



## FRF2.1 Annex 1

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This feature module describes the FRF2.1 Annex 1 feature. It includes information on the benefits of the new feature, supported platforms, related documents and so on.

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## Feature Overview

The FRF2.1 Annex 1 for Event Driven Procedures feature provides a signalling protocol for permanent virtual circuit (PVC) monitoring at the Network-to-Network Interface (NNI) for a Frame Relay switching network. FRF2.1 Annex 1 generates notification when an event occurs that changes status, and when an event occurs, it generates immediate notification.

FRF2.1 Annex 1 allows for faster notification of PVC status, such as addition, deletion, or availability, in Frame Relay switching networks with multiple switching nodes. The faster notification results in better network management as well as increased PVC scalability per interface because Local Management Interface (LMI) procedures are not needed at each NNI node for each PVC in the network.

FRF2.1 Annex 1 adds event driven procedures to the enterprise Frame Relay network. It enables fast convergence and provides quick responses to any changes within a Frame Relay network.

## Benefits

FRF2.1 Annex 1 benefits are as follows:

**PVC Status**

Faster notification of PVC status for network management purposes.

**Scalability**

Increased scalability of the number of PVCs on interfaces in a Frame Relay switching network.

## Restrictions

The FRF2.1 Annex 1 feature is supported only in the Cisco IOS Release 12.0(S) release train.

Event driven procedures do not provide reliable message exchange between peer Layer 3 entities. The PVC status messages are discarded without detection when Q.933 protocol errors occur. PVC status messages can be lost between the Q.922 and Q.933 entities due to the following types of NNI equipment problems:

- Q.933 task aborts
- Memory parity errors
- Buffer overflow

## Related Features and Technologies

FRF2.1 Annex 1 replaces Q.933 Annex A. FRF2.1 Annex 1 supports polling based, bi-directional Frame Relay NNI PVC management procedures that provide notification when a PVC outage condition occurs and recovers.

## Related Documents

- Cisco IOS Release 12.0 *Wide-Area Networking Command Reference*
- Cisco IOS Release 12.0 *Wide-Area Networking Configuration Guide*
- Cisco IOS Release 12.0 *Network Protocols Command Reference, Part 1*
- Cisco IOS Release 12.0 *Network Protocols Configuration Guide, Part 1*
- *Cisco IOS Switching Services Command Reference*

## Supported Platforms

- Cisco 12008 GSR
- Cisco 12012 GSR
- Cisco 12016 GSR

## Supported Standards

- *Frame Relay Network-to-Network Interface Implementation Agreement (Annex 1 Event Driven Procedures)*, Frame Relay Forum, July, 1995.

# Prerequisites

## Enabling FRF2.1 Annex 1 Feature

- The Frame Relay component must be loaded before FRF2.1 Annex 1 can be enabled. FRF2.1 Annex 1 will enable LAPF as part of the Annex 1 operation.
- Frame Relay switching and encapsulation must be enabled before you can configure switched PVCs.

# Configuration Tasks

See the following sections for configuration tasks for the FRF2.1 Annex 1 feature. Each task in the list indicates if the task is optional or required.

- Configuring Frame Relay Interface and Switched PVCs (Required)
- Configuring Country Code ID (Optional)
- Configuring Network ID (Optional)

## Configuring Frame Relay Interface and Switched PVCs

To configure Frame Relay switching using FRF2.1 Annex 1, PVCs must be added to both slot/port configurations. Table 1 provides the first set of commands necessary to begin this configuration task. Table 2 provides the second set of commands necessary to complete the configuration task. “Frame Relay Interface and Switched PVCs configuration” section on page 7 provides a working example of these commands.

**Table 1** *Configure Frame Relay Switching, Encapsulation and Switched PVCs on first port*

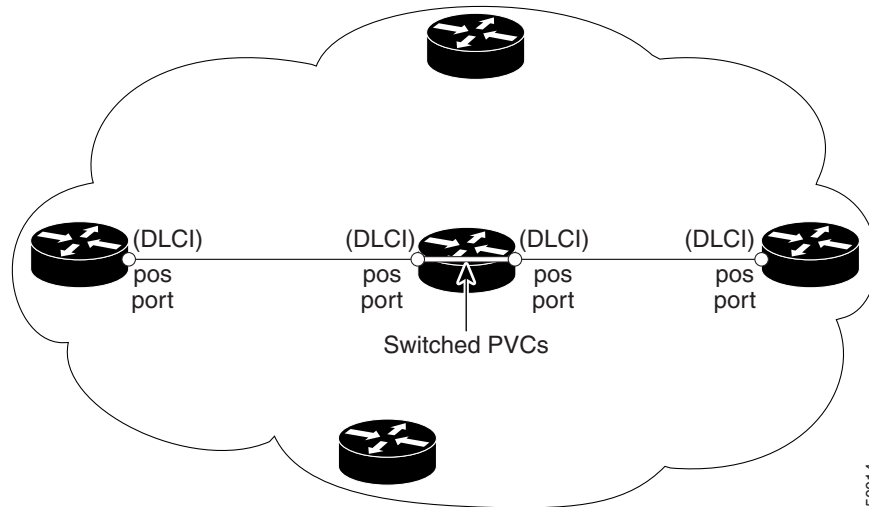
	Command	Purpose
Step 1	Router(config)# <b>frame-relay switching</b>	Enables Frame Relay switching.
Step 2	Router(config)# <b>interface</b> <i>interface[slot/port]</i>	Specifies interface for configuration mode.
Step 3	Router(config-if)# <b>encapsulation frame-relay</b>	Turns on encapsulation feature on specified interface.
Step 4	Router(config-if)# <b>frame-relay nni-annex1</b>	Turns on annex1 event driven feature.
Step 5	Router(config-if)# <b>frame-relay route dlci interface</b> <i>interface[slot/port] dlci</i>	Adds PVC from one slot/port to another slot/port.
Step 6	Router(config-if)# <b>exit</b>	Exits from PVC configured interface.

**Table 2** *Configure Encapsulation and Switched PVCs on second port*

	Command	Purpose
Step 1	Router(config)# <b>interface</b> <i>interface[slot/port]</i>	Specifies interface for configuration mode for second slot/port PVC configuration.
Step 2	Router(config-if)# <b>encapsulation frame-relay</b>	Turns on encapsulation feature on specified interface for second slot/port configuration.

	Command	Purpose
Step 3	Router(config-if)# <b>frame-relay nni-annex1</b>	Turns on annex1 event driven feature for second slot/port configuration.
Step 4	Router(config-if)# <b>frame-relay route dlc1 interface interface[slot/port] dlc1</b>	Adds PVC from second slot/port to first slot/port.
Step 5	Router(config-if)# <b>end</b>	PVCs have now been added to both slot/ports.

**Figure 1** Generic Frame Relay Switched PVC example



**Note**

The same DLCI number must be assigned between two router ports within the Frame Relay network cloud. You can assign different DLCI numbers from port to port within the same router.

## Verifying Frame Relay Interface and Switched PVCs

Use any of the following show commands to verify that the Frame Relay and switched PVCs are enabled.

- **show running interface** *interface[slot/port]*
- **show interface** *interface[slot/port]*
- **show frame-relay route**
- **show frame-relay pvc**

## Troubleshooting Tips

If you experience difficulty verifying your configuration, check your router and line cards to make sure line cards are properly seated and all other mechanical functions are operating properly. Refer to the configuration that came with your router for troubleshooting details.

If LAPF is down, verify the maximum transmission unit (MTU) size and LAPF n201 size is identical at both ends of the link. Use the following commands to verify this information:

- **show running interface**

- `show frame-relay lapf interface`

## Configuring Country Code ID

To enable the country code for use in the PVC status message, use the following commands to configure the country code number and type. Country code ID is an optional command.

	Command	Purpose
Step 1	Router# <b>config terminal</b>	Enables global configuration mode.
Step 2	Router(config)# <b>interface</b> <i>interface[slot/port]</i>	Specifies interface for configuration mode.
Step 3	Router(config-if)# <b>frame-relay country-code</b> <i>number cc type</i>	Enables country code number and type to appear in PVC message status.
Step 4	Router(config-if)# <b>end</b>	Completes country code ID configuration.

## Verifying Country Code ID

Use the following command to verify that your country code identifier was properly established:

```
show running interface interface[slot/port]
```

## Configuring Network ID

To enable the network identifier for use in the PVC status message, use the following commands to configure the network identifier. This is an optional command.

	Command	Purpose
Step 1	Router# <b>config terminal</b>	Enables global configuration mode.
Step 2	Router(config)# <b>interface</b> <i>interface[slot/port]</i>	Specifies interface for configuration mode.
Step 3	Router(config-if)# <b>frame-relay network-id</b> <i>number</i>	Enables network identifier number to appear in PVC message status.
Step 4	Router(config-if)# <b>end</b>	Completes network ID configuration.

## Verifying Network ID

Use the following command to verify that your network identifier was properly established:

```
show running interface interface[slot/port]
```

## Monitoring and Maintaining FRF2.1 Annex 1

Use following show commands to monitor and maintain this feature.

Command	Purpose
Router# <b>show frame-relay route</b>	Displays switched Frame Relay PVCs.
Router# <b>show frame-relay pvc</b>	Displays all PVCs configured on the router.
Router# <b>show frame-relay inactive-reason</b>	Displays the inactive reason on a particular PVC configured interface.
Router# <b>show running interface</b> <i>interface[slot/port]</i>	Displays configuration for a specified configured interface.

## Configuration Examples

This section provides the following configuration examples:

- Frame Relay Interface and Switched PVCs configuration
- `show frame-relay pvc interface`
- `show frame-relay route`
- `show frame-relay inactive-reason`

## Frame Relay Interface and Switched PVCs configuration

```

router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
router(config)#frame-relay switching
router(config)#interface pos3/1
router(config-if)#encapsulation frame-relay
router(config-if)#frame-relay nni-annex1
router(config-if)#frame-relay route 500 interface pos3/0 501
router(config-if)#exit
router(config)#interface pos3/0
router(config-if)#encapsulation frame-relay
router(config-if)#frame-relay nni-annex1
router(config-if)#frame-relay route 501 interface pos3/1 500
router(config-if)#end
router#
008619: 3w4d: %SYS-5-CONFIG_I: Configured from console by console
router#show running interface pos3/1
Building configuration...

Current configuration:
!
interface POS3/1
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay
  crc 16
  clock source internal
  frame-relay intf-type nni
  frame-relay nni-annex1
  frame-relay route 21 interface POS3/0 20
  frame-relay route 100 interface POS5/0 100
  frame-relay route 230 interface POS5/0 230
  frame-relay route 500 interface POS3/0 501
  frame-relay lapf n201 4470
end

```

## show frame-relay pvc interface

```

router#show frame-relay pvc interface pos3/1 100

PVC Statistics for interface POS3/1 (Frame Relay NNI)

DLCI = 100, DLCI USAGE = SWITCHED, PVC STATUS = INACTIVE, INTERFACE = POS3/1
LOCAL PVC STATUS = INACTIVE, NNI PVC STATUS = ACTIVE

input pkts 5          output pkts 5          in bytes 520
out bytes 520        dropped pkts 0          in FECN pkts 0
in BECN pkts 0      out FECN pkts 0        out BECN pkts 0
in DE pkts 0         out DE pkts 0          out bcast pkts 0
out bcast pkts 0    out bcast bytes 0
switched pkts 10
Detailed packet drop counters:
no out intf 0        out intf down 0        no out PVC 0
in PVC down 0        out PVC down 0         pkt too big 0
pvc create time 3w4d, last time pvc status changed 1w0d

```

## show frame-relay route

```

router#show frame-relay route
Input Intf      Input Dlci      Output Intf      Output Dlci      Status
-----
POS3/1          21              POS3/0           20              inactive
POS3/1          100             POS5/0           100             inactive
POS3/1          230             POS5/0           230             inactive
POS3/2          100             POS5/2           100             inactive
POS3/2          230             POS5/2           230             inactive
POS5/0          100             POS3/1           100             inactive
POS5/0          230             POS3/1           230             inactive
POS5/2          100             POS3/2           100             inactive
POS5/2          230             POS3/2           230             inactive

```

## show frame-relay inactive-reason

```

router#show frame-relay inactive-reason interface pos3/1 230
LAPF released in this network: country 25, network 2112

```

## Command Reference

This section documents new commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0(S) command reference publications.

- **frame-relay nni-annex1**
- **frame-relay country-code**
- **frame-relay network-id**
- **show frame-relay inactive-reason**



# frame-relay nni-annex1

To enable FRF2.1 Annex procedures on a Frame Relay encapsulated surface, use the **frame-relay nni-annex1** global configuration command. To increase the LAPF packet size on some GSR line cards, use the **frame-relay nni-annex1 [padding <number>]** command. To disable **frame-relay nni-annex1**, use the **no** form of this command.

**frame-relay nni-annex1 [padding <number>]**

**no frame-relay nni-annex1**

Syntax Description	padding	Hidden keyword.
	<i>number</i>	Default value 10. Valid values are from 3 to 10.

**Defaults** The default value is *number* with a value of 10.

**Command Modes** Global Interface Configuration

Command History	Release	Modification
	12.0(14)S	This command was introduced.

**Usage Guidelines** You can configure the padding size using a value between 3 and 10. Configuring the LAPF packet padding size smaller than the GSR line card will support is not allowed. This hidden keyword and syntax is used only with the GSR product line.

**Examples** The following example shows how slot 3/port 0 is configured to pad the LAPF packet out to 7 bytes:

```
router(config)#interface pos3/0
router(config-if)#frame-relay nni-annex1 padding 7
router(config-if)#end
router#show running interface pos3/0
Building configuration...
```

```
Current configuration:
!
interface POS3/0
 ip address 2.2.2.2 255.255.255.0
 no ip directed-broadcast
 encapsulation frame-relay
 crc 32
 frame-relay intf-type nni
 frame-relay nni-annex1 padding 7
 frame-relay route 20 interface POS3/2 20
 frame-relay route 21 interface POS3/1 21
 frame-relay route 22 interface POS3/1 22
 frame-relay lapf n201 4470
end
```

<b>Related Commands</b>	<b>Command</b>	<b>Description</b>
	None	

# frame-relay country-code

To enter the country code for use in the PVC status message, use the **frame-relay country-code** *number cc type* global configuration command. To disable **frame-relay country-code**, use the **no** form of this command.

**frame-relay country-code** *number cc type*

**no frame-relay country-code** *number cc type*

## Syntax Description

<i>number</i>	Default value 0. Valid value from 0 to 999.
<i>cc type</i>	Default value 0. Valid value is 0 or 1.

## Defaults

The default value is *number* with a value of 0.

The default value is *cc type* with a value of 0.

## Command Modes

Global Interface Configuration

## Command History

Release	Modification
12.0(14)S	This command was introduced.

## Usage Guidelines

Use this command when a country code is required in PVC status messages.

When you assign the *cc type*, use 0 (E.164) for country code type and 1 (X.121) for data country code type.

**Examples**

The following example shows a country code with a value of 75 and country code type value 0:

```
router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
router(config)#interface pos3/1
router(config-if)#frame-relay country-code 75 0
router(config-if)#end
router#show running interface pos3/1
Building configuration...
```

Current configuration:

```
!
interface POS3/1
no ip address
no ip directed-broadcast
encapsulation frame-relay
crc 16
clock source internal
frame-relay intf-type nni
frame-relay nni-annex1
frame-relay network-id 2112
frame-relay country-code 75 0
frame-relay route 21 interface POS3/0 20
frame-relay route 100 interface POS5/0 100
frame-relay route 230 interface POS5/0 230
frame-relay lapf n201 4470
end
```

**Related Commands**

Command	Description
<b>frame-relay network-id</b>	National network identifier for use in PVC message status.

# frame-relay network-id

To enter a National Network identifier code for use in the PVC status message, use the **frame-relay network-id** *number* global configuration command. To disable **frame-relay network-id**, use the **no** form of this command.

**frame-relay network-id** *number*

**no frame-relay network-id** *number*

<b>Syntax Description</b>	<i>number</i>	Network identifier assigned a value from 0 to 99999
<b>Defaults</b>	The default value is <i>number</i> with value of 0.	
<b>Command Modes</b>	Global Interface Configuration	
<b>Command History</b>	<b>Release</b>	<b>Modification</b>
	12.0(14)S	This command was introduced.
<b>Usage Guidelines</b>	The network identifier is determined by the user.	

**Examples**

The following example shows the network identifier configured to a value of 2112:

```

router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
router(config)#interface pos3/1
router(config-if)#frame-relay network-id 2112
router(config-if)#end
router#
008617: 3w4d: %SYS-5-CONFIG_I: Configured from console by console
router#show running interface pos3/1
Building configuration...

Current configuration:
!
interface POS3/1
  no ip address
  no ip directed-broadcast
  encapsulation frame-relay
  crc 16
  clock source internal
  frame-relay intf-type nni
  frame-relay nni-annex1
  frame-relay network-id 2112
  frame-relay country-code 75 0
  frame-relay route 21 interface POS3/0 20
  frame-relay route 100 interface POS5/0 100
  frame-relay route 230 interface POS5/0 230
  frame-relay lapf n201 4470
end

```

**Related Commands**

Command	Description
<b>frame-relay country-code</b>	Country code identifier for PVC message status.

# show frame-relay inactive-reason

To display the inactive reason on a particular PVC configured interface, use the **show frame-relay inactive-reason** *interface[slot/port] dlc* global configuration command.

**show frame-relay inactive-reason interface** *interface[slot/port] dlc*

Syntax Description	Parameter	Description
	<b>interface</b>	Keyword for interface.
	<i>interface</i>	Type of interface connection.
	<i>slot</i>	Line card slot number.
	<i>port</i>	Line card port number.
	<i>dlci</i>	Frame Relay PVC dlc number assigned a value from 16 to 1007.

**Defaults** No default behavior or values.

**Command Modes** EXEC command

Command History	Release	Modification
	12.0(14)S	This command was introduced.

**Usage Guidelines** This command is applicable only to inactive PVCs.

**Examples** The following example shows the inactive reason on slot3/port 1:

```
router#show frame-relay inactive-reason interface pos3/1 230
LAPF released in this network: country 0, network 0
```

```
router#show running interface pos3/1
Building configuration...
```

```
Current configuration:
!
interface POS3/1
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay
 crc 16
 clock source internal
 frame-relay intf-type nni
 frame-relay nni-annex1
 frame-relay route 22 interface POS3/0 22
 frame-relay route 100 interface POS5/0 100
 frame-relay route 230 interface POS5/0 230
 frame-relay lapf n201 4470
end
```

■ **show frame-relay inactive-reason**

<b>Related Commands</b>	<b>Command</b>	<b>Description</b>
	<b>show frame-relay pvc</b>	Displays all PVCs configured on the router.



# Debug Commands

This section documents new debug commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0(S) command reference publications.

- **debug frame-relay nni-extended event interface**
- **debug frame-relay nni-extended packet interface**

# debug frame-relay nni-extended event interface

To display debug messages for Frame Relay PVC NNI events, use the **debug frame-relay nni event interface** *interface[slot/port] dlci* EXEC command. To disable **debug frame-relay nni event interface**, use the **no** form of this command.

**debug frame-relay nni event interface** *interface[slot/port] dlci*

**no debug frame-relay nni event interface** *interface [slot/port] dlci*

## Syntax Description

<b>interface</b>	keyword for interface
<i>interface</i>	Type of interface connection
<i>slot</i>	Line card slot number
<i>port</i>	Line card port number
<i>dlci</i>	Frame Relay PVC dlci number

## Defaults

No default behavior or values.

## Command History

Release	Modification
12.0(14)S	This command was introduced.

## Examples

The following example shows frame-relay event debugging on slot3/port 1:

```
router#debug frame-relay nni-extended event interface pos3/1 230
Frame Relay NNI Extended event debugging is on
Display FR nni extended-switching event debug on interface POS3/1 dlci 230
```

## Related Commands

Command	Description
<b>frame-relay nni-annex1</b>	Enables FRF2.1 Annex 1 procedures on a Frame Relay encapsulated surface.

# debug frame-relay nni-extended packet interface

To display debug messages for Frame Relay PVC status messages, use the **debug frame-relay nni packet interface** *interface[slot/port] dlc* EXEC command. To disable **debug frame-relay nni packet interface**, use the **no** form of this command

**debug frame-relay nni packet interface** *interface[slot/port] dlc*

**no command debug frame-relay nni packet interface** *interface[slot/port] dlc*

## Syntax Description

<b>interface</b>	keyword for interface
<i>interface</i>	Type of interface connection
<i>slot</i>	Line card slot number
<i>port</i>	Line card port number
<i>dlci</i>	Frame Relay PVC number

## Defaults

No default behavior or values.

## Command History

Release	Modification
12.0(14)S	This command was introduced.

## Examples

The following example shows frame-relay packet debugging on slot3/port 1:

```
router#debug frame-relay nni-extended packet interface pos3/1 230
Frame Relay NNI Extended packet debugging is on
Display FR nni extended-switching packet debug on interface POS3/1 dlc
```

## Related Commands

Command	Description
<b>frame-relay nni-annex1</b>	Enables FRF2.1 Annex 1 procedures on a Frame Relay encapsulated surface.

# Glossary

**Data Link Connection Identifier (DLCI)**—A unique number assigned to a PVC end point in a frame relay network. Identifies a particular PVC endpoint within a user's access channel in a frame relay network and has local significance only to that channel.

**Encapsulation**—A process by which an interface device places an end device's protocol-specific frames inside a frame relay frame. The network accepts only frames formatted specifically for frame relay; hence, interface devices acting as interfaces to an frame relay network must perform encapsulation. See also Interface device or Frame-Relay-Capable Interface Device.

**Internet Operating System (IOS)**—Cisco system software that provides common functionality, scalability, and security for all products under the CiscoFusion architecture. Cisco IOS allows centralized, integrated, and automated installation and management of internetworks, while ensuring support for a wide variety of protocols, media, services, and platforms.

**Link Access Protocol for Frame bearer services (LAPF)**—LAPF is used to convey data link service data units between DL-service users in the U-plane for frame mode bearer services across the user-network interface.

**Local Management Interface (LMI)**—Set of enhancements to the basic Frame Relay specifications.

**maximum transmission unit (MTU)**—Maximum packet size, in bytes, that a particular interface can handle.

**Network-to-Network Interface (NNI)**—Frame Relay standard that defines the interface between two Frame Relay switches that are both located in a private network or are both located in a public network. The interface between a public switch and private one is defined by the UNI standard.

**permanent virtual circuit (PVC)**—A frame relay logical link, whose endpoints and class of service are defined by network management. Analogous to an X.25 permanent virtual circuit, a PVC consists of the originating frame relay network element address, originating data link control identifier, terminating frame relay network element address, and termination data link control identifier. Originating refers to the access interface from which the PVC is initiated. Terminating refers to the access interface at which the PVC stops. Many data network customers require a PVC between two points. Data terminating equipment with a need for continuous communication use PVCs. See also Data Link Connection Identifier (DLCI)