28 Inverse Multiplexing Over ATM (IMA)

Inverse Multiplexing over ATM (IMA) increases the bandwidth of ATM traffic by combining several physical links into a single virtual link. On the transmitting (or *near-end*) side of the physical links, IMA combines (multiplexes) an individual ATM cell stream in a cyclical fashion across physical links of an IMA *group*. Cells in the IMA group are transmitted to the receiving (or *far-end*) side of the links. The far-end side of the links disassembles (demultiplexes) the IMA group back into an individual IMA cell stream.

Alcatel's implementation is fully compliant with the *ATM Forum Inverse Multiplexing for ATM (IMA) Specification*, Version 1.0, dated July 1997 (document No. af-phy-0086.000), and the *ATM Forum Inverse Multiplexing for ATM (IMA) Specification*, Version 1.1, dated March 1999 (document No. af-phy-0086.001).

♦ Note ♦

IMA operates between the physical interface and the ATM layer of the ATM reference model. All of the features that Alcatel supports on OmniAccess, OmniSwitch, Omni Switch/Router, and OmniStack ATM access modules are supported in Alcatel's IMA hardware and software.

The following are some of the benefits of using IMA in a wide-area network (WAN):

Scalability. As the demand for bandwidth increases, additional links can be added. For example, you could configure an IMA group initially with two T1 or E1 lines and later add additional T1 or E1 lines as the needs for bandwidth increase.

IMA provides a solution for organizations with bandwidth needs greater than those provided by T1 (1.544 Mbps) or E1 (2.048 Mbps) lines, but less than T3 (44.736 Mbps) or E3 (34.368 Mbps) lines. Therefore, network administrators can avoid the higher costs of T3 and E3 lines.

Reliability. If a link for an IMA group fails, ATM cells will continue to be transmitted (although at a lower bandwidth).

Load balancing. By consolidating ATM traffic over multiple links of an single IMA group, T1 or E1 circuits can be used much more efficiently.

IMA Hardware

You can implement an IMA group with the OA-408-IMA-DS1 and OA-408-IMA-E1 remote access switches. You can use one to four DS1 or E1 ports for the IMA group. (The default is all four DS1 or E1 ports.) For example, an IMA group using all four physical T1 links transmitting at 1.544 Mbps produces a single virtual link transmitting at approximately 6 Mbps. See Chapter 1, "OmniAccess 408 Switches," for a detailed description of these switches.

IMA Software

You can create, modify, and display an IMA group and its links through Network Management Software (NMS) and User Interface (UI) commands. This chapter documents UI commands, which are part of the IMA submenu (described in *The IMA Submenu* on page 28-13). See the online documentation for descriptions of NMS IMA software.

OA-408-IMA Software Slot Numbering

OA-408-IMA switches are conceptionally into several modules. These modules are given slot numbers, which are used to monitor and manage ports and to monitor manage switch functions through software. The management module (referred to as the MPM), is labeled in software as Slot 1. The Ethernet ports (labeled on the front panel as **S3**), are labeled in software as Slot 3. The Circuit Emulation ports (labeled on the front panel as **S4**), are labeled in software in Slot 4. And the IMA ports (labeled on the front panel as **S2**), are labeled by software as Slot 2.

As a result, you will always use Slot 2 when monitoring and configuring IMA ports. For example, if you want to view the summary statistics of the second IMA port, you would enter

```
ilks 2/2
```

at the system prompt. (See *Displaying Detailed Statistics for IMA Links* on page 28-54 for more information on the **ilks** command.)

OmniAccess Default IMA Group

The OA-408-IMA-DS1 and OA-408-IMA-E1 remote access switches come with a default IMA Group (IMA Group 0), which has all four (4) DS1 or E1 ports assigned to it. Thus, the OA-408-IMA-DS1 and OA-408-IMA-E1 switches are ready to be used "out of the box." You can still create a new IMA group with user-defined parameters; however, this will replace the original default IMA group since only one (1) IMA group is supported on an OmniAccess switch.

IMA Configuration Overview

Follow the steps below to create an IMA group. All of these steps use User Interface (UI) commands that are part of the IMA submenu, which is described in *The IMA Submenu* on page 28-13. These steps present a very broad outline; all of these steps are described in greater detail later in this chapter. Instructions for configuring a sample IMA network are shown in *IMA Application Example* on page 28-8.

♦ Note ♦

You *must* install the **ima.img** image file in your switch before you can use IMA hardware or software.

Step 1. Create an IMA Group on Both Sides of the Link

You create an IMA group with the **igpa** command, which is described in greater detail in *Creating a New IMA Group* on page 28-14.

Step 2. Assign Links to the IMA Group

The **igpa** command only creates logical groups; it does not assign them to any ports (links). To assign a logical IMA group to physical links, use the **igpmem** command, which is described in greater detail in *Adding and Modifying IMA Group Membership* on page 28-17.

Step 3. Set Global IMA Parameters (Optional)

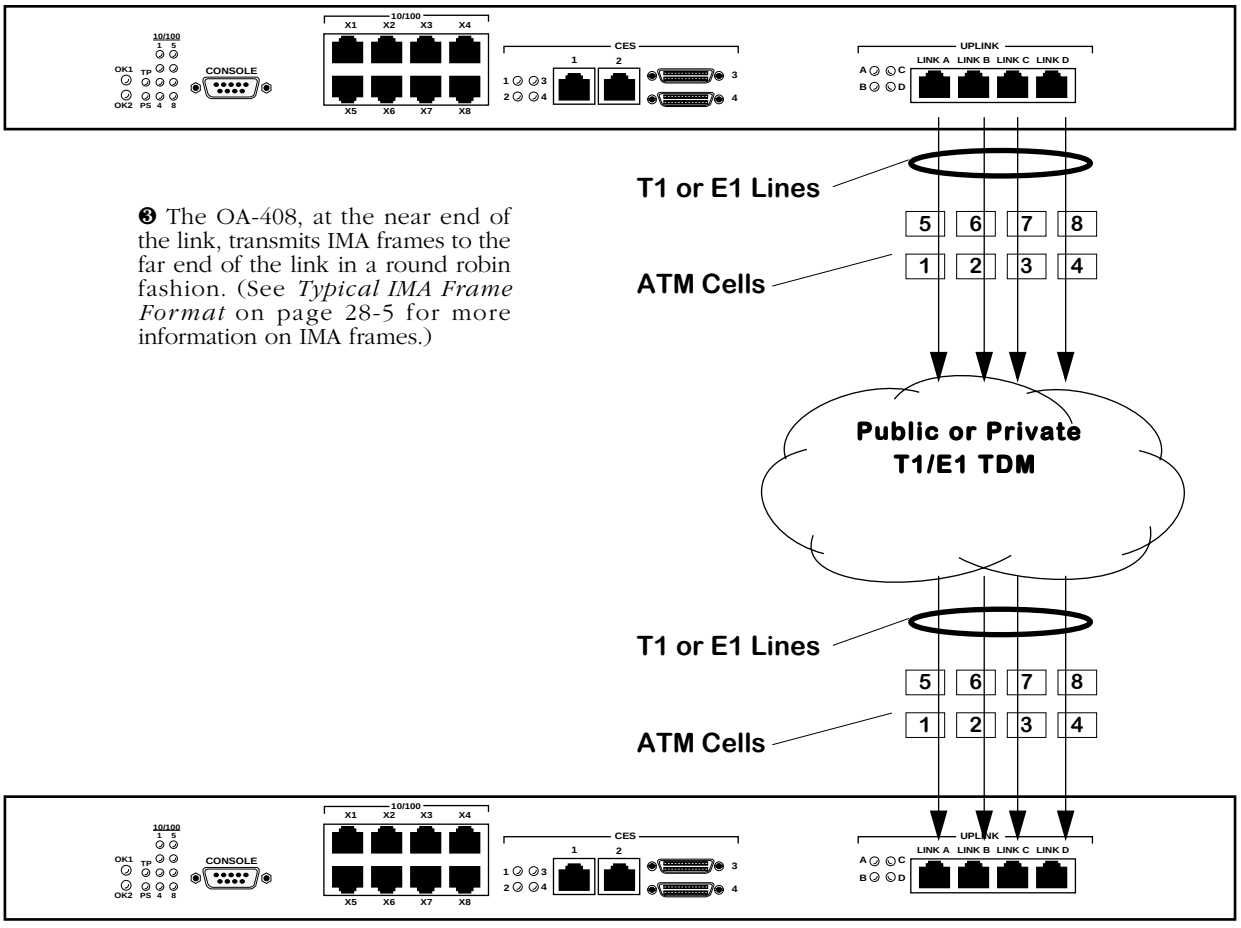
IMA submenu commands are available that allow you to assign logical IMA group parameters and physical IMA link parameters globally. For example, if you had an IMA group with four links over T1 lines and you wanted to set Extended SuperFrame (ESF) frame format, you could use the **igpm** command (described in *Modifying an IMA Group* on page 28-19) to set ESF frame format on all the ports in the IMA group in one step.

IMA Process Overview

Multiplexing of ATM cells is done on a cell by cell basis. As shown in the figure below, ATM cells are transmitted in a cyclical (i.e., "round robin") fashion among links. The links are grouped to form higher bandwidth logical links. These logical links, known as an IMA group, have a transmit rate that is approximately the sum of the physical links.

❶ OA-408 converts Ethernet frames to ATM cells.

❷ OA-408 multiplexes ATM cells into IMA frames



❸ The OA-408, at the near end of the link, transmits IMA frames to the far end of the link in a round robin fashion. (See *Typical IMA Frame Format* on page 28-5 for more information on IMA frames.)

❹ IMA frames are demultiplexed and exit the far end of the IMA group.

IMA Multiplexing and Demultiplexing Process

The IMA implementation creates IMA Control Protocol (ICP) cells that contain information (e.g., IMA configuration, synchronization, status, and defect information) which permits reconstruction of the ATM cell stream at the receiving end. In addition, the IMA implementation will create filler cells in the IMA group to maintain a constant rate of transmission.

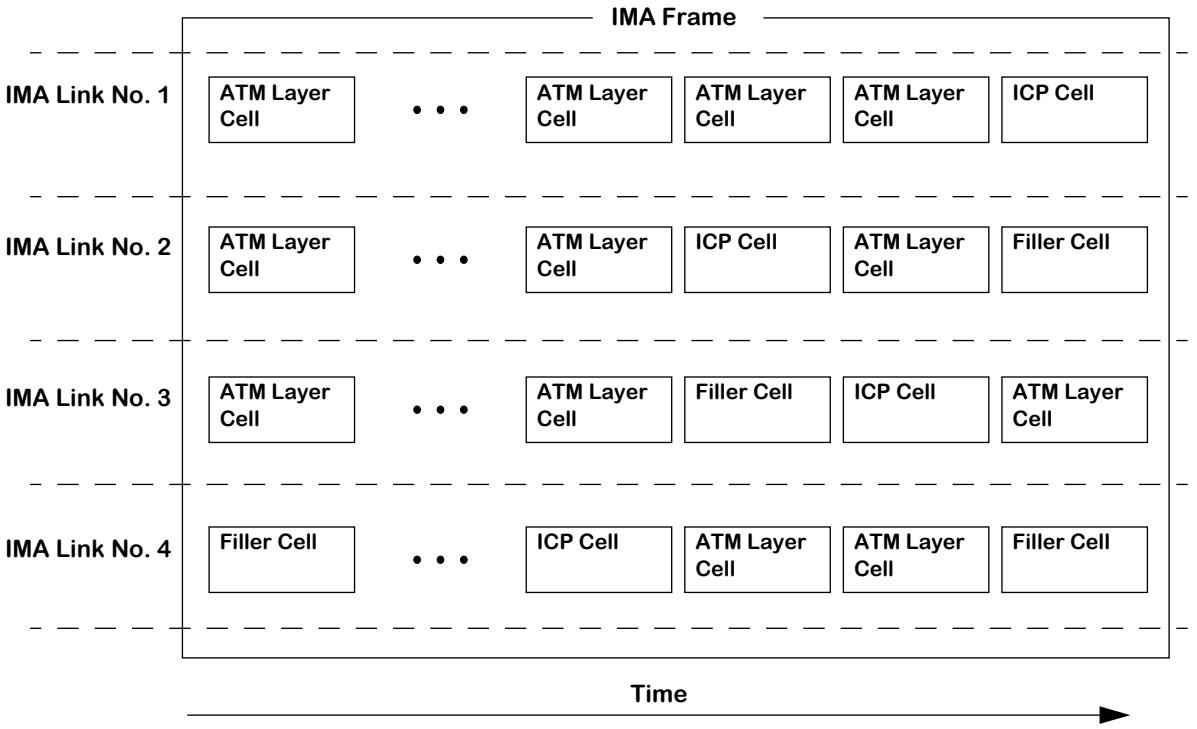
Stuff cells (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) are sent to adjust link speed variation. All of these cells are assembled into IMA frames 128 cells long (see figure below).

Demultiplexing of an IMA group is done at the far end of the IMA link. The ATM cell stream is reconstructed from information in ICP cells. The ATM cell stream is passed to the ATM layer while filler and ICP cells are discarded.

Adding and Deleting Links in an IMA Group

If a link fails, the IMA implementation will automatically use the remaining good links only. Bandwidth will be reduced and loss of cells is possible when the link initially fails. If a link is disabled intentionally, the IMA implementation will notify the far-end of the link and gracefully remove the link from the group. The bandwidth will be reduced but no cells will be lost.

You can also add links without taking the IMA group off-line. Bandwidth will be increased and no cells will be lost.



Typical IMA Frame Format

ATM Services on an IMA Group

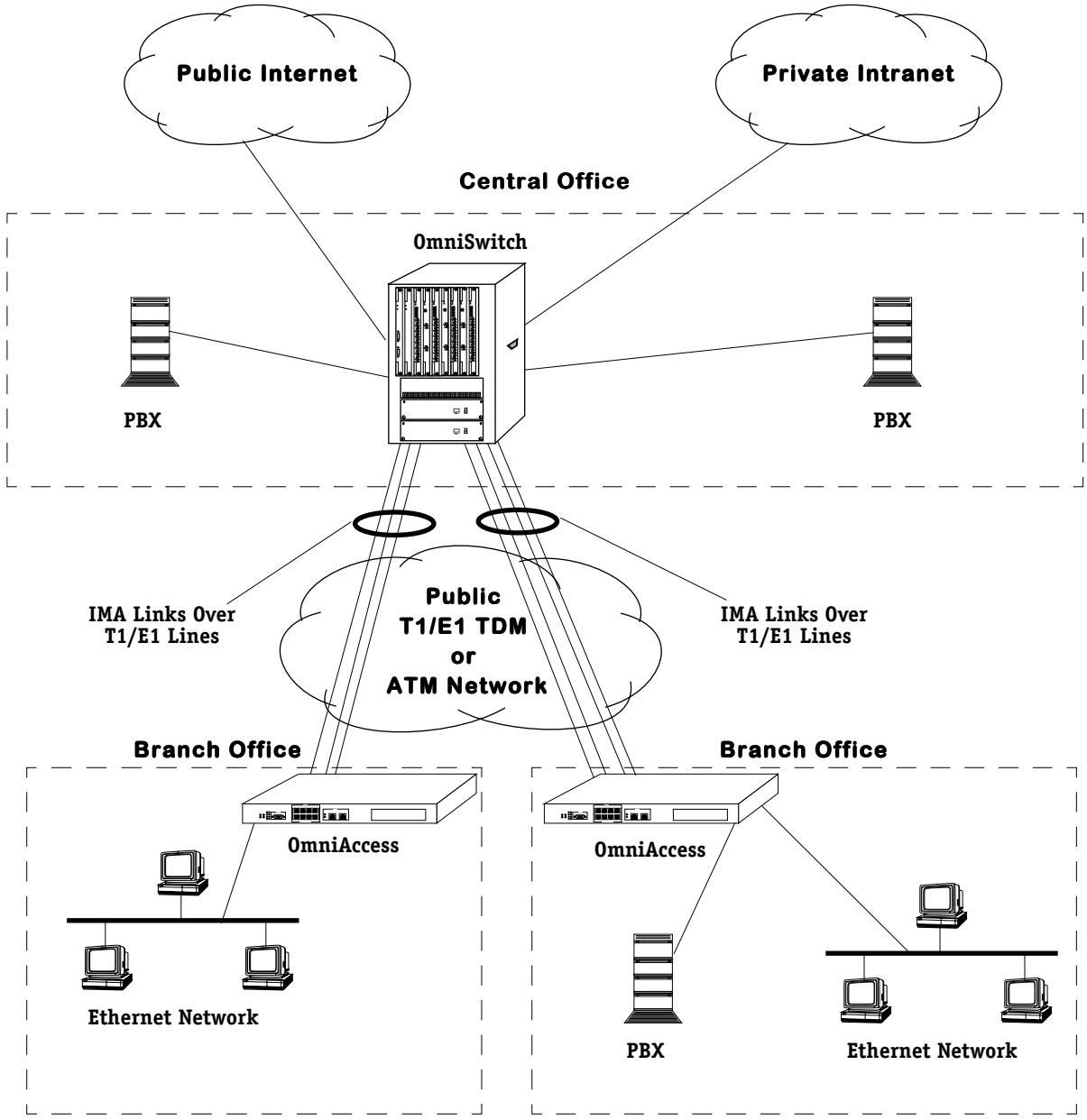
You can assign ATM services to an IMA group on the OA-408-IMA switches. You can create LANE client, ATM trunking, Classical IP (CIP), VLAN clusters, and Point-to-Point (PTOP) Bridging services. See Chapter 27, "Configuring ATM Services," for more information on ATM services commands.

Sample IMA Network

The figure on the following page shows how IMA on OA-408-IMA switches can be used to connect Ethernet workstations and PBXs in remote offices to PBXs in a central office, which is connected to the public Internet and a private Intranet.

♦ Note ♦

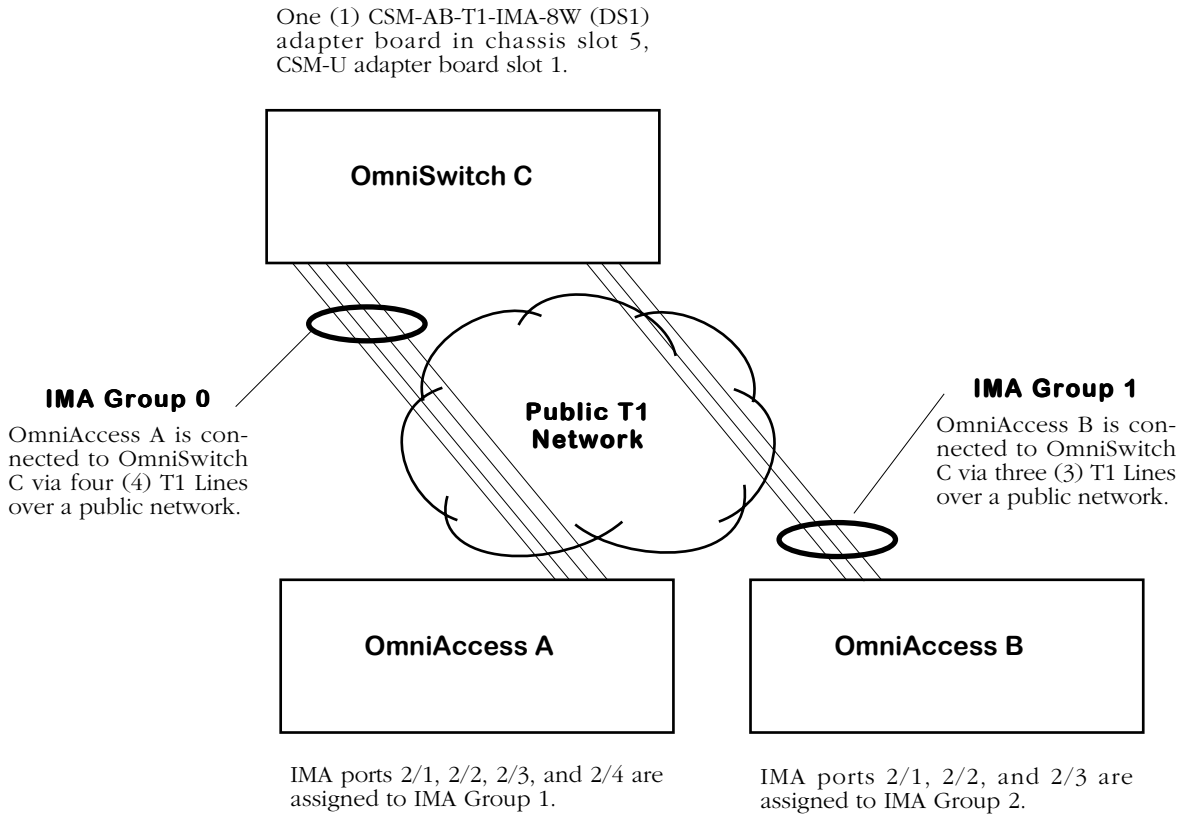
See *IMA Application Example* on page 28-8 on how to configure OmniAccess switches in a similar network.



Sample IMA Network Using OmniAccess Switches

IMA Application Example

The illustration below shows a sample IMA configuration. OmniAccess A is connected to OmniSwitch C with four (4) T1 lines over a public network. OmniAccess A uses the default IMA Group 0 (all four T1 ports are assigned to this group), which produces a virtual link transmitting ATM cells at approximately 6 Mbps. OmniAccess B is connected to OmniSwitch C with three (3) T1 lines over a public network. IMA Group 1 was created on OmniAccess B to produce a virtual link transmitting ATM cells at approximately 4.6 Mbps.



IMA Application Example Network Diagram

In addition, there is a requirement for data to be transmitted as extended superframes (ESFs) and the ports need to be set for loop timing.

How to Set Up this Network

You can configure the OmniAccess switches in the application example on the previous page through the following steps. (See the *OmniSwitch Omni Switch/Router User Manual* for documentation on configuring IMA on OmniSwitches.) You use the default IMA group on one OA-408-IMA switch and on the other OA-408-IMA switch you create a logical IMA group and assign ports to it. For the entire IMA network, you can optionally set any T1 or E1 parameters.

♦ Note ♦

IMA software operates somewhat differently on the OmniSwitch. See the *OmniSwitch Omni Switch/Router User Manual* for more information on IMA for the OmniSwitch.

Step 1. Configure the IMA Group

1. On OmniAccess A there is no need to create an IMA group since the default IMA Group 0 (with all four T1 ports assigned to it) will be used. However, you can confirm the status of IMA Group 0 with the **igps** command, which is described in *Displaying the Summary Status of an IMA Group* on page 28-33.
2. On OmniAccess B, perform the following steps to create IMA Group 1.
   a. Enter **igpa 1** at the system prompt to create IMA Group 1.
   b. Enter **save** at the **igpa** command prompt to accept the defaults. (The **igpa** command is described in greater detail in *Creating a New IMA Group* on page 28-14.)

Step 2. Assign Links to the IMA Group

1. On OmniAccess A there is no need to assign links to IMA Group 0 since all four T1 ports have already been assigned to it. However, you can confirm. the status of IMA Group 1 with the **igps** command, which is described in *Displaying the Summary Status of an IMA Group* on page 28-33.
2. On OmniAccess B, perform the following steps to assign links to IMA Group 1.
   a. Enter **igpmem 1** to add physical links to IMA Group 1.
   b. Enter **3=+1+2+3** at the prompt to add ports (links) 1 through 3 to IMA Group 1.
   c. Enter **save** at the prompt to save your settings.

Step 3. Configure Global T1 Parameters

1. You modify global parameters of an IMA group with the **igpm** command, which is described in greater detail in *Modifying an IMA Group* on page 28-19. On OmniAccess A, perform the following steps to globally set Extended Superframe (ESF) and loop timing to all the ports in IMA Group 1. (There is no need to configure OmniSwitch C since only symmetrical configurations are supported.)
   a. At the system prompt, enter **igpm 0** to configure IMA Group 0.
   b. Enter **100=2** at the **igpm** command prompt to set all the links in IMA Group 0 to

Extended Superframe (ESF).

c. Enter **102=1** at the **igpm** command prompt to set all the links in IMA Group 0 to loop timing.

d. Enter **save** at the **igpm** command prompt to save your settings.

2. On OmniAccess B, perform the following steps to globally set Extended Superframe (ESF) and loop timing to all the ports in IMA Group 1. (There is no need to configure OmniSwitch C since only symmetrical configurations are supported.)

a. At the system prompt, enter **igpm 1** to configure IMA Group 1.

b. Enter **100=2** at the **igpm** command prompt to set all the links in IMA Group 1 to Extended Superframe (ESF).

c. Enter **102=1** to set all the links in IMA Group 1 to loop timing.

d. Enter **save** at the **igpm** command prompt to save your settings.

IMA Theory of Operation

The following sections describe two important concepts, the IMA Link State Machine (LSM) and the IMA synchronization process, used to maintain IMA links. The IMA LSM is described below and the IMA synchronization process is described in *IMA Synchronization Process* on page 28-12.

IMA Link State Machine (LSM)

The IMA Link State Machine (LSM) is the transmit and receive direction of each IMA link. The LSM can be in one of the following four states:

Not In Group. The link is currently not configured to any IMA group.

Unusable. The link is configured, but is not in the usable state due to a fault, inhibition, etc.

Usable. The link is ready to operate (e.g., free of alarms and faults, etc.), but is waiting for the other end to be usable or active.

Active. The link is transmitting ATM layer cells and is part of the data round robin from or to the ATM layer.

The usable state is an "extra" state between the unusable and active state that allows coordination of the near-end and far-end sides when bringing up the link. The usable state also provides a clear synchronization point before activating links that are ready to be set to the active state.

The IMA LSM begins in the not-in-group state and remains there until the link is configured by the unit management entity. Once configured, the LSM moves to the unusable state. From the unusable state, the LSM moves between the unusable, usable, and active states.

The unusable state provides a synchronization point for application-dependent or group-level control of link usability. Link error conditions (either physical errors or IMA errors) and application-dependent conditions can delay the transition of the LSM into the usable state or can bring the IMA LSM back to the unusable state from the usable or active states. The unusable state also allows the IMA to voluntarily delay restoration of the link for reasons other than detected problems; this is referred to as inhibition of the link.

IMA Synchronization Process

Before ATM cells can be transmitted, the IMA implementation uses a cell delineation mechanism to synchronize the near end and the far end of the link. This mechanism proceeds as follows:

1. A cell-by cell IMA HUNT state is entered at startup.
2. The frame by-frame IMA PRESYNC state is entered when one (1) valid IMA Control Protocol (ICP) cell is received.
3. The frame-by-frame IMA SYNC state is entered when a user-defined number of ICP cells, which is known as the Gamma (γ) value, has been received.

The IMA implementation can leave the IMA SYNC state and return to the IMA HUNT state for the following reasons:

- If the IMA implementation detects a user-defined number of invalid ICP cells, which is known as the Alpha (α) value.
- If the IMA implementation detects a user-defined number of errored ICP cells, which is known as the Beta (β) value.

The IMA Submenu

The IMA submenu is part of the Physical Interface menu, as shown below.

Command	Physical Interface Menu
slipc	Configure SLIP (Serial Line IP) on a TTY Port
atm	Enter the ATM Management sub-menu
eth100	Enter the 100BaseT sub-menu
10/100	Enter the 10/100BaseT sub-menu
te	Enter T1/E1 Port Management sub-menu
ima	Enter IMA Port Management sub-menu

The IMA submenu contains User Interface (UI) commands to display and configure IMA ports and links. To enter the IMA submenu, enter

ima

at any system prompt. Enter a question mark (**?**) to display the commands in the IMA submenu, as shown below.

Command	IMA Management Menu
igpa	Add an IMA group
igpd	Delete an IMA group
igpm	Modify an IMA group
igps	View status of IMA groups
igpsts	View statistics of an IMA group
igpcls	Clear statistics of an IMA group
igplts	Display 24-hour period statistics of a local group
igplcs	Display current 15-minute statistics of a local group
igplis	Display 15-minute interval statistics of a local group
igpmem	Configure IMA group membership
igprst	Restart an IMA group
igptestb	Initiate a test procedure on an IMA group
igpteste	Terminate a test procedure on an IMA group
ilkm	Configure link parameters
ilks	View status of IMA links
ilksts	View statistics of an IMA link
ilkcls	Clear statistics of a link
ilklts	Display 24-hour period statistics of a local port
ilklcs	Display current 15-minute statistics of a local port
ilklis	Display 15-minute interval statistics of a local port
iupgfpga	Upgrade FPGA of an IMA module

♦ Note ♦

The **ima** submenu will not display and the **ima** commands will not be available unless the IMA software (**ima.img**) has loaded properly.

The commands in the IMA submenu are described in the sections that follow.

Creating a New IMA Group

The OA-408-IMA-DS1 and OA-408-IMA-E1 switches support one (1) IMA group. These switches are factory-configured with IMA Group 0, which has all four T1 or E1 ports assigned to it and has ATM Forum standard configuration parameters. If you want to replace this default IMA group with another one, use the **igpa** command. The syntax for this command is as follows:

igpa [<IMA group id>]

If you do not enter the **<IMA group id>** option, it will create an IMA group with the next available number. For example, if there is an existing IMA Group 0, the **igpa** command will create IMA Group 1. The group number must be between 0 and 255.

♦ Note ♦

IMA group IDs only have local significance and you could enter any valid ID number. However, you should use the same ID numbers on both sides of the links to aid tracking and debugging.

To create an IMA group with the next available group number, enter

igpa

at the system prompt. A screen similar to the following will be displayed.

Add new IMA Group 0

1)	**Description {30 Characters}**	**: IMA Group 0**
2)	**Admin Status { up(1), down(2) }**	**: up**
3)	**IMA Version { 1.0(1), 1.1(2) }**	**: 1.1**
4)	**Minimum Transmit Links { 1..4 }**	**: 1**
5)	**Minimum Receive Links { 1..4 }**	**: 1**
6)	**Maximum Differential Delay in milliseconds { 1 . . 50 }**	**: 25**
7)	**Invalid ICP before HUNT { 1..2 }**	**: 2**
8)	**Consecutive Errored ICP before HUNT { 1..5 }**	**: 2**
9)	**Consecutive Valid ICP before SYNC state { 1..5 }**	**: 1**
10)	**Unique Physical Parameters { Yes(1), No(2) }**	**: Yes**

Enter (option=value/save/cancel) :

The **igpa** command also sets all the group's parameters for you. If you want to change any of these parameters, enter the line number of the parameter, followed by an equal sign, and then the new value. For example, to change the minimum number of receive links from 1 to 2, enter:

5=2

To create the new IMA group, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**. If you entered **save**, the following message should be displayed.

Group configured successfully.

♦ Important Note ♦

The **igpa** command creates a logical IMA group but does *not* assign it to any physical connections. You must execute the **igpmem** command (described in *Adding and Modifying IMA Group Membership* on page 28-17) to assign physical ports to the IMA group.

The configurable fields (parameters) displayed by the **igpa** command are described below.

1) Description {30 Characters}

Enter a unique description of the group, using up to 30 ASCII characters. The default is **IMA Group** followed by the group number.

2) Admin Status { up(1), down(2) }

Enter **1** to enable the group (the default) or **2** to disable it. (If you disable this group then it will be unable to transmit or receive ATM cells.)

3) IMA Version{ 1.0(1), 1.1(2) }

Enter **1** to use IMA version 1.0 or **2** to use IMA version 1.1.

4) Minimum Transmit Links { 1..4 }

Enter a number from **1** (the default) to **4** to set the minimum number of active transmit links required for the IMA group to be in an Up (i.e., operational) state. You can use this field to specify the minimum required bandwidth for the IMA link. A lower number will help ensure connectivity if a link goes down. In addition, changing this field will update **Minimum Receive Links** field since only symmetric mode is currently supported.

5) Minimum Receive Links { 1..4 }

Enter a number from **1** (the default) to **4** to set the minimum number of active receive links required for the IMA group to be in an Up (i.e., operational) state. You can use this field to specify the minimum required bandwidth for the IMA link. A lower number will help ensure connectivity if a link goes down. In addition, changing this field will update **Minimum Transmit Links** field since only symmetric mode is currently supported.

♦ Important Note ♦

Fields 6 (**Maximum Differential Delay**) through 9 (**Consecutive Valid ICP before SYNC state**) are set by default to ATM Forum IMA standards. Modifying these fields can cause interoperability problems. These fields should only be modified by experienced ATM network administrators.

6) Maximum Differential Delay { 1 . . 50 }

The maximum (in milliseconds) differential delay among the links that will be tolerated on this interface. An IMA link will be removed from service if it exceeds this limit.

Enter a value from 1 to 50 milliseconds. The default is **25** milliseconds.

7) Invalid ICP before HUNT { 1..2 }

The number of invalid IMA Control Protocol (ICP) cells allowed before moving from a synchronized mode to an ICP hunt mode. This parameter is also known as the Alpha (α) value used in the IMA synchronization process, which is described in *IMA Synchronization Process* on page 28-12.

Enter either **1** or **2**. The default value is **2**.

8) Consecutive Errored ICP before HUNT { 1..5 }

The number of consecutive invalid IMA Control Protocol (ICP) cells allowed before moving from a synchronized mode to an ICP hunt mode. This parameter is also known as the Beta (β) value used in the IMA synchronization process, which is described in *IMA Synchronization Process* on page 28-12.

Enter a value from 1 to 5. The default value is **2**.

9) Consecutive Valid ICP before SYNC state { 1..5 }

The number of consecutive valid IMA Control Protocol (ICP) cells detected before moving from a pre-synchronized state to a synchronized state. This parameter is also known as the Gamma (γ) value used in the IMA synchronization process, which is described in *IMA Synchronization Process* on page 28-12.

Enter a value from 1 to 5. The default value is **5**.

10) Unique Physical Parameters { Yes(1), No(2) }

This parameters determines if the configurations of all T1/E1 ports that belong to this group should be identical or not. If you enter **1** (Yes), which is the default, then T1/E1 physical parameters will only be configurable by the **igpm** command, not the **temod** command. In addition, changing any physical port parameters with the **igpm** command will change all physical port parameters for all ports that belong to this group. See *Modifying an IMA Group* on page 28-19 for more information on the **igpm** command.

Adding and Modifying IMA Group Membership

To add or modify IMA group membership, use the **igpmem** command. This command links the logical IMA group created with the **igpa** command (see *Creating a New IMA Group* on page 28-14) to physical connections.

The syntax for this command is as follows:

```
igpmem <IMA group id>
```

Enter **igpmem** followed by the IMA group number. For example, to configure group membership for IMA Group 0, enter

```
igpmem 0
```

at the system prompt. A screen similar to the following will be displayed:

```
     Add Memberships to Group 0

Available Links:

1) Physical Slot { 2..2 }                    : 2
2) Physical Module { 1..1 }                  : 1
3) Physical Port                             : 1,2,3,4
      (Usage: '+/-<port|all>' add/remove a link port.
       Example: '3=+2+4-3' to add link port 2 & 4 and
                  remove link port 3.
                  '3=+all' add all available link ports.
                  '3=-all' remove all link ports assigned.)


Enter (option=value/save/cancel) :
```

You cannot change fields 1 (**Physical Slot**) and 2 (**Physical Module**) because these are fixed values on OA-408-IMA switches. Attempting to change these values will produce an error message. To change the values for **Physical Port** field, see *3) Physical Port* on page 28-18.

To update the values you have changed, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**.

The fields displayed by the **igpmem** command are described below.

Available Links

This field displays the physical ports that are available. For example, you can have up to four (4) links on a OA-408-IMA switch.

1) Physical Slot

This field displays **2**, the default number for the IMA uplink "slot."

2) Physical Module

This field displays **1**, the default number for the IMA uplink "module."

3) Physical Port

Enter the physical port number on the module that you want to add or delete. If you want to add a port to the IMA group, enter **3=+** followed by the port number. For example, if you want to add Port 2, enter

3=+2

at the prompt. If you want to delete a port from the IMA group, enter **3=-** followed by the port number. For example, if you want to delete Port 2, enter

3=-2

at the prompt. In addition, you can add and delete ports at the same prompt. For example, to add Ports 1, 2, and 4 and delete Port 3, enter

3=+1+2-3+4

at the prompt. To add or delete all the ports from the IMA group use the **all** option. To add all available ports, enter

3=+all

at the prompt. To delete all the ports, enter

3=-all

at the prompt.

Modifying an IMA Group

To modify an IMA group, use the **igpm** command. The configurable parameters vary depending on whether you have T1 or E1 ports. If you have E1 ports, see *Modifying an IMA Group with E1 Ports* on page 28-23. If you have T1 ports and you are using long-haul line, see *Modifying an IMA Group with T1 Ports (Long-Haul Line)* on page 28-22. And if you have T1 ports and you are using short-haul line, see the subsection below.

Modifying an IMA Group with T1 Ports (Short-Haul Line)

The syntax for this command is as follows:

```
igpm <IMA group id>
```

Enter **igpm** followed by the IMA group number. To modify IMA Group 0, for example, enter

```
igpm 0
```

at the system prompt. A screen similar to that shown below will be displayed:

```
                Modify IMA Group 0

1)    Description {30 Characters}                              : IMA Group 0
2)    Admin Status { up(1), down(2) }                          : up
3)    IMA Version { 1.0(1), 1.1(2) }                           : 1.1
4)    Minimum Transmit Links { 1..4 }                          : 1
5)    Minimum Receive Links { 1..4 }                           : 1
6)    Maximum Differential Delay in milliseconds  { 1 . . 25 } : 25
7)    Invalid ICP before HUNT { 1..2  }                        : 2
8)    Consecutive Errored ICP before HUNT { 1..5 }             : 2
9)    Consecutive Valid ICP before SYNC state { 1..5 }         : 1
10)   Unique Physical Parameters { Yes(1), No(2) }             : Yes
      100) Framing Format { ESF(2), SF(3) }                    : ESF
      101) Line Build Out { short(1), long(2) }                : short
           110) Line Length in meters { 0..200 }               : 30
      102) Transmit Clock Source
                 { loopTiming(1), localTiming(2) }             : localTiming
      103) Group Loopback
               { none(1), payload(2), line(3), inward(5) }     : none

Enter (option=value/save/cancel)    :
```

Select the number of the item you want to change. To change any of the values listed above, enter the line number, followed by an equal sign, and then the new value. For example, to change the minimum number of receive links from 1 to 2, enter:

```
4=2
```

To update the values you have changed, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**. If you entered **save**, the following message should be displayed.

```
Group configured successfully.
```

♦ Note ♦

Option 10 (**Unique Physical Parameters**) and its suboptions will not be displayed until at least one link has been created.

See *Creating a New IMA Group* on page 28-14 for fields 1 (**Description**) through 9 (**Consecutive Valid ICP before SYNC state**). The remaining configurable fields displayed by the **igpm** command are described below.

10) Unique Physical Parameters { Yes(1), No(2) }

This parameter determines if the configurations of all T1/E1 ports that belong to this group should be identical or not. If you enter **1** (Yes), which is the default, then T1/E1 physical parameters will only be configurable by the this command, not the **temod** command. In addition, changing any physical port parameters with the this command will change all physical port parameters for all ports that belong to this group.

100) Framing Format { ESF(2), SF(3) }

A T1 frame consists of twenty-four (24) 8-bit time slots and a 1-bit synchronization and control bit. Twelve (12) T1 frames can be grouped into a SuperFrame, and twenty-four (24) T1 frames can be grouped into an Extended SuperFrame.

Enter **2** for Extended SuperFrame (ESF) or **3** for SuperFrame. (Changing the framing format here will also change the framing format on all links assigned to this group.)

♦ Important Note ♦

When configuring ATM T1 lines, you can only use Extended SuperFrame (ESF) as the framing format.

101) Line Build Out { short(1), long(2) }

Long haul support is necessary if this T1 port is directly connected to a Central Office (CO) and the cable length is greater than 200 meters. If this T1 port connects locally (i.e., it is not connected to an external CSV) using less than 200 meters of cable, short haul is adequate.

Enter **1** for a cable length of 200 or less meters or **2** for a cable length greater than 200 meters. (Changing the line length here will also change the framing format on all links assigned to this group.) If you entered **1** (short), the following sub-option will be displayed:

110)Line Length in meters { 0..200 }

Enter the cable length in meters. This value must be less than or equal to 200 meters.

102) Transmit Clock Source { loopTiming(1), localTimimg(2) }

The source of the transmit clock. Loop timing means the receive clock (recovered from receive data) is used as the transmit clock. Local timing indicates the local clock source (generated from PLLs) is used as the transmit clock.

Enter **1** for loop timing or **2** for local timing (the default). (Changing the transmit clock source here will also change the framing format on all links assigned to this group.)

103) Group Loopback { none(1), payload(2), line(3), inward(5) }

The loopback configuration for this port. Loopback configurations are used to test the framing functionality within the T1 port. Framing functionality assembles T1 frames into SuperFrames and Extended SuperFrames, depending on how the port is configured. Possible values are as follows:

♦ Note ♦

Loopback states should be used for debugging purposes only.

none. The port is not in a loopback state. This is the typical live network state for a T1 port.

payload. The received signal for this IMA group is looped out of the port after passing through the port's framing functionality.

line. The received signal at this T1 port does not go through the port's framing functionality, and is looped straight back out the port.

inward. The transmitted signal from the inward side of this port is looped back internally. The signal passes through the T1 framing functionality before looping back.

Enter **1** for no group loopback, **2** for payload, **3** for line, or **5** for inward group loopback (the default).

Modifying an IMA Group with T1 Ports (Long-Haul Line)

The syntax for this command is as follows:

```
igpm <IMA group id>
```

Enter **igpm** followed by the IMA group number. To modify IMA Group 0, for example, enter

```
igpm 0
```

at the system prompt. A screen similar to that shown below will be displayed:

```
                Modify IMA Group 0

1)    Description {30 Characters}                              : IMA Group 0
2)    Admin Status { up(1), down(2) }                          : up
3)    IMA Version { 1.0(1), 1.1(2) }                           : 1.1
4)    Minimum Transmit Links { 1..4 }                          : 1
5)    Minimum Receive Links { 1..4 }                           : 1
6)    Maximum Differential Delay in milliseconds  { 1 . . 25 } : 25
7)    Invalid ICP before HUNT { 1..2  }                        : 2
8)    Consecutive Errored ICP before HUNT { 1..5 }             : 2
9)    Consecutive Valid ICP before SYNC state { 1..5 }         : 1
10)   Unique Physical Parameters { Yes(1), No(2) }             : Yes
      100) Framing Format { ESF(2), SF(3) }                    : ESF
      101) Line Build Out { short(1), long(2) }                : long
           110) Attenuation
                { 0 dB(1), -7.5dB(2), -15.0dB(3), -22.5dB(4) } : 0 dB
      102) Transmit Clock Source
                 { loopTiming(1), localTiming(2) }             : localTiming
      103) Group Loopback
                { none(1), payload(2), line(3), inward(5) }    : none

Enter (option=value/save/cancel)    :
```

Select the number of the item you want to change. To change any of the values listed above, enter the line number, followed by an equal sign, and then the new value. For example, to change the minimum number of receive links from 1 to 2, enter:

```
4=2
```

To update the values you have changed, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**. If you entered **save**, the following message should be displayed.

```
Group configured successfully.
```

♦ Note ♦

Option 10 (**Unique Physical Parameters**) and its suboptions will not be displayed until at least one link has been created.

See *Creating a New IMA Group* on page 28-14 for fields 1 (**Description**) through 9 (**Consecutive Valid ICP before SYNC state**) and see *Modifying an IMA Group with T1 Ports (Short-Haul Line)* on page 28-19 for all other fields except for **110) Attenuation**, which is described below. The remaining configurable field displayed by the **igpm** command is described below.

110)Attenuation { 0dB(1), -7.5dB(2), -15.0dB(3), -22.5dB(4) }

Enter **1** for 0 decibels (dB), **2** for -7.5 dB, **3** for - 15.0 dB, or **4** for -22.5 dB.

Modifying an IMA Group with E1 Ports

The syntax for this command is as follows:

```
igpm <IMA group id>
```

Enter **igpm** followed by the IMA group number. To modify IMA Group 0, for example, enter

```
igpm 0
```

at the system prompt. A screen similar to that shown below will be displayed:

```
                Modify IMA Group 0

1)    Description {30 Characters}                              : IMA Group 0
2)    Admin Status { enabled(1), disabled(2) }                 : enabled
3)    IMA Version { 1.0(1), 1.1(2) }                           : 1.1
4)    Minimum Transmit Links { 1..4 }                          : 1
5)    Minimum Receive Links { 1..4 }                           : 1
6)    Maximum Differential Delay in milliseconds  { 1 . . 25 } : 25
7)    Invalid ICP before HUNT { 1..2  }                        : 2
8)    Consecutive Errored ICP before HUNT { 1..5 }             : 2
9)    Consecutive Valid ICP before SYNC state { 1..5 }         : 1
10)   Unique Physical Parameters { Yes(1), No(2) }             : Yes
      100) Framing Format { E1(4), E1-CRC(5) }                 : E1-CRC
      101) Line Build Out { short(1), long(2) }                : short
           110) Cable Type { 75 Ohms(1), 120 Ohms(2) }         : 75 Ohms
      102) Transmit Clock Source
                 { loopTiming(1), localTiming(2) }             : localTiming
      103) Group Loopback
               { none(1), payload(2), line(3), inward(5) }     : n


Enter (option=value/save/cancel)     :
```

Select the number of the item you want to change. To change any of the values listed above, enter the line number, followed by an equal sign, and then the new value. For example, to change the minimum number of receive links from 1 to 2, enter:

```
5=2
```

To update the values you have changed, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**. If you entered **save**, the following message should be displayed.

```
Group configured successfully.
```

♦ Note ♦

Option 10 (**Unique Physical Parameters**) and its suboptions will not be displayed until at least one link has been created.

See *Creating a New IMA Group* on page 28-14 for fields 1 (**Description**) through 9 (**Consecutive Valid ICP before SYNC state**). The remaining configurable fields displayed by the **igpm** command are described below.

100) Framing Format { E1(4), E1-CRC(5) }

Enter **4** for E1 (standard E1 frame format using the framing bits in time slot 0 for framing) or **5** for E1-CRC (E1 frame using framing bits in both time slot 0 and CRC-4 multiframe for framing).

101) Line Build Out { short (1), long (2) }

Long haul support is necessary if this E1 port is directly connected to a Central Office (i.e., not connected via an external CSU) and the cable length is greater than 200 meters. If this E1 port connects locally using less than 200 meters of cable, then short haul is adequate.

Enter **1** for a cable length of 200 or less meters or **2** for a cable length greater than 200 meters.

110) Cable Type { 75 Ohm(1), 120 Ohm(2) }

Enter **1** to set the Line Interface Unit (LIU) to 75 Ohm or **2** to set it to 120 Ohm.

102) Transmit Clock Source { loopTiming(1), localTiming(2) }

The source of the transmit clock. Loop timing means the receive clock (recovered from receive data) is used as the transmit clock. Local timing indicates the local clock source (generated from PLLs) is used as the transmit clock.

Enter **1** for loop timing or **2** for local timing (the default).

103) Group Loopback { none(1), payload(2), line(3), inward(5) }

The loopback configuration for this port. Loopback configurations are used to test the framing functionality of the E1 port. Framing functionality assembles E1 frames into multi-frames. Possible values are as follows:

♦ Note ♦

These loopback states should be used for debugging purposes only.

none. The port is not in a loopback state. This is the typical live network state for an E1 port.

payload. The received signal at this E1 port is looped out of the port after passing through the port's framing functionality.

line. The received signal at this E1 port does not go through the port's framing functionality, and is looped straight back out the port.

inward. The transmitted signal from the inward side of this port is looped back internally. The signal passes through the E1 framing functionality before looping back.

Enter **1** for no group loopback, **2** for payload, **3** for line, or **5** for inward group loopback (the default).

Configuring IMA Link Parameters

You configure IMA links (physicals ports in an IMA group) with the **ilkm** command. The syntax for this command is as follows:

```
ilkm 2/<port>
```

Enter **ilkm** followed by **2** and the port number of the port you want to configure. For example, to configure the link parameters on IMA Port 1, enter

```
ilkm 2/1
```

at the system prompt. A screen similar to the following will be displayed:

```
Modify Link 2/1

1)  Description { 30 characters }   : IMA Link
2)  Administrative Status { up(1), down(2) }          : up


Enter (option=value/save/cancel) :
```

Select the number of the item you want to change. To change any of the values listed above, enter the line number, followed by an equal sign, and then the new value. For example, to disable the IMA link (i.e., change the administrative state from **enabled** to **disabled**), enter:

```
2=2
```

To update the values you have changed, enter **save**. If you do not want to save the changes enter **quit** or **cancel**, or press **Ctrl-D**.

The fields displayed by the **ilkm** command are described below.

1) Description { 30 characters }

Enter a description up to 30 characters long. The default is **IMA Link**.

2) Administrative Status { up(1), down(2) }

Enter **1** to enable the link (the default) or **2** to disable the link.

♦ Note ♦

If you did not set the **Unique Physical Parameters** option to **Yes** with the **igpa** or **igpm** command, then you can use the **temod** command to modify individual physical links. See Chapter 29, "Managing T1 and E1 Ports," for more information on the **temod** command.

Conducting an IMA Test

To verify the connectivity of a link within an IMA group, you can conduct an IMA test. A test pattern, which is a single byte with a value of 0 to 255, is sent from the near-end side of the IMA group in octet 17 of the IMA Control Protocol (ICP) cell and looped back over all the other links in the far-end of the IMA group.

♦ Note ♦

The **igptestb** command will not affect performance and will not disrupt user traffic since the test pattern is embedded within the ICP cell of an IMA frame.

You can initiate an IMA test procedure with the **igptestb** command, which is described in the subsection below. The test procedure will be active until you terminate it. To conclude the test procedure, use the **igpteste** command, which is described in *Ending an IMA Test* on page 28-29.

Starting an IMA Test

You initiate an IMA test with the **igptestb** command. The syntax for this command is as follows:

igptestb <IMA group id> [2/<port>]

To initiate transmission the test pattern on the first link in the group to the far-end of the IMA link, enter **igptestb** followed by the IMA group number. The far-end of the link will then send the test pattern on all of its links in sequence back to the near-end side of the IMA link.

Next, the near-end of the IMA link will send the test pattern across the last link in the group. The far-end of the IMA link will again send the test pattern in sequence back on all of its links to the near-end of the IMA link.

This test will continue until you terminate it with the **igpteste** command, which is described in *Ending an IMA Test* on page 28-29. However, only the first two passes will be displayed. If you want to monitor a test procedure while it is running, use the **igps** command, which is described in *Displaying the Summary Status of an IMA Group* on page 28-33.

For example, to initiate the IMA test procedure on IMA Group 0 on its first link, enter

```
igptestb 0
```

at the system prompt. A screen similar to the following will be displayed.

```
Trying to transmit pattern #1 (2) on link 2/1... successful
Verifying Rx pattern #1 on all links from remote
Link 2/1 ... OK
Link 2/2 ... OK
Link 2/3 ... OK
Link 2/4 ... OK
Trying to transmit pattern #2 (253) on link 2/4... successful
Verifying Rx pattern #2 on all links from remote
Link 2/1 ... OK
Link 2/2 ... OK
Link 2/3 ... OK
Link 2/4 ... OK
```

If you want to initiate the test procedure on a particular link, enter **igptestb**, followed by the IMA group number, and followed by **2** and the port number of the selected link.

For example, to initiate the test procedure on IMA Port 2 in IMA Group 0, enter

```
igptestb 0 2/2
```

at the system prompt. A screen similar to the following will be displayed.

```
Trying to transmit pattern #1 (7) on link 2/2... successful
Verifying Rx pattern #1 on all links from remote
Link 2/1 ... OK
Link 2/2 ... OK
Link 2/3 ... OK
Link 2/4 ... OK
Trying to transmit pattern #2 (248) on link 2/8... successful
Verifying Rx pattern #2 on all links from remote
Link 2/1 ... OK
Link 2/2 ... OK
Link 2/3 ... OK
Link 2/4 ... OK
```

The IMA test will continue to run until it is stopped by the **igpteste** command, which is described in *Ending an IMA Test* on page 28-29. After the initial messages are printed, you can use the **igps** command (which is described in *Displaying the Summary Status of an IMA Group* on page 28-33) or the **ilks** command (which is described in *Displaying the Summary Status of IMA Links* on page 28-41) to check the status of the IMA test.

Ending an IMA Test

You use the **igpteste** command to end an IMA test procedure. The syntax for this command is as follows:

igpteste <IMA group id>

To use this command, enter **igpteste** followed by the IMA group number of the test procedure that you activated with the **igptestb** command (see *Starting an IMA Test* on page 28-27). For example, to terminate the test on IMA Group 0, enter

igpteste 0

at the system prompt. If the test procedure terminated successfully, the following will be displayed.

Trying to disable test procedure on group 0 ... successful

Restarting an IMA Group

You use the **igprst** command to restart an IMA group. This command is equivalent to bringing an IMA group down and then bringing back up again. It is normally used when the near end of an group cannot sync up with the far end of the group. When you restart an IMA group, configuration settings and statistics are unaffected.

The syntax for this command is as follows:

igprst <IMA group id>

To use this command, enter **igprst** followed by the IMA group number. To restart IMA Group 0, for example, enter

igprst 0

at the system prompt. The following message will be displayed

Group 0 will be restarted

Do you want to continue (y/n)? (n) :

Enter **y** to restart the group or press **<Return>** to cancel (the default). If the group was successfully restarted, you should see the following message:

Group 0 successfully restarted

Deleting an IMA Group

Use the **igpd** command to delete an IMA group. The syntax for this command is as follows:

igpd <IMA group id>

To use this command, enter **igpd** followed by the IMA group number. For example, to delete IMA group 0, enter

igpd 0

at the system prompt. The following message will be displayed.

Group 0 will be deleted.

Do you want to continue? (y/n) ? (n) :

Enter **y** to delete the IMA group or press **<Return>** to cancel (the default). If you successfully deleted the group, the following will be displayed.

Group 0 successfully deleted

Upgrading IMA Flash Memory on OA-408-IMA Switches

You use the **iupgfpga** to upgrade the flash content of OA-408-IMA switches with a Field Programmable Gate Array (FPGA) file. This command reads the contents of the FPGA file and compares it to the contents of the flash memory on the switch. If a difference is found, then the **iupgfpga** command will replace the contents of the switch flash memory with the contents of the FPGA file.

♦ Important Note ♦

The **iupgfpga** command is used for hardware upgrades only. Do not use this command unless you have been directed by Alcatel to do so.

The syntax for this command is as follows:

iupgfpga 2 <file_name> | all <file_name>

Since there is only one IMA uplink slot (Slot 2) in an OA-408-IMA switch, both forms of this command will upgrade the flash memory. For example, to upgrade all the flash contents of an OA-408-IMA switch with the FPGA file **fpga319.bin**, enter

iupgfpga all fpga319.bin

at the system prompt. The following message will be displayed

Upgrading FPGA on all IMA modules in the switch with file fpga319.bin

Do you want to continue (y/n)? (n) :

Enter **y** to upgrade the OA-408-IMA switch with the **fpga319.bin** FPGA file or press **<Return>** to cancel (the default). If you entered **y**, messages similar to the following will be displayed.

********** Attempting to upgrade FPGA on 2/1 **********

Device Am29F040 (512 Kbytes) is detected

Erasing flash ..... successful

Programming flash ..... successful

Upgrading FPGA completed successfully!

Displaying the Summary Status of an IMA Group

To view the summary status of an IMA group, use the **igps** command. The syntax for this command is as follows:

igps [<IMA group id>] [all]

The **<IMA group id>** option will give you a detailed list for a single IMA group (see *Displaying the Summary Status of a Single IMA Group* on page 28-35). The **<IMA group id>** option used together with the **all** option will give you a detailed list for a single IMA group with the status of all of the links on that group (see *Displaying the Detailed Status of a Single IMA Group with Link Status* on page 28-38). If you do not use either of these options, then you will see a brief list of the IMA group (see the subsection below).

Displaying the Summary Status of an IMA Group

To view the summary status of the IMA group, enter

igps

at the system prompt. A screen similar to the following will be displayed.

IMA Group Status

Grp	Near-end State	Far-end State	Failure Status	Num of Failures Near-end	Far-end
0	operational	operational	noFailure	0	0

The fields displayed by the summary status option for the **igps** command are described below.

Grp. The IMA group number.

Near-end State. The current operational state of the near-end side of the IMA group. The following are possible values.

operational. Indicates that group is the state where it can accept or pass cells from or to the ATM layer.

notConfigured. Indicates no links have been assigned to this group yet.

startUp. Indicates that group is in the first stage of negotiating with far-end side of the IMA group. It will not move out of this state until it receives acceptable parameters (such as IMA frame length, transmit clock configuration, symmetry, etc.) from the far-end side.

startUpAck. Indicates that group has received acceptable group parameters from far-end side of the IMA group.

cfgAbrtUnsuppM. Indicates that the IMA group has received a far-end negotiable IMA frame length parameter that is not supported by the near-end side of the IMA group, such as a mismatched configuration.

cfgAbrtUnsuppV. Indicates that the IMA group has received a far-end negotiable IMA version that is not supported by the near-end side of the IMA group, such as a mismatched configuration.

cfgAbrtIncompSym. Indicates that the IMA group has received a far-end negotiable IMA group symmetry parameter that is not supported by near-end side of the IMA group.

cfgAbrtOther. Indicates that group has received unsupported far-end group parameters besides unsupported IMA frame length and incompatible symmetry.

insuffLinks. Indicates that group has completed negotiation with the far-end side of the IMA group but the number of transmit and receive active links are less than the currently-configured **Minimum Transmit Links** and **Minimum Receive Links** fields (see *Displaying the Summary Status of a Single IMA Group* on page 28-35 to display these fields).

blocked. Indicates that the IMA group is administratively disabled (i.e., the group has been inhibited by the IMA group unit management entity). The group can be blocked for maintenance purposes or for insufficient links.

Far-end State. The current operational state of the far-end of the IMA group. See the **Near-end State** field description above for possible values.

Failure Status. The reason why an IMA group failed. If the IMA group is running, then **noFailure** is displayed. The following are possible values.

noFailure. Indicates that there is no failure on this group.

startUpNE. Indicates that near-end side of the group is in a start-up state.

startUpFE. Indicates that far-end side of the group is in a start-up state.

invalidMValNe. Indicates that the near-end side of the IMA group has received an invalid IMA frame length value.

invalidMValFe. Indicates that the far-end IMA group has received an invalid IMA frame length value.

invalidVValNe. Indicates that the near-end side of the IMA group has received an invalid value for IMA version.

invalidVValFe. Indicates that the far-end IMA group has received an invalid value for IMA version.

failedAsymNe. Indicates that the near-end side of the group has received an incompatible symmetry mode.

failedAsymFe. Indicates that the far-end group has received an incompatible symmetry mode.

insuffLnksNe. Indicates that the number of active transmit and receive links in the near-end side of the group is less than the values in the current configurable **Minimum Transmit Links** and **Minimum Receive Links** fields (see *Displaying the Summary Status of a Single IMA Group* on page 28-35 to display these fields).

insuffLnksFe. Indicates that the number of active transmit and receive links in the far-end side of the group is less than the values in the current configurable **Minimum Transmit Links** and **Minimum Receive Links** fields (see *Displaying the Summary Status of a Single IMA Group* on page 28-35 to display these fields).

blockedNe. Indicates that local state of the IMA group is in a blocked state (i.e., the group has been inhibited by the IMA group unit management entity). The group can be blocked for maintenance purposes or for insufficient links.

blockedFe. Indicates that far-end group state of the IMA group is in a blocked state (i.e., the group has been inhibited by the IMA group unit management entity). The group can be blocked for maintenance purposes or for insufficient links.

otherFailure. Indicates that local group is experiencing other unknown failures.

Near-end Num of failures. The number of near-end IMA group failures reported since power-up or reboot.

Far-end Num of Failures. The number of far-end IMA group failures reported since power-up or reboot.

Displaying the Summary Status of a Single IMA Group

To view the summary configuration and operational status of a single IMA group, enter **igps** followed by the IMA group number. For example, to view the status of IMA Group 0, enter

```
igps 0
```

at the system prompt. A screen similar to the following will be displayed.

```
                    IMA Group Status for Group 0
Description                    : IMA Group 0
Admin Status                   : up
Failure Status                 : noFailure
Near-end State                 : operational
Far-end State                  : operational
Minimum Transmit Links         : 1          Minimum Receive Links  : 1
Near-end Tx Clock Mode         : CTC        Far-end Tx Clock Mode  : CTC
Tx Frame Length                : 128        Rx Frame Length        : 128
Max Diff Delay (ms)            : 25         Max Diff Delay Obs (ms): 0
Far-end IMA Group ID           : 20         Rx Timing Ref. Link    : 2/1
Invalid ICP before HUNT        : 2          Tx Timing Ref. Link    : 2/1
Cons Err ICP before HUNT       : 2
Cons Valid ICP before SYNC     : 1
Status Change Time             : 0 days, 00:01:02.31
Group Memberships              : 2/1, 2/2, 2/4
Least Delay Link               : 2/2
Most Delay Link                : 2/1
Test Pattern                   : AnyPattern
Test Link                      : AnyLink
Test Pattern Procedure         : disabled
```

The fields displayed by the **igps** command for a single IMA group are described below.

Description. The configured description of the IMA group that was set by the **igpa** or **igpm** command.

Admin Status. The configured administrative status of the IMA group, which can be enabled (**up**) or disabled (**down**).

Failure Status. The current operational failure status of the IMA group (i.e., reason why an IMA group failed). See *Displaying the Summary Status of an IMA Group* on page 28-33 for descriptions of possible values.

Near-end State. The current operational state of the near-end side of the IMA group. See *Displaying the Summary Status of an IMA Group* on page 28-33 for descriptions of possible values.

Far-end State. The current operational state of the far-end of the IMA group. See *Displaying the Summary Status of an IMA Group* on page 28-33 for descriptions of possible values.

Minimum Transmit Links. The configured minimum number of active transmit links required for the IMA group to be in an Up state.

Minimum Receive Links. The configured minimum number of active receive links required for the IMA group to be in an Up state.

Near-end Tx Clock Mode. The configured transmit clocking mode used by the near-end of the IMA group, which can be Common Transmit Clock (CTC) mode, where all the IMA links have the same transmit clock source, or Independent Transmit Clock (ITC), where at least one IMA link has a unique transmit clock source.

Far-end Tx Clock Mode. The configured transmit clocking mode used by the far-end of the IMA group, which can be Common Transmit Clock (CTC) mode, where all the IMA links have the same transmit clock source, or Independent Transmit Clock (ITC), where at least one IMA link has a unique transmit clock source.

Tx Frame Length. The configured frame length (in bytes) used by the IMA group in the transmit direction. This field will always display **128** since frame lengths of 128 bytes are the only ones currently supported.

Rx Frame Length. The configured frame length (in bytes) used by the IMA group in the receive direction. This field will always display **128** since frame lengths of 128 bytes are the only ones currently supported.

Max Diff Delay (ms). The configured maximum (in milliseconds) differential delay among the links that will be tolerated on this interface. The default is **25** milliseconds.

Max Diff Delay Obs (ms). The latest operational maximum differential delay observed (in milliseconds) among the receive links that are currently configured in this IMA group. This value indicates the most recent differential observed between the receive link with the least propagation delay and the receive link with the most propagation delay.

Invalid ICP before HUNT. The configured number of invalid IMA Control Protocol (ICP) cells before moving to the ICP hunt mode.

Rx Timing Ref. Link. The receive reference link for deriving the IMA Data Cell Rate (the rate at which IMA data cells should be exchanged between the IMA sublayer and the ATM layer).

Far-end IMA Group ID. The IMA group ID used by the far end of the link.

Tx Timing Ref. Link. The transmit reference link for deriving the IMA Data Cell Rate (rate at which IMA data cells should be exchanged between the IMA sublayer and the ATM layer).

Cons Err ICP before HUNT. The configured number of consecutive invalid IMA Control Protocol (ICP) cells before moving to the ICP hunt.

Cons Valid ICP before SYN. The configured number of consecutive valid IMA Control Protocol (ICP) cells detected before moving from a pre-synchronized state to a synchronized state. The default value is **5**.

Status Change Time. The amount of time (in days, hours, minutes, seconds, and hundredths of seconds) observed since this IMA group was last modified.

Group Memberships. The configured physical ports used by this IMA group.

Least Delay Link. The link observed with the least differential delay in the IMA group, compared to other links in this IMA group.

Most Delay Link. The link observed with the greatest differential delay in the IMA group, compared to other links in this IMA group. This value only has meaning if at least one link has been configured in the IMA group.

Test Pattern. The value observed for the IMA Test Pattern Procedure, which can be set from 0 to 255. If **AnyPattern** is displayed, then the IMA software will randomly select a value from 0 to 255.

Test Link. The beginning link used by the IMA test procedure. If **AnyLink** is displayed, then the IMA software will randomly select a link when it starts an IMA test.

Test Pattern Procedure. The configured state of the IMA test procedure, which can one of the following values:

disabled. Indicates that the current test procedure is disabled.

operating. Indicates that the current test procedure is active and the receive pattern on all links in the group match the transmit pattern.

linkFail. Indicates that the current test procedure is active but the receive pattern on one or more link does not match the transmit pattern.

Displaying the Detailed Status of a Single IMA Group with Link Status

To view the detailed status of a single IMA group with the status of the group's links, enter **igps** followed by the IMA group number and the word **all**. For example, to view the status of IMA Group 0 and its links, enter

```
igps 0 all
```

at the system prompt. A screen similar to the following will be displayed.

```
                    IMA Group Status for Group 0

Description                     : IMA Group 0
Admin Status                    : up
Failure Status                  : noFailure
Near-end State                  : operational
Far-end State                   : operational
Minimum Transmit Links          : 1          Minimum Receive Links  : 1
Near-end Tx Clock Mode          : CTC        Far-end Tx Clock Mode  : CTC
Tx Frame Length                 : 128        Rx Frame Length        : 128
Max Diff Delay (ms)             : 25         Max Diff Delay Obs (ms) : 0
Far-end IMA Group ID            : 20         Rx Timing Ref. Link    : 2/1
Invalid ICP before HUNT         : 2          Tx Timing Ref. Link    : 2/1
Cons Err ICP before HUNT        : 2
Cons Valid ICP before SYNC      : 1
Status Change Time              : 1 days, 21:11:02.48
Group Memberships               : 2/1, 2/2, 2/3
Least Delay Link                : 2/2
Most Delay Link                 : 2/1
Test Pattern                    : 255
Test Link                       : AnyLink
Test Pattern Procedure          : disabled

                    Phy.    Tx    Rx    Rel     Transmit State      Receive State
Slot  Port          Status  LID   LID   Dly   Near-end  Far-end   Near-end  Far-end
====  ====          ======  ===   ===   ===   ========  ========  ========  =======
2     1             up      0     0     0     active    active    active    active
2     2             up      1     1     0     active    active    active    active
2     3             up      2     2     0     active    active    active    active
2     4             up      3     3     0     active    active    active    active

                    Rx Test  Test Proc.      Failure Status
Slot  Port          Pattern    Status      Near-end      Far-end
====  ====          =======  ==========    =========   ==========
2     1             0        disabled      noFailure     noFailure
2     2             0        disabled      noFailure     noFailure
2     3             0        disabled      noFailure     noFailure
2     4             0        disabled      noFailure     noFailure
```

The **igps** command with the **all** option groups the fields into three sets. See *Displaying the Detailed Status of a Single IMA Group with Link Status* on page 28-38 for the first set of fields (i.e., **Description** through **Test Pattern Procedure**). The second and third sets of fields display the summary status for every port in the group. These fields are described on the pages that follow.

Phy. Status. This field displays whether the IMA link is active (**up**) or inactive (**down**). For example, if the link is free of active major alarms (e.g., LOS, Red alarm), then it is declared to be in an **up** state; otherwise, it will be declared to be in a **down** state.

Tx LID. The transmit link ID for this link.

Rx LID. The receive link ID number for this link (used by the far-end transmitter). A value of **-1** indicates that the far-end of the link has not been configured.

Rel Dly. The latest measured delay (in milliseconds) on this link as compared to the link with the least delay in the same IMA group.

Near-end Transmit State. The current state of the near-end IMA transmit link. The following are possible values:

notInGroup. Indicates that this link is currently not configured to any IMA group.

unuseNoRsn. Indicates that this link is not usable because of unknown reason.

unuseFault. Indicates that this link is not usable because it is experiencing a fault.

unuseMisco. Indicates that this link is not usable because it is misconnected.

unuseInhibit. Indicates that this link is administratively brought down while the link is in active state.

unuseFail. Indicates that this link is not usable because it is experiencing a failure.

usable. Indicates that this link is usable (e.g., free of alarms and faults, etc.).

active. Indicates that this link is in active state; it is transmitting ATM layer cells and is part of the data round robin.

Far-end Transmit State. The current state of the far-end IMA transmit link. See the **Near-end Transmit State** field description above for possible values.

Near-end Receive State. The current state of the near-end IMA receive link. See the **Near-end Transmit State** field description above for possible values.

Far-end Receive State. The current state of the far-end IMA receive link. See the **Near-end Transmit State** field description above for possible values.

Rx Test Pattern. The value of the test pattern, which can be from 0 to 255.

Test Proc. Status. The field displays the current status of the IMA test procedure. Possible values include:

disabled. Indicates that the current test procedure has been disabled.

operating. Indicates that the test procedure is active and the receive pattern on this link matches the transmit pattern.

linkFail. Indicates that the test procedure is active and the receive pattern on this link does not match the transmit pattern. When an error occurs, **linkFail** will be displayed until a subsequent read reports the value of **operating** or this field changes to **disabled**, which means that the test procedure was terminated.

Near-end Failure Status. The current link failure status of the near-end receive link. The following are possible values:

noFailure. Indicates that there is no failure on this link.

lnkFail. Indicates that this link is experiencing general failure.

lifFail. Indicates that this link is experiencing loss of IMA failure.

lodsFail. Indicates that this link is experiencing loss of delay synchronization failure.

misCnnctd. Indicates that this link is being misconnected.

blocked. Indicates that this link is being administratively brought down while it is in an active state.

fault. Indicates that this link is experiencing a fault, such as a link alarm.

feTxUnuse. Indicates that the far-end transmit state is not usable.

feRxUnuse. Indicates that the far-end receive state is not usable.

Far-end Failure Status. The current link failure status of the far-end receive link, as reported via the IMA Control Protocol (ICP). See the **Near-end Failure Status** field description above for possible values.

Displaying the Summary Status of IMA Links

To view the status of IMA links, use the **ilks** command. The syntax for this command is as follows:

ilks [2/<port>]

The **2/<port>** option will give you the status for a single IMA link (see *Displaying the Detailed Status of a Single IMA Link* on page 28-43). If you do not use this option, then you will see a list of the status for every IMA link (see the subsection below).

Displaying the Summary Status of All IMA Links

To view the summary status of every IMA link, enter

ilks

at the prompt. A screen similar to the following will be displayed.

IMA Links Status

			Transmit State		Receive State		Failure Status	
Sl	**Prt**	**Grp**	**Near-end**	**Far-end**	**Near-end**	**Far-end**	**Near-end**	**Far-end**
2	**1**	**1**	**Active**	**Active**	**Active**	**Active**	**noFailure**	**noFailure**
2	**2**	**1**	**Inactive**	**Inactive**	**Inactive**	**Inactive**	**blocked**	**blocked**

The fields displayed by the **ilks** command for all IMA links are described below.

Sl. The link's slot number.

Prt. The port number of the IMA link.

Grp. The IMA group number for this IMA link.

Near-end Transmit State. The current state of the near-end transmit link. The following are possible values:

notInGroup. Indicates that this link is currently not configured to any IMA group.

unuseNoRsn. Indicates that this link is not usable because of unknown reason.

unuseFault. Indicates that this link is not usable because it is experiencing a fault.

unuseMisco. Indicates that this link is not usable because it is misconnected.

unuseInhibit. Indicates that this link is administratively brought down while the link is in active state.

unuseFail. Indicates that this link is not usable because it is experiencing a failure.

usable. Indicates that this link is usable (e.g., free of alarms and faults, etc.).

active. Indicates that this link is in active state; it is transmitting ATM layer cells and is part of the data round robin.

Far-end Transmit State. The current state of the far-end transmit link, as determined by IMA Control Protocol (ICP) cells. See the **Near-end Transmit State** field description on the previous page for possible values.

Near-end Receive State. The current state of the near-end receive link. See the **Near-end Transmit State** field description above for possible values.

Far-end Receive State. The current state of the far-end receive link, as determined by IMA Control Protocol (ICP) cells. See the **Near-end Transmit State** field description above for possible values.

Near-end Failure Status. The current link failure status of the near-end receive link. The following are possible values:

noFailure. Indicates that there is no failure on this link.

lnkFail. Indicates that this link is experiencing general failure.

lifFail. Indicates that this link is experiencing loss of IMA failure.

lodsFail. Indicates that this link is experiencing loss of delay synchronization failure.

misCnnctd. Indicates that this link is being misconnected.

blocked. Indicates that this link is being administratively brought down while it is in an active state.

fault. Indicates that this link is experiencing a fault, such as a link alarm.

feTxUnuse. Indicates that the far-end transmit state is not usable.

feRxUnuse. Indicates that the far-end receive state is not usable.

Far-end Failure Status. The current link failure status of the far-end receive link, as determined by IMA Control Protocol (ICP) cells.

Displaying the Detailed Status of a Single IMA Link

To view the detailed status of a single IMA link, enter **ilks** followed by **2** and the port number. For example, to view to status of IMA Port 1, enter

```
ilks 2/1
```

at the prompt. A screen similar to the following will be displayed.

```
                    Link Status of 2/1

Description              : IMA Link
Admin Status             : up              Oper Status             : up
Group Index              : 0
Near-end Tx State        : active          Near-end Rx State       : active
Far-end Tx State         : active          Far-end Rx State        : active
NE Rx Failure Status     : feTxUnuse       FE Rx Failure Status    : noFailure
Tx Link ID               : 0               Rx Link ID              : 0
Relative Delay (ms)      : 0
Rx Test Pattern          : 255
Test Proc. Status        : disabled
```

The fields displayed by the **ilks** command for a single IMA link are described below.

Link Description. The configured text description (up to 30 characters) of the IMA link. This field can be modified by the **ilkm** command, which is described in *Configuring IMA Link Parameters* on page 28-26).

Admin Status. The configured administrative status of the IMA link, which can be enabled (**up**) or disabled (**down**).

Oper Status. The operational status of this IMA link, which can be active (**up**) or inactive (**down**).

Group Index. The configured IMA group number on this IMA link.

Near-end Tx State. The current state of the near-end transmit link. See the **Near-end Transmit State** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

Near-end Rx State. The current state of the near-end IMA receive link. See the **Near-end Transmit State** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

Far-end Tx State. The current state of the far-end transmit link. See the **Near-end Transmit State** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

Far-end Rx State. The current state of the far-end IMA receive link. See the **Near-end Transmit State** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

NE Rx Failure Status. The current link failure status of the near-end receive link. See the **Near-end Failure Status** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

FE Rx Failure Status. The current link failure status of the far-end receive link, as reported via the IMA Control Protocol (ICP). See the **Near-end Failure Status** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

Tx Link ID. The configured ID number for the near-end of the IMA link.

Rx Link ID. The receive link ID number for this link (used by the far-end transmitter). A value of **-1** indicates that the far-end of the link has not been configured.

Relative Delay (ms). The latest observed measured delay (in milliseconds) on this link relative to the link, in the same IMA group, with the least delay.

Rx Test Pattern. The value of the test pattern, which can be from 0 to 255.

Test Proc. Status. he value of the test pattern, which can be from 0 to 255.

Test Proc. Status. The field displays the current status of the IMA test procedure. See the **Test Proc. Status** field description in *Displaying the Summary Status of All IMA Links* on page 28-41 for descriptions of possible values.

Displaying the Statistics for an IMA Group

To view the statistics for an IMA group, use the **igpsts** command. The syntax for this command is as follows:

```
igpsts <IMA group id> [all]
```

The **all** option will give you a detailed list of statistics for an IMA group (see *Displaying Detailed Statistics for an IMA Group* on page 28-47). If you do not use this option, then you will see summary statistics for an IMA group (see *Displaying Summary Statistics for an IMA Group* on page 28-45).

Displaying Summary Statistics for an IMA Group

To view summary statistics for an IMA group, enter **igpsts** followed by the IMA group number. For example, to view a brief list of statistics for IMA Group 0, enter

```
igpsts 0
```

at the system prompt. A screen similar to the following will be displayed:

```
IMA Group Statistics for Group 0

Near-end Num of Failures  :      0    Far-end Num of Failures  :      0
Tx Available Cell Rate    :  28976    Rx Available Cell Rate    :  28976
Tx Config Links           :      8    Rx Config Links           :      8
Tx Active Links           :      8    Rx Active Links           :      8
Running Seconds           :      0    Unavailable Seconds       :      0
Rx User Cells             :      0    Tx User Cells             :      0
Tx Buffer Overflow        :      0
```

The fields displayed by the **igpsts** without the **all** option are described below.

Near-end Num of Failures. The observed number of near-end IMA group failures reported since power-up or reboot. A near-end IMA group failure can be caused by an insufficient number of links or a config-abort during startup.

Far-end Num of Failures. The observed number of far-end IMA group failures reported since power-up or reboot. A far-end IMA group failure can be caused by an insufficient number of links at the far end of the link, a blocked operational state at the far end of the link, or a config-abort at the far end of the link during startup.

Tx Available Cell Rate. The observed current rate (in cells per second) provided by this IMA group in the transmit direction. The rate only includes transmitting links in the active state.

Rx Available Cell Rate. The observed current rate (in cells per second) provided by this IMA group in the receive direction. The rate only includes receiving links in the active state.

Tx Config Links. The configured number of links to transmit in this IMA group.

Rx Config Links. The configured number of links to receive in this IMA group.

Tx Active Links. The configured number of active links that can transmit ATM cells in this IMA group (i.e., Tx state OK).

Rx Active Links. The configured number of active that can receive ATM cells in this IMA group (i.e., Rx state OK).

Running Seconds. The observed amount of time (in seconds) since this IMA group has been in operation, or the amount of time (in seconds) since this IMA group ceased operating. Basically, this field displays the amount of time since links have been assigned to this IMA group.

Unavailable Seconds. The observed number of one-second intervals where the IMA group traffic state machine is down.

Rx User Cells. The observed number of ATM layer cells received at the near end.

Tx User Cells. The observed number of ATM layer cells transmitted by the near-end side of the IMA link.

Tx Buffer Overflow. The observed number of cells exceeding the near-end of the IMA link's buffer.

Displaying Detailed Statistics for an IMA Group

To view detailed statistics for an IMA group, enter **igpsts** followed by the IMA group number and the word **all**. For example, to view a detailed list of statistics for IMA Group 0, enter

igpsts 0 all

at the system prompt. A screen similar to the following will be displayed:

IMA Group Statistics for Group 0

Near-end Num of Failures	0	Far-end Num of Failures	0
Tx Available Cell Rate	28976	Rx Available Cell Rate	28976
Num of Tx Config Links	8	Num of Rx Config Links	8
Num of Tx Active Links	8	Num of Rx Active Links	8
Running Seconds	0	Unavailable Seconds	0
Rx User Cells	0	Tx User Cells	0
Tx Buffer Overflow	0		

Slot	Port	Rx ICP Cells	Tx ICP Cells	Rx Filler Cells	Tx Filler Cells	Rx User Cells	Tx User Cells
2	1	7801	23401	990688	2971908	0	0
2	2	7800	23400	990587	2971826	0	0
2	3	7799	23399	990472	2971716	0	0
2	4	7798	23398	990367	2971605	0	0

Slot	Port	Rx Stuff Events	Tx Stuff Events	IMA Violations	OIF Anomalies	Rx Bad ICP Cells	Rx ICP w/ CRC-10 Err
2	1	0	0	0	0	0	0
2	2	0	0	0	0	0	0
3	3	0	0	0	0	0	0
2	4	0	0	0	0	0	0

Slot	Port	Tx UUS Near-end	Tx UUS Far-end	Rx UUS Near-end	Rx UUS Far-end	SES Near-end	SES Far-end
2	1	0	0	0	0	0	0
2	2	0	0	0	0	0	0
2	3	0	0	0	0	0	0
2	4	0	0	0	0	0	0

Slot	Port	UAS Near-end	UAS Far-end	Tx Fails Near-end	Tx Fails Far-end	Rx Fails Near-end	Rx Fails Far-end
2	1	0	0	0	0	0	0
2	2	0	0	0	0	0	0
2	3	0	0	0	0	0	0
2	4	0	0	0	0	0	0

Slot	Port	Cell In Rx Buffer	Rx Buffer Flushes	Rx Buffer Overflow	Rx Cells Discarded
2	1	0	0	0	0
2	2	0	0	0	0
2	3	0	0	0	0
2	4	0	0	0	0

The **igpsts** command with the **all** option groups the fields into six sets. See *Displaying Summary Statistics for an IMA Group* on page 28-45 for the first set of fields (i.e., **Near-end Num of Failures** through **Tx Buffer Overflow**) shown on the previous page. The second through sixth set of fields display operational statistics for every port in the group. These fields are described below.

Rx ICP Cells. The number of IMA Control Protocol (ICP) cells received at the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on ICP cells.)

Tx ICP Cells. The number of IMA Control Protocol (ICP) cells transmitted by the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on ICP cells.)

Rx Filler Cells. The number of filler cells received at the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Tx Filler Cells. The number of filler cells transmitted by the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Rx User Cells. The number of ATM layer cells for one port received at the near-end side of the IMA link.

Tx User Cells. The number of ATM layer cells for one port transmitted by the near-end side of the IMA link.

Rx Stuff Events. The number of stuff events (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) inserted in the receive direction.

Tx Stuff Events. The number of stuff (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) events inserted in the transmit direction.

IMA Violations. The total number of IMA Control Protocol (ICP) cells with errors, invalid ICP cells, and missing ICP cells that occurred during non-Severely Errored Second (SES) IMA conditions. IMA violations in SES-IMA conditions are not included in this count.

An SES-IMA condition is a condition in which severely-errored seconds (SES) are occurring. An SES is a second during which 30% or more of the ICP cells contain IMA violations or one or more link defect states exist (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation).

OIF Anomalies. The total number of Out of IMA Frame (OIF) anomalies that have occurred during normal traffic conditions (i.e., non-SES-IMA) at the near end of the link. OIF anomalies in SES-IMA conditions are not included in this count. (See the **IMA Violations** field description above for more information on SES-IMA conditions.)

An OIF anomaly occurs when the IMA frame synchronization mechanism exists in the IMA SYNC state (i.e., the IMA working state). When OIF anomalies persist for at least two (2) IMA frames, the Loss of IMA Frame (LIF) defect state is entered.

Rx Bad ICP Cells. The number of invalid IMA Control Protocol (ICP) cells received at the near-end side of the IMA link.

Rx ICP w/ CRC-10 Err. The number of IMA Control Protocol (ICP) cells with bad CRC-10 received at the near-end side of the IMA link.

Near-end Tx UUS. Near-end transmit unusable seconds. The number of unusable seconds at the near-end transmitting Link State Machine (LSM). The unusable state indicates that the link is configured within an IMA group but is not in use due to a fault, incorrect connectivity revealed by the test pattern procedure, or administrative inhibition for application-dependent or implementation-reasons, etc. (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Tx UUS. Far-end transmit unusable seconds. The number of unusable seconds at the far-end transmitting Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Near-end Rx UUS. Near-end receive unusable seconds. The number of unusable seconds at the near-end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Rx UUS. Far-end receive unusable seconds. The number of unusable seconds at the far-end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Near-end SES. Near-end severely-errored seconds. The number of one-second intervals in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation) during non-Unavailable Seconds (UAS)-IMA conditions.

The UAS-IMA condition begins at the onset of ten (10) contiguous severely-errored seconds (SES) and ends at the onset of ten (10) contiguous seconds with no SES.

Far-end SES. Far-end severely-errored seconds. The number of one-second intervals containing one or more Remote Defect Indicator (RDI) IMA defects (which includes IMA link-specific defects).

Near-end UAS. Near-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-SES-IMA conditions, at the near end of the link.

An SES is a second during which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists. (See the **IMA Violations** field description on page 28-48 for more information on SES-IMA conditions.)

Far-end UAS. Far-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the far end (FE) of the link.

An SES-IMA-FE condition is a second during which one or more Remote Defect Indicator (RDI)-IMA defects occurs. The RDI indicates remote defects (which includes IMA link-specific defects).

Near-end Tx Fails. The number of times a near-end transmit failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Tx Fails. The number of times a far-end transmit failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Near-end Rx Fails. The number of times a near-end receive failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Rx fails. The number of times a far-end receive failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Cells In Rx Buffer. The number of cells that are currently in the receive buffer.

Rx Buffer Flushes. The number of times that this link's receive buffer has been flushed. The buffer will be flushed if the IMA software internally detects fatal errors.

Rx Buffer Overflow. The number of times that this link's receive buffer has overflowed. For example, the receive buffer can overflow from timing differences.

Rx Cells Discarded. The number of cells discarded. For example, cells can be discarded due to bad ICP cells.

Displaying 24-Hour Performance Statistics on a Local Group

To view the local IMA group performance statistics over the most recently-completed 24-hour period, use the **igplts** command. (If the IMA interface was brought on-line within the last 24 hours, then the current 24-hour period will be displayed.) The syntax for this command is as follows:

igplts <IMA group id>

For example, to display the local IMA group performance for IMA group 0 over the most recently-completed 24-hour period, enter

igplts 0

at the system prompt. A screen similar to the following will be displayed.

```
24-hour Period Statistics for group 0

Valid Intervals        : 83 of 96          Elapsed Time    : 559 of 900

 GR-UAS-IMA     GP-FC-NE     GP-FC-FE
============  ==========  ==========
          4           1           1
```

The fields displayed by the **igplts** command are described below.

Valid Intervals. The number of valid 15-minute intervals of for which valid data was collected. The number of intervals will be 96 unless the IMA interface was brought on-line within the last 24-hours.

GR-UAS-IMA. IMA group unavailable seconds. The number of 1-second intervals where the IMA Group Traffic State Machine (GTSM), which indicates the capability of the group to transmit cells from the ATM layer, is down.

GP-FC-NE. The number of times a near-end IMA group failure has been reported. (Invalid intervals will not be counted.) These failures include the following:

Config-Aborted. This failure occurs when the far-end link attempts to use unacceptable configuration parameters.

Insufficient-Links. This failure occurs when there are insufficient transmit or receive links that are in an Active state.

GP-FC-FE. The number of times that a far-end group failure has been reported. These failures include the following:

Config-Aborted-FE. This failure occurs when the far-end link reports to use unacceptable configuration parameters.

Insufficient-Links-FE. This failure occurs when the far-end link reports that there are insufficient transmit or receive links.

Blocked-FE. This failure occurs when the far-end link reports that it is blocked

Displaying Current Performance Statistics on a Local Group

To view the current local IMA group performance statistics, use the **igplcs** command. The syntax for this command is as follows:

igplcs <IMA group id>

For example, to display the current local performance statistics for IMA group 0, enter

igplcs 0

at the system prompt. A screen similar to the following will be displayed.

```
                Current 15-minute Measurement for group 0

Valid Intervals          : 83 of 96              Elapsed Time     : 556 of 900

  GR-UAS-IMA      GP-FC-NE      GP-FC-FE
 ============   ==========   ==========
           0             0            0
```

The fields displayed by the **igpcls** command are described in *Displaying 24-Hour Performance Statistics on a Local Group* on page 28-51.

Displaying Performance Statistics Intervals on a Local Group

To view up to 96 15-minute intervals of local IMA group performance statistics, use the **igplis** command. The syntax for this command is as follows:

igplis <IMA group id>

For example, to display 96 15-minute intervals of local performance statistics for IMA group 0, enter

igplis 0

at the system prompt. A screen similar to the following will be displayed.

15-minute Interval Statistics for group 0

Valid Intervals : 83 of 96 Elapsed Time : 561 of 900

Intv#	GR-UAS-IMA	GP-FC-NE	GP-FC-FE
1	4	1	1
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0

Press any key to see next screen.

All of the fields displayed by the **igpcls** command except for the **Intv#** field, which is described below, are described in *Displaying 24-Hour Performance Statistics on a Local Group* on page 28-51.

Intv#. The interval number for this instance, which can be from 1 to 96. A **1** in this field indicates the most recently completed 15-minute interval and a **96** indicates the least recently completed 15-minute interval (assuming that all 96 intervals are valid).

Displaying Detailed Statistics for IMA Links

To display detailed operational statistics of the link associated with a particular port use the **ilksts** command. The syntax for this command is as follows:

ilksts 2/<port>

Enter **ilksts** followed by 2 and the port number. For example, to display the statistics of the link on IMA Port 1, enter

ilksts 2/1

at the system prompt. A screen similar to the following will be displayed:

IMA Link Statistics for 2/1

Rx ICP Cells	:	**2624374**	**Tx ICP Cells**	:	**2624374**
Rx Filler Cells	:	**333295510**	**Tx Filler Cells**	:	**333295510**
Tx Stuffs	:	**0**	**Rx Stuff**	:	**0**
Rx User Cells	:	**0**	**Tx User Cells**	:	**0**
Rx Bad ICP Cells	:	**0**	**Rx ICP w/ Bad CRC-10**	:	**0**
Cells In Rx Buffer	:	**0**	**Rx Buffer Flushes**	:	**0**
Rx Buffer Overflow	:	**0**	**Rx Cells Discarded**	:	**0**
IMA Violations	:	**0**	**OIF Anomalies**	:	**0**
Far-end SES	:	**0**	**Near-end SES**	:	**0**
Far-end UAS	:	**0**	**Near-end UAS**	:	**0**
Near-end Tx UUS	:	**0**	**Near-end Rx UUS**	:	**0**
Far-end Tx UUS	:	**0**	**Far-end Rx UUS**	:	**0**
Near-end Tx Failures	:	**0**	**Near-end Rx Failures**	:	**0**
Far-end Tx Failures	:	**0**	**Far-end Rx Failures**	:	**0**

The fields displayed by the **ilksts** command are described below.

Rx ICP Cells. The number of IMA Control Protocol (ICP) cells received at the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Tx ICP Cells. The number of IMA Control Protocol (ICP) cells transmitted by the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Rx Filler Cells. The number of filler cells received at the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Tx Filler Cells. The number of filler cells transmitted by the near-end side of the IMA link. (See *IMA Process Overview* on page 28-4 for more information on filler cells.)

Tx Stuffs. The number of stuff events (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) inserted in the transmit direction.

Rx Stuff. The number of stuff events (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) inserted in the receive direction.

Rx User Cells. The number of ATM layer cells received at the near-end side of the IMA link.

Tx User Cells. The number of ATM layer cells transmitted by the near-end side of the IMA link.

Rx Bad ICP Cells. The number of invalid IMA Control Protocol (ICP) cells received at the near-end side of the IMA link.

Rx ICP w/ Bad CRC-10. The number of IMA Control Protocol (ICP) cells with a CRC-10 error received at the near-end side of the IMA link.

Cells In Rx Buffer. The number of cells that are currently in the receive buffer.

Rx Buffer Flushes. The number of times that this link's receive buffer has been flushed. The buffer will be flushed if the IMA software internally detects fatal errors.

Rx Buffer Overflow. The number of times that this link's receive buffer has overflowed. For example, the receive buffer can overflow from timing differences.

Rx Cells Discarded. The number of cells discarded. For example, cells can be discarded due to bad ICP cells.

IMA Violations. The total number of IMA Control Protocol (ICP) cells with errors, invalid ICP cells, and missing ICP cells that occurred during non-Severely Errored Second (SES) IMA conditions. IMA violations in SES-IMA conditions are not included in this count.

An SES-IMA condition is a second in which severely-errored seconds (SES) are occurring. An SES is second during which 30% or more of the ICP cells contain IMA violations or one or more link defect states exist (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation).

OIF Anomalies. The total number of Out of IMA Frame (OIF) anomalies that have occurred during normal traffic conditions (i.e., non-SES-IMA) at the near end of the link. OIF anomalies in SES-IMA conditions are not included in this count. (See the **IMA Violations** field description above for more information on SES-IMA conditions.)

An OIF anomaly occurs when the IMA frame synchronization mechanism exists in the IMA SYNC state (i.e., the IMA working state). When OIF anomalies persist for at least two (2) IMA frames, the Loss of IMA Frame (LIF) defect state is entered.

Far-end SES. Far-end severely-errored seconds. The number of one-second intervals containing one or more Remote Defect Indicator (RDI) IMA defects (which includes IMA link-specific defects).

Near-end SES. Near-end severely-errored seconds.The number of one-second intervals in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation) during non-Unavailable Seconds (UAS)-IMA conditions.

The UAS-IMA condition begins at the onset of ten (10) contiguous severely-errored seconds (SES) and ends at the onset of ten (10) contiguous seconds with no SES.

Far-end UAS. Far-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the far end (FE) of the link.

An SES-IMA-FE condition is a second one or more Remote Defect Indicator (RDI)-IMA defects. The RDI indicates remote defects (which includes IMA link-specific defects).

Near-end UAS. Near-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the near end of the link.

An SES is a second in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists. (See the **IMA Violations** field description above for more information on SES-IMA conditions.)

Near-end Tx UUS. Near-end transmit unusable seconds. The number of unusable seconds at the near-end transmitting Link State Machine (LSM). The unusable state indicates that the link is configured within an IMA group but is not in use due to a fault, incorrect connectivity revealed by the test pattern procedure, or administrative inhibition for application-dependent or implementation-reasons, etc. (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Near-end Rx UUS. Near-end receive unusable seconds. The number of unusable seconds at the near-end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Tx UUS. Far-end transmit unusable seconds. The number of unusable seconds at the far-end transmitting Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Rx UUS. Far-end receive unusable seconds. The number of unusable seconds at the near end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Near-end Tx Num of Failures. The number of times a near-end transmit failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Near-end Rx Num of Failures. The number of times a near-end receive failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Tx Num of Failures. The number of times a far-end transmit failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Rx Num of Failures. The number of times a far-end receive failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Displaying 24-Hour Performance Statistics on a Local Link

To display performance statistics of the local link associated with a particular port over a 24-hour period, use the **ilklts** command. The syntax for this command is as follows:

ilklts 2/<port>

Enter **ilklts** followed by **2** and the port number. For example, to display the statistics of the link on IMA Port 4, enter

ilklts 2/4

at the system prompt. A screen similar to the following will be displayed:

24-hour Period Statistics for port 4 on slot 2

Valid Intervals	**: 96 of 96**		**Elapsed Time**	**: 25 of 900**	
Ima Violations	**:**	**2**	**Oif Anomalies**	**:**	**0**
Far-end SES	**:**	**0**	**Near-end SES**	**:**	**0**
Far-end UAS	**:**	**0**	**Near-end UAS**	**:**	**0**
Near-end Tx UUS	**:**	**4**	**Near-end Rx UUS**	**:**	**1**
Far-end Tx UUS	**:**	**2**	**Far-end Rx UUS**	**:**	**0**
Near-end Tx Failures	**:**	**0**	**Near-end Rx Failures**	**:**	**0**
Far-end Tx Failures	**:**	**0**	**Far-end Rx Failures**	**:**	**0**
Tx Stuffs	**:**	**107841**	**Rx Stuff**	**:**	**107840**

The fields displayed by the ilklts command are described below.

Valid Intervals. The number of valid 15-minute intervals of for which valid data was collected. The number of intervals will be 96 unless the IMA interface was brought on-line within the last 24-hours.

Elapsed Time. The number of seconds that have elapsed since the beginning of the current measurement period.

IMA Violations. The total number of ICP cells with errors, invalid ICP cells, and missing ICP cells that occurred during non-Severely Errored Second (SES) IMA conditions. IMA violations in SES-IMA conditions are not included in this count.

An SES-IMA condition is a second during which severely-errored seconds (SES) are occurring. An SES is second in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exist (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation).

OIF Anomalies. The total number of Out of IMA Frame (OIF) anomalies that have occurred during normal traffic conditions (i.e., non-SES-IMA) at the near end of the link. OIF anomalies in SES-IMA conditions are not included in this count. (See the **IMA Violations** field description above for more information on SES-IMA conditions.)

An OIF anomaly occurs when the IMA frame synchronization mechanism exists in the IMA SYNC state (i.e., the IMA working state). When OIF anomalies persist for at least two (2) IMA frames, the Loss of IMA Frame (LIF) defect state is entered.

Far-end SES. Far-end severely-errored seconds. The number of one-second intervals containing one or more Remote Defect Indicator (RDI) IMA defects (which includes IMA link-specific defects).

Near-end SES. Near-end severely-errored seconds.The number of one-second intervals in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation) during non-Unavailable Seconds (UAS)-IMA conditions.

The UAS-IMA condition begins at the onset of ten (10) contiguous severely-errored seconds (SES) and ends at the onset of ten (10) contiguous seconds with no SES.

Far-end UAS. Far-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the far end (FE) of the link.

An SES-IMA-FE condition is a second one or more Remote Defect Indicator (RDI)-IMA defects. The RDI indicates remote defects (which includes IMA link-specific defects).

Near-end UAS. Near-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the near end of the link.

An SES is a second in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists. (See the **IMA Violations** field description on the previous page for more information on SES-IMA conditions.)

Near-end Tx UUS. Near-end transmit unusable seconds. The number of unusable seconds detected at the near-end transmitting Link State Machine (LSM). The unusable state indicates that the link is configured within an IMA group but is not in use due to a fault, incorrect connectivity revealed by the test pattern procedure, or administrative inhibition for application-dependent or implementation-reasons, etc. (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Near-end Rx UUS. Near-end receive unusable seconds. The number of unusable seconds at the near-end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Tx UUS. Far-end transmit unusable seconds. The number of unusable seconds at the far-end transmitting Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Far-end Rx UUS. Far-end receive unusable seconds. The number of unusable seconds at the near end receiving Link State Machine (LSM).

Near-end Tx Num of Failures. The number of times a near-end transmit failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Near-end Rx Num of Failures. The number of times a near-end receive failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Tx Num of Failures. The number of times a far-end transmit failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Far-end Rx Num of Failures. The number of times a far-end receive failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Rx Stuffs. The number of stuff events (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) inserted in the receive direction.

Tx Stuff. The number of stuff (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) events inserted in the transmit direction.

Displaying Current Performance Statistics on a Local Link

To display the current performance statistics of the local link associated with a particular port, use the **ilklcs** command. The syntax for this command is as follows:

ilklcs 2/<port>

Enter **ilklcs** followed by **2** and the port number. For example, to display the statistics of the link on IMA Port 4, enter

ilklcs 2/4

at the system prompt. A screen similar to the following will be displayed:

Current 15-minute Measurement for port 4 on slot 2

Valid Intervals	**: 96 of 96**		**Elapsed Time**	**: 23 of 900**	
Ima Violations	**:**	**0**	**Oif Anomalies**	**:**	**0**
Far-end SES	**:**	**0**	**Near-end SES**	**:**	**0**
Far-end UAS	**:**	**0**	**Near-end UAS**	**:**	**0**
Near-end Tx UUS	**:**	**0**	**Near-end Rx UUS**	**:**	**0**
Far-end Tx UUS	**:**	**0**	**Far-end Rx UUS**	**:**	**0**
Near-end Tx Failures	**:**	**0**	**Near-end Rx Failures**	**:**	**0**
Far-end Tx Failures	**:**	**0**	**Far-end Rx Failures**	**:**	**0**
Tx Stuffs	**:**	**41**	**Rx Stuff**	**:**	**4**

The fields displayed by the **ilklcs** command are described in *Displaying 24-Hour Performance Statistics on a Local Link* on page 28-57.

Displaying Performance Statistics Intervals on a Local Link

To display up to 96 15-minute intervals of performance statistics of the local link associated with a particular port, use the **ilklis** command. The syntax for this command is as follows:

ilklis 2/<port>

Enter **ilklis** followed by **2** and the port number. For example, to display the statistics of the link on IMA Port 4, enter

ilklis 2/4

at the system prompt. A screen similar to the following will be displayed:

15-minute Interval Statistics for port 4 on slot 2

Valid Intervals : 2 of 96 Elapsed Time : 285 of 900

Intv#	IMA Violations	OIF Anomalies	SES Near-end	SES Far-end	UAS Near-end	UAS Far-end	Rx UUS Near-end	Rx UUS Far-end
1	0	0	0	0	0	0	0	0
2	2	2	4	3	0	0	702	701

Intv#	Tx UUS Near-end	Tx UUS Far-end	Rx Fails Near-end	Rx Fails Far-end	Tx Fails Near-end	Tx Fails Far-end	Rx Stuff Events	Tx Stuff Events
1	0	0	0	0	0	0	0	0
2	702	701	0	0	0	0	343	1576

The fields displayed by the ilklis command are described below.

Valid Intervals. The number of valid 15-minute intervals of for which valid data was collected. The number of intervals will be 96 unless the IMA interface was brought on-line within the last 24-hours.

Elapsed Time. The number of seconds that have elapsed since the beginning of the current measurement period.

Intv#. The interval number for this instance, which can be from 1 to 96. A **1** in this field indicates the most recently completed 15-minute interval and a **96** indicates the least recently completed 15-minute interval (assuming that all 96 intervals are valid).

IMA Violations. The total number of ICP cells with errors, invalid ICP cells, and missing ICP cells that occurred during non-Severely Errored Second (SES) IMA conditions. IMA violations in SES-IMA conditions are not included in this count.

An SES-IMA condition is a second during which severely-errored seconds (SES) are occurring. An SES is second in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exist (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation).

OIF Anomalies. The total number of Out of IMA Frame (OIF) anomalies that have occurred during normal traffic conditions (i.e., non-SES-IMA) at the near end of the link. OIF anomalies in SES-IMA conditions are not included in this count. (See the **IMA Violations** field description on the previous page for more information on SES-IMA conditions.)

An OIF anomaly occurs when the IMA frame synchronization mechanism exists in the IMA SYNC state (i.e., the IMA working state). When OIF anomalies persist for at least two (2) IMA frames, the Loss of IMA Frame (LIF) defect state is entered.

SES Near-end. Near-end severely-errored seconds.The number of one-second intervals in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists (e.g., loss of signal, out of frame/loss of frame, or loss of cell delineation) during non-Unavailable Seconds (UAS)-IMA conditions.

The UAS-IMA condition begins at the onset of ten (10) contiguous severely-errored seconds (SES) and ends at the onset of ten (10) contiguous seconds with no SES.

SES Far-end. Far-end severely-errored seconds. The number of one-second intervals containing one or more Remote Defect Indicator (RDI) IMA defects (which includes IMA link-specific defects).

UAS Near-end. Near-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the near end of the link.

An SES is a second in which 30% or more of the IMA Control Protocol (ICP) cells contain IMA violations or one or more link defect states exists. (See the **IMA Violations** field description on the previous page for more information on SES-IMA conditions.)

UAS Far-end. Far-end unavailable seconds. The number of unavailable seconds, which begins at the onset of 10 contiguous Severely Errored Second (SES) IMA conditions and ends at the onset of 10 contiguous non-Severely Errored Second (SES) IMA conditions, at the far end (FE) of the link.

An SES-IMA-FE condition is a second one or more Remote Defect Indicator (RDI)-IMA defects. The RDI indicates remote defects (which includes IMA link-specific defects).

Rx UUS Near-end. Near-end receive unusable seconds. The number of unusable seconds at the near-end receiving Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Rx UUS Far-end. Far-end receive unusable seconds. The number of unusable seconds at the near end receiving Link State Machine (LSM).

Tx UUS Near-end. Near-end transmit unusable seconds. The number of unusable seconds detected at the near-end transmitting Link State Machine (LSM). The unusable state indicates that the link is configured within an IMA group but is not in use due to a fault, incorrect connectivity revealed by the test pattern procedure, or administrative inhibition for application-dependent or implementation-reasons, etc. (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Tx UUS Far-end. Far-end transmit unusable seconds. The number of unusable seconds at the far-end transmitting Link State Machine (LSM). (See *IMA Link State Machine (LSM)* on page 28-11 for more information on the LSM.)

Rx Fails Near-end . The number of times a near-end receive failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Rx Fails Far-end. The number of times a far-end receive failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Tx Fails Near-end. The number of times a near-end transmit failure alarm condition has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Tx Fails Far-end. The number of times a far-end transmit failure alarm condition (e.g., link defect, loss of an IMA frame, loss LODS) has occurred on this link. A failure alarm occurs when a required function cannot be performed and the defect persists for a set amount of time.

Rx Stuff Events. The number of stuff events (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) inserted in the receive direction.

Tx Stuff Events. The number of stuff (i.e., repetition of ICP cells over one IMA link to compensate for timing differences with other links within the IMA group) events inserted in the transmit direction.

Clearing IMA Group Statistics

You clear IMA group statistics with the **igpcls** command. The syntax for this command is as follows:

igpcls <IMA group id> [all]

To clear the group's statistics but not its links, enter **igpcls** followed by the IMA Group number. For example, to clear the statistics for IMA Group 0 but not its links, enter

igpcls 0

at the system prompt. If the statistics were successfully cleared, then he following will be displayed.

Statistics of group 0 have been cleared.

The **all** option will clear the statistics of an IMA group and all of its links. For example, to clear the statistics for IMA Group 0 and the statistics for all of its links, enter

igpcls 0 all

at the system prompt. If the statistics were successfully cleared, then a screen similar to the following will be displayed.

Statistics of group 0 have been cleared.
Statistics of link 2/1 have been cleared.
Statistics of link 2/2 have been cleared.
Statistics of link 2/3 have been cleared.
Statistics of link 2/4 have been cleared.

Clearing IMA Link Statistics

You clear the accumulated statistics for an IMA link with the **ilkcls** command. The syntax for this command is as follows:

ilkcls 2/<port>

Enter **ilkcls** followed by **2** and the port number of the link. For example, to clear all the statistics of the IMA link on IMA Port 1, enter

ilkcls 2/1

at the system prompt. If the statistics were successfully cleared, the following will be displayed.

Statistics of port 2/1 have been cleared.

Troubleshooting IMA Networks

Refer to the steps below for general guidelines on troubleshooting problems in IMA networks. In general, always look to simple problems first (e.g., T1 or E1 connection problems).

1. Check the IMA group's link status with the **igps** command using the group ID with the **all** option to find the link(s) with non-operational status (see *Displaying the Detailed Status of a Single IMA Group with Link Status* on page 28-38).

2. Check specific links with the **ilks** command (see *Displaying the Summary Status of IMA Links* on page 28-41) and/or the **ilksts** command (see *Displaying Detailed Statistics for IMA Links* on page 28-54) to determine link status and/or statistics. If you discover a problem with one of the links, proceed to Step 4.

   If you do not find any problems with IMA links, use the **igps** command with the group ID to check the configuration of the IMA group(s) and use the **igpm** command to correct any problems.

3. Check the T1/E1 port status and/or statistics with the status/statistics commands in the **te** submenu (e.g., the **tes**, **telts**, and **terts** commands). (See Chapter 29, "Managing T1 and E1 Ports," for more information on the **te** submenu.) Correct any problems with physical connections and use the **igpm** and/or **temod** commands to correct any software problems.

If you still cannot determine the nature of the problem(s), you can try restarting the IMA group(s) with the **igprst** command, which is described in *Restarting an IMA Group* on page 28-30. However, restarting an IMA group may cause loss of data and might not solve the problems. If you have determined that there are absolutely no physical or configuration problems, contact Alcatel technical support for assistance.