



Lossless Compression and ATM Cell Switching and BITS Clocking

The Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source features introduce a new compression technique in DSP firmware and add enhancements to Cisco IOS that include cell switching on ATM segmentation and reassembly (SAR), and the use of an external BITS clocking source. These features enable Cisco multiservice routers to be used to transparently groom and compress traffic in a wireless service provider network and enable a service provider to optimize the bandwidth used to backhaul the traffic from a cell site to the mobile central office for more efficient use of existing T1 and E1 lines.

- [Finding Feature Information, page 1](#)
- [Prerequisites for Lossless Compression and ATM Cell Switching and BITS Clocking, page 2](#)
- [Restrictions for Lossless Compression and ATM Cell Switching and BITS Clocking, page 2](#)
- [Information About Lossless Compression and ATM Cell Switching and BITS Clocking, page 3](#)
- [How to Configure Lossless Compression and ATM Cell Switching and BITS Clocking, page 4](#)
- [Additional References for ATM OAM Traffic Reduction, page 16](#)
- [Feature Information for Lossless Compression and ATM Cell Switching and BITS Clocking, page 17](#)

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Lossless Compression and ATM Cell Switching and BITS Clocking

You must use a Cisco 3660 or Cisco 3745 with the following components installed:

Table 1: Supported Network Modules

Feature	Cisco 3660	Cisco 3745
Lossless compression R1	NM-HDV	NM-HDV
ATM cell switching	AIM-ATM or AIM-ATM-VOICE-30 NM- <i>x</i> FE2W with VWIC- <i>x</i> MFT-T1/E1	AIM-ATM or AIM-ATM-VOICE-30 NM- <i>x</i> FE2W with VWIC- <i>x</i> MFT-T1/E1 VWIC- <i>x</i> MFT-T1/E1 (on-board WIC slot)
BITS clocking	NM-HDV NM- <i>x</i> FE2W with VWIC- <i>x</i> MFT-T1/E1	NM-HDV NM- <i>x</i> FE2W with VWIC- <i>x</i> MFT-T1/E1 VWIC- <i>x</i> MFT-T1/E1 (on-board WIC slot)

Restrictions for Lossless Compression and ATM Cell Switching and BITS Clocking

- Operations, administration, and maintenance (OAM) cell insertion is not supported on cell-switched PVCs.
- AIM-ATM and AIM-ATM-VOICE-30 modules support a maximum of four T1/E1s. This can consist of two incoming and two outgoing, or three incoming and one outgoing T1/E1s. An IMA group cannot be split between multiple AIMS.
- Certain combinations of AIM modules can become inoperable when installed in a Cisco 3745. This problem only affects Cisco 3745 routers manufactured before June 11, 2003. See the following link for detailed information about this problem:

<http://www.cisco.com/en/US/ts/fn/200/fn25194.html>

- Voice activity detection (VAD) and echo cancellation are disabled when lossless compression is enabled.
- Lossless compression R1 is supported for VoATM calls with AAL2 and subcell multiplexing. VoIP calls are not supported at this time.

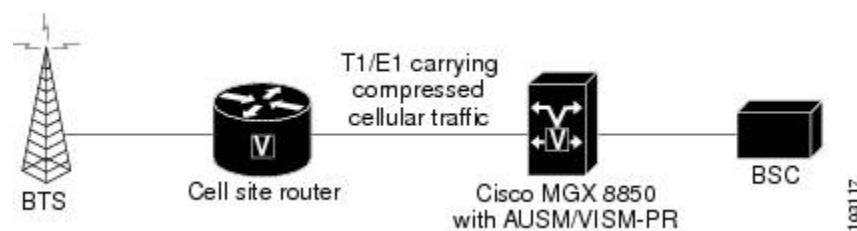
- ATM cell switching is limited to a maximum of 25 connections per AIM-ATM.
- Do not configure more than 29 LLCC channels per NM-HDV module. Configuring more than 29 LLCC channels can cause unreliable operation.
- J1 controller is not supported.
- Traffic policing is not supported.
- For Cisco 3660 routers with two NM-HDV modules installed, do not install the modules in the following slot combinations:
 - Slot 1 and Slot 3
 - Slot 2 and Slot 4
 - Slot 5 and Slot 6

Using these slot combinations can result in packet loss.

Information About Lossless Compression and ATM Cell Switching and BITS Clocking

The Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source features work together to groom and compress T1 and E1 traffic between cell sites and a mobile central office. These features require a Cisco 3660 or Cisco 3745 router to be installed at the base transceiver station (BTS). This cell site router performs ATM switching and compression of cell site traffic for transport to the base station controller (BSC). A Cisco MGX 8850 with AUSM and VISM-PR terminates the T1/E1 lines that carry lossless compression codec (LLCC) traffic, converting the traffic back to PCM before passing it to the BSC. The figure below shows a sample topology that makes use of the Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source features.

Figure 1: Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source Features



To configure the Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source feature, you should understand the following concepts:

Lossless Compression Codec on NM-HDV

The Lossless Compression R1 feature introduces a new compression technique in DSP firmware and the VISM card-- the lossless compression codec (LLCC). LLCC operates in a similar fashion to the existing clear channel codec: the decoded 64kbps PCM stream is a bit-exact replica of the PCM stream provided on the

TDM side of the encoding DSP. However, rather than simply packetizing the PCM stream, the LLCC encoder applies a lossless data compression scheme. This results in a net reduction in the data transmission rate, yielding a reduction in the packet transmission rate.

ATM Cell Switching on AIM-ATM and AIM-ATM-VOICE-30

The Cisco ATM Cell Switching feature enables the router to perform cell switching between two ATM connections on AIM-ATM and AIM-ATM-VOICE-30 cards, giving the router the ability to receive ATM traffic from the BTS and backhaul it to the mobile central office.

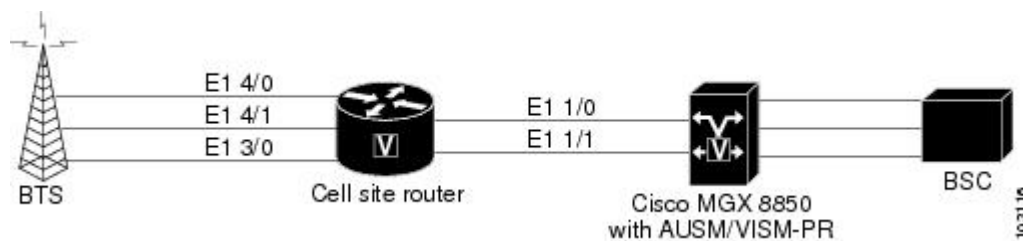
BITS Clocking on the Cisco 3660 and Cisco 3745

BITS (Building Integrated Timing Supply) network clocking enables a Cisco 3660 or Cisco 3745 router to derive network timing from the central office. BITS must be configured on the cell site router to support this feature.

How to Configure Lossless Compression and ATM Cell Switching and BITS Clocking

The instructions that follow refer to the sample configuration shown in the figure below. With this configuration, the cell site router supports three E1 connections to the BTS. Compressed cellular traffic is transported to the BSC (by way of the Cisco MGX 8850) over the E1 1/0 and E1 1/1 interfaces. Additionally, BITS clocking is derived from E1 1/1.

Figure 2: Sample Configuration



Configuring the Cell Site Router for BITS Clocking

BITS clocking enables the router at a cell site to derive timing from the mobile central office. BITS clocking ensures that data flows to a single network clock source, preventing mismatches and data slips in traffic between the BTS and the BSC. The procedure that follows configures the AIM to receive BITS clocking from E1 1/1 controller.

To configure the cell site router for BITS clocking, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **network-clock-participate** *slot number*
4. **network-clock-select priority** *slot number*
5. **controller t1 | e1 slot/port**
6. **clock source {line [primary | bits] | internal}**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password when prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	network-clock-participate <i>slot number</i> Example: Router(config)# network-clock-participate slot 1	Allows the network module in the specified slot to use the network clock for its timing.
Step 4	network-clock-select priority <i>slot number</i> Example: Router(config)# network-clock-select 1 E1 1/1	Specifies a port to be used as a timing source for the network clock, and the priority level for the use of that port. The source that is given the highest priority is used first; if it becomes unavailable, the source with the second-highest priority is used, and so forth.
Step 5	controller t1 e1 slot/port Example: Router(config)# controller e1 1/1	Enters controller configuration mode for the selected T1 or E1.
Step 6	clock source {line [primary bits] internal} Example: Router(config-controller)# clock source line bits	Specifies that the clock is generated from the T1 or E1 BITS source.

Configuring ATM Cell Switching

The procedure that follows configures the cell site router to switch ATM traffic with the Cisco MGX 8850 at the BSC. This procedure configures ATM switching between E1 3/0 and E1 1/0, using the AIM installed in Slot 1.

To configure ATM cell switching, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **network-clock-participate** *slot number*
4. **network-clock-participate** *slot number*
5. **network-clock-participate** *aim number*
6. **controller t1** | **e1 slot/port**
7. **mode atm aim** *aim-slot*
8. **controller t1** | **e1 slot/port**
9. **mode atm aim** *aim-slot*
10. **interface atm** *interface-number* / *subinterface-number*
11. **pvc vpi / vci** **l2transport**
12. **interface atm** *interface-number* / *subinterface-number*
13. **pvc vpi / vci** **l2transport**
14. **connect id atm slot . port-1 atm slot . port-2**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password when prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	network-clock-participate <i>slot number</i> Example: Router(config)# network-clock-participate slot 1	Enables the network module in the specified slot to use the network clock for its timing.

	Command or Action	Purpose
Step 4	network-clock-participate <i>slot number</i> Example: Router(config)# network-clock-participate slot 3	Enables the network module in the specified slot to use the network clock for its timing.
Step 5	network-clock-participate <i>aim number</i> Example: Router(config)# network-clock-participate aim 0	Specifies that the AIM in Slot 0 will derive clocking from the network source.
Step 6	controller t1 e1 slot/port Example: Router(config)# controller e1 1/0	Enters controller configuration mode for the selected T1 or E1.
Step 7	mode atm aim <i>aim-slot</i> Example: Router(config-controller)# mode atm aim 0	Sets the mode of the T1 or E1 controller in AIM Slot 0.
Step 8	controller t1 e1 slot/port Example: Router(config)# controller e1 3/0	Enters controller configuration mode for the selected T1 or E1.
Step 9	mode atm aim <i>aim-slot</i> Example: Router(config-controller)# mode atm aim 0	Sets the mode of the T1 or E1 controller in AIM Slot 0.
Step 10	interface atm <i>interface-number / subinterface-number</i> Example: Router(config) # interface atm 1/0	Enters configuration mode for the selected ATM interface.
Step 11	pvc <i>vpi / vci</i> l2transport Example: Router(config-if)# pvc 10/110 l2transport	Creates a PVC for the virtual path identifier (VPI) and virtual channel identifier (VCI) and specifies that the PVC is switched, not terminated.

	Command or Action	Purpose
Step 12	interface atm <i>interface-number / subinterface-number</i> Example: Router (config) # interface atm 3/0	Enters configuration mode for the selected ATM interface.
Step 13	pvc vpi / vci l2transport Example: Router(config-if)# pvc 30/130 l2transport	Creates a PVC for the VPI and VCI and specifies that the PVC is switched.
Step 14	connect id atm slot . port-1 atm slot . port-2 Example: Example: Router(config)# connect Switched-Conn atm 1/0 10/110 atm 3/0 30/130	Defines connections between T1 or E1 controller ports and the ATM interface.

Configuring the Lossless Compression Codec

The procedure that follows configures an LLCC voice channel on E1 4/0 and sends it over the ATM network using E1 1/0 and the AIM installed in Slot 1.

To configure the lossless compression codec, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **network-clock-participate** *slot number*
4. **network-clock-participate** *slot number*
5. **network-clock-participate** *aim number*
6. **voice service** {pots | voatm | vofr | voip}
7. **session protocol aal2**
8. **subcell-mux**
9. **codec aal2-profile custom** *profile-number* **codec**
10. **controller t1** | **e1** *slot/port*
11. **mode atm aim** *aim-slot*
12. **controller t1** | **e1** *slot/port*
13. **ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** *signaling method*
14. **interface atm** *interface-number* /*subinterface-number*
15. **pvc** *vpi* /*vci*
16. **vbr-rt** *peak-rate* *average-rate* *burst*
17. **encapsulation aal2**
18. **dial-peer voice** *tag* **voatm**
19. **destination-pattern** *string*
20. **session protocol aal2-trunk**
21. **session target** *interface* **pvc** *vpi/vci*
22. **signal-type** *cas* | *cept* | *ext-signal* | **transparent**
23. **codec aal2-profile custom** *profile-number* **codec**
24. **voice-port** {*slot-number* /*subunit-number* /*port* | *slot* /*port* :*ds0-group-no* }
25. **playout-delay** {*fax* | **maximum** | **nominal**} *milliseconds*
26. **connection** {*plar* | *tie-line* | *plar-opx*} *digits* | {**trunk** *digits* [*answer-mode*]}

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. Enter your password when prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	network-clock-participate <i>slot number</i> Example: Router(config)# network-clock-participate slot 1	Enables the network module in the specified slot to use the network clock for its timing.
Step 4	network-clock-participate <i>slot number</i> Example: Router(config)# network-clock-participate slot 4	Enables the network module in the specified slot to use the network clock for its timing.
Step 5	network-clock-participate <i>aim number</i> Example: Router(config)# network-clock-participate aim 0	Specifies that the AIM in Slot 0 will derive clocking from the network source.
Step 6	voice service {pots voatm vofr voip} Example: Router(config)# voice service voatm	Enters voice service configuration mode and specifies VoATM as the encapsulation type.
Step 7	session protocol aal2 Example: <div style="text-align: center;"> Router(config-voi-serv)# session protocol aal2 </div>	Enters voice-service-session configuration mode and specifies ATM adaptation layer 2 (AAL2) trunking.
Step 8	subcell-mux Example: Router(conf-voi-serv-sess)# subcell-mux	Enables AAL2 common part sublayer (CPS) subcell multiplexing.
Step 9	codec aal2-profile custom <i>profile-number</i> codec Example: Router# codec aal2-profile custom 51 0 0 llcc 40 0 15	Sets the codec profile for the DSP on a per-call basis and specifies the lossless compression codec.
Step 10	controller t1 e1 slot/port Example: Router(config)# controller e1 1/0	Enters controller configuration mode for the selected T1 or E1.

	Command or Action	Purpose
Step 11	mode atm aim <i>aim-slot</i> Example: Router(config-controller)# mode atm aim 0	Sets the mode of the T1 or E1 controller in AIM Slot 0.
Step 12	controller t1 e1 slot/port Example: Router(config)# controller e1 4/0	Enters controller configuration mode for the selected T1 or E1.
Step 13	ds0-group <i>ds0-group-number</i> timeslots <i>timeslot-list</i> type <i>signaling method</i> Example: Router(config-controller)# ds0-group 0 timeslots 1 type ext-sig	Specifies the DS0 time slots that make up a logical voice port on a T1 or E1 controller and specifies the signaling type used by the router.
Step 14	interface atm <i>interface-number</i> /<i>subinterface-number</i> Example: Router(config) # interface atm 1/0	Enters configuration mode for the selected ATM interface.
Step 15	pvc <i>vpi</i> /<i>vci</i> Example: Router(config-if-atm)# pvc 10/110	Enters configuration mode for the selected PVC.
Step 16	vbr-rt <i>peak-rate</i> <i>average-rate</i> <i>burst</i> Example: Router(config-if-atm-pvc)# vbr-rt 1920 1920 255	Configures real-time variable bit rate (VBR) for VoATM voice connections.
Step 17	encapsulation aal2 Example: Router(config-if-atm-pvc)# encapsulation aal2	Configures the encapsulation type for the ATM virtual circuit.
Step 18	dial-peer voice <i>tag</i> voatm Example: Router(config)# dial-peer voice 1001 voatm	Defines a dial-peer and specifies the method of voice encapsulation as VoATM.

	Command or Action	Purpose
Step 19	destination-pattern <i>string</i> Example: Router(config-dial-peer) # destination-pattern 1001	Specifies the prefix to be used by the dial peer.
Step 20	session protocol aal2-trunk Example: Router(config-dial-peer) # session protocol aal2-trunk	Specifies the dial peer uses AAL2 nonswitched trunk session protocol.
Step 21	session target interface pvc vpi/vci Example: Router(config-dial-peer) # session target atm 1/0 pvc 10/100 9	Specifies the network-specific address for the VoATM dial peer.
Step 22	signal-type cas cept ext-signal transparent Example: Router(config-dial-peer) # signal-type ext-signal	Specifies that external signaling is used when connecting to the dial peer. The DSP does not generate any signaling frames.
Step 23	codec aal2-profile custom profile-number codec Example: Router(config-dial-peer) # codec aal2-profile custom 51 llcc	Sets the codec profile for the DSP on a per-call basis and specifies the lossless compression codec.
Step 24	voice-port {slot-number /subunit-number /port slot /port :ds0-group-no } Example: Router(config) # voice-port 2/0:0	Enters voice-port configuration mode.
Step 25	playout-delay {fax maximum nominal} milliseconds Example: Router(config-voice-port) # playout-delay nominal 25	Tunes the playout buffer to accommodate packet jitter caused by switches in the WAN. The nominal keyword specifies the initial (and minimum allowed) delay time that the DSP inserts before playing out voice packets, in milliseconds.
Step 26	connection {plar tie-line plar-opx} digits {trunk digits [answer-mode]}	Associates this voice-port to destination-pattern 1001.

	Command or Action	Purpose
	Example: <pre>Router(config-voice-port)# connection trunk 1001</pre>	

What to Do Next



Note

To ensure that the voice-port configuration takes affect, issue the **shutdown** command, followed by **no shutdown** to enable it again.

Disabling Connection Admission Control

Connection admission control (CAC) is a set of actions taken by each ATM switch during connection setup to determine whether the requested QoS will violate the QoS guarantees for established connections. CAC reserves bandwidth for voice calls, however, the bandwidth required when LLCC is used is dynamic and usually less than what is generally reserved by CAC. Disabling CAC may help in better utilization of bandwidth when LLCC is used.

To disable CAC, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *interface-number /subinterface-number*
4. **pvc** *vpi /vci*
5. **cac_off**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. Enter your password when prompted.

	Command or Action	Purpose
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface atm interface-number /subinterface-number Example: Router(config) # interface atm 1/0	Enters configuration mode for the selected ATM interface.
Step 4	pvc vpi /vci Example: Router(config-if-atm) # pvc 10/110	Enters configuration mode for the selected PVC.
Step 5	cac_off Example: Router# (config-if-atm-vc) # cac_off	Disables call admission control.

Verifying Lossless Compression and ATM Cell Switching and BITS Clocking

To verify the configuration use the following commands.

- **show connection all**
- **show voice dsp**
- **show voice call port-id**
- **show voice trunk supervisory summary**
- **show interfaces**

show connection all

The following example shows output from the **show connection all** command. In this example, Switched-Conn is a cell-switched connection established between PVC 10/110 and PVC 30/130, which are configured under ATM1/0 and ATM3/0 respectively.

```
Router# show connection all
ID      Name                Segment 1                Segment 2                State
=====
3       V-100-700                E1 1/0 (VOICE) 00        DSP 07/00/00             UP
4       V-120-700                E1 1/2 (VOICE) 00        DSP 07/00/00             UP
5       Switched-Conn            ATM1/0 10/110            ATM3/0 30/130            UP
```

The **show connection all** command displays the state of Switched-Conn. If it is in the UP state, then it means the ATM cell switching connection is operational.

show voice dsp

The following example shows output from the **show voice dsp** command:

```
Router# show voice dsp
DSP   DSP      DSPWARE  CURR   BOOT
TYPE  NUM  CH  CODEC    VERSION  STATE  STATE  RST  AI  VOICEPORT  TS  PAK  TX/RX
=====
C549  000  04  llcc      4.3.392  busy   idle    0  4/0:0    04    0  1752/1752
```

The **show voice dsp** command shows if the LLCC codec has been applied to the voice port. Additionally, the TX/RX COUNT indicates if packet exchange is occurring. If LLCC is operational, then TX/RX COUNT will display similar values.

show voice call port-id

The **show voice call** command gives detailed information about the lossless compression codec. The following example shows output from the **show voice call** command:



Note

The **show voice call** command has a limitation that causes it to display invalid values. To ensure that accurate values are reported, invoke this command twice and look at the second output.

```
Router# show voice call 4/0:0
4/0:0 1
      vtsp level 0 state = S_CONNECTvpm level 1 state = S_TRUNKED
vpm level 0 state = S_UP
lossless compression summary:
  average compression ratio since reset      = 50
  current compression ratio                  = 50
  max buffer size (ms)                       = 41
  nominal buffer size (ms)                   = 25
  current buffer size (ms)                   = 26
  total encoder input frame count             = 5534
  total encoder output frame count            = 2767
  encoded tx front-end compressed frame count = 2767
  encoded tx back-end compressed frame count  = 0
  encoded tx frame count (no compression)     = 0
  underflow error count                      = 0
  overflow error count                       = 0
  decode error count                         = 0
  tx signalling frame count                   = 11
  rx signalling frame count                   = 10
  rx bad checksum frame count                 = 0
  rx good checksum frame count                = 2777
```

show voice trunk supervisory summary

The following example shows output from the **show voice trunk supervisory summary** command:

```
Router# show voice trunk supervisory summary
SLOW SCAN
4/0:0(1) : state : TRUNK_SC_CCS_CONNECT, master
```

show interfaces

The following example shows output from the **show interfaces** command:

```
Router# show interfaces atm1/0
ATM1/0 is up, line protocol is up
  Hardware is ATM AIM E1
  MTU 4470 bytes, sub MTU 4470, BW 1920 Kbit, DLY 20000 usec,
    reliability 0/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Encapsulation(s): AAL5
  255 maximum active VCs, 256 VCs per VP, 0 current VCCs
  VC Auto Creation Disabled.
  VC idle disconnect time: 300 seconds
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: Per VC Queueing
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 packets output, 0 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 output buffer failures, 0 output buffers swapped out
```

Additional References for ATM OAM Traffic Reduction

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
ATM commands	<i>Cisco IOS Asynchronous Transfer Mode Command Reference</i>

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
None	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Lossless Compression and ATM Cell Switching and BITS Clocking

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to . An account on Cisco.com is not required.

Table 2: Feature Information for Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source

Feature Name	Releases	Feature Information
Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source	12.3(4)XD 12.3(7)T	<p>The Lossless Compression R1, ATM Cell Switching, and External BITS Clocking Source features introduce a new compression technique in DSP firmware and add enhancements to Cisco IOS that include cell switching on ATM segmentation and reassembly (SAR), and the use of an external BITS clocking source. These features enable Cisco multiservice routers to be used to transparently groom and compress traffic in a wireless service provider network and enable a service provider to optimize the bandwidth used to backhaul the traffic from a cell site to the mobile central office for more efficient use of existing T1 and E1 lines.</p> <p>The following commands were introduced or modified: cac_off, clock source (T1/E1 controller), codec aal2-profile, connect (atm).</p>