Configuring IMA Port Adapter Interfaces

This chapter describes inverse multiplexing over ATM (IMA) and the steps required to configure the IMA port adapters in the Catalyst 8540 MSR, Catalyst 8510 MSR, and LightStream 1010 ATM switch routers. These port adapters group multiple low-speed links into one larger virtual trunk or IMA group.

Note This chapter provides advanced configuration instructions for the Catalyst 8540 MSR, Catalyst 8510 MSR and LightStream 1010 ATM switch routers. For complete descriptions of the commands mentioned in this chapter, refer to the *ATM Switch Router Command Reference* publication. For hardware installation and cabling instructions, refer to the *ATM Port Adapter and Interface Module Installation Guide*.

For more information on how to configure your IMA-specific network equipment, refer to the Cisco IOS publications on the Documentation CD-ROM.

This chapter includes the following sections:

- Overview of IMA on page 20-1
- Configuring the T1/E1 IMA Port Adapter on page 20-3
- Configuring IMA Group Functions on page 20-6
- Configuring IMA Group Parameters on page 20-13

Note IMA is only possible on switches with FC-PFQ installed.

Overview of IMA

IMA allows you to aggregate multiple low-speed links into one larger virtual trunk or IMA group. An inverse multiplexer appears to your ATM switch router as one logical pipe. This IMA group provides modular bandwidth for user access to ATM networks for connections between ATM network elements at rates between the traditional order multiplex levels, such as between T1 or E1 and T3 or E3.

IMA involves inverse multiplexing and demultiplexing of ATM cells in a cyclical fashion among links grouped to form a higher bandwidth logical group with a rate approximately the sum of the link rates. This group of links is called an IMA group.

Inverse multiplexing in the transmit direction controls the distribution of cells onto the group of physical links available to the IMA group interface. It also handles differential delays and deals with links that are added or dropped, or fail and are later restored. In the receive direction, the IMA interface

performs differential delay compensation and recombines the cells into the original ATM cell stream while allowing minimal cell delay variation (CDV). The IMA process of splitting and recombining the ATM cell stream is as transparent to the layer above as a traditional single-link physical layer interface.

Figure 20-1 illustrates the configuration of the T1 IMA port adapters (with eight ports each) on two switches which create a virtual IMA group connection.

Figure 20-1   IMA Grouping Example
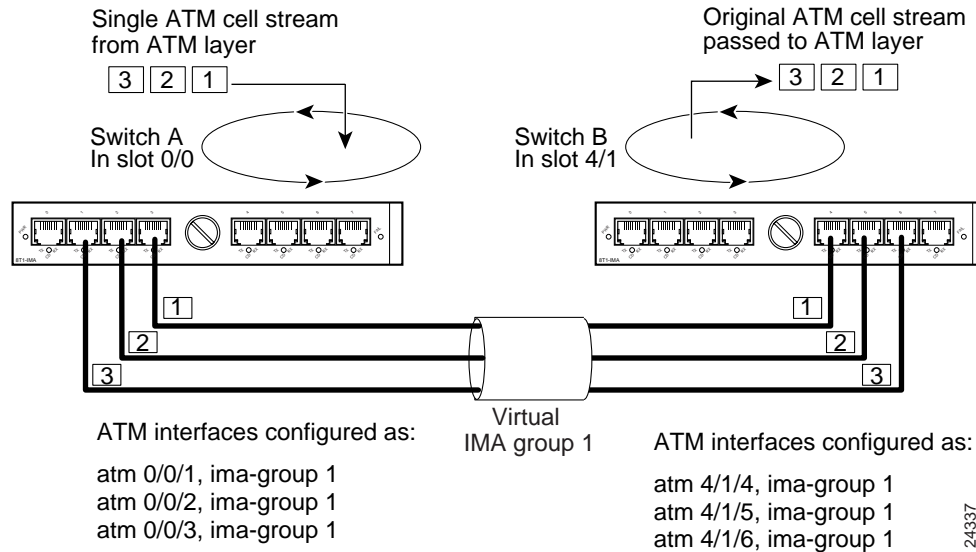
IMA groups terminate at each end of the IMA virtual link. The transmit IMA receives the ATM cell stream from the ATM layer and distributes it on a cell-by-cell basis across the multiple T1 or E1 links within the IMA group. At the far-end, the receiving IMA recombines the cells from each link, also on a cell-by-cell basis, recreating the original ATM cell stream. The aggregate cell stream is then passed to the ATM layer.

The IMA frame is the unit of control in the IMA protocol. An IMA frame is a series of consecutive cells. Periodically, the transmit IMA sends special cells that permit reconstruction of the ATM cell stream at the receiving IMA. These cells, defined as IMA Control Protocol (ICP) cells, provide the definition of an IMA frame. The transmitter must align the transmission of IMA frames on all links (shown in Figure 20-2) to allow the receiver to adjust for differential link delays among the constituent physical links. Based on this required behavior, the receiver can detect the differential delays by measuring the arrival times of the IMA frames on each link.

The transmitting end sends cells continuously. If no ATM layer cells are sent between ICP cells within an IMA frame, the transmit IMA sends filler cells to maintain a continuous stream of cells at the physical layer. Filler cells, which provide cell rate decoupling at the IMA sublayer, are discarded by the receiving IMA.

A new OAM cell is defined for use by the IMA protocol. This cell has codes that define it as either an ICP cell or a filler cell.

Within the IMA frame, the ICP cell appears at the ICP cell offset position, which can vary among the links. Figure 20-2 shows an example of the transmission of IMA frames over three links. On interface 0/0/1, the ICP cells have their cell offset set to 0 and are the first cells in each IMA frame. On interface 0/0/2, the ICP cells have the ICP cell offset set to 3 and are the fourth cells in each IMA frame. On interface 0/0/3, the ICP cells have their ICP cell offset set to 1 and are the second cells in each IMA frame.

Figure 20-2   IMA Frames
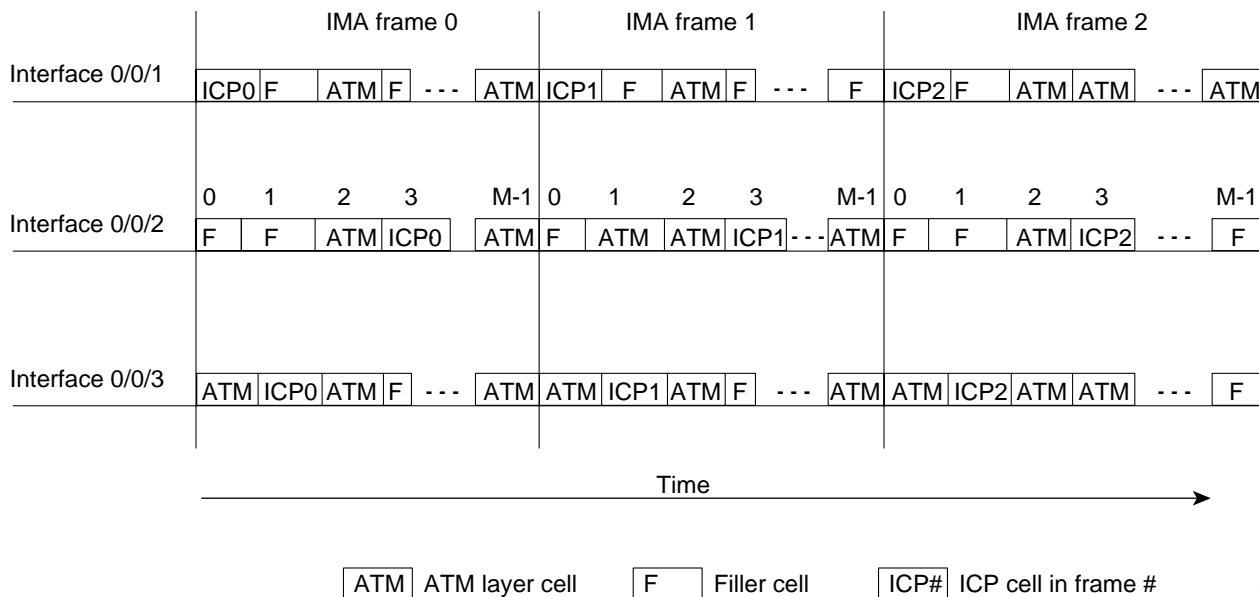
Note   These ICP cells are distributed more evenly over the IMA frame but are shown closer for illustration purposes. Within an IMA frame, the ICP cells on all links have the same IMA frame sequence number.

Configuring the T1/E1 IMA Port Adapter

The T1/E1 IMA port adapter provides eight physical ports. Each port adapter supports up to four IMA groups and independent ATM interfaces. The following are possible combinations:

- Four IMA groups
- Three IMA groups and one independent ATM interface
- Two IMA groups and two independent ATM interfaces
- One IMA group and three independent ATM interfaces
- No IMA group and four independent ATM interfaces

The T1 line operates at 1.544 Mbps, which is equivalent to 24 time slots (DS0 channels). The T1 time slot provides usable bandwidth of n x 64 kbps, where n is the time slot from 1 to 24. The E1 line operates at 2.048 Mbps.

T1/E1 IMA port adapters support interface overbooking. For configuration information, see the "Configuring Interface Overbooking" section on page 8-37.

Note   By default, T1/E1 IMA interfaces are shut down when the port adapter is installed.

Default T1/E1 IMA Interface Configuration

The following defaults are assigned to all T1/E1 IMA port adapter interfaces:

- Clock source = system clock

- Transmit clock source = network derived

- Loopback = no loopback

- BERT = disabled

The following port adapter types have specific defaults assigned.

T1 port adapter:

- Framing = extended super frame (ESF)

- Line build-out (LBO) = short 133

- Linecode = b8zs

- Facilities Data Link (FDL) = no FDL

- Yellow = enabled

E1 port adapter:

- Framing = pcm30adm

- Line build-out (LBO) = short gain12 22db

- Linecode = hdb3

- National bits = 1 1 1 1 1 1

The following defaults are assigned to all IMA groups:

- Minimum number of active links = 1

- Clock mode = common

- Differential delay = 25 milliseconds

- Frame length = 128 cells

- Test link = first link in the group

- Test pattern = value of test link

Configuring the T1/E1 IMA Interface

To manually change any of your default configuration values, perform the following steps, beginning in global configuration mode:

Note IMA is only possible on switches with FC-PFQ installed.

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Specifies the ATM interface and enters interface configuration mode.
Step 2	Switch(config-if)# **bert pattern** {**2^15** | **2^20** | **2^23** | **0s** | **1s** | **2^11** | **2^20-QRSS** | **alt-0-1**} **interval** *minutes*	Configures the bit error rate test pattern.
Step 3	Switch(config-if)# **clock source** {**free-running** | **loop-timed** | **network-derived**}	Configures the type of clocking.
Step 4	Switch(config-if)# **framing** {**esfadm** | **sfadm**}	Modifies the T1 IMA framing type.
	Switch(config-if)# **framing** {**cleare1** | **crc4adm** | **pcm30adm**}	Modifies the E1 IMA framing type.
Step 5	Switch(config-if)# **lbo** {**long** {**gain26** | **gain36**} {**-15db** | **-22.5db** | **-7.5db** | **0db**}} | {**short** {**133ft** | **266ft** | **399ft** | **533ft** | **655ft**}}	Modifies the T1IMA line build-out.
	Switch(config-if)# **lbo** {**long gain43** {**120db** | **75db**} | **short gain12 22db**}	Modifies the E1 IMA line build-out.
Step 6	Switch(config-if)# **loopback** {**cell** | **diagnostic** | **line** | **local** | **payload** | **pif** | **remote** {**line** {**inband** | **fdl** {**ansi** | **bellcore**}} | **payload** [**fdl ansi**]}}	Configures the T1 line loopback.
	Switch(config-if)# **loopback** {**cell** | **diagnostic** | **line** | **payload** | **pif**}	Configures the E1 line loopback.
Step 7	Switch(config-if)# **linecode** {**ami** | **b8zs**}	Modifies the T1 line code format.
	Switch(config-if)# **linecode** {**ami** | **hdb3**}	Modifies the E1 line code format.
Step 8	Switch(config-if)# **fdl** {**ansi** | **att**}	Configures T1 FDL format.
Step 9	Switch(config-if)# **yellow** {**detection** | **generation**}	Enables T1 yellow alarm detection.
Step 10	Switch(config-if)# **national reserve** *bit-pattern*	Modifies the E1 national bits.

Example

The following example shows how to change the clock source to free running:

```
Switch(config)# interface atm 0/0/3
Switch(config-if)# clock source free-running
```

Displaying the T1/E1 IMA Interface Configuration

To display the physical T1/E1 IMA interface configuration, use the following EXEC command:

Command	Purpose
show controllers atm *card*/*subcard*/*port*	Displays the physical interface configuration and status.

Example

The following example shows a T1 IMA ATM interface 0/0/3 configuration, including the change to the clock source configuration from the previous section:

```
Switch# show controller atm 0/0/3
ATM0/0/3 is up
        PAM State is UP
        Firmware Version: 1.6
        FPGA Version : 1.2
        Boot version : 1.2
Port type: T1    Port rate: 1.5 Mbps    Port medium: UTP
Port status:Good Signal    Loopback:None    Flags:8000
fdl is DISABLED
Yellow alarm enabled in both tx and rx
linecode is B8ZS
TX Led: Traffic Pattern    RX Led: Traffic Pattern    CD Led: Green
TX clock source:  free-running
T1 Framing Mode:  ESF ADM format
LBO (Cablelength) is short 133
Counters:
    Key: txcell  - # cells transmitted
        rxcell   - # cells received
        hcs      - # uncorrectable HEC errors
        chece    - # rx Correctable HEC errors
        uicell   - # unassigned/idle cells dropped
        oocd     - # rx out of cell deliniation
        rx_fovr  - # rx FIFO over run
        tx_fovr  - # tx FIFO over run
        coca     - # tx Change of cell allignment
        pcv      - # path code violations
        lcv      - # line code violations
        es       - #
--More--
```

Configuring IMA Group Functions

To configure IMA group functions on an ATM switch router, perform the tasks in the following sections:

- Creating an IMA Group Interface on page 20-6
- Adding an Interface to an Existing IMA Group on page 20-8
- Deleting an Interface from an IMA Group on page 20-10
- Deleting an IMA Group on page 20-11

Creating an IMA Group Interface

To create an IMA group interface, first link a physical interface to the IMA group. After configuring the physical interface as part of an IMA group, you can then create the IMA group interface. An IMA group interface is identified by its card, subcard, and IMA group number. For example, IMA group 1 configured on the physical interface card 0 and subcard 0 is identified as 0/0/ima1. IMA group numbers range from 0 to 3.

Note   You must create the IMA group at both ends of the connection.

To create an IMA group interface at both ends of the connection, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Specifies the ATM port and enters interface configuration mode.
Step 2	Switch(config-if)# **shutdown**	Shuts down the interface prior to configuring the IMA group.
Step 3	Switch(config-if)# **ima-group** *number*	Assigns the interface to an IMA group number.
Step 4	Switch(config-if)# **no shutdown**	Reenables the interface.
Step 5	Switch(config-if)# **exit** Switch(config)#	Returns to global configuration mode.
Step 6	Switch(config)# **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the IMA group 0 to 3 and enters interface configuration mode.
Step 7	Switch(config-if)# **no shutdown**	Creates the IMA group.
Step 8	—	Repeat this procedure on the other end of the connection.

Note The IMA group numbers on each end of the interface can differ. For example, you can configure the interfaces in IMA group 1 on Switch A and in IMA group 2 on Switch B.

Example

The following example shows how to create the IMA group interface 0/0/ima1 shown in Figure 20-1 starting with Switch A, ATM interface 0/0/1:

```
SwitchA(config)# interface atm 0/0/1
SwitchA(config-if)# shutdown
SwitchA(config-if)# ima-group 1
SwitchA(config-if)# no shutdown
SwitchA(config-if)# exit
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# no shutdown
```

The following example shows how to create the IMA group interface 4/1/ima1 shown in Figure 20-1 on Switch B, ATM interface 4/1/4:

```
SwitchB(config)# interface atm 4/1/4
SwitchB(config-if)# shutdown
SwitchB(config-if)# ima-group 1
SwitchB(config-if)# no shutdown
SwitchB(config-if)# exit
SwitchB(config)# interface atm 4/1/ima1
SwitchB(config-if)# no shutdown
```

Adding an Interface to an Existing IMA Group

An interface can be added to an existing IMA group link by assigning the IMA group number.

> **Note** You must configure the IMA group at both ends of the physical connection.

To configure the interfaces at both ends of the connection as members of an existing IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Specifies the ATM port and enters interface configuration mode.
Step 2	Switch(config-if)# **shutdown**	Prior to configuring the IMA group, shuts down the interface.
Step 3	Switch(config-if)# **ima-group** *number*	Assigns the interface to an IMA group number.
Step 4	Switch(config-if)# **no shutdown**	Reenables the interface.
Step 5	—	Repeat this procedure on the other end of the connection.

> **Note** You can use the **ima-group** command to move an interface from one IMA group to another.

Examples

The following example shows how to configure ATM interface 0/0/2 on Switch A as part of the IMA group 1 shown in Figure 20-1:

```
SwitchA(config)# interface atm 0/0/2
SwitchA(config-if)# shutdown
SwitchA(config-if)# ima-group 1
SwitchA(config-if)# no shutdown
```

The following example shows how to configure ATM interface 4/1/5 on Switch B as part of the IMA group 1 shown in Figure 20-1:

```
SwitchB(config)# interface atm 4/1/5
SwitchB(config-if)# shutdown
SwitchB(config-if)# ima-group 1
SwitchB(config-if)# no shutdown
```

The following example shows how to move ATM interface 4/1/5 on Switch B to the IMA group 3:

```
SwitchB(config)# interface atm 4/1/5
SwitchA(config-if)# shutdown
SwitchB(config-if)# ima-group 3
SwitchB(config-if)# no shutdown
```

Displaying the IMA Group Configuration

To display the IMA group configuration, use the following EXEC commands:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima***group* [**detailed**]]	Displays IMA group interface configuration and status.
show interfaces atm *card*/*subcard*/**ima***group*	Displays IMA interface configuration and status.

Example

The following example shows the IMA group interface configuration for IMA group 0/0/ima1 interface:

```
SwitchA# show ima interface atm 0/0/ima1
ATM0/0/ima1 is up
        Group Index    = 2
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1    MinNumRxLinks = 1
        DiffDelayMax  = 25    FrameLength    = 128
        NeTxClkMode   = common(ctc) CTC_Reference_Link = ATM0/0/3
        TestLink      = 3        Testpattern      = Not Specified
        TestProcStatus    = disabled   GTSM change timestamp = 990426154350
IMA Link Information:
Link            Physical Status        NearEnd Rx Status      Test Status
-----           ---------------        ----------------       --------------
ATM0/0/2        up                     active                 disabled
ATM0/0/3        up                     active                 disabled
```

The following example shows the interface configuration for T1 IMA group 0/0/ima1:

```
SwitchA# show interfaces atm 0/0/ima1
ATM0/0/ima1 is up, line protocol is up
  Hardware is imapam_t1_ima
  MTU 4470 bytes, sub MTU 4470, BW 1500 Kbit, DLY 0 usec, rely 255/255, load 1/255
  Encapsulation ATM, loopback not set, keepalive not supported
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     223 packets input, 11819 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
     215 packets output, 11395 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

The following example shows the ATM layer interface configuration of the T1 IMA group 0/0/ima1:

```
SwitchA# show atm interface atm 0/0/ima1

Interface:      ATM0/0/ima1      Port-type:       imapam_t1_ima
IF Status:      UP               Admin Status:    up
Auto-config:    enabled          AutoCfgState:    completed
IF-Side:        Network          IF-type:         NNI
Uni-type:       not applicable   Uni-version:     not applicable
Max-VPI-bits:   8                Max-VCI-bits:    14
Max-VP:         255              Max-VC:          16383
ConfMaxSvpcVpi: 255              CurrMaxSvpcVpi:  255
ConfMaxSvccVpi: 255              CurrMaxSvccVpi:  255
ConfMinSvccVci: 35              CurrMinSvccVci:  35
Svc Upc Intent: pass             Signalling:      Enabled
ATM Address for Soft VC: 47.0091.8100.0000.0040.0b0a.2a81.4000.0c80.0090.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      3        0       0       0       0        0       0          3          3
Logical ports(VP-tunnels):    0
Input cells:    105              Output cells:    109
5 minute input rate:             0 bits/sec,      0 cells/sec
5 minute output rate:            0 bits/sec,      0 cells/sec
Input AAL5 pkts: 58, Output AAL5 pkts: 60, AAL5 crc errors: 0
```

Deleting an Interface from an IMA Group

To delete an interface from an IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Specifies the ATM port and enters interface configuration mode.
Step 2	Switch(config-if)# **no ima-group**	Deleted the interface from an IMA group number.

Example

The following example shows how to delete an interface from an IMA group:

```
Switch(config)# interface atm 0/0/1
Switch(config-if)# no ima-group
```

Confirming the Interface Deletion

To confirm the interface deletion from the IMA group, use the following EXEC command:

Command	Purpose
show ima interface atm *card*/*subcard*/*port*	Displays IMA group interface configuration and status.

Example:

The following example shows how to verify that the interface is deleted from the IMA group:

```
SwitchA# show ima interface atm 0/0/1
ATM0/0/1 is not a part of IMA group
```

Deleting an IMA Group

To delete an IMA group, use the following global configuration command:

Command	Purpose
no interface atm *card*/*subcard*/**ima**group	Deletes the IMA group from the T1/E1 IMA interface.

> **Note** When you delete an IMA group, the interfaces remain configured as members of the IMA group. When you recreate the IMA group, the member interfaces reinitialize automatically.

Example

The following example shows how to delete ATM interface 0/0/ima1 and administratively shut down the member interfaces:

```
Switch(config)# no interface atm 0/0/ima1
```

Confirming the IMA Group Deletion

To confirm the IMA group deletion, perform the following steps in user EXEC mode:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima**group [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows how to verify that the interface is deleted from the IMA group:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm 0/0/2
Switch(config-if)# shut
Switch(config-if)# ima-group 0
Switch(config-if)# no shut
Switch(config-if)# exit
Switch(config)# interface atm 0/0/ima0
Switch(config-if)# no shut
Switch(config-if)# end
Switch# show ima interface atm 0/0/ima0
ATM0/0/ima0 is up
        Group Index    = 5
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1    MinNumRxLinks = 1
        DiffDelayMax  = 25   FrameLength   = 128
        NeTxClkMode   = common(ctc)  CTC_Reference_Link = ATM0/0/2
        TestLink      = 2        Testpattern      = Not Specified
        TestProcStatus    = disabled   GTSM change timestamp = 000210165420
IMA Link Information:
Link            Physical Status        NearEnd Rx Status        Test Status
-----           ---------------        -----------------        ---------------
ATM0/0/2        up                     active                   disabled
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm 0/0/ima0
Switch(config-if)# end
Switch(config)# no interface atm 0/0/ima0
Switch(config)# exit
Switch# show ima interface atm 0/0/ima0
                                    ^
% Invalid input detected at '^' marker.

Switch#
```

Configuring IMA Group Parameters

This section describes how to configure inverse multiplexing over ATM (IMA) group parameters after configuring an IMA group at the interface level. These tasks include configuring active minimum links, interface clock mode, link differential delay, frame length, and test pattern.

Configuring IMA Group Minimum Active Links

You can configure an IMA group to require a minimum number of active links. This number is the minimum number of links required for the IMA group to become operational and provides a guaranteed minimum bandwidth. For example, if the **active-minimum-links** command number is configured as 3, the minimum number of active links necessary for the IMA group to be active is three and the minimum bandwidth available is approximately 3 x T1 speed.

To configure the minimum active links on the IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/**ima**group Switch(config-if)#	Specifies the IMA group to configure and enters interface configuration mode.
Step 2	Switch(config-if)# **ima active-links-minimum** *number*	Specifies the minimum number of active links for an IMA group.

> **Note** Only when the minimum number of links are active in the IMA group does the group come up. The IMA group remains down if the IMA group has fewer active links than the minimum number of active links configured.

Example

The following example shows how to configure the minimum number of active links that must be up for the IMA group to function as 3:

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# ima active-links-minimum 3
```

Displaying the IMA Group Minimum Active Links Configuration

To display the IMA group minimum active links configuration, use the following EXEC command:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima**group [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows the IMA group interface minimum active links configuration:

```
SwitchA# show ima interface
ATM0/0/ima1 is up
        Group Index    = 5
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 3   MinNumRxLinks = 3
        DiffDelayMax  = 25    FrameLength    = 128
        NeTxClkMode   = common(ctc)  CTC_Reference_Link = ATM0/0/2
        TestLink      = 2         Testpattern      = Not Specified
        TestProcStatus      = disabled    GTSM change timestamp = 990427165502
IMA Link Information:
Link            Physical Status         NearEnd Rx Status       Test Status
-----           ---------------         ----------------        ---------------
ATM0/0/2        up                      active                  disabled
ATM0/0/3        up                      active                  disabled
ATM0/0/4        up                      active                  disabled
ATM0/0/5        up                      active                  disabled
```

Configuring IMA Group Interface Clock Mode

The links configured as part of a IMA group interface can derive their clocking from one single clock source using common transmit clocking (CTC) mode, or the link clocking can be derived individually from different clock sources using independent transmit clocking (ITC) mode. For example, if three interfaces are configured as members of an IMA group interface, one can be configured to use the reference clock, and the remaining links can derive their clocking from the local oscillator.

To configure the clocking mode on the IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the IMA group to configure and enters interface configuration mode.
Step 2	Switch(config-if)# **ima clock-mode** {**common** | **independent**}	Specifies the transmit clock mode for the IMA group.

Example

The following example shows how to configure the IMA group clocking mode as independent:

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# ima clock-mode independent
```

Displaying the IMA Group Interface Clock Mode Configuration

To display the IMA group transmit clock mode configuration, use the following EXEC command:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima***group* [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows the IMA group clock mode configuration:

```
SwitchA# show ima interface
ATM0/0/ima1 is up
        Group Index   = 4
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1    MinNumRxLinks = 1
        DiffDelayMax  = 25   FrameLength   = 128
→       NeTxClkMode   = independent(itc)
        TestLink    = 3        Testpattern     = Not Specified
        TestProcStatus    = disabled   GTSM change timestamp = 990427121150
IMA Link Information:
Link          Physical Status       NearEnd Rx Status      Test Status
-----         --------------        ----------------       --------------
ATM0/0/2      up                    active                 disabled
ATM0/0/3      up                    active                 disabled
```

Configuring IMA Group Link Differential Delay

The transmitter on the T1/E1 IMA port adapter must align the transmission of IMA frames on all links as shown in Figure 20-2. Alignment allows the receiver to adjust for differential delays among the members of the IMA group. Based on this required behavior, the receiver can detect the differential delays by measuring the arrival times of the IMA frames on each link.

The transmitting end of the IMA group connection sends cells continuously. If there are no ATM layer cells to send between ICP cells within an IMA frame, the transmit IMA sends filler cells to maintain a continuous stream of cells at the physical layer.

The receiving end of the IMA group connection must allocate sufficient buffer space to compensate for the differential delay between the member links. The maximum differential delay value configured for the IMA group determines the size of these buffers.

To configure the maximum differential delay allowed in the IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the IMA group and enters interface configuration mode.
Step 2	Switch(config-if)# **ima differential-delay-maximum** *msecs*	Specifies the maximum link differential delay tolerated for the IMA group in milliseconds. For T1, the range is 25 to 250 milliseconds, and for E1, the range is 25 to 190 milliseconds.

Example

The following example shows how to configure the maximum allowable differential delay to 100 milliseconds between all interfaces assigned to the IMA group.

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# ima differential-delay-maximum 100
```

Displaying the IMA Group Link Differential Delay Configuration

To display the IMA group maximum differential delay configuration, use the following EXEC command:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima***group* [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows the IMA group maximum differential delay configuration:

```
SwitchA# show ima interface
ATM0/0/ima1 is up
        Group Index    = 4
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1     MinNumRxLinks = 1
→       DiffDelayMax   = 100   FrameLength    = 128
        NeTxClkMode    = common(ctc)  CTC_Reference_Link = ATM0/0/3
        TestLink       = 3        Testpattern      = Not Specified
        TestProcStatus    = disabled   GTSM change timestamp = 990427135611
IMA Link Information:
Link            Physical Status       NearEnd Rx Status       Test Status
-----           --------------        ----------------        --------------
ATM0/0/2        up                    active                  disabled
ATM0/0/3        up                    active                  disabled
```

Configuring IMA Group Frame Length

The IMA protocol uses the frame length parameter to determine the number of cells that make up an IMA frame.The IMA group frame length determines the amount of framing overhead and the amount of data lost in case of frame corruption or loss. A small frame length causes more overhead but loses less data if a problem occurs. The recommended frame length is 128.

To configure the frame length on the IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the IMA group to configure and enters interface configuration mode.
Step 2	Switch(config-if)# **ima frame-length** {**128** | **256** | **32** | **64**}	Specifies the frame length of the IMA group transmit frames, in number of cells.

Example

The following example shows how to configure the frame length transmitted as 256 cells for IMA group 0/0/ima1:

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# ima frame-length 256
```

Displaying the IMA Group Frame Length Configuration

To display the IMA group frame length configuration, use the following EXEC command:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima***group* [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows the IMA group frame length configuration:

```
SwitchA# show ima interface
ATM0/0/ima1 is up
        Group Index   = 4
        State: NearEnd = operational, FarEnd = operational
        FailureStatus = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1    MinNumRxLinks = 1
  →     DiffDelayMax  = 25    FrameLength   = 256
        NeTxClkMode   = common(ctc)  CTC_Reference_Link = ATM0/0/3
        TestLink      = 3       Testpattern     = Not Specified
        TestProcStatus    = disabled   GTSM change timestamp = 990427143739
IMA Link Information:
Link           Physical Status        NearEnd Rx Status       Test Status
-----          ---------------        ----------------        --------------
ATM0/0/2       up                     active                  disabled
ATM0/0/3       up                     active                  disabled
```

Configuring IMA Group Test Pattern

An IMA group can have a test pattern defined to provide extra support to verify the connectivity of links within an IMA group. It uses a test pattern sent over one link to verify connectivity to the rest of the group. The test pattern should be looped over all the other links in the group at the far end of the connection. The test procedure is performed using the ICP cells exchanged between both ends of the IMA virtual links.

To configure the test pattern to be transmitted on the IMA group, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the IMA group and enters interface configuration mode.
Step 2	Switch(config-if)# **ima test** [**link** *link-value*] [**pattern** *pattern-value*]	Specifies the specific link and pattern or test pattern only for the IMA group.
Step 3	Switch(config-if)# **no ima test**	Stops the test on the IMA group.

Examples

The following example shows how to configure the test pattern 8 to transmit over link 3 of IMA group 0/0/ima1:

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# ima test link 3 pattern 8
```

The following example shows how to stop the test on IMA group 0/0/ima1:

```
SwitchA(config)# interface atm 0/0/ima1
SwitchA(config-if)# no ima test
```

Displaying the IMA Group Test Pattern Configuration

To display the IMA group test pattern configuration, use the following EXEC command:

Command	Purpose
show ima interface [**atm** *card*/*subcard*/**ima***group* [**detailed**]]	Displays IMA group interface configuration and status.

Example

The following example shows the IMA group test pattern configuration:

```
SwitchA# show ima interface
ATM0/0/ima1 is up
        Group Index    = 4
        State: NearEnd = operational, FarEnd = operational
        FailureStatus  = noFailure
IMA Group Current Configuration:
        MinNumTxLinks = 1    MinNumRxLinks = 1
        DiffDelayMax  = 25   FrameLength   = 128
        NeTxClkMode   = common(ctc)  CTC_Reference_Link = ATM0/0/3
→       TestLink      = 3    TestPattern   = 8
        TestProcStatus    = operating  GTSM change timestamp = 990427143950
IMA Link Information:
Link           Physical Status       NearEnd Rx Status       Test Status
-----          --------------        ----------------        --------------
ATM0/0/2       up                    active                  operating
ATM0/0/3       up                    active                  operating
```