

Inverse Multiplexing over ATM on Cisco 7X00 Routers and ATM Switches

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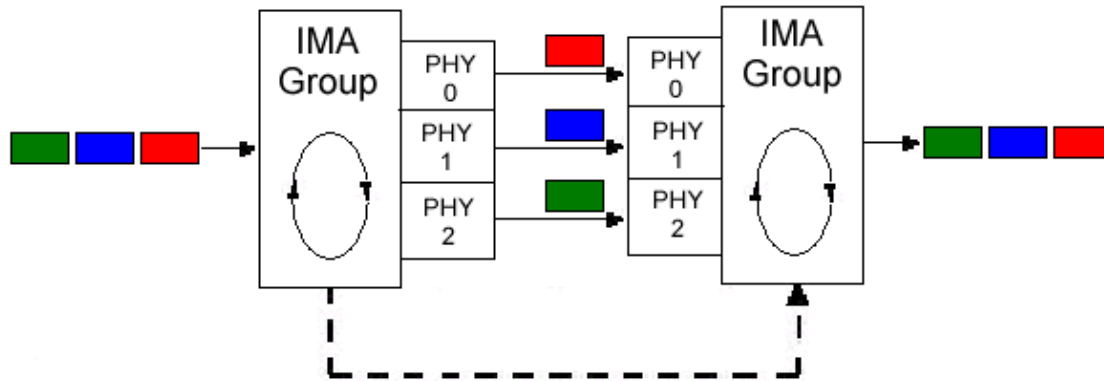
Introduction

Inverse Multiplexing over ATM (IMA) involves inverse multiplexing and de-multiplexing of ATM cells in a cyclical fashion among physical links grouped to form a higher-bandwidth and logical link. The rate of the logical link is approximately the sum of the rate of the physical links in the IMA group. Streams of cells are distributed in a round-robin manner across the multiple T1/E1 links and reassembled at the destination to form the original cell stream. Sequencing is provided using IMA Control Protocol (ICP) cells.

In the transmit direction, the ATM cell stream received from the ATM layer is distributed on a cell by cell basis across the multiple links within the IMA group. At the far-end, the receiving IMA unit reassembles the cells from each link on a cell-by-cell basis and recreates the original ATM cell stream. The image below displays how cell streams are transmitted across multiple interfaces and recombined to form the original cell stream. The receiving interface discards the ICP cells, and the aggregate cell stream is then passed to the ATM layer.

Periodically, the transmit IMA sends special cells that permit reconstruction of the ATM cell stream at the receiving IMA. These ICP cells provide the definition of an IMA frame.

Cell streams are transmitted across multiple interfaces and recombined to form the original stream.



Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

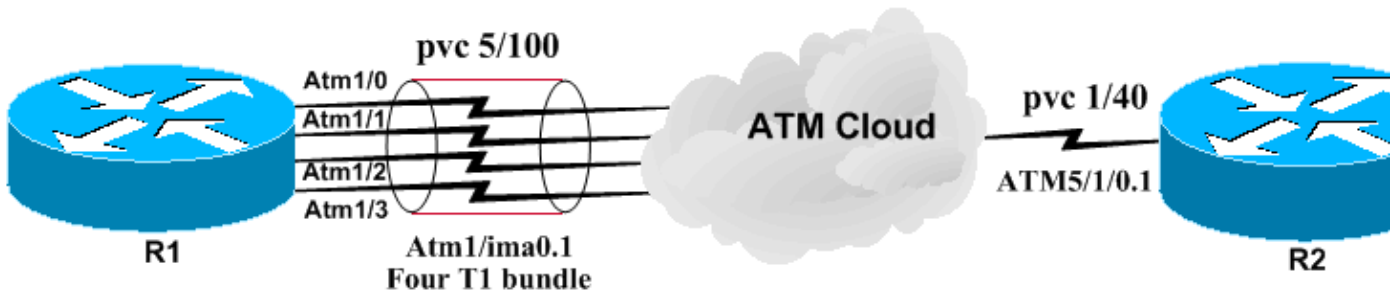
The information in this document is based on these software and hardware versions:

- For Cisco 7200 series routers, the eight-port T1/E1 IMA port adapters are supported since Cisco IOS® Software version 12.0(5)XE, 12.0(7)XE, 12.1(1)E, and 12.1(5)T.
- For Cisco 7500 series routers, the eight-port T1/E1 IMA port adapters are supported on the following VIPs:
 - ◆ VIP2-40 – since Cisco IOS version 12.0(5)XE, 12.0(7)XE, 12.1(1)E.
 - ◆ VIP2-50 – since Cisco IOS version 12.0(5)XE, 12.0(7)XE, 12.1(1)E and 12.1(5)T.
 - ◆ VIP4-80 – since Cisco IOS 12.2(1)T, 12.2(1), 12.0(16)S, and 12.1(7)E.
- For Cisco LightStream 1010 and Catalyst 8510 ATM switch routers, the eight-port T1/E1 IMA modules are supported since Cisco IOS version 12.0(4a)W5(11a) and require an ATM switch processor with a per-flow queuing feature card (FC-PFQ).
- For Cisco Catalyst 8540 ATM switch routers, the eight-port T1/E1 IMA modules are supported since Cisco IOS version 12.0(7)W5(15c).

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Network Diagram

This document uses this network setup:



Conventions

For more information on document conventions, refer to Cisco Technical Tips Conventions.

ICP (IMA Control Protocol) Cells

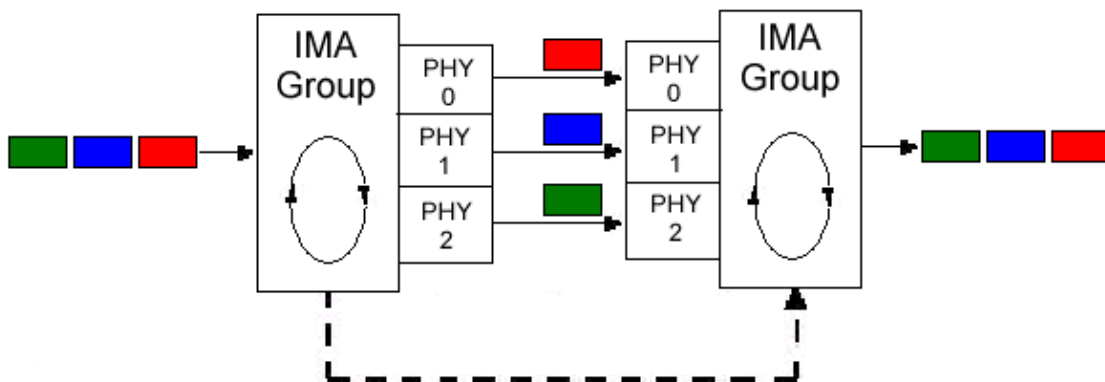
ICP cells are transmitted between IMA interfaces. These cells are used for decoupling and restructuring of ATM cell streams. The transmitting IMA aligns the sending of IMA frames on all links. This allows the receiver to adjust for any delays that may be experienced across the links. In the image above (it has been simplified for this example), the transmission is from left to right. However, this data and the ICP cells are sent in both directions. The receiver can therefore detect delay by measuring the arrival times of the IMA frames on each physical port. By default, each frame consists of 128 cells. As a result, one of every 128 cells is an IMA cell. Frame length is viewed with the **show ima interface** command.

Note: ICP cells are discarded by the receiving interface. Therefore, counter information does not display ICP cells. Please refer to ATM Control Cells Illustrated for a more detailed explanation ATM control cells.

IMA Filler Cells

An IMA device always sends a continuous stream. If no ATM layer cells are being sent, then an IMA filler cell is transmitted to provide a constant stream at the physical layer. Inserted filler cells allow for rate decoupling at the IMA sublayer.

Note: Filler cells are discarded by the receiver. Therefore, counter information does not display filler cells. Please refer to ATM Control Cells Illustrated for a more detailed explanation on ATM control cells.



Configuration

This document uses these configurations:

- c7200-IMA
- LightStream 1010-2
- Router-B

Follow these steps to configure the router labeled c7200-IMA:

1. Group the T1/E1 interfaces that you need. Note that the interface must be on the same port adapter.
2. Define any physical level parameters (if required). Scrambling would be one example.
3. Create an IMA interface and configure it with virtual circuits (VCs) just like you configure a standard, non-IMA ATM interface.

The IMA interface has the following syntax: **interface atm x/ima**y where *x* is the slot number and *y* is the IMA-group number.

In the configuration below, only PVCs are configured.

c7200-IMA
<pre> hostname c7200-IMA ! interface ATM1/0 no ip address no ip directed-broadcast ima-group 0 ! interface ATM1/ima0 no ip address no ip directed-broadcast no atm ilmi-keepalive ! interface ATM1/ima0.1 point-to-point ip address 100.100.100.1 255.255.255.0 no ip directed-broadcast pvc 5/100 encapsulation aal5snap ubr 600 ! interface ATM1/1 no ip address no ip directed-broadcast ima-group 0 ! interface ATM1/2 no ip address no ip directed-broadcast ima-group 0 ! interface ATM1/3 no ip address no ip directed-broadcast ima-group 0 </pre>

LightStream 1010-2
<pre> hostname ls1010-2 ! interface ATM0/0/0 no ip directed-broadcast lbo short 133 ima-group 0 ! interface ATM0/0/1 </pre>

```

no ip address
no ip directed-broadcast
clock source free-running
lbo short 133
ima-group 0
!
interface ATM0/0/2
no ip address
no ip directed-broadcast
lbo short 133
ima-group 0
!
interface ATM0/0/3
no ip address
no ip directed-broadcast
lbo short 133
ima-group 0
!
interface ATM0/0/ima0
no ip address
no ip directed-broadcast
no ip route-cache cef
no atm ilmi-keepalive
atm pvc 5 100 interface ATM0/1/0 1 40

```

Router-B

```

hostname Router-B
!
interface ATM5/1/0
no ip address
no ip route-cache distributed
atm pvc 1 0 16 ilmi
no atm ilmi-keepalive
!
interface ATM5/1/0.1 point-to-point
ip address 100.100.100.2 255.255.255.0
pvc 1/40
ubr 600
encapsulation aal5snap

```

These are additional considerations regarding this configuration:

- Traffic shaping parameters can vary based on your environment. Please refer to Understanding Router Support for ATM Real-Time Service Categories.
- Scrambling may or may not be required at the interface level depending on carrier configurations. Please refer to When Should Scrambling Be Enabled on ATM Virtual Circuits for more information.

Verify

This section provides information you can use to confirm your configuration is working properly.

Certain **show** commands are supported by the Output Interpreter Tool (registered customers only) , which allows you to view an analysis of **show** command output.

Use these commands to test whether your network is operating properly:

- **show atm vc**
- **show interface atm 1/ima0**
- **show ima interface atm1/ima0**

- **show ima interface atm1/ima0 detail**
- **show controller atm 1/0**
- **ping**

The output shown below is a result of entering these commands on the devices shown in the network diagram above. This output shows that the network is operating properly. Use the **show atm vc** command to display the PVCs and traffic information. As can be seen below, the PVC 1/500 is UP and using UBR with a Peak Cell Rate (PCR) of 600 kbps.

```
c7200-IMA# show atm vc
```

Interface	Name	VCD	VPI	VCI	Type	Encaps	SC	Peak Kbps	Avg/Min Kbps	Burst Cells	Status
1/ima0.1	1	5	100	PVC	SNAP	UBR	600				UP

Use the **show interface atm 1/ima 0** command to look for input/output errors. A large number of input/output errors means that the line is not clean.

```
c7200-IMA# show interface atm 1/ima0
ATM1/ima0 is up, line protocol is up

Hardware is IMA PA
MTU 4470 bytes, sub MTU 4470, BW 1523 Kbit, DLY 20000 usec,
  reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ATM, loopback not set
Keepalive not supported
Encapsulation(s): AAL5
2048 maximum active VCs, 1 current VCCs
VC idle disconnect time: 300 seconds
3 carrier transitions
Last input 00:01:24, output 00:01:24, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0 (size/max/drops); Total output drops: 0
Queueing strategy: Per VC Queueing
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  464 packets input, 17320 bytes, 0 no buffer
  Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  474 packets output, 17176 bytes, 0 underruns
  0 output errors, 0 collisions, 0 interface resets
  0 output buffer failures, 0 output buffers swapped out
```

Issue the **show ima interface** command to look for IMA failures. The output below shows that there are no failures, and that NearEnd and FarEnd are operational.

```
c7200-IMA# show ima interface atm1/ima0
ATM1/ima0 is up
  ImaGroupState:      NearEnd = operational, FarEnd = operational
  ImaGroupFailureStatus = noFailure
IMA Group Current Configuration:
  ImaGroupMinNumTxLinks = 1          ImaGroupMinNumRxLinks = 1
  ImaGroupDiffDelayMax = 250        ImaGroupNeTxClkMode = common(ctc)
  ImaGroupFrameLength = 128         ImaTestProcStatus = disabled
  ImaGroupTestLink = 0              ImaGroupTestPattern = 0xFF
IMA Link Information:
  Link                Link Status          Test Status
  -----
ATM1/0                up                    disabled
ATM1/1                up                    disabled
ATM1/2                up                    disabled
ATM1/3                up                    disabled
```

c7200-IMA# show ima interface atml/ima0 detail

ATM1/ima0 is up

ImaGroupState: NearEnd = operational, FarEnd = operational
ImaGroupFailureStatus = noFailure

IMA Group Current Configuration:

ImaGroupMinNumTxLinks = 1 ImaGroupMinNumRxLinks = 1
ImaGroupDiffDelayMax = 250 ImaGroupNeTxClkMode = common(ctc)
ImaGroupFrameLength = 128 ImaTestProcStatus = disabled
ImaGroupTestLink = 0 ImaGroupTestPattern = 0xFF

IMA MIB Information:

ImaGroupSymmetry = symmetricOperation
ImaGroupFeTxClkMode = common(ctc)
ImaGroupRxFrameLength = 128
ImaGroupTxTimingRefLink = 0 ImaGroupRxTimingRefLink = 1
ImaGroupTxImaId = 0 ImaGroupRxImaId = 0
ImaGroupNumTxCfgLinks = 4 ImaGroupNumRxCfgLinks = 4
ImaGroupNumTxActLinks = 4 ImaGroupNumRxActLinks = 4
ImaGroupLeastDelayLink = 3 ImaGroupDiffDelayMaxObs = 0

IMA group counters:

ImaGroupNeNumFailures = 3 ImaGroupFeNumFailures = 3
ImaGroupUnAvailSecs = 2 ImaGroupRunningSecs = 427185

IMA Detailed Link Information:

ATM1/0 is up

ImaLinkRowStatus = active
ImaLinkIfIndex = 1 ImaLinkGroupIndex = 51

ImaLinkState:

NeTx = active
NeRx = active
FeTx = active
FeRx = active

ImaLinkFailureStatus:

NeRx = noFailure
FeRx = noFailure

ImaLinkTxLid = 0 ImaLinkRxLid = 0
ImaLinkRxTestPattern = 65 ImaLinkTestProcStatus = disabled
ImaLinkRelDelay = 0

IMA Link counters :

ImaLinkImaViolations = 1
ImaLinkNeSevErroredSec = 32 ImaLinkFeSevErroredSec = 8
ImaLinkNeUnavailSec = 543 ImaLinkFeUnavailSec = 0
ImaLinkNeTxUnusableSec = 2 ImaLinkNeRxUnusableSec = 572
ImaLinkFeTxUnusableSec = 78 ImaLinkFeRxUnusableSec = 78
ImaLinkNeTxNumFailures = 0 ImaLinkNeRxNumFailures = 9
ImaLinkFeTxNumFailures = 4 ImaLinkFeRxNumFailures = 4

ATM1/1 is up

ImaLinkRowStatus = active
ImaLinkIfIndex = 2 ImaLinkGroupIndex = 51

ImaLinkState:

NeTx = active
NeRx = active
FeTx = active
FeRx = active

ImaLinkFailureStatus:

NeRx = noFailure
FeRx = noFailure

ImaLinkTxLid = 1 ImaLinkRxLid = 1
ImaLinkRxTestPattern = 65 ImaLinkTestProcStatus = disabled
ImaLinkRelDelay = 0

IMA Link counters :

ImaLinkImaViolations = 1
ImaLinkNeSevErroredSec = 1 ImaLinkFeSevErroredSec = 0
ImaLinkNeUnavailSec = 0 ImaLinkFeUnavailSec = 0
ImaLinkNeTxUnusableSec = 2 ImaLinkNeRxUnusableSec = 2
ImaLinkFeTxUnusableSec = 0 ImaLinkFeRxUnusableSec = 0

```
ImaLinkNeTxNumFailures = 0          ImaLinkNeRxNumFailures = 0
ImaLinkFeTxNumFailures = 0          ImaLinkFeRxNumFailures = 0
```

ATM1/2 is up

```
ImaLinkRowStatus = active
ImaLinkIfIndex   = 3          ImaLinkGroupIndex   = 51
ImaLinkState:
    NeTx = active
    NeRx = active
    FeTx = active
    FeRx = active
ImaLinkFailureStatus:
    NeRx = noFailure
    FeRx = noFailure
ImaLinkTxLid     = 2          ImaLinkRxLid       = 2
ImaLinkRxTestPattern = 65    ImaLinkTestProcStatus = disabled
ImaLinkRelDelay  = 0
IMA Link counters :
ImaLinkImaViolations = 1
ImaLinkNeSevErroredSec = 1    ImaLinkFeSevErroredSec = 0
ImaLinkNeUnavailSec = 0      ImaLinkFeUnAvailSec = 0
ImaLinkNeTxUnusableSec = 2    ImaLinkNeRxUnUsableSec = 2
ImaLinkFeTxUnusableSec = 0    ImaLinkFeRxUnusableSec = 0
ImaLinkNeTxNumFailures = 0    ImaLinkNeRxNumFailures = 0
ImaLinkFeTxNumFailures = 0    ImaLinkFeRxNumFailures = 0
```

ATM1/3 is up

```
ImaLinkRowStatus = active
ImaLinkIfIndex   = 4          ImaLinkGroupIndex   = 51
ImaLinkState:
    NeTx = active
    NeRx = active
    FeTx = active
    FeRx = active
ImaLinkFailureStatus:
    NeRx = noFailure
    FeRx = noFailure
ImaLinkTxLid     = 3          ImaLinkRxLid       = 3
ImaLinkRxTestPattern = 65    ImaLinkTestProcStatus = disabled
ImaLinkRelDelay  = 0
IMA Link counters :
ImaLinkImaViolations = 1
ImaLinkNeSevErroredSec = 1    ImaLinkFeSevErroredSec = 0
ImaLinkNeUnavailSec = 0      ImaLinkFeUnAvailSec = 0
ImaLinkNeTxUnusableSec = 2    ImaLinkNeRxUnUsableSec = 2
ImaLinkFeTxUnusableSec = 0    ImaLinkFeRxUnusableSec = 0
ImaLinkNeTxNumFailures = 0    ImaLinkNeRxNumFailures = 0
ImaLinkFeTxNumFailures = 0    ImaLinkFeRxNumFailures = 0
```

Note: It is a good idea to check the controller to verify that it is up and that there are no alarms reported.

```
c7200-IMA# show controller atm 1/0
```

Interface ATM1/0 is up

```
Hardware is IMA PA - DS1 (1Mbps)
Framer is PMC PM7344, SAR is LSI ATMIZER II
Firmware rev: G114, ATMIZER II rev: 3
  idb=0x621903D8, ds=0x62198DE0, vc=0x621BA340, pa=0x62185EC0
  slot 1, unit 1, subunit 0, fci_type 0x00BA, ticks 414377
  400 rx buffers: size=512, encap=64, trailer=28, magic=4
Curr Stats:
  rx_cell_lost=0, rx_no_buffer=0, rx_crc_10=0
  rx_cell_len=0, rx_no_vcd=827022, rx_cell_throttle=0, tx_aci_err=0
Rx Free Ring status:
  base=0x3CFF0040, size=1024, write=432
Rx Compl Ring status:
  base=0x7B095700, size=2048, read=464
```



```

Tx Ring status:
  base=0x3CFE8040, size=8192, write=476
Tx Compl Ring status:
  base=0x4B099740, size=4096, read=238
BFD Cache status:
  base=0x621B52C0, size=5120, read=5119
Rx Cache status:
  base=0x621A0D00, size=16, write=0
Tx Shadow status:
  base=0x621A1140, size=8192, read=463, write=476
Control data:
  rx_max_spins=2, max_tx_count=17, tx_count=13
  rx_threshold=267, rx_count=0, tx_threshold=3840
  tx bfd write indx=0x10DF, rx_pool_info=0x621A0DA0
Control data base address:
  rx_buf_base = 0x4B059E60          rx_p_base = 0x62199300
  rx_pak      = 0x621A0A14          cmd = 0x621990A0
  device_base = 0x3C800000        ima_pa_stats = 0x4B09D860
s dram_base = 0x3CE00000          pa_cmd_buf = 0x3CFFFC00
  vcd_base[0] = 0x3CE3C400        vcd_base[1] = 0x3CE1C000
  chip_dump   = 0x4B09E63C        dpram_base = 0x3CD80000
  sar_buf_base[0] = 0x3CE54000    sar_buf_base[1] = 0x3CF2A000
  bfd_base[0] = 0x3CFD4000        bfd_base[1] = 0x3CFC0000
  acd_base[0] = 0x3CE8CE00        acd_base[1] = 0x3CE5C800
  pci_atm_stats = 0x4B09D780
fdl is DISABLED
Scrambling is Disabled
Yellow alarm is Enabled in Rx and Enabled in Tx
linecode is B8ZS
T1 Framing Mode:  ESF ADM format
LBO (Cablelength) is long gain36 0db
Facility Alarms:
  No Alarm

```

To test connectivity, we ping from one end of the 7200 router to the other end (router B) and ensure that the pings are successful. Failure in the pings indicates that the IMA ports or IP addressing may be configured wrong.

```

c7200-IMA# ping 100.100.100.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 100.100.100.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/6/8 ms

```

Troubleshoot

There is currently no specific troubleshooting information available for this configuration.

Related Information

- [Inverse Multiplexing for ATM \(IMA\) Frequently Asked Questions](#)
- [Inverse Multiplexing for ATM \(IMA\) Technical Support](#)
- [Multiport T1/E1 ATM Port Adapters with Inverse Multiplexing over ATM](#)
- [Technical Support & Documentation – Cisco Systems](#)

