Vanguard Managed Solutions

Vanguard Applications Ware
IP and LAN Feature Protocols

Asynchronous Transfer Mode

Notice

Restricted Rights Notification for U.S. Government Users

The software (including firmware) addressed in this manual is provided to the U.S. Government under agreement which grants the government the minimum “restricted rights” in the software, as defined in the Federal Acquisition Regulation (FAR) or the Defense Federal Acquisition Regulation Supplement (DFARS), whichever is applicable.

If the software is procured for use by the Department of Defense, the following legend applies:

Restricted Rights Legend

Use, duplication, or disclosure by the Government
is subject to restrictions as set forth in
subparagraph (c)(1)(ii) of the
Rights in Technical Data and Computer Software
clause at DFARS 252.227-7013.

If the software is procured for use by any U.S. Government entity other than the Department of Defense, the following notice applies:

Notice

Notwithstanding any other lease or license agreement that may pertain to, or accompany the delivery of, this computer software, the rights of the Government regarding its use, reproduction, and disclosure are as set forth in FAR 52.227-19(C).

Unpublished - rights reserved under the copyright laws of the United States.

Proprietary Material

Part No. T0100-11, Rev H
Publication Code: DS
First Printing: April 2000

Manual is current for Release 6.5 of Vanguard Applications Ware.

To comment on this manual, please send e-mail to LGEN031@vanguardms.com

Contents

Overview

Introduction

Asynchronous Transfer Mode (ATM) is a cell-switching and multiplexing protocol. It combines the capacity and constant transmission delay aspects of circuit switching with the flexibility and efficiency of packet switching. It allows for scalability in bandwidth from megabits to gigabits per second.

ATM provides fast and effective transmission of mixed media traffic. This is due, in part, to these ATM characteristics:

- Fixed cell size
- Faster switching of cells
- Built-in QoS support
- Traffic integration capabilities
- Dynamic Bandwidth Allocation

Networks transporting converged voice, data, and video traffic require all of these characteristics. These characteristics make ATM a perfect choice for transporting existing LAN traffic, such as Ethernet and Token Ring, and multiple Layer-3 protocol traffic, such as IP and IPX. Consequently, the inter-working of these protocols over ATM is critical to the efficiency of these networks.

Supplemental Documentation

For related and supplemental documentation, please refer to the Vanguard Applications Ware documentation web page at:

http://www.vanguardms.com/support/documentation

To fully understand our ATM implementation, refer to these specific documents:

- *Command Line Interface Feature Protocol Manual* (Part Number T0106-09)
- *Bandwidth Management Basics Guide* (Part Number T0108)
- *SNMP/MIB Management Feature Protocol Manual* (Part Number T0106-04)

In This Manual

Topic	See Page

Asynchronous Transfer Mode (ATM)

Introduction

This section provides background information on the various components that make up ATM. It is intended for use as a primer before understanding the ways in which Vanguard Managed Solutions has implemented this transport protocol.

Note

References are included to specific areas of the VanguardMS implementation later in this manual.

ATM Cell Structure

ATM is a technology based on switching of fixed length cells. These cells are created by segmenting larger data frames so that the data fits into the data area, or payload, of multiple ATM cells. In ATM, each cell is fixed at 53 bytes with the payload occupying 48 bytes and the cell header occupying the remaining 5 bytes. This is illustrated in Figure 1.

It is important to realize that even if there is a payload of only one data byte needing transport, the ATM cell is always going to be 53 bytes long.

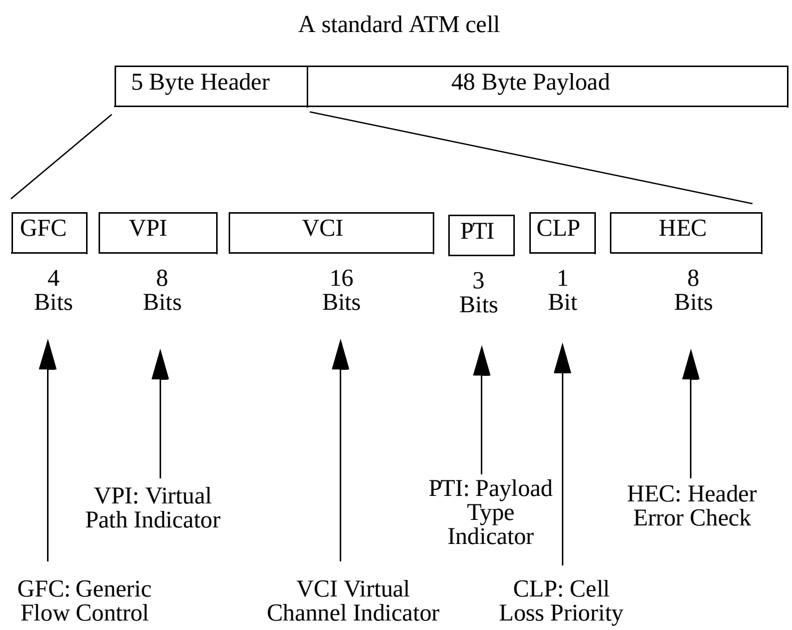

Figure 1. ATM Cell Construction at the User-Network Interface (UNI)

The use of short fixed cells simplifies the demand on switching hardware. This results in higher speeds and reduced transit delay in multi-node networks. Smaller cells are handled much more efficiently in hardware queues. The smaller, equally sized cells reduce the transit delay variations typically encountered when using variable length frames found, for example, in Frame Relay frames.

Because only the 5 byte header is checked for errors, ATM does not provide link level error recovery. Higher layer protocols (based on the OSI model) are responsible for payload error checking.

This table describes the components of the standard ATM cell as shown in Figure 1:

Field	***Description***
Generic Flow Control	The four bits making up the GFC field is used to control the flow of cells between a user and an access switch.
Virtual Path Identifier	The eight bit Virtual Path Identifier (VPI) field is used in conjunction with the Virtual Channel Identifier (VCI) field to identify a cell's next destination as it transits through other ATM switches towards its final destination.
Virtual Channel Identifier	The 16 bit Virtual Channel Identifier (VCI) field is used in conjunction with the VPI field to identify a cell's next destination as it transits through other ATM switches towards its final destination.
Payload Type Indicator	This three bit field indicates whether a cell contains user data or maintenance traffic (such as management or congestion information.)
Cell Loss Priority	This one bit flag identifies whether the cell meets the requirements of the traffic contract. For example, it does not exceed the sustained cell rate of a variable bit rate connection for longer than the maximum burst size. The condition of this bit can determine what action an ATM switch takes on the cell when network congestion occurs. • CLP = 0: The cell is less likely to be discarded during network congestion. • CLP = 1: The cell is more likely to be discarded if the network becomes congested.
Header Error Control	This control field is used for detection and, if possible, correction of single bit errors found in the cell header.

ATM Adaptation Layers

The ATM Adaptation Layer (AAL) converts data frames into the ATM payload-header cell structure shown in Figure 1. The AAL is divided into two separate levels. One level is used to add to the data fields that format the data into as an integrated number of 48 bytes including AAL control fields. A second level is used to reassemble the data back into its original format. This is known as Segmentation and Reassembly (SAR). Different AALs support the various requirements of different data types. There are four distinct AALs:

- AAL1: Used by applications that need a constant bit rate (CBR). These applications are generally time-sensitive and require extensive end-to-end timing control. An example of this is PCM encoded voice traffic.
- AAL2: Used by multimedia applications that use some form of compression that allows variable bit rates (VBR). Even though the AAL2 data is compressed, there is still a need for end-to-end timing.
- AAL3/4: Used for transport of both connection less and connection-oriented data. This AAL has IEEE 802.6 compatibility, used by SMDS, which significantly increases cell overhead beyond what is supported in AAL5.

■Note

For more information on SMDS, refer to the *Switched Multimegabit Data Service Manual* (Part Number T0103-08).

- AAL5: This is the preferred AAL for packet-oriented data transport. It is connection-oriented, virtually avoids corrupted data delivery, and adds a minimum of cell overhead. For details on how VanguardMS has implemented AAL5, refer to the “ATM Adaptation Layer 5 (AAL5)” section on page 12.

ATM Traffic Management and QoS

Introduction

ATM networks implement several different traffic and congestion control mechanisms, collectively referred to as traffic management, to guarantee the network performance required in new and existing network connections.

Traffic management lets ATM networks deliver:

- Quality of Service for individual connections.
- Protection against congestion conditions that result in performance degradation.
- Network resource optimization for new ATM connections.

Traffic Management in ATM Networks

The primary goal of ATM is to avoid congestion: a state where network conditions prohibit network components from meeting negotiated levels of service. ATM traffic can be unpredictable and multiple network nodes always vie for the same network resources. ATM allows data recipients to be notified whenever cells transiting a network experience congestion. Using mechanisms at higher OSI levels, these recipients can notify the senders of data to reduce the rate at which data is transmitted whenever a configured congestion threshold point is reached. In cases of severe network congestion, the network may discard cells. Usually a discard policy is implanted in the network to fairly and intelligently discard cells.

Traffic management in an ATM network is divided into two specific areas:

- Traffic Control: A set of actions configured into the network to avoid congestion conditions.
- Congestion Control: A set of actions configured into the network to minimize the amount of congestion and the duration that the network is congested.

In an ATM network, traffic management:

- Maximizes use of available bandwidth to achieve desired network performance.
- Supports multiple traffic types at varying speeds.
- Satisfies the connection-based QoS requirements of multiple types of traffic.
- Minimizes the reliance on AAL and higher-layer traffic management schemes to reduce congestion.

Example

ATM can support different types of applications (video, voice, data, or any combination of the three) over the same physical network. This is beneficial because there can be significant variance in network loading.

E-mail applications for example, place no limitations on the time it takes for a message to reach its recipients. This application works properly despite the fact that an insignificant amount of network resources (bandwidth) have to be allocated.

However, real-time video conferencing is quite different. This application can require vast amounts of bandwidth though the actual bandwidth in use varies from moment to moment. The transit time for cells containing digitized video conferencing data must be extremely short. Additionally, video conferencing applications do not work well when there is a significant delay variation in cells arriving at their destination. The network must have strict demands on it to ensure that a real-time video conferencing application operates correctly.

Quality of Service

Quality of Service (QoS) is a measurement of the delay and the dependability of a specific connection. QoS allocates network resources when a connection is used by traffic management to ensure that the network performance objectives are met. Six parameters must be specified, the first three of which can be negotiated at connection setup time (or when a PVC is provisioned at subscription):

- Peak-to-Peak CDV (Cell Delay Variation): Specifies any acceptable variation in cell transfer delay such as jitter.
- Maximum cell transfer delay (maxCTD): Specifies an acceptable end-to-end cell transfer delay.
- Cell Loss Ratio (CLR): Specifies an acceptable number of lost cells relative to the total number of transmitted cells.

The remaining three are

- Cell Error Ratio (CER): Identifies the number of errored cells/(successfully transmitted cells+errored cells).
- Severely Errored Cell Block Ratio (SECBR): Identifies the number of severely errored cell blocks/total transmitted cell blocks.
- Cell Misinsertion Rate (CMR). Identifies the number of mis-inserted cells/ time interval.

Traffic Contract

When an ATM connection request is created by either signaling (SVC) or subscription (PVC) an implicit traffic contract is created. This contract indicates that the ATM network supports the connection, and the associated QoS requirements, for as long as the network stays within the agreed upon parameter values.

Service Categories

There are five ATM service categories relating to Traffic Management and QoS:

- Constant Bit Rate (CBR)
- Unspecified Bit Rate (UBR)
- Variable Bit Rate-real time (VBR rt)
- Variable Bit Rate-non-real time (VBR-nrt)
- Available Bit Rate (ABR)

■Note

Constant Bit Rate, VBR and Unspecified Bit Rate (UBR) categories are supported by the implementation of ATM.

Constant Bit Rate (CBR)

Applications and connections requiring a constant amount of bandwidth use the Constant Bit Rate (CBR) category. The bandwidth and resources available on a CBR connection are fixed at the Peak Cell Rate (PCR) for as long as the connection is established. While required when cell transmission is sustained at the PCR, the Constant Bit Rate may become inefficient when the cell transmission rate falls below the PCR.

CBR service emulates high-speed lines such as T1, and support real-time applications requiring very short network delay and low cell delay variation.

Constant Bit Rate ATM stations can become deactivated if the total aggregate PCR does not exceed the link speed. This occurs because the CBR scheduling is very rigid and has to fit into the transmit scheduling table in a certain way. Even though it appears that bandwidth is available, if it does not fit in the scheduling table, the station is not created. To increase the chances of fitting into the scheduling table, the larger CBR entries (PCR rate) should be created first. To workaround this issue, use VBR stations.

Unspecified Bit Rate (UBR)

Unspecified Bit Rate services are used strictly for applications and connections that have no requirements for service guarantees (are more tolerant of delays and losses). Traffic management or QoS parameters are not applied on a UBR connection and traffic contracts do not typically exist.

UBR services can be used at link access speeds when the necessary network resources are available. However, cells transmitted have the highest risk of being lost in the event of network congestion or failure since this is a best effort service. When this occurs, a higher layer protocol such as TCP attempts to recover the lost cells.

UBR is commonly used with LAN application that transfer data over an ATM network because it does not require initial information on either QoS or traffic rates.

Variable Bit Rate real-time (VBR-rt)

Applications and connections requiring very short and tightly controlled network delay and CDV and having variable bandwidth requirements, use the Variable Bit Rate real-time (VBR-rt) service.

In the VBR-rt service, cells can be bursty (up to a maximum of the Peak Cell Rate) over short periods of time. On average though, the PCR is met for the duration of the connection. Cells exceeding the maximum Cell Transfer Delay (max CTD) do not have impact on applications using VBR-rt. Cell input rate variation allows multiple VBR-rt sources to be statistically multiplexed, over one physical connection, to maximize available network resources.

Variable Bit Rate non-real-time (VBR-nrt)

Applications and connections that are insensitive to network delay and have bandwidth requirements that vary, such as SNA, use the Variable Bit Rate non-real-time (VBR-nrt) service. These applications are typically much more sensitive to CLR.

Cell input rate variation allows multiple VBR nrt sources to be statistically multiplexed over one physical connection to maximize available network resources.

Available Bit Rate (ABR)

Available Bit Rate (ABR) service is used in for applications that are, like UBR, more tolerant of delays and losses than other services. These applications have cell input rates that vary depending on network feedback. This information is available from Resource Management (RM) cells the indicate the current network status, including congestion status. The ABR uses this information to regulate the cell input rate to the network.

ATM Traffic Management Mechanisms

To provide optimized network resources, and avoid or limit congestion, various traffic management mechanisms are used. These include:

- Connection Admission Control (CAC)
- Usage Parameter Control (UPC)
- Selective Cell Discard
- Traffic Shaping
- Explicit Forward Congestion Indication (EFCI)
- Resource Management using Virtual Paths
- Frame Discard
- Generic Flow Control

Connection Admission Control (CAC)

Connection Admission Control (CAC) identifies the traffic and QoS parameters for a specific connection, and then decides if that connection can be established or if it should be rejected. If sufficient bandwidth is available, the QoS requirements can be met, and there is no impact to other existing connections, the connection request is approved. However, if any one of these conditions is not met, the connection request fails.

CAC determines which traffic parameters are required by the UPC function and allocates network resources accordingly.

Usage Parameter Control (UPC)

Usage Parameter Control (UPC) monitors and controls traffic. This is sometimes known as Traffic Policing because it polices traffic as it enters the ATM network. UPC enforces all traffic contracts, and tags (if the CLP bit is set to 0) or discards (if the CLP bit is set to 1) cells as necessary.

Selective Cell Discard

The Selective Cell Discard function operates in a congested network environment. It discards cells that have the CLP bit set to 1, that is, the cells do not meet the requirements of a traffic contract as enforced by the UPC. This protects those cells that met the requirements of an existing traffic contract and have their CLP bit set to zero (0).

■ **Note**

Refer to the “ATM Cell Structure” section on page 3 for additional information.

Traffic Shaping

Traffic shaping is used to modify ATM cell traffic to optimize network efficiency while maintaining all required QoS functionality. Traffic shaping is typically an optional function that can be performed anywhere within an ATM network.

Explicit Forward Congestion Indication (EFCI)

The Explicit Forward Congestion Indication (EFCI) is found in one of the two bits that make up the Payload Type Indicator field in the ATM cell header.

This bit may be turned on (set to 1) when a cell transits a network containing congested links. This indicates that congestion exists somewhere in the network but does not identify where. This indicator should be used by the receiving node to notify the transmitting node to reduce the data transmission rate. This is analogous to the FECN bit in frame relay

Resource Management Using Virtual Paths

Virtual paths allow effective network resource management by maximizing the allocation of resources on that network. Since one Virtual Path contains multiple Virtual Channels, managing the Virtual paths simplifies traffic management.

Frame Discard

Frame discard (dropping cells) is how ATM deals with network congestion. If cells are derived from data using AAL5 procedures, then when one cell is dropped, all cells are dropped until the ATM switch receives the end-of-frame indicator in the last associated cell.

Generic Flow Control

The first four bits in an ATM cell indicate either controlled or uncontrolled traffic.

- Controlled traffic has a congestion control function applied,
- Uncontrolled traffic, which is the most popular implementation, relies on external congestion control.

■Note

Generic Flow Control is rarely used.

Vanguard Managed Solutions ATM Implementation

Introduction

This section describes the current implementation of the ATM feature protocol.

ATM Features

The implementation of ATM offers these features:

- Permanent Virtual Circuits. Up to 300 PVCs are supported by the Vanguard Managed Solutions implementation of ATM. A WAN Adapter LCON connects directly to an ATM Station to create an ATM Virtual Circuit.
- T1 and E1 Support.
- ATM Adaptation Layer 5 (AAL5)
- RFC 1483 support. Encapsulation is controlled by the WAN Adapter.
  - RFC 1483 LLC SNAP
  - RFC 1483 VC Multiplexing
- Legacy protocol traffic encapsulated using SoTCP and transmitted over ATM using RFC 1483 encapsulation.
- RFC 1577. Inverse Address Resolution Protocol, known as InARP, for PVCs is supported and controlled at the LCON.
- Quality of Service. Prioritization of traffic across Virtual Channel Connections (VCCs), using CBR and UBR (refer to “Constant Bit Rate (CBR)” on page 20 and “Unspecified Bit Rate (UBR)” on page 20, is based on available traffic management and standard ATM QoS functions.

Product Support

The implementation of ATM is supported on Vanguard 6435 or 6455 products only. You must also have an ATM Enhanced Vanguard Daughtercard installed in your node.

■Note
Refer to the *Vanguard 6435/6455 Manual* (Part Number T0166) for related information on installing an ATM Enhanced Daughtercard.

ATM Software Implementation

Introduction

This section describes the ATM software implementation including:

- "ATM Adaptation Layer 5 (AAL5)" section on page 12.
- "Operations, Administration, and Maintenance (OAM) Flows" section on page 17.
- "Service Categorization" section on page 20.
- "Quality of Service (QoS)" section on page 21.
- "IP Encapsulation (RFC 1483 and RFC 1577)" section on page 22.

ATM Adaptation Layer 5 (AAL5)

Introduction

ATM Adaptation Layer 5 (AAL5) is the most common AAL used for packet data. It supports connection oriented transfer of IP data over ATM.

AAL5 uses a convergence sublayer to augment PDUs with transmission error detection and end-to-end SAR information. The convergence sublayer also adds sufficient padding to make that augmented PDU an integral number of 48 bytes.

Additionally, AAL5 uses segmentation to manipulate the original data frames prior to transport across the ATM network (see Figure 2). First it renames data frames (carrying any type of data including voice or video) as Protocol Data Units (PDUs). Then enough padding is inserted to ensure that, after the ATM trailer is added, the total number of bytes is evenly divisible by 48. The resultant PDU (with trailer) is divided into multiple 48 byte ATM cell payloads and a five byte ATM cell header is added to each payload. This results in the standard 53 byte ATM cell.

The first bit of the Payload Type Indicator field in the cell header, and the Length field in the PDU trailer, are used to ensure that the receiving node knows how to reassemble the cells back into the original frame.

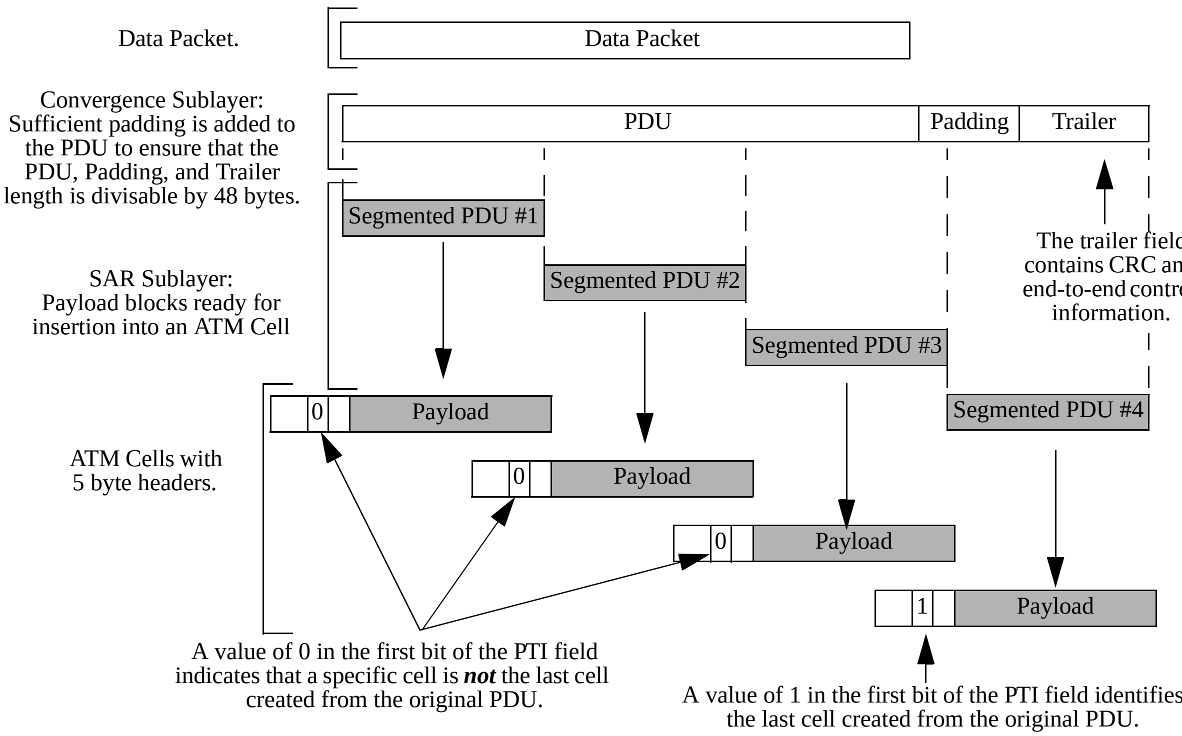

Figure 2. AAL5 Segmentation and Reassembly (SAR)

Reassembling the PDU

When the cells reach their final destination, the payload of each cell is extracted and assembled into a frame that is transmitted to the user device. When the cells are initially created, the first bit in the Payload Type Indicator field (see Figure 1) is set to 0. However, this does not apply to the cell carrying the last payload of the original frame. When the last cell is received, it contains the Length and CRC fields of the PDU trailer.

The cell that immediately precedes the last cell contains user data, padding (if needed), and the UU and CPI fields of the PDU trailer. The Length Field in the PDU trailer is used, by the receiving node, to discard the padding and preserve all of the data. The Length field in the PDU trailer (see Figure 3) identifies the amount of actual data in the PDU. This lets the receiving node calculate the amount of padding that was added, and what must subsequently be discarded.

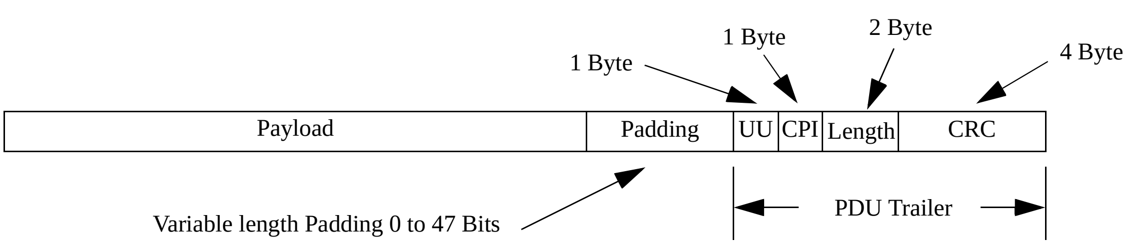

Figure 3. AAL5 PDU Reassembly

Point to Multipoint Connectivity Example

Description

Figure 4 shows how a centralized corporate head office can be connected to multiple branch office LANs using multiple ATM PVCs (LCONs). This is accomplished using a point to multipoint configuration over a public or private WAN. Each of the virtual connections (LCONs) at the head office router are put into a single Logical IP Subnet (LIS) using GROUP LCONs. ATM then transports the conventional LAN traffic between the head office and branch offices LAN segments through the ATM WAN using multiple ATM PVCs.

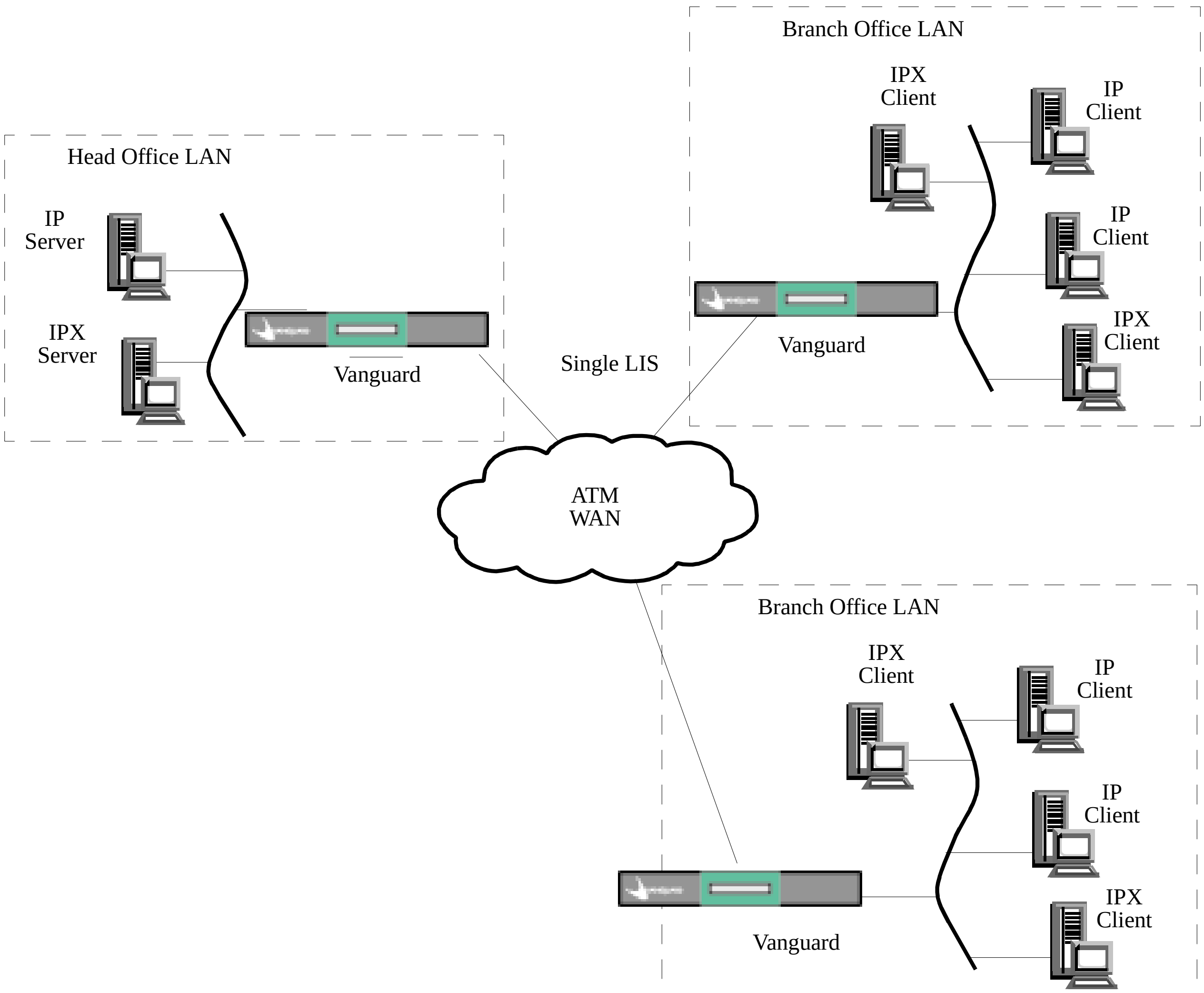

Figure 4. Point to Multipoint Example

Frame Relay to ATM Service Interworking Example

Description

Figure 5 shows how a central site connects to an ATM network and multiple branch sites connect to a Frame Relay network. The necessary interworking, between the ATM and Frame Relay networks, is provided by an Inter-Working Software (IWS) function that is generally offered through an Internet Service Provider (ISP). Each end of the connection is therefore unaware of the different link level protocols being used by them. In this example the link level protocols are Frame Relay and ATM.

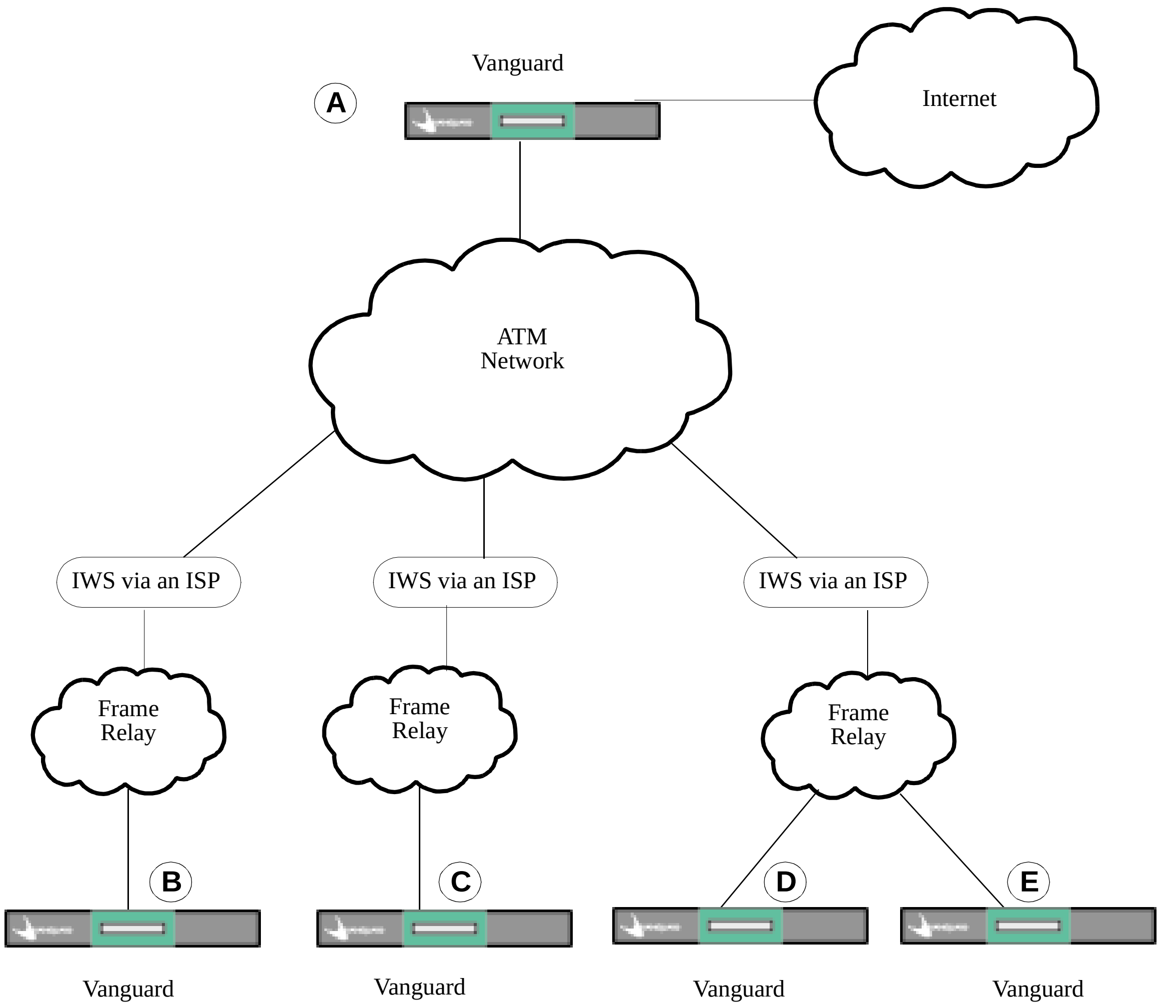

Figure 5. Frame Relay to ATM Example

■ **Note**

These devices run IWS - Inter-Working Software - to translate RFC 1483 and the Frame Relay Link RFC 1294 Encapsulation. This function is generally provided through an ISP or related service provider.

Translational and Transparent Modes

Both Translational and Transparent modes of intenetworking can be used in this example.

Translational Mode Service Internetworking

This can be achieved by enabling ATM on the central router (A in Figure 5) and configuring each of the virtual connections (LCONs) connecting to branch nodes B, C, D, and E (in Figure 5) with RFC1483 encapsulation. The branch nodes use normal RFC1294 encapsulation on all virtual connections to the central site.

An IWF function exits between the ATM and Frame Relay networks. This provides translation of encapsulation headers (RFC1483 to/from RFC1294) and the ARP packets (ARP to/from ATMARP) exchanged on the virtual connections between the central router and branch nodes.

Transparent Mode Service Internetworking

This can be achieved by using an IWF function between the ATM and Frame Relay networks. Translation of Encapsulation headers (RFC1483 to/from RFC1294) and ARP packets (ARP to/from ATMARP) is not provided in this example configuration. Both ends of the virtual connection between the central router and branch nodes must be configured with RFC1294 encapsulation to eliminate the need to translate the encapsulation header and ARP packets.

Operations, Administration, and Maintenance (OAM) Flows

Introduction

Networks containing equipment from multiple vendors require network monitoring strategies to create a reliable network. Operations, Administration, and Maintenance (OAM) identifies standard data elements that are inserted into data streams to provide and detect particular information about the network and the elements it comprises. OAM provides these functions for each Virtual Path and Virtual Channel connection:

- Fault Management. Fault management OAM cells are used to send two types of warning messages: Alarm Indication Signal (AIS) and Remote Defect Indication (RDI). RDI is sometimes referred to as Far End Reporting Failure or FERF.
- Activation/Deactivation of Continuity Checking. Continuity Check cells monitor the connection and Loopback cells allow for the testing of any given connection.

OAM Flows

There are five standard OAM flows, numbered F1 through F5. The implementation of ATM supports F5 flows and these operate at the Virtual Channel level.

OAM flows can be either segment or end-to-end. An end-to-end flow covers from one VCC endpoint to the other. A segment flow only covers a portion of the entire VCC. Segment flows also allow the management of a specific piece of the connection.

OAM cells for an F5 flow use the same VPI and VCI as the user cells of the VCC. The PTI field in an ATM header (see Figure 1) is used to distinguish between segment and end-to-end F5 flows.

Fault Management

Fault management encompasses three different types of events. It determines when a failure has occurred, notifies other network elements within the connection of the failure, and provides methods of isolating and diagnosing the failure.

AIS and RDI

In Figure 6 a VP or VC connection exists between end nodes 100 and 400. If a failure occurs (shown between nodes 200 and 300) an AIS signal is sent to node 400. This is considered the downstream direction and notifies node 400 of the failure.

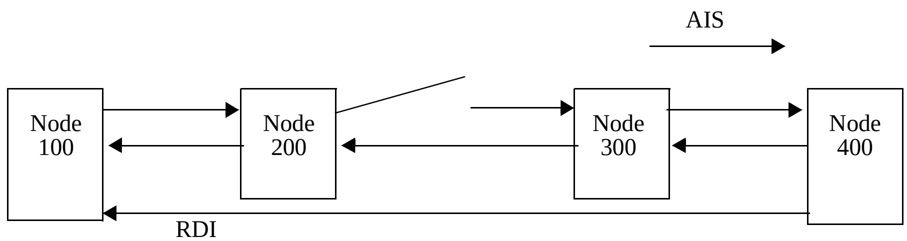

Figure 6. AIS and RDI for Signal Direction Failure

Node 400, after receiving the AIS signal, sends an RDI signal all the way back to node 100. When this occurs the connection failure message is received. If the RDI failure message were not received by node 100 it would never know that a failure had occurred between nodes 200 and 300. AIS reports defects or failures in the forward direction while RDI does the same but in the backward direction.

A single failure can result in many OAM cells being generated. Once a fault is detected and OAM cell is periodically sent through the connection. The period of time between OAM cells is in the order of seconds and this is used to regulate the number of cells that are sent. This ensures that AIS and RDI are delivered efficiently.

Continuity Check

Continuity Checking is referred to as CC, cells monitor the availability of a connection. Refer to Figure 7. Continuity Checking monitors connection availability by tracking the elapsed timed between received cells (CC or user data). In the absence of user data the End Point will send CC cells at the rate of 1 CC cell per second (ITU-T I.610 02/1999). If a circuit is idle, that is, no cells have been received, for more than a fixed time period (ITU-T I.610 02/1999 specifies the interval to be 3.5 +-0.5 seconds) the End Point will declare Loss of Continuity (LOC) state and begin sending RDI cells. The next cell received will cancel the LOC state.

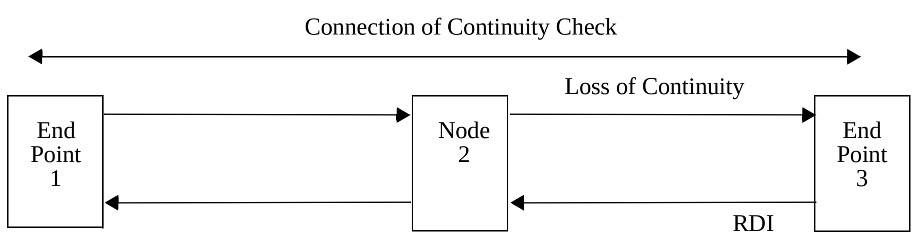

Figure 7. Continuity Checking

During normal operation, End Point #3 periodically receives a CC or user data cell. A discontinuity between node 2 and End Point 3 causes End Point 3 not to receive the cell for a period of time. When sufficient time has passed a Loss of Continuity state is declared and the RDI signal is generated. The RDI is transmitted all the way back to the other end point (there could be many other nodes between the two end points) where End Point #1 becomes aware of the discontinuity.

Continuity checks can be activated or deactivated and all results of the checks can be monitored.

End-to-End Loopback

Loopback cells determine connectivity at specific points in a network. They also allow you to isolate defective elements in a network.

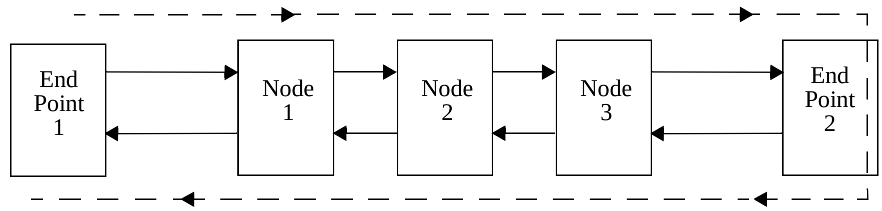

Figure 8. End-to-End Loopback

Figure 8 shows an end-to-end loopback that can be used by an end point to verify connectivity with a remote end point. In Figure 8, End Point #1 is the originator of an end-to-end loopback cell that has a loopback indication of 1, a Loopback ID indicating the end point, and a correlation tag that it looks for in received OAM cells. The loopback destination, End Point #2, removes the loopback cell, decrements the Loopback indication field to 0, and then retransmits the loopback cell in the other direction. Nodes 1, 2, and 3, convey the end-to-end loopback cell between the End Points and, eventually, End Point #1 extracts the loopback cell to match up the correlation tags. This technique is used to verify the continuity of VP or VC links between End Point #1 and End Point #2.

Service Categorization

Introduction

The implementation of ATM uses two types of services: Constant Bit Rate (CBR) and Unspecified Bit Rate (UBR).

Constant Bit Rate (CBR)

Constant Bit Rate (CBR) data provides a constant data flow. CBR uses guaranteed bandwidth whenever this connection type is used and is structured in its use of that bandwidth.

CBR connections require fixed amounts of bandwidth (specified by the Peak Cell Rate) that are continuously available throughout the time a connection is made. A sending ATM station may transmit cells at a rate equal to or less than the specified PCR. It may also be silent for some period but the bandwidth remains available.

CBR connections are used for real time applications, such as video and voice, that have tightly controlled Cell Transfer Delay (CTD) and Cell Delay Variation (CDV) characteristics. CBR is not, however, restricted to such applications.

Once a CBR connection is established, the negotiated QoS is assured to all cells that conform to the connection requirements. Any cells that are delayed beyond that specified for the Cell Transfer Delay (CTD) are less significant to the application.

Some applications generate traffic smoothly, that is, the volume of traffic remains relatively constant over a specific period of time. Other applications have response time requirements that are so tightly constrained that the use of CBR connections can be justified. Some examples of these applications are:

- Video Conferencing.
- Interactive audio such as telephony.
- Audio/video distribution. For example, this may include television, distance learning and pay-per-view entertainment.
- Audio/video retrieval. For example video-on-demand and audio libraries.

Unspecified Bit Rate (UBR)

Unspecified Bit Rate (UBR) provides a less structured form of data flow and uses any available bandwidth. When CBR and UBR data exists simultaneously, CBR uses all of the bandwidth it is allowed and UBR uses the remainder.

A UBR connection offers an efficient option for applications have less demanding of bandwidth requirements. These applications, such as FTP, have limited service requirements and are tolerant of Cell Transfer Delay or loss. For example, text/data/image transfer (FAX), e-mail, and remote terminal operation (telecommuting), applications operate relatively efficiently through the use of spare available bandwidth though not quite as efficiently as when CBR connections are used. However these applications can use the less expensive UBR connection.

UBR is a Best Effort service that should not be used in mission critical applications or environments. As a best effort service, UBR offers little in the way of specified QoS as it provides very loose, if any, Cell Transfer Delay (CTD), Cell Delay Variation (CDV), and Cell Loss Ratio (CLR) characteristics and has no negotiated bandwidth or service guarantee.

Quality of Service (QoS)

Description

Quality of Service is provided to out implementation of ATM through the prioritization of traffic across VCCs and is based on Traffic Management.

The fixed, relatively small size of ATM cells, and well defined traffic management rules, allow multimedia traffic to be transmitted over a single line. This is accomplished through the assignment of this multimedia traffic to different VCCs, each of which has specific QoS characteristics.

For example, packetized voice traffic can be placed on a channel set up for VBRrt (Variable Bit rate-real time) characteristics although file transfer traffic might be placed on an Unspecified Bit Rate (UBR) channel.

In the Vanguard 6435/6455, traffic travelling from the ATM port is tagged according to the QoS requirements defined for the LCON at the ATM station. Policy Based Routing (PBR) then routes traffic to the correct LCON. This in turn connects the QoS configured LCON with the correct ATM station.

■ **Note**

Refer to the *IP Routing Manual* (Part Number T0100-03) for related information on Policy Based Routing.

IP Encapsulation (RFC 1483 and RFC 1577)

Introduction

In this implementation:

- ATM is used to forward IP traffic.
- Logical subnetting is imposed on ATM networks.
- Routing for the inter-subnet communication is required.

Consequently, an ATM network is divided into Logical IP Subnets that represent a single IP subnetwork. An address resolution mechanism maps IP addresses to ATM addresses to establish link level connectivity to the ATM endpoint in the LIS.

ATM is divided into logical subnets and follows the Classical IP over ATM approach.

RFC 1483 Encapsulation

Introduction

Network Interconnection and bridged traffic are transmitted in the payload field of an AAL5 Protocol Data Unit (PDU). This requires a standardized method of encapsulating the routed and bridged traffic in an AAL5 PDU so that transmitted data traffic is uniquely identified at the receiving end.

RFC 1483 supports two different types of encapsulation:

- LLC/SNAP Encapsulation
- VC Based Multiplexing

Each encapsulation type offers a different method of multiplexing routed and bridged traffic over an ATM virtual connection. Each also has it’s own advantages and disadvantages. The selection of a particular type of encapsulation is performed by static configuration and the encapsulation type selected is dependant on the ATM environment.

LLC/SNAP Encapsulation

LLC/SNAP encapsulation allows the transportation of multi-protocol traffic (routed and bridged packets) over a single ATM virtual connection. This is made possible by encoding the transported Protocol ID (PID) into the LLC/SNAP header. The PDU protocol is therefore identified by the LLC/SNAP header that is placed immediately in front of the AAL5 PDU.

When using LLC encapsulation, both routed and bridged PDUs are identified by prefixing the LLC header. This header may be followed by the Subnetwork Attachment Point (SNAP) header. Protocol traffic that does not have a universally identified PID must have the SNAP header added.

Figure 9 shows the format of LLC & SNAP headers.

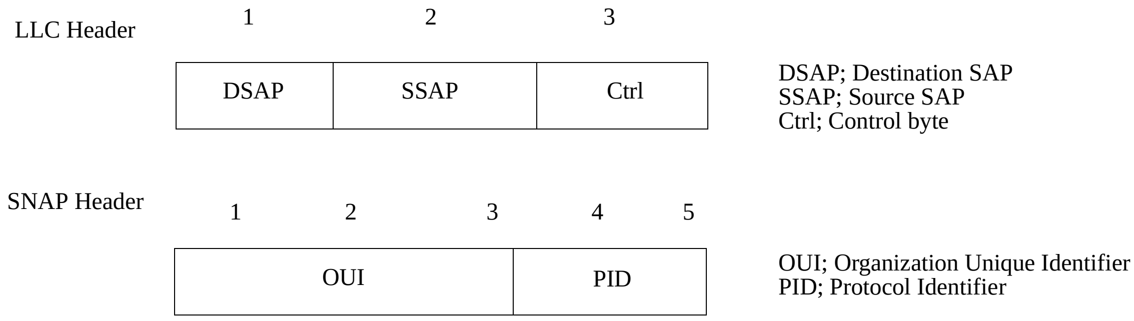

Figure 9. LLC and SNAP Header Structure

Address Resolution for IP Traffic Using RFC 1577

Introduction

Address resolution of multiple protocols over ATM feature follows the Classical IP Over ATM model for the transportation of connectionless IP traffic over connection oriented ATM networks.

Classical IP Over ATM

The Classical IP Over ATM is classical in that it assumes that logical subnetting and inter-subnet routing are imposed on the ATM network The ATM network is therefore divided into ‘Logical IP Subnets’ that represent a single IP subnetwork. An address resolution mechanism maps IP addresses to ATM addresses (the combination of the VPI and VCI) to establish link level connectivity to the ATM endpoint.

Address Resolution in PVC only ATM Environments

In a PVC environment, virtual circuits are established as part of initialization. The IP address of the communication station at the other end is unknown to each VC end point. However, in Point to Multipoint networks, containing ATM PVCs, the IP address of the remote end determines VC (LCON) to which the IP traffic, destined to a particular destination, is forwarded.

Static Address Resolution

The IP address of a remote node is statically configured on each of the virtual connections (LCONs). Consequently, there is no need for a specific address resolution mechanism to dynamically learn the remote end's IP address. In the case of unnumbered interfaces, the remote end router id uniquely identifies that remote end. On unnumbered links, therefore, the remote end's router id should be configured as the next hop IP address.

Dynamic Address Resolution

With Dynamic Address Resolution, a station dynamically learns the IP address of the other nodes. This is accomplished through a mechanism called Inverse ATM ARP (InATMARP). InATMARP builds a database to store IP Address to ATM VC mappings. Dynamic Address resolution on a particular A VC (LCON) using dynamic address resolution is identified by the NULL Nexthop Hop IP Address value in the LCON (VC) configuration.

Inverse ATM ARP (InATMARP)

InATMARP resolves IP address to the ATM VC used to reach the ATM peer representing that IP Address. This mechanism is used on virtual connections using RFC 1483 LLC/SNAP encapsulation.

InATMARP Protocol Operation

1) When a PVC is active, the clients at both ends of the PVC send an InATMARP request to each other to identify the IP address of remote end of the PVC. Each client sends it's own IP address in the InATMARP request packet. If the Source and Target ATM Address is know, this is included in the packet. If this information is not known, the corresponding length fields are set to 0. When unnumbered interfaces exist, each client sends it's router id in the InATMARP request, as it's IP address.

2) After receiving the InATMARP request, each client maps the Source IP address, in the InATMARP packet, to the VC (LCON) on which the request is received. The local ATMARP database is updated with the entry representing this map.

3) After processing the InATMARP request, each client sends their IP address in the InATMARP reply packet . This fills in the Source and Target ATM Address fields, if they are present in InATMARP request packet. When unnumbered interfaces exist, each client sends it's router id in the InATMARP reply, as it's IP address.

4) Once an InATMARP reply is received each client updates their local ATMARP database. The database then contains a current map that corresponds to the IP address that exists in the InATMARP reply. Once this occurs, both clients know each other's IP address and the PVC between them becomes operational. IP traffic can then be exchanged between them.

InATMARP Retries

If an ATM client does not receive the InATMARP reply within 10 second after submitting a request it retransmits the InATMARP request to the remote end. The client stops sending these requests after three attempts and the corresponding ATM PVC between the Clients is not used for sending internetworking traffic

Encapsulation using RFC 1483

Many access protocols, including VoIP, can be IP encapsulated for use on an ATM port. Network protocols, in particular Frame Relay Interface (FRI), use this technique so that the ATM port has characteristics similar to a Frame Relay FRI port, with Bypass stations.

■Note

The ATM port primarily supports IP encapsulation traffic, though in some cases the Serial Over TCP (SoTCP) feature is used. SoTCP is necessary to send serial traffic such as SNA/SDLC and Bisync over ATM. For additional information on SoTCP, refer to the *SoTCP Feature Protocol Manual* (Part Number T0100-06).

The ATM transport of IP encapsulation is referred to as Classical IP over ATM. Vanguard Managed Solutions's current implementation conforms to RFC1577 with RFC1483 encapsulation. Our current implementation also supports IPX and Bridging over ATM. These additional protocols are supported using the appropriate RFC 1483 encapsulation.

ATM and Frame Relay ports can be inter-connected over a carrier network. This is possible when the network provides Frame Relay Forum implementation Agreement 8 (Frame Relay Service Internetworking) Service internetworking allows an ATM virtual circuit channel to be mapped to a Frame Relay virtual circuit. In this case, you can have two modes: transparent and translation. The translation mode causes an ATM 1483 header to be translated to a Frame relay 1490 header. Wherever a Frame Relay channel interworks with an ATM channel, and no encapsulation conversion is used, RFC1490 encapsulation must be used at the ATM end of the circuit.

Traffic Supported

These traffic types are supported by RFC 1483 LLC/SNAP or VC_MUX Encapsulation:

- IP (unicast or multicast & broadcast) traffic received from either from an external source or generated internally from within the node.
- Bridged LAN (802.3 & 802.5) traffic received from either from an external source or generated internally from within the node.
- IPX traffic received from either from an external source or generated internally from within the node.
- RTP/UDP/IP header compressed packets sent or received by the node.

■Note

AppleTalk traffic, either received from an external source or generated internally from within the node, is not supported by RFC 1483 LLC/SNAP or VC_MUX Encapsulation.

Configuration Example

Introduction

This section describes a typical ATM configuration example.

Configuration Example

Figure 10 shows an example ATM configuration illustrating a point to point ATM network connection between two Vanguard 6455 devices. Figure 10 shows the point to point nature of this example and identifies the parameters that must be changed (and the values they must be changed to), to work properly.

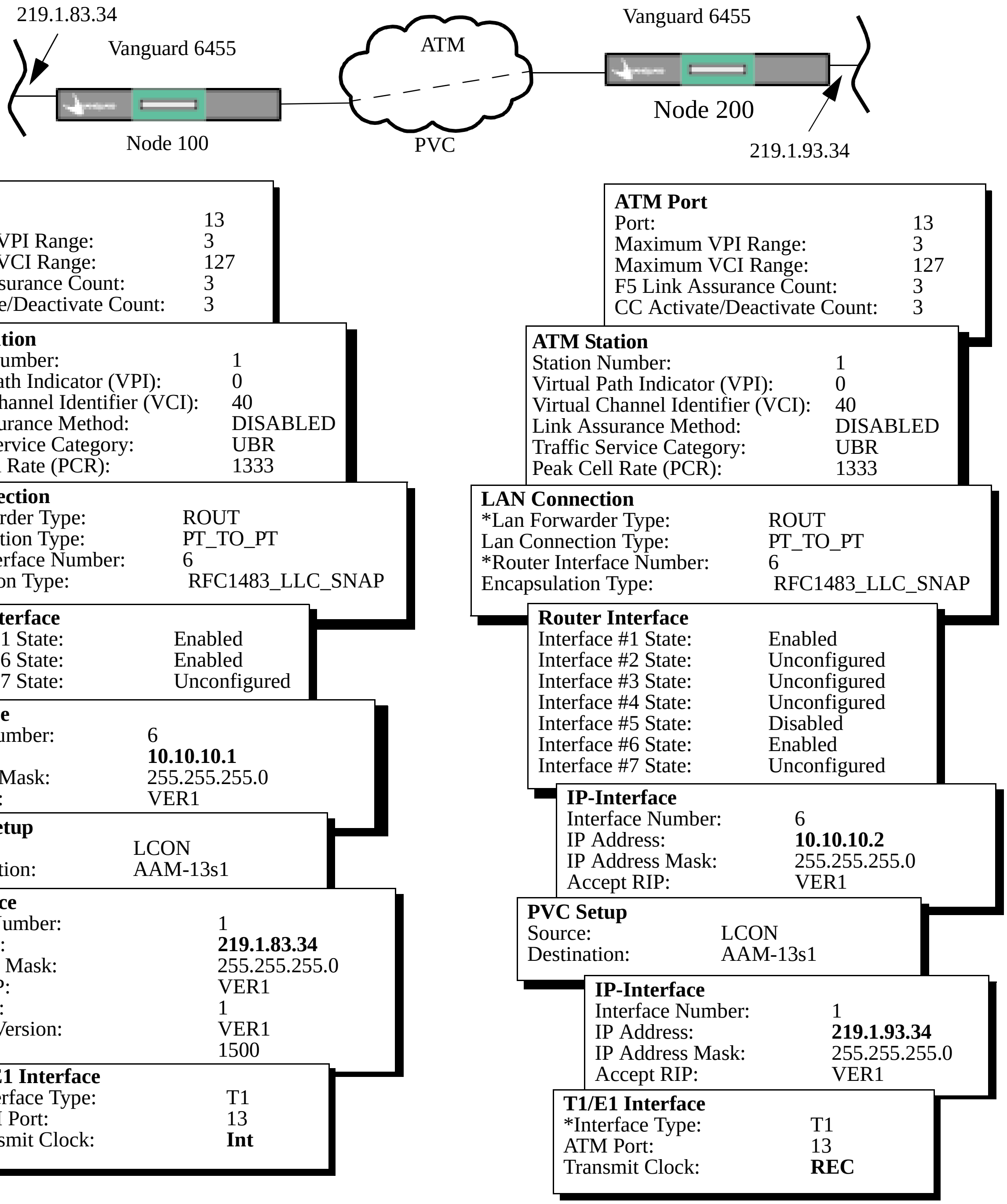

Figure 10. Frame Relay SVC Configuration Example

Configuring ATM

Introduction

This section describes how to configure ATM on a Vanguard device.

Configuration Process

When configuring ATM in a Vanguard 6435 or Vanguard 6455 you must follow this process

Step	Configure	See...
1	ATM Access Module Port Record.	page 29
2	Warm Boot the Node.	page 32
3	The T1/E1 Interface.	page 33
4	ATM Access Module Station Record.	page 35
5	LAN Connection Table.	page 39

■ **Note**

You will also have to configure the LAN and WAN interfaces. Please refer to the *Vanguard Configuration Basics* manual (Part Number T0113) for information concerning this configuration.

Configuring an ATM Access Module (AAM) Port Record

Follow These Steps Follow these steps to configure the ATM Access Module (AAM) Port Record:

Step	Action
1	From the CTP Main menu, select **Configure**.
2	From the Configure Menu, select **Configure ATM**.
3	Select the AAM port type and then configure the parameters as shown in Figure 11. ■ **Note** The AAM port type indicates an ATM Access Module port. This identifier is used for an ATM port in our ATM implementation.

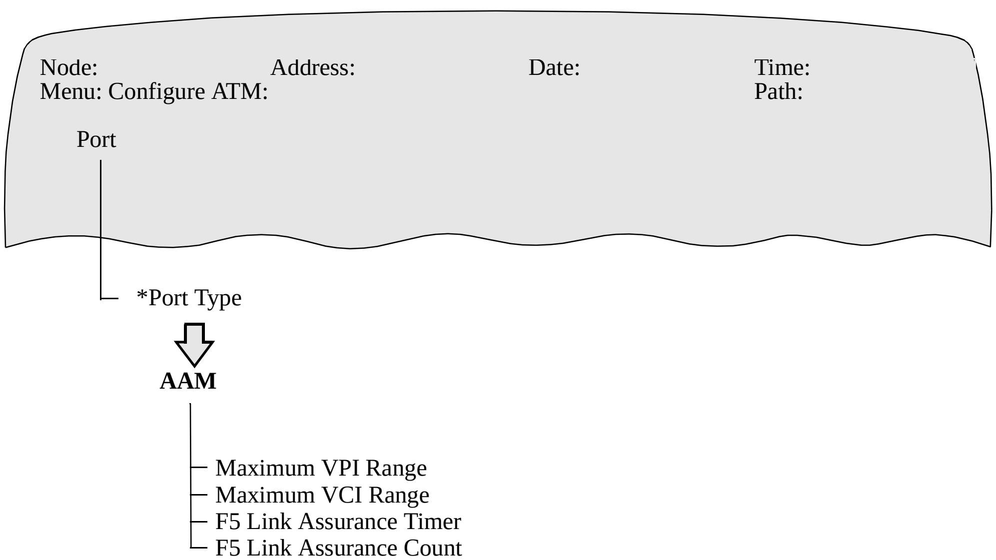

Figure 11. ATM Port Parameters

AAM Port Parameters

These are the parameters that appear after selecting the AAM Port Type:

Maximum VPI Range

Range	1, 3, 7, 15
Default	3
Description	Specifies the maximum Virtual Path Indicator (VPI) value that any station on this port can operate with. Increasing this value has the effect of decreasing the maximum Virtual Channel Identifier (VCI) that you can specify. ■ **Note** The value 1 may be preceded by a negative (-) symbol. This symbol should be ignored. ■ **Note** Changes to this parameter require a Node boot to take effect.

Maximum VCI Range

Range	63, 127, 255, 511
Default	127
Description	Specifies the maximum Virtual Channel Indicator (VCI) value that any station on this port can operate with. Increasing this value has the effect of decreasing the maximum Virtual Path Identifier (VPI) that you can specify. ■ **Note** Changes to this parameter require a Node boot to take effect.

F5 Link Assurance Timer

Range	1 to 120
Default	3
Description	Specifies the time to wait before sending the next loopback cell. ■ **Note** This only applies to stations which have the **Link Assurance Method** parameter set to **Loopback**.

F5 Link Assurance Count

Range	1 to 120
Default	3
Description	Specifies the maximum number of consecutive loopback cells to be sent without receiving a response before declaring Loss of Continuity state. ■ **Note** This only applies to stations which have the **Link Assurance Method** parameter set to **Loopback**

CC Activate/Deactivate Timer

Range	5 to 120
Default	5
Description	Specifies the amount of time, in seconds, that a node will wait for a reply to a transmitted proposal to activate or deactivate the Continuity Checking option. ■ **Note** This only applies to stations which have the **Link Assurance Method** parameter set to **Negotiate**.

CC Activate/Deactivate Retry

Range	3 to 120
Default	3
Description	Specifies the number of times the Activate/Deactivate Continuity Checking proposal is sent before declaring that the negotiation has failed. ■ **Note** This only applies to stations which have the **Link Assurance Method** parameter set to **Negotiate**.

Warm Booting an ATM Node

Introduction

Booting updates the operational parameters of a node using the ATM parameters stored in configuration memory (CMEM).

Warm Booting an ATM Node

To boot the ATM Node:

Step	*Action*
1	Select **Boot** from the Main menu.
2	Select the **Node (Warm)** option. This message appears: **Boot the Node** **WARNING: Booting the node will cause all current calls to be abnormally disconnected. This operation may result in lost data and disruption of network user sessions.** **`Proceed (y/n):`**
3	Press **y** and **Enter**.

Configuring the T1/E1 Interface

Follow These Steps The T1/E1 interface operates as an unchannelized port. Therefore many of the parameters used for a channelized port are not used for ATM. It is not necessary for you to change any of your standard T1/E1 configuration parameters when configuring ATM on a port. Figure 12 shows T1/E1 Interface parameter that must be configured.

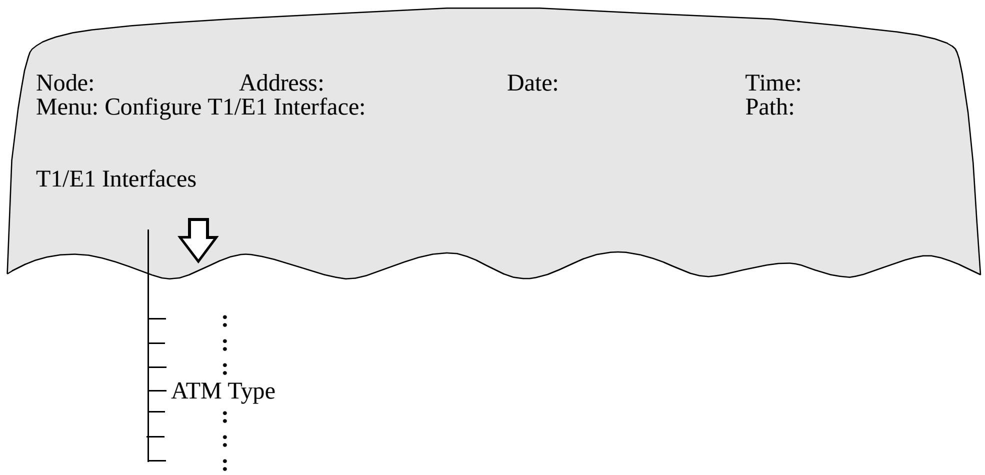

Figure 12. Configuring T1/E1 Interfaces

Follow these steps to configure the T1/E1 interface for use with ATM:

Step	***Action***
1	From the CTP Main menu, select **Configure**.
2	From the Configure Menu, select **Configure T1/E1 Interface**.
3	Type an Entry Number. The entry number is based on where the ATM Enhanced Daughtercard (EDC) is installed. For example: • When the ATM EDC is installed in slot number 2 (port 10) the Entry number is **2**. • When the EDC is installed in slot number 3 (port 13) the Entry Number is **3**.
4	Save the configuration.

T1/E1 Interface Parameter

This parameter must be configured:

ATM Port

Range	10, 13
Default	10
Description	Specifies the slot number in which the ATM Enhanced Daughtercard is installed: • 10: Enhanced Daughtercard slot number 2. • 13: Enhanced Daughtercard slot number 3. **■Note** This parameter does not appear if the ATM EDC is not installed.

Configuring the AAM Station Record

Follow These Steps Follow these steps to configure the ATM Access Module (AAM) Station Record:

Step	Action
1	From the CTP Main menu, select **Configure**.
2	From the Configure Menu, select **AAM Station**.
3	Type the appropriate Station Number and press **Enter**.
4	Configure the parameters as shown in Figure 13.

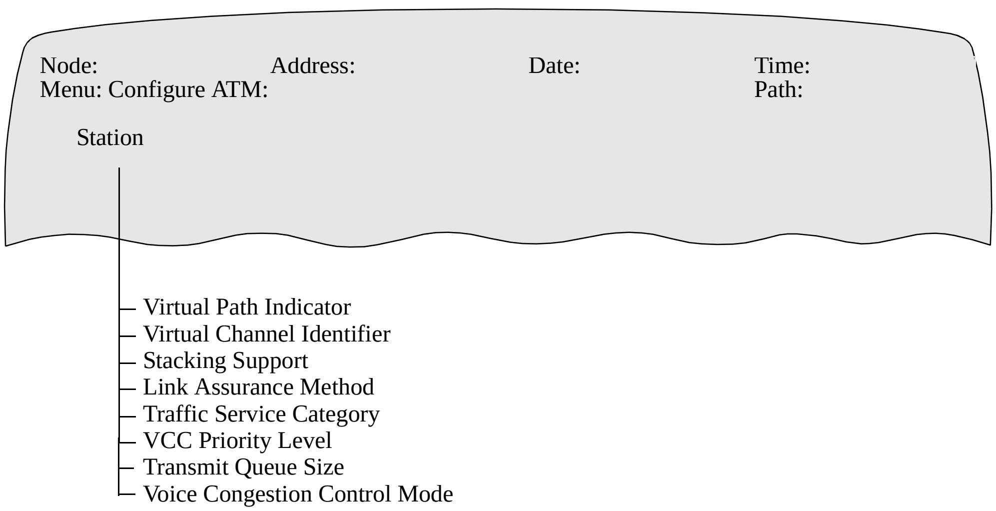

Figure 13. ATM Access Module (AAM) Station Record Parameters

AAM Station Parameters

These are the ATM Access Module (AAM) station parameters:

Station Number

Range	1 to 300
Default	1
Description	Identifies the station number on the AAM port.

Virtual Path Identifier (VPI)

Range	0 to 15
Default	0
Description	Specifies the VPI value in cells for the virtual channel associated with this connection. This is the provisioned virtual path number for the station of circuit type PVC on the ATM port.

Virtual Channel Identifier (VCI)

Range	32 to 511
Default	0
Description	Specifies the VCI value used in cells for the virtual channel associated with this connection. This is the provisioned virtual channel number for the station of circuit type PVC on the ATM port.

Stacking Support

Range	ENABLE, DISABLE
Default	DISABLE
Description	Specifies whether protocol stacking support is enabled to receive stack connection requests. In the case of PPPoFR, this allows FRI station to receive a stack connection request initiated by PPP.

Link Assurance Method

Range	DISABLED, LOOPBACK, NEGOTN, ENABLED
Default	DISABLE
Description	Specifies which Link Assurance method is used to determine end-to-end data channel integrity: • DISABLED: No Link Assurance messages are sent. • LOOPBACK: Link Assurance using F5 Loopback Cells. • NEGOTN: Link Assurance using CC Cells activated by the negotiating stage. • ENABLED: Link Assurance using CC Cells without negotiating.

Traffic Service Category

Range	CBR, UBR, VBR
Default	UBR
Description	Specifies the service type to be used on the station. The service types are: • UBR: Unspecified Bit Rate. • CBR: Constant Bit Rate. • VBR: Variable Bit Rate. ■ **Note** Changes to this parameter require an AAM Virtual Port boot to take effect.

VCC Priority Level

Range	NORMAL, HIGH
Default	NORMAL
Description	Specifies the priority of the station VCC in comparison to other stations within the same service category (either UBR of VBR). For VBR traffic category, setting this parameter to HIGH BRnrt (non-real time), select NORMAL. • NORMAL - Normal priority. • HIGH - High priority.

Transmit Queue Size

Range	0 to 400
Default	32
Description	The transmit queue buffers data packets according to the service level specified before they are sent to the network. Packets are discarded at the node if the transmit data rate exceeds the service level causing the queue to become full. The queue prevents potential discards of bursty data. A queue size of 0 disables data packet queueing.

Voice Congestion Control Mode

Range	DISABLED, ENABLED
Default	DISABLED

Voice Congestion Control Mode

Description	When Voice Congestion Control Mode is enabled and voice is detected, the data rate is forced into Committed Information Rate (CIR). The data rate is regulated using 50ms windows, and voice is prioritized in each window. When Voice Congestion Control Mode is disabled, the station operates normally.

Configuring the LAN Connection Table

What You See in This Record

Figure 14 shows the parameters that must be configured, in the LAN Connection Table Record, to support multiple protocols over ATM.

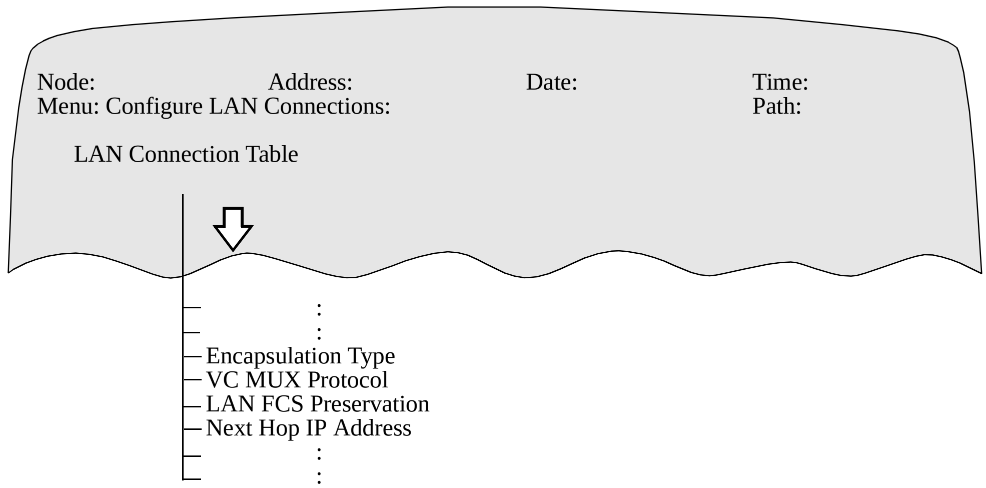

Figure 14. LAN Connection Table

LAN Connection Table Record Parameters

These are the ATM LAN Connection Table parameters that must be configured:

Encapsulation Type

Range:	CODEX, RFC1294, RFC877, RFC1483_LLC_SNAP, RFC1483_VC_MUX
Default:	CODEX
Description:	Specifies the data encapsulation format to be used on this LAN connection: • CODEX: Codex Proprietary Encapsulation. • RFC 877: RFC 877 Encapsulation. • RFC 1294: RFC 1294 Multiprotocol Encapsulation. • RFC 1483_LLC_SNAP: RFC 1483 LLC/SNAP Encapsulation. • RFC1483_VC_MUX: RFC 1483 VC Based Multiplexing Encapsulation. ■ **Note** If you configure this parameter for RFC1483_VC_MUX encapsulation the next parameter ‘VC_MUX_Protocol’ appears. Otherwise that parameter is not displayed. ■ **Note** Changes to this parameter require a Table Record Boot to take effect.

VC MUX Protocol

Range:	IP, IPX, 802.3, 802.5
Default:	IP
Description:	Specifies the type of traffic that can be sent or received on this LAN Connection using rfc1483_VC_Mux type Encapsulation: • IP: Internet Protocol traffic • IPX: Internetworking Packet Exchange traffic • 802.3: Ethernet traffic • 802.5: Token Ring traffic Only the traffic type selected for this parameter are permitted on this LAN Connection. ■ **Note** This parameter appears only if the parameter Encapsulation Type is set to RFC1483_VC_MUX. ■ **Note** Changes to this parameter require a Table Record Boot to take effect.

LAN FCS Preservation

Range:	Enable, Disable
Default:	Disable
Description:	Specifies whether the LAN Frame Check Sequence (FCS) is preserved for bridged packets (802.3 & 802.5) sent or received on this LAN Connection: • Disable: LAN FCS is not preserved within bridged packets sent or received on this LAN Connection and the receiving LAN port has to regenerate the FCS. • Enable: LAN FCS is preserved within sent and received bridged packets on this LAN Connection ■ **Note** This parameter appears only if the parameter Encapsulation Type for this LAN connection is set to either RFC1294, RFC1483_LLC_SNAP, or RFC1483_VC_MUX. ■ **Note** Changes to this parameter require a Table Record Boot to take effect.

Next Hop IP Address

Range:	A valid IP address in dotted decimal notation
Default:	0.0.0.0
Description:	Specifies the IP address of the Router Interface on the other end of this LAN Connection which is the next hop on the path to the final destination. This LAN Connection is used if it is the optimum route to reach the destination IP address. Note that the Network and Host portion of the IP address is needed. Using 0.0.0.0 for a LAN connection results in either of the following conditions: • LCON using RFC 1294 encapsulation and mapped to either a Frame Relay (BYPASS/Annex G) or an ATM station. • A LAN connection using RFC 1483 LLC/SNAP encapsulation and mapped to an ATM station. InvATMARP is not supported on LCONs using RFC1483 _VC_MUX encapsulation. For all other LAN connections a value of 0.0.0.0 causes this parameter to be ignored. ■ **Note** This parameter appears only if the parameter LAN Connection Type is set to GROUP. ■ **Note** Changes to this parameter require a Table Record Boot to take effect.

Statistics

Introduction

This section describes statistics for the ATM Access Module, including:

- “Detailed LAN Connection Statistics” section on page 43
- “Detailed AAM Port Statistics” section on page 44
- “Detailed AAM Station Statistics” section on page 48

Detailed LAN Connection Statistics

Introduction

This section describes the detailed LAN Connection statistics related to ATM.

Detailed LAN Connection Statistics

To view Detailed LAN Connection Statistics:

Step	*Action*
1	From the CTP Main menu, select **Status/statistics**.
2	From the Status/statistics Menu, select **LAN Connection Statistics**.
3	From the LAN Connection Statistics menu, select **Detailed LAN Connection Stats**.
4	Type the LAN Connection Number and press Enter to display the selected statistics.

LAN Connection Statistics

When you select LAN Connection Statistics, the Detailed LAN Connection Statistics screen provides three pages of detailed information about all current LAN Connections and LAN Connection Groups. The first page identifies the Encapsulation Type and, as shown in Figure 15, the ATM related encapsulation type configured for this ATM LAN connection is identified.

■ **Note**

In case of GROUP LCONs, the Next Hop IP Address is shown regardless of whether it is configured statically or learned through InvARP/InATMARP.

```
Node:                Address:             Date:          Time:
Detailed LAN Connection Statistics: LCON-1               Page: 1 of 3

 Call Summary:

 Connection Type: GROUP SVC(1)    Encapsulation Type: RFC1483_LLC_SNAP
 Connection State: Connected
 Forwarders Connected: Router
 Remote Address: 80094
 Next Hop IP Address: 134.33.200.4
                :
                :
```

Figure 15. Detailed LAN Connection Statistics Screen

■ **Note**

For additional statistics information and the definition of related LAN Connection Statistics terminology refer to the *Vanguard Router Basics Manual* (Part Number T0100-01).

Detailed AAM Port Statistics

Introduction

This section describes the Vanguard statistics used in ATM. You can use the information in the statistics screens to monitor node operation.

Detailed ATM Port Statistics

To view Detailed AAM Port Statistics:

Step	Action
1	From the CTP Main menu, select **Statistics**.
2	From the Statistics Menu, select **Detailed AAM Port Station**.
3	At the prompt, type the desired port number and press Enter to display the selected statistics.

Detailed AAM Port Statistics Screens

Figures 16, 17, and 18 show an example of the Detailed AAM Port Statistics.

```
 Node:                 Address:                Date:         Time:
 Detailed AAM Port Statistics : Port 10                      Page 1 of 3

Port Status: UP
                   IN        OUT
Data Summary:             Last Statistics Reset:
                   IN        OUT
 Characters:       0         378    Characters/sec:        0       0
 Frames:           0         27     Frames/sec:            0       0

 Operation and Maintenance Summary
   OAM Cells:      0         0

 ATM layer Summary
   Tot. Good Cells:0         0

Physical/ATM summary:
  Err Cells (Cor) 0
  Err Cells (Dis) 0
  Cell Delineation State: OUT OF SYNC
  Cell Delineation Stat Change Time:

 Press any key to continue (esc to exit)...
```

Figure 16. Detailed ATM Port Statistics Page 1 of 3

```
Node:              Address:              Date:        Time:
Detailed AAM Port Statistics : Port 10                Page 2 of 3


Number of Operating Stations: 1

Operating Stations: 1 - 4




Press any key to continue (esc to exit)...
```

Figure 17. Detailed AAM Port Statistics Page 2 of 3

```
Node:              Address:              Date:        Time:
Detailed AAM Port Statistics : Port 1                 Page 3 of 3


Stn#  VPI  VCI  Adm  Peer  Adj    Stn#  VPI  VCI  Adm  Peer  Adj
====  ===  ===  ===  ====  ====   ====  ===  ==== ==== ====  ====


1       0   32    1    1    0       2    0   33    1     1    10
3       0   34    1    1    0       4    0   35    1     1    0




Press any key to continue (esc to exit)...
```

Figure 18. Detailed ATM Port Statistics Page 3 of 3

AAM Port Statistics Screen Terms

This table explains the terms found in the AAM Port Statistics screens:

Term	Description
Port Status	There are three status indicators that indicate: • DISABLED: The AAM port is disabled. • UP: The AAM Port is enabled and can pass data. • DOWN: The AAM port is disabled and can not pass data.
Data Summary	• Characters: Indicates the total number of octets that have been received and sent since the last reset of the port statistics. • Frames: Indicates the total number of frames that have been received and sent since the last reset of the port statistics. • Characters/sec: Indicates the calculated average number of data octets per second that are received or transmitted on a port over a 64 second interval. • Frames/sec: Indicates the calculated average number of data frames per second that are received or transmitted on a port over a 64 second interval.
Last Statistics Reset	The date and time of the last statistics reset. Resetting the statistics does not clear the last call information from the detailed port statistics screen. This information is cleared only on a node boot.
Operation and Maintenance Summary	OAM Cells IN/OUT: Identifies the total number of OAM cells, on all VCCs, that have been received or transmitted.
ATM Layer Summary	Total Good Cells:

Term	***Description** (continued)*
Physical Layer Summary	• Err Cells (Cor): Identifies the number of received cells with cell header errors that have been corrected. • Err Cells (Dis): Identifies the number of received cells with cell header error that are not corrected, using Header Error Check field, because there are too many bit errors. • Cell Delineation State: Identifies the current state of the physical layer with respect to cell delineation. – SYNC: The physical layer is in sync with ATM cell delineation. – OUT OF SYNC: Indicates that the physical layer is out of sync with ATM cell delineation. • Cell Delineation State Change Time: Indicates when the last state change (moving from OUT OF SYNC to IN SYNC) took place.
Stn#	Indicates the station for which these statistics appear.
VPI	Indicates the configured Virtual Path Indicator
VCI	Indicates the configured Virtual Channel Indicator
Adm	Indicates the administrative state of the station. Values include: • 0: Disabled • 1: Enabled
Peer	Indicates the state of this nodes peer (the node at the other end of the ATM link). Values include: • 0: Down • 1: Up
Adj	Indicates the state of the adjacent station. This is the entity inside the node to which the PVC is connected. Values include: • 0: Down • 1: Up

Detailed AAM Station Statistics

Introduction

This section describes the detailed AAM Station Statistics and explains screen terms.

AAM Station Statistics

To view AAM Station Statistics:

Step	Action
1	From the CTP Main menu, select **Statistics**.
2	From the Configure Menu, select **AAM Station .**
3	At the prompt, type the desired port number.

AAM Station Statistics Screen

Figure 19 shows an example of the AAM Station Statistics.

```
 Node:              Address:              Date:        Time:
 Detailed AAM Station Statistics : Port 10, Station 1 Page 1 of 1

Station Status: DOWN

                IN      OUT                                 IN    OUT

Data Summary:                     Last Statistics Reset:
Octets:           0       0       Frames:                   0      0

Operation and Maintenance Summary:
 F5 Cells:        0       0
 AIS Cells:       0
 RDI Cells:       0       0
 CC Cells:        0       0

VCI Failures:     0              Negotiated CC State:   Running




 Press any key to continue (esc to exit)...
```

Figure 19. AAM Station Statistics

AAM Station Statistics Screen Terms

This table explains the terms found in the AAM Station Statistics screens.

Term	***Description***
Station Status	Indicates the current station status. • DISABLED: The AAM station is disabled. • UP: The AAM station is enabled and can pass data. • DOWN: The AAM station is disabled and unable to pass data.
Last Statistics Reset	Indicates the date and time that the statistics were last reset. Resetting the statistics does not clear the last recorded statistics information from the detailed station statistics screen. This information is cleared only when the node is booted.
Data Summary	• Octets IN/OUT: Indicates the total number of data octets that have been received and sent since the last reset of the station statistics. • Frames: Indicates the total number of data frames that have been received and sent since the last reset of the station statistics.
Operation and Maintenance Summary:	• F5 Cells IN/OUT: Indicates the total number of F5 OAM cells that have been received and sent since the last reset of the station statistics. • AIS Cells IN: Indicates the total number of station AIS OAM cells that are received/ transmitted. • RDI Cells IN/OUT: Indicates the total number of station RDI OAM cells that are received/transmitted. • VC Failure.
Negotiated CC State	Displayed only when the Link Assurance Method parameter is configured to Negotiate. • Running: The CC Link Assurance has been negotiated successfully and is running. • Failed: The CC Link Assurance negotiation has failed. • Negotiating: The CC Link Assurance negotiation process is in progress.