Using ATM Base Pak

Version 2.1

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July 2000

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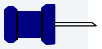
Chapter 1: Overview

The ATM Base Pak provides ATM connectivity for small embedded devices that communicate over an ATM network.

This chapter provides a brief introduction to ATM networking and an overview of the Microware ATM Base Pak. It includes the following sections:

- **Introduction to ATM**
- **ATM Base Pak Overview**



Note

The **Introduction to ATM** section provides a brief overview of ATM technology. The following resources provide a comprehensive review of ATM:

- McDysan, D., and Sphon, D. ***ATM—Theory and Application***. McGraw Hill. 1995.
- Minoli, D., and Vitella, D. ***ATM and Cell Relay Service for Corporate Environments***. McGraw Hill. 1994.
- de Prycker, M. ***Asynchronous Transfer Mode—A Solution for Broadband ISDN, 2nd Edition***. Ellis Horwood. 1993.

Introduction to ATM

Asynchronous Transfer Mode (ATM) is a connection-oriented transfer mode in which transmitted data is segmented into fixed size cells. The cells are reassembled at the destination to recreate the original traffic. It is asynchronous in the sense that the occurrence of cells belonging to an individual user (connection) is not necessarily periodic. ATM was designed to maximize network utilization and at the same time minimize time-delay variation. It accommodates a complete range of user traffic such as bulk data (variable or available bit rate), voice (variable bit rate traffic with real time characteristics), and video (constant bit rate), all multiplexed over one physical medium. ATM was especially designed for optical fiber and takes advantage of its extremely low error rate.

ATM is defined by the ATM Forum and the International Telecommunications Union - Telecommunications Standards Sector (ITU-TSS).

Some of the features of ATM included the following:

- ATM implements the negotiation of the bandwidth and quality of service for a connection. These are characteristics that can be measured, guaranteed and sold. Connections may be established and released dynamically (using ATM signalling).
- Improved physical media utilization and throughput is achieved by transporting data in fixed size cells consisting of a 5 byte header and a 48 byte payload. No “size field” is needed in the header. A field in the header identifies the connection for reassembly of the cells into the original traffic format (for example IP PDUs). Cell sequence integrity is maintained on a connection—all cells are received in the order in which they were transmitted so no “sequence number” field is required in the header.

Various ATM Adaptation Layers (AAL) enhance the service provided by the ATM Layer to meet the requirements of a specific type of user traffic. The AAL has two sublayers, the Common Part Convergence Sublayer (CPCS) and the Segmentation And Reassembly (SAR) layer. The most common AAL is AAL type 5 (AAL-5) which can map a network PDU into an AAL-5 PDU, segment the PDU into cells for transmission at the connection negotiated rate, and reassemble the received cells back into the original

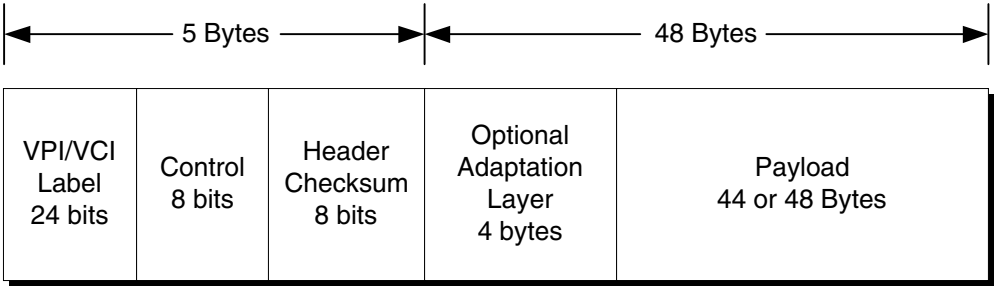
AAL-5 PDU. The only difference between an IP PDU and an AAL-5 PDU is some padding and an 8-byte trailer appended in the last cell. The trailer has a field for the length of the AAL-5 payload and a CRC. AAL-5 is used for Internet Protocol Over ATM (IPOA).

ATM is ideally suited for Local Area Networks (LAN) and Wide Area Networks (WAN). It can support connection-oriented, circuit-switched, real-time networks and bursty, connectionless networks. ATM is a widely accepted underlying technology used in Broadband Integrated Services Digital Network (B-ISDN) and Interactive Television (ITV).

ATM Cell

In ATM communication, data is segmented into small cells and transferred by the use of cell-switching. Each cell consists of a 5-byte header and 48 bytes of payload. The header identifies the connection to which the cell belongs and is used for demultiplexing and routing. Cell sequence integrity is maintained for the connection.

Figure 1-1 An ATM Cell



VPI/VCI Label consists of a Virtual Path Identifier (VPI) and a Virtual Channel Identifier (VCI) which specify connection points across an ATM network.

Control is used for buffer management, identifying payload type, and multiplexing.

Header Checksum is used to detect and correct errors in the header.

Payload is the data being transferred—voice, data, video.

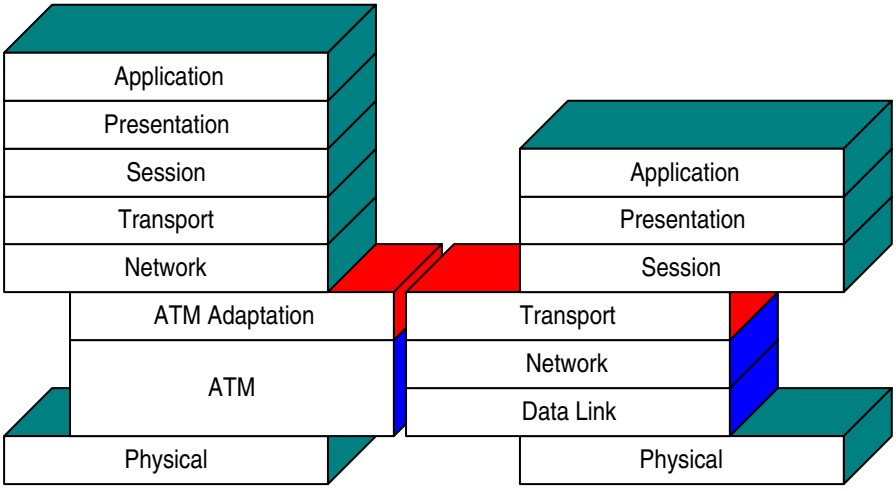
ATM Architecture

ATM is a layered architecture. The layers and sublayers, highest to lowest, include the following:

- The ATM Adaptation Layer (AAL): responsible for the adaptation of information of the higher layers into the ATM cells. This layer is further divided into the Common Part Convergence Sublayer (CPCS) and the Segmentation and Reassembly (SAR) sublayer. The CPCS maps the higher layer Protocol Data Units (PDU) onto an AAL specific Service Data Units (SDU). The SAR segments the SDUs into 48-byte payload cell payloads and then reassembles the cells at the destination.
- The ATM Layer: multiplexes (demultiplexes) the cells of different connections (identified by the VPI/VCI) onto (from) the single cell stream used by the TC sublayer. Before a cell is delivered to the AAL, its header can be extracted. After a cell is received from the AAL, its header is added.
- The Physical (PHY) layer: usually on a separate device and separated from the ATM sublayer by the Universal Test and Operations Interface for ATM (UTOPIA). It consists of the Transmission Convergence (TC) sublayer and the Physical Media Dependent (PMD) sublayer.
- The TC sublayer: transforms the flow of cells into a steady flow of bits and bytes for transmission over the physical medium. On transmit, the TC sublayer maps the cells to the frame format, generates the Header Error Check (HEC), sends idle cells when the ATM layer has no user traffic. On reception, the TC sublayer delineates individual cells in the received bit stream, and uses the HEC to detect and correct received errors.

- The PMD sublayer: supports purely medium dependent functions. This sublayer defines the parameters at the lowest level, such as speed of the bits on the media which may be electrical or optical.

Figure 1-2 ATM Protocol Architecture and the 7-Layer OSI Model



Classical IP over ATM

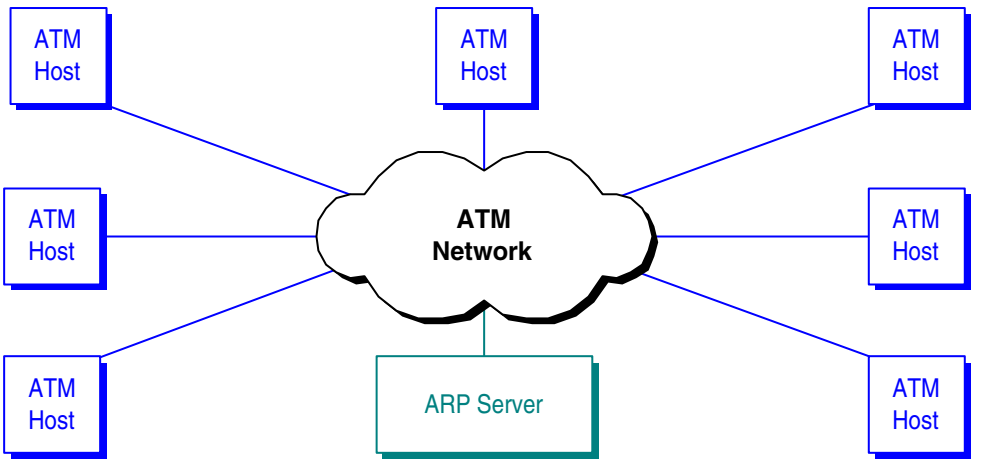
Classical Internet Protocol (IP) over ATM is defined in ***RFC 1577*** (***Request for Comments: 1577, Classical IP and ARP Over ATM***). ***RFC 1577*** defines the application of ATM as a direct replacement for the LAN-based paradigm. ***RFC 1577*** describes an ATM network configured as a Logical IP Subnet (LIS). Every machine on the subnet is assumed to have ATM connectivity. This model enables large packet lengths and is preferred when all IP end stations in the subnet support ATM.

For More Information

RFC 1577 is available from the USC Information Sciences Institute at http://www.isi.edu.

The ATM LIS consists of IP members, one of which acts as an Address Resolution Protocol (ARP) server. Each IP member has a unique ATM address and IP address. The ARP server maintains the mapping between the ATM address and the IP address for every member of the LIS. Figure 1-3 shows the ARP Server and ATM Host relationship.

Figure 1-3 ATM Logical IP Subnet (LIS)



ATM ARP

Every member of the LIS acts as a client of the ARP server. Each client registers its IP address and ATM address at initialization time with the ARP server. The ARP server stores these in its ARP table. The ARP server refreshes the ARP table periodically by issuing Inverse ATMARP (InATMARP) requests.

Each client has its own client ARP table. In ***RFC 1577***, the client ARP table is built by querying the ARP server as needed. The entries periodically time out and must be refreshed.

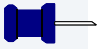
In this implementation, the client ARP table can be configured both statically and dynamically. Applications can manually add entries into the ARP table; manually added entries never time out.

This implementation also supports a network where there is no ARP server. In this case, the network must be either all Permanent Virtual Circuits (PVCs) or the ARP table must be filled manually.

Connecting to the ATM Network

Access to the ATM network is gained through a User Network Interface (UNI). ATM users send data to the network over a virtual circuit. The virtual circuit defines the logical networking path between two endpoints on the network. Virtual circuits are defined in software or in the memory of the networking devices.

Virtual circuits can be predefined and left in place—permanent virtual circuits; or set up and torn down on demand—switched virtual circuits.



Note

ATM signaling software is required to establish switched virtual circuits.

Setting up connections

The act of setting up the ATM connection—in the IP over ATM implementation—is transparent to the TCP/IP and UDP/IP modules. The ATM connection is managed by the Logical Link Control (LLC)/Sub-Network Attachment Point (SNAP) protocol driver. This driver interacts with the ATM signalling protocol stack. The connection can be either a PVC manually established between members, or a Switched Virtual Circuit (SVC), dynamically established using ATM signalling.

PVCs are used when:

- there are relatively few members on the network.
- the members are not likely to be removed from the network.
- signalling software is unavailable.

For a PVC, InATMARP is used to find out the IP address of the other endpoint of the connection.

SVC connections are dynamically negotiated, opened, and closed. Typically, if an SVC is not used for some time, it is closed to allow for efficient use of bandwidth.

Sending Data: The LLC/SNAP Protocol Driver

Data is encapsulated in LLC/SNAP packets. This is performed by prefixing IP packets with an LLC header identifying the packet as IP. This is followed by a SNAP header identifying the payload type (IP data, ARP, or InATMARP).

The sequence of sending LLC/SNAP packets is illustrated in **Figure 1-4** and outlined below.

Step 1. The LLC/SNAP driver registers with the ARP server if there is one.

Step 2. The LLC/SNAP driver receives a request from the TCP/IP or UDP/IP stack to transfer an IP datagram.

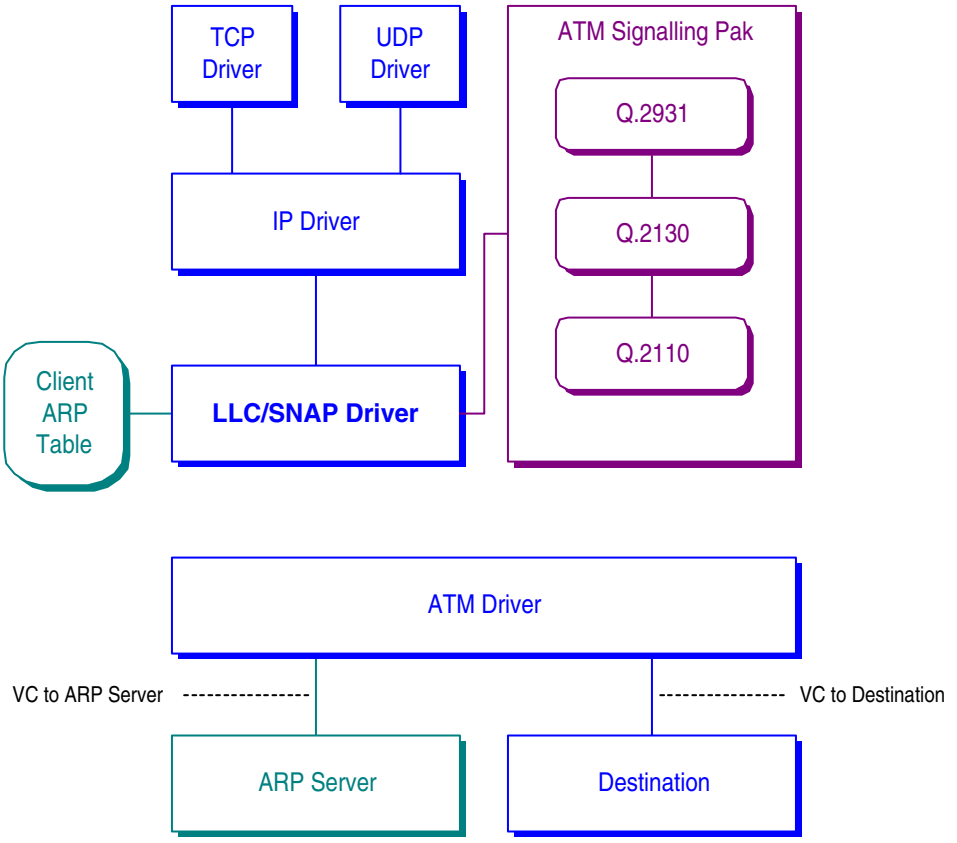
Step 3. The LLC/SNAP driver looks up the destination IP address in the Client ARP table lookup.

Step 4. The LLC/SNAP driver completes an ARP request if needed to find out the ATM address corresponding to that IP address.

Step 5. The LLC/SNAP driver interacts with the ATM signalling stack to establish an SVC to the destination. If there is a PVC or SVC connection already present, this step is omitted.

Step 6. The data is transferred over the SVC.

Figure 1-4 Sending LLC/SNAP Packets

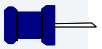


Note

If no data is transferred for a period of time, the SVC is torn down. A subsequent data transfer results in a new SVC being set up.

ATM Base Pak Overview

The ATM Base Pak enables networked embedded systems to connect to and communicate over ATM network topologies. It adds device-level ATM interface and IP over ATM support for SoftStax—the Microware communications and control environment for OS-9.



Note

ATM signalling protocol stacks are available in source and binary object form for UNI and NNI side-switched virtual circuit (SCV) operation in the Soft-ATM™ for OS-9 product.

The ATM Base Pak includes the following components:

- The LLC/SNAP protocol driver and descriptors to run IP over ATM networks (including source and binaries).
- Driver and descriptors for the NEC98401 ATM SAR processor (including source and binaries).
- Driver and descriptors for the MPC860SAR processor.
- Driver and descriptors for the MPC8260 processor.
- Header files and library (atm.l) used by applications to perform ATM-specific control functions.
- Utilities and test programs.

Utilities

The ATM Base Pak includes utilities and test programs, enabling users to transfer data between protocol stacks. Data can be transferred using UDP, TCP, or raw byte streams. The utilities provide throughput and diagnostic information for the data transferred.

The following utilities are included in the ATM Base Pak:

- addvc - Adds/deletes entries from the ATM ARP cache
- atmaddr - Gets/sets the machine's ATM address
- bm_rx/bm_tx - Tests data transfer on the ATM driver without upper layer protocols

Application Programming Interfaces (APIs)

Applications use Microware's standard Integrated Telecommunications Environment for Multimedia (ITEM) library in SoftStax for connectivity, control, and data transfer. This enables network independent applications written with ITEM to operate immediately over ATM networks.

An ATM library that adds functions specific to ATM communication and control is included as an extension to the ITEM library.

File Manager

The ATM Base Pak links into the SoftStax environment beneath the Stacked Protocol File Manager (SPF). The SoftStax tight network/OS integration enables the speed and efficiency crucial for maximizing throughput while minimizing footprint and CPU utilization over ATM networks.

Protocol Drivers

The ATM Base Pak includes a Logical Link Control/SubNetwork Attachment Point (LLC/SNAP) Protocol Driver which encapsulates IP packets by prefixing them with LLC and SNAP headers. The headers identify the packet protocol as IP and the packet payload type as IP data, ARP or InARP. TCP/IP and UDP/IP protocol drivers (available separately in the LAN Communications Pak) can simply be stacked on the LLC/SNAP module without any added coding (interworking) required.

If an ATM UNI signaling stack is installed, the LLC/SNAP protocol driver interacts directly with this stack to create SVC connections. This interaction is compliant with Request for Comment (RFC) 1755 (ATM Signalling Support for IP over ATM). The LLC/ SNAP driver isolates the signaling stack from applications and makes TCP/IP connectivity transparent to the applications. If no signaling software is required, the LLC/SNAP protocol supports Permanent Virtual Circuit (PVC) connectivity in compliance with RFC 1577.

Device Drivers

The ATM Base Pak contains source and binaries for ATM device drivers that provide ATM connectivity by controlling and managing the ATM Adaptation Layer and the ATM Layer within the network hardware interface. Entry points contained in the driver for sending and receiving packets use AAL-5 framing and can be easily modified for specific hardware and methods of sending and receiving packets over ATM.

Integrated Diagnostics

Drivers in the ATM Base Pak also are provided in debugging versions, enabling quick and easy analysis during application and protocol stack development. Debugging version drivers create debug data modules that can be analyzed for quick and easy problem resolution.

Chapter 2: LLC/SNAP Protocol Driver

This chapter provides information about the LLC/SNAP protocol driver and explains its functions and operations. It includes the following sections:

- **Introduction**
- **LLC/SNAP Driver Operation**
- **Making the Driver and Descriptor**
- **LLC/SNAP Driver Specific Setstats and Getstats**

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Introduction

The LLC/SNAP protocol driver (also referred to in this document as the `sp1577` driver) performs classical IP and ARP over ATM as defined in ***RFC 1577***. IP packets are encapsulated in LLC/SNAP packets and carried in the CPCS SDU payload field of AAL5.

Encapsulation

The LLC/SNAP encapsulation is performed by prefixing IP packets with an LLC header identifying the packet protocol as IP. This is followed by a SNAP header identifying the packet payload type (IP data, ARP, or InATMARP). The LLC/SNAP headers conform to the IEEE 802.2 specification. For IP address resolution to ATM hardware address and vice versa, ***RFC 1577*** specifies ATMARP and InATMARP respectively.

Functions

The LLC/SNAP driver provides the following basic functions:

- Handles LLC/SNAP headers in outgoing/incoming packets. When a packet arrives over a Virtual Circuit (VC), the driver strips the LLC/SNAP header and passes it up the stack to the IP protocol driver. When a packet is sent over the network, the driver encapsulates it in an LLC/SNAP header and passes it down to the ATM driver.
- Handles ATMARP/InATMARP to interpret the mapping between IP addresses and ATM addresses as per ***RFC 1577***. The protocol driver keeps an ATMARP cache. The driver can be configured to not perform ATMARP, depending on the flags set in the descriptor. In this case, the application must populate the ARP table. To manually add entries to the ARP cache in the application, use the call `_os_ss_vc_add()` in the

library `atm.l`.To manually delete entries from the ARP cache by the application, use the call `_os_ss_vc_delete()` in the library `atm.l`. Each entry in the ARP table may be a PVC or a SVC. You can also make the system act as an ATMARP server or client by configuring the descriptor.

- Interacts with the ATM signaling stack to set up/tear down VCs. The driver can also be configured not to interact with the signalling stack. In this case, when the application populates the ARP cache, it must pass in the Virtual Path Indicator/Virtual Channel Indicator (VPI/VCI) for a PVC or SVC that is already set up.

LLC/SNAP Driver Operation

The following sections describe how the LLC/SNAP driver operates.

ARP Table

The LLC/SNAP driver maintains an ARP table containing entries in the form:

```
<VPI/VCI, ATM address/sub-address, IP address>
```

The LLC/SNAP driver uses the destination IP address as a search key to find a matching entry when an IP packet is to be sent out. When the matching entry is not found, the possible actions are:

- If ARP is enabled, an ARP operation is performed to the ARP Server, an ARP reply is received, and the reply is entered into ARP cache.
- If ARP is not enabled, `ENETUNREACH` error is returned.

Once the ARP entry is found (which contains the ATM address for the destination machine), the LLC/SNAP driver checks if there is an existing VC to that machine. If not, it tries to open a VC to it via the ATM signalling stack. Once a VC is established, the packet is sent over the VC.

The LLC/SNAP driver can be configured in a number of ways. In a completely *RFC 1577*-compliant implementation, the ARP cache is populated using ATMARP and InATMARP, and the LLC/SNAP driver interacts directly with the ATM signalling stack to create VCs. The LLC/SNAP driver can also be configured to not perform ARP. Applications may also set up the VCs themselves by using PVCs or the ATM signalling stack directly. When an application sets up the VC, the application populates the LLC/SNAP driver's ARP cache using the `_os_ss_vc_add()` call in `atm.l`.

ARP table entries can also be specified in the descriptor. If the ARP entry is manually configured, it never times out. Other entries are set up using the ATMARP time out value specified in a timer (default 15 minutes).

Signalling Stack Interaction

The LLC/SNAP driver can be configured so when a VC needs to be set up, it interacts directly with the ATM signalling stack.

The LLC/SNAP driver uses the ITEM interface to make an outgoing call via the ATM signalling stack if a VC does not exist. The LLC/SNAP driver can also be set up to register with the signalling stack for incoming IP over ATM calls. When the call is received, the LLC/SNAP driver answers the call. In either case, when the call is completed, the LLC/SNAP driver extracts the VPI/VCI information from the ATM signalling stack. The LLC/SNAP driver then creates an in-band data path to the ATM driver and sets the VC on the path using the `SPF_SS_VC_SET` setstat.

For More Information

For more information about the setstat `SPF_SS_VC_SET`, refer to Chapter 7: Library Function Reference.

While the call is being made, any packets ready to be sent out over that VC are queued in LLC/SNAP. The maximum packet size queued is determined by the `PD_WRITESZ` field in the path options. If `PD_WRITESZ` is `0`, then the queue size in infinite.

VC Tear Down

A VC is torn down when one of the following occurs:

- An `_os_ss_vc_delete()` call is made. This deletes a `<IP,ATM address,VC>` mapping entry from the ARP cache and closes the associated VC. This is the opposite of the `_os_ss_vc_add()` call adding a `<IP,ATM address>` mapping to the ARP cache.
- All IP paths (sockets) are closed and the LLC/SNAP device is terminated. This closes all VCs.
- A Far End Hang-up is received for this connection.

- A configurable (default 20 minutes) idle timer expires.

Interaction with Upper Layers

When a protocol above is pushed and the LLC/SNAP driver is called with `SPF_SS_OPEN` or `SPF_SS_PUSH`, the driver performs a getstat call using the `spf_ss_pb` parameter block and code `SPF_GS_PROTID`. This getstat identifies to the driver which protocol is being pushed on top. The protocol ID should be such that the LLC/SNAP driver can map incoming packets to this protocol. If this happens incorrectly, the protocol above never receives data. Currently, the only upper protocol supported is IP.

For More Information

For more information about these getstats and setstats, refer to the ***SPF Porting Guide***.

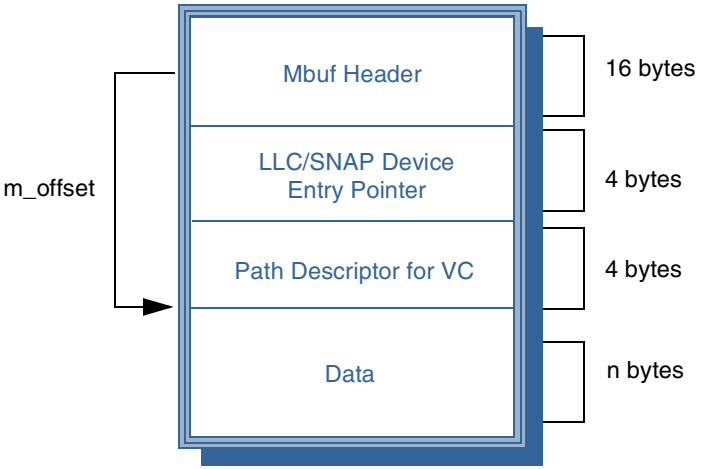
Interaction with the ATM Driver

For every VC, the LLC/SNAP driver creates a path to the ATM driver and pushes itself on top of it. This path is used for reading and writing data on the VC and is referred to as the in-band path. The LLC/SNAP driver also stores the device entry for the ATM driver and the path descriptor for each path.

When a packet is to be transmitted over a VC, the LLC/SNAP driver sets the current path descriptor (`lustat->lu_pathdesc`) in the ATM driver logical unit to be the in-band path descriptor for that VC entry. It then calls in to the ATM driver downdata entry point. The ATM driver has a mapping between the path descriptor and the VC in the per-path static storage, which it uses to find the VC for that path. It then sends the packet over that VC.

When an incoming packet is received, the ATM driver stores the packet in an mbuf (buffer encapsulating networking packets) packet chain with the mbuf `m_offset` field containing the offset from the start of the mbuf to the start of the data. Four bytes after the mbuf header, the ATM driver must store the LLC/SNAP driver device entry. Eight bytes after the mbuf header, the ATM driver must store the path descriptor of any path corresponding to that VC.

Figure 2-1 Incoming ATM Packet

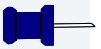


For More Information

Refer to the ***SPF Porting Guide*** for more information about mbufs.

Making the Driver and Descriptor

LLC/SNAP Driver



Note

The LLC/SNAP driver source is not shipped with the ATM Base Pak. The section below applies only if you have made special arrangements to purchase the LLC/SNAP driver source code.

The driver source is located in `$MWOS/SRC/DPIO/SPF/DRVR/SP1577`. The makefile `spfdbg.mak` makes the version of the driver that implements the run-time debug data module named `dbg_llcsnap`. To look at this debug module, you can perform a `dump -m <module name> 74`. The makefile `spfdrvr.mak` makes the non-debug version of the driver.

The driver object itself is in the directory:

```
$MWOS/<OS9 or OS9000>/<TRGT>/CMDS/BOOTOBJS/SPF/sp1577
```

where TRGT may be `68000`, `CPU32`, `68020`, or `PPC`

The the executable module for the debug version is:

```
$MWOS/<OS9 or OS9000>/<TRGT>/CMDS/BOOTOBJS/SPF/MON/sp1577
```

where TRGT may be `68000`, `CPU32`, `68020`, or `PPC`

To make the non-debug version of the driver, use `os9make` as follows:

```
os9make -f spfdrvr.mak
```

To make the debug version of the driver, use `os9make` as follows:

```
os9make -f spfdbg.mak
```

LLC/SNAP Descriptor

The LLC/SNAP descriptor is a data module that stores information the driver uses for initialization. To create new descriptors, edit the file `DEFS/spf_desc.h` located in:

```
$MWOS/SRC/DPIO/SPF/DRVR/SP1577
```

To make the descriptor, use the makefile `spfdesc.mak` in the same directory. This makes the descriptors, found in the following table, in the directory:

```
$MWOS/<OS9 or OS9000>/<TRGT>/CMDS/BOOTOBJS/SPF
```

where TRGT may be `68000`, `CPU32`, `68020`, or `PPC`

Table 2-1 Descriptors

Descriptor	Description
`llcsnap_hju`	For Soft-ATM™ signalling, UNI side, no ARP
`llcsnap_hjn`	For Soft-ATM™ signalling, switch emulation side (NNI), no ARP
`llcsnap`	Regular LLC/SNAP descriptor with no ARP.
`llcsnapa`	Regular LLC/SNAP descriptor with ARP client features.
`llcsnapn`	LLC/SNAP descriptor for the network side of the switch. This descriptor, when used, configures the signalling software to emulate the network side of an ATM switch.
`llcsnapns`	LLC/SNAP descriptor with no ATM signalling.
`llcsnaps`	Regular LLC/SNAP descriptor with ARP server features.

Configuring Your Descriptor

You can `#define` the following macros for your descriptor. If you do not want to define macros, `defs.h` has default values for most macros. If you decide to override these values, do so in the file `spf_desc.h`. To run the makefile, type `os9make -f spfdesc.mak`. To delete all the descriptor modules, type `os9make -f spfdesc.mak purge`.

Table 2-2 Macros

Macro	Description	Default
`DEBUG_NAME`	Debug data module name.	`dbg_llcsnap`
`NUM_INIT_VC`	Number of VCs defined in descriptor.	`0`
`INIT_VC_TABLE`	Table for VCs defined in the descriptor.	`{0}`
`HW_DESC_NAME`	Name of ATM HW descriptor in the stack below.	None
`DESC_NAME`	Name of descriptor.	None
`MAX_NUM_ARP`	Maximum number of entries in the ARP table.	`50`
`HTL`	ATM address type and length.	`0`
`STL`	ATM sub-address type and length.	`0`

Table 2-2 Macros (continued)

Macro	Description	Default
HA	ATM address.	{0}
SA	ATM sub-address.	{0}
DO_ARP_FLAG	Flag indicating ARP is to be done.	0 (ARP off by default)
ARP_SERVER_FLAG	Flag indicating the device is an ARP server.	0
ARP_WAIT_SZ	Max number of ARP requests pending.	10
ARP_RETRY	Max ARP retry count.	3
ARP_CLIENT_VALID	Number of seconds a client ARP entry is valid.	15*60
ARP_SRVR_VALID	Number of seconds a server ARP entry is valid.	60*60
ARP_TIMEOUT	Timeout in seconds.	60
INARP_START	If set (1), respond to InATMARPs without waiting for the setstat.	1
MIN_TIMER_ INTERVAL	Minimum timer period.	60

Table 2-2 Macros (continued)

Macro	Description	Default
INARP_TIMEOUT	InATMARP timeout period in seconds.	60
V_NO_ANSWER	If set, then no incoming IP calls accepted.	0
V_NO_SIG	If set, then signalling stack is not used.	0
V_NETWORK_SIDE	If set, signalling stack is configured as the network side.	0
V_PROT_STACK	Name of signalling protocol stack. Network side: User side:	 "/atm/hjn0" "/atm/hju0"
V_NO_BLOCK_ON_CONNECT	If set, then don't block while making connections.	0
V_VC_TIMEOUT	Number of seconds in which a SVC times out if there is no traffic.	20*60

LLC/SNAP Driver Specific Setstats and Getstats

The following setstats and getstats are specific to the LLC/SNAP driver:

Table 2-3 Setstats/Getstats

Call	Description	Library Call
ITE_PROFILE	Gets the IP call profile parameters	ite_path_profileget()
SPF_SS_ATMADDR	Gets/Sets ATM address	_os_gs_atmaddr() _os_ss_atmaddr()
SPF_SS_INARP_ON	Turns on InATMARP	_os_ss_inarp_on()
SPF_SS_VC_ADD	Adds ARP cache entries	_os_ss_vc_add()
SPF_SS_VC_DELETE	Deletes ARP cache entries	_os_ss_vc_delete()

For More Information

For more information about these library calls, refer to Chapter 7: Library Function Reference of this manual.

ITE_PROFILE

This getstat entry in the LLC/SNAP driver returns the IP call profile parameters kept in the logical unit static storage. The call profile is passed by LLC/SNAP to the ATM signalling software. It contains parameters such as AAL parameters, bearer capabilities, and QOS. The call profile can be changed by the application and passed back to the LLC/SNAP driver during the `_os_ss_vc_add()` call.

For More Information

Refer to `atm_pr.h` for details about the IP call profile parameters.

SPF_SS_ATMADDR

This getstat/setstat entry gets or sets the host ATM address.

SPF_SS_INARP_ON

This setstat entry turns on the driver's InATMARP capability. Typically, the system should only respond to InATMARPs after the IP address has been set.

SPF_SS_VC_ADD

This setstat entry adds a new VC to the ARP cache of VC entries.

SPF_SS_VC_DELETE

This setstat entry deletes a VC from the ARP cache of VC entries.

Chapter 3: Sample ATM Device Driver

This chapter describes the following sample ATM device driver included with the ATM Base Pak:

- **sp98401 Device Driver**

Information about the driver source code and how to configure the descriptors is also provided.

Note

The sp860sar device driver and the sp1577 protocol driver are shipped with this version of ATM Base Pak.

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sp98401 Device Driver

The spn98401 sample driver was written for the ZeitNet ZN1221 ATM Adapter for the PCI bus. The driver has been tested with the ZN1221 installed in PCI slot 2 (slots numbered 0-3) of a Motorola PowerStack™ Series E. The NEC SAR chip on the ZeitNet board is the µPD98401.

For More Information

For more information, refer to ***User's Manual µPD98401 Local ATM SAR Chip (NESCOT-S10)***, published by NEC.

The `spn98401` sample driver runs on OS-9, PowerPC systems.

Device Driver

Source files for the device driver are located in:

```
MWOS/SRC/DPIO/SPF/DRVR/SPN98401
```

Makefiles to compile and link the driver are:

```
MWOS/OS9000/PPC/PORTS/SPN98401/spfdrvr.mak
MWOS/OS9000/PPC/PORTS/SPN98401/spfdbg.mak
```

Makefile `spfdbg.mak` compiles the driver so a data module, `atm_dbg`, is created when the driver is initialized. All functions in the driver may be compiled to write debugging statements into this data module. The data module may be read using the `dump -m atm_dbg 80` command or from Rombug using:

- `Rombug: l atm_dbg`
- `Rombug: d .rr7+80`

Device Descriptors

Source files for the device descriptors are:

```
MWOS/OS9000/PPC/PORTS/SPN98401/DEFS/spf_desc.h
MWOS/SRC/DPIO/SPF/DRVR/SPN98401/defs.h
MWOS/SRC/DPIO/SPF/DRVR/SPN98401/*.h
```

The makefile for the device descriptors is:

```
MWOS/OS9000/PPC/PORTS/SPN98401/spfdesc.mak
```

The object module for the driver and a stub file for use with Rombug, both created with `spfdrvr.mak`, are located in:

```
MWOS/OS9000/PPC/PORTS/SPN98401/CMDS/BOOTOBJS
```

The object modules for the device descriptors are also in the above directory.

The object module for the driver and a stub file for use with Rombug, both created with `spfdbg.mak`, are located in:

```
MWOS/OS9000/PPC/PORTS/SPN98401/CMDS/BOOTOBJS/MON
```

Source Files

There are three categories of source files for `spn98401`:

1. C include files:

   ```
   defs.h
   n98401.h
   drstat.h
   history.h
   ```

2. C source files for functions called by the SPF file manager:

   ```
   dr_iniz.c
   dr_setstat.c
   dr_getstat.c
   dr_downdata.c
   dr_term.c
   main.c
   ```

3. C source files for interrupt service routines:

```
hw_isr.c
tx_indication.c
isr_rqa.c
rx_aal5.c
rx_raw.c
```

About the Source Files

defs.h

`defs.h` has the following attributes:

- Included by all device driver C source files and `spf_desc.h`.
- Includes all other required `*.h` files.
- Defines constants to determine how the C source is compiled.
- Defines macros used as constants for initializing the C data structures mapping to the structures defined for the SAR.
- Defines structures for logical unit static storage and per path static storage and VC related structures kept in driver static storage.
- Declares prototypes for all functions.

n98401.h

`n98401.h` has the following attributes:

- Defines all structures needed by the SAR.
- Defines descriptors for receive (Rx) and transmit (Tx) channels.

drstat.h

`drstat.h` has the following attributes:

- Defines structures for driver static storage.

- Defines constants for initializing driver static storage.

  Modify this file to change the shapers or receive free buffer pools.

dr_iniz.c

`dr_iniz.c` has the following functionality:

- Contains required SPF function `dr_iniz` called by the first iniz when no other device descriptors are attached to the driver.
- Optionally creates the debugging data module `atm_dbg`.
- Reads the PCI configuration space to enable interrupts.
- Installs `hw_isr`, the interrupt service routine.
- Allocates memory for the receive and transmit indication mailboxes.
- Initializes all the SAR registers, including the shapers registers.
- Pre-allocates an array of pointers to mbufs and a linked list of batches for each of the 32 receive free buffer pools in use.
- Calls function `isr_rqa` to initialize each receive free buffer pool descriptor being used.

dr_setstat.c

`dr_setstat.c` facilitates opening and closing paths and VPI/VCIs.

dr_getstat.c

`dr_getstat.c` returns statistics accumulated in receive and transmit channel descriptors.

dr_downdata.c

`dr_downdata.c` sends mbufs to the SAR for transmission.

dr_term.c

`dr_term.c` returns memory and mbufs allocated to the driver by `dr_iniz`.

hw_isr.c

`hw_isr.c` reads the SAR general status register for each interrupt and then invokes the interrupt specific service routine below.

tx_indication.c

`tx_indication.c` is called by `hw_isr` to handle a transmit indication interrupt.

isr_rqa.c

`isr_rqa.c` is called by:

- `dr_iniz` to initialize the receive free buffer pools with batches of free buffers (mbufs).
- `hw_isr` to add batches to the receive free buffer pools when batches have been consumed down to the alert level.

rx_aal5.c

`rx_aal5.c` is called by `hw_isr` to receive an AAL-5 SDU.

rx_raw.c

`rx_raw.c` is called by `hw_isr` to receive Operations and Management Flow 5 (OAMF5) cells.

Modifying the Device Driver

Modify the driver to change, delete, or add debugging text written to `atm_dbg`. For example, in `dr_iniz.c` you could modify the following code fragment—which writes the SAR general status register contents to `atm_dbg`—to write the interrupt mask register contents. You could then move the new code to anywhere in `dr_iniz.c`.

```
#if defined(DEBUG_INIZ)
    D_D("GSR_reg", *GSR_reg);
#endif
```

In makefile `spfdbg.mak`, use the macro definition:

```
DEFINE =-dDEBUG_ENABLE -dDEBUG_INIZ
```

The shaper and receive free buffer pool used by an application are determined by the device descriptor opened by the application. The device descriptors are defined in the file `spf_desc.h`.

To select a different receive free buffer pool for a device descriptor, change macros `LU_POOL` and `POOL_NO` in `spf_desc.h`, then recompile and relink the device descriptors using `spfdesc.mak`.

To select a different shaper, change the macro `SHAPER_NO`, then recompile and relink.

To modify the 16 traffic shapers defined by the SAR scheduler registers, modify the following macros found in `drstat.h`:

`SCH_REGS0_INIT`	Determines the average rate parameters I and M (I cells in M cell periods), for each VPI/VCI linked to a shaper.
`SCH_REGS3_INIT`	Determines the peak cell rate and the bucket size for each VPI/VCI linked to a shaper.

For More Information

For more information, refer to **Scheduling and Traffic Shapers** and **The Receive Free Buffer Pools** later in this chapter.

Modifying the Device Descriptors

Files for modifying the device descriptors are:

```
MWOS/OS9000/PPC/PORTS/SPN98401/spfdesc.mak
MWOS/OS9000/PPC/PORTS/SPN98401/DEFS/spf_desc.h
```

The following are the macros for each device descriptor in `spf_desc.h`. Default values are in file `defs.h`.

Macros for Transmit Packet Descriptor Word 0

`GFC`	Generic flow control field in cell header. Do not change.
`CPCS_UU`	Common part convergence sublayer user-to-user indication field of AAL-5 trailer. Do not change.
`CPI`	Common part indicator of AAL-5 trailer. Do not change.
`SHAPER_NO`	Selects one of shapers 0-15. Required.
`TX_QUE_SIZE`	Number of packet descriptors in the transmit circular queue. Required.
`PKT_DESC_0`	Initializes all of default packet descriptor word 0. Required.

Macros Initializing Device Descriptor Fields for Rx

`LU_POOL`	Receive free buffer pool number kept in logical unit static storage.
`POOL_NO`	Receive free buffer pool number for receive VC table word 0.
`RX_VC_WORD_0`	Initializes receive VC table word 0.
`RX_VC_WORD_1`	Initializes receive VC table word 1.

Macro for Rx and Tx

`CELL_TYPE`	AAL field of packet descriptor: 1 for AAL-5, 0 for all others.

Parameters for Configuring the spn98401 Device Driver

The parameters for configuring the device driver are listed below according to the file containing them. To change a variable you must change the file and then recompile and relink the driver or the device descriptors.

Parameters in spf_desc.h

File `spf_desc.h` defines the device descriptors. To modify or create a device descriptor, modify `spf_desc.h`, then recompile and relink using `spfdesc.mak`.

For More Information

For more information, refer to the section Modifying the Device Descriptors.

Modify the following macros:

`SHAPER_NO`	Select one of 16 traffic shapers controlling the transmission of cells.
`LU_POOL`	Select one of 32 receive free buffer pools for receiving AAL-5 SDUs.
`POOL_NO`	Select one of 32 receive free buffer pools for receiving AAL-5 SDUs.
`TX_QUE_SIZE`	Specify the size of the transmit circular queue of packet descriptors.

For More Information

See Scheduling and Traffic Shapers and The Receive Free Buffer Pools.

A code fragment of `spf_desc.h` is included below.

```
/************************************************
/atm: Tx/Rx device descriptor for NEC SAR chip n98401, ATM driver spn98401
************************************************/
#ifdef atm
#define TX_RX_CHAN0 1
#include <SPN98401/defs.h>

    /* Macros that initialize the device */
/* descriptor common fields */
#define LUN 0

/* Macros that initialize the device */
/* descriptor specific fields */
/* Macros for word 0 of Packet Descriptor (more */
/* in defs.h) */

#define GFC             0x00000000
#define CPCS_UU         0x00000000
#define CPI             0x00000000

#define SHAPER_NO       3
#define TX_QUE_SIZE     256
#define PKT_DESC_0\
        S_M_1|CLP_00|PTI_000|GFC|AAL5|MB_2|CPCS_UU|CPI

/* Macros that initialize device descriptor */
/* specific fields for receive */
#define LU_POOL         0x0A
#define POOL_NO         0x000A0000
#define RX_VC_WORD_0    MB_0|POOL_NO

/* Macro for both Rx and Tx */
#define CELL_TYPE       AAL5_MBUF

/* 0x555 cells * 48 bytes/cell = 65520 Bytes */
#define MAX_SEGMENTS    0x00000555

#define RX_VC_WORD_1    RX_AAL5|MAX_SEGMENTS
#endif /atm
/*****************************************/
```

Parameters in defs.h

The following macros are found in `defs.h`:

`RX_IND_CNT`	Specifies the number of receive indications in the circular mailbox structures for receive mailboxes 0 and 1. To prevent the mailbox from filling, `#define RX_IND_CNT 128` should be sufficient.
`TX_IND_CNT`	Specifies the number of transmit indications in the circular mailbox structures for transmit mailboxes 2 and 3. `#define TX_IND_CNT 256` should be sufficient.
`OAM_TX_QUE_SIZE`	One transmit circular queue is used for transmitting all OAMF5 cells. This macro specifies the size of this queue.
`OAM_TX_SHAPER`	This macro specifies the shaper used for transmitting the OAMF5 cells.
`UA_CELL_GEN`	Selects the shaper that may be designated the Unassigned Cell Generator, to send idle cells when no transmit traffic is available. This feature is not currently used but may be implemented by enabling code in file `dr_iniz.c`.

Batches and mbufs are pre-allocated for assignment to the queues of batches of free buffers. These queues are kept by each receive free buffer pool in control memory. For many driver applications, most receive free buffer pools are not used. For example, if the driver were to be used only to receive MPEG-2 data and to transmit and receive control data on a separate VC, then only two different receive free buffer pools would be needed. One receive free buffer pool would be sized for the needs of MPEG-2 PDUs and data rates, and the other would be sized for the specific protocol (TCP/IP or perhaps X.25). It would not be necessary to pre-allocate batches and mbufs for the other 30 pools and memory could be saved.

`POOLS_USED`	Selects the receive free buffer pools enabled.

Note

You must be careful that macros `LU_POOL` and `POOL_NO` in `spf_desc.h` only specify a pool enabled by `POOLS_USED` in `defs.h`.

Scheduling and Traffic Shapers

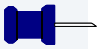
The SAR chip has 16 traffic shapers that determine a priority, average rate, and peak cell rate for each channel (transmit VC table) linked to the shaper.

The 16 shapers are defined by the contents of 80 shaper registers, 5 per shaper. The registers are initialized by `dr_iniz` when driver `spn98401` is initialized. These registers may not be changed dynamically (while the SAR is active).

The shapers are configured by modifying the following macros in `drstat.h`:

`SCH_REGS0_INIT`	I, M fields. The quotient I/M defines the average rate for the shaper.
`SCH_REGS3_INIT`	Peak cell rate, credit (bucket size) fields. Peak cell rate defines the minimum gap (in cell times) between any two consecutive transmissions from a channel linked to the shaper. Credit defines the maximum number of credits accumulated in a shaper's bucket (the maximum burst of cells at the peak cell rate).
`SCH_REGS4_INIT`	Priority, enable fields. Priority defines the priority level assigned to a shaper. It is a 4-bit field; 0x0 is the highest and 0xF is the lowest. Channels linked to a shaper are served only when channels linked to higher priority shapers are not waiting for service. The enable bit enables (set) or disables (clear) the shaper.

Before each cell transmission time the SAR determines which active channel (a VCI/VPI with data to be transmitted) transmits its data in the next cell. This determination is based on the priority, peak cell rate, and average rate of the shaper assigned to the channel.



Note

The shaper used by a channel is selected in the device descriptor with macro `SHAPER_NO` in `spf_desc.h`.

Channels linked to higher priority shapers are selected for transmission before channels linked to shapers with lower priority. Shaper 0 must have the highest priority and if i>j, then the priority of shaper i <= priority of shaper j. Channels for constant bit rate traffic should be assigned to shapers with higher priority than shapers used for non-realtime traffic. Priority is assigned in the second field of macro `SCH_REGS4_INIT`.

The peak cell and average rates are implemented by each shaper by the Dual Leaky Bucket algorithm. The peak cell rate determines the minimum allowed cell times between cells transmitted for a channel linked to a shaper. The peak cell rate is specified in the first field of macro `SCH_REGS3_INIT`.

The average rate determines the average spacing between cells (in cell times) for all channels linked to a shaper. The average rate for a shaper is defined by fields I and M in macro `SCH_REGS0_INIT` (I cells in M cell times). The average rate determines how often credits are added to the bucket (of bucket size credits). Credits are depleted as cells are transmitted, and the cells may be transmitted at the peak cell rate until the bucket is empty. The peak cell rate is the burst rate. Credit is the maximum burst size.

The Receive Free Buffer Pools

The SAR implements 32 receive free buffer pools. A receive free buffer pool descriptor in control memory defines each pool. Additional parameters are used by the driver for replenishing the pools with batches of free buffers and for pre-allocating batches and mbufs (free buffers) at iniz time. See file drstat.h.

WD_0_POOL_*

A macro `WD_0_POOL_*` is defined in `drstat.h` for each of the 32 pools. These macros are used to initialize fields of the receive free buffer pool descriptors required by the SAR:

`alert_level`	SAR interrupts host when batches in a pool drop below this level. Coding is `n*4`.
`buf_size`	Size of the free buffers in the pool, coding is `64*(2**n)`, but `n` cannot be greater than 8.
`batch_size`	The number of free buffers in each batch.

RX_BUF_POOL_DESC_INIT

The macro `RX_BUF_POOL_DESC_INIT` defines the following parameters required by the driver:

`add_count`	The number of batches to add when the number of batches in the pool declines to the `alert_level`.
`batch_init`	The number of batches to pre-allocate in a linked list kept in driver static storage. Batches are pre-allocated so the slow `_os_srqmem` does not need to be called by the interrupt service routine, `isr_rqa`, when adding batches to the pool.
`mbuf_init`	The number of mbufs to pre-allocate into an array kept in driver static storage. The data portions of these mbufs become the free buffers of batches. Again, this is done to reduce the time spent in `isr_rqa`.

`cell_type` Must be of type: `AAL5_MBUF`, `AAL5_SCL`, `OAM`, or `RAW`.

Pool Numbers

Pools are used for different purposes according to their numbers:

Receiving OAMF5 cells:	Pool 0 only
Receiving cells into AAL-5 SDUs:	Pools 1-31
Receiving cells into non AAL-5 SDUs:	Pools 0-7

drstat.h

The following is sample code from `drstat.h`.

```
/* Initialize rx_buf_pool_w0. Pool 0 is for OAMF5 only.
                                    unused_1
                                        alert_level  (n*4)
                                            buf_size   (64*2**n), n < 9
                                                batch_size (number of mbufs, free_buffers)
                                                    batch_count (init to 0, not used) */

#define WD_0_POOL_00                0,   0,   0,   1,   0
#define WD_0_POOL_01                0,   4,   0,   4,   0
#define WD_0_POOL_02                0,   1,   2,   4,   0
#define WD_0_POOL_03                0,   1,   2,   4,   0
#define WD_0_POOL_04                0,   4,   2,   4,   0
#define WD_0_POOL_05                0,   4,   2,   4,   0
#define WD_0_POOL_06                0,   4,   2,   4,   0
#define WD_0_POOL_07                0,   4,   2,   4,   0
#define WD_0_POOL_08                0,   1,   5,   4,   0
#define WD_0_POOL_09                0,   1,   8,   1,   0

#define RX_BUF_POOL_DESC_INIT /* 32 Receive Free Buffer Pool Descriptors */ \
/*                next_batch \
                      *Last_batch \
                           add_count \
                               batch_init \
                                   mbuf_init usually batch_init*4 \
                                       cell_type \
                                           rx_type \
                                               in_use \
                                                   no_share \
                                                       *Rd_raw_pool \
                                                           buf_bytes*/\

WD_0_POOL_00,     0,   0,   0,   3,   9,   4,   4,   0,   0,   0,   64,      /* Pool 0 */ \
WD_0_POOL_01,     0,   0,   8,   24,  72,  1,   1,   0,   0,   0,   64,      /* Pool 1 */ \
WD_0_POOL_02,     0,   0,   6,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 2 */ \
WD_0_POOL_03,     0,   0,   6,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 3 */ \
WD_0_POOL_04,     0,   0,   8,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 4 */ \
WD_0_POOL_05,     0,   0,   8,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 5 */ \
WD_0_POOL_06,     0,   0,   8,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 6 */ \
WD_0_POOL_07,     0,   0,   8,   24,  72,  1,   1,   0,   0,   0,   256,     /* Pool 7 */ \
WD_0_POOL_08,     0,   0,   8,   24,  96,  1,   1,   0,   0,   0,   2048,    /* Pool 8 */ \
```

```
WD_0_POOL_09,    0,   0,   6,   48, 256,1,   1,   0,   0,   0,   6384,    /* Pool 9 */ \
```

Pre-allocating mbufs

The number of mbufs pre-allocated to a receive free buffer pool is specified by the `mbuf_init` field in macro `RX_BUF_POOL_DESC_INIT` in `drstat.h`. You must take into consideration the protocol layers above the driver when pre-allocating mbufs because a mbuf is only returned to the pre-allocated pool (by setting the `SPF_DONE` bit in the `m_flags` field) when an upper layer protocol no longer needs the mbuf. Receive free buffer pools used by channels with numerous or slow upper layer protocols need more pre-allocated mbufs.

At startup time, a sufficiently large pool of mbufs must be created for the spn98401 driver and other drivers and protocols using the mbuf pool. The mbuf pool is created by `mbinstall`. For example in file `/h0/sys/startbsd` the line `mbinstall -m=4096k <>>>/nil` creates an mbuf pool of 4 MB.

Chapter 4: Installing and Running ATM Base Pak

This chapter describes installing and running ATM Base Pak. It includes the following sections:

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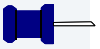
Installing ATM Base Pak

The steps for installing ATM Base Pak on your host development system are described in ***Getting Started with Microware Products***, which is part of your product package.

You should also read either ***Enhanced OS-9 for the EST SBC8260 Board Guide*** or ***Enhanced OS-9 for the 8XXFADS Board Guide***.

Once the software is installed, you can start building your ATM system as described in this chapter.



Note

You must install an Enhanced OS-9 software package before installing ATM Base Pak.

Hardware and Software Requirements

Hardware Requirements

Host Development System Hardware Requirements

Your host PC must meet the following minimum requirements:

- 32MB of free disk space (an additional 235MB of free disk space is required to run PersonalJava for OS-9)
- 16MB of RAM (64MB recommended)
- For the 8XXFADS target, the Motorola MPC8BUG ISA bus ADI card and 37 pin cable.
- For the SBCATMF target, the Embedded Support Tools Corp. (EST) visionICE incircuit emulator.

Target System Hardware Requirements

One of the following board sets is required:

Set for Motorola MPC860SAR processor:

- Motorola MPC8XXFADS board.
- Motorola 860SR FADSDB daughter board.
- Motorola 860SAR-PHY board.

Set for Motorola MPC8260 processor:

- EST SBC8260 board.
- EST SBCATMF daughter board with the MPC8260.

The drivers and descriptors were developed and tested on the following hardware:

- SBC8260/SBCATMF board with Motorola MPC8260 processor
- MPC8XXFADS/860SR FADSDB/860SAR-PHY board
- Motorola PowerStacks with Zeitnet ATM interface cards.

Software Requirements

Host Development System Software Requirements

Your host development system must have the following applications:

- Windows 95, Windows 98 or Windows NT 4.0
- A terminal emulation program (such as `Hyperterminal` that comes with Microsoft Windows 95, Windows 98, and Windows NT 4.0).
- Enhanced OS-9 for PowerPC.
- ATM Base Pak.
- Soft-ATM™ for OS-9 (optional).
- For the 8XXFADS target, the Motorola MPC8bug or MPC8bug95 software.
- For the SBCATMF target, the EST visionICE Software Tools.

Target System Software Requirements

All software for using ATM Base Pak on your target system is included with the Enhanced OS-9 for PowerPC CD.

Demonstration Testing Environment

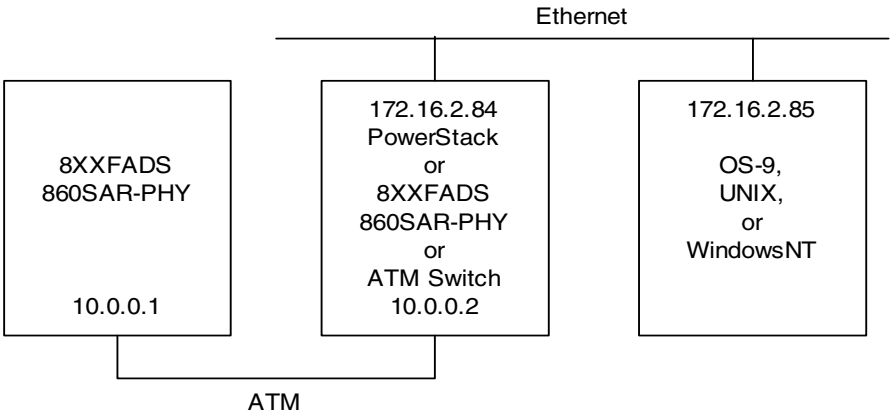
A simple demonstration testing environment can consist of the following elements:

- MPC8XXFADS/860SR FADSDB/860SAR-PHY board or SBC8260/SBCATMF board with device descriptors hju0 and llcsnap_hju installed.
- PowerStack, emulating an ATM switch, with descriptors hjn0 and llcsnapn_hjn installed.
- Ethernet Local Area Network (LAN)

In this environment, the target and PowerStack are linked only by their ATM interfaces. The PowerStack is connected to an Ethernet LAN. This configuration is described in **Figure 4-1**.

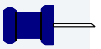
When you are able to establish telnet sessions between the 8XXFADS and the IP nodes on the LAN, IPOA using ATM signalling is functioning.

Figure 4-1 Demonstration Testing Environment



Building the Boot ROM

The boot ROM for your reference board can be built using the Configuration Wizard. The Configuration Wizard generates a S-record file, called `rom.S`, for downloading the boot ROM to the reference board. For the SBC8260 target the rom.S file must be converted to a rom.bin file using the EST convert program.



Note

The example below describes building a boot ROM for both the Motorola PowerPC 8XXFADS reference board and the EST SBCATMF reference board.

To modify the `Parameter List` in the Configuration Wizard, you must know the following characteristics about your system:

- The IP address for the reference board, 10.0.0.1 in the example below.
- The IP address for the IPOA interface on the adjacent node, 10.0.0.2 in the example below.
- The ATM address (or NSAP address—Network Service Access Point), 1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1 in the example below.
- The ATM address for the adjacent node, 3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3 in the example below.

The ATM addresses contain 20 bytes (numbers). When connecting the target to an ATM switch, you must know the ATM format of the ATM addresses on the network to be joined. You must also correctly initialize the following fields of the ATM address:

- AFI - Authority and Format Identifier (1 byte)
- IDI - Initial Domain Part, AFI and one of DCC, IDC, E.164
- HO-DSP - High Order Domain Specific Part
- ESI - End System Identifier

- SEL - Selector

For More Information

See ***ATM User-Network Interface (UNI) Signalling Specification Version 4.0***, section 3.0, for addressing specifications. This is available from the ATM Forum.

Building the boot ROM is performed in following four stages:

- **Stage 1: Modifying the Parameter List**
- **Stage 2: Configuring for IP Over ATM**
- **Stage 3: Selecting Files for the Boot ROM**
- **Stage 4: Executing the Build Command**

Stage 1: Modifying the Parameter List

You can use the Configuration Wizard to automatically execute a commands at boot time that would normally be run entered at the command line or executed from a script file after booting. An example is shown below.

Step 1. Click the `Start` button on the Windows desktop.

Step 2. Select `Programs` --> `Enhanced OS-9 for PowerPC` --> `Configuration Wizard.` The Configuration Wizard opening screen will be displayed.

Note

If this is the first OS-9 boot ROM built for your reference board, or this is the first time you have used the Configuration Wizard, it is highly recommended at this point that you read the ***Enhanced OS-9 Board Guide*** for your particular reference board and complete the Enhanced OS-9 Tutorial.

Step 3. Configure the opening Configuration Wizard screen.

1. Select the appropriate reference board in the Port Selection menu `860SARFADS` or `SBC8260`.
2. Select the current MWOS location.
3. Name your configuration.
4. Select Advanced Mode.

Step 4. Click `OK`.

At this point, the Configuration Wizard main configuration window will be displayed.

Step 5. From the Configuration Wizard main configuration window, select `Configure -> Bootfile -> Disk Configuration`.

Step 6. From the Disk Configuration window, select the `Init Options` tab.

Step 7. Under the Initial Device Name section, click the `User button`. This enables the Parameter List option.

Step 8. In the Parameter List concatenate, in order, the strings below:

```
setenv SHELL shell;
mbinstall -m1024k;
ipstart;
ifconfig atm0 10.0.0.1 binding /hju0;
route add default 10.0.0.2;
atmaddr /hju0
   -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1;
addvc    /llcsnap_hju 0x000000 -i=10.0.0.2
```

```
   -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3;
telnetd -f=shell<>>>/nil&;
ex shell -l<>>>/term&\n;
```

Step 9. Click `OK`. The main configuration window will be displayed.

Stage 2: Configuring for IP Over ATM

When using Configuration Wizard to build a boot ROM containing modules from the ATM Base Pak for a testbed exercising IPOA, you may wish to build a boot ROM that does not enable the Ethernet device on the target, relying instead on IP over ATM.

Step 1. In `Configure -> Bootfile -> Network Configuration` select the `Interface` tab. In window Disable/Enable Interface disable Ethernet.

Step 2. In `Configure -> Coreboot -> Main Configuration` select the `Debugger` tab. In the Remote Debug Connection window do not select Ethernet.

Stage 3: Selecting Files for the Boot ROM

Step 1. From the Configuration Wizard main configuration window, select `Configure -> Bootfile -> Network Configuration` and the `SoftStax Options` tab.

Step 2. Configure the SoftStax Options window as follows:

Select: `ifconfig, ndbmod, route, routed, telnet, netstat`.

If you are using Soft-ATM™:

Select: `Soft-ATM` the ATM if the target is to be an ATM end node.

Select: `Soft-ATM Switch` if the target is to emulate an ATM switch.

Stage 4: Executing the Build Command

Step 1. Build rom.S. Select `Configure -> Build Image`. The Master Builder window will be displayed.

Step 2. From the Master Builder window, select `Coreboot + Bootfile` in the Build Type/Options section.

Step 3. Make the following selections in the Include section:

- `ROM Utility Set`
- `Disk Support`
- `Disk Utilities [fdisk, format....]`
- `SoftStax [SPF] Support`
- `User Modules`

Step 4. Click Build. rom.S is saved to one of the following directories.

```
/MWOS/OS9000/821/PORTS/8XXFADS/BOOTS/INSTALL/PORTBOOT/rom.S
/MWOS/OS9000/8260/PORTS/SBC8260/BOOTS/INSTALL/PORTBOOT/rom.S
```

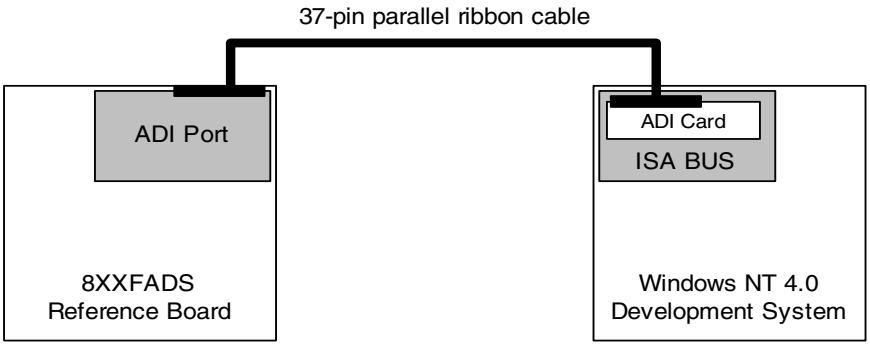
Use the EST convert program to generate file rom.bin from rom.S using:

```
convert rom.S -b -a -l fe000000 -u fe3fffff -z
```

Connecting the Host and Target

Figure 4-2 shows a typical development system (host) and the 8XXFADS reference board (target).

Figure 4-2 Connecting the Host and Target



The application development interface (ADI) card, 37-pin parallel ribbon cable, and MPC8bug software are available for the SUN4 workstation (S-bus) and Windows PC (ISA bus). MPC8bug requires 600K of memory. It communicates with the 8XXFADS system through the onboard ADI debug port on the 8XXFADS via the ADI connection.

The ADI parallel port supplies a parallel link from the 8XXFADS motherboard to various host computers. They are connected with a 37-line cable to the ADI board installed in the host computer. There are four versions of the ADI board available to support a connection to a PC, Macintosh, VMEbus computer, or SUN4 workstation. You can connect the 8XXFADS board to these computers if they have the appropriate software drivers installed. Each 8XXFADS can have eight possible slave addresses set for its ADI port, which enables up to eight ADS boards to be connected to the same ADI.

If the host system used to generate rom.S is not equipped with the ADI board and MPC8bug software, you must transfer rom.S to the node that has this equipment.

The Windows host and SBC8260 target are connected via Ethernet and the EST visionICE incircuit emulator. Obtain an IP address for the incircuit emulator and connect it to the Ethernet. Connect the incircuit emulator to the SBC8260 board at the JTAG JP5 10 pin connector.

Loading the Boot ROM on the 8XXFADS

The Configuration Wizard generates a bootrom file in S-record format named rom.S. To download rom.S to the 8XXFADS you must have a node configured with the Motorola ADI (Application Development Interface) board and MPC8bug software. The ADI board, MPC8bug software and manuals are available from Motorola.

Complete the following steps to download `rom.S`.

Step 1. FTP the following file to the node that has the Motorola MPC8bug software and hardware.

```
\MWOS\OS9000\8260\PORTS\8XXFADS\BOOTS\INSTALL\PORTBOOT\
rom.S
```

Step 2. Power down the 8XXFADS.

Step 3. Connect the MPC8bug ISA bus card to the 8XXFADS using the 37-pin cable and connectors.

Step 4. Power up the 8XXFADS.

Step 5. Run the `mpc8bug` command with no parameters to see the syntax and semantics of the command. Then run `mcp8bug` using a command similar to:

```
c:\mpc8bug> mpc8bug 1 0
```

The drive specification in your command will vary according to what drive Enhanced OS-9 is installed on your system.

Step 6. Download rom.S using the commands

```
f860SARbug>  reset :h
f860SARbug>  loadf rom.S 0
```

Step 7. Power down the 8XXFADS and disconnect the 37 pin cable.

Step 8. Power up and boot the 8XXFADS.

Loading the Boot ROM on the SBC8260

The Configuration Wizard generates a bootrom file in S-record format named rom.S. The rom.S file must be converted to before it can be loaded into the flash memory on the SBC8260.

Complete the following steps to download `rom.bin`.

Step 1. Connect the visionICE to the Ethernet and to the JTAG JP5 10 pin connector on the SBC8260.

Step 2. Power on the visionICE and the SBC8260.

Step 3. Start the visionICE software using:

`Start> Programs> visionICE> visionICE Utility Panel`

Connect to visionICE Over NET xxx.xxx.xxx.xxx? `Yes`

If the `>ERR>` prompt appears enter:

`>ERR> in`

The `>BKM>` prompt should then be presented

Step 4. Open the Configuration and Communications Dialog window using the 1st icon on the visionICE Utilities window.

Step 5. Select the `Communications` tab. Select the `Connect` button and wait for the connect to be established.

Step 6. Open the Program Target Flash or visionICE Flash Card window, 4th icon on the visionICE Utilities window.

Step 7. Select the PC Host File Name and PATH:

`\mwos\OS9000\8260\PORTS\SBC8260\BOOTS\SYSTEMS\PORTBOOT\rom.bin`

Step 8. Select the Programming Algorithm (Flash Device(s) and Configuration:

`AMD 29F080 [1024 x 8] 4 devices`

Step 9. Select the Base Address `FE000000`.

Step 10. Select `Erase All`.

Step 11. Select Start Address `00000000`.

Step 12. Select `Erase and Program`.

Chapter 5: Testing the ATM System

This chapter describes how to test an ATM interface for connectivity and data throughput using the ATM Base Pak and Soft-ATM™ for OS-9. It includes the following sections.

- **Introduction**
- **Configuring for ATM Testing**
- **Test Examples**

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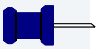
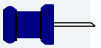
Introduction

A demonstration testing environment was described in **Chapter 4: Installing and Running ATM Base Pak**.



Note

The PowerStack in the testing environment described can be replaced by an 8XXFADS loaded with the `hjn0` and `llcsnap_hjn` device descriptors. Also, the 8XXFADS can be connected to an ATM switch. The SBC8260 can be used instead of the 8XXFADS.



Note

The utilities and test programs in this package enable you to transfer data using either UDP/IP, TCP/IP, or as raw bytes. The utilities provide throughput information for the data transferred.

For More Information

See **Chapter 6: Utilities** for more information about the ATM utilities provided with ATM Base Pak.

Configuring for ATM Testing

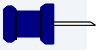
The following steps describe how to configure your system for testing ATM connectivity and data throughput.

Choose one of the following configurations:

- **ATM with Signalling Setup**
- **ATM Without Signalling Setup**
- **InATMARP Setup**

Note

Scripts for the following setups can be found in `MWOS/SRC/SYS`.



Note

In the example scripts that follow, `shell` should be replaced with `mshell` if in the Wizard you specified `mshell` in the following tab:

```
Configure -> Bootfile -> Disk Configuration -> Init Options tab
```

ATM with Signalling Setup

Step 1. On the PowerStack or target board run the following script:

```
-tnx
*   Script sig_gw to start ATM signalling configured to emulate
*   an ATM switch on a PowerStack or target board.
*   This script should be run before ATM signalling is started
*   on the client node.
*
*   Porting modifications:
*   Change the directory names in the load commands, if
*       necessary.
*   Remove the load command if the modules are in ROM.
*   Change the mbinstall memory size, if necessary.
*   Change the IP address, broadcast and netmask fields in
*       the ifconfig commands.
*   Change the ATM address field ( -a switch ) in the atmaddr
*       and addvc commands.
*   Change the IP address field in the addvc command.

*   load the LAN modules
* Sysmbuf arpenet ftp
* ftpd    ftpdchostnameidbdump
* idbgen fconfig inetd inetdb
* ipo ipstart mbdump mbinstall
* ndbmod ndpio netstat ping
* pk pkdrvr pkmanr aw0
* route route0routed sp1603
* spde0 spenet spfs pfndpd
* spfndpdcspip spraw sproute
* sptcps pudp tcp0t elnet
* telnetd telnetdc udp0

*   load the ATM modules
* addvc atmaddr bm_rx  bm_tx
* hjn0 llcsnap_hjn sp1577 rdbg
* spatmsigspatmsig.stbspn98401
* spn98401.stb


*   If the node emulating a switch is to also be a gateway you must load a
*   version of descriptor ip0 that configured to act as a gateway.
*   See /mwos/SRC/DPIO/SPF/DRVR/SPIP/DEFS/spf_desc.h.
load -d LANv1.4/ip0_gw

*   We assume the directory LANv1.4 has all the LAN modules needed.
load -d LANv1.4/*

*   We assume the directory ATM has all the ATM modules needed.
load -d ATM/*
```

```
mbinstall -m=4096k<>>>/nil

*   if necessary, create a new inetdb2 module
ndbmod create inetdb2 11 100 0 0 0 0 0 0 0 400 65 80

*   add hosts
ndbmod hostname add gw_1
ndbmod host     add 10.0.0.1 8xx_1

*   the ipstart command must precede the ifconfig commands
ipstart

*   add ATM interface
ifconfig atm0 10.0.0.2 binding /llcsnap_hjn

*   add the Ethernet interface for the PowerStack if a separate Ethernet device
*   is to be used
ifconfig ent0 172.16.2.84 netmask 255.255.0.0 broadcast 172.16.255.255 binding
/spde0/enet

*   add the Ethernet interface for the 8XXFADS if a separate Ethernet device
*   is to be used
**ifconfig ent0 172.16.1.116 netmask 255.255.0.0 broadcast 172.16.255.255
**    binding /spqe0/enet

*   Select and set the ATM address of the host.
*   See "Using Soft-ATM(TM) for OS-9" for information about ATM addresses.
atmaddr /llcsnap_hjn -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3

*   Add an ARP entry with VC = 0 indicating that the VC needs
*   to be set by using InATMARP.
*   The ARP entry has IP address 10.0.0.1 and ATM address in ascii.
addvc /llcsnap_hjn 0x0 -i=10.0.0.1 -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1

telnetd -f=shell<>>>/nil&;
ftpd<>>>/nil&
```

Step 2. On the 8XXFADS of SBC8260 enter the following commands at the shell prompt. You can also use the Parameter List in the Configuration Wizard to include the commands in the bootrom and run automatically at bootime.

For More Information

Using the Configuration Wizard to modify the Parameter List is described in **Chapter 4: Installing and Running ATM Base Pak**.

```
* Script sig
setenv SHELL shell;
mbinstall -m1024k;
ipstart;
ifconfig atm0 10.0.0.1 binding /llcsnap_hju;
route add default 10.0.0.2;
atmaddr /llcsnap_hju -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1;
addvc /llcsnap_hju 0x00 -i=10.0.0.2 -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3;
telnetd -f=shell<>>>/nil&;
ex shell -l<>>>/term&\n;
```

For More Information

See ***Using Soft-ATM™ for OS-9*** for more information about using ATM with signalling.

ATM Without Signalling Setup

Step 1. On the PowerStack or target board run the following script:

```
-tnx
*   Script nosig_gw to start ATM with signalling disabled.
*   This script may run be on a PowerStack or target board.

*   Porting modifications:
*   Change the directory name in the load command, if
*       necessary.
*   Remove the load command if the modules are in ROM.
*   Change the mbinstall memory size, if necessary.
*   Change the IP address, broadcast and netmask fields in
*       the ifconfig commands.
*   Change the ATM address field ( -a switch ) in the atmaddr
*       and addvc commands.
*   Change the IP address field in the addvc command.

*   If the node emulating a switch is to also be a gateway you must load a
*   version ofdescriptor ip0 that configured to act as a gateway.
*   See /mwos/SRC/DPIO/SPF/DRVR/SPIP/DEFS/spf_desc.h.
load -d LANv1.4/ip0_gw

*   We assume the directory LANv1.4 has all the LAN modules needed.
load -d LANv1.4/*

*   We assume the directory ATM has all the ATM modules needed.
load -d ATM/*

mbinstall -m=4096k<>>>/nil

*   if necessary, create a new inetdb2 module
ndbmod create inetdb2 11 100 0 0 0 0 0 0 0 400 65 80

*   add hosts
ndbmod hostname add gw_1
ndbmod host     add 10.0.0.1 8xx_1

*   the ipstart command must precede the ifconfig commands
ipstart

*   add ATM interface
ifconfig atm0 10.0.0.2 binding /llcsnapns

*   add the Ethernet interface for the PowerStack if a separate Ethernet device
*   is to be used
ifconfig ent0 172.16.2.84 netmask 255.255.0.0 broadcast 172.16.255.255 binding
/spde0/enet

*   add the Ethernet interface for the 8XXFADS if a separate Ethernet device
```

```
*   is to be used
**ifconfig ent0 172.16.1.116 netmask 255.255.0.0 broadcast 172.16.255.255
**    binding /spqe0/enet

*   Select and set the ATM address of the host.
*   See "Using Soft-ATM(TM) for OS-9" for information about ATM addresses.
atmaddr /llcsnapns -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3

*   Specify a VC, e.g. 0x010020 and use the -p switch to make the VC permanent   *
in the ATMARP table
*   The ARP entry has IP address 10.0.0.1 and ATM address in ascii.
addvc /llcsnapns 0x010020 -i=10.0.0.1 -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1 -p

telnetd -f=shell<>>>/nil&;
ftpd<>>>/nil&
```

Step 2. On the target board enter the following commands at the shell prompt. You can also use the Parameter List in the Configuration Wizard to include the commands in the bootrom and run automatically at bootime.

For More Information

Using the Configuration Wizard to modify the Parameter List is described in **Chapter 4: Installing and Running ATM Base Pak**.

```
* Script nosig.
setenv SHELL shell;
mbinstall -m1024k;
ipstart;
ifconfig atm0 10.0.0.1 binding /llcsnapns;
route add default 10.0.0.2;
atmaddr /llcsnapns -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1;
addvc /llcsnapns 0x010020 -i=10.0.0.2 -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3
-p;
telnetd -f=shell<>>>/nil&;
ex shell -l<>>>/term&\n;
```

InATMARP Setup

Step 1. On the PowerStack or target board run the following script:

```
-tnx
*   Script nosig_gw_inARP to start ATM with signalling disabled.
*   This script may run on a PowerStack or target board.
*   Start this script AFTER the other side has been started.

*   Porting modifications:
*   Change the directory name in the load command, if
*       necessary.
*   Remove the load command if the modules are in ROM.
*   Change the mbinstall memory size, if necessary.
*   Change the IP address, broadcast and netmask fields in
*       the ifconfig commands.
*   Change the ATM address field ( -a switch ) in the atmaddr
*       and addvc commands.
*   Change the IP address field in the addvc command.

*   If the node emulating a switch is to also be a gateway you must load a
*   version ofdescriptor ip0 that configured to act as a gateway.
*   See /mwos/SRC/DPIO/SPF/DRVR/SPIP/DEFS/spf_desc.h.
load -d LANv1.4/ip0_gw

*   We assume the directory LANv1.4 has all the LAN modules needed.
load -d LANv1.4/*

*   We assume the directory ATM has all the  modules needed.
load -d ATM/*

mbinstall -m=4096k<>>>/nil

*   if necessary, create a new inetdb2 module
ndbmod create inetdb2 11 100 0 0 0 0 0 0 0 400 65 80

*   add hosts
ndbmod hostname gw_1
ndbmod host     add 10.0.0.1 8xx_1

*   the ipstart command must precede the ifconfig commands
ipstart

*   add ATM interface
ifconfig atm0 10.0.0.2 binding /llcsnapns

*   add the Ethernet interface for the PowerStack if a separate Ethernet device
*   is to be used
ifconfig ent0 172.16.2.84 netmask 255.255.0.0 broadcast 172.16.255.255 binding
/spde0/enet

*   add the Ethernet interface for the 8XXFADS if a separate Ethernet device
*   is to be used
**ifconfig ent0 172.16.1.116 netmask 255.255.0.0 broadcast 172.16.255.255
**    binding /spqe0/enet

*   Select and set the ATM address of the host.
*   See “Using Soft-ATM(TM) for OS-9” for information about ATM addresses.
```

```
atmaddr /llcsnapns -a=3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3

*   Add a PVC to the ARP table with the IP address set to 0.
*   This will generate an InATMARP request to the other side
*   for its IP address.
addvc /llcsnapns 0x010020 -p

telnetd -f=shell<>>>/nil&;
ftpd<>>>/nil&
```

Step 2. On the target board enter the following commands at the shell prompt. You can also use the Parameter List in the Configuration Wizard to include the commands in the bootrom and run automatically at bootime.

For More Information

Using the Configuration Wizard to modify the Parameter List is described in **Chapter 4: Installing and Running ATM Base Pak**.

```
* Script nosig_inARP.  Start this side first.
setenv SHELL shell;
mbinstall -m1024k;
ipstart;
ifconfig atm0 10.0.0.1 binding /llcsnapns;
route add default 10.0.0.2;
atmaddr /llcsnapns -a=1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1;
addvc /llcsnapns 0x010020 -i=10.0.0.2 -p;
telnetd -f=shell<>>>/nil&;
ex shell -l<>>>/term&\n;
```

Test Examples

The following two test examples are provided with the ATM Base Pak:

- Data Transfer Tests
- InATMARP Test

Data Transfer Tests

There are three variations of Data Transfer Tests outlined below, including the following:

- UDP/IP Data Transfer Test
- TCP Data Transfer Test
- Raw Data

UDP/IP Data Transfer Test

To test UDP/IP over ATM, complete the following steps:

Step 1. On the PowerStack, run target:

```
target
```

Step 2. On the target board (10.0.0.2 is the IP address of the PowerStack) run beam:

```
beam  10.0.0.2  100
```

This test sends 100 UDP/IP packets of 1000 bytes from the PowerStack to the target board.

For More Information

Refer to ***Using LAN Communications Pak*** for a detailed description of `beam` and `target` or run `target -?` and `beam -?.`

TCP Data Transfer Test

To test TCP over ATM, complete the following steps:

Step 1. On PowerStack run tcprecv:

```
tcprecv <filename>
```

Step 2. On the target board, run tcpsend:

```
tcpsend 10.0.0.2 <filename>
```

This sends `<filename>` from the 8XXFADS to the PowerStack.

For More Information

For more information about `tcpsend` and `tcprecv`, refer to ***Using LAN Communications Pak***.

For testing TCP over ATM, the utilities `telnet` and `ftp` may also be used.

Raw Data

To test the ATM driver without protocols, complete the following steps:

Step 1. On the target board, run `bm_rx`:

```
bm_rx /atm 200 100
```

Step 2. On PowerStack, run `bm_tx`:

```
bm_tx /atm 200 100
```

where:

`atm` is the device.

`200` is the packet count.

`100` is the packet size.

`bm_rx` and `bm_tx` prompt for a VC which must be entered in hexadecimal. For the 8XXFADS the VPI must be less than 0x40, enter VC: `39FFFF`. For the SBC8260 the VPI must be 0x0C or less and the VCI must be 0xF or less. The ranges of the VPI and VCI may be changed in the device descriptor for the SBC8260.

InATMARP Test

To test InATMARP, complete the following steps:

Step 1. On the target board, run target:

```
target
```

Step 2. On the PowerStack (10.0.0.1 is the IP address of the 8XXFADS), run beam:

```
beam 10.0.0.1 100
```

This should cause the PowerStack to send 1000 packets to the target board. If the `InATMARP` response sent out when the statement `addvc /llcsnaps 0x100020 -p` was executed did not result in a reply, then the `beam` fails. Otherwise, the target board should receive 100 packets.

Chapter 6: Utilities

This chapter describes the utilities provided with ATM Base Pak. The utilities and test programs in this package enable you to transfer data for testing within your development system. The utilities provide throughput information for the data transferred.

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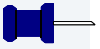
Utilities

The following utilities are provided with ATM Base Pak.

Table 6-1 ATM Base Pak Utilities

Utility	Description
`addvc`	Adds/deletes entries from the ATM ARP cache.
`atmddr`	Gets/sets the machine's ATM address.
`bm_rx/bm_tx`	Tests data transfer on ATM driver without upper layer protocols.



Note

In addition, the following utilities are used from the LAN Communications Pak: `beam`, `ftp`, `ndbmod`, `target`, `tcpsend`, `tcprecv`, and `telnet`.

For more information, see the ***Using LAN Communications Pak*** manual.

addvc

Add/Delete Entries from LLC/SNAP Driver ATM ARP Cache

Syntax

```
addvc <desc name> <0x VC number in hex>
<option option ...>
```

Description

This utility adds or deletes entries from the LLC/SNAP driver's ATM ARP cache. Only one entry can be added or deleted at a time.

The LLC/SNAP driver can be configured in a number of ways. In a completely ***RFC 1577***-compliant implementation with ATMARP and InATMARP and where the LLC/SNAP driver interacts directly with the ATM signalling stack to create VCs, the `addvc` utility is not required. This is because the ARP cache is created by communicating with an ARP server.

In many cases, there is no ARP server and the LLC/SNAP driver is not configured to perform ATMARP. Also, the application may set up the VCs directly either by using PVCs or by using the ATM signalling stack directly. In these cases, the application fills up the LLC/SNAP driver's ARP cache.

An entry in the ARP cache is specified by a three-part identifier `<VPI/VCI number, ATM address/sub-address,`

`IP address>`.

An entry can be specified partially. For example, if the VC is already set up by the application, then the ATM address can be left out with only the VPI/VCI number and the IP address specified. If LLC/SNAP sets up connections using the signalling stack, you need only specify the IP address and the ATM address.

If the IP address is not specified, and the VC is specified, then the LLC/SNAP driver uses InATMARP to find out the IP address of the other end of the connection.

The source for `addvc` is in `$MWOS/SRC/SPF/UTILS/ADDVC`.

The binary object is in `$MWOS/OS9/68000/CMDS` or `$MWOS/OS9000/PPC/CMDS`.

Parameters

`VC number in hex`	Is `(VPI<<16)|VCI`. The VPI must be less than 0x40 for the `spn98401` driver.

Options

`-d`	Delete the specified VC.
`-i=<ip address>`	IP address at the other VC endpoint.
`-s`	Entry is for the ARP server.
`-p`	Entry is a PVC.
`-at=<atm address type>`	1:E.164, 0:NSAP (default).
`-a=<atm address>`	ATM address specified as <x.y.z....> where x, y, z, . . . are integers from 0 to 255. The maximum size of the address and sub-address is 20 bytes.
`-s=<atm subaddress>`	ATM sub-address specified as <x.y.z....> where x, y, z, . . . are integers from 0 to 255. The maximum size of the address and sub-address is 20 bytes.
`-r`	Entry is the broadcast route (all broadcast packets are sent over this VC).
`-?`	Parameters.

atmddr

Get/Set the Machine's ATM Address

Syntax

```
atmaddr <desc name> <option option ...>
```

Description

This utility gets or sets the machine's ATM address. The ATM address is used for ATMARP/InATMARP and for setting up SVCs. During SVC call control, this ATM address is used as the calling party number. If the ATM address is not set using this call, then the default value from the descriptor is used.

The source for `atmaddr` is in `$MWOS/SRC/SPF/UTILS/ATMADDR`.

The binary object is in `$MWOS/OS9/68000/CMDS` or `$MWOS/OS9000/PPC/CMDS`.

Options

`-g` Get the ATM address.

`-at=<atm address type>`
1:E.164, 0:NSAP (default).

`-a=<atm address>` ATM address specified as <x.y.z....> where x, y, z, . . . are integers from 0 to 255. The maximum size of the address and sub-address is 20 bytes.

`-s=<atm subaddress>`
ATM sub-address specified as <x.y.z....> where x, y, z, . . . are integers from 0 to 255. The maximum size of the address and sub-address is 20 bytes.

Syntax

```
bm_rx <desc_name> <number of packets> <packet size>
```

and

```
bm_tx <desc_name> <number of packets> <packet size>
-s= <delay>
```

Description

These utilities enable you to test the data transfer on the ATM driver without any upper layer protocols. The VC must be entered in hexadecimal. The VPI must be less than 0x40.

Parameters

`desc_name`	Is the device descriptor.
`number of packets`	Is the packet count.
`packet size`	Is the packet size.
`-s= <delay>`	Is the pause between packets.

Chapter 7: Library Function Reference

This chapter provides details of the atm.l library in the ATM Base Pak.

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Introduction

Applications use the ITEM library to open and close paths and transfer data.

Table 7-1 Functions

Function	Description	Library
`_os_gs_atmaddr()`	Gets ATM address.	`atm.l`
`_os_gs_vc_set()`	Gets VC for a path.	`atm.l`
`_os_ss_atmaddr()`	Sets ATM address.	`atm.l`
`_os_ss_inarp_on()`	Turns on InATMARP.	`atm.l`
`_os_ss_vc_add()`	Adds ARP cache entries.	`atm.l`
`_os_ss_vc_delete()`	Deletes ARP cache entries.	`atm.l`
`_os_ss_vc_set()`	Sets VC for a path.	`atm.l`
`ite_path_profileget()`	Gets the call profile for IP.	`item.l`

For More Information

For information regarding generic calls such as opening and closing paths and transferring data, as well as the `ite_path_profileget()` call, refer to the documentation on the ITEM library in the ***SoftStax Programming Reference Manual***.

Structures

The following structures are used by the `atm.l` functions:

Table 7-2 Structures

Structure	Description
`ss_atmaddr_pb`	Structure holding the ATM address.
`vc_struct`	Structure used to add to or delete from the ARP cache.

Declaration

The `Ss_atmaddr_pb` structure is declared in the file `atm.h` as follows:

```
typedef struct _ss_atmaddr_pb {
   u_int8 ht1;     /* type and length of atm address */
   u_int8 st1;     /* type and length of atm subaddress */
   u_char ha[ATM_ADDRESS_SIZE];/* atm address  */
   u_char sa[ATM_ADDRESS_SIZE];/* atm subaddress */
}  ss_atmaddr_pb, *Ss_atmaddr_pb;
```

Description

This structure is used by applications to pass the ATM address and sub-address to the LLC/SNAP driver.

Fields

The fields in the `Ss_atmaddr_pb` structure are as follows:

`ht1`	The low order six bits define the address length. The seventh bit defines the address type. If the bit is set then the type is E.164. Otherwise it is NSAP.
`sl1`	The low order six bits define the sub-address length. The seventh bit defines the sub-address type. This must be of type NSAP so the bit must be set to `0`.
`ha`	This is the 20 byte ATM address.
`sa`	This is the 20 byte ATM subaddress.

Vc_struct

Declaration

The `Vc_struct` structure is declared in the file `atm.h` as follows:

```
typedef struct _vc_struct {
   u_int32 ip_addr;/* ip address*/
   u_int8 htl;     /* type and length of dest atm address */
   u_int8 stl;     /* type & length of dest atm subaddress */
   u_int32 arp_server_flag :1;
            /* if set to 1 then this is the VC to */
            /* the ARP server */
   u_int32 default_vc :1;/* if 1 this is the default route */
   u_int32 pvc_flag :1;  /* if 1 this is a pvc */
   u_char rsvd;          /* reserved */
   u_int32 vc;           /* VPI << 16 | VCI of the vc */
   u_char ha[ATM_ADDRESS_SIZE];/* dest atm address */
   u_char sa[ATM_ADDRESS_SIZE];/* dest atm sub address */
   Atm_profile profile;
            /* ptr to profile structure to use for */
            /* connection. If NULL then use the */
            /* default profile */
}   vc_struct, *Vc_struct;
```

Description

This structure is used add or delete entries in the ARP cache. It specifies the IP address, ATM address and optionally the VPI/VCI.

Fields

The fields in the `Vc_struct` structure are as follows:

`ip_addr`	The IP address.
`ht1`	The low order six bits define the ATM destination address length. The seventh bit defines the address type.

st1	The low order six bits define the ATM destination subaddress length. The seventh bit defines the subaddress type.
arp_server_flag	If set to 1, this is the VC to the ARP server.
default_vc	If set to 1, this is the default route.
pvc_flag	If set to 1, this is a PVC.
rsvd	Is reserved for future use.
vc	The VC, i.e., VPI<<16 | VCI.
ha	The ATM destination address.
sa	The ATM destination subaddress.
profile	Is a pointer to the profile structure to use for the connection. If NULL, then use the default profile. Refer to atm_pr.h for more information about this structure.

Function Descriptions

Each section of a function description is defined as follows:

The **Syntax** section shows the function prototype with the required parameters and their data types.

The **Libraries** section lists the name of the library in which the function is located.

The **Description** section provides a description of the function.

The **Attributes** section lists various attributes of each function in relation to OS-9—including whether the function is compatible with OS-9 and/or OS-9 for 68K; whether the function is in user state and/or system state; and whether the function is safe for use in a threaded application.

The **Parameters** section provides details about each of the parameters.

Non-fatal Errors are errors detected within the library call and are a direct result of that particular call yet not as detrimental as a fatal error.

Indirect Errors are the result of invalid parameter values passed to and detected by another function call. They are not directly returned by the original calling function.

The **See Also** section directs you to related functions or materials that provide more information about the function.

_os_gs_atmaddr()

Gets ATM Address

Syntax

```
#include <atm.h>
error_code _os_gs_atmaddr (
   path_id         path,
   Ss_atmaddr_pb   pb);
```

Libraries

atm.l

Description

This call gets the ATM address for the machine.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

path	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as ite_path_open(), socket(), and _os_open().
pb	Points to atmaddr_pb.

Non-fatal Errors

EOS_PARAM	pb is NULL.

Indirect Errors

_os_chkmem()

See Also

_os_ss_atmaddr()

_os_gs_vc_set()

Gets VC For a Path

Syntax

```
#include <atm.h>
error_code _os_gs_vc_set (
   path_id    path,
   u_int32    *vc);
```

Libraries

atm.l

Description

`_os_gs_vc_set()` gets the VC associated with the path.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

`path`	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as `ite_path_open()`, `_os_open()`, and `socket()`.
`vc`	Is (`VPI<<16 | VCI`).

See Also

`_os_ss_vc_set()`

_os_ss_atmaddr()

Sets ATM Address

Syntax

```
#include <atm.h>
error_code _os_ss_atmaddr (
   path_id         path,
   Ss_atmaddr_pb   pb);
```

Libraries

atm.l

Description

This call sets the ATM address for the machine. This function is required before the LLC/SNAP driver can respond to any InATMARP requests.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

path	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as ite_path_open(), _os_open(), and socket().
pb	Pointer to atmaddr_pb.

Non-fatal Errors

EOS_PARAM	pb is NULL.

See Also

_os_gs_atmaddr()

_os_ss_inarp_on()

Activates InATMARP Capability

Syntax

```
#include <atm.h>
error_code _os_ss_inarp_on(path_id path);
```

Libraries

`atm.l`

Description

This call activates the InATMARP capability of the LLC/SNAP driver. The LLC/SNAP descriptor can be configured so initially the LLC/SNAP driver does not respond to InATMARP requests. Applications can then use this setstat to turn InATMARP on.

This is useful in environments where the client IP address is obtained dynamically by BOOTP. In this case, when the BOOTP is done, the IP address is obtained. The `_os_ss_inarp_on()` call can then be made to turn on the InATMARP capability in the LLC/SNAP driver.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

`path`	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as `ite_path_open()`, `_os_open()`, and `socket()`.

_os_ss_vc_add()

Adds ARP Cache Entries

Syntax

```
#include <atm.h>
error_code _os_ss_vc_add (
   path_id      path,
   Vc_struct    vc_info);
```

Libraries

atm.l

Description

This setstat manually adds ARP cache entries to the LLC/SNAP driver. The `vc_struct` structure is passed in during the call. The structure specifies the IP address, ATM address, the VC, and various flags.

There are many cases where one or more of the parameters are not specified:

- If the LLC/SNAP driver is setting up the SVCs by interacting with the signalling stack directly, then the VC should be set to 0.
- If the VC is already set up either by the application or if it is a PVC, then the ATM address need not be specified if the IP address is specified.
- If the VC is already set up either by the application or if it is a PVC, then the IP address need not be specified if the ATM address is specified. The LLC/SNAP driver determines the IP address by using InATMARP.

Normally ARP entries are created by using ATMARP. These entries time out as specified in a timer (default is every 15 minutes). The entries created using `_os_ss_vc_add()` never timeout and remain in the ARP table until a `_os_ss_vc_delete()` is performed.

SVCs set up by the LLC/SNAP driver through the signalling stack time out as specified in a timer (default is every 20 minutes) if there is no network traffic on that SVC. PVCs and SVCs not set up by the LLC/SNAP driver remain in the ARP table until the application calls `_os_ss_vc_delete()`.

When the call is made, a call profile can be passed inside the `vc_struct` parameter. This call profile is used for SVCs set up on this ARP entry. The default profile can be obtained using the call `ite_path_getprofile()`, changed, and passed back in during the `_os_ss_vc_add()` call. This allows the application to control the way the VC is set up in terms of bandwidth and traffic parameters.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

`path`	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as `ite_path_open()`, `_os_open()`, and `socket()`.
`vc_info`	Pointer to `vc_struct`.

Non-fatal Errors

`EOS_DEVBY`	The IP address is already in use.
`EOS_MEMFUL`	ARP cache is full.

See Also

`_os_ss_vc_delete()`
`_os_ss_vc_set()`

_os_ss_vc_delete()

Deletes ARP Cache Entries

Syntax

```
#include <atm.h>
error_code _os_ss_vc_delete (
   path_id      path,
   Vc_struct    vc_info);
```

Libraries

atm.l

Description

This setstat deletes an entry from the ARP cache. If a VC is open for that entry, then it is closed.

This call takes in the same VC struct described in `_os_ss_vc_add()` and has the same `vc_struct` parameter.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

`path`	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as `ite_path_open()`, `_os_open()`, and `socket()`.
`vc_info`	Pointer to `vc_struct`.

Non-fatal Errors

`EOS_CREF`	ARP entry not found.

See Also

_os_ss_vc_add()
_os_ss_vc_set()

_os_ss_vc_set()

Sets VC For a Path

Syntax

```
#include <atm.h>
error_code _os_ss_vc_set (
   path_id   path,
   u_int32   vc);
```

Libraries

atm.l

Description

os_ss_vc_set sets the VC associated with the specified path.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

path	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as ite_path_open(), _os_open(), and socket().
vci	Is (VPI<<16 | VCI).

See Also

_os_gs_vc_set()
_os_ss_vc_add()
_os_ss_vc_delete()

ite_path_profileget()

Gets The Call Profile For IP

Syntax

```
#include <spf_oob.h>
#include <atm_profile.h>
error_code ite_path_getprofile (
   path_id      path,
   conn_type    *conn,
   u_int32      *pr_size,
   void         *pr_buffer);
```

Libraries

`item.l`

Description

This call gets the default IP call profile. In the `conn_type` structure passed in, the service type should be set to `ITE_SVC_DATA_IP`. `pr_buffer` must point to an `atm_profile` structure (refer to `atm_pr.h`) and `pr_size` must be set to `sizeof(atm_profile)`. The call returns the `atm_profile` structure in `pr_buffer`.

Attributes

Operating System:	OS-9 and OS-9 for 68K
State:	User
Threads:	Safe

Parameters

`path`	Contains a handle identifying the I/O path. This handle is usually obtained from calls such as `ite_path_open()`, `_os_open()`, and `socket()`.
`*conn`	Input parameter. Must have the service type set to `ITE_SVC_DATA_IP`.

`*pr_size`	Size of the buffer passed in.
`*pr_buffer`	Pointer to user's buffer.

See Also

`_os_ss_vc_add()`

For More Information

Refer to the ***SoftStax Programming Reference Manual*** for more information about this call.

Chapter 8: Porting an ATM Driver

This chapter provides information on using the sample ATM driver and general requirements for writing your own ATM drivers.

Introduction

The ATM driver lies at the bottom of the protocol stack and provides ATM connectivity by controlling the ATM network device at the hardware interface.

Design Overview

The ATM driver, like every SPF driver, has the following entry points:

Table 8-1 Entry Points

Entry Point	Description
`dr_downdata`	Sends data packets over ATM connection
`dr_getstat`	Handles getstat codes
`dr_iniz`	Initializes hardware, allocates memory, installs interrupt service routine
`dr_setstat`	Handles setstat codes
`dr_term`	Terminates hardware, deallocates memory, uninstalls interrupt service routine
`dr_updata`	Unused – returns `EOS_UNKSVC`

For More Information

For more information on SPF driver porting, refer to the ***SoftStax Porting Guide***.

ATM Driver Functions

This section lists the requirements for an ATM driver. It also describes the actions taken by the ATM driver on various events, such as open/close and incoming packet.

On Open/Push

The ATM driver must be able to support multiple protocol stacks above it. This means directly above the ATM driver there could be, simultaneously, different kinds of protocol drivers. The ATM driver must keep static storage on a per OS-9 path basis. Every path has its own per path storage. During push time (`SPF_SS_PUSH`), the ATM driver should store the updriver device entry in the per path storage. Also, with every path there is an associated VPI/VCI. More than one path can have the same VPI/VCI, as long as they have the same protocol driver directly above the ATM driver.

To Set the VPI/VCI

To set the VPI/VCI, applications use the setstat `SPF_SS_VC_SET` (or `_os_ss_vc_set()` in `atm.l`). This takes as a parameter a 32-bit integer which is (`VPI<<16|VCI`).

Memory for the example driver has been configured so VPIs must be less than 0x40.

On Close

If the path is closed and no other path using this VPI/VCI exists, the ATM driver must deallocate all local VC channel storage associated with that VC. The actual call control for closing the VC is outside the scope of the ATM driver and is handled by the signalling stack in conjunction with the application or the LLC/SNAP driver.

On an Incoming Packet

The ATM driver searches the per-path storage for the first path with the VPI/VCI on which the incoming packet arrived. The ATM driver then sends the packet in an mbuf to the upper protocol driver on that path using `DR_FMCALLUP_PKT`.

For More Information

For more information about the ATM Packet, refer to Interaction with the ATM Driver in Chapter 2: LLC/SNAP Protocol Driver of this manual.

For more information about `DR_FMCALLUP_PKT`, refer to the ***SoftStax Porting Guide***.

On an Outgoing Packet

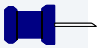
The ATM driver searches for the current path descriptor in the per-path static storage.The ATM driver then sends the data out on the VPI/VCI associated with that path.

Limits on VPIs/VCIs

The 24-bit VPI/VCI is changed to the 16-bit VC number by concatenating the `n` Least Significant Bits (LSBs) of the VPI with the 16 -`n` LSBs of the VCI.

The VPI/VCI Reduction Register (VRR) has a `SHIFT` field containing `n` and a `MASK` field. Macro `VRR_REG` in `defs.h` defines the VRR register. The `n` LSBs of the VPI are shifted over the `n` Most Significant Bits (MSBs) of the VCI. The 16-bit result is then ANDed with the `MASK` field (the mask is not applied to the LSB) to generate the `VC_Number`. The `VC_Number` is then right-shifted one bit to become a pointer into the receive lookup table. The `VC_Number` must not point to a control memory area outside the receive

lookup table area which is bounded by 0 and the start of the receive free buffers pool descriptors. For example, if receive free buffer pool descriptors start at 0x2000 (see macro `PMA_ADDR` in `defs.h`) and the VRR `SHIFT` field is 8, then the maximum VPI is 63.



Note

The ATM driver and descriptors for the NEC and 8XXFADS are currently set up so the VPI must be less than 0x40. For the SBC8260 the descriptor is setup so the VPI must be 0x0C or less and the VCI must be in the range 0x10 - 0x01.

ATM Driver Specific Setstats and Getstats

The following setstats and getstats are specific to the ATM driver:

Table 8-2 Setstats/Getstats

Call	Description	Library Call
SPF_SS_VC_SET	Gets VPI/VCI on a path Sets VPI/VCI on a path	_os_gs_vc_set() _os_ss_vc_set()

For More Information

For more information about these library calls, refer to **Chapter 7: Library Function Reference**.

SPF_SS_VC_SET

This setstat/getstat entry in the ATM driver sets or gets the VPI/VCI on a path. This takes as a parameter a 32-bit integer which is `VPI<<16|VCI` (the first 16 bits is the VPI and the next 16 bits is the VCI). The ZeitNet board memory has been configured to restrict the range of VPI/VCIs and only allows VPIs less than 0x40.

This setstat code also gets the VPI/VCI on a path.

Special Considerations for ATM

The ATM driver allocates mbufs for incoming packets. These mbufs are released by upper layers. Since the ATM data rates are high, the mbuf pool is likely to be exhausted unless upper layer protocol drivers quickly return mbufs to the mbuf pool. Also, experience with developing the example driver shows that, at ATM data rates, if the ATM driver has to get a mbuf from the SysMbuf pool in interrupt context, the driver is too slow and can cause overflows and packet loss. To overcome this:

- During initialization, the driver allocates an array of mbufs and sets the `SPF_NOFREE` bit on these mbufs. When a mbuf is sent to the upper layers and they attempt to release it, the mbuf library checks the `SPF_NOFREE` bit. Since it is set, the library simply sets the `SPF_DONE` bit. When the ATM driver needs a free mbuf, instead of going to the SysMbuf pool, it can simply scan its array of preallocated mbufs, searching for an mbuf with the `SPF_DONE` bit set. The ATM driver can then clear the `SPF_DONE` bit and reuse the mbuf.
- During the `SPF_SS_UPDATE` setstat, the driver sets the `stk_reliable` flag to `STK_RELIABLE`. ATM performs a Cyclic Redundancy Check (CRC) for each incoming AAL-5 frame. Therefore, upper layers need not verify the checksum on the packets. If the ATM driver sets the `stk_reliable` flag, the upper layer protocols may disable checksum verification on incoming packets. This leads to faster mbuf release.

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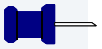

Note

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http://www.atmforum.com/

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MICROWARE SOFTWARE

Numerics

16-CAP Carrierless Amplitude/Phase Modulation with 16 constellation points: The modulation technique used in the 51.84 Mb Mid-Range Physical Layer Specification for Category 3 Unshielded Twisted-Pair (UTP-3).

64-CAP Carrierless Amplitude/Phase Modulation with 64 constellation points.

A

AAL

ATM Adapation Layer: The standards layer that allows multiple applications to have data converted to and from the ATM cell. A protocol used that translates higher layer services into the size and format of an ATM cell.

AAL Connection

Association established by the AAL between two or more next higher layer entities.

AAL-1

ATM Adaptation Layer Type 1: AAL functions in support of constant bit rate, time-dependent traffic such as voice and video.

AAL-2

ATM Adaptation Layer Type 2: This AAL is still undefined by the International Standards bodies. It is a placeholder for variable bit rate video transmission.

AAL-3/4

ATM Adaptation Layer Type 3/4: AAL functions in support of variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support. Originally two AAL types, i.e. connection-oriented and connectionless, which have been combined.

AAL-5

ATM Adaptation Layer Type 5: AAL functions in support of variable bit rate, delay-tolerant connection-oriented data traffic requiring minimal sequencing or error detection support.

ABR

Available Bit Rate: ABR is an ATM layer service category for which the limiting ATM layer transfer characteristics provided by the network may change subsequent to connection establishment. A flow control mechanism is specified which supports several types of feedback to control the source rate in response to changing ATM layer transfer characteristics. It is expected that an end-system that adapts its traffic in accordance with the feedback will experience a low cell loss ratio and obtain a fair share of the available bandwidth according to a network specific allocation policy. Cell delay variation is not controlled in this service, although admitted cells are not delayed unnecessarily.

ACM

Address Complete Message: A BISUP call control message from the receiving exchange to sending exchange indicating the completion of address information.

ACR

Attenuation to Crosstalk Ratio: One of the factors that limits the distance a signal may be sent through a given media. ACR is the ratio of the power of the received signal, attenuated by the media, over the power of the NEXT crosstalk from the local transmitter, usually expressed in decibels (db). To achieve a desired bit error rate, the received signal power must usually be several times larger than the NEXT power or plus several db. Increasing a marginal ACR may decrease the bit error rate.

ACR

Allowed Cell Rate: An ABR service parameter, ACR is the current rate in cells/sec at which a source is allowed to send.

Address Prefix

A string of 0 or more bits up to a maximum of 152 bits that is the lead portion of one or more ATM addresses.

Address Resolution

Address Resolution is the procedure by which a client associates a LAN destination with the ATM address of another client or the BUS.

Adjacency

The relationship between two communicating neighboring peer nodes.

Administrative Domain

A collection of managed entities grouped for administrative reasons.

ADPCM

Adaptive Differential Pulse Code Modulation: A reduced bit rate variant of PCM audio encoding (see also PCM). This algorithm encodes the difference between an actual audio sample amplitude and a predicted amplitude and adapts the resolution based on recent differential values.

ADTF

ACR Decrease Time Factor: This is the time permitted between sending RM-cells before the rate is decreased to ICR (Initial Cell Rate). The ADTF range is .01 to 10.23 sec. with granularity of 10 ms.

AFI

Authority and Format Identifier: This identifier is part of the network level address header.

Aggregation

Token A number assigned to an outside link by the border nodes at the ends of the outside link. The same number is associated with all uplinks and induced uplinks associated with the outside link. In the parent and all higher-level peer group, all uplinks with the same aggregation token are aggregated.

AHFG

ATM-attached Host Functional Group: The group of functions performed by an ATM-attached host that is participating in the MPOA service.

Ai

Signaling ID assigned by Exchange A.

AIM

ATM Inverse Multiplexer: A term discontinued because of conflict with an established product. Refer to AIMUX.

AIMUX

ATM Inverse Multiplexing: A device that allows multiple T1 or E1 communications facilities to be combined into a single broadband facility for the transmission of ATM cells.

AIR

Additive Increase Rate: An ABR service parameter, AIR controls the rate at which the cell transmission rate increases. It is signaled as AIRF, where AIRF = AIR*Nrm/PCR.

AIRF

Additive Increase Rate Factor: Refer to AIR.

AIS

Alarm Indication Signal: An all ones signal sent down or up stream by a device when it detects an error condition or receives an error condition or receives an error notification from another unit in the transmission path.

Alternate Routing

A mechanism that supports the use of a new path after an attempt to set up a connection along a previously selected path fails.

AMI

Alternate Mark Inversion: A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

Ancestor Node

A logical group node that has a direct parent relationship to a given node (i.e., it is the parent of that node, or the parent's parent, ...).

ANI

Automatic Number Identification: A charge number parameter that is normally included in the Initial Address Message to the succeeding carrier for billing purposes.

ANM

Answer Message: A BISUP call control message from the receiving exchange to the sending exchange indicating answer and that a through connection should be completed in both directions.

ANSI

American National Standards Institute: A U.S. standards body.

API

Application Program Interface: API is a programmatic interface used for interprogram communications or for interfacing between protocol layers.

API_connection

Native ATM Application Program Interface Connection: API_connection is a relationship between an API_endpoint and other ATM devices that has the following characteristics:

- Data communication may occur between the API_endpoint and the other ATM devices comprising the API_connection
- Each API_connection may occur over a duration of time only once; the same set of communicating ATM devices may form a new connection after a prior connection is released
- The API_connection may be presently active (able to transfer data), or merely anticipated for the future

APPN

Advanced Peer to Peer Network: IBM network architecture for building dynamic routing across arbitrary network topologies. Intended as an eventual replacement for SNA, IBM's static routed, hierarchical network architecture.

ARE

All Routes Explorer: A specific frame initiated by a source which is sent on all possible routes in Source Route Bridging.

ARP

Address Resolution Protocol: The procedures and messages in a communications protocol which determines which physical network address (MAC) corresponds to the IP address in the packet.

ASP

Abstract Service Primitive: An implementation-independent description of an interaction between a service-user and a service-provider at a particular service boundary, as defined by Open Systems Interconnection (OSI).

Assigned Cell

Cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

Asynchronous Time Division Multiplexing

A multiplexing technique in which a transmission capability is organized in a priori unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

ATM

Asynchronous Transfer Mode: A transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Address

Defined in the UNI Specification as 3 formats, each having 20 bytes in length including country, area and end-system identifiers.

ATM Layer Link

A section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link

A virtual path link (VPL) or a virtual channel link (VCL).

ATM Peer-to-Peer Connection

A virtual channel connection (VCC) or a virtual path connection (VPC).

ATM Traffic Descriptor

A generic list of traffic parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-User Connection

An association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher entities or between two or more ATM-entities). The communications over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) issued for both directions of a connection at an interface.

ATS

Abstract Test Suite: A set of abstract test cases for testing a particular protocol. An "executable" test suite may be derived from an abstract test suite.

Attenuation

The process of the reduction of the power of a signal as it passes through most media. Usually proportional to distance, attenuation is sometimes the factor that limits the distance a signal may be transmitted through a media before it can no longer be received.

B

B-ICI

B-ISDN Inter-Carrier Interface: An ATM Forum defined specification for the interface between public ATM networks to support user services across multiple public carriers.

B-ICI SAAL

B-ICI Signaling ATM Adaptation Layer: A signaling layer that permits the transfer of connection control signaling and ensures reliable delivery of the protocol message. The SAAL is divided into a Service Specific part and a Common part (AAL5).

B-ISDN

Broadband ISDN: A high-speed network standard (above 1.544 Mbps) that evolved Narrowband ISDN with existing and new services with voice, data and video in the same network.

B-LLI

Broadband Low Layer Information: This is a Q.2931 information element that identifies a layer 2 and a layer 3 protocol used by the application.

B-TE

Broadband Terminal Equipment: An equipment category for B-ISDN which includes terminal adapters and terminals.

BBC

Broadband Bearer Capability: A bearer class field that is part of the initial address message.

BCD

Binary Coded Decimal: A form of coding of each octet within a cell where each bit has one of two allowable states, 1 or 0.

BCOB

Broadband Connection Oriented Bearer: Information in the SETUP message that indicates the type of service requested by the calling user.

BCOB-A

Bearer Class A: Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-C

Bearer Class C: Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-X

Bearer Class X: Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

BECN

Backward Explicit Congestion Notification: A Resource Management (RM) cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

BER

Bit Error Rate: A measure of transmission quality. It is generally shown as a negative exponent, (e.g., 10-7 which means 1 out of 107 bits are in error or 1 out of 10,000,000 bits are in error).

BHLI

Broadband High Layer Information: This is a Q.2931 information element that identifies an application (or session layer protocol of an application).

Bi

Signaling ID assigned by Exchange B.

BIP

Bit Interleaved Parity: A method used at the PHY layer to monitor the error performance of the link. A check bit or word is sent in the link overhead covering the previous block or frame. Bit errors in the payload will be detected and may be reported as maintenance information.

BIS

Border Intermediate System.

BISUP

Broadband ISDN User's Part: A SS7 protocol which defines the signaling messages to control connections and services.

BN

Bridge Number: A locally administered bridge ID used in Source Route Bridging to uniquely identify a route between two LANs.

BN

BECN Cell: A Resource Management (RM) cell type indicator. A Backwards Explicit Congestion Notification (BECN) RM-cell may be generated by the network or the destination. To do so, BN=1 is set, to indicate the cell is not source-generated, and DIR=1 to indicate the backward flow. Source generated RM-cells are initialized with BN=0.

BOM

Beginning of Message: An indicator contained in the first cell of an ATM segmented packet.

Border Node

A logical node that is in a specified peer group, and has at least one link that crosses the peer group boundary.

BPDU

Bridge Protocol Data Unit: A message type used by bridges to exchange management and control information.

BPP

Bridge Port Pair (Source Routing Descriptor): Frame header information identifying a bridge/LAN pair of a Source route segment.

Broadband

A service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access

An ISDN access capable of supporting one or more broadband services.

Broadcast

Data transmission to all addresses or functions.

BT

Burst Tolerance: BT applies to ATM connections supporting VBR services and is the limit parameter of the GCRA.

Btag

Beginning Tag: A one octet field of the CPCS_PDU used in conjunction with the Etag octet to form an association between the beginning of message and end of message.

BUS

Broadcast and Unknown Server: This server handles data sent by an LE Client to the broadcast MAC address ('FFFFFFFFFFFF'), all multicast traffic, and initial unicast frames which are sent by a LAN Emulation Client.

BW

Bandwidth: A numerical measurement of throughput of a system or network.

C

CAC

Connection Admission Control: Connection Admission Control is defined as the set of actions taken by the network during the call set- up phase (or during call re-negotiation phase) in order to determine whether a connection request can be accepted or should be rejected (or whether a request for re-allocation can be accommodated).

Call

A call is an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

CAS

Channel Associated Signaling: A form of circuit state signaling in which the circuit state is indicated by one or more bits of signaling status sent repetitively and associated with that specific circuit.

CBDS

Connectionless Broadband Data Service: A connectionless service similar to Bellcore's SMDS defined by European Telecommunications Standards Institute (ETSI).

CBR

Constant Bit Rate: An ATM service category which supports a constant or guaranteed rate to transport services such as video or voice as well as circuit emulation which requires rigorous timing control and performance parameters.

CCR

Current Cell Rate: The Current Cell Rate is an RM-cell field set by the source to its current ACR when it generates a forward RM-cell. This field may be used to facilitate the calculation of ER, and may not be changed by network elements. CCR is formatted as a rate.

CCS

Common Channel Signaling: A form signaling in which a group of circuits share a signaling channel. Refer to SS7.

CD-ROM

Compact Disk-Read Only Memory: Used by a computer to store large amounts of data. Commonly used for interactive video games.

CDF

Cutoff Decrease Factor: CDF controls the decrease in ACR (Allowed Cell Rate) associated with CRM.

CDV

Cell Delay Variation: CDV is a component of cell transfer delay, induced by buffering and cell scheduling. Peak-to-peak CDV is a QoS delay parameter associated with CBR and VBR services. The peak-to- peak CDV is the ((1-a) quantile of the CTD) minus the fixed CTD that could be experienced by any delivered cell on a connection during the entire connection holding time. The parameter "a" is the probability of a cell arriving late. See CDVT.

CDVT

Cell Delay Variation Tolerance-ATM layer functions may alter the traffic characteristics of ATM connections by introducing Cell Delay Variation. When cells from two or more ATM connections are multiplexed, cells of a given ATM connection may be delayed while cells of another ATM

connection are being inserted at the output of the multiplexer. Similarly, some cells may be delayed while physical layer overhead or OAM cells are inserted. Consequently, some ran domness may affect the inter-arrival time between consecutive cells of a connection as monitored at the UNI. The upper bound on the "clumping" measure is the CDVT.

CE

Connection Endpoint: A terminator at one end of a layer connection within a SAP.

CEI

Connection Endpoint Identifier: Identifier of a CE that can be used to identify the connection at a SAP.

Cell

A unit of transmission in ATM. A fixed-size frame consisting of a 5-octet header and a 48-octet payload.

Cell Header

ATM Layer protocol control information.

Cells in Frames

Cells In Frames is a protocol established by the CIF Alliance which specifies how to transport ATM protocol over Ethernet, Token Ring and other frame protocols. CIF uses software at the workstation instead of a new hardware Network Interface Card to do QOS scheduling and ABR flow control.

CER

Cell Error Ratio: The ratio of errored cells in a transmission in relation to the total cells sent in a transmission. The measurement is taken over a time interval and is desirable to be measured on an in-service circuit.

CES

Circuit Emulation Service: The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

Child Node

A node at the next lower level of the hierarchy which is contained in the peer group represented by the logical group node currently referenced. This could be a logical group node, or a physical node.

Child Peer Group

A child peer group of a peer group is any one containing a child node of a logical group node in that peer group. A child peer group of a logical group node is the one containing the child node of that logical group node.

CI

Congestion Indicator: This is a field in a RM-cell, and is used to cause the source to decrease its ACR. The source sets CI=0 when it sends an RM-cell. Setting CI=1 is typically how destinations indicate that EFCI has been received on a previous data cell.

CIP

Carrier Identification Parameter: A 3 or 4 digit code in the initial address message identifying the carrier to be used for the connection.

CIR

Committed Information Rate: CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

CL

Connectionless Service: A service which allows the transfer of information among service subscribers without the need for end-to- end establishment procedures.

CLP

Cell Loss Priority: This bit in the ATM cell header indicates two levels of priority for ATM cells. CLP=0 cells are higher priority than CLP=1 cells. CLP=1 cells may be discarded during periods of congestion to preserve the CLR of CLP=0 cells.

CLR

Cell Loss Ratio: CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

CMIP

Common Management Interface Protocol: An ITU-TSS standard for the message formats and procedures used to exchange management information in order to operate, administer maintain and provision a network.

CMR

Cell Misinsertion Rate: The ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

CNR

Complex Node Representation: A collection of nodal state parameters that provide detailed state information associated with a logical node.

COD

Connection Oriented Data: Data requiring sequential delivery of its component PDUs to assure correct functioning of its supported application, (e.g., voice or video).

COM

Continuation of Message: An indicator used by the ATM Adaptation Layer to indicate that a particular ATM cell is a continuation of a higher layer information packet which has been segmented.

Common Peer Group

The lowest level peer group in which a set of nodes is represented. A node is represented in a peer group either directly or through one of its ancestors.

Communication endpoint

An object associated with a set of attributes which are specified at the communication creation time.

Configuration

The phase in which the LE Client discovers the LE Service.

Connection

An ATM connection consists of concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connection

In switched virtual connection (SVC) environments the LAN Emulation Management entities set up connections between each other using UNI signaling.

Connectionless

Refers to ability of existing LANs to send data without previously establishing connections.

Control Connections

A Control VCC links the LEC to the LECS. Control VCCs also link the LEC to the LES and carry LE_ARP traffic and control frames. The control VCCs never carry data frames.

Corresponding Entities

Peer entities with a lower layer connection among them.

CPCS

Common Part Convergence Sublayer: The portion of the convergence sublayer of an AAL that remains the same regardless of the traffic type.

CPCS-SDU

Common Part Convergence Sublayer-Service Data Unit: Protocol data unit to be delivered to the receiving AAL layer by the destination CP convergence sublayer.

CPE

Customer Premises Equipment: End user equipment that resides on the customer's premise which may not be owned by the local exchange carrier.

CPN

Calling Party Number: A parameter of the initial address message that identifies the calling number and is sent to the destination carrier.

Crankback

A mechanism for partially releasing a connection setup in progress which has encountered a failure. This mechanism allows PNNI to perform alternate routing.

CRC

Cyclic Redundancy Check: A mathematical algorithm that computes a numerical value based on the bits in a block of data. This number is transmitted with the data and the receiver uses this information and the same algorithm to insure the accurate delivery of data by comparing the results of algorithm and the number received. If a mismatch occurs, an error in transmission is presumed.

CRF

Cell Relay Function: This is the basic function that an ATM network performs in order to provide a cell relay service to ATM end-stations.

CRF

Connection Related Function: A term used by Traffic Management to reference a point in a network or a network element where per connection functions are occurring. This is the point where policing at the VCC or VPC level may occur.

CRM

Missing RM-Cell Count: CRM limits the number of forward RM-cells which may be sent in the absence of received backward RM-cells.

CRM

Cell Rate Margin: This is a measure of the difference between the effective bandwidth allocation and the allocation for sustainable rate in cells per second.

CRS

Cell Relay Service: A carrier service which supports the receipt and transmission of ATM cells between end users in compliance with ATM standards and implementation specifications.

CS

Convergence Sublayer; The general procedures and functions that convert between ATM and non-ATM formats. This describes the functions of the upper half of the AAL layer. This is also used to describe the conversion functions between non-ATM protocols such as frame relay or SMDS and ATM protocols above the AAL layer.

CSU

Channel Service Unit: An interface for digital leased lines which performs loopback testing and line conditioning.

CT

Conformance Test: Testing to determine whether an implementation complies with the specifications of a standard and exhibits the behaviors mandated by that standard.

CTD

Cell Transfer Delay: This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

D

DA

Destination Address: Information sent in the forward direction indicating the address of the called station or customer.

DA

Destination MAC Address: A six octet value uniquely identifying an endpoint and which is sent in IEEE LAN frame headers to indicate frame destination.

Data Connections

Data VCCs connect the LECs to each other and to the Broadcast and Unknown Server. These carry Ethernet/IEEE 802.3 or IEEE 802.5 data frames as well as flush messages.

DCC

Data Country Code: This specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the data country code are encoded in Binary Coded Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value "F" to fill the two octets.

DCE

Data Communication Equipment: A generic definition of computing equipment that attaches to a network via a DTE.

Default Node Representation

A single value for each nodal state parameter giving the presumed value between any entry or exit to the logical node and the nucleus.

Demultiplexing

A function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection.

DES

Destination End Station: An ATM termination point which is the destination for ATM messages of a connection and is used as a reference point for ABR services. See SES.

Dijkstra's Algorithm

An algorithm that is sometimes used to calculate routes given a link and nodal state topology database.

DIR

This is a field in an RM-cell which indicates the direction of the RM- cell with respect to the data flow with which it is associated. The source sets DIR=0 and the destination sets DIR=1.

Direct Set

A set of host interfaces which can establish direct layer two communications for unicast (not needed in MPOA).

DLPI

UNIX International, Data Link Provider Interface (DLPI) Specification: Revision 2.0.0, OSI Work Group, August 1991.

Domain

Refer to Administrative Domain.

DS

Distributed Single Layer Test Method: An abstract test method in which the upper tester is located within the system under test and the point of control and observation (PCO) is located at the upper service boundary of the Implementation Under Test (IUT) - for testing one protocol layer. Test events are specified in terms of the abstract service primitives (ASP) at the upper tester above the IUT and ASPs and/or protocol data units (PDU) at the lower tester PCO.

DS-0

Digital Signal, Level 0: The 64 kbps rate that is the basic building block for both the North American and European digital hierarchies.

DS-1

Digital Signal, Level 1: The North American Digital Hierarchy signaling standard for transmission at 1.544 Mbps. This standard supports 24 simultaneous DS-0 signals. The term is often used interchangeably with T1 carrier although DS-1 signals may be exchanged over other transmission systems.

DS-2

Digital Signal, Level 2: The North American Digital Hierarchy signaling standard for transmission of 6.312 Mbps that is used by T2 carrier which supports 96 calls.

DS-3

Digital Signal, Level 3: The North American Digital Hierarchy signaling standard for transmission at 44.736 Mbps that is used by T3 carrier. DS-3 supports 28 DS-1s plus overhead.

DS3 PLCP

Physical Layer Convergence Protocol: An alternate method used by older T carrier equipment to locate ATM cell boundaries. This method has recently been moved to an informative appendix of the ATM DS3 specification and has been replaced by the HEC method.

DSE

Distributed Single-Layer Embedded (Test Method): An abstract test method in which the upper tester is located within the system under test and there is a point of control and observation at the upper service boundary of the Implementation Under Test (IUT) for testing a protocol layer, or sublayer, which is part of a multi-protocol IUT.

DSS1

Digital Subscriber Signalling System #1: N-ISDN UNI Signalling

DSS2 Setup

DSS2 Digital Subscriber Signalling System #2: B-ISDN UNI Signalling

DSU

Data Service Unit: Equipment used to attach users' computing equipment to a public network.

DTE

Data Terminal Equipment: A generic definition of external networking interface equipment such as a modem.

DTL

Designated Transit List: A list of nodes and optional link IDs that completely specify a path across a single PNNI peer group.

DTL Originator

The first switching system within the entire PNNI routing domain to build the initial DTL stack for a given connection.

DTL

Terminator The last switching system within the entire PNNI routing domain to process the connection and thus the connection's DTL.

DXI

Data Exchange Interface: A variable length frame-based ATM interface between a DTE and a special ATM CSU/DSU. The ATM CSU/DSU converts between the variable-length DXI frames and the fixed-length ATM cells.

E.164

A public network addressing standard utilizing up to a maximum of 15 digits. ATM uses E.164 addressing for public network addressing.

E1

Also known as CEPT1, the 2.048 Mbps rate used by European CEPT carrier to transmit 30 64 kbps digital channels for voice or data calls, plus a 64 kbps signaling channel and a 64 kbps channel for framing and maintenance.

E3

Also known as CEPT3, the 34.368 Mbps rate used by European CEPT carrier to transmit 16 CEPT1s plus overhead.

Edge Device

A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

EFCI

Explicit Forward Congestion Indication: EFCI is an indication in the ATM cell header. A network element in an impending-congested state or a congested state may set EFCI so that this indication may be examined by the destination end-system. For example, the end- system may use this indication to implement a protocol that adaptively lowers the cell rate of the connection during congestion or impending congestion. A network element

that is not in a congestion state or an impending congestion state will not modify the value of this indication. Impending congestion is the state when a network equipment is operating around its engineered capacity level.

EFS

Error Free Seconds: A unit used to specify the error performance of T carrier systems, usually expressed as EFS per hour, day, or week. This method gives a better indication of the distribution of bit errors than a simple bit error rate (BER). Also refer to SES.

ELAN

Emulated Local Area Network: A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

EMI

Electromagnetic Interference: Equipment used in high speed data systems, including ATM, that generate and transmit many signals in the radio frequency portion of the electromagnetic spectrum. Interference to other equipment or radio services may result if sufficient power from these signals escape the equipment enclosures or transmission media. National and international regulatory agencies (FCC, CISPR, etc.) set limits for these emissions. Class A is for industrial use and Class B is for residential use.

EML

Element Management Layer: An abstraction of the functions provided by systems that manage each network element on an individual basis.

EMS

Element Management System: A management system that provides functions at the element Management Layer.

End Station

These devices (e.g., hosts or PCs) enable the communication between ATM end stations and end stations on "legacy" LAN or among ATM end stations.

Entry Border Node

The node which receives a call over an outside link. This is the first node within a peer group to see this call.

EOM

End of Message: An indicator used in the AAL that identifies the last ATM cell containing information from a data packet that has been segmented.

ER

Explicit Rate: The Explicit Rate is an RM-cell field used to limit the source ACR to a specific value. It is initially set by the source to a requested rate (such as PCR). It may be subsequently reduced by any network element in the path to a value that the element can sustain. ER is formatted as a rate.

ES

End System: A system where an ATM connection is terminated or initiated. An originating end system initiates the ATM connection, and terminating end system terminates the ATM connection. OAM cells may be generated and received.

ESF

Extended Superframe: A DS1 framing format in which 24 DS0 times lots plus a coded framing bit are organized into a frame which is repeated 24 times to form a superframe.

ESI

End System Identifier: This identifier distinguishes multiple nodes at the same level in case the lower level peer group is partitioned.

ETSI

European Telecommunications Standards Institute: The primary telecommunications standards organization.

Exception

A connectivity advertisement in a PNNI complex node representation that represents something other than the default node representation.

Exit Border Node

The node that will progress a call over an outside link. This is the last node within a peer group to see this call.

Exterior

Denotes that an item (e.g., link, node, or reachable address) is outside of a PNNI routing domain.

Exterior Link

A link which crosses the boundary of the PNNI routing domain. The PNNI protocol does not run over an exterior link.

Exterior Reachable Address

An address that can be reached through a PNNI routing domain, but which is not located in that PNNI routing domain.

Exterior Route

A route which traverses an exterior link.

F

Fairness

As related to Generic Flow Control (GFC), fairness is defined as meeting all the agreed quality of service (QOS) requirements, by controlling the order of service for all active connections.

FC

Feedback Control: Feedback controls are defined as the set of actions taken by the network and by the end-systems to regulate the traffic submitted on ATM connections according to the state of network elements.

FCS

Frame Check Sequence: Any mathematical formula which derives a numeric value based on the bit pattern of a transmitted block of information and uses that value at the receiving end to determine the existence of any transmission errors.

FDDI

Fiber Distributed Data Interface: A 100 Mbps Local Area Network standard that was developed by ANSI that is designed to work on fiber-optic cables, using techniques similar to token-ring.

FEBE

Far End Block Error: A maintenance signal transmitted in the PHY overhead that a bit error(s) has been detected at the PHY layer at the far end of the link. This is used to monitor bit error performance of the link.

FEC

Forward Error Correction: A technique for detection and correction of errors in a digital data stream.

FG

Functional Group: A collection of functions related in such a way that they will be provided by a single logical component. Examples include the Route Server Functional Group (RSFG), the IASG (Internetwork Address Sub-Group), Coordination Functional Group (ICFG), the Edge Device Functional Group (EDFG) and the ATM attached host Behavior Functional Group (AHFG).

Flush Protocol

The flush protocol is provided to ensure the correct order of delivery of unicast data frames.

Foreign Address

An address that does not match any of a given node's summary addresses.

Forwarding Description

The resolved mapping of an MPOA Target to a set of parameters used to set up an ATM connection on which to forward packets.

FRS

Frame-Relay Service: A connection oriented service that is capable of carrying up to 4096 bytes per frame.

FRTT

Fixed Round-Trip Time: This is the sum of the fixed and propagation delays from the source to the furthest destination and back.

G.703

ITU-T Recommendation G.703, "Physical/Electrical Characteristics of Hierarchical Digital Interfaces".

G.704

ITU-T Recommendation G.704, "Synchronous Frame Structures Used at Primary and Secondary Hierarchy Levels".

G.804

ITU-T Recommendation G.804, "ATM Cell Mapping into Plesiochronous Digital Hierarchy (PDH)".

GCAC

Generic Connection Admission Control: This is a process to determine if a link has potentially enough resources to support a connection.

GCRA

Generic Cell Rate Algorithm: The GCRA is used to define conformance with respect to the traffic contract of the connection. For each cell arrival the GCRA determines whether the cell conforms to the traffic contract. The UPC function may implement the GCRA, or one or more equivalent algorithms to enforce conformance. The GCRA is defined with two parameters: the Increment (I) and the Limit (L).

GFC

Generic Flow Control: GFC is a field in the ATM header which can be used to provide local functions (e.g., flow control). It has local significance only and the value encoded in the field is not carried end-to-end.

H-Channel

H-Channels are ISDN bearer services that have pre-defined speeds, starting and stopping locations on a PRI and are contiguously transported from one PRI site through networks to another PRI site.

H0 Channel

A 384 kbps channel that consists of six contiguous DS0s (64 kbps) of a T1 line.

H10 Channel

The North American 1472 kbps channel from a T1 or primary rate carrier. This is equivalent to twenty-three (23) 64 kbps channels.

H11 Channel

The North American primary rate used as a single 1536 kbps channel. This channel uses 24 contiguous DS0s or the entire T1 line except for the 8 kbps framing pattern.

H12

The European primary rate used as a single 1920 kbps channel (30 64 kbps channels or the entire E1 line except for the 64 kbps framing and maintenance channel.

HBFG

Host Behavior Functional Group: The group of functions performed by an ATM-attached host that is participating in the MPOA service.

HDLC

High Level Data Link Control: An ITU-TSS link layer protocol standard for point-to-point and multi-point communications.

Header

Protocol control information located at the beginning of a protocol data unit.

HEC

Header Error Control: Using the fifth octet in the ATM cell header, ATM equipment may check for an error and corrects the contents of the header. The check character is calculated using a CRC algorithm allowing a single bit error in the header to be corrected or multiple errors to be detected.

Hello Packet

A type of PNNI Routing packet that is exchanged between neighboring logical nodes.

Hierarchically Complete Source Route

A stack of DTLs representing a route across a PNNI routing domain such that a DTL is included for each hierarchical level between and including the current level and the lowest visible level in which the source and destination are reachable.

Hop-by-Hop Route

A route that is created by having each switch along the path use its own routing knowledge to determine the next hop of the route, with the expectation that all switches will choose consistent hops such that the call will reach the desired destination. PNNI does not use hop-by-hop routing.

Horizontal Link

A link between two logical nodes that belong to the same peer group.

Host Apparent Address

A set of internetwork layer addresses which a host will directly resolve to lower layer addresses.

I

I.356

ITU-T Specifications for Traffic Measurement.

I.361

B-ISDN ATM Layer Specification.

I.362

B-ISDN ATM Layer (AAL) Functional Description.

I.363

B-ISDN ATM Layer (AAL) Specification.

I.432

ITU-T Recommendation for B-ISDN User-network Interface.

IASG

Internetwork Address Sub-Group: A range of internetwork layer addresses summarized in an internetwork layer routing protocol.

ICD

International Code Designator: This identifies an international organization. The registration authority for the International Code Designator is maintained by the British Standards Institute. The length of this field is two octets.

ICR

Initial Cell Rate: An ABR service parameter, in cells/sec, that is the rate at which a source should send initially and after an idle period.

IDU

Interface Data Unit: The unit of information transferred to/from the upper layer in a single interaction across the SAP. Each IDU contains interface control information and may also contain the whole or part of the SDU.

IEC

Inter-exchange Carrier: A long distance telephone company.

IEEE

Institute of Electrical and Electronics Engineers: A worldwide engineering publishing and standards-making body for the electronics industry.

IEEE 802.3

A Local Area Network protocol suite commonly known as Ethernet. Ethernet has either a 10 Mbps or 100 Mbps throughput and uses Carrier Sense Multiple Access bus with Collision Detection CSMA/CD. This method allows users to share the network cable. However, only one station can use the cable at a time. A variety of physical medium dependent protocols are supported.

IEEE 802.5

A Local Area Network protocol suite commonly known as Token Ring. A standard originated by IBM for a token passing ring network that can be configured in a star topology. Versions supported are 4 Mbps and 16 Mbps.

IETF

Internet Engineering Task Force: The organization that provides the coordination of standards and specification development for TCP/IP networking.

ILMI

Integrated Local Managment Interface: An ATM Forum defined interim specification for network management functions between an end user and a public or private network and between a public network and a private network. This is based on a limited subset of SNMP capabilities.

Induced Uplink

An uplink "A" that is created due to the existence of an uplink "B" in the child peer group represented by the node that created uplink "A". Both "A" and "B" share the same upnode, which is higher in the PNNI hierarchy than the peer group in which uplink "A" is seen.

Inside Link

Synonymous with horizontal link.

Instance ID

A subset of an object's attributes which serve to uniquely identify a MIB instance.

Interior

Denotes that an item (e.g., link, node, or reachable address) is inside of a PNNI routing domain.

Internal Reachable Address

An address of a destination that is directly attached to the logical node advertising the address.

IOP

Interoperability: The ability of equipment from different manufacturers (or different implementations) to operate together.

IP

Internet Protocol: Originally developed by the Department of Defense to support interworking of dissimilar computers across a network. This protocol works in conjunction with TCP and is usually identified as TCP/IP. A connectionless protocol that operates at the network layer (layer 3) of the OSI model.

IPX

Novell Internetwork Packet Exchange: A built-in networking protocol for Novell Netware. It was derived from the Xerox Network System protocol and operates at the network layer of the OSI protocol model.

IS

Intermediate System: A system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

ISO

International Organization for Standardization: An international organization for standardization, based in Geneva, Switzerland, that establishes voluntary standards and promotes global trade of 90 member countries.

ITU-T

International Telecommunications Union Telecommunications: ITU-T is an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry. The fundamental standards for ATM have been defined and published by the ITU-T (Previously CCITT).

ITU H.222

An ITU-T Study Group 15 standard that addresses the multiplexing of multimedia data on an ATM network.

ITU Q.2100

B-ISDN Signaling ATM Adapation Layer Overview.

ITU Q.2110

B-ISDN Adapation Layer -- Service Specific Connection Oriented Protocol.

ITU Q.2130

B-ISDN Adapation Layer -- Service Specific Connection Oriented Function for Support of Signaling at the UNI.

ITU Q.2931

The signaling standard for ATM to support Switched Virtual Connections. This is based on the signaling standard for ISDN.

ITU Q.931

The signaling standard for ISDN to support SVCs. The basis for the signaling standard developed for Frame Relay and ATM.

ITU Q.933

The signaling standard for Frame Relay to support SVCs. This is based on the signaling standard for ISDN.

IUT

Implementation Under Test: The particular portion of equipment which is to be studied for testing. The implementation may include one or more protocols.

IWF

Interworking Function

J

Joining

The phase in which the LE Client establishes its control connections to the LE Server.

JPEG

Joint Photographic Experts Group: An ISO Standards group that defines how to compress still pictures.

L

LAN

Local Area Network: A network designed to move data between stations within a campus.

LANE

LAN Emulation: The set of services, functional groups and protocols which provide for the emulation of LANS utilizing ATM as a backbone to allow connectivity among LAN and ATM attached end stations.

LAPD

Link Access Procedure D: A layer 2 protocol defined by CCITT (original name of ITU-T). This protocol reliably transfers blocks of information across a single Layer 1 link and supports multiplexing of different connections at Layer 2.

Layer Entity

An active element within a layer.

Layer Function

A part of the activity of the layer entities.

Layer Service

A capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data

Data transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

LB

Leaky Bucket: Leaky Bucket is the term used as an analogous description of the algorithm used for conformance checking of cell flows from a user or network. See GCRA, UPC and NPC. The "leaking hole in the bucket" applies to the sustained rate at which cells can be accommodated, while the "bucket depth" applies to the tolerance to cell bursting over a given time period.

LE

LAN Emulation. Refer to LANE.

LE_ARP

LAN Emulation Address Resolution Protocol: A message issued by a LE client to solicit the ATM address of another function.

Leadership Priority

The priority with which a logical node wishes to be elected peer group leader of its peer group. Generally, of all nodes in a peer group, the one with the highest leadership priority will be elected as peer group leader.

Leaky Bucket

An informal term for the Generic Cell Rate Algorithm.

LEC

Local Exchange Carrier: A telephone company affiliate of a Regional Bell Operating Company or an Independent Telephone Company.

LEC

LAN Emulation Client: The entity in end systems which performs data forwarding, address resolution, and other control functions.

LECID

LAN Emulation Client Identifier: This identifier, contained in the LAN Emulation header, indicates the ID of the ATM host or ATM-LAN bridge. It is unique for every ATM Client.

LECS

LAN Emulation Configuration Server: This implements the policy controlled assignment of individual LE clients to different emulated LANs by providing the LES ATM addresses.

LES

LAN Emulation Server: This implements the control coordination function for the Emulated LAN, examples are enabling a LEC to join an ELAN, resolving MAC to ATM addresses.

LGN

Logical Group Node: LGN is a single node that represents the lowest level peer groups in the respective higher level peer group.

LIJP

Leaf Initiated Joint Parameter: Root screening options and Information Element (IE) instructions carried in SETUP message.

Link

An entity that defines a topological relationship (including available transport capacity) between two nodes in different subnetworks. Multiple links may exist between a pair of subnetworks. Synonymous with logical link.

Link Aggregation Token

Refer to Aggregation Token.

Link Attribute

A link state parameter that is considered individually to determine whether a given link is acceptable and/or desirable for carrying a given connection.

Link Connection

A link connection (e.g., at the VP-level) is a connection capable of transferring information transparently across a link without adding any overhead, such as cells for purposes for monitoring. It is delineated by connection points at the boundary of the subnetwork.

Link Constraint

A restriction on the use of links for path selection for a specific connection.

Link Metric

A link parameter that requires the values of the parameter for all links along a given path to be combined to determine whether the path is acceptable and/or desirable for carrying a given connection.

Link State Parameter

Information that captures an aspect or property of a link.

LNNI

LANE NNI: The standardized interface between two LAN servers (LES-LES, BUS-BUS, LECS-LECS and LECS-LES).

LOC

Loss of Cell Delineation: A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost cell delineation. Used to monitor the performance of the PHY layer.

LOF

Loss of Frame: A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost frame delineation. This is used to monitor the performance of the PHY layer.

Logical Group Node

A logical node that represents a lower level peer group as a single point for purposes of operating at one level of the PNNI routing hierarchy.

Logical Link

An abstract representation of the connectivity between two logical nodes. This includes individual physical links, individual virtual path connections, and parallel physical links and/or virtual path connections.

Logical Node

An abstract representation of a peer group or a switching system as a single point.

Logical Node ID

A string of bits that unambiguously identifies a logical node within a routing domain.

LOP

Loss of Pointer: A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost the pointer to the start of cell in the payload. This is used to monitor the performance of the PHY layer.

LOS

Loss of Signal: A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost the received signal. This is used to monitor the performance of the PHY layer.

LPF

Low Pass Filter: In an MPEG-2 clock recovery circuit, it is a technique for smoothing or averaging changes to the system clock.

LSAP

Link Service Access Point: Logical address of boundary between layer 3 and LLC sublayer 2.

LSB

Least Significant Bit: The lowest order bit in the binary representation of a numerical value.

LSR

Leaf Setup Request: A setup message type used when a leaf node requests connection to existing point-to-multipoint connection or requests creation of a new multipoint connection.

LT

Lower Tester: The representation in ISO/IEC 9646 of the means of providing, during test execution, indirect control and observation of the lower service boundary of the IUT using the underlying service provider.

LTE

SONET Lite Terminating Equipment: ATM equipment terminating a communications facility using a SONET Lite Transmission Convergence (TC) layer. This is usually reserved for end user or LAN equipment. The SONET Lite TC does not implement some of the maintenance functions used in long haul networks such as termination of path, line and section overhead.

LUNI

LANE UNI: The standardized interface between a LE client and a LE Server (LES,LECS and BUS).

M

M1

Management Interface 1: The management of ATM end devices.

M2

Management Interface 2: The management of Private ATM networks or switches.

M3

Management Interface 3: The management of links between public and private networks.

M4

Management Interface 4: The management of public ATM networks.

M5

Management Interface 5: The management of links between two public networks.

MAC

Media Access Control: IEEE specifications for the lower half of the data link layer (layer 2) that defines topology dependent access control protocols for IEEE LAN specifications.

MAN

Metropolitan Area Network: A network designed to carry data over an area larger than a campus such as an entire city and its outlying area.

Managed System

An entity that is managed by one or more management systems, which can be either Element Management Systems, Subnetwork or Network Management Systems, or any other management systems.

Management Domain

An entity used here to define the scope of naming.

Management System

An entity that manages a set of managed systems, which can be either NEs, subnetworks or other management systems.

MaxCR

Maximum Cell Rate: This is the maximum capacity usable by connections belonging to the specified service category.

MBS

Maximum Burst Size: In the signaling message, the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

MCDV

Maximum Cell Delay Variance: This is the maximum two-point CDV objective across a link or node for the specified service category.

MCLR

Maximum Cell Loss Ratio: This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

MCR

Minimum Cell Rate: An ABR service traffic descriptor, in cells/sec, that is the rate at which the source is always allowed to send.

MCTD

Maximum Cell Transfer Delay: This is the sum of the fixed delay component across the link or node and MCDV.

Metasignaling

ATM Layer Management (LM) process that manages different types of signaling and possibly semipermanent virtual channels (VCs), including the assignment, removal and checking of VCs.

Metasignaling VCs

The standardized VCs that convey metasignaling information across a User-Network Interface (UNI).

MIB

Management Information Base: A definition of management items for some network component that can be accessed by a network manager. A MIB includes the names of objects it contains and the type of information retained.

MIB Attribute

A single piece of configuration, management, or statistical information which pertains to a specific part of the PNNI protocol operation.

MIB Instance

An incarnation of a MIB object that applies to a specific part, piece, or aspect of the PNNI protocol's operation.

MIB Object

A collection of attributes that can be used to configure, manage, or analyze an aspect of the PNNI protocol's operation.

MID

Message Identifier: The message identifier is used to associate ATM cells that carry segments from the same higher layer packet.

MIR

Maximum Information Rate: Refer to PCR.

MMF

Multimode Fiberoptic Cable: Fiberoptic cable in which the signal or light propagates in multiple modes or paths. Since these paths may have varying lengths, a transmitted pulse of light may be received at different times and smeared to the point that pulses may interfere with surrounding pulses. This may cause the signal to be difficult or impossible to receive. This pulse dispersion sometimes limits the distance over which a MMF link can operate.

MPEG

Motion Picture Experts Group: An ISO Standards group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA

Multiprotocol over ATM: An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

MPOA Client

A device which implements the client side of one or more of the MPOA protocols, (i.e., is a SCP client and/or an RDP client. An MPOA Client is either an Edge Device Functional Group (EDFG) or a Host Behavior Functional Group (HBFG).

MPOA Server

An MPOA Server is any one of an ICFG or RSFG.

MPOA Service Area

The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server.

MPOA Target

A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes that MPOA devices may use as lookup keys.

Mrm

An ABR service parameter that controls allocation of bandwidth between forward RM-cells, backward RM-cells, and data cells.

MSB

Most Significant Bit: The highest order bit in the binary representation of a numerical value.

MT

Message Type: Message type is the field containing the bit flags of a RM-cell. These flags are as follows:

DIR = 0 for forward

RM-cells = 1 for backward;

RM-cells BN = 1 for Non-Source Generated (BECN),

RM-cells = 0 for Source Generated

RM-cells CI = 1 to indicate congestion = 0 otherwise NI = 1 to indicate no additive increase allowed = 0 otherwise RA -- Not used for ATM Forum ABR.

MTP

Message Transfer Part: Level 1 through 3 protocols of the SS7 protocol stack. MTP 3 (Level 3) is used to support BISUP.

Multicasting

The transmit operation of a single PDU by a source interface where the PDU reaches a group of one or more destinations.

Multiplexing

A function within a layer that interleaves the information from multiple connections into one connection.

Multipoint Access

User access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Multipoint Connection

A Multipoint-to-Multipoint Connection is a collection of associated ATM VC or VP links, and their associated nodes, with the following properties:

1. All Nodes in the connection, called endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.

2. Each of the endpoints on the connection can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Multipoint-to-Point Connection

A Point-to-Multipoint Connection may have zero bandwidth from the Root node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection. Note that UNI 4.0 does not support this connection type.

N-ISDN

Narrowband Integrated Services Digital Network: Services include basic rate interface (2B+D or BRI) and primary rate interface (30B+D - Europe and 23B+D - North America or PRI). Supports narrowband speeds at/or below 1.5 Mbps.

Native Address

An address that matches one of a given node's summary addresses.

NDIS

Network Driver Interface Specification: Refer to 3COM/Microsoft, LAN Manager: Network Driver Interface Specification, October 8, 1990.

NE

Network Element: A system that supports at least NEFs and may also support Operation System Functions/Mediation Functions. An ATM NE may be realized as either a standalone device or a geographically distributed system. It cannot be further decomposed into managed elements in the context of a given management function.

NEF

Network Element Function: A function within an ATM entity that supports the ATM based network transport services, (e.g., multiplexing, cross-connection).

Neighbor Node

A node that is directly connected to a particular node via a logical link.

NEL

Network Element Layer: An abstraction of functions related specifically to the technology, vendor, and the network resources or network elements that provide basic communications services.

NEXT

Near End Crosstalk: Equipment that must concurrently receive on one wire pair and transmit on another wire pair in the same cable bundle must accommodate NEXT interference. NEXT is the portion of the transmitted signal that leaks into the receive pair. Since at this point on the link the transmitted signal is at maximum and the receive signal has been attenuated, it may be difficult to maintain an acceptable ACR with the received signal if the cable media allows large amounts of crosstalk leakage to occur. Foiled or shielded cables generally have less crosstalk than unshielded varieties.

NM

Network Management Entity: The body of software in a switching system that provides the ability to manage the PNNI protocol. NM interacts with the PNNI protocol through the MIB.

NML

Network Management Layer: An abstraction of the functions provided by systems which manage network elements on a collective basis, so as to monitor and control the network end-to-end.

NMS

Network Management System: An entity that implements functions at the Network Management Layer. It may also include Element Management Layer functions. A Network Management System may manage one or more other Network Management Systems.

NMS Environment

A set of NMS which cooperate to manage one or more subnetworks.

NNI

Network Node Interface: An interface between ATM switches defined as the interface between two network nodes.

Nodal Attribute

A nodal state parameter that is considered individually to determine whether a given node is acceptable and/or desirable for carrying a given connection.

Nodal Constraint

A restriction on the use of nodes for path selection for a specific connection.

Nodal Metric

A nodal parameter that requires the values of the parameter for all nodes along a given path to be combined to determine whether the path is acceptable and/or desirable for carrying a given connection.

Nodal State Parameter

Information that captures an aspect or property of a node.

Node

Synonymous with logical node.

NPC

Network Parameter Control: Network Parameter Control is defined as the set of actions taken by the network to monitor and control traffic from the NNI. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior which can affect the QoS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions. Refer to UPC.

Nrm

An ABR service parameter, Nrm is the maximum number of cells a source may send for each forward RM-cell.

NSAP

Network Service Access Point: OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

NSR

Non-Source Routed: Frame forwarding through a mechanism other than Source Route Bridging.

NT

Network Termination: Network Termination represents the termination point of a Virtual Channel, Virtual Path, or Virtual Path/Virtual Channel at the UNI.

NTSC

National Television System Committee: An industry group that defines how television signals are encoded and transmitted in the US.

Nucleus

The interior reference point of a logical node in the PNNI complex node representation.

nx64K

This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels (where n= integer > 1). The 64K or DS0 channel is the basic rate provided by the T Carrier systems.

O

OAM

Operations Administration and Maintenance: A group of network management functions that provide network fault indication, performance information, and data and diagnosis functions.

Octet

A term for eight (8) bits that is sometimes used interchangeably with "byte" to mean the same thing.

ODI

Open Data-Link Interface: This refers to Novell Incorporated, Open Data-Link Interface Developer's Guide, March 20, 1992.

One Hop Set

A set of hosts which are one hop apart in terms of internetwork protocols TTLs (TTL=0 -on the wire+).

OOF

Out of Frame. Refer to LOF.

OSI

Open Systems Interconnection: A seven (7) layer architecture model for communications systems developed by the ISO for the interconnection of data communications systems. Each layer uses and builds on the services provided by those below it.

OSPF

Open Shortest Path First: A link-state routing algorithm that is used to calculate routes based on the number of routers, transmission speed, delays and route cost.

OUI

Organizationally Unique Identifier: The OUI is a three-octet field in the IEEE 802.1a defined SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

Outlier

A node whose exclusion from its containing peer group would significantly improve the accuracy and simplicity of the aggregation of the remainder of the peer group topology.

Outside Link

A link to an outside node.

Outside Node

A node which is participating in PNNI routing, but which is not a member of a particular peer group.

P

PAD

Packet Assembler and Disassembler: A PAD assembles packets of asynchronous data and emits these buffers in a burst to a packet switch network. The PAD also disassembles packets from the network and emits the data to the non-packet device.

Parent Node

The logical group node that represents the containing peer group of a specific node at the next higher level of the hierarchy.

Parent Peer Group

The parent peer group of a peer group is the one containing the logical group node representing that peer group. The parent peer group of a node is the one containing the parent node of that node.

Path Constraint

A bound on the combined value of a topology metric along a path for a specific connection.

PBX

Private Branch eXchange: PBX is the term given to a device which provides private local voice switching and voice-related services within the private network. A PBX could have an ATM API to utilize ATM services, for example Circuit Emulation Service.

PC

Protocol Control: Protocol Control is a mechanism which a given application protocol may employ to determine or control the performance and health of the application. Example, protocol liveness may require that protocol control information be sent at some minimum rate; some applications may become intolerable to users if they are unable to send at least at some minimum rate. For such applications, the concept of MCR is defined. Refer to MCR.

PCM

Pulse Code Modulation: An audio encoding algorithm which encodes the amplitude of a repetitive series of audio samples. This encoding algorithm converts analog voice samples into a digital bit stream.

PCO

Point of Control and Observation: A place (point) within a testing environment where the occurrence of test events is to be controlled and observed as defined by the particular abstract test method used.

PCR

Program Clock Reference: A timestamp that is inserted by the MPEG-2 encoder into the Transport Stream to aid the decoder in the recovering and tracking the encoder clock.

PCR

Peak Cell Rate: The Peak Cell Rate, in cells/sec, is the cell rate which the source may never exceed.

PDH

Plesiochronous Digital Hierarchy: PDH (plesiochronous means nearly synchronous), was developed to carry digitized voice over twisted pair cabling more efficiently. This evolved into the North American, European, and Japanese Digital Hierarchies where only a discrete set of fixed rates is available, namely, nxDS0 (DS0 is a 64 kbps rate) and then the next levels in the respective multiplex hierarchies.

PDU

Protocol Data Unit: A PDU is a message of a given protocol comprising payload and protocol-specific control information, typically contained in a header. PDUs pass over the protocol interfaces which exist between the layers of protocols (per OSI model).

Peer Entities

Entities within the same layer.

Peer Group

A set of logical nodes which are grouped for purposes of creating a routing hierarchy. PTSEs are exchanged among all members of the group.

Peer Group Identifier

A string of bits that is used to unambiguously identify a peer group.

Peer Group Leader

A node which has been elected to perform some of the functions associated with a logical group node.

Peer Group Level

The number of significant bits in the peer group identifier of a particular peer group.

Peer Node

A node that is a member of the same peer group as a given node.

PES

Packetized Elementary Stream: In MPEG-2, after the media stream has been digitized and compressed, it is formatted into packets before it is multiplexed into either a Program Stream or Transport Stream.

PG

Peer Group: A set of logical nodes which are grouped for purposes of creating a routing hierarchy. PTSEs are exchanged among all members of the group.

PGL

Peer Group Leader: A single real physical system which has been elected to perform some of the functions associated with a logical group node.

PHY

OSI Physical Layer: The physical layer provides for transmission of cells over a physical medium connecting two ATM devices. This physical layer is comprised of two sublayers: the PMD Physical Medium Dependent sublayer, and the TC Transmission Convergence sublayer. Refer PMD and TC.

Physical Layer (PHY) Connection

An association established by the PHY between two or more ATM entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

Physical Link

A real link which attaches two switching systems.

PICS

Protocol Implementation Conformance Statement: A statement made by the supplier of an implementation or system stating which capabilities have been implemented for a given protocol.

PID

Protocol Identification. Refer to OUI.

PIXIT

Protocol Implementation eXtra Information for Testing: A statement made by a supplier or implementor of an IUT which contains information about the IUT and its testing environment which will enable a test laboratory to run an appropriate test suite against the IUT.

Plastic Fiber Optics

An optical fiber where the core transmission media is plastic in contrast to glass or silica cores. Proposed plastic fibers generally have larger attenuation and dispersion than glass fiber but may have applications where the distance is limited. Plastic systems may also offer lower cost connectors that may be installed with simple tools and a limited amount of training.

PLCP

Physical Layer Convergence Protocol: The PLCP is defined by the IEEE 802.6. It is used for DS3 transmission of ATM. ATM cells are encapsulated in a 125microsecond frame defined by the PLCP which is defined inside the DS3 M-frame.

PLL

Phase Lock Loop: Phase Lock Loop is a mechanism whereby timing information is transferred within a data stream and the receiver derives the signal element timing by locking its local clock source to the received timing information.

PM

Physical Medium: Physical Medium refers to the actual physical interfaces. Several interfaces are defined including STS-1, STS-3c, STS-12c, STM-1, STM-4, DS1, E1, DS2, E3, DS3, E4, FDDI-based, Fiber Channel-based, and STP. These range in speeds from 1.544Mbps through 622.08 Mbps.

PMD

Physical Media Dependent: This sublayer defines the parameters at the lowest level, such as speed of the bits on the media.

PNI

Permit Next Increase: An ABR service parameter, PNI is a flag controlling the increase of ACR upon reception of the next backward RM-cell. PNI=0 inhibits increase. The range is 0 or 1.

PNNI

Private Network-Network Interface: A routing information protocol that enables extremely scalable, full function, dynamic multi-vendor ATM switches to be integrated in the same network.

PNNI Protocol Entity

The body of software in a switching system that executes the PNNI protocol and provides the routing service.

PNNI Routing Control Channel

VCCs used for the exchange of PNNI routing protocol messages.

PNNI Routing Domain

A group of topologically contiguous systems which are running one instance of PNNI routing.

PNNI Routing Hierarchy

The hierarchy of peer groups used for PNNI routing.

PNNI Topology State Element

A collection of PNNI information that is flooded among all logical nodes within a peer group.

PNNI Topology State Packet

A type of PNNI Routing packet that is used for flooding PTSEs among logical nodes within a peer group.

POH

Path Overhead: A maintenance channel transmitted in the SONET overhead following the path from the beginning multiplexer to the ending demultiplexer. This is not implemented in SONET Lite.

Point-to-Multipoint Connection

A Point-to-Multipoint Connection is a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root Node sends information, all of the remaining nodes on the connection, called Leaf Nodes, receive copies of the information.

2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See note below for UNI 4.0 support)

3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: UNI 4.0 does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection

A connection with only two endpoints.

Port Identifier

The identifier assigned by a logical node to represent the point of attachment of a link to that node.

PRI

Primary Rate Interface: An ISDN standard for provisioning of 1.544 Mbit/s (DS1 - North America, Japan, et al) or 2.048 Mbit/s (E1 - Europe) ISDN services. DS1 is 23 "B" channels of 64 kbit/s each and one signalling "D" channel of 64 kbit/s/ E1 is 30 "B" channels of 64 kbit/s each and one signalling "D" channel of 64 kbit/s.

PRS

Primary Reference Source

Primitive

An abstract, implementation independent, interaction between a layer service user and a layer service provider.

Private ATM Address

A twenty-byte address used to identify an ATM connection termination point.

Protocol

A set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information

Information exchanged between corresponding entities, using a lower layer connection, to coordinate their joint operation.

PT

Payload Type: Payload Type is a 3-bit field in the ATM cell header that discriminates between a cell carrying management information or one which is carrying user information.

PTI

Payload Type Indicator: Payload Type Indicator is the Payload Type field value distinguishing the various management cells and user cells. Example: Resource Management cell has PTI=110, end-to-end OAM F5 Flow cell has PTI=101.

PTMPT

Point-To-Multipoint: A main source to many destination connections.

PTS

Presentation Time Stamp: A timestamp that is inserted by the MPEG-2 encoder into the packetized elementary stream to allow the decoder to synchronize different elementary streams (i.e. lip sync).

PTSE

PNNI Topology State Element: A collection of PNNI information that is flooded among all logical nodes within a peer group.

PTSP

PNNI Topology State Packet: A type of PNNI Routing packet that is used for flooding PTSEs among logical nodes within a peer group.

PVC

Permanent Virtual Circuit: This is a link with static route defined in advance, usually by manual setup.

PVCC

Permanent Virtual Channel Connection: A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

PVPC

Permanent Virtual Path Connection: A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A Permanent VPC is one which is provisioned through some network management function and left up indefinitely.

QD

Queuing Delay: Queuing Delay refers to the delay imposed on a cell by its having to be buffered because of unavailability of resources to pass the cell onto the next network function or element. This buffering could be a result of oversubscription of a physical link, or due to a connection of higher priority or tighter service constraints getting the resource of the physical link.

QoS

Quality of Service: Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection: o Cell Loss Ratio o Cell Transfer Delay o Cell Delay Variation

Q.SIG

A symmetrical adaptatation of N-ISDN signalling (DSS1) for inter-PBX signalling.

R

RBOC

Regional Bell Operating Company: Seven companies formed to manage the local exchanges originally owned by AT&T. These companies were created as a result of an agreement between AT&T and the United States Department of Justice.

RD

Routing Domain: A group of topologically contiguous systems which are running one instance of routing.

RDF

Rate Decrease Factor: An ABR service parameter, RDF controls the decrease in the cell transmission rate. RDF is a power of 2 from 1/32,768 to 1.

RO

Read-Only: Attributes which are read-only can not be written by Network Management. Only the PNNI Protocol entity may change the value of a read-only attribute. Network Management entities are restricted to only reading such read-only attributes. Read-only attributes are typically for statistical information, including reporting result of actions taken by auto-configuration.

RW

Read-Write : Attributes which are read-write can not be written by the PNNI protocol entity. Only the Network Management Entity may change the value of a read-write attribute. The PNNI Protocol Entity is restricted to only

reading such read-write attributes. Read-write attributes are typically used to provide the ability for Network Management to configure, control, and manage a PNNI Protocol Entity's behavior.

Registration

The address registration function is the mechanism by which Clients provide address information to the LAN Emulation Server.

Relaying

A function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

RFC

Request For Comment: The development of TCP/IP standards, procedures and specifications is done via this mechanism. RFCs are documents that progress through several development stages, under the control of IETF, until they are finalized or discarded.

RFC1695

Definitions of Managed Objects for ATM Management or AToM MIB.

RFI

Radio Frequency Interface: Refer to EMI.

RIF

Rate Increase Factor: This controls the amount by which the cell transmission rate may increase upon receipt of an RM-cell. The additive increase rate AIR=PCR*RIF. RIF is a power of 2, ranging from 1/32768 to 1.

RISC

Reduced Instruction Set Computing: A computer processing technology in which a microprocessor understands a few simple instructions thereby providing fast, predictable instruction flow.

RM

Resource Management: Resource Management is the management of critical resources in an ATM network. Two critical resources are buffer space and trunk bandwidth. Provisioning may be used to allocate network resources in order to separate traffic flows according to service characteristics. VPCs play a key role in resource management. By reserving capacity on VPCs, the processing required to establish individual VCCs is reduced. Refer to RM-cell.

RM-Cell

Resource Management Cell: Information about the state of the net work like bandwidth availability, state of congestion, and impending congestion, is conveyed to the source through special control cells called Resource Management Cells (RM-cells).

Route Server

A physical device that runs one or more network layer routing protocols, and which uses a route query protocol in order to provide network layer routing forwarding descriptions to clients.

Router

A physical device that is capable of forwarding packets based on network layer information and that also participates in running one or more network layer routing protocols.

Routing Computation

The process of applying a mathematical algorithm to a topology database to compute routes. There are many types of routing computations that may be used. The Djikstra algorithm is one particular example of a possible routing computation.

Routing Constraint

A generic term that refers to either a topology constraint or a path constraint.

Routing Protocol

A general term indicating a protocol run between routers and/or route servers in order to exchange information used to allow computation of routes. The result of the routing computation will be one or more forwarding descriptions.

RS

Remote single-layer (Test Method): An abstract test method in which the upper tester is within the system under test and there is a point of control and observation at the upper service boundary of the Implementation Under Test (IUT) for testing one protocol layer. Test events are specified in terms of the abstract service primitives (ASP) and/or protocol data units at the lower tester PCO.

RSE

Remote Single-layer Embedded (Test Method): An abstract test method in which the upper tester is within the system under test and there is a point of control and observation at the upper service boundary of the Implementation Under Test (IUT) for testing a protocol layer or sublayer which is part of a multi-protocol IUT.

RSFG

Route Server Functional Group: The group of functions performed to provide internetworking level functions in an MPOA System. This includes running conventional interworking Routing Protocols and providing inter-IASG destination resolution.

SA

Source Address: The address from which the message or data originated.

SA

Source MAC Address: A six octet value uniquely identifying an end point and which is sent in an IEEE LAN frame header to indicate source of frame.

SAAL

Signaling ATM Adaptation Layer: This resides between the ATM layer and the Q.2931 function. The SAAL provides reliable transport of Q.2931 messages between Q.2931 entities (e.g., ATM switch and host) over the ATM layer; two sublayers: common part and service specific part.

SAP

Service Access Point: A SAP is used for the following purposes:

1. When the application initiates an outgoing call to a remote ATM device, a destination_SAP specifies the ATM address of the remote device, plus further addressing that identifies the target software entity within the remote device.

2. When the application prepares to respond to incoming calls from remote ATM devices, a local_SAP specifies the ATM address of the device housing the application, plus further addressing that identifies the application within the local device.

There are several groups of SAPs that are specified as valid for Native ATM Services.

SAR

Segmentation and Reassembly: Method of breaking up arbitrarily sized packets.

Scope

A scope defines the level of advertisement for an address. The level is a level of a peer group in the PNNI routing hierarchy.

SCCP

Signaling Connection and Control Part: A SS7 protocol that provides additional functions to the Message Transfer Part (MTP). It typically supports Transaction Capabilities Application Part (TCAP).

SCP

Service Control Point: A computer and database system which executes service logic programs to provide customer services through a switching system. Messages are exchanged with the SSP through the SS7 network.

SCR

Sustainable Cell Rate: The SCR is an upper bound on the conforming average rate of an ATM connection over time scales which are long relative to those for which the PCR is defined. Enforcement of this bound by the UPC could allow the network to allocate sufficient resources, but less than those based on the PCR, and still ensure that the performance objectives (e.g., for Cell Loss Ratio) can be achieved.

SDH

Synchronous Digital Hierarchy: The ITU-TSS International standard for transmitting information over optical fiber.

SDT

Structured Data Transfer: An AAL1 data transfer mode in which data is structured into blocks which are then segmented into cells for transfer.

SDU

Service Data Unit: A unit of interface information whose identity is preserved from one end of a layer connection to the other.

SE

Switching Element: Switching Element refers to the device or network node which performs ATM switching functions based on the VPI or VPI/VCI pair.

SEAL

Simple and Efficient Adapation Layer: An earlier name for AAL5.

Segment

A single ATM link or group of interconnected ATM links of an ATM connection.

SEL

Selector: A subfield carried in SETUP message part of ATM endpoint address Domain specific Part (DSP) defined by ISO 10589, not used for ATM network routing, used by ATM end systems only.

Semipermanent Connection

A connection established via a service order or via network management.

SES

Severely Errored Seconds: A unit used to specify the error performance of T carrier systems. This indicates a second containing ten or more errors, usually expressed as SES per hour, day, or week. This method gives a better indication of the distribution of bit errors than a simple Bit Error Rate (BER). Refer also to EFS.

SES

Source End Station: An ATM termination point, which is the source of ATM messages of a connection, and is used as a reference point for ABR services. Refer to DES.

SF

SuperFrame: A DS1 framing format in which 24 DS0 timeslots plus a coded framing bit are organized into a frame which is repeated 12 times to form the superframe.

Shaping Descriptor

N ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of a connection.

SIPP

SMDS Interface Protocol: Protocol where layer 2 is based on ATM, AAL and DQDB. Layer 1 is DS1 and DS3.

SMDS

Switched Multi-Megabit Data Services: A connectionless service used to connect LANs, MANs and WANs to exchange data.

SMF

Single Mode Fiber: Fiber optic cable in which the signal or light propagates in a single mode or path. Since all light follows the same path or travels the same distance, a transmitted pulse is not dispersed and does not interfere with adjacent pulses. SMF fibers can support longer distances and are limited mainly by the amount of attenuation. Refer to MMF.

SN

Sequence Number: SN is a 4 octet field in a Resource Management cell defined by the ITU-T in recommendation I.371 to sequence such cells. It is not used for ATM Forum ABR. An ATM switch will either preserve this field or set it in accordance with I.371.

SN cell

Sequence Number Cell: A cell sent periodically on each link of an AIMUX to indicate how many cells have been transmitted since the previous SN cell. These cells are used to verify the sequence of payload cells reassembled at the receiver.

SNA

Systems Network Architecture: IBM's seven layer, vendor specific architecture for data communications

SNC

Subnetwork Connection: In the context of ATM, an entity that passes ATM cells transparently, (i.e., without adding any overhead). A SNC may be either a stand-alone SNC, or a concatenation of SNCs and link connections.

SNMP

Simple Network Management Protocol: Originally designed for the Department of Defense network to support TCP/IP network management. It has been widely implemented to support the management of a broad range of network products and functions. SNMP is the IETF standard management protocol for TCP/IP networks.

SONET

Synchronous Optical Network: An ANSI standard for transmitting information over optical fiber. This standard is used or accepted in the United States and Canada and is a variation of the SDH International standard.

Source Route

As used in this document, a hierarchically complete source route.

Source Traffic

A set of traffic parameters belonging to the ATM Traffic Descriptor Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

SPE

SONET Synchronous Payload Envelope.

Split System

A switching system which implements the functions of more than one logical node.

SPTS

Single Program Transport Stream: An MPEG-2 Transport Stream that consists of only one program.

SR

Source Routing: A bridged method whereby the source at a data exchange determines the route that subsequent frames will use.

SRF

Specifically Routed Frame: A Source Routing Bridging Frame which uses a specific route between the source and destination.

SRT

Source Routing Transparent: An IETF Bridging Standard combining Transparent Bridging and Source Route Bridging.

SRTS

Synchronous residual Time Stamp: A clock recovery technique in which difference signals between source timing and a network reference timing signal are transmitted to allow reconstruction of the source timing at the destination.

SSCF

Service Specific Coordination Function: SSCF is a function defined in Q.2130, B-ISDN Signaling ATM Adaptation Layer-Service Specific Coordination Function for Support of Signaling at the User-to- Network Interface.

SSCOP

Service Specific Connection Oriented Protocol: An adaptation layer protocol defined in ITU-T Specification: Q.2110.

SSCS

Service Specific Convergence Sublayer: The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

SS7

Signal System Number 7: A family of signaling protocols originating from narrowband telephony. They are used to set-up, manage and tear down connections as well as to exchange non-connection associated information. Refer to BISUP, MTP, SCCP and TCAP.

STC

System Time Clock: The master clock in an MPEG-2 encoder or decoder system.

STE

Spanning Tree Explorer: A Source Route Bridging frame which uses the Spanning Tree algorithm in determining a route.

STE

SONET Section Terminating Equipment: SONET equipment that terminates a section of a link between a transmitter and repeater, repeater and repeater, or repeater and receiver. This is usually implemented in wide area facilities and not implemented by SONET Lite.

STM

Synchronous Transfer Module: STM is a basic building block used for a synchronous multiplexing hierarchy defined by the CCITT/ITU-T. STM-1 operates at a rate of 155.52 Mbps (same as STS-3).

STM-1

Synchronous Transport Module 1: SDH standard for transmission over OC-3 optical fiber at 155.52 Mbps.

STM-n

Synchronous Transport Module "n" : (where n is an integer) SDH standards for transmission over optical fiber (OC-'n x 3) by multiplexing "n" STM-1 frames, (e.g., STM-4 at 622.08 Mbps and STM-16 at 2.488 Gbps).

STM-nc

Synchronous Transport Module "n" concatenated: (where n is an integer) SDH standards for transmission over optical fiber (OC-'n x 3) by multiplexing "n" STM-1 frames, (e.g., STM-4 at 622.08 Mbps and STM-16 at 2.488 Gbps, but treating the information fields as a single concatenated payload).

STP

Signaling Transfer Point: A high speed, reliable, special purpose packet switch for signaling messages in the SS7 network.

STP

Shielded Twisted Pair: A cable containing one or more twisted pair wires with each pair having a shield of foil wrap.

STS-1

Synchronous Transport Signal 1: SONET standard for transmission over OC-1 optical fiber at 51.84 Mbps.

STS-n

Synchronous Transport Signal "n" : (where n is an integer) SONET standards for transmission over OC-n optical fiber by multiplexing "n" STS-1 frames, (e.g., STS-3 at 155.52 Mbps STS-12 at 622.08 Mbps and STS-48 at 2.488 Gbps).

STS-nc

Synchronous Transport Signal "n" concatenated: (where n is an integer) SONET standards for transmission over OC-n optical fiber by multiplexing "n" STS-1 frames, (e.g., STS-3 at 155.52 Mbps STS-12 at 622.08 Mbps and STS-48 at 2.488 Gbps but treating the information fields as a single concatenated payload).

Sublayer

A logical sub-division of a layer.

Subnet

The use of the term subnet to mean a LAN technology is a historical use and is not specific enough in the MPOA work. Refer to Internetwork Address Sub-Group, Direct Set, Host Apparent Address Sub-Group and One Hop Set for more specific definitions.

Subnetwork

A collection of managed entities grouped together from a connectivity perspective, according to their ability to transport ATM cells.

subNMS

Subnetwork Management System: A Network Management System that is managing one or more subnetworks and that is managed by one or more Network Management Systems.

Summary Address

An address prefix that tells a node how to summarize reachability information.

SUT

System Under Test: The real open system in which the Implementation Under Test (IUT) resides.

SVC

Switched Virtual Circuit: A connection established via signaling. The user defines the endpoints when the call is initiated.

SVCC

Switched Virtual Channel Connection: A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

SVE

SAP Vector Element: The SAP address may be expressed as a vector, (ATM_addr, ATM_selector, BLLI_id2, BLLI_id3, BHLI_id), where:

- ATM_addr corresponds to the 19 most significant octets of a device's 20-octet ATM address (private ATM address structure) or the entire E.164 address (E.164 address structure)

- ATM_selector corresponds to the least significant octet of a device's 20-octet ATM address (private ATM address structure only)
- BLLI_id2 corresponds to an octet in the Q.2931 BLLI information element that identifies a layer 2 protocol
- BLLI_id3 corresponds to a set of octets in the Q.2931 BLLI information element that identify a layer 3 protocol
- BHLI_id corresponds to a set of octets in the Q.2931 BHLI information element that identify an application (or session layer protocol of an application)

Each element of the SAP vector is called a SAP Vector Element, or SVE. Each SVE consists of a tag, length, and value field.

SVPC

Switched Virtual Path Connection: A Switched Virtual Path Connection is one which is established and taken down dynamically through control signaling. A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell.

Switched Connection

A connection established via signaling.

Switching System

A set of one or more systems that act together and appear as a single switch for the purposes of PNNI routing.

Symmetric Connection

A connection with the same bandwidth value specified for both directions.

T1E1

An ANSI standards sub-committee dealing with Network Interfaces.

T1M1

An ANSI standards sub-committee dealing with Inter-Network Operations, Administration and Maintenance.

T1Q1

An ANSI standards sub-committee dealing with performance.

T1S1

An ANSI standards sub-committee dealing with services, architecture and signaling.

T1X1

An ANSI standards sub-committee dealing with digital hierarchy and synchronization.

TB

Transparent Bridging: An IETF bridging standard where bridge behavior is transparent to the data traffic. To avoid ambiguous routes or loops, a Spanning Tree algorithm is utilized.

TBE

Transient Buffer Exposure: This is a negotiated number of cells that the network would like to limit the source to sending during startup periods, before the first RM-cell returns.

TC

Transaction Capabilities: TCAP (see below) plus supporting Presentation, Session and Transport protocol layers.

TC

Transmission Convergence: The TC sublayer transforms the flow of cells into a steady flow of bits and bytes for transmission over the physical medium. On transmit, the TC sublayer maps the cells to the frame format, generates the Header Error Check (HEC), sends idle cells when the ATM layer has none to send. On reception, the TC sublayer delineates individual cells in the received bit stream, and uses the HEC to detect and correct received errors.

TCAP

Transaction Capabilities Applications Part: A connectionless SS7 protocol for the exchange of information outside the context of a call or connection. It typically runs over SCCP and MTP 3.

TCP

Transmission Control Protocol: Originally developed by the Department of Defense to support interworking of dissimilar computers across a network. A protocol which provides end-to-end, connection-oriented, reliable transport layer (layer 4) functions over IP controlled networks. TCP performs the following functions: flow control between two systems, acknowledgements of packets received and end-to-end sequencing of packets.

TCP

Test Coordination Procedure: A set of rules to coordinate the test process between the lower tester and the upper tester. The purpose is to enable the lower tester to control the operation of the upper tester. These procedures may, or may not, be specified in an abstract test suite.

TCR

Tagged Cell Rate: An ABR service parameter, TCR limits the rate at which a source may send out-of-rate forward RM-cells. TCR is a constant fixed at 10 cells/second.

TCS

Transmission Convergence Sublayer: This is part of the ATM physical layer that defines how cells will be transmitted by the actual physical layer.

TDF

An ABR service parameter, TDF controls the decrease in ACR associated with TOF. TDF is signaled as TDFF, where TDF = TDFF/RDF times the smallest power of 2 greater or equal to PCR. TDF is in units of 1/seconds.

TDFF

Refer to TDF. TDFF is either zero or a power of two in the range 1/64 to 1 in units of 1/cells.

TDM

Time Division Multiplexing: A method in which a transmission facility is multiplexed among a number of channels by allocating the facility to the channels on the basis of time slots.

TE

Terminal Equipment: Terminal equipment represents the endpoint of ATM connection(s) and termination of the various protocols within the connection(s).

TLV

Type / Length / Value: A coding methodology which provides a flexible and extensible means of coding parameters within a frame. Type indicates parameter type. Length indicates parameter's value length. Value indicates the actual parameter value.

TM

Traffic Management: Traffic Management is the aspect of the traffic control and congestion control procedures for ATM. ATM layer traffic control refers to the set of actions taken by the network to avoid congestion conditions. ATM layer congestion control refers to the set of actions taken by the network to minimize the intensity, spread and duration of congestion. The following functions form a framework for managing and controlling traffic and congestion in ATM networks and may be used in appropriate combinations.

- Connection Admission Control
- Feedback Control
- Usage Parameter Control
- Priority Control
- Traffic Shaping
- Network Resource Management
- Frame Discard
- ABR Flow Control

TMP

Test Management Protocol: A protocol which is used in the test coordination procedures for a particular test suite.

TNS

Transit Network Selection: A signaling element that identifies a public carrier to which a connection setup should be routed.

TOF

Time Out Factor: An ABR service parameter, TOF controls the maximum time permitted between sending forward RM-cells before a rate decrease is required. It is signaled as TOFF where TOF=TOFF+1. TOFF is a power of 2 in the range: 1/8 to 4,096.

TOFF

Time Out Factor: Refer to TOF.

Topology Aggregation

The process of summarizing and compressing topology information at a hierarchical level to be advertised at the level above.

Topology Attribute

A generic term that refers to either a link attribute or a nodal attribute.

Topology Constraint

A topology constraint is a generic term that refers to either a link constraint or a nodal constraint.

Topology Database

The database that describes the topology of the entire PNNI routing domain as seen by a node.

Topology Metric

A generic term that refers to either a link metric or a nodal metric.

Topology State Parameter

A generic term that refers to either a link parameter or a nodal parameter.

TP-MIC

Twisted-Pair Media Interface Connector: This refers to the connector jack at the end user or network equipment that receives the twisted pair plug.

TPCC

Third Party Call Control: A connection setup and management function that is executed from a third party that is not involved in the data flow.

Trail

An entity that transfers information provided by a client layer network between access points in a server layer network. The transported information is monitored at the termination points.

Trailer

Protocol control information located at the end of a PDU.

Transit Delay

The time difference between the instant at which the first bit of a PDU crosses one designated boundary and the instant at which the last bit of the same PDU crosses a second designated boundary.

Trm

An ABR service parameter that provides an upper bound on the time between forward RM-cells for an active source. It is 100 times a power of two with a range of 100*2-7 to 100*20

TS

Transport Stream: One of two types of streams produced by the MPEG-2 Systems layer. The Transport Stream consists of 188 byte packets and can contain multiple programs.

TS

Traffic Shaping: Traffic Shaping is a mechanism that alters the traffic characteristics of a stream of cells on a connection to achieve better network efficiency, while meeting the QoS objectives, or to ensure conformance at a subsequent interface. Traffic shaping must maintain cell sequence integrity on a connection. Shaping modifies traffic characteristics of a cell flow with the consequence of increasing the mean Cell Transfer Delay.

TS

Time Stamp: Time Stamping is used on OAM cells to compare time of entry of cell to time of exit of cell to be used to determine the cell transfer delay of the connection.

TTCN

Tree and Tabular Combined Notation: The internationally standardized test script notation for specifying abstract test suites. TTCN provides a notation which is independent of test methods, layers and protocol.

UBR

Unspecified Bit Rate: UBR is an ATM service category which does not specify traffic related service guarantees. Specifically, UBR does not include the notion of a per-connection negotiated bandwidth. No numerical commitments are made with respect to the cell loss ratio experienced by a UBR connection, or as to the cell transfer delay experienced by cells on the connection.

UDP

User Datagram Protocol: This protocol is part of the TCP/IP protocol suite and provides a means for applications to access the connectionless features of IP. UDP operates at layer 4 of the OSI reference model and provides for the exchange of datagrams without acknowledgements or guaranteed delivery.

UME

UNI Management Entity: The software residing in the ATM devices at each end of the UNI circuit that implements the management interface to the ATM network.

Unassigned Cells

A cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which has been generated and does not carry information from an application using the ATM Layer service.

UNI

User-Network Interface: An interface point between ATM end users and a private ATM switch, or between a private ATM switch and the public carrier ATM network; defined by physical and protocol specifications per ATM Forum UNI documents. The standard adopted by the ATM Forum to define connections between users or end stations and a local switch.

Unicasting

The transmit operation of a single PDU by a source interface where the PDU reaches a single destination.

UPC

Usage Parameter Control: Usage Parameter Control is defined as the set of actions taken by the network to monitor and control traffic, in terms of traffic offered and validity of the ATM connection, at the end-system access. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior, which can affect the QoS of other already established connections, by detecting violations of negotiated parameters and taking appropriate actions.

Uplink

Represents the connectivity from a border node to an upnode.

Upnode

The node that represents a border node's outside neighbor in the common peer group. The upnode must be a neighboring peer of one of the border node's ancestors.

UT

Upper Tester: The representation in ISO/IEC 9646 of the means of providing, during test execution, control and observation of the upper service boundary of the IUT, as defined by the chosen Abstract Test Method.

UTOPIA

Universal Test & Operations Interface for ATM: Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

UTP

Unshielded Twisted Pair: A cable having one or more twisted pairs, but with no shield per pair.

V

UBR

VBR

Variable Bit Rate: An ATM Forum defined service category which supports variable bit rate data traffic with average and peak traffic parameters.

VC

A communications channel that provides for the sequential unidirectional transport of ATM cells.

VCC

Virtual Channel Connection: A concatenation of VCLs that extends between the points where the ATM service users access the ATM layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATM-entity) for processing signify the endpoints of a VCC. VCCs are unidirectional.

VCI

Virtual Channel Identifier: A unique numerical tag as defined by a 16 bit field in the ATM cell header that identifies a virtual channel, over which the cell is to travel.

VCL

Virtual Channel Link: A means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

VCO

Voltage Controlled Oscillator: An oscillator whose clock frequency is determined by the magnitude of the voltage presented at its input. The frequency changes when the voltage changes.

VD

Virtual Destination. Refer to VS/VD.

VF

Variance Factor: VF is a relative measure of cell rate margin normalized by the variance of the aggregate cell rate on the link

Virtual Channel Switch

A network element that connects VCLs. It terminates VPCs and translates VCI values. It is directed by Control Plane functions and relays the cells of a VC.

Virtual Path Switch

A network element that connects VPLs. It translates VPI (not VCI) values and is directed by Control Plane functions. It relays the cell of the VP.

VLAN

Virtual Local Area Network: Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

VP

Virtual Path: A unidirectional logical association or bundle of VCs.

VPC

Virtual Path Connection: A concatenation of VPLs between Virtual Path Terminators (VPTs). VPCs are unidirectional.

VPI

Virtual Path Identifier: An eight bit field in the ATM cell header which indicates the virtual path over which the cell should be routed.

VPL

Virtual Path Link: A means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

VPT

Virtual Path Terminator: A system that unbundles the Vcs of a VP for independent processing of each VC.

VS

Virtual Scheduling: Virtual Scheduling is a method to determine the conformance of an arriving cell. The virtual scheduling algorithm updates a Theoretical Arrival Time (TAT), which is the "nominal" arrival time of the cell assuming that the active source sends equally spaced cells. If the actual arrival time of a cell is not "too" early relative to the TAT, then the cell is conforming. Otherwise the cell is non-conforming.

VS

Virtual Source. Refer to VS/VD.

VS/VD

Virtual Source/Virtual Destination: An ABR connection may be divided into two or more separately controlled ABR segments. Each ABR control segment, except the first, is sourced by a virtual source. A virtual source implements the behavior of an ABR source endpoint. Backwards RM-cells received by a virtual source are removed from the connection. Each ABR control segment, except the last, is terminated by a virtual destination. A virtual destination assumes the behavior of an ABR destination endpoint. Forward RM-cells received by a virtual destination are turned around and not forwarded to the next segment of the connection.

VTOA

Voice and Telephony Over ATM: The ATM Forum voice and telephony over ATM service interoperability specifications address three applications for carrying voice over ATM networks; desktop (or LAN services), trunking (or WAN services), and mobile services.

W

WAN

Wide Area Network: This is a network which spans a large geographic area relative to office and campus environment of LAN (Local Area Network). WAN is characterized by having much greater transfer delays due to laws of physics.

XDF

Xrm Decrease Factor: An ABR service parameter, XDF controls the decrease in ACR associated with Xrm. It is a power of two in range: [0, 1].

Xrm

An ABR service parameter, Xrm limits the number of forward RM-cells which may be sent in the absence of received backward RM-cells. The range is 0-255.

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Product Discrepancy Report

To: Microware Customer Support

FAX: 515-224-1352

From:_____

Company:_____

Phone:_____

Fax:_____Email:_____

Product Name:

Description of Problem:

_____

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Host Platform_____

Target Platform_____

RadiSys.

MICROWARE SOFTWARE