMetricval=0..63]
   [DELMType={INTernal|EXTERNAL}] [EXPMetricval=0..63]
   [EXPMType={INTernal|EXTERNAL}] [ERRMetricval=0..63]
   [ERRMType={INTernal|EXTERNAL}]
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-prefix* is an OSI NSAP address prefix.
- *circ-id* is an integer from 1 to 255.
- *macadd* is an Ethernet MAC address in dashed hexadecimal notation.

Description

This command adds a static reachable address (RA) to the routing table of the specified CLNS virtual router.

The CLNS parameter specifies the virtual router that the RA is being added to. The default is 0.

The RA parameter specifies the NSAP reachable address prefix that the static RA defines a path to.

The CIRCUIT specifies the circuit over which the address prefix can be reached.

The SNPASOURCE parameter specifies how to determine the SNPA address to which PDUs for this reachable address prefix should be forwarded. If NONE, the SNPA address is implied by the nature of the subnetwork (i.e., a PPP link). If EXPLICIT, the SNPA address is given by the ETHERNETADDRESS parameter. The default is NONE.

The ETHERNETADDRESS parameter specifies the Ethernet MAC address where PDUs with this destination NSAP prefix should be forwarded. This parameter should be used if the value for the SNPASOURCE parameter is EXPLICIT.

The DEFMETRICVAL parameter specifies the default metric for reaching the specified NSAP prefix via this static route. The default is 20.

The DEFMTYPE parameter specifies whether the default metric is internal or external. The default is INTERNAL.

The DELMETRICVAL parameter specifies the delay metric value for reaching the specified NSAP prefix via this static route. The default is 20.

The DELMTYPE parameter specifies whether the delay metric is internal or external. The default is INTERNAL.

The EXPMETRICVAL parameter specifies the expense metric value for reaching the specified NSAP prefix via this static route. The default is 20.

The EXPMTYPE parameter specifies whether the expense metric is internal or external. The default is INTERNAL.

The ERRMETRICVAL parameter specifies the error metric value for reaching the specified NSAP prefix via this static route. The default is 20.

The ERRMTYPE parameter specifies whether the error metric is internal or external. The default is INTERNAL.

Examples To create a static route that points to one or more systems with NSAP prefixes of 47.12ac.5689.1235.acdb, reachable via circuit 1 (which is over a PPP link), use the command:

```
add clns ra=47.12ac.5689.1235.acdb circu=1
```

Related Commands
delete clns ra
purge clns
set clns ra
show clns ra
show clns route

delete clns adjacency

Syntax `DELete CLNS[=`*`virtual-router-id`*`] ADJacency=`*`nsap-system-id`*

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-system-id* is the system ID part of an NSAP address.

Description This command deletes a static adjacency entry from the adjacency database of the specified CLNS virtual router.

The CLNS parameter specifies which virtual router the adjacency is to be deleted from. The default is 0.

The ADJACENCY parameter specifies the system ID of the end system that is adjacent to the router.

Examples To delete a static adjacency with system ID 1d2b.345a.975d from CLNS virtual router zero, use the command:

```
del clns adj=1d2b.345a.975d
```

Related Commands
add clns adjacency
purge clns
show clns adjacency

delete clns area

Syntax `DELete CLNS[=`*`virtual-router-id`*`] AREa=`*`nsap-area-address`*

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-area-address* is an OSI NSAP area address.

Description This command deletes an area NSAP address from a CLNS virtual router.

The CLNS parameter specifies the identity number of the virtual router that the area address is to be deleted from. The default is 0.

The AREA parameter specifies the area NSAP address that is to be deleted from the virtual router.

Note that a CLNS virtual router requires at least one area NSAP address configured at all times.

Examples To delete an area NSAP address of 47.12ac.5689.1235.acdb from the CLNS virtual router with identifier 0, use the command:

```
del clns=0 are=47.12ac.5689.1235.acdb
```

Related Commands **add clns area**
show clns area

delete clns circuit

Syntax `DELete CLNS[=`*`virtual-router-id`*`] CIRCuit=`*`circ-id`*

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.

Description This command deletes an interface from a CLNS virtual router.

The CLNS parameter specifies the virtual router from which the interface is to be deleted. The default is 0.

The CIRCUIT parameter specifies the circuit that is to be deleted.

Examples To delete circuit 5 from CLNS virtual router 0, use the command:

```
del clns circu=5
```

Related Commands **add clns circuit**
set clns circuit
show clns ra

delete clns ra

Syntax

```
DELete CLNS[=virtual-router-id] CIRCuit=circ-id
   RA=nsap-prefix
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-prefix* is an OSI NSAP address prefix.
- *circ-id* is an integer from 1 to 255.

Description

This command deletes a static route from the routing table of the specified CLNS virtual router.

The CLNS parameter specifies the virtual router that the route is being deleted from. The default is 0.

The RA parameter specifies the NSAP address prefix that the static route defines a path to.

The CIRCUIT specifies the circuit over which the address prefix can be reached. This parameter is required for positive identification of the RA.

Examples

To delete a static route that points to a router with an NSAP prefix of 47.12ac.5689.1235.acdb.`4298.1d70.0000.00` at the remote end of a PPP link attached to interface ppp0, use the command:

```
del clns ra=47.12ac.5689.1235.acdb.4298.1d70.0000.00 circ=1
```

Related Commands

add clns ra
set clns ra
show clns ra
show clns route

disable clns circuit

Syntax

```
DISable CLNS[=virtual-router-id] CIRCuit=circ-id
```

where

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.

Description

This command disables CLNS packet transmission and reception on a particular interface associated with the CLNS virtual router. Circuits are enabled by default.

The CLNS parameter specifies which virtual router the interface is associated with. The default is 0.

The CIRCUIT parameter specifies the circuit to be disabled.

Examples To disable CLNS packet processing on the circuit with identifier 1 on CLNS virtual router 0, use the command:

```
dis clns circ=1
```

Related Commands
add clns circuit
delete clns circuit
enable clns circuit
set clns circuit
show clns ra

disable clns debug

Syntax

```
DISable CLNS[=virtual-router-id] DEBug={ALL|ENGDEBUG|
   ENGTRACE|PACKET|PKT|TRACE|TRACEMORE} [,..]
```

where *virtual-router-id* is an integer from 0 to 2

Description This command disables the CLNS debugging features.

The CLNS parameter specifies which virtual router debugging is to be disabled on. The default is 0.

The DEBUG parameter specifies which debugging features are to be disabled. The debugging that results from each option is described in Table 48-2 on page 48-22.

Examples To disable the CLNS packet debugging on CLNS virtual router 0, use the command:

```
dis clns deb=pkt
```

Related Commands enable clns debug

enable clns

Syntax

```
ENAble CLNS[=virtual-router-id] AREa=nsap-area-address
   SYStemid=nsap-system-id
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-area-address* is an OSI NSAP area address in the dotted hexadecimal notation.
- *nsap-system-id* is the system ID part of an NSAP address.

Description This command enables a CLNS virtual router for the first time. Once a virtual router has been enabled it is possible to assign interfaces to it allowing OSI IS-IS and ES-IS routing to be performed.

The CLNS parameter specifies the identifier of the virtual router. If no value for the CLNS parameter is specified it defaults to 0.

The AREA parameter specifies the NSAP area address of the CLNS virtual router.

The SYSTEMID parameter specifies the NSAP system ID to be used by this virtual router. The ID must be unique within its area. The default for this parameter is derived from the router's primary MAC address.

Examples To enable the CLNS virtual router with identifier 0 and NSAP area address 47.12ac.5689.1235.acdb, use the command:

```
ena clns are=47.12ac.5689.1235.acdb
```

Related Commands

add clns area
delete clns area
purge clns
reset clns
set clns
show clns
show clns area

enable clns circuit

Syntax `ENAble CLNS[=`*`virtual-router-id`*`] CIRCuit=`*`circ-id`*

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.

Description This command enables CLNS packet transmission and reception on a particular circuit associated with a CLNS virtual router. Circuits are enabled by default.

The CLNS parameter specifies which virtual router the interface is associated with. The default is 0.

The CIRCUIT parameter specifies which circuit is to be enabled.

Examples To enable the CLNS circuit with identifier 1 on CLNS virtual router 0, use the command:

```
ena clns ciru=1
```

Related Commands

add clns circuit
delete clns circuit
disable clns circuit
set clns circuit
show clns ra

enable clns debug

Syntax

```
ENAble CLNS[=virtual-router-id] DEBug={ALL|ENGDEBUG|
   ENGTRACE|PACKET|PKT|TRACE|TRACEMORE} [,...]
```

where *virtual-router-id* is an integer from 0 to 2

Description

This command enables the CLNS debugging features.

The CLNS parameter specifies the virtual router where debugging is to be enabled. The default is 0.

The DEBUG parameter specifies the debugging features to enable. The debugging that results from each option is described in Table 48-2.

Table 48-2: CLNS debugging options

Parameter	Meaning
ALL	Enables all CLNS debugging types
ENGDEBUG	Displays routing engine debug information
ENGTRACE	Displays information about the flow of data within the routing engine
PACKET	Displays CLNS packets that have been received and transmitted
PKT	Also displays CLNS packets that have been received and transmitted
TRACE	Displays information about the flow of data peripheral to the routing engine
TRACEMORE	Displays more detailed information about the flow of data peripheral to the routing engine

Examples

To enable the CLNS packet debugging on CLNS virtual router 0, use the command:

```
ena clns=0 deb=pkt
```

Related Commands

disable clns circuit

purge clns

Syntax `PURge CLNS[=virtual-router-id]`

where *virtual-router-id* is an integer from 0 to 2

Description This command clears the CLNS configuration on the specified virtual router. This also clears all the routing and adjacency tables. Purging leaves the virtual router disabled.

The CLNS parameter specifies which virtual router is to have its configuration purged. The default is 0.

Examples To clear the CLNS configuration on virtual router, use the command:

```
pur clns
```

Related Commands **reset clns**
show clns

reset clns

Syntax `RESET CLNS[=virtual-router-id]`

where *virtual-router-id* is an integer from 0 to 2

Description This command resets the CLNS virtual router to its manually configured state. Dynamically acquired information is deleted, including dynamic routes and adjacencies.

The CLNS parameter specifies the virtual router to reset. The default is 0.

Examples To reset CLNS virtual router 0, use the command:

```
reset clns
```

Related Commands **enable clns circuit**
set clns
show clns

set clns

Syntax

```
SET CLNS[=virtual-router-id] [AREAAddrmax=1..6]
   [AREAMaxcheck={ON|OFF|YES|NO|TRue|FALse}]
   [CSNPinterval=1..600] [ESHelloint=1..65535]
   [IIHelloint=1..65535] [LEvel={L1|L2}]
   [LSPMAxgenint=1..65535] [LSPMIngenint=1..65535]
   [LSPmtu=512..1492] [MAXPathsplits=1..3]
   [MINLSptxint=1..65535] [MINBRoadlsptxint=1..65535]
   [PSNPinterval=1..65535] [WAIttime=1..65535]
```

where *virtual-router-id* is an integer from 0 to 2

Description

This command changes the configuration of a CLNS virtual router.

The CLNS parameter specifies the identity number of the virtual router whose configuration is to be changed. The default is 0.

The AREAADDRMAX parameter specifies the maximum number of area addresses permitted on the virtual router. The default is 3.

The AREAMAXCHECK parameter specifies whether checking of maximum area addresses is performed. If YES is specified, checking is performed. If NO is specified, checking is not performed. The default is ON.

The CSNPINTERVAL parameter specifies the interval, in seconds, between Complete Sequence Number PDUs. The default is 10.

The ESHELLOINT parameter specifies the value, in seconds, to be used for the suggested ES configuration timer in ISH PDUs when soliciting the ES configuration. The default is 10.

The IIHELLOINT parameter specifies the interval, in seconds, between the generation of IIH PDUs by the designated IS on a LAN. The default is 10.

The LEVEL parameter specifies what kind of intermediate system the virtual router is. If L1 is specified, the router is a level 1 intermediate system. If L2 is specified, the router is a level 2 intermediate system. The default is L2.

The LSPMAXGENINT parameter specifies the maximum time, in seconds, between generated LSPs. The default is 900.

The LSPMINGENINT parameter specifies the minimum time, in seconds, between generated LSPs. The default is 10.

The LSPMTU parameter specifies the maximum allowable size, in bytes, of LSPs and SNPs. The default is 1492.

The MAXPATHSPLITS parameter specifies how many different paths with equal routing metric value can be used to simultaneously reach the same destination. The default is 2.

The MINLSPTXINT parameter specifies the minimum time in seconds between re-transmissions of an LSP. The default is 5.

The MINBROADLSPTXINT parameter specifies the minimum time, in milliseconds, between transmission of LSPs on broadcast circuits. The default is 33.

The PSNPINTERVAL parameter specifies the interval, in seconds, between Partial Sequence Number PDUs. The default is 2.

The WAITTIME parameter specifies the number of seconds to delay in Waiting State before entering On State. The default is 60.

Examples To set virtual router 0 to be a level 1 type intermediate system, use the command:

```
set clns=0 le=L1
```

Related Commands

add clns area
delete clns area
enable clns
reset clns
show clns

set clns circuit

Syntax

```
SET CLNS[=virtual-router-id] CIRCuit=circ-id
   [IIHpint=1..65535] [L1DEFmetricval=0..63]
   [L1DELmetricval=0..63] [L1EXPmetricval=0..63]
   [L1ERRmetricval=0..63] [L2DEFmetricval=1..63]
   [L2DELmetricval=0..63] [L2EXPmetricval=0..63]
   [L2ERRmetricval=0..63] [ISIS={ON|OFF|YES|NO|TRue|
   FALse}] [L2only={ON|OFF|YES|NO|TRue|FALse}]
   [L1Priority=1..127] [L2Priority=1..127] [ESIS={ON|OFF|
   YES|NO|TRue|FALsa}] [ISConfint=1..65535]
   [ESConfint=1..65535] [RDHint=1..65535]
   [VLantag=1..4094]
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 0 to 255.

Description This command is used to change the CLNS configuration of an interface that is attached to a CLNS virtual router.

The CLNS parameter specifies the CLNS virtual router the interface is attached to. The default is 0.

The CIRCUIT parameter specifies an identifier for the circuit.

The IIHPINT parameter specifies the seconds between IIH PDUs. It is also used as the period between ISH PDUs when polling the ES configuration. The default is 10.

The L1DEFMETRICVAL parameter specifies the value for the L1 default metric. The default is 20.

The L1DELMETRICVAL parameter specifies the value for the L1 delay metric. The default is 20.

The L1EXPMETRICVAL parameter specifies the value for the L1 expense metric. The default is 20.

The L1ERRMETRICVAL parameter specifies the value for the L1 error metric. The default is 20.

The L2DEFMETRICVAL parameter specifies the value for the L2 default metric. The default is 20.

The L2DELMETRICVAL parameter specifies the value for the L2 delay metric. The default is 20.

The L2EXPMETRICVAL parameter specifies the value for the L2 expense metric. The default is 20.

The L2ERRMETRICVAL parameter specifies the value for the L2 error metric. The default is 20.

The ISIS parameter specifies whether ISIS PDUs are transmitted and received on this interface. The default is YES.

The L2ONLY parameter specifies whether the interface is to be used for level 2 ISIS PDUs. If YES, level 2 ISIS PDUs are transmitted on this interface; level 1 ISIS PDUs are discarded. The default is NO.

The L1PRIORITY parameter specifies priority for the router becoming the LAN L1 Designated Intermediate System for a broadcast interface. This parameter can be specified only for a broadcast interface.

The L2PRIORITY parameter specifies priority for the router becoming the LAN L2 Designated Intermediate System for a broadcast interface. This parameter can be specified only for a broadcast interface.

The ESIS parameter specifies whether this interface connects the router to one or more End Systems. If YES, the interface connects the router to an End System (or in the case of a broadcast interface, a number of End Systems). The default is YES.

The ISCONFINT parameter specifies the value for the IS configuration timer. It determines how often an Intermediate System reports configuration information to End Systems. The default is 10.

The ESCONFINT parameter specifies the suggested End System configuration timer value, which is advertised in IS Hello PDUs transmitted on the interface. The default is 600.

The RDHINT parameter specifies the holding time to be specified in Redirect PDUs transmitted on the interface. The default is 600.

The VLANTAG parameter specifies which ethernet Virtual LAN (VLAN) is to be used by the circuit. This parameter can be used only for an Ethernet interface. There is no default.

Examples To change (to 50) the value for the level 1 default metric on circuit 5 (which is attached to the CLNS virtual router 0), use the command:

```
set clns=0 circ=5 l1def=50
```

Related Commands
add clns circuit
delete clns circuit
disable clns circuit
enable clns circuit
show clns circuit counters

set clns ra

Syntax

```
SET CLNS[=virtual-router-id] RA=nsap-prefix
   CIRCuit=circ-id ETHernetaddress=macadd
```

where:

- *virtual-router-id* is an integer from 0 to 2.
- *nsap-prefix* is an OSI NSAP address prefix.
- *circ-id* is an integer from 1 to 255.
- *macadd* is an Ethernet MAC address in dashed hexadecimal notation.

Description This command changes the Ethernet address that is used with a static reachable address (RA). This command can be used only for an Ethernet circuit.

The CLNS parameter specifies the virtual router that the RA is defined for. The default is 0.

The RA parameter specifies the NSAP reachable address prefix that the static RA defines a path to.

The CIRCUIT parameter specifies the circuit over which the address prefix can be reached. This parameter is present as an identifier of the RA and cannot be changed. It must be the same as the value specified when the RA was added.

The ETHERNETADDRESS parameter specifies the Ethernet MAC address to which PDUs with this destination NSAP prefix should be forwarded. This parameter should be used if the value for the SNPASOURCE parameter is EXPLICIT.

Examples To change the Ethernet address for a static RA with an NSAP prefix of 47.12ac.5689.1235.acdb.4298.1d70 on circuit 2 of virtual router 0, use the command:

```
set clns ra=47.12ac.5689.1235.acdb.4298.1d70 circ=2
   eth=00-00-cd-50-00-01
```

Related Commands
add clns ra
delete clns ra
show clns ra
show clns route

show clns

Syntax `SHow CLNS`

Description This command displays a summary of all CLNS virtual routers that are configured on the router (Figure 48-3, Table 48-3).

Figure 48-3: Example output from the **show clns** command

```
CLNS Virtual Rounters
  Router   Level   Area Addresses    System ID
-----------------------------------------------------------
      0      L2    47.2222.3333      0000.cd00.a4d6
                   47.5678.5678
      1      L2    47.2345.7890      0100.cd00.a4d6
```

Table 48-3: Parameters in the output of the **show clns** command

Parameter	Meaning
Router	Virtual router identifier.
Level	Whether the virtual router is a level 1 (L1) or level 2 (L2) intermediate system.
System ID	6-byte number (in dotted hexadecimal form) that is used as the system ID part of the virtual router's NSAP address.
Area Addresses	List of the virtual router's area addresses.

Examples To display a summary of all the CLNS virtual routers configured on the router, use the command:

```
sh clns
```

Related Commands
enable clns circuit
purge clns
reset clns
set clns
show clns detail

show clns adjacency

Syntax `SHow CLNS[=virtual-router-id] ADJacency`

where *virtual-router-id* is an integer from 0 to 2

Description This command displays information about the CLNS adjacency database (Figure 48-4 on page 48-29, Table 48-4 on page 48-29).

The CLNS parameter specifies the virtual router's adjacency database information to display. The default is 0.

Figure 48-4: Example output from the **show clns adjacency** command

```
ES Adjacencies
Circ  SysID            Type     SNPA                        State
-------------------------------------------------------------------------------
   1  2345.6782.ad12   Manual   00-00-cd-00-0d-01             UP

IS Adjacencies
Circ  SysID            Type     SNPA               Usage  HTime  Priority  State
-------------------------------------------------------------------------------
1 0000.cd00.a0db       L1IS     00-00-cd-00-a0-db  L1L2   66080  1854      UP

Area Adjacencies
Circ Area
-------------------------------------------------------------------------------
1 47.1234.1234
1 47.1234.2222
```

Table 48-4: Parameters in the output of the **show clns adjacency** command

Parameter	Meaning
ES Adjacencies	Summary of end systems that are adjacent to the virtual router.
Circ (ES Adjacencies)	Circuit index of the circuit via which the end system is adjacent to the router.
SysID (ES Adjacencies)	The system ID of the adjacent system.
Type (ES Adjacencies)	"Manual" if the adjacency was added by the user, or "Auto" if the adjacency was added by the CLNS engine.
SNPA (ES Adjacencies)	Sub-network point of attachment of the end system.
State (ES Adjacencies)	The state of the adjacency (UP/DOWN). Adjacencies created manually always have this value set to UP.
IS Adjacencies	Summary of intermediate systems that are adjacent to the virtual router.
Circ (IS Adjacencies)	Circuit index of the circuit via which the intermediate system is adjacent to the router.
SysID (IS Adjacencies)	The system ID of the adjacent system.
Type (IS Adjacencies)	The type of the neighbouring system. Intermediate System (IS), Level 1 IS (L1IS), or Level 2 IS (L2IS).
SNPA (IS Adjacencies)	Sub-network point of attachment of the intermediate system.
Circ (Area Adjacencies)	Circuit index of the circuit via which the area is adjacent to the router.
Area	The adjacent area address.
Usage	The usage of the adjacency. Level 1 traffic only (L1), Level 2 traffic only (L2), or Level 1 and 2 traffic (L1L2).
Htimer	The holding time for this adjacency updated from received IIH PDUs.
Priority	Priority of the adjacent intermediate system for becoming the LAN (Level 1 or Level 2, depending on Type) Designated Intermediate System.
State (IS Adjacencies)	The state of the adjacency.
Area Adjacencies	Area addresses of adjacent intermediate systems as reported in IIH PDUs.

Examples To display information from the adjacency database of CLNS virtual router 0, use the command:

```
sh clns adj
```

Related Commands
add clns adjacency
delete clns adjacency

show clns area

Syntax `SHow CLNS[=virtual-router-id] AREa`

where *virtual-router-id* is an integer from 0 to 2

Description This command displays information about the NSAP area addresses associated with the virtual router (Figure 48-5 on page 48-30, Table 48-5 on page 48-30).

The CLNS parameter specifies the virtual router's area address information to display. The default is 0.

Figure 48-5: Example output from the **show clns area** command

```
Manual Area Addresses
-------------------------------------------------------------
    47.2222.3333
    47.5678.5678

Union of Area Addresses
-------------------------------------------------------------
    47.2222.3333
    47.5678.5678
```

.
Table 48-5: Parameters in the output of the **show clns area** command

Parameter	Meaning
Manual Area Addresses	Set of manual area addresses configured on this intermediate system.
Union of Area Addresses	Union of the sets of area addresses reported in all Level 1 LSPs received by this instance of the protocol.

Examples To display information about the area addresses associated with CLNS virtual router 0, use the command:

```
sh clns are
```

Related Commands
add clns area
delete clns area
enable clns
show clns
show clns detail

show clns circuit

Syntax `SHow CLNS[=`*`virtual-router-id`*`] CIRCuit[=`*`circ-id`*`]`

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.

Description This command displays either a summary of all CLNS circuits on all virtual routers, or information about a specific circuit attached to the specified CLNS virtual router (Figure 48-6 on page 48-31, Table 48-6 on page 48-32).

The CLNS parameter specifies the virtual router's circuit information to display. The default is 0.

The CIRCUIT parameter specifies the circuit's information to display. If no value is specified, summary information about all circuits attached to each CLNS virtual router is displayed (Figure 48-7 on page 48-33, Table 48-8 on page 48-34).

Figure 48-6: Example output from the **show clns circuit** command

```
Interface                              eth0
Circuit State                          Enabled
Type                                   broadcast
Hello Interval                         3
L1 Metrics:
  Default                              20
  Delay                                20
  Expense                              20
  Error                                20
L2 Metrics:
  Default                              20
  Delay                                20
  Expense                              20
  Error                                20
IS-IS State                            Enabled
L2 Only                                No
L1 IS Priority                         64
L2 IS Priority                         64
L1 Allocated Circuit ID                0000.cd00.a4d6.05
L1 Designated IS                       0000.cd00.a4d6
L2 Allocated Circuit ID                0000.cd00.a4d6.05
L2 Designated IS                       0000.cd00.a4d6
Pt To Pt Circuit ID                    0000.cd00.a4d6.05
Multicast Address Type                 Group
ES-IS Configuration:
  ES-IS State                          Enabled
  IS Configuration Interval            10
  Suggested ES Configuration Interval  600
  Redirect PDU Hold Time               600
```

Table 48-6: Parameters in the output of the **show clns circuit** command

Parameter	Meaning
Interface	The interface over which the circuit transmits and receives packets.
Circuit State	The operational state of the circuit.
Type	Either "broadcast" or "ptToPt". Broadcast if the circuit is over an Ethernet interface or ptToPt if the circuit is over a PPP interface or a virtual interface.
Hello Interval	The period, in seconds, between IIH PDUs.
L1 Metrics	Values for the L1 metrics for this circuit.
L2 Metrics	Values for the L2 metrics for this circuit.
IS-IS State	Whether the IS-IS protocol is enabled on this interface; one of "Yes" or "No".
L2 Only	"Yes" indicates that this circuit is to be used for level 2. "No" indicates that this circuit may be used for level 1 or 2.
L1 IS Priority	The priority for becoming LAN Level 1 Designated Intermediate System on a broadcast circuit.
L2 IS Priority	The priority for becoming LAN Level 2 Designated Intermediate System on a broadcast circuit.
L1 Allocated Circuit ID	The LAN ID allocated by the LAN Level 1 Designated Intermediate System.
L1 Designated IS	The ID of the LAN Level 1 Designated Intermediate System on this circuit.
L2 Allocated Circuit ID	The LAN ID allocated by the LAN Level 2 Designated Intermediate System.
L2 Designated IS	The ID of the LAN Level 2 Designated Intermediate System on this circuit.
Pt To Pt Circuit ID	The point to point ID of the circuit.
Multicast Address Type	Type of multicast address used for sending HELLO PDUs on this circuit. "Group" is the only defined value for this parameter.
ES-IS Configuration	Configuration of the ES-IS protocol on this circuit.
ES-IS State	State of the ES-IS protocol.
IS Configuration Interval	Value in seconds of how often an IS reports configuration information to ESs.
Suggested ES Configuration Interval	Value in seconds to be used for the suggested ES configuration timer value, advertised in IS Hellos generated by the system on this circuit.
Redirect PDU Hold Time	The holding time in seconds to be specified in Redirect PDUs generated by the system on this circuit.

Figure 48-7: Example output from the **show clns circuit** command when no **circuit** value is specified

```
Virtual
Router     Circuit    Interface   SNPA               State
-----------------------------------------------------------
     0           1     virt1      -                  UP
                 5     eth0       00-00-cd-00-a4-d6  UP
     1           3     virt0      -                  UP
                 2     ppp0       -                  DOWN
-----------------------------------------------------------
-----------------------------------------------------------
Virtual Interface Rx Queue Length   0
-----------------------------------------------------------
```

Table 48-7: Parameters in the output of the **show clns circuit** command when no **circuit** value is specified

Parameter	Meaning
Virtual Router	ID of the virtual router to which the subsequent circuit belongs.
Circuit	ID of the circuit.
Interface	Type and instance of the interface that provides the circuit.
SNPA	Sub-network point of attachment. If the interface is Ethernet, the MAC address is shown. If the circuit is point to point, no value is shown.
State	Operational state of the circuit. (UP/DOWN).
Virtual Interface Rx Queue Length	Number of packets in the receive queue of the virtual interface between CLNS virtual routers.

Examples

To display information about the circuit with the ID of 1 attached to CLNS virtual router 0, use the command:

```
sh clns circ=1
```

To display information about all circuits on all virtual routers use, the command

```
sh clns circ
```

Related Commands

add clns circuit
delete clns circuit
disable clns circuit
enable clns circuit
set clns circuit
show clns counters

show clns circuit counters

Syntax `SHow CLNS[=`*`virtual-router-id`*`] CIRCuit=`*`circ-id`* `COUnters`

where:

- *virtual-router-id* is an integer from 0 to 2.
- *circ-id* is an integer from 1 to 255.

Description This command displays the circuit counter of a circuit attached to the specified CLNS virtual router (Figure 48-8 on page 48-34, Table 48-8 on page 48-34).

The CLNS parameter specifies to which virtual router the circuit is attached. The default is 0.

The CIRCUIT parameter specifies which circuit's counters is displayed.

Figure 48-8: Example output from the **show clns circuit counters** command

```
Counters
  Adjacency State Changes               0
  Initialisation Failures               0
  Rejected Adjacencies                  0
  Control PDUs Tx                       3168
  Control PDUs Rx                       0
  ID Field Length Mismatches            0
  L1 Designated IS Changes              2
  L2 Designated IS Changes              2
  IS ES Reachability Changes            0
  Invalid ES-IS PDUs Rx                 0
  CLNS PDUs Rx                          0
  CLNS PDUs Tx                          0
  Bad DSAP PDUs Rx                      0
  Control Packets Rx                    0
  Data Packets Rx                       0
  Packets Tx                            3562
```

Table 48-8: Parameters in the output of the **show clns circuit counters** command

Parameter	Meaning
Adjacency State Changes	Number of times an adjacency state change has occurred on this circuit.
Initialisation Failures	Number of times initialisation of this circuit has failed.
Rejected Adjacencies	Number of times an adjacency has been rejected on this circuit.
Control PDUs Tx	Number of IS-IS control PDUs sent on this circuit.
Control PDUs Rx	Number of IS-IS control PDUs received on this circuit.
ID Field Length MisMatches	Number of times an IS-IS control PDU with an ID field length different to that for this system has been received.
L1 Designated IS Changes	Number of times the LAN Level 1 Designated Intermediate System has changed.
L2 Designated IS Changes	Number of times the LAN Level 2 Designated Intermediate System has changed.

Table 48-8: Parameters in the output of the **show clns circuit counters** command

Parameter	Meaning
IS ES Reachability Changes	Number of changes in reachability of End Systems from this circuit.
Invalid ES-IS PDUs Rx	Number of ISO 9452 PDUs received that were discarded as a result of the PDU Header Error Detection or Protocol Error Processing Functions specified in ISO 9542.
CLNS PDUs Rx	Number of CLNS PDUs received on this circuit.
CLNS PDUs Tx	Number of CLNS PDUs transmitted on this circuit.
Bad DSAP PDUs Rx	Number CLNS PDUs received with a bad DSAP.
Control Packets Rx	Number of control packets received on this circuit.
Data Packets Rx	Number of data packets received on this circuit.
Packets Tx	Number of packets transmitted over this circuit.

Examples To display circuit counters for circuit 2, which is attached to CLNS virtual router 0, use the command:

```
sh clns circ=2 cou
```

Related Commands

add clns circuit
delete clns circuit
disable clns circuit
enable clns circuit
set clns circuit
show clns ra
show clns counters

show clns counters

Syntax `SHow CLNS COUnters`

Description This command displays counters relating to sent and received packets for all CLNS virtual routers (Figure 48-9 on page 48-36, Table 48-9 on page 48-36).

Figure 48-9: Example output from the **show clns counters** command.

```
                Done          No Circuit
pktOut          4676                   0     (DBdeleted 4676)
fragOut            0                   0
discard            0
errorReport        0
redirect           0
routingFrame       0
forward            0                   0
forwardLocal       0
forwardFrag        0
rxEth                                  0
rxPPP                                  0
rxVirt                                 0
rxVlan                                 0
```

Table 48-9: Parameters in the output of the **show clns counters** command

Parameter	Meaning
Done	The number of times the indicated event was done successfully.
No Circuit	The number of times the indicated event failed because the specified circuit did not exist.
pktOut	Transmission of an OSI routing process PDU.
DBdeleted	Deletion of the buffer containing an OSI routing process PDU as requested by the OSI routing process.
fragOut	Transmission of a PDU fragment.
discard	Number of discarded PDUs.
errorReport	Generation of a CLNS error report PDU.
redirect	Received a PDU and sent an ES-IS redirect PDU toward the PDU's origin.
routingFrame	Sent an ES-IS or IS-IS frame to the routing process.
forward	Forwarded a CLNS PDU to another system.
forwardLocal	Forwarded a CLNS PDU to the local system.
forwardFrag	Fragmented and then forwarded a CLNS PDU to another system.
rxEth	Received a packet from Ethernet.
rxPPP	Received a packet from PPP.
rxVirt	Received a packet from a virtual interface.
rxVlan	Received a packet from a VLAN interface.

Examples To display counters relating to sent and received packets for all CLNS virtual routers, use the command:

```
sh clns cou
```

Related Commands

enable clns
reset clns
purge clns
set clns
show clns circuit counters

show clns detail

Syntax `SHow CLNS[=`***virtual-router-id***`] DETail`

where *virtual-router-id* is an integer from 0 to 2

Description This command displays detailed information about a CLNS virtual router (Figure 48-10 on page 48-37, Table 48-10 on page 48-38).

The CLNS parameter specifies which CLNS virtual router's configuration is displayed. The default is 0.

Figure 48-10: Example output from the **show clns detail** command

```
clns 0
  State                                    ENABLED
  Level                                    L2
  System ID                                0000.cd00.a4d6
  Area Addresses                           47.2222.3333
                                           47.5678.5678
  Maximum Path Splits                      2
  Minimum LSP Transmit Int (seconds)       5
  Minimum Broadcast LSP Int (seconds)      33
  Maximum LSP Generation Int (seconds)     900
  Minimum LSP Generation Int (seconds)     10
  CSNP Interval (seconds)                  10
  PSNP Interval (seconds)                  2
  L1 LSP MTU (bytes)                       1492
  Maximum Number of Area Addresses         3
  ES Hello Interval (seconds)              10
  IS-IS Hello Interval (seconds)           10
  Wait Time                                60
  L1 Database State                        UP
  Corrupted LSPs Detected                  0
  L1 Database Overloads                    0
  Manual Area Address Drops                0
  Attempts To Exceed Max Sequence Num.     0
  Sequence Number Skips                    0
  Own LSP Purges                           0
  System ID Length Mismatches              0
  Maximum Area Addresses Mismatch          0
  L2 LSP MTU (bytes)                       1492
  L2 Database State                        UP
  L2 Database Overloads                    0
  Maximum Area Address Checking            ON
```

Table 48-10: Parameters in the output of the **show clns detail** command

Parameter	Meaning
State	Whether the CLNS virtual router is ENABLED or DISABLED.
Level	Type of the virtual router: level 1 (L1) or level 2 (L2).
System ID	6-byte number (in dotted hexadecimal form) that is used as the system ID part of the virtual router's NSAP address.
Area Addresses	List of the virtual router's area addresses.
Maximum Path Splits	Maximum numbers of equal cost paths that router traffic may be split between.
Minimum LSP Transmit Int	Minimum number of seconds between transmission of link state PDUs.
Minimum Broadcast LSP Int	Minimum number of seconds between transmission of link state PDUs over broadcast circuits.
Maximum LSP Generation Int	Maximum number of seconds between generation of link state PDUs.
Minimum LSP Generation Int	Minimum number of seconds between generation of link state PDUs.
CSNP Interval	Number of seconds between transmission of complete sequence number PDUs.
PSNP Interval	Number of seconds between transmission of partial sequence number PDUs.
L1 LSP MTU	Maximum allowable size of L1 link state PDUs.
Maximum Number of Area Addresses	Maximum number of area addresses the virtual router may have at one time.
ES Hello Interval	Number of seconds between transmission of ES hello packets.
IS-IS Hello Interval	Number of seconds betw.een transmission of IS-IS hello packets
Wait Time	Number of seconds to delay in Waiting State before entering On State.
L1 Database State	Whether the L1 database is up.
Corrupted LSPs Detected	Number of corrupted LSPs detected.
L1 Data base Overloads	Number of times the LSP L1 database has become overloaded.
Manual Area Address Drops	Number of times a manual address has been dropped from the area.
Attempts To Exceed Max Sequence Num	Number of times the IS has attempted to exceed the maximum sequence number.
Sequence Number Skips	Number of times a sequence number skip has occurred.
Own LSP Purges	Number of times a zero-aged copy of the system's own LSP is received from some other node.
System ID Length Mismatches	Number of times a PDU is received with a different value for ID field length than the field length for the receiving system.
Maximum Area Address Mismatches	Number of times a PDU is received with a different value for Maximum Area Addresses than the Maximum Area Addresses for the receiving system.
L2 LSP MTU	Maximum allowable size of L2 link state PDUs.

Table 48-10: Parameters in the output of the **show clns detail** command (continued)

Parameter	Meaning
L2 Database State	Whether the L2 database is up.
L2 Database Overloads	Number of times the Level 2 LSP database has become overloaded.
Maximum Area Address Checking	Whether maximum area addresses per IS version of ISO10589 are checked.

Examples To display detailed information about CLNS virtual router 0, use the command:

```
sh clns det
```

Related Commands
enable clns
reset clns
purge clns
set clns
show clns

show clns ra

Syntax `SHow CLNS[=virtual-router-id] RA`

where *virtual-router-id* is an integer from 0 to 2

Description This command displays information from the reachable address database of a CLNS virtual router (Figure 48-11 on page 48-39, Table 48-11 on page 48-40).

The CLNS parameter specifies the database of a specific router to display. The default is 0.

Figure 48-11: Example output from the **show clns ra** command.

```
Reachable Addresses
------------------------------------------------------------------------------
Destination                                        NextHop
Circ    Type     MapType   Metrics:   Def    Del    Exp    Err    State
------------------------------------------------------------------------------
22.2222.2222                                     00-00-cd-0d-00-01
   5    Manual   Explicit             20     20     20     20     UP
11.1111.1111.1111.1111.1111.11                   00-00-cd-00-0d-01
   5    Manual   Explicit             20     20     20     20     UP
47.2222.2222                                     00-00-cd-11-00-0d
   5    Manual   Explicit             20     20     20     20     UP
```

Table 48-11: Parameters in the output of the **show clns ra** command

Parameter	Meaning
Destination	Destination of this Reachable Address. This is an Address Prefix.
Next Hop	SNPA Address to which a PDU may be forwarded in order to reach a destination that matches the address prefix of the Reachable Address.
Circ	ID of the circuit to use for this reachable address
Type	How the RA was obtained. "Manual" indicates the RA was added by system management. "Automatic" indicates the RA was added by the routing engine.
Map Type	How the next hop SNPA Address is obtained. "None" indicates that no address is required because the circuit is point to point. "Explicit" indicates that the address is an Ethernet address that has been specified either by system management or the routing engine.
Metrics	Values for the four metric types (default, delay, expense, error) for the RA.
State	Operation state of the RA.

Examples To display information from the reachable address database of CLNS virtual router 0, use the command:

```
sh clns ra
```

Related Commands

add clns ra
delete clns ra
set clns ra
show clns route

show clns route

Syntax `SHow CLNS[=`*`virtual-router-id`*`] ROUte[=ALL]`

where *virtual-router-id* is an integer from 0 to 2

Description This command displays information from the CLNS routing database (Figure 48-12 on page 48-41, Table 48-12 on page 48-41).

The CLNS parameter specifies the virtual router's routing database information to display. The default is 0.

If no value is specified for the ROUTE parameter, routes using the default metric are displayed. If ALL is specified, all routes are displayed.

Figure 48-12: Example output from the **show clns route=all** command

```
CLNS 0 Routes - all metrics
-------------------------------------------------------------------------------
Destination             Circ:NextHop            Source   |Metric  :ext  :value
-------------------------------------------------------------------------------
L1 Routes:
0000.cd00.a4d6          4   :0000.cd00.a4d6     ISIS-L1  Default  No    20
0000.cd00.a4d6          4   :0000.cd00.a4d6     ISIS-L1  Delete   No    20
0000.cd00.a4d6          4   :0000.cd00.a4d6     ISIS-L1  Expense  No    20
0000.cd00.a4d6          4   :0000.cd00.a4d6     ISIS-L1  Error    No    20

L2 Routes:
40.1234.1234            4   :0000.cd00.a4d6     ISIS-L2  Default  No    40
47.5678.5678            100 :0100.cd00.a0db     ISIS-L2  Default  No    20
40.1234.1234            4   :0000.cd00.a4d6     ISIS-L2  Delete   No    40
47.5678.5678            100 :0100.cd00.a0db     ISIS-L2  Delete   No    20
40.1234.1234            4   :0000.cd00.a4d6     ISIS-L2  Expense  No    40
47.5678.5678            100 :0100.cd00.a0db     ISIS-L2  Expense  No    20
40.1234.1234            4   :0000.cd00.a4d6     ISIS-L2  Error    No    40
47.5678.5678            100 :0100.cd00.a0db     ISIS-L2  Error    No    20

Learned Manual Routes:
48                      100 :0100.cd00.a0db     ISIS     Default  No   40

Manual Routes:
34                      4   :00-00-00-00-00-01  Manual   Default  No   20
-------------------------------------------------------------------------------
```

Table 48-12: Parameters in the output of the **show clns route=all** command

Parameter	Meaning	
Destination	Destination end system ID or address prefix.	
Circ	Circuit that the route is over.	
Next Hop	System ID of the next hop to reach destination.	
Source	Source of the route:	
	Manual	manually configured information on the system
	ISIS-L1	ISIS Level 1 LSPs
	SIS-L2	ISIS Level 2 LSPs
	ISIS	ISIS LSPs of unknown
	Esis	ES Hellos
Metric	The metric used by this route (default, delay, expense, error).	
ext	Whether the metric has an external component or is just internal. "Yes" if there is an external component.	
value	Path metric value for this route.	
L1 Routes	Level 1 routing information.	
L2 Routes	Level 2 routing information.	
Learned Manual Routes	Manual routing information learned from other Intermediate systems.	
Manual Routes	Manually added routing information.	

Examples To display information from the routing database of CLNS virtual router 0 about routes using the default metric, use the command:

```
sh clns rou
```

Related Commands

add clns ra
delete clns ra
set clns ra
show clns ra