



Release Notes for Cisco uBR7200 Series for Cisco IOS Release 12.1 T

November 27, 2000



Note

You can find the most current Cisco IOS documentation on Cisco Connection Online (CCO). These electronic documents may contain updates and modifications made after the hardcopy documents were printed.

These release notes for the Cisco uBR7200 Series Universal Broadband Routers describe the enhancements provided in Cisco IOS Release 12.1(5)T. These release notes are updated as needed.

For a list of the software caveats that apply to Release 12.1(5)T, see the “Caveats” section on page 41, the *Caveats for Cisco IOS Release 12.1* document, and the *Caveats for Cisco IOS Release 12.1 T* document. The caveats documents are updated for every maintenance release and are on CCO and the Documentation CD-ROM.

Use these release notes with *Cross-Platform Release Notes for Cisco IOS Release 12.1*, located on CCO and the Documentation CD-ROM.

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Introduction

The Cisco uBR7200 Series Universal Broadband Routers—the Cisco uBR7223, the Cisco uBR7246, and the Cisco uBR7246 VXR—are based on the Data Over Cable Service Interface Specification (DOCSIS) standards. Each is designed to be installed at a service provider's headend facility.

Cisco uBR7200 Series Universal Broadband Routers allow two-way transmission of digital data and Voice over IP (VoIP) traffic over a hybrid-fiber coaxial (HFC) network. These routers function as the cable modem termination system (CMTS) for subscriber-end devices such as Cisco uBR904 and Cisco uBR924 Cable Access Routers, and other DOCSIS-compliant cable modems (CMs) and set top boxes (STBs).

For cable plants not fully upgraded to support two-way cable transmission, the routers support DOCSIS-compliant telco return, where the cable modem's return path to the CMTS is via a dial-up telephone line connection instead of an upstream channel over the coaxial cable. The telco-return delivery mechanism enables cable operators to accelerate deployment of high-speed data services before the cable systems are upgraded to two-way plants.

The introduction of the WT2700 Wireless Technology Suite also allows the Cisco uBR7223, the Cisco uBR7246, and the Cisco uBR7246 VXR Universal Broadband Routers to become a two-way high-speed point-to-point broadband fixed wireless system that provides a fixed, dedicated wireless link from one headend site to another. This link delivers full-duplex data in unlicensed U-NII band (5.725 to 5.825 GHz). The WT2700 Wireless Technology Suite includes the point-to-point wireless modem card, which is installed in the Cisco uBR7200 series chassis, and the power feed panel, which is an external component.

The Cisco uBR7200 series routers support Internet Protocol (IP) routing with a wide variety of protocols and combinations of Ethernet, Fast Ethernet, Gigabit Ethernet, serial, High-Speed Serial Interface (HSSI), Packet over SONET (POS) OC-3 and OC-12c, and Asynchronous Transfer Mode (ATM) media.

Cisco IOS Release 12.1(5)T supports cable & fixed wireless system configurations using the Cisco uBR7246 VXR, Cisco uBR7246, and Cisco uBR7223.

Cisco uBR7246 VXR Universal Broadband Router

The Cisco uBR7246 VXR offers an industry-proven CMTS and carrier-class router in a scalable platform with a high-performance network processing engine to support data, voice, and video services for medium to large network installations.

The Cisco uBR7246 VXR provides the following major hardware features:

- High-performance network processing engine
- I/O controller
- Up to two network interface port adapters
- Up to four cable and/or wireless modem cards
- Up to two removable power supplies providing load-sharing and redundancy capabilities
- Two Personal Computer Memory Card International Association (PCMCIA) slots that allow for software upgrades through the use of Flash memory cards

**Note**

The Cisco uBR7246 VXR chassis does not support the MC11-FPGA cable modem card.

Cisco uBR7246 Universal Broadband Router

The Cisco uBR7246 offers an industry-proven CMTS and carrier-class router in a scalable platform to support data, voice, and video services for medium to large network installations.

The Cisco uBR7246 provides the following major hardware features:

- Network processing engine
- I/O controller
- Up to two network interface port adapters
- Up to four cable and/or wireless modem cards
- Up to two removable power supplies providing load-sharing and redundancy capabilities
- Two PCMCIA slots that allow for software upgrades through the use of Flash memory cards

Cisco uBR7223 Universal Broadband Router

The Cisco uBR7223 is a cost-effective, scalable interface between subscriber cable modems and the backbone data network, and is designed specifically for small to medium network installations.

The Cisco uBR7223 provides the following major hardware features:

- Network processing engine
- I/O controller
- One network interface port adapter
- Up to two cable and/or wireless modem cards
- One removable power supply (The Cisco uBR7223 does not feature load-sharing and redundant power supply capability like the Cisco uBR7246 VXR and Cisco uBR7246.)
- Two PCMCIA slots that allow for software upgrades through the use of Flash memory cards

Universal Broadband Router Overview

Table 1 provides a quick overview of the major hardware features of the three universal broadband routers.

Table 1 Cisco uBR7200 Series Universal Broadband Routers Overview

Hardware Supported	Cisco uBR7246 VXR	Cisco uBR7246	Cisco uBR7223
Network Processing Engine	One of the following: NPE-225 NPE-300	One of the following: NPE-150 NPE-200 NPE-225	One of the following: NPE-150 NPE-200 NPE-225
I/O Controller	1	1	1
Network Interface Port Adapters	up to 2	up to 2	1
Cable and/or Wireless Modem Cards	up to 4	up to 4	up to 2

Table 1 Cisco uBR7200 Series Universal Broadband Routers Overview

Hardware Supported	Cisco uBR7246 VXR	Cisco uBR7246	Cisco uBR7223
Removable Power Supplies	up to 2	up to 2	1
PCMCIA Slots	2	2	2

**Note**

Earlier release notes stated that the NPE-175 was also supported on the Cisco uBR7200 series routers. Because the NPE-175 has reached its end of life and was never made orderable on the Cisco uBR7200 series routers, it has been removed from the table.

Early Deployment Releases

These release notes describe the Cisco uBR7200 Series Universal Broadband Routers for Cisco IOS Release 12.1(5)T. Release 12.1 T is an early deployment (ED) release based on Release 12.1; early deployment releases contain fixes to software caveats as well as support for new Cisco hardware and software features. Other early deployment releases of the Cisco uBR7200 series routers are shown in Table 2; unless otherwise indicated, feature support is cumulative from release to release.

Table 2 Early Deployment Releases for the Cisco uBR7200 Series Universal Broadband Routers

ED Release	Additional Software Features ¹	Additional Hardware Features
Release 12.1(5)T	<ul style="list-style-type: none"> • AutoInstall using DHCP² for LAN Interfaces • Cable Downstream Frequency Override CLI³ • Closed User Group Selection Facility Suppress Option • IGMP⁴ Version 3 • Interface Index Persistence • Interface Range Specification • MSDP⁵ MIB⁶ • NAT⁷—Support for NetMeeting Directory (Internet Locator Service—ILS) • NTP⁸ MIB • Parser Cache • PIM⁹ Dense Mode State Refresh • PPPoE¹⁰ Termination on Cable interfaces • Router-Port Group Management Protocol 	None

Table 2 Early Deployment Releases for the Cisco BR7200 Series Universal Broadband Routers

ED Release	Additional Software Features ¹	Additional Hardware Features
Release 12.1(3)T	<ul style="list-style-type: none"> • Circuit Interface Identification MIB • Expression MIB Support of Delta, Wildcarding, and Aggregation • Individual SNMP¹¹ Trap Support • Source Specific Multicast 	None
Release 12.1(2)T	<ul style="list-style-type: none"> • Enhanced Per Modem Error Counter • MC16S LED¹² Enhancement • MPLS¹³ VPN¹⁴ Support for Subinterfaces and Interface Bundles • SNMP Cable Modem Remote Query 	None
Release 12.1(1a)T1	<ul style="list-style-type: none"> • Baseline Privacy Interface (BPI) MIB • Cable Subinterfaces and Interface Bundling Support for Virtual Private Networks • DOCSIS Quality of Service Enhancements • Dynamic Mobile Hosts • Enhanced Modem Status Display • Firewall Enhancements • Redirect-Number Support for RADIUS¹⁵ and TACACS+¹⁶ Servers • Upstream Address Verification Enhancement 	<ul style="list-style-type: none"> • Point-to-Point Wireless Modem Card and associated hardware components • Cisco Cable Clock Card • MC16E Cable Modem Card • MC16S Cable Modem Card

1. Only major features are listed. See the *Release Notes* for each particular release for a comprehensive feature list.
2. DHCP = Dynamic Host Configuration Protocol
3. CLI = command line interface
4. IGMP = Internet Group Management Protocol
5. MSDP = Multicast Source Discovery Protocol
6. MIB = Management Information Base
7. NAT = Network Address Translation
8. NTP = Network Time Protocol
9. PIM = Protocol Independent Multicast
10. PPPoE = Point-to-Point Protocol over Ethernet
11. SNMP = Simple Network Management Protocol
12. LED = light emitting diode
13. MPLS = Multiprotocol Label Switching
14. VPN = Virtual Private Network
15. RADIUS = Remote Access Dial-In User Service
16. TACACS+ = Terminal Access Controller Access Control System Plus

System Requirements

This section describes the system requirements for Release 12.1(5)T:

- Memory Recommendations, page 6
- System Interoperability, page 7
- Hardware Supported, page 8
- Determining Your Software Release, page 13
- Upgrading to a New Software Release, page 13
- Feature Set Tables, page 13

Memory Recommendations

Table 3 displays the memory recommendations of the Cisco IOS feature sets for the Cisco uBR7200 Series Universal Broadband Routers for Cisco IOS Release 12.1(5)T. Cisco uBR7200 Series Universal Broadband Routers are available with a 16-MB or 20-MB Type II PCMCIA Flash memory card.

Table 3 *Memory Recommendations for the Cisco uBR7200 Series Universal Broadband Routers, Release 12.1(5)T Feature Sets*

Feature Set	Software Image	Recommended Flash Memory	Recommended DRAM Memory	Runs From
Two-Way Data/VoIP and Wireless Images				
DOCSIS Two-Way	ubr7200-p-mz	16 MB Flash	64 MB DRAM	RAM
DOCSIS Two-Way IP Plus	ubr7200-is-mz	16 MB Flash	64 MB DRAM	RAM
DOCSIS Two-Way with BPI	ubr7200-k1p-mz	16 MB Flash	64 MB DRAM	RAM
DOCSIS Two-Way IP Plus with BPI	ubr7200-ik1s-mz	16 MB Flash	64 MB DRAM	RAM
Telco-Return Images				
DOCSIS IP Plus Telco Return	ubr7200-ist-mz	16 MB Flash	64 MB DRAM	RAM
DOCSIS IP Plus Telco Return with BPI	ubr7200-ik1st-mz	16 MB Flash	64 MB DRAM	RAM

The image subset legend for Table 3 is as follows:

- i = IP routing and non cable interface bridging including Network Address Translation (NAT)
- k1 = DOCSIS Baseline Privacy, which is subject to export controls
- p = IP routing with Intermediate System-to-Intermediate System (IS-IS) and Border Gateway Protocol (BGP); no bridging and no NAT
- s = “Plus” features: NAT and Inter-Switch Link (ISL)
- t = DOCSIS telco return



Note

All Cisco IOS Release 12.1(5)T images require 64 MB of DRAM. All images support all of the hardware listed in “Hardware Supported” on page 8, unless otherwise indicated.

System Interoperability

This section clarifies the operation of certain features in the Cisco uBR7200 Series Universal Broadband Routers:

- DOCSIS 1.0 Baseline Privacy

DOCSIS Baseline Privacy Interface (BPI) gives subscribers data privacy across the RF network, encrypting traffic flows between the CMTS and CM. BPI ensures that a CM, uniquely identified by its Media Access Control (MAC) address, can obtain keying material for services only it is authorized to access.

To enable BPI, choose software at both the CMTS and CM that support the mode of operation. For the Cisco uBR7200 series software, choose an image with “k1” in its file name or BPI in the feature set description.

The CM must also support BPI. CMs must have factory-installed RSA private/public key pairs to support internal algorithms to generate key pairs prior to first BPI establishment. BPI must be enabled via the DOCSIS configuration file.



Note RSA stands for Rivest, Shamir, and Adelman, inventors of a public-key cryptographic system.

- CM Interoperability

The Cisco uBR7200 series interoperates with the following cable modems:

- DOCSIS-based two-way CMs that support basic Internet access, VoIP, or VPN.
- Telco-return CMs—To support telco return, use a Cisco uBR7200 series software image that contains “t” in its file name. The telco-return CM must be DOCSIS-based or compliant, and must be configured to support telco return.



Note Some third-party telco-return CMs cannot receive traffic over the same downstream channel as CMs operating on a two-way data system. In these instances, segment your cable plant to allow more than one downstream channel.

- EuroDOCSIS CMs or set top boxes (STBs) with integrated EuroDOCSIS CMs using Cisco MC16E Cable Modem Cards and Cisco IOS Release 12.1(1a)T1 or higher. EuroDOCSIS operation support includes 8-MHz Phase Alternating Line (PAL) or Systeme Electronique Couleur Avec Memoire (SECAM) channel plans.

- DOCSIS 1.0 Extensions

The Cisco uBR7200 series support DOCSIS 1.0 quality of service (QoS) extensions that include:

- Multi-SID support, allowing the definition of multiple Service IDs (SIDs) on the upstream: Voice traffic can be designated on a higher QoS committed information rate (CIR) secondary SID, while data traffic can be forwarded on a best-effort basis on a primary SID. Secondary SIDs are higher QoS CIR-type classes that have a nonzero minimum reserved rate (CIR-type service). These SIDs receive preferential treatment at the CMTS for grants over any tiered best-effort type data SID of that upstream. Reliable operation with voice requires multiple SIDs—at least two per CM to separate voice from data. In DOCSIS 1.0, SIDs are set up statically. When supporting DOCSIS 1.0 extensions, SIDs can be set up statically or dynamically. Both the CMTS and CM must support this capability.

- CM-initiated dynamic MAC messages: Dynamic Service Addition (DSA) and Dynamic Service Deletion (DSD). These messages allow dynamic SIDs to be created and deleted at run-time on a per-VoIP call basis.
- Unsolicited grant service (constant bit-rate scheduling) on the upstream: This helps provide a higher-quality channel for upstream VoIP packets from an Integrated Telephony Cable Modem (ITCM) such as the Cisco uBR924 Cable Access Router.
- Ability to provide separate downstream rates for any given ITCM, based on the IP-precedence value in the packet: This helps separate voice signaling and data traffic that goes to the same ITCM to address rate shaping purposes.
- Concatenation—To increase the per-CM upstream throughput in certain releases of software, Cisco uBR7200 series software supports a concatenated burst of multiple MAC frames from a CM that supports concatenation.

**Note**

All DOCSIS 1.0 extensions are activated only when a CM or Cisco uBR924 that supports these extensions solicits services via dynamic MAC messages or the feature set. If the CMs in your network are pure DOCSIS 1.0-based, they will receive regular DOCSIS 1.0 treatment from the CMTS.

- **Clock Synchronization**

The Cisco uBR7200 series support clock hardware and software to enable high-quality delivery of IP telephony services through synchronized data transmissions. To support the clock feature set, a Cisco uBR7246 VXR chassis must be used. The Cisco uBR7246 VXR must contain a clock card and an MC16S or MC16E Cable Modem Card. Only the MC16S and the MC16E Cable Modem Cards support the external clock reference from the clock card to distribute that signal to CMs or set top boxes (STBs) attached to the specific network segments. The chassis must be running Cisco IOS Release 12.1(1a)T1 or higher.

Each cable modem must also support VoIP applications and the clock reference feature set to enable synchronized timing. The Cisco uBR924 Cable Access Router, running Cisco IOS Release 12.0(7)T or later, supports the clock reference feature set automatically.

Hardware Supported

Cisco IOS Release 12.1(5)T supports the following Cisco uBR7200 Series Universal Broadband Routers:

- Cisco uBR7223
- Cisco uBR7246
- Cisco uBR7246 VXR

For detailed descriptions of the new hardware features, see the “New and Changed Information” section on page 18.

Network Processing Engines

The Cisco uBR7223 and the Cisco uBR7246 support the following Network Processing Engines (NPEs) in Cisco IOS Release 12.1(5)T:

- NPE-150
- NPE-200
- NPE-225

The Cisco uBR7246 VXR supports the following NPEs in Cisco IOS Release 12.1(5)T:

- NPE-225
- NPE-300



Note

The NPE-300 is not supported on the Cisco uBR7223 and the Cisco uBR7246. The NPE-150 and NPE-200 are not supported on the Cisco uBR7246 VXR.

Cable Modem Cards

Cisco IOS Release 12.1(5)T supports the following cable modem cards, all of which provide connection to the HFC network:

- MC11C cable modem cards (which replace the original MC11-FPGA cable modem cards that are also supported for existing installations) offer the following ports:
 - one upstream port
 - one downstream port
- MC12C cable modem cards (which replace the original MC12 cable modem cards) offer the following ports:
 - two upstream ports
 - one downstream port
- MC14C cable modem cards (which replace the original MC14 cable modem cards) offer the following ports;
 - four upstream ports
 - one downstream port
- MC16C cable modem cards (which replace the MC16B cable modem cards that are also supported for existing installations) offer the following ports:
 - six upstream ports
 - one downstream port
- MC16E cable modem cards provide connection to an HFC network using the proposed EuroDOCSIS (Annex A) standard, and offer the following ports:
 - six upstream ports
 - one downstream port

- MC16S spectrum management cable modem cards offer the following ports:
 - six upstream ports, with dedicated hardware support for enhanced hardware-based spectrum management
 - one downstream port

Table 4 provides a quick overview of the cable modem cards that are supported in Cisco IOS Release 12.1(5)T.

Table 4 Cisco uBR7200 Series Universal Broadband Routers Cable Modem Cards

Cable Modem Card	Upstream Ports	Downstream Ports	Additional Features
MC11C	1	1	
MC12C	2	1	
MC14C	4	1	
MC16C	6	1	
MC16E	6	1	EuroDOCSIS (Annex A) Support
MC16S	6	1	Enhanced software- and hardware-based Spectrum Management Support

Port Adapter Cards

Table 5 lists and describes the port adapters supported by Cisco uBR7200 series routers in Cisco IOS Release 12.1(5)T.



Note

Not all Cisco uBR7200 series routers support all port adapters. Some port adapters must be at certain revision levels to be used in the Cisco uBR7246 VXR router.



Note

Not all port adapters are supported with the point-to-point wireless modem card. The HSSI, 10BaseT Ethernet, 100BaseT Ethernet, serial Frame Relay, ATM, and POS interfaces are fully supported. The Gigabit Ethernet port adapter was not supported with the point-to-point wireless modem card at the time the Cisco IOS Release 12.1(5)T software was released.



Tips

The Cisco IOS Releases shown in Table 5 are the minimum releases in the 12.1 EC train that support each port adapter. However, Cisco recommends using the most current release of a train if possible.

Table 5 Cisco uBR7200 Series Universal Broadband Routers Port Adapter Releases

Product Number	Cisco uBR7223 ¹	Cisco uBR7246 ¹	Cisco uBR7246 VXR ¹
Ethernet			
PA-4E—4-port Ethernet 10BaseT port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T ²
PA-8E—8-port Ethernet 10BaseT port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T ³
PA-FE-TX—1-port 100BaseTX Fast Ethernet port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T

Table 5 Cisco uBR7200 Series Universal Broadband Routers Port Adapter Releases (continued)

Product Number	Cisco uBR7223 ¹	Cisco uBR7246 ¹	Cisco uBR7246 VXR ¹
PA-FE-FX—1-port 100BaseFX Fast Ethernet port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-2FEISL-TX—2-port 100BaseTX Fast Ethernet port adapter with Inter-Switch Link (ISL) support	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-2FEISL-FX—2-port 100BaseFX Fast Ethernet port adapter with Inter-Switch Link (ISL) support	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-12E/2FE—12-port 10BaseT and 2-port 10/100BaseTX port adapter	Not applicable	12.0(5)T1	Not applicable
Gigabit Ethernet			
PA-GE—1-port, full-duplex, IEEE 802.3z- compliant Gigabit Ethernet (GE) port adapter ⁴	Not applicable	Not applicable	12.0(7)T
Serial			
PA-4T+—4-port synchronous serial port adapter	12.0(5)T1	12.0(5)T1	12.1(1a)T1
PA-8T-232—8-port EIA/TIA-232 synchronous serial port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-8T-V35—8-port V.35 synchronous serial port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-8T-X21—8-port X.21 synchronous serial port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-4E1G-75—4-port unbalanced (75-ohm) E1-G.703/G.704 synchronous serial port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-4E1G-120—4-port balanced (120-ohm) E1-G.703/G.704 synchronous serial port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-E3—1-port high-speed serial E3 interface port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-T3—1-port T3 serial interface port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-2E3—2-port high-speed serial E3 interface port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-2T3—2-port T3 serial interface port adapter	12.0(5)T1	12.0(5)T1	12.1(3)T
PA-MC-E3—1-port multi-channel E3, medium-speed serial interface port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-MC-T3—1-port T3 (channelized into 28 independent T1 data lines) port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-MC-2T1—2-port multichannel DS1 Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) single-wide port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-MC-4T1—4-port multichannel DS1 ISDN PRI single-wide port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-MC-8E1/120—8-port multichannel E1 ISDN PRI single-wide port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-MC-8T1—8-port multichannel DS1 ISDN PRI single-wide port adapter	12.0(5)T1	12.0(5)T1	Not applicable
HSSI			
PA-H—1-port HSSI port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T ⁵

Table 5 Cisco uBR7200 Series Universal Broadband Routers Port Adapter Releases (continued)

Product Number	Cisco uBR7223 ¹	Cisco uBR7246 ¹	Cisco uBR7246 VXR ¹
PA-2H—2-port HSSI port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T ⁶
ATM			
PA-A1-OC3SMI—1-port ATM OC-3c/STM-1 single-mode intermediate reach port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-A1-OC3MM—1-port ATM OC-3c/STM-1 multimode port adapter	12.0(5)T1	12.0(5)T1	Not applicable
PA-A2-4E1XC-OC3SM—5-port ATM CES ⁷ (4 E1 120-ohm CBR ⁸ ports and 1 OC-3 ATM single-mode port) port adapter	Not applicable	12.0(5)T1	Not applicable
PA-A2-4E1XC-E3ATM—5-port ATM CES ⁷ (4 E1 120-ohm CBR ⁸ ports and 1 E3 ATM port) port adapter	Not applicable	12.0(5)T1	Not applicable
PA-A2-4T1C-OC3SM—5-port ATM CES ⁷ (4 T1 CBR ⁸ ports and 1 OC-3 ATM single-mode port) port adapter	Not applicable	12.0(5)T1	Not applicable
PA-A2-4T1C-T3ATM—5-port ATM CES ⁷ (4 T1 CBR ⁸ ports and 1 T3 ATM port) port adapter	Not applicable	12.0(5)T1	Not applicable
PA-A3-E3—1-port E3 ATM, PCI-based port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-A3-T3—1-port T3 ATM, PCI-based port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-A3-OC3MM—1-port OC-3c ATM, PCI-based multimode port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-A3-OC3SMI—1-port OC-3c ATM, PCI-based single-mode intermediate reach port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-A3-OC3SML—1-port OC-3c ATM, PCI-based single-mode long reach port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
Packet-Over-SONET (POS)			
PA-POS-OC3SML—1-port POS OC-3 single-mode, long reach port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-POS-OC3SMI—1-port OC3 single-mode, intermediate reach port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T
PA-POS-OC3MM—1-port POS OC3 multimode port adapter	12.0(5)T1	12.0(5)T1	12.0(7)T

- The release number in this column indicates the Cisco IOS release in which the interface was introduced.
- To use a PA-4E 4-port Ethernet 10BaseT port adapter in a Cisco uBR7246 VXR, be sure you have the minimum required hardware revision (version 1.14, part number 800-02070-04) or a more recent version of the port adapter.
- To use a PA-8E 8-port Ethernet 10BaseT port adapter in a Cisco uBR7246 VXR, be sure you have the minimum required hardware revision (version 1.14, part number 800-02069-04) or a more recent version of the port adapter.
- The Gigabit Ethernet port adapter must be combined with the appropriate optical fiber cable and a Gigabit Interface Converter (GBIC).
- To use a PA-H 1-port HSSI port adapter in a Cisco uBR7246 VXR, be sure you have the minimum required hardware revision (version 1.17, part number 800-02747-06) or a more recent version of the port adapter.
- To use a PA-2H 2-port HSSI port adapter in a Cisco uBR7246 VXR, be sure you have the minimum required hardware revision (version 1.3, part number 800-03306-02) or a more recent version of the port adapter.
- CES = circuit emulation services.
- CBR = constant bit rate.

Determining Your Software Release

To determine the version of Cisco IOS software running on the Cisco uBR7200 Series Universal Broadband Router, log in to the router and enter the **show version** EXEC command:

```
router> show version
Cisco Internetwork Operating System Software
IOS (tm) 12.1 T Software (ubr7200-is-mz), Version 12.1(5)T, RELEASE SOFTWARE
```

Upgrading to a New Software Release

For general information about upgrading to a new software release, see Software Advisor at <http://tools.cisco.com/Support/Fusion/FusionHome.do>

Feature Set Tables

The Cisco IOS software is packaged in feature sets consisting of software images—depending on the platform. Each feature set contains a specific set of Cisco IOS features.

Cisco IOS Release 12.1 T supports the same feature sets as Cisco IOS Release 12.1, but Cisco IOS Release 12.1 T can include new features supported by the Cisco uBR7200 series.

Table 6 lists the features and feature sets supported by the Cisco uBR7200 series in Cisco IOS Release 12.1(5)T and uses the following conventions:

- Yes—The feature is supported in the software image.
- No—The feature is not supported in the software image.
- In—The number in the “In” column indicates the Cisco IOS release in which the feature was introduced. For example, (3) means a feature was introduced in 12.1(3)T. If a cell in this column is empty, the feature was included in the initial base release.



Note

This table might not be cumulative or list all the features in each image. You can find the most current Cisco IOS documentation on CCO. These electronic documents may contain updates and modifications made after the hardcopy documents were printed.

Table 6 Feature List by Feature Sets for Cisco uBR7200 Series Universal Broadband Routers

Feature	Feature Set						
	In ¹	DOCSIS Two-way	DOCSIS Two-way with BPI	DOCSIS Two-way, IP Plus	DOCSIS Two-way, IP Plus, Telco Return	DOCSIS Two-way, IP Plus with BPI	DOCSIS Two-way, IP Plus, Telco Return with BPI
Internet							
Dynamic Host Configuration Protocol (DHCP) Server		Yes	Yes	Yes	Yes	Yes	Yes
Dynamic Mobile Hosts	(1)	Yes	Yes	Yes	Yes	Yes	Yes

Table 6 Feature List by Feature Sets for Cisco uBR7200 Series Universal Broadband Routers (continued)

Feature	Feature Set						
	In ¹	DOCSIS Two-way	DOCSIS Two-way with BPI	DOCSIS Two-way, IP Plus	DOCSIS Two-way, IP Plus, Telco Return	DOCSIS Two-way, IP Plus with BPI	DOCSIS Two-way, IP Plus, Telco Return with BPI
DRP ² Server Agent		Yes	Yes	Yes	Yes	Yes	Yes
Telco Return		No	No	No	Yes	No	Yes
Time of Day (ToD) Server		Yes	Yes	Yes	Yes	Yes	Yes
IP Routing							
Easy IP (Phase 1)		Yes	Yes	Yes	Yes	Yes	Yes
Hot Standby Router Protocol (HSRP) over ISL ³ in Virtual LAN Configurations		No	No	Yes	Yes	Yes	Yes
IP Type of Service and Precedence for GRE ⁴ Tunnels		Yes	Yes	Yes	Yes	Yes	Yes
IP Enhanced IGRP ⁵ Route Authentication		Yes	Yes	Yes	Yes	Yes	Yes
NAT—Support for NetMeeting Directory (Internet Locator Service—ILS)	(5)	No	No	Yes	Yes	Yes	Yes
Per-Modem Filters		Yes	Yes	Yes	Yes	Yes	Yes
PPPoE Termination on Cable Interfaces	(5)	No	No	Yes	Yes	Yes	Yes
Router-Port Group Management Protocol	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Management							
AutoInstall using DHCP for LAN Interfaces	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Circuit Interface Identification MIB	(3)	Yes	Yes	Yes	Yes	Yes	Yes
Cisco Call History MIB Command Line Interface		Yes	Yes	Yes	Yes	Yes	Yes
Cisco IOS Internationalization		Yes	Yes	Yes	Yes	Yes	Yes
Enhanced Modem Status Display	(1)	Yes	Yes	Yes	Yes	Yes	Yes
Enhanced Per Modem Error Counter	(2)	Yes	Yes	Yes	Yes	Yes	Yes
Entity MIB, Phase 1		Yes	Yes	Yes	Yes	Yes	Yes
Expression MIB Support of Delta, Wildcarding, and Aggregation	(3)	Yes	Yes	Yes	Yes	Yes	Yes

Table 6 Feature List by Feature Sets for Cisco uBR7200 Series Universal Broadband Routers (continued)

Feature	Feature Set						
	In ¹	DOCSIS Two-way	DOCSIS Two-way with BPI	DOCSIS Two-way, IP Plus	DOCSIS Two-way, IP Plus, Telco Return	DOCSIS Two-way, IP Plus with BPI	DOCSIS Two-way, IP Plus, Telco Return with BPI
Interface Index Persistence	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Interface Range Specification	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Individual SNMP Trap Support	(3)	Yes	Yes	Yes	Yes	Yes	Yes
Interface Command Enhancements		Yes	Yes	Yes	Yes	Yes	Yes
MC16S LED Enhancements	(2)	Yes	Yes	Yes	No	Yes	No
MSDP MIB	(5)	Yes	Yes	Yes	Yes	Yes	Yes
NTP MIB	(5)	Yes	Yes	Yes	Yes	Yes	Yes
MIB Enhancements		Yes	Yes	Yes	Yes	Yes	Yes
Parser Cache	(5)	Yes	Yes	Yes	Yes	Yes	Yes
RF ⁶ Interface MIB		Yes	Yes	Yes	Yes	Yes	Yes
SNMP Cable Modem Remote Query	(2)	Yes	Yes	Yes	Yes	Yes	Yes
SNMPv2C ⁷ and SNMPv3 ⁸		Yes	Yes	Yes	Yes	Yes	Yes
Multimedia							
Bi-Directional PIM	(1)	Yes	Yes	Yes	Yes	Yes	Yes
IGMP Version 3	(5)	Yes	Yes	Yes	Yes	Yes	Yes
IP Multicast Load Splitting across Equal-Cost Paths		Yes	Yes	Yes	Yes	Yes	Yes
IP Multicast over ATM ⁹ Point-to-Multipoint Virtual Circuits		Yes	Yes	Yes	Yes	Yes	Yes
IP Multicast over Token Ring LANs		Yes	Yes	Yes	Yes	Yes	Yes
PIM Dense Mode State Refresh	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Source Specific Multicast	(3)	Yes	Yes	Yes	Yes	Yes	Yes
Stub IP Multicast Routing		Yes	Yes	Yes	Yes	Yes	Yes
Quality of Service							
DOCSIS 1.0+ ¹⁰ QoS Enhancements	(1)	Yes	Yes	Yes	Yes	Yes	Yes
Downstream QoS Handling		Yes	Yes	Yes	Yes	Yes	Yes
Downstream Traffic Shaping		Yes	Yes	Yes	Yes	Yes	Yes
Dynamic Map-Advance		Yes	Yes	Yes	Yes	Yes	Yes

Table 6 Feature List by Feature Sets for Cisco uBR7200 Series Universal Broadband Routers (continued)

Feature	Feature Set						
	In ¹	DOCSIS Two-way	DOCSIS Two-way with BPI	DOCSIS Two-way, IP Plus	DOCSIS Two-way, IP Plus, Telco Return	DOCSIS Two-way, IP Plus with BPI	DOCSIS Two-way, IP Plus, Telco Return with BPI
Upstream Traffic Shaping		Yes	Yes	Yes	Yes	Yes	Yes
Upstream Address Verification	(1)	Yes	Yes	Yes	Yes	Yes	Yes
Improved Upstream QoS		Yes	Yes	Yes	Yes	Yes	Yes
QoS Configuration		Yes	Yes	Yes	Yes	Yes	Yes
QoS Profile Enforcement		Yes	Yes	Yes	Yes	Yes	Yes
Read/Create Implementation of QoS		No	Yes	Yes	Yes	Yes	Yes
RTP ¹¹ Header Compression		Yes	Yes	Yes	Yes	Yes	Yes
Multiple SID Support (static only)		Yes	Yes	Yes	Yes	Yes	Yes
Dynamic SID support		Yes	Yes	Yes	Yes	Yes	Yes
Security							
Automated Double Authentication		Yes	Yes	Yes	Yes	Yes	Yes
Baseline Privacy Interface (BPI) Encryption	(1)	No	Yes	No	No	Yes	Yes
Cable Modem and Multicast Authentication using RADIUS		No	Yes	No	No	Yes	Yes
Closed User Group Selection Facility Suppress Option	(5)	Yes	Yes	Yes	Yes	Yes	Yes
Firewall Enhancements	(1)	Yes	Yes	Yes	Yes	Yes	Yes
HTTP ¹² Security		Yes	Yes	Yes	Yes	Yes	Yes
Named Method Lists for AAA ¹³ Authorization & Accounting		Yes	Yes	Yes	Yes	Yes	Yes
Per-Modem and Per-Host Access List Support		Yes	Yes	Yes	Yes	Yes	Yes
Per-User Configuration		Yes	Yes	Yes	Yes	Yes	Yes
Redirect-Number Support for RADIUS and TACACS+ Servers	(1)	No	No	No	Yes	No	Yes
Reflexive Access Lists		Yes	Yes	Yes	Yes	Yes	Yes
Vendor-Proprietary RADIUS Attributes		Yes	Yes	Yes	Yes	Yes	Yes
Switching							
Fast-Switched Policy Routing		Yes	Yes	Yes	Yes	Yes	Yes

Table 6 Feature List by Feature Sets for Cisco uBR7200 Series Universal Broadband Routers (continued)

Feature	Feature Set						
	In ¹	DOCSIS Two-way	DOCSIS Two-way with BPI	DOCSIS Two-way, IP Plus	DOCSIS Two-way, IP Plus, Telco Return	DOCSIS Two-way, IP Plus with BPI	DOCSIS Two-way, IP Plus, Telco Return with BPI
VPN							
MPLS VPN Support for Subinterfaces and Interface Bundles	(2) ¹⁴	Yes	Yes	Yes	Yes	Yes	Yes
Cable Subinterfaces and Interface Bundling Support for Virtual Private Networks	(1)	Yes	Yes	Yes	Yes	Yes	Yes
WAN Optimization							
PAD ¹⁵ Subaddressing		Yes	Yes	Yes	Yes	Yes	Yes
WAN Services							
Bandwidth Allocation Control Protocol (BACP)		Yes	Yes	Yes	Yes	Yes	Yes
Enhanced Local Management Interface (ELMI)		Yes	Yes	Yes	Yes	Yes	Yes
Frame Relay Enhancements	(1)	Yes	Yes	Yes	Yes	Yes	Yes
Frame Relay MIB Extensions	(1)	Yes	Yes	Yes	Yes	Yes	Yes
Frame Relay Router ForeSight	(1)	Yes	Yes	Yes	Yes	Yes	Yes
ISDN ¹⁶ Advice of Charge		Yes	Yes	Yes	Yes	Yes	Yes
ISDN Caller ID Callback		Yes	Yes	Yes	Yes	Yes	Yes
ISDN Multiple Switch Type		Yes	Yes	Yes	Yes	Yes	Yes
ISDN NFAS ¹⁷		Yes	Yes	Yes	Yes	Yes	Yes
Microsoft Point-to-Point Compression (MPPC)		Yes	Yes	Yes	Yes	Yes	Yes
National ISDN Switch Types for BRI ¹⁸ and PRI ¹⁹		Yes	Yes	Yes	Yes	Yes	Yes
VPDN ²⁰ MIB and Syslog Facility		Yes	Yes	Yes	Yes	Yes	Yes
X.25 Enhancements		Yes	Yes	Yes	Yes	Yes	Yes
X.25 Switching between PVCs ²¹ and SVCs ²²		Yes	Yes	Yes	Yes	Yes	Yes

1. This column indicates the maintenance release in which the feature was introduced: (1) means a feature was introduced in Release 12.1(1a)T1, (2) means a feature was introduced in Release 12.1(2)T, etc. If this cell in this column is empty, this feature was introduced in the initial base release.

2. DRP = Director Response Protocol

3. ISL = Inter-Switch Link

4. GRE = generic routing encapsulation

5. IGRP = Interior Gateway Routing Protocol

6. RF = radio frequency
7. SNMPv2 = Simple Network Management Protocol version 2
8. SNMPv3 = Simple Network Management Protocol version 3
9. ATM = Asynchronous Transfer Mode
10. The DOCSIS 1.0+ QoS Enhancements is a set of Cisco's Quality of Service extensions to DOCSIS 1.0 to enable basic VoIP service over the DOCSIS link before DOCSIS 1.1 becomes available.
The main enhancements include support for dynamic creation and teardown of flows during voice calls, support for one new slot scheduling mechanism (UGS) for voice slots, and per IP-precedence rate shaping on the downstream.
11. RTP = Real-Time Transport Protocol
12. HTTP = Hypertext Transfer Protocol
13. AAA = authentication, authorization, and accounting
14. This feature is supported in Cisco IOS Release 12.1(2)T, Release 12.1(5)T, and higher releases. Release 12.1(3)T does not support this feature.
15. PAD = packet assembler/disassembler
16. ISDN = Integrated Services Digital Network
17. NFAS = non-facility-associated signaling
18. BRI = Basic Rate Interface
19. PRI = Primary Rate Interface
20. VPDN = virtual private dial-up network
21. PVC = permanent virtual circuit
22. SVC = switched virtual circuit

New and Changed Information

The following sections list the new hardware and software features supported by the Cisco uBR7200 Series Universal Broadband Routers for Cisco IOS Release 12.1 T

No New Hardware Features in Release 12.1(5)T

There are no new hardware features supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(5)T.

New Software Features in Release 12.1(5)T

The following new software features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(5)T.

AutoInstall Using DHCP for LAN Interfaces

The AutoInstall Using DHCP for LAN Interfaces feature replaces the use of the Bootstrap Protocol (BOOTP) with the use of the Dynamic Host Configuration Protocol (DHCP) for Cisco IOS AutoInstall over LAN interfaces. AutoInstall is a Cisco IOS software feature that provides for the configuration of a new routing device automatically when the device is initialized. DHCP (defined in RFC 2131) is based on the Bootstrap Protocol, which provides the framework for passing configuration information to hosts on a TCP/IP network. DHCP adds the capability of automatic allocation of reusable network addresses and additional configuration options.

In Cisco IOS Release 12.1(5)T, the IP address procurement phase of the AutoInstall process is now accomplished using DHCP for Ethernet, Token Ring, and FDDI interfaces. Before this release, IP addresses for LAN interfaces were obtained using BOOTP during the AutoInstall process. The

AutoInstall Using DHCP for LAN Interfaces feature also allows the routing device to recognize IP address allocation messages coming from regular BOOTP servers, providing a seamless transition for those devices already using BOOTP servers for AutoInstall. Additionally, this feature allows for the uploading of configuration files using unicast Trivial File Transfer Protocol (TFTP).

For further details, see the following document on CCO:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t5/dt_dhcpa.htm

Cable Downstream Frequency Override CLI

The following new CLI command turns off the cable downstream frequency override on a per-interface basis:

[no] cable downstream override

The default configuration enables the cable downstream frequency override. Only the **[no] cable downstream override** command is displayed and allows the cable downstream frequency override to be turned off.

Closed User Group Selection Facility Suppress Option

A closed user group (CUG) selection facility is a specific encoding element that allows a destination data terminal equipment (DTE) to identify the CUG to which the source and destination DTEs belong. The Closed User Group Selection Facility Suppress Option feature enables a user to configure an X.25 data communications equipment (DCE) interface or X.25 profile with a DCE station type to remove the CUG selection facility from incoming call packets destined for the preferential CUG only or for all CUGs. You can also remove the selection facility from a CUG with outgoing access (CUG/OA).

IGMP Version 3

Internet Group Management Protocol (IGMP) is a protocol used by IPv4 systems to report IP multicast group memberships to neighboring multicast routers. On networks with hosts directly attached, IGMP Version 3 (IGMPv3) adds support for “source filtering”, which enables a multicast receiver to signal to a router which groups it wants to receive multicast traffic from, and from which source(s) this traffic is expected. Based on this membership information, Cisco IOS software only forwards traffic that is requested by the host or by other routers via Protocol Independent Multicast [PIM] to that network. In addition to restricting traffic on the network of the receiver host, IGMPv3 membership information can also be propagated to multicast routing protocols to enable the forwarding of traffic from permitted sources or to restrict traffic from denied sources along the entire multicast data delivery path.

In the Source Specific Multicast (SSM) feature, introduced in Cisco IOS Release 12.1(3)T, hosts must explicitly include sources when joining a multicast group (this is known as “channel subscription”). IGMPv3 is the industry-designated standard protocol for hosts to signal channel subscriptions in SSM. In deployment cases where IGMPv3 cannot be used (for example, if it is not supported by the receiver host or its applications), there are two other mechanisms to enable SSM: URL Rendezvous Directory (URD) and IGMP Version 3 lite (IGMP v3lite). Both of these features were introduced with SSM in Cisco IOS Release 12.1(3)T.

Interface Index Persistence

One of the most commonly used identifiers used in SNMP-based network management applications is the Interface Index (ifIndex) value. IfIndex is a unique identifying number associated with a physical or logical interface; as far as most software is concerned, the ifIndex is the “name” of the interface.

Although there is no requirement in the relevant Request for Comments (RFCs) that the correspondence between particular ifIndex values and their interfaces be maintained across reboots, applications such as device inventory, billing, and fault detection increasingly depend on the maintenance of this correspondence.

Cisco IOS Release 12.1(5)T adds support for an ifIndex value that can persist across reboots, enabling users to avoid the workarounds previously required for consistent interface identification. The Interface Index Persistence feature allows for greater accuracy when collecting and processing network management data by uniquely identifying input and output interfaces for traffic flows and SNMP statistics. Relating each interface to a known entity (such as an ISP customer) allows network management data to be more effectively utilized.

For further details, see the following document on CCO:

<http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t5/dt5ifidx.htm>

Interface Range Specification

The Interface Range Specification feature allows specification of a range of interfaces to which subsequent commands are applied and supports definition of macros that contain an interface range. The Interface Range Specification feature is implemented with the **range** keyword, which is used with the **interface** command. In the interface configuration mode with the **range** keyword, all entered commands are applied to all interfaces within the range until you exit interface configuration mode.

MSDP MIB

The Multicast Source Discovery Protocol (MSDP) MIB feature adds support in Cisco IOS software for the MSDP MIB. This MIB describes objects used for managing MSDP operations using Simple Network Management Protocol (SNMP). Documentation for this MIB exists in the form of an Internet Draft titled “Multicast Source Discovery Protocol MIB” (draft-ietf-msdp-mib-03.txt) and is available through the Internet Engineering Task Force (IETF) at <http://www.ietf.org>

Refer to the following document for further information:

<http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t5/dt5msdp.htm>

NAT—Support for NetMeeting Directory (Internet Locator Service—ILS)

Microsoft NetMeeting is a Windows-based application that enables multi user interaction and collaboration from a user’s PC over the Internet or an intranet. Support for the NetMeeting Directory (ILS) allows connections by name from the directory built into the NetMeeting application. Destination IP addresses do not need to be known in order for a connection to be made.

NTP MIB

The Network Time Protocol (NTP) is used to synchronize timekeeping among a set of distributed time servers and clients. The Cisco NTP MIB enables users to remotely monitor an NTP server using the Simple Network Management Protocol (SNMP), provided the MIB itself is implemented on that server. Use of the NTP MIB to monitor the NTP status of routing devices is accomplished using software on a network management system (NMS). There are no new or modified Cisco IOS software commands associated with this feature.

The Cisco implementation of the NTP MIB is based on NTP version 3 (RFC-1305). The MIB objects are all read-only. SNMP requests are processed by reading the corresponding variables from the NTP subsystem and returning them in the response. The NTP MIB defines a set of NTP server system

objects, including an NTP server peers table and an NTP server filter register table. For complete details on the Cisco implementation of the NTP MIB, see the MIB file itself at <ftp://ftp.cisco.com/pub/mibs/v2/CISCO-NTP-MIB.my>.

Parser Cache

The Parser Cache feature optimizes the parsing (translation) of Cisco IOS software configuration command lines by remembering how to parse recently encountered command lines. This feature was developed to improve the scalability of the Cisco IOS software command-line interface (CLI) parser when processing large configuration files. This improvement is especially useful for those cases in which thousands of virtual circuits must be configured for interfaces, or hundreds of access control lists (ACLs) are required. The parser chain cache can rapidly recognize and translate configuration lines that differ slightly from previously used configuration lines (for example, pvc 0/100, pvc 0/101, and so on). Testing indicates an improvement to load time of between 30% and 36% for large configuration files when using the parser cache.

The parser cache is enabled by default on all platforms using Cisco IOS Release 12.1(5)T or later. A new global configuration command, **[no] parser cache**, allows the disabling or reenabling of this feature.

PIM Dense Mode State Refresh

The PIM Dense Mode State Refresh feature keeps the pruned state in PIM dense mode from timing out by periodically forwarding a control message down the source-based distribution tree. The control message refreshes the prune state on the outgoing interfaces of each router in the distribution tree.

PPPoE Termination on Cable interfaces

The PPPoE on Cable Interfaces feature adds support for PPPoE by allowing a direct connection to cable interfaces. PPPoE provides service-provider digital-subscriber line (DSL) support. The support of PPPoE on cable interfaces of the Cisco uBR7200 series routers allows customer premises equipment (CPE) behind the cable modem to use PPP as a mechanism to get their IP addresses and use it for all subsequent data traffic, just like a dial-up PPP client. In a PPP dial-up session, the PPPoE session is authenticated and the IP address is negotiated between the PPPoE client and the server, which could be either a Cisco uBR7200 series router or a Home Gateway.

Router-Port Group Management Protocol

The Router-Port Group Management Protocol (RGMP) feature introduces a Cisco protocol that restricts IP multicast traffic in switched networks. RGMP is a Layer 2 protocol that enables a router to communicate to a switch (or a networking device that is functioning as a Layer 2 switch) the multicast group for which the router would like to receive or forward traffic.

No New Hardware Features in Release 12.1(3)T

There are no new hardware features supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(3)T.

New Software Features in Release 12.1(3)T

The following new software features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(3)T.

Circuit Interface Identification MIB

The Circuit Interface Identification MIB feature adds support for a new Cisco enterprise MIB, used to assist in SNMP monitoring of circuit-based interfaces. The Circuit Interface MIB (CISCO-CIRCUIT-INTERFACE-MIB) provides a MIB object that can be used to identify individual circuit-based interfaces (for example, interfaces using ATM or Frame Relay). This user-specified identification will then be returned when linkup and linkdown SNMP traps are generated for the interface.

The Circuit Interface MIB consists of a single table, with each row being a sequence of two objects: Circuit Interface Description (cciDescr) and Circuit Interface Status (cciStatus). The “cciDescr” object is used to identify circuits using a textual description of up to 255 characters specified by the user (note that MIB objects are modified using network management system [NMS] applications, and can not be configured using the Cisco IOS command-line interface). When the row is created by a user, a value is set for the cciDescr object. The table is indexed by “ifIndex” from the IF-MIB. The “cciStatus” is the “RowStatus” object for the rows in the table. The “cciStatus” object can be set to only two values by the user: “createAndGo(4)”, which creates a new row, and “destroy(6)”, which removes an existing row. If the row is created successfully, the “cciStatus” will be active(1). When creating a new row, the user should set the “cciDescr” object along with the “cciStatus” in a single **snmp set pdu** command. If the row is already active, only the “cciDescr” object can be modified. The other option is to delete the row first by setting the “cciStatus” to “destroy(6)” and then recreate the row with a new value for “cciDescr”. When creating a new row, the “ifIndex” is validated first. If the “ifIndex” value is not valid, the row is not created and an error code is returned. Similarly, when an interface is deleted and there was a corresponding row in this table, that row will be deleted automatically.

After an identifying description is created for an interface by a user, the description (the “cciDescr” object) will be sent along with the other varbinds as part of linkup and linkdown trap notifications.

For further details, see the CISCO-CIRCUIT-INTERFACE-MIB.my file.

Expression MIB Support of Delta, Wildcarding, and Aggregation

This feature adds support of the Delta, Wildcarding, Delta Wildcarding, and Aggregation features in the Distributed Management Expression MIB (EXPRESSION-MIB) to Cisco IOS software for use by SNMP.

The Delta function enables the Expression MIB to use Delta values of an object instead of absolute values when evaluating an expression. Delta is obtained by taking the difference between the current value of an object and its previous value.

The Wildcarding function of the Expression MIB allows evaluation of multiple instances of an object. This is useful in cases where an expression needs to be applied to all instances of an object. The user need not individually specify all instances of an object in the Expression but only has to set the “expWildcardedObject” in “expObjectTable” to TRUE for the respective object.

Aggregation is performed using the sum function in the Expression MIB. The operand to the sum function has to be a wildcard object. The result of the sum function is the sum of values of all instances of the wildcard object.

For a complete description of Expression MIB functionality, see the "Distributed Management Expression MIB" Internet-Draft document, available through the IETF at <http://www.ietf.org/ids.by.wg/disman.html>.

Individual SNMP Trap Support

The Individual SNMP Trap Support feature adds the ability to enable or disable SNMP system management notifications (traps) individually. SNMP traps that can be specified are “authentication”, “linkup”, “linkdown”, and “coldstart”. This feature expands the functionality of the **snmp-server enable traps snmp** command.

For documentation, see

<http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t3/dtitraps.htm>

Source Specific Multicast

The Source Specific Multicast (SSM) feature is an extension of IP multicast, where datagram traffic is forwarded to receivers from only those multicast sources that the receivers have explicitly joined. When SSM is used, only source-specific multicast distribution trees (no shared trees) are created.

SSM is a datagram delivery model that best supports one-to-many applications, also known as broadcast applications. SSM is the core networking technology for the Cisco implementation of the IP Multicast lite suite of solutions targeted for audio and video broadcast application environments. This feature module introduces the following Cisco IOS components that support SSM:

- PIM-SS (PIM source specific)
- Internet Group Management Protocol Version 3 lite (IGMP v3lite)
- URL Rendezvous Directory (URD)

The Cisco implementation of SSM will soon be deployed with Internet Group Management Protocol Version 3 (IGMPv3) support. Cisco developed IGMP v3lite and URD to support the deployment of applications using SSM services before the introduction of IGMPv3.

No New Hardware Features in Release 12.1(2)T

There are no new hardware features supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(2)T.

New Software Features in Release 12.1(2)T

The following new software features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(2)T.

MC16S LED Enhancement

Using Cisco IOS Release 12.1(2)T, MGR ACT LED behavior on the Cisco MC16S Cable Modem Card differs (see Table 7). This feature also stops Spectrum Scanning on one or more upstream ports if the upstream or the whole interface is shut down

Table 7 Cable Modem Card LEDs

LED Label	Color	State	Description
Enabled	Green	On	Indicates that the cable modem card is operating normally: receiving DC power from the router midplane and enabled for operation.
	N/A	Off	Either the card is shut down or the slot is not working.
Upstream	Green	On	For each upstream port, indicates that the upstream path is enabled.
	N/A	Off	Either the port is not configured, shut down, or the slot is not working.
Downstream	Green	On	For each downstream port, indicates that the downstream path is enabled.
	N/A	Off	Either the port is not configured, shut down, or the slot is not working.
MGR ACT (MC16S only)	Green	On	With Release 12.0.7 XR2 or Release 12.1(1a)T1, indicates that a spectrum group has been configured. With Release 12.1.(2)T, indicates that the MC16S Spectrum Management Card has initiated an upstream frequency hop from a potentially “noisy” channel to a cleaner channel.
	N/A	Off	Either the port is not configured, shut down, or the slot is not working.

MPLS VPN Support for Subinterfaces and Interface Bundles

Cisco IOS Release 12.1(2)T includes MPLS support as part of its VPN offerings for cable subinterfaces and interface bundles. The software offers enhancements made to tags placed on the fronts of packets that contain forwarding information used to make switching decisions for cable interfaces and bundles. This tag switching infrastructure combines advanced routing protocol capabilities to define IP VPNs by selectively advertising IP reachability information to just those subscribers within the same VPN or extranet on a cable interface.

The MPLS-VPN approach of creating VPNs for individual ISPs requires subinterfaces to be configured on cable interfaces or bundles. Refer to the “Cable Subinterfaces and Interface Bundling” section on page 33 for definitions of subinterfaces and interface bundles. One subinterface is required for each ISP. The subinterfaces are tied to VPN Routing Forwarding (VRF) tables for respective ISPs.

Apart from creating one subinterface for an ISP, an additional subinterface is created on the cable interface bound to the management VPN. The management VPN is the one that connects the Cisco uBR7200 series to a Provider Enterprise (PE) router that connects to management servers such as CNR and ToD. MPLS VPN support also allows interfaces to be bound to a VRF table where each VRF belongs to an ISP. This allows Cisco uBR7200 series downstream and upstream plant segments to be shared by multiple ISPs. PCs behind respective CMs obtain their IP addresses from the respective ISP address pool. Traffic coming from those CMs is routed to the ISP’s point of interconnect router.

For MPLS commands, refer to *Cisco MPLS VPN Solutions Command Reference*.

The Cisco uBR7200 series support a CM-to-cable subinterface association by mapping the SIDs that are assigned to that CM to the subinterface. This mapping is created by gleaned DHCP reply messages meant for the PC. The IP address stored in the DHCP reply is matched for its subnet value against the subnet value configured for each of the subinterfaces over a physical interface or a cable bundle. The

subnet information can be derived by the IP address and the mask value configured for the subinterface. All other SIDs for the CM that are created after the initial DHCP configuration of CM are bound to the same subinterface by the Cisco uBR7200 series router.

The SID-to-subinterface mapping created by gleaning DHCP reply is used to associate an incoming packet to the correct subinterface and switched using VRF configured on that subinterface.



Note

MPLS VPN support is included in Cisco IOS Release 12.1(2)T, Release 12.1(5)T, and higher releases. Release 12.1(3)T does not include MPLS VPN support.

Enhanced Per Modem Error Counter

The Cisco uBR7200 series supports display of per modem error counters. The new command introduced is

show cable modem [*<ip-addr>* | *<mac-addr>*] error

Sample display:

```
cmts#show cable modem errors
MAC Address      SID  I/F          CRC      HCS
00d0.ba26.eee7  1    Cable4/0/U0  0         0
```



Note

Both CRC and HCS are on a per CM basis.

The CMTS maintains the above error counters to begin to populate the MIB objects pertaining to RFC 2670:

- docsIfCmtsCmStatusUnerrored
- docsIfCmtsCmStatusCorrecteds
- docsIfCmtsCmStatusUncorrectables
- docsIfCmtsCmStatusSignalNoise
- docsIfCmtsCmStatusMicroreflections

This saves administrators from having to poll the “docsIfSignalQualit” table on every cable modem. With the CMTS maintaining error counters, along with the above table and entries in place, administrators can poll the CMTS, rather than all CMs—providing a more scalable network management model.

SNMP Cable Modem Remote Query

The feature provides a new MIB, SNMP Cable Modem Remote Query, so that the cable modem termination system (CMTS) cable modem (CM) poller and the CMs' status polled from the CMTS CM poller can be configured and queried via SNMP.

A new CLI command has been implemented for turning on the trap:

snmp-server enable cable cm-remote-query



Note

In the release notes for Cisco IOS Release 12.1(2), this feature was referred to as CISCO-DOCS-REMOTE-QUERY-MIB

New Hardware Features in Release 12.1(1a)T1

The following new hardware features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(1a)T1.

Broadband Wireless—Point-to-Point

The Cisco high-speed point-to-point broadband fixed wireless system provides a fixed, dedicated wireless link from one site to another. This link delivers full-duplex data in the Unlicensed National Information Infrastructure (U-NII) band (5.725 to 5.825 GHz).

The broadband fixed wireless system consists of a Cisco uBR7200 Series Universal Broadband Router (Cisco uBR7246 or Cisco uBR7223) and one or more point-to-point wireless modem cards, each with a power feed panel and one or two wireless transverters.

The point-to-point wireless modem cards are installed in a Cisco uBR7200 series router. Each modem card is cabled to a power feed panel installed either in the same equipment rack as the router or mounted on a wall. Cables from the power feed panel are attached to one or two wireless transverters, which are installed on antenna masts. The system is managed using a command-line interface (CLI) or CiscoView.

The Cisco IOS software has a number of new and enhanced commands to support the point-to-point wireless modem card. The point-to-point wireless modem card is also one component of a complete fixed wireless subsystem. For more information about the new commands and additional wireless hardware, see the *Cisco uBR7200 Series Wireless Modem Card and Subsystem Installation and Configuration* publication.



Note

Not all port adapters are supported with the point-to-point wireless modem card. The HSSI, 10BaseT Ethernet, 100BaseT Ethernet, and serial Frame Relay interfaces are fully supported. The ATM, POS, and Gigabit Ethernet port adapters were not supported with the point-to-point wireless modem card at the time Release 12.1(1a)T1 was released.

Cable Modem Card (MC16E)

The MC16E Cable Modem Card provides one downstream and six upstream connections to the cable network, similar to the MC16C Cable Modem Card, except that it supports the ITU J.83 Annex A physical layer and the proposed EuroDOCSIS (Annex A) standard (Cable Labs ECR RFI-R-98036). The MC16E card has the following differences with the current MC16C card:

- Downstream 36.125 MHz interface, with an 8-MHz DAVIC/DVB channel width and interleave factor of I=12, J=17
- Downstream symbol rate of 6.592 Msymbols/sec at 64 and 256 QAM
- Downstream channel range of 85 to 860 MHz
- Upstream channel range from 5 to 65 MHz
- Supported in the Cisco uBR7200 series MIBs
- Supports EuroDOCSIS-compliant cable modems and set top boxes (STBs)

All cable interface commands have been updated to support the MC16E Cable Modem Card.

Cisco Cable Clock Card

The Cisco Cable Clock Card enables the uBR7246 VXR to synchronize to an external T1 timing source and propagate the clock to the downstream DOCSIS-based cable access routers. It is designed for cable networks running VoIP applications.

When installed in the Cisco uBR7246 VXR chassis, the Cisco Cable Clock Card can propagate a national clock signal throughout the router's midplane by locking onto an external T1 signal originating over the PSTN, locking onto a T1 clock signal originating from a port adapter installed in the same chassis, or connecting to a GPS receiver generating a T1 clock signal.

Spectrum Management Cable Modem Card (MC16S)

The software for the MC16S Spectrum Management Cable Modem Cards is a driver running on the Cisco uBR7200 Series Universal Broadband Routers. Using a Peripheral Component Interconnect (PCI) interface, the Universal Broadband Router line card software interacts with the cable modem card. Data is passed back and forth, as direct memory access (DMA) transfers, from the Cisco uBR7200's memory to the cable modem card.

Additionally, the MC16S Cable Modem Cards support Universal Broadband Router line card management and control with the modem card Management Information Bases (MIBs), Media Access Control (MAC) control software, and logical link management software based on DOCSIS standards.

In addition to its cable modem card, the MC16S provides dedicated hardware support for advanced spectrum management through a daughter spectrum management card. This card contains a spectrum analyzer that samples the 5- to 42-MHz upstream frequency spectrum in real-time, analyzing the number of offline cable modems. If a user-defined threshold value is reached, the spectrum management card takes a snapshot of the available upstream spectrum and passes that information to the IOS software, which analyzes it for possible significant ingress and impulse noise.

Using this analysis, the IOS software evaluates the upstream frequency spectrum and, if necessary automatically hops to a frequency that can provide a clean upstream channel. This eliminates "blind" frequency hops and can improve response time to ingress noise impairments.

The **cable upstream** interface command now includes a new parameter when used to configure an interface on the MC16S Cable Modem Card, to allow the creation of a range of channel width. The new syntax is **cable upstream port channel-width channel-width-1 channel-width-2** where the possible channel width values are 200000, 400000, 800000, 1600000, 3200000.

The **cable upstream port modulation-profile modulation-number** command configures the upstream modulation profile.



Note

The MC16S Spectrum Management Card is calibrated using a 24.016 MHz, 0 dBmV reference signal injected into the card's front F-connector. The worst case accuracy is specified as +/- 3 dB over the DOCSIS upstream frequency band (5-45 MHz) and operating temperature range (0 to 40 degrees Centigrade).

New Software Features in Release 12.1(1a)T1

The following new software features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(1a)T1.

Baseline Privacy Interface MIB

Cisco uBR7200 Series Universal Broadband Routers now include support for the DOCSIS Baseline Privacy Interface (BPI) MIB. This allows an SNMP manager to monitor and manage the router's BPI configuration, including whether BPI is enabled, status of current authorization keys, current timeout values, real-time status counters, and additional information about authorization errors.



Note

The SNMP manager must load the DOCS-BPI-MIB.my MIB to access the BPI attributes.

Bi-Directional Protocol Independent Multicast (PIM)

Bi-directional Protocol Independent Multicast (bidir-PIM) is an extension of Protocol Independent Multicast sparse mode (PIM SM), which implements shared sparse trees with bidirectional flow of data. In contrast to PIM SM, bidir-PIM avoids keeping a source-specific state in routers and therefore allows multicast distribution trees to scale to an arbitrary number of sources.

Bidirectional flow allows improved data delivery to receivers close to the source, because the traffic traveling upstream to the rendezvous point (RP) is “turned around” and forwarded on downstream branches. Bidirectional shared trees can therefore distribute datagrams from sources to the RP and directly to receivers. Moreover, the bidir-PIM protocol does not build source trees from sources to the RP or to receivers. Instead, source transmissions travel up the shared tree toward the RP and to receivers along the way. The RP only needs to forward datagrams downward on those branches of the shared tree not covered by the path from the source to the RP.

When compared to unidirectional trees in PIM SM, bidir-PIM reduces the amount of state that routers must explicitly keep. Each router in a bidirectional multicast routing domain needs to only keep state for the group and not each source sending to each group. Explicit joins are used for members to join the shared tree. However, sources do not use registers to get their data on the shared tree.

DOCSIS Quality of Service Enhancements

A number of DOCSIS quality of service (QoS) enhancements have been added to Cisco IOS Release 12.1(1a)T1; these features parallel some of those that are expected in the DOCSIS 1.1 specification when it is finalized.



Note

These QoS enhancements are in addition to the currently existing QoS traffic shaping and tiered best effort features.

- **Concatenation Support**—DOCSIS Concatenation combines multiple upstream packets into one packet to reduce packet overhead and overall latency, as well as increase transmission efficiency. Using concatenation, a DOCSIS cable modem needs to make only one bandwidth request for a concatenated packet, as opposed to making a different bandwidth request for each individual packet; this technique is especially effective for bursty real-time traffic, such as voice calls.

Concatenation is enabled by default for current cable modem cards (see the “Cable Modem Cards” section on page 9), but can be disabled with the Cisco IOS **no cable upstream number concatenation** interface command. The **show controller** command displays whether concatenation is enabled on an interface.



Note Concatenation is supported only with cable modems that support DOCSIS concatenation.

- Embedded Client Signaling (dynamic SIDs)—Supports the dynamic creation, configuration, and deletion of Service Identifiers (SIDs) to accommodate different classes of service. This allows cable modems to request high-priority or high-bandwidth data streams as needed, such as when a VoIP call is made.



Note Dynamic SIDs can be used only with cable modems that also support this feature. Otherwise, cable modems must use the static SIDs supported in previous releases.

- IP Precedence-Based Rate Limiting—In addition to the currently supported traffic shaping techniques, Cisco IOS Release 12.1(1a)T1 supports a new configuration field that associates a maximum bandwidth (in kbps) with a particular setting of the IP type of service (ToS) bits. This can be used to ensure that certain traffic, such as data, does not exceed a preset rate limit and thereby interfere with higher-priority real-time traffic, such as VoIP calls.
- Support for Unsolicited Grants—New fields in the DOCSIS configuration file can be used so that when a cable modem requests a voice or fax SID, the MAC scheduler on the Cisco uBR7200 series router schedules fixed periodic slots on the upstream for that traffic flow. The cable modem does not have to contend for these slots, and because the Cisco uBR7200 series router controls the timing of the slots, it has a very precise control over potential delay and jitter. This provides a Constant Bit Rate (CBR) traffic flow for real-time traffic such as voice and fax calls.

In addition, the Cisco uBR7200 series router can create QoS profiles for G.711 fax traffic and G.729 voice traffic. These profiles can be customized with the scheduling parameters required for the G.711 and G.729 CODECs being used at the subscriber’s site.

Dynamic Mobile Hosts

This feature addresses a security hole that occurs when the Cisco uBR7200 router supports mobile hosts. (Mobile host are hosts that can move from one modem to another modem). Anyone who knows the MAC address of a mobile host can “fake” the mobile host, thereby causing denial of access for the real mobile host.

To avoid this security hole, the Dynamic Mobile Hosts feature pings the mobile host on the old SID to verify that the host has indeed been moved.

Enhanced Modem Status Display

The Cisco uBR7200 Series Universal Broadband Router supports polling of the cable modems to obtain parameter and status information on an ongoing basis. Two new Cisco IOS commands are added to support this feature.

The **cable modem remote** command configures the router for the polling interval; the **no** version of this command disables the status polling. The **show cable modem remote-query** command displays the collected information:

- Downstream receive power level
- Downstream signal/noise ratio (SNR)
- Upstream power level
- Transmit timing offset
- Micro reflection (in dB)

Firewall Enhancements

Cisco IOS Release 12.1(1a)T1 enhances the previous Cisco IOS Secure Integrated Software feature set with the following set of features:

- Context-Based Access Control (CBAC) that intelligently filters TCP and UDP packets based on the application-layer protocol. This includes Java applets, which can be blocked completely or allowed only from known and trusted sources.
- Detection and prevention of the most common denial of service (DoS) attacks, such as ICMP and UDP echo packet flooding, synchronize/start (SYN) packet flooding, half-open or other unusual TCP connections, and deliberate misfragmentation of IP packets.
- Support for a broad range of commonly used protocols, including H.323 and NetMeeting, FTP, HTTP, MS Netshow, RPC, SMTP, SQL*Net, and TFTP.
- Authentication Proxy for authentication and authorization of web clients on a per-user basis.
- Dynamic port mapping that maps the default port numbers for well-known applications to other port numbers. This can be done on a host-by-host basis or for an entire subnet, providing a large degree of control over which users can access different applications.
- Configurable alerts and audit trail.
- Intrusion Detection System (IDS) that recognizes the signatures of 59 common attack profiles. When an intrusion is detected, IDS can either send an alarm to a syslog server or to NetRanger Director, drop the packet, or reset the TCP connection.
- User-configurable audit rules.
- Configurable real-time alerts and audit trail logs.

For general information, see the description of the *Cisco IOS Firewall Feature Set* in the *Cisco Product Catalog*. For detailed information, see the *Cisco IOS Firewall Feature Set* documentation set, as well as the sections on Traffic Filtering and Firewalls in the *Security Configuration Guide* and *Security Command Reference* (available on the Documentation CD-ROM and CCO).

Frame Relay Support

Frame Relay provides a packet-switching data communications capability that is used across the interface between user devices, such as the Cisco uBR7200 Series Universal Broadband Routers, and network equipment (switching nodes). As an interface between user and network equipment, Frame Relay provides a means for statistically multiplexing many logical data conversations (virtual circuits) over a single physical transmission link. A Frame Relay service may support Permanent Virtual Circuits (PVCs) or Switched Virtual Circuits (SVCs). The Cisco uBR7200 Series Universal Broadband Routers support PVCs only.

Frame Relay features include the following:

- Cisco and IETF encapsulation
- Cisco, ANSI, and ITU LMI with auto-sensing
- UNI DTE, DCE, and NNI
- Inverse ARP
- Traffic Shaping
- Adaptive Shaping using BECN
- Broadcast Queue
- CDP over FR
- TCP/IP Header Compression
- RTP Header Compression
- Cisco and IETF MIBs
- Syslog Trap Alert for DLCI loss
- Weighted Fair Queuing at the interface level based on DLCI classification
- DLCI IP RTP priority support

Interface Command Enhancements

Several Cisco IOS cable interface commands have been enhanced:

- The **show controller cx/0 upstream number** and **show interface cx/0 upstream number** commands display the following additional statistic counters:
 - Average percent of upstream utilization in minislots
 - Average percent of contention slots
 - Average percent of initial ranging slots
 - Average percent of minislots that were due because the MAP scheduler was not able to request them in time
- The **show interface cx/0 sid [number] counters** command now supports a **verbose** option that displays two additional statistics:
 - Number of bandwidth requests successfully received by the Cisco uBR7200 Series Universal Broadband Router from the specified SID on the specified cable interface
 - Number of grants issued by the Cisco uBR7200 Series Universal Broadband Router to the specified SID
- The **show cable flap-list** and **show cable modem** commands now indicate when the Cisco uBR7200 Series Universal Broadband Router has detected an unstable return path for a particular modem and has compensated with a power adjustment. An asterisk appears in the power adjustment field for a modem when a power adjustment has been made; an exclamation point appears when the modem has reached its maximum power transmit level and cannot increase its power level any further.
- Other power adjustment changes have been made to the **cable upstream power-adjust** command to allow the Cisco uBR7200 series router to better adjust when a cable modem seems to “bounce” (the modem requires frequent power adjustments in opposite directions). When this situation

occurs, instead of making large power adjustments for each correction, you can configure the Cisco uBR7200 series router to calculate the average value of the power corrections before making power adjustments.

- The **cable upstream power-adjust threshold** command now accepts a range of 0–10 dB. The previous range was 0–2 dB.
- The **cable upstream power-adjust noise % of power adjustment** command sets the threshold value (in percent) for a particular upstream switching between regular power adjustments and the noise power adjustment method (which uses an averaging algorithm before sending any correction).
- The **cable upstream frequency-adjust averaging % of frequency adjustment** command sets the threshold (in percent) for a particular upstream switching between regular frequency adjustments and the average frequency adjustment method (which uses an averaging algorithm before sending any correction).
- The **show cable modem** command now supports a number of new options:
 - **show cable modem detail** adds signal/noise ratio (SNR) information for each cable modem on each interface
 - **show cable modem summary** displays the total number of modems connected for each upstream channel, including the number of currently active modems
 - **show cable modem [interface [upstream number]]** displays the total number of modems for the specified interface or upstream
 - **show cable modem [interface [upstream number]] registered** displays the total number of registered modems for the specified interface or upstream
 - **show cable modem [interface [upstream number]] unregistered** displays the total number of unregistered modems for the specified interface or upstream
 - **show cable modem [interface [upstream number]] offline** displays the total number of offline modems for the specified interface or upstream, including status information for each modem before going offline and the time each modem went offline
- The **cable downstream if-output** command is enhanced with the following options to generate test signals on the downstream interface:
 - **cable downstream if-output prbs** shuts down the downstream interface and outputs a PRBS test signal
 - **cable downstream if-output continuous-wave** shuts down the downstream interface and outputs an unmodulated carrier signal

The previous **cable downstream if-output** command has not changed and continues to output a standard modulated signal. The **no cable downstream if-output** command also has not changed—it stops all signal output and shuts down the interface.

- A new command changes the cable modem registration value (the T9 timer). The **cable registration-timeout minutes** command sets the T9 timer to the new value (from 2 to 60 minutes). The **no cable registration-timeout** command resets the T9 timer to its default of 3 minutes.
- Cisco IOS software has a number of new and enhanced commands to support the point-to-point wireless modem card. For more information, refer to the *Cisco uBR7200 Series Wireless Modem Card and Subsystem Installation and Configuration* publication.

Redirect-Number Support for RADIUS and TACACS+ Servers

If a telco-return customer is being authenticated by a RADIUS or TACACS+ server, and if the number dialed by the cable modem is being redirected to another number for authentication, Cisco IOS Release 12.1(1a)T1 can include the original number in the information sent to the authentication server. The original number can be sent as a Cisco Vendor Specific Attribute (VSA) for TACACS+ servers and as RADIUS Attribute 93 (Ascend-Redirect-Number) for RADIUS servers. This allows the service provider to determine whether the customer dialed a number that requires special billing arrangements, such as a toll-free number.

This feature is enabled with the **aaa nas redirected-station** command and disabled with the **no aaa nas redirected-station** command; other AAA configuration commands also apply as appropriate. The RADIUS Attribute 93 is sent by default; to also send a VSA attribute for TACACS+ servers, use the **radius-server vsa send accounting** and **radius-server vsa send authentication** commands. To configure the RADIUS server to use RADIUS Attribute 93, add the **non-standard** option to the **radius-server host** command.



Note

This feature is valid only when using port adapters that are configured for a T1 or E1 ISDN PRI or BRI interface. In addition, the telco switch performing the number redirection must be able to provide the redirected number in the Q.931 Digital Subscriber Signaling System Network Layer.

Cable Subinterfaces and Interface Bundling

Cisco uBR7200 series software supports the definition of logical network layer interfaces over a cable physical interface or a bundle of cable interfaces. The system also supports subinterface creation on either a physical cable interface or a bundle of cable interfaces. This allows a service provider to share one IP subnet across multiple cable interfaces that are grouped into a cable interface bundle. All of the cable interfaces on a Cisco uBR7200 Series Universal Broadband Router can be grouped into a single bundle so that only one subnet is required for each router. This eliminates the requirement that a separate IP subnet be used for each individual cable interface. This in turn avoids the performance, memory, and security problems that result if a bridging solution is used to manage subnets, especially for a large number of subscribers.



Note

Cable interface bundling is applicable only in two-way cable configurations. It is not supported in telco-return configurations.

The CMTS administrator can perform the following tasks:

- Define subinterfaces on a cable physical interface and assign Layer 3 configurations to each subinterface.
- Bundle a group of physical interfaces and define a bundle master Layer 3 configuration or define subinterfaces on the bundle master and give each subinterface Layer 3 configurations.

The command to create a subinterface over a cable interface is the same as that defined by Cisco IOS for other software applications:

```
interface cable x/y.n
```

where *x* is the slot number, *y* is the port number, and *n* is the subinterface number.

Two new commands implement the bundling feature:

- **[no] cable bundle** *number* [*master*] — Configures cable interfaces into bundles.

- **show cable bundle *number* forwarding table** — Displays all the currently known cable devices in the bundle.

Administrators can create subinterfaces on cable interfaces or cable interface bundles to support VPN. Each subinterface can be assigned to a specific pool of IP addresses, mapping that subinterface to a particular VPN customer network. A Generic Routing Encapsulation (GRE) tunnel can also be created between the Cisco uBR7200 series router and the router that serves as the VPN customer gateway.

When a cable modem registers with the Cisco uBR7200 Series Universal Broadband Router, its IP address is used to identify the subinterface being used by the cable modem; this information is used to associate the Service Identifier (SID) assigned to the modem to that subinterface (and thus the VPN customer network).

**Note**

Cisco IOS Release 12.1(1a)T1 and Release 12.1(3)T do not include MPLS support as part of its VPN support on the cable subinterfaces. Cisco IOS Release 12.1(2)T and Release 12.1(5)T and higher releases do support MPLS over VPN.

A subinterface can be created on any cable interface that is not part of a cable interface bundle. A subinterface can also be created on the master cable interface bundle; subinterfaces cannot be created on non master bundles.

Subinterfaces support the following existing cable interface commands:

- **cable arp**
- **cable dhcp-giaddr**
- **cable helper-address**
- **cable ip-broadcast-echo**
- **cable ip-multicast-echo cable proxy-arp**
- **cable source-verify**

**Caution**

Configure an IP address on the master interface only. An attempt to add an interface to a bundle will be rejected if an IP address is configured and the interface is not specified as a master interface.

When bundling cable interfaces, only the interface configured to be the bundle master is allowed to have subinterfaces. An interface that has subinterface(s) defined over it will not be allowed to be part of a bundle.

MIB objects on cable interface bundles are not supported as of the date of this publication.

For more information on cable bundling, see the chapter *Understanding System Operations* of the *Cisco uBR7200 Series Software Configuration Guide*.

Upstream Address Verification Enhancement

This feature prevents the spoofing of IP addresses by verifying that each upstream data packet comes from the cable modem known to be associated with the source IP address in the packet. The **cable source-verify [dhcp]** cable interface command specifies that DHCP lease query requests are sent to verify any unknown source IP address found in upstream data packets. This feature requires a DHCP server that supports the new LEASEQUERY message type.



Note

Cisco Network Registrar (CNR) supports the LEASEQUERY message type in software Release 3.01(T) and greater.

New Hardware Features in Release 12.1(1)

The following new hardware features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(1).

- IEEE 802.3z Gigabit Ethernet Port Adapter
- Network Processing Engines (NPE-300)
- Cisco uBR7246 VXR Chassis
- Cable Modem Cards (MC12C and MC14C)
- Cable Modem Card (MC16C)
- Multichannel DS1/PRI Port Adapter
- Multichannel E1/PRI Port Adapter
- Cable Modem Card (MC16B)

New Software Features in Release 12.1(1)

The following new software features are supported by the Cisco uBR7200 Series Universal Broadband Routers in Cisco IOS Release 12.1(1).

- Basic Wiretap Support
- Cisco IOS Secure Integrated Software
- Downstream Frequency Override
- Additional or Changed Show Commands
 - The **show cable qos** command is changed to **show cable qos-profile *n*** command, where the optional argument *n* can be used to display a specific profile.
 - The **show int cx/y sid** command displays more complete Service ID (SID) status information.
 - The **show cable modem** command displays a list of options for a single modem to be specified by entering either the cable modem's IP address or MAC address.
 - The **show cable burst-profile** command has been removed. Its functions have been incorporated into the **show cable modulation-profile** command, which now includes an added option *number* that displays the modulation profile *number*.
- Automated Double Authentication
- Burst Profile Configuration
- Cable Modem and Multicast Authentication Using RADIUS
- DHCP Client ID/Remote ID Options
- DHCP Cable Modem Host ID
- DOCSIS 1.0 Quality of Service (QoS)
- Downstream Channel ID

- Downstream Rate Shaping with IP Type of Service Bits
- Dynamic Map-Advance
- Encrypted Baseline Privacy Key Exchange
- Improved and Extended Command-Line Interface
- Integrated Time-of-Day Server
- Inter-Switch Link Support for Non-Cable Interfaces
- Management Information Base Enhancements
 - “docsIfUpChannelFrequency” now has a range starting with 0, where 0 indicates that the frequency is unknown or not specified
 - “docsIfUpChannelWidth” now has a range of 0–16 MHz. The value of 0 means the channel width is unknown or not configured
 - “docsIfQosProfileTable” is now read-create
 - “docsIfQosProfBaselinePrivacy” is a new object
 - “docsIfQosProfStatus” is a new object
 - “docsIfCmtsQosProfilePermissions” is a new object
 - “docsIfCmtsCmStatusValue” is a new object
- Parse Bookmarks
- Per-Modem Filters
- Service Assurance Agent
- Spectrum Management Enhancements
- Upstream Address Verification
- Upstream and Downstream Traffic Shaping
- Committed Access Rate
- Cisco IOS SNMPv3
- Integrated DHCP Server
- NetFlow Policy Routing
- NetFlow Switching
- Process MIB
- Resource Reservation Protocol
- Tag Switching
- Web Cache Control Protocol
- Weighted Random Early Detection
- Weighted Fair Queuing

Limitations and Restrictions

Cisco IOS Release 12.1(5)T for the Cisco uBR7200 Series Universal Broadband Routers contains the following limitations and restrictions. Unless otherwise indicated, these limitations and restrictions apply to all previous software releases as well.

Wireless Modem Card Support for Port Adapters

Not all port adapters are supported with the point-to-point wireless modem card. The HSSI, 10BaseT Ethernet, 100BaseT Ethernet, serial Frame Relay, ATM, and POS interfaces are fully supported. The Gigabit Ethernet port adapter was not supported with the point-to-point wireless modem card at the time the Cisco IOS Release 12.1(5)T software was released.

Wireless System Power Feed Panel

The cable that supplies -48VDC to the wireless system's power feed panel should not exceed 3 meters in length.

Important Notes

The following sections contain important notes about Cisco IOS Release 12.1 T that apply to Cisco uBR7200 Series Universal Broadband Routers.

Deferral Notice for Cisco IOS Release 12.1(1)T

The following caveat has caused all images in the Cisco IOS Release 12.1(1)T to be deferred:

CSCdp99255

RM7000 may skip instructions during installation. Please refer to the "Closed and Resolved Caveats for Release 12.1(1a)T1" section on page 47 for more caveat information.

If you already have this image in your network, please replace it with images from the Cisco IOS Release 12.1(1a)T1 release, currently available on CCO.

Minimum 64 MB of DRAM is Required

The Cisco uBR7200 Series Universal Broadband Router must have a minimum of 64 MB of DRAM to run all Cisco IOS Release 12.1(5)T images.

Last Maintenance Release of Cisco IOS Release 12.1 T

The last maintenance release of the 12.1 T release train is 12.1(5)T. The migration path for customers who need bug fixes for the 12.1 T features is the 12.2 mainline release. The 12.2 mainline release has the complete feature content of 12.1 T and will eventually reach general deployment (GD).

The last maintenance release was renamed from 12.1(4)T to 12.1(5)T to synchronize with its parent software base, the 12.1(5) mainline release, and to reflect that 12.1(5)T has all the bug fixes of the 12.1(5) mainline release. The 12.1 T release train is a superset of the 12.1 mainline release; hence any defect fixed in the 12.1 mainline is also fixed in 12.1 T. The set of features for 12.1(4)T is the same as that for 12.1(5)T. There was no change in the feature content of the release. The release was renamed so that the releases would be consistent with the Cisco release process.

Supported MIBs

The Cisco uBR7200 Series Universal Broadband Routers support the following categories of MIBs:

- **SNMP standard MIBs**—These are the MIBs that are required by any agent supporting SNMPv1 or SNMPv2 network management.
- **Cisco’s platform and network-layer enterprise MIBs**—Common across most of Cisco’s router platforms. If your network management applications are already configured to support other Cisco routers, such as the 2600 series or 7200 series, no further configuration is needed unless the version of Cisco IOS software being used has updated these MIBs.
- **Cable-specific and wireless-specific MIBs**—Provide information about the cable and wireless interfaces and related information on the uBR7200 series routers. They include both DOCSIS-specific MIBs and Cisco-specific enterprise MIBs. If your network management applications have not already been configured for the uBR7200 series routers, these MIBs must be loaded.
- **Deprecated MIBs**—Supported in earlier releases of Cisco IOS software but have been replaced by more standardized, scalable MIBs. Network Management applications and scripts should convert to the replacement MIBs as soon as possible.

The cable-specific and wireless-specific MIBs are described in the following sections. For information on the SNMP standard MIBs and Cisco’s platform and network-layer enterprise MIBs, see Cisco’s MIB web site at <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

Cable-Specific and Wireless-Specific MIBs

Table 8 shows the cable-specific and wireless-specific MIBs that are supported on the Cisco uBR7200 Series Universal Broadband Routers. The table also provides a brief description of each MIB’s contents and the Cisco IOS Software Release in which the MIB was initially functional—earlier releases might have had unsupported prototype versions of the MIB; later releases might have added new attributes and functionality. Because of interdependencies, the MIBs must be loaded in the order given in the table.



Note

The names given in Table 8 are the filenames for the MIBs as they exist on Cisco’s FTP site. Most MIBs are available in both SNMPv1 and SNMPv2 versions; the SNMPv1 versions have *V1SMI* as part of their filenames.

Table 8 *Cable-Specific and Wireless-Specific MIBs Supported on Cisco uBR7200 Series Universal Broadband Routers*

MIB Filename	Description	Release
SNMPv2-SMI.my	This module specifies the Structure of Management Information (SMI) for SNMPv2, as defined in RFC 1902.	11.3 T
SNMPv2-SMI-V1SMI.my		

Table 8 Cable-Specific and Wireless-Specific MIBs Supported on Cisco uBR7200 Series Universal Broadband Routers

MIB Filename	Description	Release
SNMPv2-TC.my SNMPv2-TC-V1SMI.my	This module defines the textual conventions as specified in RFC 1903.	11.3 T
SNMPv2-MIB.my SNMPv2-MIB-V1SMI.my	The management protocol, SNMPv2, provides for the exchange of messages that convey management information between the agents and the management stations, as defined in RFC 1907.	11.3 T
CISCO-SMI.my CISCO-SMI-V1SMI.my	This module specifies the SMI for Cisco's enterprise MIBs.	11.3 T
CISCO-TC.my CISCO-TC-V1SMI.my	This module defines the textual conventions used in Cisco's enterprise MIBs.	11.3 T
IF-MIB.my IF-MIB-V1SMI.my	This module describes generic objects for the Layer 3 network interface sublayers. This MIB is an updated version of MIB-II's <i>if</i> table and incorporates the extensions defined in RFC 2233.	11.3 T 12.1(2)T
DOCS-IF-MIB.my DOCS-IF-MIB-V1SMI.my	This module describes the DOCSIS-compliant Radio Frequency (RF) interfaces in cable modems and cable modem termination systems, as defined in RFC 2670.	12.1(1a)T1
DOCS-BPI-MIB.my	This module—available in an SNMPv2 version only—describes the attributes for the DOCSIS-specified Baseline Privacy Interface (BPI) on cable modems and the CMTS.	11.3(11)NA 12.0(7)XR
CISCO-DOCS-EXT-MIB.my CISCO-DOCS-EXT-MIB-V1SMI.my	This module extends the DOCSIS standard RFI MIB (DOCS-IF-MIB) with Cisco-specific extensions, such as QoS attributes and connection status and other information regarding the cable modems and CPE devices supported by the CMTS.	11.3(9)NA 12.0(5)T1
CISCO-DOCS-REMOTE-QUERY-MIB.my (also referred to as SNMP Cable Modem Remote Query)	This module facilitates SNMP polling of remote CMs on a CMTS.	12.1(2)T
CISCO-CIRCUIT-INTERFACE-MIB.my	This module adds support for a new Cisco enterprise MIB, used to assist in SNMP monitoring of circuit-based interfaces.	12.1(3)T
CISCO-MSDP-MIB.my	This module enables users to manage Multicast Source Discovery Protocol operations using SNMP	12.1(5)T
CISCO-NTP-MIB.my	This module enables users to remotely monitor an NTP server using SNMP.	12.1(5)T
EXPRESSION-MIB.my	This module adds support of the Delta, Wildcarding, Delta Wildcarding, and Aggregation features in the Distributed Management Expression MIB (EXPRESSION-MIB)	12.1(3)T
CISCO-CABLE-SPECTRUM-MIB.my CISCO-CABLE-SPECTRUM-MIB-V1SMI.my	This module describes the spectrum management flap list attributes.	12.0(5)T1

Table 8 Cable-Specific and Wireless-Specific MIBs Supported on Cisco uBR7200 Series Universal Broadband Routers

MIB Filename	Description	Release
CISCO-WIRELESS-TC-MIB.my CISCO-WIRELESS-TC-MIB-V1SMI.my	This module contains the textual conventions for the other wireless modem card MIB modules.	12.0(7)XR
CISCO-WIRELESS-EXP-MIB.my CISCO-WIRELESS-EXP-MIB-V1SMI.my	This module is the Cisco Wireless Radio Experimental MIB for the Cisco wireless modem card and related subsystem.	12.0(7)XR
CISCO-WIRELESS-IF-MIB.my CISCO-WIRELESS-IF-MIB-V1SMI.my	This module is the MIB Module for the Cisco Wireless Radio Point-to-Point interface specification.	12.0(7)XR
CISCO-WIRELESS-P2P-BPI-MIB.my CISCO-WIRELESS-P2P-BPI-MIB-V1SMI.my	This module is the MIB Module for the Baseline Privacy Interface (BPI) as implemented on the wireless modem card. This is a variation of the DOCSIS BPI MIB that has been customized for the point-to-point wireless modem subsystem.	12.0(7)XR

Deprecated MIBs

Old Cisco Management Information Bases (MIBs) will be replaced in a future release. Currently, OLD-CISCO-* MIBs are being converted into more scalable MIBs—without affecting existing Cisco IOS products or NMS applications. You can update from deprecated MIBs to the replacement MIBs as shown in Table 9.

Table 9 Replacements for Deprecated MIBs

Deprecated MIB	Replacement
OLD-CISCO-APPLETALK-MIB	RFC1243-MIB
OLD-CISCO-CHASSIS-MIB	ENTITY-MIB
OLD-CISCO-CPUK-MIB	To be decided
OLD-CISCO-DECNET-MIB	To be decided
OLD-CISCO-ENV-MIB	CISCO-ENVMON-MIB
OLD-CISCO-FLASH-MIB	CISCO-FLASH-MIB
OLD-CISCO-INTERFACES-MIB	IF-MIB CISCO-QUEUE-MIB
OLD-CISCO-IP-MIB	To be decided
OLD-CISCO-MEMORY-MIB	CISCO-MEMORY-POOL-MIB
OLD-CISCO-NOVELL-MIB	NOVELL-IPX-MIB
OLD-CISCO-SYS-MIB	(Compilation of other OLD* MIBs)
OLD-CISCO-SYSTEM-MIB	CISCO-CONFIG-COPY-MIB
OLD-CISCO-TCP-MIB	CISCO-TCP-MIB
OLD-CISCO-TS-MIB	To be decided
OLD-CISCO-VINES-MIB	CISCO-VINES-MIB
OLD-CISCO-XNS-MIB	To be decided

**Note**

Some of the MIBs listed in Table 9 represent feature sets that are not supported on Cisco uBR7200 Series Universal Broadband Routers.

**Note**

Cisco Management Information Base (MIB) User Quick Reference is no longer published. If you have an account with CCO, you can find the current list of MIBs supported by Cisco. To reach the *Cisco Network Management Toolkit*, go to CCO, press **Login**, then go to **Software Center: Network Mgmt Products: Cisco Network Management Toolkit: Cisco MIB**.

Caveats

Caveats describe unexpected behavior in Cisco IOS software releases. Severity 1 caveats are the most serious caveats; severity 2 caveats are less serious. Severity 3 caveats are moderate caveats.

For more information on caveats in Cisco IOS Release 12.1 T, see the *Caveats for Cisco IOS Release 12.1 T* document. All caveats in Cisco IOS Release 12.1 are also in Cisco IOS Release 12.1 T. For information on caveats in Cisco IOS Release 12.1, see *Caveats for Cisco IOS Release 12.1*. These documents list severity 1 and 2 caveats and only selected severity 3 caveats, and are located on CCO and the Documentation CD-ROM.

**Note**

If you have an account with CCO, you can use Bug Navigator II to find caveats of any severity for any release. To reach Bug Navigator II, go to CCO and press **Login**. Then go to **Software Center: Cisco IOS Software: Cisco Bugtool Navigator II**. Another option is to go to <http://www.cisco.com/support/bugtools>.

Open Caveats for Release 12.1(5)T

There are no open caveats specific to the Cisco uBR7200 series router that require documentation in the Cisco IOS Release 12.1(5)T release notes. For a list of open caveats for Release 12.1 T, refer to *Caveats for Cisco IOS Release 12.1 T*.

Closed and Resolved Caveats for Release 12.1(5)T

All the caveats listed in this section are closed or resolved in Cisco IOS Release 12.1(5)T.

- CSCdr80563

The Cisco uBR7246 VXR Universal Broadband Router equipped with an NPE-300, Cisco uBR-MC16C or Cisco uBR-MC16E cable modem card, and a Cisco PA-FE-TX Fast Ethernet port adapter, may not boot correctly from flash after a power cycle. This is a timing issue. The port adapter hardware lacks sufficient time to stabilize after a reset, while the driver code starts. Workaround: Reboot the router if this problem is encountered.

This is resolved in Cisco IOS Release 12.1(5)T.

- CSCds02764
When a Cisco uBR7200 series router sends a LEASEQUERY packet to a Cisco Network Registrar (CNR), the Cisco uBR7200 router might misinterpret the LEASEQUERY reply from the CNR. There is no workaround.
This is resolved in Cisco IOS Release 12.1(5)T.
- CSCdr80563
The Cisco uBR7246 VXR Universal Broadband Router equipped with an NPE-300, Cisco uBR-MC16C or Cisco uBR-MC16E cable modem card, and a Cisco PA-FE-TX Fast Ethernet port adapter, may not boot correctly from Flash memory after a power cycle. This is a timing issue. The port adapter hardware lacks sufficient time to stabilize after a reset, while the driver code starts.
Workaround: Reboot the router if this problem is encountered.
This is resolved in Cisco IOS Release 12.1(5)T.
- CSCdr91706 and Cisco IOS HTTP Vulnerability
A defect in multiple releases of Cisco IOS software will cause a Cisco router or switch to halt and reload if the Cisco IOS HTTP service is enabled, browsing to `http://router-ip/anytext?/` is attempted, and the enable password is supplied when requested. This defect can be exploited to produce a denial of service (DoS) attack.
The vulnerability, identified as Cisco bug ID CSCdr91706, affects virtually all mainstream Cisco routers and switches running Cisco IOS software releases 12.0 through 12.1, inclusive. This is not the same defect as CSCdr36952.
The vulnerability has been corrected and Cisco is making fixed releases available for free to replace all affected Cisco IOS releases. Customers are urged to upgrade to releases that are not vulnerable to this defect as shown in detail below.
This vulnerability can only be exploited if the enable password is known or not set.
You are strongly encouraged to read the complete advisory, which is available at <http://www.cisco.com/warp/public/707/ioshttpserverquery-pub.shtml>.
This is resolved in Cisco IOS Release 12.1(5)T.

Open Caveats for Release 12.1(3)T

There are no open caveats specific to the Cisco uBR7200 series router that require documentation in the Cisco IOS Release 12.1(3)T release notes. For a list of open caveats for Release 12.1 T, refer to *Caveats for Cisco IOS Release 12.1 T*.

Closed and Resolved Caveats for Release 12.1(3)T

All the caveats listed in this section are closed or resolved in Cisco IOS Release 12.1(3)T.

- CSCdp17526
If a POS port adapter has fair-queuing enabled, it cannot be replaced via online insertion and removal (OIR). If such a POS port adapter is replaced by online removal and insertion, it can no longer transmit packets. The router must be reloaded to recover from this error; the only workaround is to disable fair-queuing before replacing a POS port adapter.
This is resolved in Cisco IOS Release 12.1(3)T.

- CSCdr52543

The upstream port of a line card might be poorly initialized and not receive upstream bursts from the cable modems. In that case, the modems are not able to complete the initial ranging and continue to power-cycle infinitely.

This situation only occurs if the upstream port has non default physical-layer configuration parameters stored in the startup configuration.

Workaround: Configure the following sequence of **cable interface configuration** commands so that the upstream port can start receiving data while allowing non default physical-layer configuration parameters:

cable upstream {port} shutdown

no cable upstream {port} shutdown

Alternative workaround: Use default physical-layer configuration parameters for the upstream port.

This is resolved in Cisco IOS Release 12.1(3)T.

Open Caveats for Release 12.1(2)T

There are no open caveats specific to the Cisco uBR7200 series router that require documentation in the Cisco IOS Release 12.1(2)T release notes. For a list of open caveats for Release 12.1 T, refer to *Caveats for Cisco IOS Release 12.1 T*.

Closed and Resolved Caveats for Release 12.1(2)T

All the caveats listed in this section are closed or resolved in Cisco IOS Release 12.1(2)T.

- CSCdm62122 and CSCdm90388

When an MC16C or MC16S Cable Modem Card is configured for a mixed burst profile (station maintenance packets are using QPSK modulation and data packets are using 16-QAM modulation), the MC16S does not hop to a new frequency band when noise interferes with data packets but only at much higher noise levels when station maintenance packets are dropped. Workaround: Use 16-QAM modulation for all modes (request, initial, station, and data).

This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdp66700

The following new object is now supported to meet DOCSIS OSSI compliance: “ifCounterDiscontinuityTime”. This will cause a discontinuity on CMTS if you reset interface counters using CLI commands **clear counters** or **clear counters cable 5/0**.

This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdp73335

Modem calls over BRI do not work correctly.

This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr05920

Prior to this fix, CMs will fail to complete initial ranging when minislots size is set to 128 ticks and channel width is set to 200000 Hz.

Workaround: It is recommended that the user not use this non default upstream channel setting of 128 ticks/mslot, channel width = 200000, until an image with the fix is available. The problem will NOT happen with the default setting of minislot size = 8 ticks, channel width = 1600000. However, if for any reason user MUST use minislot size = 128 ticks, the following hidden command can be used to allow CMs to complete initial ranging.

cmts(config-if)#no cable downstream map-guardband

However, the above workaround can cause a non optimal operation of the upstream burst receiver. Some CRC errors/No energy detection problem can be produced as a side result of the workaround. Thus, the workaround is recommended only if the user MUST use minislot size=128 ticks.

This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr47549

An upstream reset function that was added for MC16E cards caused MC16B cards to lose upstream. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr23835

If at least three cable interfaces were configured in a bundle and the bundle master was not the lowest-numbered cable interface, removing one of the slave interfaces from the bundle followed by removing another slave caused a crash. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr23090

If a frequency hop was triggered on an upstream port serving constant bit rate (CBR) slots, the Cisco uBR7200 series router crashed. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr19087

In bundling, if the IP address on the master interface was configured with certain values, modems on all cable interfaces within the bundle were not able to pass the CM initialization phase. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdr13184

A problem occurred when there was simultaneous traffic to the same CM with different IP precedence rate limits, which are configured by using the Cisco Vendor-specific subtype IP precedence rate limit. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdp98512

If a Cisco uBR7200 Series Universal Broadband Router had non compliant DOCSIS CMs on an upstream port that ranged with a negative timing offsets, the modems deceived the CMTS Map building code into using a large Map Advance when the dynamic Map Advance algorithm was active on each upstream port.

The result of this situation was that all other CMs on that upstream port were unable to send data upstream to the CMTS and went offline. The router generated a warning log message every time a CM with bad timing offset was detected. A sample warning message follows:

```
%UBR7200-5-BADTXOFFSET:Bad timing offset -10 detected for cable modem 0010.9500.0a6a
```

This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdp89661

If an administrator tried to delete a CMTS-created static QoS profile used for G.729 or G.711 upstream CBR service, the CMTS prevented destruction of such profiles. The Cisco uBR7200 crashed when the first Voice/Fax call using the undeleted profile terminated. This is resolved in Cisco IOS Release 12.1(2)T.

- CSCdp85836
Spectrum Management task used many CPU cycles and caused CPU utilization to increase. This is resolved in Cisco IOS Release 12.1(2)T.
- CSCdp82100
If VRFs were configured on cable subinterfaces and **cable dhcp-giaddr policy** was configured on the subinterface, then primary addresses configured on the cable subinterface were used for CMs and secondary address hosts. During testing, it was found that the giaddr was set to the primary address for both CMs and hosts.

If there was no VRF configured, then it behaved correctly. This is resolved in Cisco IOS Release 12.1(2)T.
- CSCdp78309
In Cisco IOS Release 12.1 T, the definition of 'k1' images for the Cisco uBR9xx series was changed from BPI support only to include SSH support. This change caused an inconsistency with Cisco uBR7200 images, since the definition of 'k1' images for the Cisco uBR7200 was not changed and does not include SSH. The definition of 'k1' images for the Cisco uBR7200 must therefore be updated to include SSH, in all release trains supporting SSH. This is resolved in Cisco IOS Release 12.1(2)T.

Open Caveats for Cable-Specific Functionality for Release 12.1(1a)T1

This section describes possibly unexpected behavior for cable-specific features for Cisco IOS Release 12.1(1a)T1.



Note

The caveats for the wireless modem card are listed in the separate section, “Open Caveats for Wireless Modem Card Functionality for Release 12.1(1a)T1” on page 46.

- CSCdm68421
If a POS interface starts receiving incoming traffic while a Cisco uBR7246 or uBR7246 VXR router is still booting, the router stops booting until the incoming traffic stops. The workaround is to prevent any incoming traffic from coming into a POS interface until the router finishes its bootup process. (This problem can also occur on a Cisco 7200 series router.)
- CSCdm92017 and CSCdp20117
If the **show controller** command is entered during online insertion and removal (OIR) of a cable modem line card or port adapter, the Cisco uBR7200 series router can crash and must be reloaded to recover. The workaround is to avoid entering CLI commands while physically removing and inserting a cable modem line card or port adapter. (This problem can also occur on other routers.)
- CSCdp18494
When noise with a minimum frequency of 0.2 MHz at an amplitude greater than 20 dBmV occurs on an upstream channel on an MC16S Cable Modem Card, noise can also occur at the center frequency harmonics. This affects the MC16S card’s ability to analyze the noise levels on the different upstream channels.

Open Caveats for Wireless Modem Card Functionality for Release 12.1(1a)T1

This section describes possibly unexpected behavior by the point-to-point wireless modem card and wireless subsystem in Cisco IOS Release 12.1(1a)T1, which is the first release that supports the point-to-point wireless modem card.

- CSCdm55663

When the point-to-point wireless modem card is configured for maximum IF cable loss, the receiver's sensitivity may be reduced by 1.5 to 2 dB.
- CSCdm56880

Under very infrequent conditions, the point-to-point wireless modem card establishes a link of marginal quality, taking longer than normal to synchronize. However, the link does resynchronize correctly after several seconds, with no further impact on signal stability.
- CSCdm81104

The temperature of a wireless transverter cannot be read on demand—the temperature is not accurately displayed when the Cisco uBR7200 series router is queried using SNMP requests. In addition, the temperature of a transverter is reported to the console only when the factory set threshold is crossed. There is no workaround to read the transverter's temperature on demand.
- CSCdp08266

The point-to-point wireless modem card does not currently calculate or display received signal strength. The workaround is to use the following procedure to calculate an estimate for the received signal strength.

 - a. Measure the total AGC attenuation of the system with the **radio histogram totalGain <n> 1 2 50 coll 10 per 10 sum true** command, where <n> is the antenna number (1 or 2).
 - b. Find the average total gain value in the displayed histogram data.
 - c. Determine the currently configured cable loss for the radio interface by giving the **show run** command and finding the **radio cableloss** command for that radio interface.
 - d. Calculate the estimated received signal strength (in dBm) with the following calculation:
estimated received signal strength = ((average total gain) / 2) – 96 dBm
- CSCdp12605

When two wireless transverters are powered by a single DC power supply, applying or removing power to one transverter can create transients on the DC line. Depending on the regulation of the DC supply, these transients could affect the operation of the second transverter until DC power restabilizes—in extreme situations, this could result in the resetting of the second transverter. The workaround is to use a separate DC power supply for each transverter.
- CSCdp27784

The **radio snapshot** command allows up to four simultaneous snapshots, except when collecting **rx-timedomainchannel** snapshot types. Time domain snapshots for either antenna must be collected one at a time.

Closed and Resolved Caveats for Release 12.1(1a)T1

All the caveats listed in this section are closed or resolved in Cisco IOS Release 12.1(1a)T1.

- CSCdp99255

The RM7000 processor used by C7140 and NPE-300 has a bug in version 1.X that may cause skipping or incorrect installation instruction execution. This leads to unpredictable results including memory corruption and crashes. Software has worked around the problem in accordance with manufacturer's recommendation.

This caveat led to the deferral of Cisco IOS Release 12.1(1)T images.

Related Documentation

The following sections describe the documentation available for the Cisco uBR7200 series. These documents consist of hardware and software installation guides, Cisco IOS configuration and command references, system error messages, feature modules, and other documents.

Documentation is available as printed manuals or electronic documents, except for feature modules, which are available online on CCO and the Documentation CD-ROM.

Use these release notes with these documents:

- Release-Specific Documents, page 47
- Platform-Specific Documents, page 48
- Feature Modules, page 49
- Cisco IOS Software Documentation Set, page 50

Release-Specific Documents

The following documents are specific to Release 12.1 and are located on CCO and the Documentation CD-ROM:

- *Cross-Platform Release Notes for Cisco IOS Release 12.1*

On CCO:

Technical Documents: Documentation Home Page: Cisco IOS Software Configuration: Cisco IOS Release 12.1

On the Documentation CD-ROM:

Cisco Product Documentation: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Release Notes: Cross Platform Release Notes

- Product bulletins, field notices, and other release-specific documents on CCO:

Technical Documents

- *Caveats for Cisco IOS Release 12.1* and *Caveats for Cisco IOS Release 12.1 T*

As a supplement to the caveats listed in the “Caveats” section in these release notes, see *Caveats for Cisco IOS Release 12.1* and *Caveats for Cisco IOS Release 12.1 T*, which contain caveats applicable to all platforms for all maintenance releases of Release 12.1.

On CCO:

Technical Documents: Documentation Home Page: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Caveats

On the Documentation CD-ROM:

Cisco Product Documentation: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Caveats



Note If you have an account with CCO, you can use Bug Navigator II to find caveats of any severity for any release. You can reach Bug Navigator II on CCO at **Service & Support: Online Technical Support: Software Bug Toolkit** or at <http://www.cisco.com/support/bugtools>.

Platform-Specific Documents

The following platform-specific documents are available.

Cisco uBR7200 Series Routers

These documents are available for the Cisco uBR7200 Series Universal Broadband Routers on CCO and the Documentation CD-ROM:

- *Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide*
- *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*
- *Cisco uBR7200 Series Universal Broadband Router Configuration Notes*
- *Cisco uBR7200 Series Universal Broadband Router Cable Modem Card Hardware Installation*
- *Cisco Network Registrar for the uBR7200 Series Universal Broadband Router*
- *Broadband Command Consolidation*

On CCO:

Technical Documents: Documentation Home Page: Broadband/Cable Solutions: Cisco uBR7200 Series Universal Broadband Routers



Note The *Broadband Command Consolidation* is available on CCO through the following path: **Technical Documents: Documentation Home Page: Broadband/Cable Solutions**

On the Documentation CD-ROM:

Cisco Product Documentation: Broadband/Cable Solutions: Cisco uBR7200 Series Universal Broadband Routers



Note The *Broadband Command Consolidation* is available on the Documentation CD-ROM through the following path: **Cisco Product Documentation: Broadband/Cable Solutions**

**Note**

Information about features of the uBR7200 Series Universal Broadband Router, as well as software release notes, are available on CCO at:
http://www.cisco.com/univercd/cc/td/doc/product/cable/cab_r_sw/index.htm

Cisco Broadband Fixed Wireless Modem Card

These documents are available for the point-to-point wireless modem card (and other components of the Cisco WT2700 Wireless Technology Suite) on CCO and the Documentation CD-ROM:

- *Site Planning Guide*
- *Cisco uBR7200 Series Universal Broadband Router Wireless Modem Card and Subsystem Installation & Configuration*
- *Cisco Broadband Fixed Wireless System Power Feed Panel Replacement Instructions*

On CCO:

Technical Documents: Documentation Home Page: Cisco Product Documentation: Broadband/Wireless Solutions

On the Documentation CD-ROM:

Cisco Product Documentation: Broadband/Wireless Solutions

Cisco uBR900 Series Cable Access Routers

The documentation for the Cisco uBR900 Series Cable Access Routers is available on CCO and the Documentation CD-ROM at the following locations:

On CCO:

Technical Documents: Documentation Home Page: Broadband/Cable Solutions: Cisco uBR900 Series Cable Access Routers

On the Documentation CD-ROM:

Cisco Product Documentation: Broadband/Cable Solutions: Cisco uBR900 Series Cable Access Routers

Feature Modules

Feature modules describe new features supported by Cisco IOS Release 12.1(5)T and are updates to the Cisco IOS documentation set. A feature module consists of a brief overview of the feature, benefits, configuration tasks, and a command reference. As updates, the feature modules are available online only. Feature module information is incorporated in the next printing of the Cisco IOS documentation set.

On CCO:

Technical Documents: Documentation Home Page: Cisco IOS Software Configuration: Cisco IOS Release 12.1: New Feature Documentation

On the Documentation CD-ROM:

Cisco Product Documentation: Cisco IOS Software Configuration: Cisco IOS Release 12.1: New Feature Documentation: New Features in Release 12.1 T

Feature Navigator

Feature Navigator is a web-based tool that enables you to quickly determine which Cisco IOS software images support a particular set of features and which features are supported in a particular Cisco IOS image.

Feature Navigator is available 24 hours a day, 7 days a week. To access Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, e-mail the Contact Database Administration group at cdbadmin@cisco.com. If you do not have an account on Cisco.com, go to <http://www.cisco.com/register> and follow the directions to establish an account.

To use Feature Navigator, you must have a JavaScript-enabled web browser such as Netscape 3.0 or later, or Internet Explorer 4.0 or later. Internet Explorer 4.0 always has JavaScript enabled. To enable JavaScript for Netscape 3.x or Netscape 4.x, follow the instructions provided with the web browser. For JavaScript support and enabling instructions for other browsers, check with the browser vendor.

Feature Navigator is updated when major Cisco IOS software releases and technology releases occur. You can access Feature Navigator at the following URL:

<http://www.cisco.com/go/fn>

Cisco IOS Software Documentation Set

The Cisco IOS software documentation set consists of the Cisco IOS configuration guides, Cisco IOS command references, and several other supporting documents, which are shipped with your order in electronic form on the Documentation CD-ROM, unless you specifically order the printed versions.

Documentation Modules

Each module in the Cisco IOS documentation set consists of two books: a configuration guide and a corresponding command reference. Chapters in a configuration guide describe protocols, configuration tasks, and Cisco IOS software functionality, and contain comprehensive configuration examples. Chapters in a command reference provide complete command syntax information. Use each configuration guide with its corresponding command reference.

On CCO and the Documentation CD-ROM, two master hot-linked documents provide information for the Cisco IOS software documentation set.

On CCO:

Technical Documents: Documentation Home Page: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Configuration Guides and Command References

On the Documentation CD-ROM:

Cisco Product Documentation: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Configuration Guides and Command References: Cisco IOS Interface Configuration Guide or Cisco IOS Interface Command Reference

Release 12.1 Documentation Set

Table 10 describes the contents of the Cisco IOS Release 12.1 software documentation set, which is available in electronic form, and also in printed form upon request.

**Note**

You can find the most current Cisco IOS documentation on CCO and the Documentation CD-ROM. These electronic documents may contain updates and modifications made after the paper documents were printed.

On CCO:

Technical Documents: Documentation Home Page: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Configuration Guides and Command References

On the Documentation CD-ROM:

Cisco Product Documentation: Cisco IOS Software Configuration: Cisco IOS Release 12.1: Configuration Guides and Command References

Table 10 *Cisco IOS Software Release 12.1 Documentation Set*

Books	Major Topics
<ul style="list-style-type: none"> • <i>Cisco IOS Configuration Fundamentals Configuration Guide</i> • <i>Cisco IOS Configuration Fundamentals Command Reference</i> 	Configuration Fundamentals Overview Cisco IOS User Interfaces Cisco IOS File Management Cisco IOS System Management Cisco IOS User Interfaces Commands Cisco IOS File Management Commands Cisco IOS System Management Commands
<ul style="list-style-type: none"> • <i>Cisco IOS Bridging and IBM Networking Configuration Guide</i> • <i>Cisco IOS Bridging and IBM Networking Command Reference, Volume I</i> • <i>Cisco IOS Bridging and IBM Networking Command Reference, Volume II</i> 	Using Cisco IOS Software Overview of SNA Internetworking Bridging IBM Networking
<ul style="list-style-type: none"> • <i>Cisco IOS Dial Services Configuration Guide: Terminal Services</i> • <i>Cisco IOS Dial Services Configuration Guide: Network Services</i> • <i>Cisco IOS Dial Services Command Reference</i> 	Preparing for Dial Access Modem Configuration and Management ISDN and Signalling Configuration PPP Configuration Dial-on-Demand Routing Configuration Dial-Backup Configuration Terminal Service Configuration Large-Scale Dial Solutions Cost-Control Solutions Virtual Private Networks X.25 on ISDN Solutions Telco Solutions Dial-Related Addressing Services Interworking Dial Access Scenarios
<ul style="list-style-type: none"> • <i>Cisco IOS Interface Configuration Guide</i> • <i>Cisco IOS Interface Command Reference</i> 	Interface Configuration Overview Configuring LAN Interfaces Configuring Serial Interfaces Configuring Logical Interfaces

Table 10 Cisco IOS Software Release 12.1 Documentation Set (continued)

Books	Major Topics
<ul style="list-style-type: none"> • <i>Cisco IOS IP and IP Routing Configuration Guide</i> • <i>Cisco IOS IP and IP Routing Command Reference</i> 	<ul style="list-style-type: none"> IP Addressing and Services IP Routing Protocols IP Multicast
<ul style="list-style-type: none"> • <i>Cisco IOS AppleTalk and Novell IPX Configuration Guide</i> • <i>Cisco IOS AppleTalk and Novell IPX Command Reference</i> 	<ul style="list-style-type: none"> AppleTalk and Novell IPX Overview Configuring AppleTalk Configuring Novell IPX
<ul style="list-style-type: none"> • <i>Cisco IOS Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Configuration Guide</i> • <i>Cisco IOS Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Command Reference</i> 	<ul style="list-style-type: none"> Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Overview Configuring Apollo Domain Configuring Banyan VINES Configuring DECnet Configuring ISO CLNS Configuring XNS
<ul style="list-style-type: none"> • <i>Cisco IOS Multiservice Applications Configuration Guide</i> • <i>Cisco IOS Multiservice Applications Command Reference</i> 	<ul style="list-style-type: none"> Multiservice Applications Overview Voice Video Broadband
<ul style="list-style-type: none"> • <i>Cisco IOS Quality of Service Solutions Configuration Guide</i> • <i>Cisco IOS Quality of Service Solutions Command Reference</i> 	<ul style="list-style-type: none"> Quality of Service Overview Classification Congestion Management Congestion Avoidance Policing and Shaping Signalling Link Efficiency Mechanisms Quality of Service Solutions
<ul style="list-style-type: none"> • <i>Cisco IOS Security Configuration Guide</i> • <i>Cisco IOS Security Command Reference</i> 	<ul style="list-style-type: none"> Security Overview Authentication, Authorization, and Accounting (AAA) Security Server Protocols Traffic Filtering and Firewalls IP Security and Encryption Other Security Features
<ul style="list-style-type: none"> • <i>Cisco IOS Switching Services Configuration Guide</i> • <i>Cisco IOS Switching Services Command Reference</i> 	<ul style="list-style-type: none"> Cisco IOS Switching Services Overview Cisco IOS Switching Paths Cisco Express Forwarding NetFlow Switching Multiprotocol Label Switching Multilayer Switching Multicast Distributed Switching Virtual LANs LAN Emulation

Table 10 Cisco IOS Software Release 12.1 Documentation Set (continued)

Books	Major Topics
<ul style="list-style-type: none"> • <i>Cisco IOS Wide-Area Networking Configuration Guide</i> • <i>Cisco IOS Wide-Area Networking Command Reference</i> 	<ul style="list-style-type: none"> Wide-Area Networking Overview Configuring ATM Configuring Frame Relay Configuring Frame Relay-ATM Interworking Configuring SMDS Configuring X.25 and LAPB
<ul style="list-style-type: none"> • <i>Cisco IOS Configuration Master Index</i> • <i>Cisco IOS Command Reference Master Index</i> • <i>Cisco IOS Debug Command Reference</i> • <i>Cisco IOS Dial Services Quick Configuration Guide</i> • <i>Cisco IOS Software System Error Messages</i> • <i>Cisco IOS Configuration Guide Master Index</i> • <i>New Features in 12.1-Based Limited Lifetime Releases</i> • <i>New Features in Release 12.1 T</i> • Release Notes (Release note and caveat documentation for 12.1-based releases and various platforms) 	

**Note**

The *Cisco Management Information Base (MIB) User Quick Reference* publication is no longer published. For the latest list of MIBs supported by Cisco, see *Cisco Network Management Toolkit* on Cisco Connection Online. From CCO, click on the following path: **Service & Support: Software Center: Network Mgmt Products: Cisco Network Management Toolkit: Cisco MIB.**

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- Telnet: [cco.cisco.com](telnet://cco.cisco.com)
- Modem using standard connection rates and the following terminal settings: VT100 emulation; 8 data bits; no parity; and 1 stop bit.
 - From North America, call 408 526-8070
 - From Europe, call 33 1 64 46 40 82

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To contact TAC by e-mail, use one of the following:

Language	E-mail Address
English	tac@cisco.com
Hanzi (Chinese)	chinese-tac@cisco.com
Kanji (Japanese)	japan-tac@cisco.com
Hangul (Korean)	korea-tac@cisco.com
Spanish	tac@cisco.com
Thai	thai-tac@cisco.com

In North America, TAC can be reached at 800 553-2447 or 408 526-7209. For other telephone numbers and TAC e-mail addresses worldwide, consult the following web site:
<http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml>.

Software Configuration Tips on the Cisco Technical Assistance Center Home Page

If you have a CCO log-in account, you can access the following URL, which contains links and tips on configuring your Cisco products:

http://www.cisco.com/kobayashi/technotes/serv_tips.shtml

This URL is subject to change without notice. If it changes, point your Web browser to CCO, press **Login**, and click on this path: **Technical Assistance Center: Technical Tips**.

The following sections are provided from the Technical Tips page:

- Access Dial Cookbook—Contains common configurations or recipes for configuring various access routes and dial technologies.
- Field Notices—Notifies you of any critical issues regarding Cisco products and includes problem descriptions, safety or security issues, and hardware defects.
- Frequently Asked Questions—Describes the most frequently asked technical questions about Cisco hardware and software.
- Hardware—Provides technical tips related to specific hardware platforms.
- Hot Tips—Describes popular tips and hints gathered from the Cisco Technical Assistance Center (TAC). Most of these documents are available from the TAC Fax-on-demand service. To reach Fax-on-demand and receive documents at your fax machine from the United States, call 888 50-CISCO (888 502-4726). From other areas, call 650 596-4408.
- Internetworking Features—Lists tips on using Cisco IOS software features and services.
- Sample Configurations—Provides actual configuration examples that are complete with topology and annotations.

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