



Network Services Engine

This document describes how to configure the network services engine (NSE) on Cisco 7200 VXR series routers. It includes the following sections:

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Feature Overview

The network services engine (NSE) is the latest processor engine for Cisco 7200 VXR series routers. The NSE delivers wire rate OC-3 throughput while running concurrent high-touch WAN edge services. It is the first Cisco processing engine to offer integrated hardware acceleration increasing Cisco 7200 VXR series system performance by 50 to 300% for combined “high touch” edge services. The NSE takes advantage of a new technology called Parallel eXpress Forwarding (PXF).

Benefits

Accelerated Services

The following features are accelerated on the NSE: Network Address Translation (NAT), weighted fair queuing (WFQ), and NetFlow for both enterprise and service provider customers.

PXF Field Upgradable

Parallel eXpress Forwarding (PXF) is based on microcode and can be upgraded with new software features in future IOS releases.

The PXF processor enables IP parallel processing functions that work with the primary processor to provide accelerated IP Layer 3 feature processing. The PXF processor off-loads IP packet processing and switching functions from the Route Processor (RP) to provide accelerated and highly consistent switching performance when coupled with one or more of several IP services features such as access control lists (ACLs), address translation, quality of service (QoS), flow accounting, and traffic shaping.

PXF offers the advantage of hardware-based switching power, plus the flexibility of a programmable architecture. The PXF architecture provides future-proofing—if additional features are added in the future, an application-specific integrated circuit (ASIC) will not be required. New features for accelerated services can be added by reprogramming the PXF processor.

System Requirements

An NSE-1 can be used on existing Cisco 7200 VXR series routers with Cisco IOS Release 12.1(1)E or later version of Cisco IOS Release 12.1 E, and with Cisco IOS Release 12.1(5)T or later version of Cisco IOS Release 12.1 T.

High Performance

Network layer services such as traffic management, security, and QoS benefit significantly from NSE-1 high-performance. NSE-1 is the first Cisco processing engine to offer integrated hardware acceleration increasing Cisco 7200 VXR series system performance by 50 to 300 percent for combined “high-touch” WAN edge services.

Restrictions

Normal IOS packet debugging facilities are not enabled while PXF is configured. To enable IOS packet debugging facilities, disable PXF using the **no ip pxf** configuration command.

Related Documents

- *Network Processing Engine and Network Services Engine Installation and Configuration*
- For configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.



Note You can access Cisco IOS software configuration and hardware installation and maintenance documentation on the World Wide Web at <http://www.cisco.com>, <http://www-china.cisco.com>, or <http://www-europe.cisco.com>.

Supported Platforms

- Cisco 7204 VXR
- Cisco 7206 VXR

Supported Standards, MIBs, and RFCs

Standards

None

MIBs

None

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on CCO at <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

RFCs

None

Prerequisites

Before enabling the PXF processor, you must have IP routing and IP Cisco Express Forwarding (CEF) switching turned on.

Configuration Tasks

The PXF processor is turned on by default. If it is ever disabled, you must enable it to take advantage of IP packet switching and feature acceleration.



Note

Before enabling the PXF processor, you must have IP routing and IP CEF switching turned on.

See the following sections for configuration tasks. Each task in the list indicates if it is optional or required:

- Configuring the Network Services Engine (Required)
- Verifying the Network Services Engine (Optional)

Configuring the Network Services Engine

	Command	Purpose
Step 1	Router# configure terminal	Enters global configuration mode.
Step 2	Router(config)# [no] ip pxf	Enables PXF processing.

Verifying the Network Services Engine

Enter the **show pxf accounting** command to view all interfaces.

```
Router# show pxf accounting ?
  ATM          ATM interface
  Ethernet     IEEE 802.3
  FastEthernet FastEthernet IEEE 802.3
  Hssi         High Speed Serial Interface
  Null         Null interface
  POS          Packet over Sonet
  Serial       Serial
  summary     PXF summary statistics
```

Troubleshooting Tips

Use the following workarounds if you encounter an error message:

Error Message	Workaround
WARNING:PXF Exception:mac_xid=0x10000 *** IHB watchdog timer expired 6d16h:%PXF-2-EXCEPTION:pxf exception on pxf tmc.	Run the show pxf crash command to obtain more information.
PXF processor hang and error message: WARNING:PXF Exception:mac_xid=0x8 *** External Memory Column 3 exception, type = 20	This error message indicates that the PXF processor has been left in HALT state. During boot up, the PXF processor is in error state and cannot be brought up. To workaround this problem, reload the router.
PXF processor crash and error message: 00:49:37:Fatal pxf interrupt, int_reg=0x80, int_mask=0xFFFF, config=0x1FF4000 00:49:37:-Traceback= 6055B9CC 60530D10	This message indicates the PXF processor encountered a serious error and crashed. To workaround this problem, reload the router.

Monitoring and Maintaining the NSE

Command	Purpose
Router# show pxf accounting	Displays PXF switching statistics for all interfaces.
Router# show pxf accounting ethernet	Displays PXF switching statistics for ethernet interfaces.
Router# show pxf accounting null	Displays PXF switching statistics for NULL interfaces.
Router# show pxf accounting pos	Displays PXF switching statistics for packet OC-3 interfaces.
Router# show pxf accounting serial	Displays PXF switching statistics for serial interfaces.
Router# show pxf accounting summary	Displays a summary of PXF switching statistics.
Router# show pxf crash	Displays PXF crash information.

Command	Purpose
Router# show pxf feature cef	Displays PXF routing feature tables for CEF.
Router# show pxf feature nat	Displays PXF routing tables for NAT.
Router# show pxf interface	Displays a summary of the interfaces in the router and the PXF features and capabilities are enabled on these interfaces.

Configuration Examples

This section provides two configuration examples using **show** commands:

- Use the **show version** command to display the configuration of the system hardware, including the NPE or NSE and the software version. The following example shows an NSE installed in a Cisco 7206 VXR router:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-JS-M), Version 12.1(5)T
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Wed 22-Mar-00 08:37 by Biff
Image text-base:0x60008900, data-base:0x6141C000
```

(display text omitted)

```
cisco 7206VXR (NSE-1) processor (revision A) with 122880K/8192K bytes of memory.
R7000 CPU at 262Mhz, Implementation 39, Rev 1.0, 256KB L2 Cache6 slot VXR midplane,
Version 2.0
```

(display text omitted)

```
PFX processor tmc is running.
6 FastEthernet/IEEE 802.3 interface(s)
10 Serial network interface(s)
2 HSSI network interface(s)
2 Channelized T3 port(s)
125K bytes of non-volatile configuration memory.
```

- Use the **show c7200** command to obtain information about the router.

```
Router# show c7200
Network IO Interrupt Throttling:
throttle count=0, timer count=0
active=0, configured=0
netint usec=4000, netint mask usec=200

C7200 Midplane EEPROM:
Hardware revision 2.0          Board revision A0
Serial number 16061833        Part number 73-3223-05
Test history 0x0              RMA number 00-00-00
MAC=00b0.4aae.4000, MAC Size=1024
EEPROM format version 1, Model=0x6
EEPROM contents (hex):
0x20:01 06 02 00 00 F5 15 89 49 0C 97 05 00 B0 4A AE
0x30:40 00 04 00 00 00 00 00 00 01 13 50 00 00 FF 00
```

```

C7206VXR CPU EEPROM:
Hardware revision 1.2          Board revision A0
Serial number 15053437        Part number 73-3453-04
Test history 0x0              RMA number 00-00-00
EEPROM format version 1
EEPROM contents (hex):
0x20:01 C2 01 02 00 E5 B2 7D 49 0D 7D 04 00 00 00 00
0x30:50 00 00 00 00 01 14 00 00 00 FF FF FF FF FF FF

```

```

C7200 PE EEPROM:
Hardware Revision :1.0
Top Assy. Part Number :800-05272-04
Part Number :73-4068-02
Board Revision :A0
PCB Serial Number :12342775
RMA History :00
Fab Version :02
Fab Part Number :28-3146-02
Product Number :NSE1
EEPROM format version 4
EEPROM contents (hex):
0x00:04 FF 40 00 DE 41 01 00 C0 46 03 20 00 14 98 04
0x10:82 49 0F E4 02 42 41 30 C1 8B 31 32 33 34 32 37
0x20:37 35 20 20 20 04 00 02 02 85 1C 0C 4A 02 CB 84
0x30:4E 53 45 31 FF FF FF FF FF FF FF FF FF FF FF FF
0x40:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x50:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x60:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
0x70:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

```

Command Reference

This section documents new commands. All other commands used with this feature are documented in the Cisco IOS Release 12.1 command reference publications.

- **show pxf accounting**
- **show pxf crash**
- **show pxf feature cef**
- **show pxf feature nat**
- **show pxf interface**

show pxf accounting

To show PXF switching statistics for individual interfaces, use the **show pxf accounting EXEC** command.

```
show pxf accounting interface [slot/port]
```

Syntax Description		
	<i>interface</i>	(Optional) Specifies the type of interface to display.
	<i>slot</i>	(Optional) Backplane slot number on the Cisco 7200 VXR series routers. On the Cisco 7200 VXR series routers, the value can be 0 to 6.
	<i>port</i>	(Optional) Port number of the interface. On the Cisco 7200 VXR series routers, the value can be 0 to 5.

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.1(1)E	This command was introduced.
	12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T.

Usage Guidelines You can display information about the following interface types using the **show pxf accounting interface** command:

Keyword	Interface Type
<i>atm</i>	ATM interface
<i>ethernet</i>	Ethernet interface
<i>fastethernet</i>	FastEthernet interface
<i>hssi</i>	High Speed Serial interface
<i>null</i>	Null interface
<i>pos</i>	Packet-over-SONET interface
<i>serial</i>	Synchronous serial interface
<i>summary</i>	PFX summary statistics

Examples

The following is sample output from the **show pxf accounting ?** command:

```
Router# show pxf accounting ?
  ATM          ATM interface
  Ethernet     IEEE 802.3
  FastEthernet FastEthernet IEEE 802.3
  Hssi        High Speed Serial Interface
  Null        Null interface
  POS         Packet over Sonet
  Serial      Serial
  summary    PXF summary statistics
```

The following example is sample output from the **show pxf accounting ethernet** command using a ethernet interface in slot 4 on a Cisco 7200 VXR series router:

```
Router# show pxf accounting ethernet 4/0
Interface  Pkts In  Chars In  Pkts Out  Chars Out  Punted  Dropped
Ethernet4/0  0        0        122      11490     4       0
```

The following example is sample output from the **show pxf accounting null** command using a null interface in slot 0 on a Cisco 7200 VXR series router:

```
Router# show pxf accounting null 0/0
Interface  Pkts In  Chars In  Pkts Out  Chars Out  Punted  Dropped
nu0/0     0        0        0         0         4932    0
```

The following example is sample output from the **show pxf accounting pos** command using a Packet-over-SONET interface in slot 4 on a Cisco 7200 VXR series router:

```
Router# show pxf accounting pos
Interface  Pkts In  Chars In  Pkts Out  Chars Out  Punted  Dropped
POS4/0    19       1064     0         0         44     0
```

The following example is sample output from the **show pxf accounting serial** command using a serial interface in slot 5 on a Cisco 7200 VXR series router:

```
Router# show pxf accounting serial 5/0
Interface  Pkts In  Chars In  Pkts Out  Chars Out  Punted  Dropped
Serial5/0  0        0        0         0         0       0
```

The following example is sample output from the **show pxf accounting summary** command:

```

Router# show pxf accounting summary
      Pkts      Dropped  RP Processed      Ignored
      Total          0          48360          0

PXF Statistic:
Packets RP -> PXF:
  switch ip:          0
  switch raw:      30048360
  qos fastsend:     0
  qos enqueue:      1938
Total:              30050298

Packets PXF -> RP:
  qos pkts:          1938
  fast pkts:      30000000
  drops:total       0
  punts:total       48360
  "    not IP      :    40572
  "    CEF no adjacency :    7788
Total:              30050298

Packets ignored:          0 | ring space:
  shadow ring full:      0 | shadow ring:      16384
  in ring full:         0 | inring:           968
  PXF inactive:         0

tx credits:              16230330 | delayed credits:          0
holdq enqueues:          0 | requeue drops:           0
interrupts:              40538 | interrupt misses:      1947
interrupt packets:      53326
pending read bytes:      0

      Interface  Pkts In  Chars In  Pkts Out  Chars Out  Punted  Dropped
      Fa0/0      0      0      30000000  1740000000  970     0
      Et1/0      0      0      0      0      21309   0
      Et1/1      0      0      0      0      0       0
      Et1/2      0      0      0      0      0       0
      Et1/3      0      0      0      0      0       0
      Se2/0      0      0      0      0      963     0
      Se2/1      0      0      0      0      0       0
      Se2/2      0      0      0      0      0       0
      Se2/3      0      0      0      0      0       0
      Fa3/0      0      0      0      0      963     0
      PO4/0     30000000  1440000000  0      0      963     0
      AT5/0      0      0      0      0     23192   0
      Vi1        0      0      0      0      0       0
      Vt1        0      0      0      0      0       0
      Vi2        0      0      0      0      0       0

```

Related Commands

Command	Description
show pxf crash	Displays PXF crash information.
show pxf interface	Displays a summary of the interfaces in the router and the PXF features and capabilities are enabled on these interfaces.
show pxf feature	Displays the PXF routing feature tables for enabled PXF features.

show pxf crash

To show PXF crash information, use the **show pxf crash EXEC** command.

show pxf crash

Syntax Description This command has no arguments or keywords.

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.1(1)E	This command was introduced.
	12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T.

Examples

The following is sample output from the **show pxf crash** command:

```
Router# show pxf crash
  EX_Type = 0x80000000
  EX_ID(b0~3,16~17) = 0x00400
  CPU_EX_ID(b0~15) = 0x0004
  IHB_EX_Type(b0~5) = 0x00
  XRAM0(b0~13) = 0x00000
  XRAM1(b0~13) = 0x00000
  XRAM2(b0~13) = 0x00000
  XRAM3(b0~13) = 0x00000
  Pipeline:7FDEFD pdone[3210]:1F 17 17 1D

  ICM0(b4~13) = 0x00000  ICM1(b4~13) = 0x00000
  ICM2(b4~13) = 0x00010  ICM3(b4~13) = 0x00000
  LOCK0(b0~4) = 0x00000  LOCK1(b0~4) = 0x00000
  LOCK2(b0~4) = 0x00000  LOCK3(b0~4) = 0x00000
  CPU0/2: SW EX Type=0x00000000 LBUS EX Type=0x00000081 HW EX
  Type=0x00000400

  CPU:row=0x0 column=0x2 cpu=0x2
  PC:0000098E  LR:0000087F  CR:002C4C00
  r0:00000000  r1:8001CEA0  r2:80784390  r3:00000000
  r4:00005400  r5:80D3BA04  r6:80A7CA00  r7:00000004
  r8:00000000  r9:00000008  r10:80092324  r11:800A6200
  r12:00000033  r13:00000008  r14:00000000  r15:00000000
  misr1a:00000000  misr1bhi:00000000  misr1blo:00000000  misr2hi:00000000
  misr2lo:00000000  reserve:00000000  reserve:00000000  reserve:00000000
  sisr1a:01000040  sisr1b:00000000  irhi:4402200F  irlo:00000000
  cAll:C20DE822  DCD1:00020400  DCD2:00000002  CNTL:00000000
  TBuf intr 0:1111111F
  TBuf intr 1:020FFFF0
  TBuf intr 2:00003C80
  TBuf intr 3:80000000
```

```
TBuf intr 4:00000400
Xram return:00000000
Icram return hi:80024E00
Icram return lo:800A4E00
TBuf addr 0:005E6800 TBuf sblock1 0:8078A374 TBuf sblock0 0:804FD600
TBuf addr 1:005E6800 TBuf sblock1 1:8078A374 TBuf sblock0 1:804FD600
TBuf addr 2:005E6800 TBuf sblock1 2:8078A374 TBuf sblock0 2:804FD600
TBuf addr 3:005E6800 TBuf sblock1 3:8078A374 TBuf sblock0 3:804FD600
TBuf addr 4:005E6800 TBuf sblock1 4:8078A374 TBuf sblock0 4:804FD600
TBuf addr 5:005E6800 TBuf sblock1 5:8078A374 TBuf sblock0 5:804FD600
TBuf addr 6:005E6800 TBuf sblock1 6:8078A374 TBuf sblock0 6:804FD600
TBuf addr 7:005E6800 TBuf sblock1 7:8078A374 TBuf sblock0 7:804FD600
```

show pxf feature cef

To display PXF routing feature tables for Cisco Express Forwarding (CEF), use the **show pxf feature cef EXEC** command.

show pxf feature cef *entry*

Syntax Description	entry	Display PXF entry.
--------------------	-------	--------------------

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.1(1)E	This command was introduced.
	12.1(5)T	This command integrated into Cisco IOS Release 12.1(5)T.

Examples The following is sample output from the **show pxf feature cef** command:

```
Router# show pxf feature cef entry
Shadow 16-4-4-8 PXF Mtrie:
  41 leaves, 1968 leaf bytes, 15 nodes, 267000 node bytes
  5 invalidations
  46 prefix updates
  refcounts: 66746 leaf, 66720 node
```

```
Prefix/Length      Refcount   Parent
0.0.0.0/0          62282
0.0.0.0/32         3          0.0.0.0/0
171.69.12.128/27   34         0.0.0.0/0
171.69.12.128/32   3          171.69.12.128/27
171.69.12.129/32   3          171.69.12.128/27
171.69.12.130/32   3          171.69.12.128/27
171.69.12.131/32   3          171.69.12.128/27
171.69.12.147/32   3          171.69.12.128/27
```

(display text omitted)

Related Commands	Command	Description
	show pxf feature nat	Displays PXF routing feature tables for NAT.

show pxf feature nat

To display PXF routing tables for Network Address Translation (NAT), use the **show pxf feature nat** EXEC command.

```
show pxf feature nat [entry | stat | tcp]
```

Syntax	Description
<i>entry</i>	Displays NAT information.
<i>stat</i>	Displays NAT processing information.
<i>tcp</i>	Displays NAT TCP logging information.

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.1(1)E	This command was introduced.
	12.1(5)T	This command integrated into Cisco IOS Release 12.1(5)T.

Examples The following is sample output from the **show pxf feature entry** command:

```
Router# show pxf feature nat entry
--- 171.69.12.175      192.168.0.129      ---      ---
--- 171.69.12.163      192.168.0.7        ---      ---
--- 171.69.12.161      192.168.0.13       ---      ---
--- 171.69.12.162      192.168.0.3        ---      ---
--- 171.69.12.165      192.168.0.8        ---      ---
--- 171.69.12.168      192.168.0.14       ---      ---
--- 171.69.12.170      192.168.0.12       ---      ---
--- 171.69.12.166      192.168.0.15       ---      ---
--- 171.69.12.164      192.168.0.16       ---      ---
```

Related Commands	Command	Description
	show pxf feature cef	Displays PXF routing feature tables for CEF.

show pxf interface

To show a summary of the interfaces on the router and the PXF features or capabilities enabled on these interfaces use the **show pxf interface** command.

show pxf interface

Syntax Description This command has no arguments or keywords.

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.1(3a)E	This command was introduced.
	12.1(5)T	This command integrated into Cisco IOS Release 12.1(5)T.

Examples The following is sample output from the **show pxf interface** command:

```
Router# show pxf interface
  Intf  I/f #  Attributes
Fa0/0   3    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 101)
Et1/0   4    Raw, Encap
Et1/1   5    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 13)
Et1/2   6    Raw, Encap
Et1/3   7    Raw, Encap
Se2/0   8    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 5)
Se2/1   9    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 5)
Se2/2  10    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 5)
Se2/3  11    Raw, Encap, QoS(Cr 0, Thrsh 2, Max 5)
Fa3/0  12    Raw, Encap
PO4/0  13    Raw, Encap
AT5/0  14    Raw, Encap
```

Related Commands	Command	Description
	show pxf feature	Displays the PXF routing feature tables for enabled PXF features.

■ show pxf interface