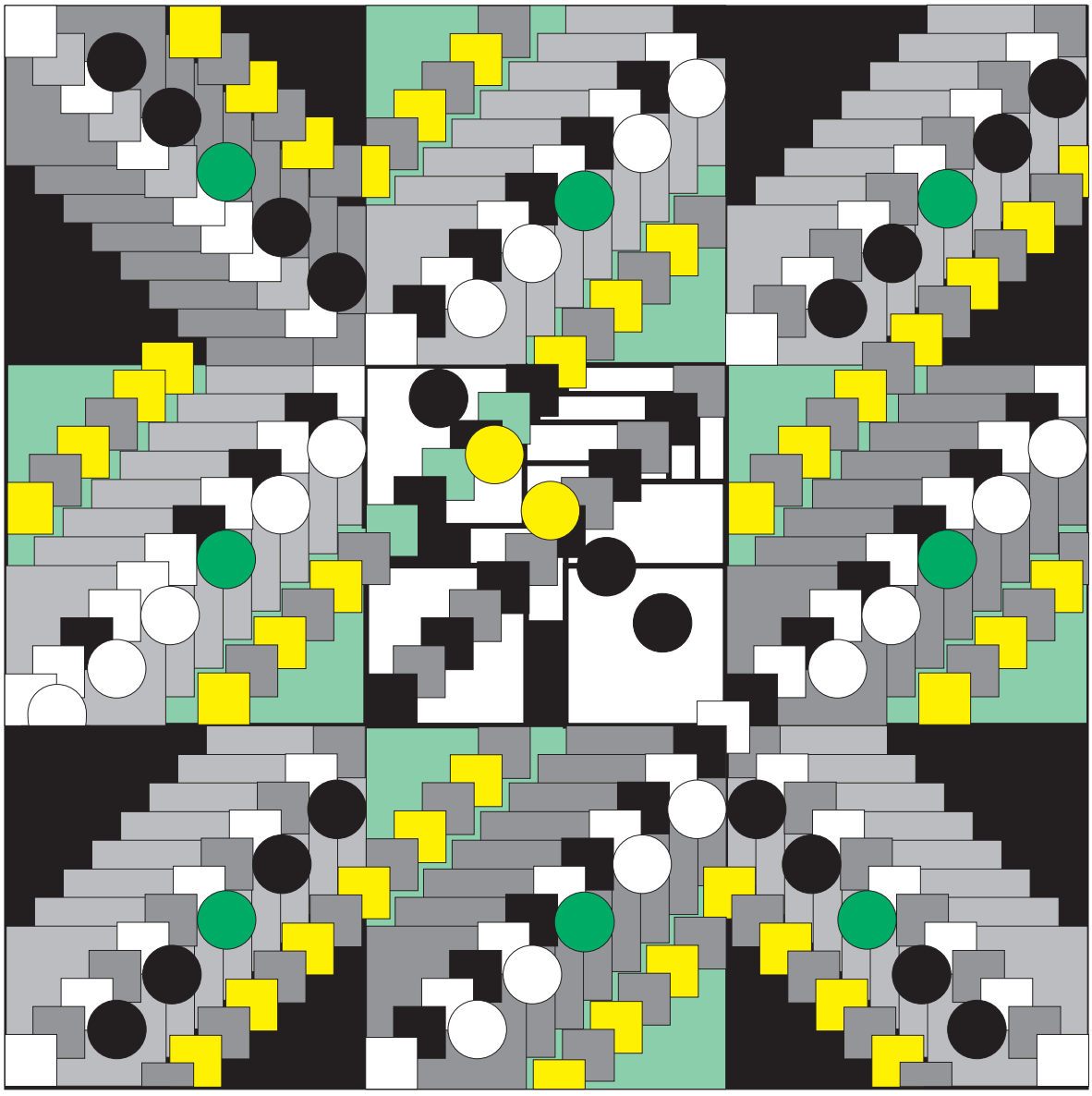
2220 Nways BroadBand Switch
Models 300, 500, and 501

IBM

Planning Series
ATM Interface Specifications



GA33-0378-06

2220 Nways BroadBand Switch
Models 300, 500, and 501

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Note

Before using the information given in this document, be sure to read the general information and notices provided in the *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References*, GA33-0379.

Seventh Edition (February 1999)

This edition applies to the following IBM licensed programs:

- Nways Switch Control Program Version 2 Release 2 (V2R2)
- Nways 2220 Switch Manager for AIX Version 1 replaces Nways Enterprise Manager Release 3.

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About This Document

Who Should Use This Document

Use this document if you are responsible for:

- Planning the installation of a network using IBM 2220 Nways BroadBand Switches (Nways Switches).
- Installing and configuring the network.

Purpose of This Document

This document describes the:

- Functions provided by IBM Networking BroadBand Services (NBBS) architecture on asynchronous transfer mode (ATM) interfaces of Nways Switches.
- Special features for bandwidth utilization, optimization, and automatic rerouting of connections.

How This Document Is Organized

The document is organized as follows:

- "Chapter 1. Nways Switch and Asynchronous Transfer Mode" on page 1 gives an introduction to the ATM access services provided by the Nways Switch.
- "Chapter 2. Configuring ATM Resources" on page 11 provides recommendations for configuring ATM resources.
- "Chapter 3. More Information on ATM Options" on page 19 describes certain ATM options.
- "Chapter 4. ATM / Frame Relay Interworking" on page 33 describes interworking between ATM and Frame-Relay networks.
- A Glossary is provided at the end.

Where To Find More Information

This document is a supplement to the *2220 Nways BroadBand Switch Planning Guide*, GA33-0293. For a complete list of customer information manuals, refer to "Bibliography" on page 55.

What's New in This Book

The following functions are new or have changed in the Nways Switch Control Program since the last edition of this book:

- Support for switched virtual connections (SVCs) has been added.
- Interworking between ATM and Frame Relay networks is now supported.

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Chapter 1. Nways Switch and Asynchronous Transfer Mode

This document describes how the IBM 2220 Nways BroadBand Switch (*Nways Switch)* supports the asynchronous transfer mode (ATM) protocol.

ATM is a high-speed, connection-oriented switching and multiplexing protocol that transmits different types of traffic (voice, video, and data) simultaneously.

The Nways Switch supports non-real-time, real-time, and non-reserved ATM traffic over permanent virtual circuits (PVCs). It provides a non-reserved logical queue for applications that require only best-effort delivery. ATM devices such as hubs, routers, and stations are attached through ATM logical ports. In a Networking BroadBand Services (NBBS) network, ATM traffic is transported over ATM and non-ATM trunks that connect Nways Switches. The ATM trunks are leased lines.

Figure 1 shows the different types of ATM and non-ATM traffic supported by Nways Switches in an 2220 network.

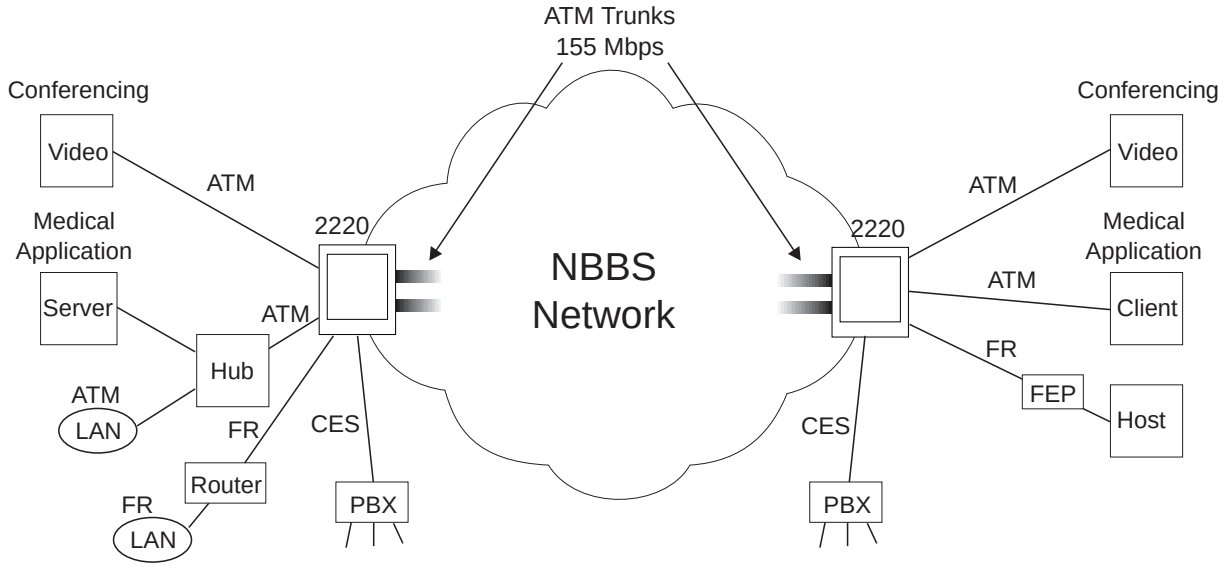

Figure 1. ATM Traffic Supported by NBBS Network

Legend:

ATM Asynchronous transfer mode

CES Circuit emulation services

FEP Front-end processor

FR Frame relay

LAN Local area network

PBX Private branch exchange

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Access Services

The Nways Switch provides the following ATM access services:

- Traffic at constant bit rate (CBR) and variable bit rate (VBR)
- Permanent virtual circuit (PVC) mode
- Virtual path (VP) and virtual channel (VC) services
- Input traffic policing at VP and VC level through the cell loss priority (CLP) mechanism, depending on the negotiated quality of service (QoS)
- Output traffic shaping in DCE mode at VP and VC level, depending on DTE characteristics
- Operation, administration, and maintenance (OAM) functions (for details, see “Operation, Administration, and Maintenance” on page 30).
- Support of ATM Forum UNI 3.0 and 3.1, and ITU-T B-ISDN Recommendations.

Interim Local Management Interface

On ATM logical ports, the Nways Switch does not support the interim local management interface (ILMI). Only permanent virtual connections (PVCs) that do not require the ILMI are supported.

Transport Services

The Nways Switch provides the following ATM transport services:

- Transport of ATM and non-ATM traffic over high bandwidth links
- Virtual path (VP) and virtual channel (VC) switching
- All types of traffic, not only ATM, are supported on ATM trunks.
- Support of ATM Forum 3.0 and 3.1, and ITU-T B-ISDN Recommendations.
- Support of ATM Bearer Service trunks.

Traffic Over ATM Trunks

In a 2220 network, you can define ATM trunks as leased lines that transport native ATM cells and non-ATM traffic segmented into ATM cells. Non-ATM traffic in ATM adaptation layer 5 (AAL5) for frame relay, HDLC, and CES protocols is supported.

Traffic Over Non-ATM Trunks

An NBBS network handles ATM traffic the same way whether it flows over ATM or non-ATM trunks. Non-ATM trunks transport ATM cells and non-ATM traffic as variable length packets in packet transfer mode (PTM), which is the native transfer mode of the NBBS architecture.

Interim Local Management Interface

The Nways Switch does not support the interim local management interface (ILMI) over ATM trunks. ATM trunks are, therefore, leased lines. Service provider trunks are not supported.

ATM Bearer Service

The ATM Bearer Service allows you to split ATM interfaces (ATM UNI and NNI) into several logical trunks. The logical trunks are mapped over ATM virtual paths on an ATM service provider.

ATM interfaces DS3/E3/STM1 in trunk mode with ATM Type 2 adapters (FC 5451) are supported. You can define up to 32 logical trunks for each ATM adapter. For LICs with two interfaces (for example, LIC 551 with two DS3s and LIC 552 with two E3s), the 32 logical trunks are shared between the two interfaces.

ATM Forum Traffic Descriptors

ATM traffic descriptors are defined in ATM Forum specification TM 4.0 and ITU-T specification I.371. The ATM traffic descriptors described in Table 1 are used when configuring ATM connections.

Table 1. ATM Traffic Descriptors

ATM Forum Traffic Descriptors					
1	**2**	**3**	**4**	**5**	**6**
PCR(0+1) CDVT(0+1) SCR(0) MBS(0) Without tagging	PCR(0+1) CDVT(0+1) SCR(0) MBS(0) With tagging	PCR(0+1) CDVT(0+1) Without tagging	PCR(0+1) CDVT(0+1) PCR(0) CDVT(0) Without tagging	PCR(0+1) CDVT(0+1) PCR(0) CDVT(0) With tagging	PCR(0+1) CDVT(0+1) SCR(0+1) MBS(0+1) Without tagging

Legend

PCR	Peak cell rate (cells per second)
CDVT	Cell delay variation tolerance (seconds)
SCR	Sustainable cell rate (cells per second)
MBS	Maximum burst size at PCR (number of cells)
CLP	Cell loss priority
(0+1)	Cells with CLP=0 and cells with CLP=1 (aggregate traffic)
(0)	Cells with CLP=0 (high-priority traffic). Traffic in excess with CLP=0 is discarded at network entry, or tagged with CLP=1 and accepted on a best-effort basis.

Cell Loss Priority

Cell loss priority (CLP) is indicated in a bit of the ATM cell header. When set, it indicates that the cell can be discarded during traffic congestion. By default, CLP bits are set to 0. At a network interface, if the ATM traffic does not conform to its configured characteristics, the CLP bits are set to 1 and the cells are said to be *tagged.* They are accepted into the network, but will be the first ones to be discarded. CLP value applies only to discarding and not to cell order.

ATM traffic is made up of two flows, flow with CLP=0 and flow with CLP=1. When both types of traffics are processed together, independently of their CLP status, the resulting flow is said to be *aggregate.*

Peak Cell Rate

Peak cell rate (PCR) defines the maximum rate at which cell flow is accepted (in cells per second). It is characterized by a minimum time interval between two consecutive cells. This time is inverse of the PCR. Peak cell rate that applies to the aggregate flow (with CLP=0 and CLP=1) is written PCR(0+1).

Sustainable Cell Rate

Sustainable cell rate (SCR) defines the average cell rate (in cells per second). It applies to variable bit rate (VBR) connections where the attached devices transmit for a certain period, then remain idle for another period. Sustainable cell rate that applies to the aggregate flow (with CLP=0 and CLP=1) is written SCR(0+1). It is possible to monitor the SCR only on flow with CLP=0. This is written SCR(0).

Maximum Burst Size

Maximum burst size (MBS) defines the size of the maximum burst transmitted at the peak cell rate (in number of cells). When maximum burst size is accepted, the connection must comply with the sustainable cell rate.

Cell Delay Variation Tolerance

Although a cell that arrives early is not considered to conform, a certain level of tolerance is allowed to account for jitter in network and switching equipment. This tolerance is specified by the *cell delay variation tolerance* (CDVT), which defines the time during which a limited burst of cells is accepted at the link speed (in seconds). There is no cumulative effect. Once the maximum burst defined by the CDVT has been accepted, the connection must comply to the PCR for a certain time.

Traffic Control

In an 2220 network, ATM traffic is controlled by means of:

- Traffic priority
- Bandwidth reservation
- Traffic policing
- Traffic shaping.

Traffic Priority

Traffic priority is configured through quality of service (QoS) with:

- High priority for voice traffic
- Medium priority for compressed voice or video traffic
- Low priority for data traffic
- Non-reserved traffic transported on best-effort delivery.

For details on selecting a QoS, see “Using Predefined ATM QoSs” on page 14.

Bandwidth Reservation

When a connection is set up, its parameters are checked to reserve bandwidth along the route using the NBBS reservation mechanism. This process is called *connection admission control* (CAC). It may be triggered by the non-disruptive path switching (NDPS) option in case of link failure. For details, see “Selecting Traffic Descriptors” on page 22.

Traffic Policing

Input traffic is permanently monitored (policed) against its traffic descriptors. Any cell that does not conform to the *usage parameter control* (UPC) is tagged or discarded. The UPC function guarantees that the input traffic meets the reservation criteria. It ensures correct network operation. For details, see “Traffic Policing” on page 23.

Traffic Shaping

Each network induces delays and jitter due to congestion and queuing. Shaping is needed at network exit to reshape connection traffic depending on its traffic descriptors. Without shaping, traffic may be discarded at the next network interface. For details, see “Traffic Shaping” on page 27.

Physical Lines

The Nways Switch supports ATM on the following physical lines (layer 1 of the OSI reference model):

- SONET STS-3c/SDH STM-1 lines (OC3) with:
  - Single mode optical fiber
  - Multiple mode optical fiber
  - Electrical interface
- E3 lines
- DS3 lines.

Physical lines are either port lines or trunk lines. A *port line* attaches an ATM device or switch to an Nways Switch and serves as a port to the 2220 network. ATM port lines transport only ATM traffic. A *trunk line* connects two Nways Switches through an ATM high-speed line. ATM trunks transport both ATM and non-ATM traffic.

Table 2 on page 6 shows the characteristics of the ATM network interfaces, depending on the line interface type.

Table 2. Physical Lines Supported by ATM

Characteristics	**DS3, E3**	**SDH/Sonet**
LIC type	551, 552	553, 554, 555, 556
Local Management Interface (LMI)	Public UNI	
Operation, Administration, and Management (OAM)	Physical level: F1, F2, F3 (I.610) Logical level: F4 and F5 (I.610), segment and end-to-end	
Framing	C-bit parity multiplex for DS3 ITU-T G.832 E3	SONET STS-3c (T1-105) SDH STM-1 (ITU-T G.708/G.709)
Cell delineation	ATM Forum, I.432	
Rate decoupling	I.432 I.361 ATM Forum 3.0/3.1	
VCI and VPI values	In conformance with standards: any VP/VC combination is supported except for values that are reserved by standards.	
Addressing structure	• Private networks: – OSI NSAP (ISO 8348 and ITU-T X.213) – Private numbering plan. • Public networks: – E.164 (ITU-T Recommendation E.164) – Private ATM address structure.	

For cabling information, see the *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References*, GA33-0379

ATM Network Interfaces

ATM logical ports (layer 2 of the OSI reference model) are called *ATM network interfaces*. ATM network interfaces are generated by the Control Program and are used:

- To provide ATM access services to physical ATM port lines. The ATM network interface sets up and maintains ATM connections in a 2220 network.
- To set up 2220 trunks using ATM Virtual Paths over an ATM service provider (ATM Bearer Service).

ATM Connections

Virtual Path and Virtual Channel Connections

Virtual path connections (VPCs) and virtual channel connections (VCCs) are supported on ATM user network interface (UNI) or network node interface (NNI). The number of bits in the virtual path identifier (VPI) field is 8 for UNI and 12 for NNI. UNI signaling and ILMI are supported on SVCs.

VCCs

VCCs connect external ATM devices. Each VCC is managed individually by the access agent in the source Nways Switch. VCCs always come in pairs, one VCC in each direction.

VPCs

A virtual path connection (VPC) can be seen as a bundle of virtual channels managed by the connected ATM devices. Each virtual path (VP) is managed by the access agent level in the source Nways Switch. VPCs come in pairs with one VPC in each direction.

Permanent and Switched Virtual Connections

In NBBS architecture, ATM connections are point-to-point connections that transport real-time, non-real-time, and non-reserved traffic over permanent virtual circuits (PVCs) and switched virtual connections (SVCs).

- PVC call setup (at power-on or by the operator) and SVC call setup can coexist in the same adapter.
- The maximum number of PVC and SVC calls in an ATPA2 is 1000.
- The maximum number of SVC calls at one time is 400.
- Traffic descriptors supported in SVC calls are the same as those for PVC calls.
- Policing is supported by means of a dual GCRA.
- Point-to-point calls are supported.

PVCs and SVCs can be set-up in both virtual path (VP) mode and virtual channel (VC) mode. The header used to route ATM cells contains labels that are swapped by routing tables in the Nways Switches along the route.

PVCs

ATM permanent virtual connections (PVCs) are pre-configured connections, started manually by the network manager or automatically by 2220 nodes. See “Activating Connections” on page 19 for details on configuring PVCs in the 2220.

SVCs

ATM switched virtual connections (SVCs) are started and removed dynamically by DTEs using ATM signalling.

SVCs can be created over switched ports that are defined as:

- IISP (Interim Interswitch Signalling Protocol) ports
- Public or Private UNI DCEs
- Public or Private UNI DTEs
- Q.2931 DTEs.

SVC Specifications:

- Supported by IBM 2220 models 300, 500, and 501 with the ATPA2 adapter (LICs 551, 552, 553, 554, 555, and 556).
- Meets the following specifications:
  - ITU-TS Q.2110/Q.2130 (ATM Access L2)
  - ATM Forum UNI 3.1 and 4.0
  - ATM Forum IISP v.1.0
  - ATM Forum ILMI 4.0
  - ITU Q.2931 (BISDN-DSS2-UNI).

- Supports different signalling protocols on the same ATM LIC when the LIC supports two lines (LIC 551 and LIC 552).
- Supports automatic address registration (ILMI). Up to 200 DTE addresses can be registered in an ATPA2 adapter.
- Supports both NSAP (Network Service Access Point) and E.164 addressing. Supports mapping of NSAP and E.164 addresses when attaching to a Public UNI network.
- Supports the five ATM QoS classes, and can be mapped to any NBBS QoS.
- Point-to-Multipoint connections, ABR, and shaping are not supported.
- OAM support is limited to:
  - Fault Management: Handles AIS or RDI calls
  - Loopback: Wraps OAM loopback calls.

Example: SVCs on IISP Ports: IISP, also called PNNI Phase 0, provides signalling between switches using static routes. This permits switches from different vendors to interoperate.

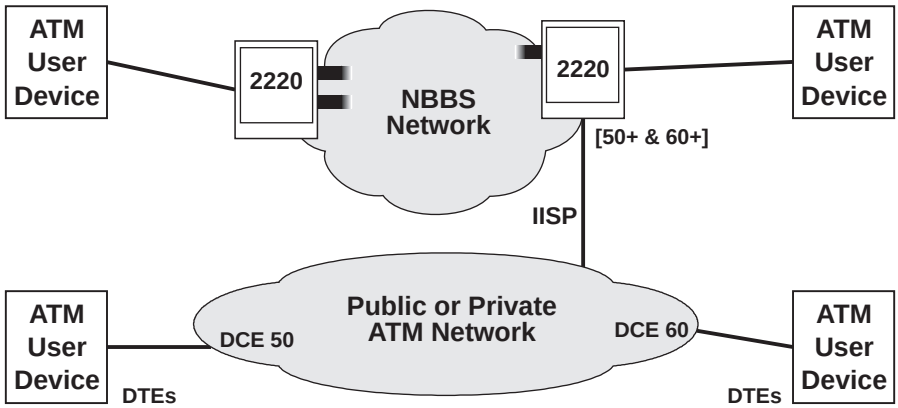

Figure 2. 2220 ATM Ports Defined as IISP and Connected to Public or Private ATM Network

- IISP links define resources with wildcards.
- ILMI registration is not permitted.

Example: SVCs on Public or Private UNI DCEs: The 2220 can be configured as an ATM private network that DTEs can attach to. When supported, ILMI (Integrated Local Management Interface) allows automatic address registration of DTEs.

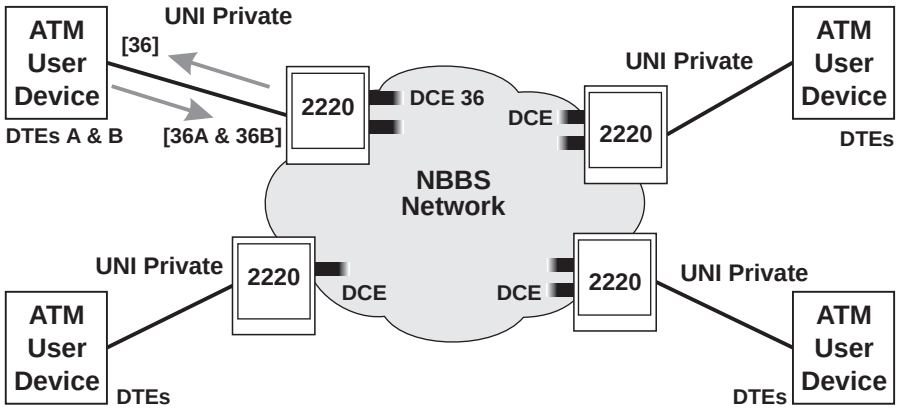

Figure 3. 2220 ATM Ports Defined as Private UNI DCEs

- UNI versions 3.1 and 4.0, as either Public UNI or Private UNI(VP0 VC5), are supported.
- ILMI address registration (VP0 VP16) must be used for Private UNI, and may be used for Public UNI.
- Network prefix and user part are exchanged on ILMI and registered in directory services for topology discovery.

Example: SVCs on Public or Private UNI DTEs: This configuration permits clustering of 2220 networks connected using SVCs.

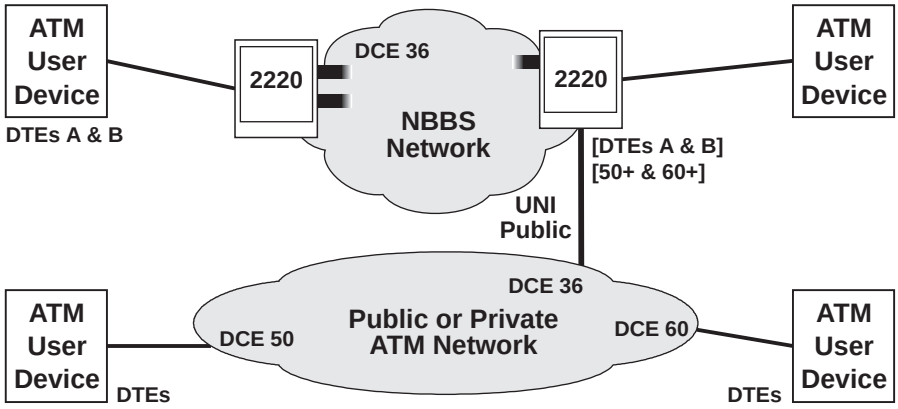

Figure 4. 2220 ATM Ports Defined as Public UNI DTEs Interconnected with a Public or Private ATM Network

- User part of a Public UNI DTE corresponds to the DTEs attached to the NBBS network.
- Resources are defined using wildcards.
- ILMI registration is optional.

Example: SVCs on Q.2931 DTEs: This configuration shows an NBBS network attached to a public network.

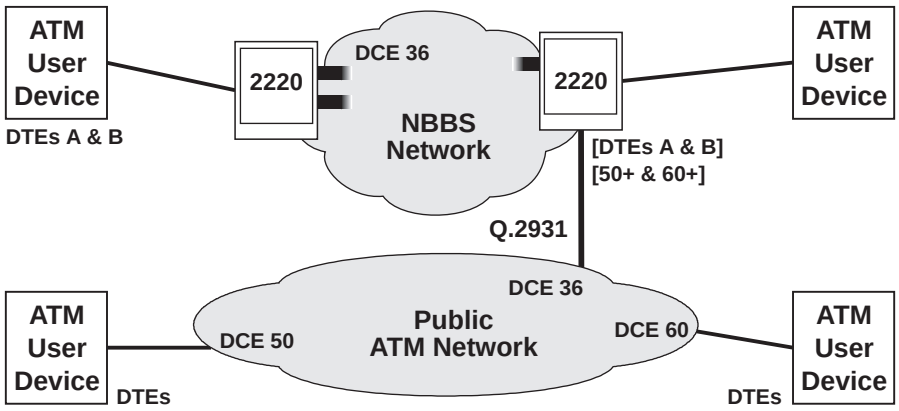

Figure 5. 2220 ATM Ports Defined as Q.2931 DTE and Connected to Public ATM Network

- User part of a Q.2931 link corresponds to the DTEs attached to the NBBS network.
- Resources are defined using wildcards.
- ILMI registration is optional.

ATM Trunks

An *ATM trunk* is a logical resource created by the Control Program to provide transport services to a physical trunk line in the 2220 network or over an ATM service provider. The use of logical trunks optimizes bandwidth and maintains the CP spanning tree.

There are two ways to use ATM trunks:

- *ATM leased line trunks* transport ATM traffic between Nways Switches over ATM leased lines.
- *ATM Bearer Service trunks* transport ATM traffic between Nways Switches over the ATM Virtual Paths of an ATM service provider.

Frame Relay / ATM Interworking

The IBM 2220 supports interworking between Frame Relay and ATM networks with two functions:

Network Interworking Function (NIWF)
Two Frame Relay devices communicating over an ATM network.

Service Interworking Function (SIWF)
A Frame Relay device communicating with an ATM device, where neither device knows that the other device is connected using a different protocol.

These interworking functions are described in “Chapter 4. ATM / Frame Relay Interworking” on page 33.

Chapter 2. Configuring ATM Resources

This chapter provides guidelines for configuring ATM resources.

Nways Switch Configuration Programs

ATM resources (line attachment, network interfaces, virtual path connections, virtual paths, virtual channel connections, and logical trunks) are configured using either:

- Nways Switch Configuration Tool Version 2 (NCT2) from a dedicated configuration station running OS/2 or AIX
- Nways Switch Manager (component of the Nways Enterprise Manager) from a network management station.

For detailed information on the configuration parameters to set, refer to the online help provided with each application. For guidelines on how to configure ATM resources, refer to the *Nways Switch Configuration Overview* provided with NCT2.

Configuring ATM Network Interfaces

You can configure ATM network interfaces in the following ways:

- To support ATM ports that set up and maintain ATM connections in a 2220 network.
- As ATM Bearer Service trunks that transport ATM traffic between Nways Switches over the ATM Virtual Paths of an ATM service provider.

Some of the general ATM network interface parameters to set are as follows:

- ATM network interface name: up to 32 characters
- Line attachment location: rack, slot, and position
- Network interface type: public user network interface (UNI), private UNI, or carrier to carrier.
- Maximum bandwidth available (default value: line speed).

The following ATM network interface parameters are required for ATM ports:

- Maximum number of virtual paths and virtual channels that can be created on each ATM interface
- Number of bits used in ATM cell headers for virtual path identifiers (VPIs) and virtual channel identifiers (VCIs).
- Attached resource identification: on each ATM network interface, you may define up to 16 resources. Each resource is defined by its:
  - Identifier type: E.164, network service address point (NSAP), or private numbering plan (PNP)
  - Identifier which must match the specified type.
- Protocol role: user side, network side, or user and network sides.
- Connection initiator and completor by default.

Creating ATM Connections

Before creating ATM connections, you must create ATM network interfaces on both Nways Switches at the end-points of the connection. You configure one ATM network interface for each ATM physical port line.

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On one end, the network interface serves as *connection initiator*. On the other end, the network interface serves as *connection completor*. A connection is always activated from the initiator network interface.

Creating ATM Bearer Service Trunks

Before creating ATM Bearer Service trunks, you must create ATM network interfaces on both Nways Switches at the end-points of the trunk. You configure one ATM network interface for each ATM physical line that accesses the ATM service provider.

Configuring ATM Virtual Connections

You configure an ATM connection on an ATM network interface configured as *connection initiator*. When you create an ATM connection, the configuration program automatically creates the return connection on the Nways Switch at the remote end-point of the connection.

Some of the VCC and VPC parameters to configure are as follows:

- VCC or VPC name
- Virtual circuit number (allocated by the NCT2)
- VPI or VCI on initiator side (allocated by the NCT2)
- VPI or VCI on completor side (selected from the list of ATM resources configured on the completor Nways Switch)
- Resource identifier and type at both initiator and completor sides

You must also define the following options for an ATM connection:

- ATM QoS for the forward and backward paths (for details, see “ATM QoS Options” on page 13)
- Policing (always enabled)
- If required, shaping and shaping speed
- Connection activation: permanently activated or not (for details, see “Activating Connections” on page 19)
- Accounting selection and bandwidth sensitivity over which accounting information is recorded.

You must define the following OAM options:

- Fault support: enabled or disabled
- Loopback: enabled or disabled
- Performance monitoring and continuity check are always disabled.

You specify the following ATM traffic options:

- One of the following ATM traffic standards:
  - No CLP/No SCR
  - CLP without Tagging/No SCR
  - CLP with Tagging/No SCR
  - No CLP/SCR
  - CLP without Tagging/SCR
  - CLP with Tagging/SCR

- Peak cell rate (in cells per second)
- Sustainable cell rate (in cells per second)
- Maximum burst size (in cells)
- Cell delay variation tolerance (in seconds).

ATM QoS Options

You assign a quality of service (QoS) to each ATM connection according to traffic type and the way the connection is to be handled by the 2220 network. The following QoS options define the characteristics of a virtual connection:

- Non-disruptive path switching
- Real-time class 1
- Real-time class 2
- Non-real-time
- Low-speed trunk line
- High priority
- Non-reserved.

Non-Disruptive Path Switching (NDPS)

Non-disruptive path switching (NDPS) ensures that when a link fails in the 2220 network or if the current path is lacking resources, connections with the NDPS option are rerouted to another available path or to a parallel 2220 trunk. The Nways Switch that is connection initiator reroutes the connections. When the NDPS option is not selected, connections are terminated and re-established by the Retry mechanism only when the path is available. See “Non-Disruptive Path Switching” on page 19 for more information.

Real-Time Class 1 (RT1)

Real-time class 1 (RT1) is a logical queue in each transit Nways Switch and is used for real-time applications, such as constant bit rate and voice, that require low delay and jitter. RT1 provides lowest delay and jitter.

Real-Time Class 2 (RT2)

Real-time class 2 (RT2) is a logical queue used for real-time applications that support more delay and jitter than RT1. RT2 provides better bandwidth optimization than RT1 but increases the end-to-end delay. When you configure RT2 for voice, the cell delay variation (CDV) and cell transfer delay (CTD) values are reduced.

Non-Real-Time (NRT)

Non-real-time (NRT) is a logical queue which is used for applications requiring guaranteed bandwidth but not sensitive to delay or jitter. Frame relay and HDLC are examples of such applications.

Low-Speed (LS) Trunk Line

In data transmission, the low-speed trunk lines may have a wide end-to-end transfer delay because the transmitted data is buffered by the Nways Switch adapters along

the path. For data traffic that does not need real-time transmission, these transfer delays have a minor impact on the data applications that are connected through the 2220 network.

When you select *low-speed* (LS) trunk line, the end-to-end delay allowed is greater, but the selection of a suitable path is easier. If low-speed lines are used and LS is not selected, connections may be rejected because the maximum end-to-end delay calculated on the path is wider than the required delay.

High Priority (HPRI)

If a path fails, it is possible that there is no longer sufficient bandwidth to support all existing connections. If you select *high priority* (HPRI), the bandwidth preemption function ensures that the connection is given first access to bandwidth. Other connections receive the remaining bandwidth.

Bandwidth preemption applies when one of the following events occurs:

- Connections are activated.
- A link fails.
- Connections with the NDPS option are rerouted.

For more information, see “Bandwidth Preemption” on page 20.

Non-Reserved (NR)

Non-reserved (NR) is a logical queue used for applications that do not require delay and bandwidth guarantees, only best-effort delivery. Non-reserved is also used for internal 2220 network control flow.

ATM non-reserved traffic supports the use of Explicit Forward Congestion Indication (EFCI) in ATM port and trunk adapters. Early Packet Discard (EPD) is supported on Virtual Circuit (VC) connections for ATM Bearer Service trunks and on ATM ports. EPD-like support is provided on Virtual Path (VP) connections. To improve performance on ATM Bearer Service trunks, the cell buffering size is increased to 16 000 cells.

Using Predefined ATM QoSs

Nways Switch configuration programs provide predefined QoSs that you can assign to ATM connections according to traffic type. You select a predefined QoS for any of the following ATM traffic types:

- Non-real-time
- Real-time
- Non-reserved.

QoS for ATM Non-Real-Time Traffic

Table 3 on page 15 displays the QoS options defined for ATM non-real-time traffic. Each name starts with QOSATMNRT.

Table 3. Predefined QoS for ATM Non-Real-Time Traffic

QoS Name	Non Disruptive Path Switching (NDPS)	Low Speed Trunk Lines (LS)	High Priority (HPRI)
QOSATMNRT			
QOSATMNRTNDPS	X		
QOSATMNRTLS		X	
QOSATMNRTNDPSLS	X	X	
QOSATMNRTHPRI			X
QOSATMNRTNDPSHPRI	X		X
QOSATMNRTLSHPRI		X	X
QOSATMNRTNDPSLSHPRI	X	X	X

QoS for ATM Real-Time Traffic

Table 4 displays the QoS options defined for ATM real-time traffic. Each name starts with QOSATMRT.

Table 4. Predefined QoS for ATM Real-Time Traffic

QoS Name	Real-Time 1 (RT1)	Real-Time 2 (RT2)	Voice	Non Disruptive Path Switching (NDPS)	High Priority (HPRI).
QOSATMRT1VOICE	X		X		
QOSATMRT1VOICENDPS	X		X	X	
QOSATMRT1VOICEHPRI	X		X		X
QOSATMRT1VOICENDPSHPRI	X		X	X	X
QOSATMRT2		X			
QOSATMRT2NDPS		X		X	
QOSATMRT2HPRI		X			X
QOSATMRT2NDPSHPRI		X		X	X
QOSATMRT2VOICE		X	X		
QOSATMRT2VOICENDPS		X	X	X	
QOSATMRT2VOICEHPRI		X	X		X
QOSATMRT2VOICENDPSHPRI		X	X	X	X

QoS for ATM Non-Reserved Traffic

Table 5 on page 16 displays the QoS options defined for ATM non-reserved traffic. Each name starts with QOSATMNR.

Table 5. Predefined QoS for ATM Non-Reserved Traffic

QoS Name	Non-Reserved (NR)	Non-Disruptive Path Switching (NDPS)	High Priority (HPRI)
QOSATMNR	X		
QOSATMNRNDPS	X	X	
QOSATMNRHPRI	X		X
QOSATMNRNDPSHPRI	X	X	X

Configuring ATM Trunks

Some of the ATM trunk parameters that you must configure are as follows:

- Logical trunk name: up to 32 characters
- Line attachment location: rack, slot, and position
- Propagation delay (obtained from your telecommunication company)
- Administrative state after loading the Nways Switch Control Program: unlocked or locked.

When you configure an ATM trunk, you specify advanced options using the following parameters:

- Bandwidth reservable: defaulted to 85% for traffic and 15% for network control (displayed by the NCT2)
- Smallest connection size: defaulted to 0.101 kbps
- CP spanning tree preferability: selected in the range 0-15 (0 means never used for CP spanning tree update)
- Traffic support, circuit emulation and real-time selection
- Link liveness interval: defaulted to 500 ms
- Link liveness timeout: defaulted to 1500 ms
- ATM parameters (detailed below):
  - Maximum bandwidth available
  - Usable virtual path identifier (VPI) range
  - Reserved virtual channel identifier (VCI) range
  - Negotiable VCI range
  - Usable VCI range.

Maximum Bandwidth Available

Use the Maximum Bandwidth Available option to specify the total amount of bandwidth to be used for a trunk. ATM shaping enforces this value, which is the physical line speed by default.

Restriction: On ATM trunks, Frame-Relay and voice traffic are transported using the ATM adaptation layer 5. If voice packets wait for Frame-Relay packets to be transmitted, the voice connection experiments jitter and packets may be lost. To avoid such a condition, do not configure a bandwidth with less than **6 Mbps**.

VPI Range

Use the virtual path identifier (VPI) range to define the range of contiguous VPIs for one destination. The common carriers may perform VPI switching but it is assumed that the VPI sequence is the same on each side of the line. For example, VPIs 10 to 20 on one end corresponds to VPIs 45 to 55 on the other end. The lowest VPI of the range transports ATM virtual channel connections (VCCs) as well as NBBS control traffic and non-ATM traffic. The remaining VPIs transport ATM virtual path connections (VPCs). For ATM trunk leased lines, you use the default range: 0 to 255.

If no VPCs are required in the network, configure a single virtual path (VP). The range is reduced to a single value (24) and the VP is shaped according to the specific bandwidth. This VP can transport any type of traffic in VCCs but not in VPCs.

If VPCs are required, the range allows the number of required VPCs plus one. For example, if five VPCs are required on the trunk, define a range from 21 to 26. The VPs are shaped as a group depending on the specified bandwidth.

VCI Ranges

Although it is recommended that you keep the default values, you may configure the following parameters on VPs that transport VCCs (the first VP in the VPI range). If you change the default values, make sure that the same values are configured on both sides of the trunk.

Reserved VCI Range
VCI values (0 to 31) are reserved according to the ATM Forum and ITU-T Recommendations.

Negotiable VCI Range
VCI values (32 to 255) are used to carry NBBS control traffic and non-ATM data traffic, such as HDLC or frame relay. Only one VCI and the ATM AAL5 are used to split and join the data packets.

Usable VCI Range
VCI values (256 to 65 535) are used for ATM virtual channel connections, including ATM and X.25 traffic.

ATM VP Trunks (Bearer Service)

The ATM Bearer Service allows you to split a physical ATM interface into up to 32 logical NBBS trunks that are mapped over ATM virtual paths (VPs) in an interconnecting ATM network. On LICs that have two interfaces (LIC 551 and 552), the 32 logical trunks are shared between the two interfaces.

Each ATM VP trunk must be defined either in Virtual Circuit Connection (VCC) or Virtual Path Connection (VPC) mode. You cannot use both modes on the same VP trunk. On a physical ATM interface, however, you can combine a set of ATM VP trunks in VCC mode with a set of ATM VP trunks in VPC mode.

In ATM VP trunks in VCC mode, voice, CBR, X.25, Frame Relay, ISDN, and ATM VC connections can be freely mixed until the trunk's throughput capacity is reached. ATM VP trunks do not support ATM VPC connections.

ATM VP trunks in VPC mode can accept only one VPC. Because only one connection is accepted, the remaining bandwidth is set to 0.

Chapter 3. More Information on ATM Options

Default QoS Options

Table 6 displays the default values used by the Nways Switch Control Program for ensuring QoS in ATM traffic.

Table 6. ATM QoS: System Defaults

QoS Option	ATM Data	ATM Voice
Bandwidth adjustment (ADJ)	No	No
Bandwidth keeping (KEEP)	No	No
Logical queues	Real-time class 2 (RT2), non-real-time (NRT), or non-reserved (NR)	Real-time class 1 or 2 (RT1 or RT2)
End-to-end delay	200 ms to 10 s	2 ms to 10 s
Maximum number of hops	10	10

When a connection is established, the Path Selection function minimizes the number of hops and the trunk load to guarantee the required end-to-end delay.

Activating Connections

When a connection is activated, the connection setup is started over the network. If the following conditions are not satisfied, the connection setup fails:

- The required Nways Switch resources (adapter, line interface coupler, and line attachments) must be available.
- The line must be unlocked.
- The remote equipment must be ready.

In an 2220 network, the Nways Switch that is the connection initiator activates the connection in one of the following ways:

- If the Permanent Mode option is selected, the connection is activated when the Nways Switch resources, the line, and the remote equipment are ready.
- If the Permanent Mode option is **not** selected, the connection is activated only when a network operator enters the Start Connection command from Nways 2220 Switch Manager.

Non-Disruptive Path Switching

Non-disruptive path switching (NDPS) restores a connection over another network path or a parallel trunk if the current trunk fails or if there is insufficient bandwidth when bandwidth adaptation is performed.

When a trunk fails or when bandwidth adaptation cannot be successfully performed, the connections with the NDPS attribute are rerouted on another trunk (when possible). Connections are rerouted in the following order based on connection priority:

1. High priority (HPRI)
2. Real-time class 1 (RT1)

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3. Real-time class 2 (RT2)
4. Non-real-time (NRT)
5. Non-reserved (NR)

When connections have the same priority, the connection with the widest bandwidth is rerouted first. If necessary, low-priority connections are preempted on the trunk used for rerouting (see “Bandwidth Preemption”).

When many connections require NDPS at the same time, a wide amount of traffic control is created in the 2220 network. This can result in long rerouting delays. (For more information on selecting a QoS with the NDPS option, see “Non-Disruptive Path Switching (NDPS)” on page 13.)

Bandwidth Preemption

Bandwidth preemption stops a low priority connection so that a higher priority connection can use its resources. Bandwidth preemption is used during connection setup and link failure.

Because bandwidth adaptation is not available for ATM connections, there is no preemption on bandwidth request. For more information on selecting a QoS with bandwidth preemption, see “High Priority (HPRI)” on page 14.

At Connection Setup

Preemption at connection setup is performed as follows:

1. A low-priority connection, without the non-disruptive path selection (NDPS) option in its quality of service, is established.
2. A request occurs to establish a new connection with a higher priority and there is not enough trunk capacity to support both connections at the same time.
3. The high-priority connection is established.
4. The low-priority connection is terminated and its resources (bandwidth and label) are released.

   If the low-priority connection has the NDPS option, it is immediately rerouted with its initial bandwidth. The connection is not terminated.

If the new connection has the same priority as an established connection, and if there is not enough bandwidth available, the new connection is rejected.

After Link Failure

Preemption after link failure is performed as follows:

1. A low-priority connection without NDPS is established on a trunk. A connection with a higher priority is also established on the trunk.
2. The bandwidth capacity of the trunk becomes insufficient.
3. The high-priority connection is rerouted.
4. The low-priority connection is terminated and its resources are released.

   If the low-priority connection has the NDPS option, it is immediately rerouted with its initial mean bit rate. The connection is not terminated.

If there is not enough bandwidth available to reroute the high-priority connection, even when the low-priority connections are preempted, the high-priority connection is terminated and the low-priority connections are kept.

Traffic Descriptors

This section provides recommendations for configuring the peak cell rate (PCR) and sustainable cell rate (SCR) of ATM connections.

PCR and CDVT

You must specify an input traffic inferior to the peak cell rate (PCR) otherwise cell discarding will occur at the next network interface. When defining a value for cell delay variation tolerance (CDVT), take into account shaping and jitter in the transit nodes.

PCR(0) Flow

When PCR(0) and CDVT(0) are declared, non-conforming cells are either:

- Discarded. Thus, the PCR(0) flow is a good choice for a constant bit rate (CBR) application (for example, video).
- Tagged: CLP is changed from 0 to 1 to indicate that the cell is accepted on a best-effort basis. The decision to discard is transferred to the next network interface.

An example of PCR(0) flow is a video application using CLP=0 cells to carry image data and CLP=1 cells to improve image quality (more color and more detail). The CLP=0 cells conform to both PCR(0+1) and PCR(0) tests. The CLP=1 cells that conform to the PCR(0+1) test bypass the second test on PCR(0) and may be discarded.

PCR(0+1) Flow

For aggregate flow (CLP=0 and CLP=1), define PCR(0+1) in relation with the shaping speed (if the traffic is shaped), or to the access rate (if the traffic is not shaped). Any cell that does not conform to PCR(0+1) and to the associated CDVT(0+1) is discarded.

For each connection, define the PCR of the aggregate flow. Here are recommendations:

- The CBR traffic is shaped. Set the PCR to the CBR cell rate.
- For variable bit rate (VBR) traffic, the worst case scenario occurs when long bursts of cells arrive at the maximum cell rate. This may lead to overestimating the required bandwidth. Select shaping to avoid overestimation.

  It is also possible to check for implicit shaping along the path from the source to the network interface. A CBR connection may also be shaped by the source itself.

An example of PCR(0+1) flow is an ATM virtual channel that crosses a 25 Mbps link before reaching the network on a 155 Mbps interface. If the jitter of the intermediate devices is correct, define PCR as 25 Mbps rather than 155 Mbps.

Note: *Mbps* stands for 1 000 000 bits per second.

SCR

Sustainable cell rate (SCR) and burst tolerance (BT) depend on the traffic source. If the traffic characteristics are known, you can set SCR(0+1) and SCR(0) easily.

If the source is unknown, you may either:

- Assume the worst case scenario and only declare PCR(0+1).

  In this case, there is a chance of overestimating required bandwidth and of wasting network resources.
- Arbitrarily define a level of reservation and use the tagging option to let the excess traffic flow into the network.

  In this case, there is a chance of underestimating the required bandwidth and of having cells discarded. A basic rule is to limit the level of excess traffic to the amount of reserved traffic.

Selecting Traffic Descriptors

For each new connection, the Nways Switch reserves an amount of bandwidth on the route. The connection is activated only if enough bandwidth is available.

For each ATM connection:

- With traffic descriptors 1, 2, and 6, the sustained cell rate (SCR) and mean burst size (MBS) are used in addition to the access rate, PCR, and CDVT.
- With traffic descriptors 3, 4, and 5, the access rate, peak cell rate (PCR), and cell delay variation tolerance (CDVT) parameters are used to compute the bandwidth reservation.

When selecting Nways Switch traffic descriptors, follow these guidelines:

- For a constant bit rate (CBR) application, use one of the following options:
  - PCR(0+1)
  - PCR(0+1) and PCR(0) without tagging.
- For variable traffic rate (VBR) where the source traffic is known, use one of the following options:
  - PCR(0+1) and SCR(0+1)
  - PCR(0+1) and SCR(0) without tagging
  - PCR(0+1) and SCR(0) with tagging.
- For non-reserved traffic, use one of the following options:
  - PCR(0+1) and PCR(0) with tagging
  - PCR(0+1) and SCR(0) with tagging.

  The reservation is based on PCR(0) or SCR(0), which are as low as necessary to limit the reservation. All the traffic is non-reserved and has the lowest priority. You can use PCR(0+1) as an upper limit. Otherwise, set PCR(0+1) to the line speed.
- In the other cases, use one of the following options:
  - PCR(0+1)
  - PCR(0+1) and SCR(0) with tagging
  - PCR(0+1) and PCR(0) with tagging.

    Here, the reserved bandwidth is limited to PCR(0) and the remaining traffic is considered as excess traffic.

Table 7 summarizes the recommendations for selecting the traffic control parameters.

Table 7. ATM Traffic Descriptors and Priority Parameters

Parameters	High Priority	Medium Priority	Low Priority	Non Reserved
Traffic Priority	Real-time class 1 (RT1)	Real-time class 2 (RT2)	Non-real-time (NRT)	Non-reserved (NR)
Traffic Descriptor	3	Variable bit rate: 1 2 6 Constant bit rate: 3 4 5	Variable bit rate: 1 2 6 Constant bit rate: 3 4 5	2, 5

Traffic Policing

The Nways Switch provides *input traffic policing* on ATM port interfaces. Policing depends on traffic descriptor values and is represented by a generic cell rate algorithm (GCRA) with six combinations of traffic descriptors, as follows:

PCR(0+1) and SCR(0), without tagging
Control the peak cell rate of the aggregate traffic and the sustainable cell rate of traffic with CLP=0. There is discarding of non-compliant cells by SCR(0) policing.

PCR(0+1) and SCR(0), with tagging
Control the peak cell rate of the aggregate traffic and the sustainable cell rate of the traffic with CLP=0. There is tagging of non-compliant cells by SCR(0) policing.

PCR(0+1) without tagging
Control the peak cell rate of the aggregate traffic (CLP=0 and CLP=1).

PCR(0+1) and PCR(0), without tagging
Control the peak cell rate of the aggregate traffic and traffic with CLP=0. There is discarding of non-compliant cells by PCR(0) policing.

PCR(0+1) and PCR(0), with tagging
Control the peak cell rate of the aggregate traffic and traffic with CLP=0. There is tagging of non-compliant cells by PCR(0) policing.

PCR(0+1) and SCR(0+1), without tagging
Control the peak cell rate and sustainable cell rate of the aggregate traffic.

Traffic Descriptors 1 and 2

For traffic descriptors 1 and 2, policing is performed using the same two GCRAs as in descriptor 6, except that the second GCRA only handles cells with CLP=0.

Cells with CLP=0 that deviate from CDVT(0) are either:

- Discarded (for traffic descriptor 1)
- Transmitted with CLP=1 (for traffic descriptor 2 with *tagging*).

Figure 6 on page 24 shows the GCRA used for traffic descriptor 1.

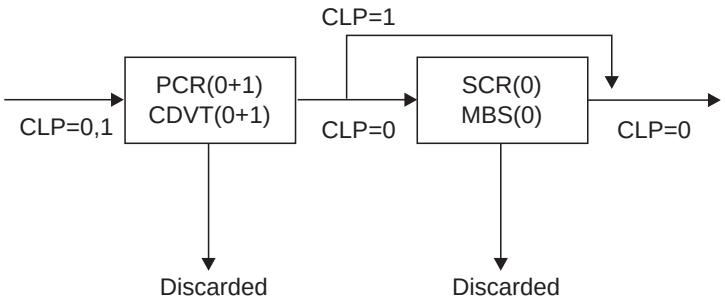

Figure 6. Policing Algorithm for Traffic Descriptor 1 (Without Tagging)

Figure 7 shows the GCRA used for traffic descriptor 2.

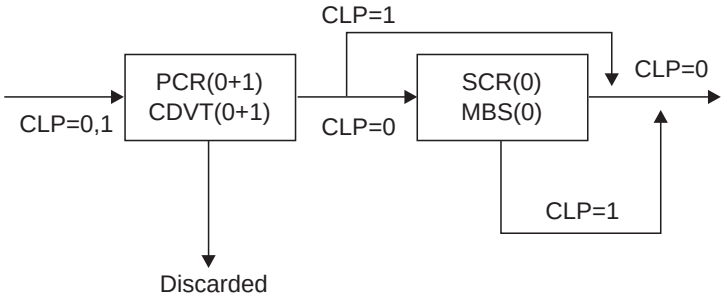

Figure 7. Policing Algorithm for Traffic Descriptor 2 (With Tagging)

Traffic Descriptor 3

For traffic descriptor 3, policing is performed on all arriving cells, whether the CLP is 0 or 1.

PCR(0+1)
The peak cell rate (PCR) specifies the upper bound of the traffic received on the ATM connection. The **minimum** theoretical arrival time between cells is given by T(PCR)=1/PCR (where PCR is given in cells per second).

CDVT(0+1)
The cell delay variation tolerance (CDVT) specifies the **maximum** delay between the theoretical inter-arrival time and an early arrival time for each cell. A cell arriving outside of this tolerance is discarded. For details, see Figure 9 on page 25.

Figure 8 on page 25 shows the generic cell rate algorithm (GCRA) used for traffic descriptor 3.

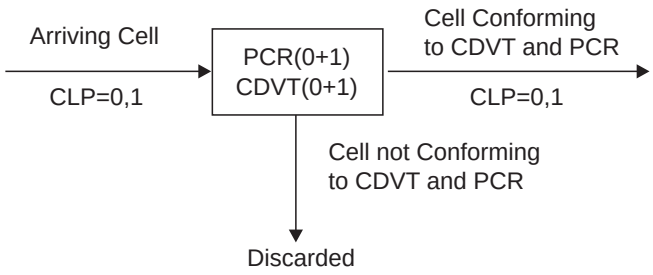

Figure 8. Policing Algorithm for Traffic Descriptor 3

Figure 9 shows an example of policing of input cells.

In the figure, cell 3 arrives ahead of its theoretical arrival time but within the CDVT and is accepted. Cell 4 arrives ahead of its theoretical arrival time and ahead of the CDVT, and is discarded.

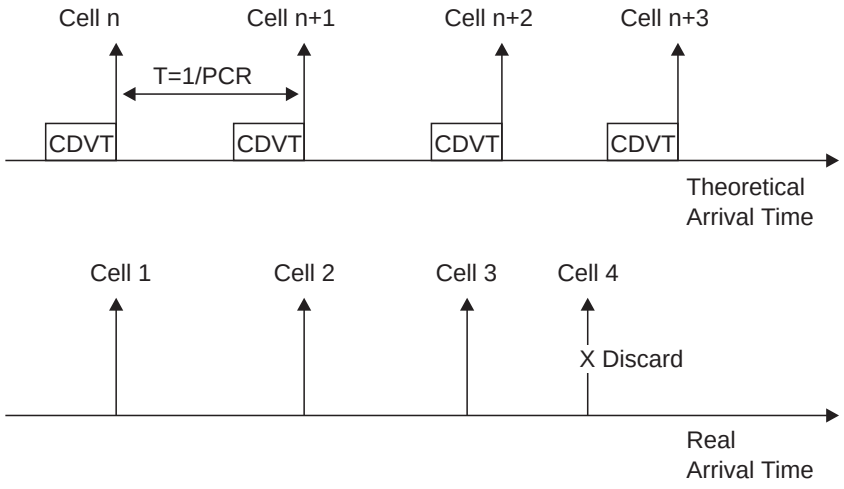

Figure 9. Policing of Input Cells

Traffic Descriptors 4 and 5

For traffic descriptors 4 and 5, policing is performed by successive use of two GCRAs:

1. A GCRA based on PCR(0+1) and CDVT(0+1) handles cells as does the GCRA used for traffic descriptor 3.
2. A GCRA based on PCR(0) and CDVT(0) handles cells with CLP=0.

Cells having CLP=0, which deviate from CDVT(0), are either:

- Discarded (for traffic descriptor 4).
- Transmitted with their CLP forced to 1 (for traffic descriptor 5). Forcing CLP to 1 is called *tagging*. Tagged traffic is allowed to enter the 2220 network. If a lack of resources occurs, it may be discarded at any intermediate stage.

Figure 10 on page 26 shows the GCRA used for traffic descriptor 4.

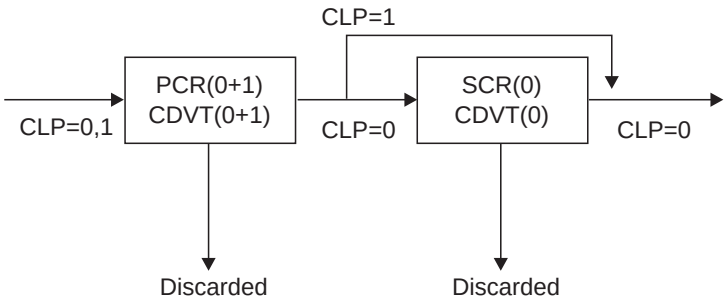

Figure 10. Policing Algorithm for Traffic Descriptor 4 (Without Tagging)

Figure 11 shows the GCRA used for traffic descriptor 5.

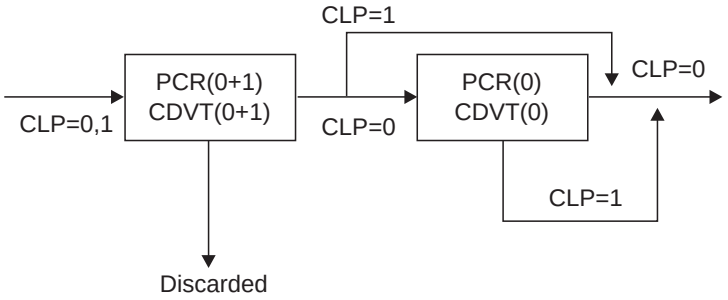

Figure 11. Policing Algorithm for Traffic Descriptor 5 (With Tagging)

Traffic Descriptor 6

For traffic descriptor 6, policing is performed by successive use of two GCRAs:

1. A GCRA based on PCR(0+1) and CDVT(0+1) handles cells as does the GCRA used for traffic descriptor 3.
2. A GCRA based on SCR(0+1) and MBS(0+1) handles cells with CLP=0 or CLP=1 using the following parameters:
   - Sustainable cell rate (SCR), which specifies the upper bound to the average bit rate traffic. T(SCR)=1/SCR is the minimum theoretical inter-arrival time between cells (in the second GCRA)
   - Maximum burst size (MBS) at the peak cell rate. When combined with PCR and SCR, the MBS determines the CDVT to be used by the second GCRA.

Cells with CLP=0 or CLP=1 are handled the same way by the second GCRA. Figure 12 shows the GCRA used for traffic descriptor 6.

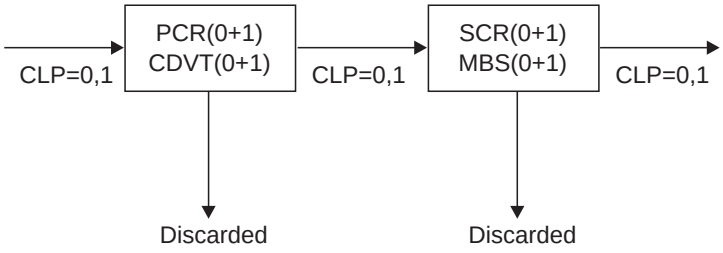

Figure 12. Policing Algorithm for Traffic Descriptor 6

Traffic Shaping

Shaping is a method for controlling traffic.

Where to Implement Shaping

Shaping may be implemented:

- At network entrance
- On each trunk
- At network exit.

At network entrance, the shaping function is usually implemented in the receive part of the port adapters, where it is often integrated in the usage parameter control (UPC) function (GCRA and GCRA with spacer). In this case, shaping smooths the traffic entering the network, minimizes congestion inside the network, and allows high utilization of the links. One disadvantage is that there may be cell discarding at network exit.

On each trunk, traffic is reshaped and additional processing and delays are required in network nodes.

At network exit, the shaping function does not protect the network but minimizes the cell discard at the next UPC crossed (user network interface or network node interface). If connection admission control (CAC) is supported in addition to UPC, the network must be protected from heavy congestion using reserved traffic. In this case, the shaping function is restricted to the output port interface.

The Nways Switch provides *output traffic shaping* on ATM port interfaces. No shaping is required at the network entry because the Nways Switch provides large buffers and manages input queues. The *non-reserved service* uses the availability bit rate (ABR) and is based on a shaping function implemented in customer premises equipment (CPE). Therefore, when the CPE is directly connected to the network access node, shaping in the input part of the adapter is unnecessary.

Types of Shaping

The Nways Switch provides the following types of shaping:

- Virtual channel (VC) shaping
- Virtual path (VP) shaping
- Group shaping.

VC shaping
When one connection is set up per virtual channel, the virtual channel connections (VCCs) are managed and shaped individually. This type of shaping is the only one which provides shaping per individual VC . It is recommended when the next UPC strictly controls connection traffic.

VP shaping
When one connection is set up per virtual path, shaping is performed per virtual path connection (VPC). There is no guarantee of fairness among virtual path connections.

Group shaping
When the VCCs are handled at the virtual path level, all the VCCs of a given virtual path (VP) are shaped together.

One of the advantages of group shaping over VC shaping is that the shaping period is shorter. Another advantage is that the Nways Switch groups the VCCs into a single VP, which is handled by a VP cross-connect.

A drawback is that higher cell congestion and dispersal can occur at the VC level, which may cause higher cell discard at the next network interface.

Shaping Methods

Nways Switch shaping is based on a cyclic calendar, where slots are allocated to connections. This is done in order to minimize cell congestion and dispersal. The calendar represents the scheduling of the cells from the different connections during a period of X cells (X representing the length of the calendar).

In the Nways Switch, the calendar has 16 384 entries per OC3 line, and 8 192 per T3 or E3 line. Depending on the connection parameters, a certain number of slots are assigned to this connection among the N possible ones (N=8192 or 16 384). For example, on an OC3 link, a connection with a shaping speed of 149 753 Mbps reserves all the slots of the calendar.

The following rules apply:

1. **The sum of the shaping speeds on a given output adapter must be less than the line speed.** If it is not, when the number of slots available in the calendar is less than the connection requirement, the call is rejected.
2. **The smallest shaping speed corresponds to one slot in the calendar.** This means that:
   - On an OC3 link, it is 149753÷16384 = 9.1 kbps. A connection with a shaping speed value of less than 9.1 kbps is shaped at 9.1 kbps.

     Note: *kbps* stands for 1000 bits per second.
   - On a T3 link, the smallest shaping speed is 5.5 kbps.
   - On an E3 link, the smallest shaping speed is 4.3 kbps.
3. **The granularity of shaping depends on line type.**
   - On an OC3 link, the accuracy of the transmission rate is 9.1 kbps.

     A connection with a shaping speed value of X kbps is shaped at Y kbps, where `Y=(INT(X÷9.4)+1)×9.4`
   - On a T3 link, the accuracy of the transmission rate is 5.5 kbps.
   - On an E3 link, the accuracy of the transmission rate is 4.3 kbps.

If the shaping speed (S) is different from 0, the cells of this connection are shaped at this speed. The number of slots corresponding to this speed (N×S÷line speed) are allocated in the calendar, with an interval between two consecutive slots roughly corresponding to line speed divided by S. This choice is a good one when shaping is important for certain connections but not for others. When this is the case, all non-shaped connections are queued together.

If the shaping speed is 0, the cells of this connection are shaped at a speed corresponding to the bandwidth reserved for this connection. This permits all the connections to be shaped. It also gives a certain margin to the sustainable cell rate, which should minimize queuing and delays, but applies only to VC or VP shaping mode. Note that the sum of reservations on a link is always less than the link speed.

Using Shaping

The sum of the shaping speeds must be less than the line speed, and no overbooking is allowed.

Since shaping limits the throughput of the egress traffic, one must ensure that the mean incoming traffic does not exceed the shaping speed. Otherwise, traffic overflow occurs and, when too many connections are simultaneously in overflow, congestion may occur in the egress adapter.

The adapter can simultaneously handle three congested connections while maintaining the requested quality of service for the other connections. Above this figure, the resulting situation depends on traffic patterns. The worst case scenario occurs when four connections saturate the adapter. When this is the case, cells are lost and major delays occur on other connections.

To prevent this situation, when shaping is enabled, a check is performed at connection setup to guarantee that incoming traffic does not exceed shaping capacity.

This check is done as follows:

- Both CLP=0 and CLP=1 flows are to be considered when configuring shaping because the flows are not differentiated in the input queues. The connection may send aggregate traffic up to PCR(0+1) for all the traffic descriptors except PCR(0+1)+SCR(0+1). In this case, the CLP=1 flow is controlled by the SCR(0+1) GCRA and the amount of aggregate traffic which can enter the network is at most SCR(0+1).
- If the connection traffic descriptor is PCR(0+1)+SCR(0+1), shaping speeds between SCR(0+1) and the line speed are accepted. In detail, the lower speed limit is the equivalent capacity calculated using PCR(0+1), SCR(0+1), and burst tolerance (BT).
- Otherwise, shaping speeds from PCR(0+1) to the line speed are accepted.

When an adapter supports a mix of shaped and non-shaped connections, the cells of the non-shaped connections are transmitted when there are idle slots (non-reserved) in the calendar.

For proper performance of non-shaped connections, it is necessary to have room in the calendar. Connection admission control (CAC) guarantees reservation of a maximum of 85% of bandwidth on a line. If the shaping speed is close to that of the reservation made for the network, the reservation guarantees that the shaping is not completely used.

This is the case for PCR(0+1) and PCR(0+1)+SCR(0+1). The same rule must also be verified for PCR(0+1)+PCR(0) or SCR(0). In these cases, the reservation is made for the CLP=0 flow, while CLP=0 and CLP=1 flows are sent inside the network.

If there is an important gap between PCR(0+1) and PCR(0) or SCR(0), the reserved bandwidth in the calendar PCR(0+1) may be much larger than the bandwidth reserved inside the network PCR(0) or than the equivalent capacity. The 15% margin available on the trunk may no longer be available in the calendar and the non-shaped connections may face major delays and jitter.

Operation, Administration, and Maintenance

This section describes how NBBS architecture handles operation, administration, and maintenance (OAM) functions. An 2220 network handles ATM alarms on VPCs and VCCs.

OAM on Virtual Path Connections

The ATM adapter either receives an alarm indicator signal (AIS) cell related to a VP from the connected ATM device or generates an AIS cell when an anomaly is detected on the VP or physical link. In both cases, the AIS cell is propagated to the remote VP end, which answers with a remote defect indication (RDI) cell. The ATM adapter acts as the VP connecting point. Because VPCs carry traffic transparently, the ATM adapter is also transparent to alarms (AIS or RDI) that are raised on these virtual connections.

Figure 13 shows the OAM flows on VPCs.

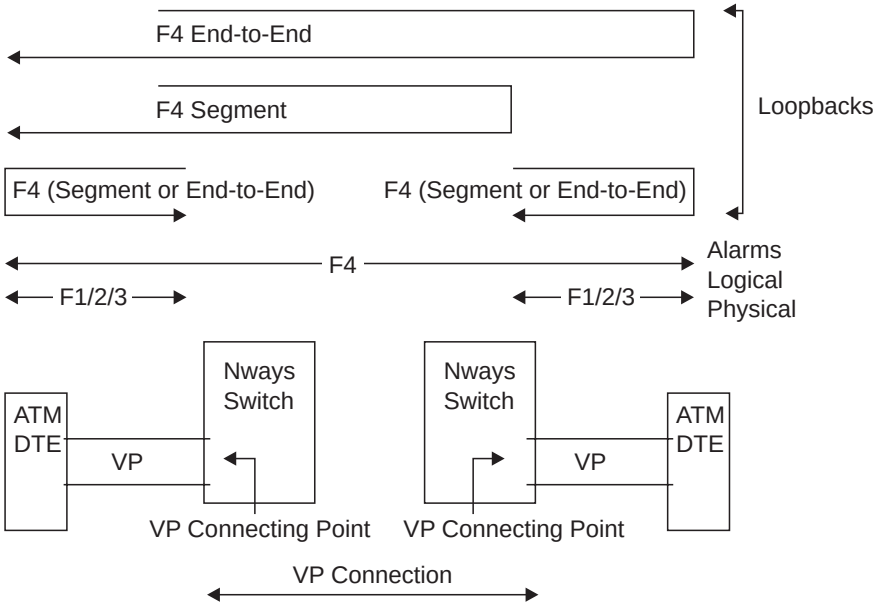

Figure 13. OAM Handling on VPCs

The F1, F2, F3, F4, and F5 terms are defined by the ATM Forum.

- F1, F2, and F3 refer to the physical layer
- F4 refers to the VP level (ATM layer)
- F5 refers to the VC level (ATM layer)

OAM on Virtual Channel Connections

An adapter may handle alarms at either the VC or VP level, as a VP must be defined for the VCs.

VP-Level Alarms

An ATM adapter either:

- Receives an AIS cell related to a VP from the connected ATM device and answers by an RDI cell
- Generates an AIS cell when an anomaly is detected on the VP or physical link to the connected ATM device.

In both cases, a VC AIS cell is sent to the remote ends of every VC using that VP, which answer by an RDI cell. The ATM adapter acts as the VP end point.

VC-Level Alarms

Alarms at the VC level are received or detected, and propagated, to the remote VC end by the ATM adapter. There is no effect on the VP.

Figure 14 shows OAM flows on VCCs.

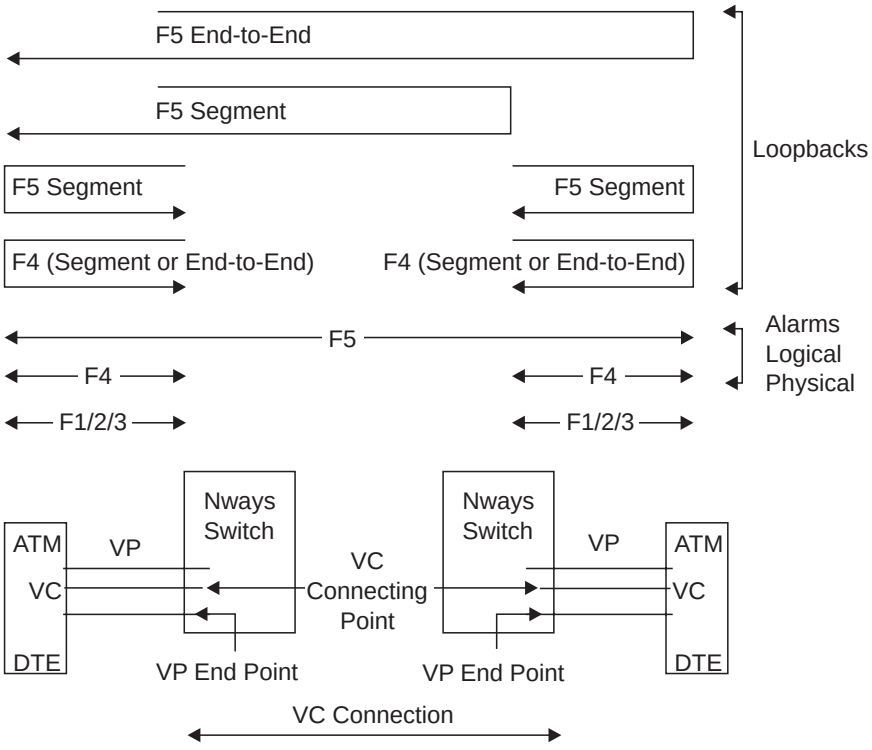

Figure 14. OAM Handling on VC Connections

Congestion Management

The 2220 network handles three types of congestion:

- Input traffic congestion
- Virtual path (VP) or virtual channel (VC) congestion on transmit side
- Adapter congestion.

Input Traffic Congestion

This type of congestion is described in “Traffic Policing” on page 23. Using traffic descriptors without tagging prevents the adapter from attaining congestion on virtual connections.

VP or VC Congestion

VP or VC congestion occurs on transmit side of an ATM adapter when the amount of resources and buffers used by a virtual connection (VPC or VCC) reaches a maximum threshold. Using traffic descriptors with tagging can generate congestion when a significant amount of cells having CLP=1 are sent over a virtual connection. Cells are discarded until resource and buffer usage fall below the threshold. The process protects other virtual connections against adapter congestion.

Adapter Congestion

Adapter congestion happens when there are no more resources available in a port adapter. All incoming cells are discarded. This can occur if too many VPCs and VCCs, using traffic descriptors with tagging, handle heavy traffic at the same time.

Selective Discard in ATM Trunks

Cells with CLP=1 may be discarded in case of congestion. NBBS architecture provides an additional discarding mechanism at the trunk level.

For each connection, a usage parameter control (UPC) may be applied to the aggregate flow (CLP=0 and CLP=1) or to the cells with CLP=0. When the UPC processes the CLP=0 flow, the connection is flagged (CLP=1) in the trunk to indicate that selective discarding is occurring.

When there is trunk congestion, cells with CLP=1 are discarded in flagged connections because reservation is based on CLP=0 flow. Cells with CLP=1 are transported only on a best-effort basis.

For the other connections, the reservation is based on the aggregate flow. Since NBBS guarantees that no congestion occurs on reserved traffic, the source of congestion is caused by the traffic in excess, namely, traffic with CLP=1 on the flagged connection.

Chapter 4. ATM / Frame Relay Interworking

Overview

The IBM 2220 supports two types of interworking between Frame Relay and ATM devices, according to ITU-T Recommendation I.555:

Network Interworking (NIWF)
Two Frame Relay devices communicating over an ATM network.

Service Interworking (SIWF)
A Frame Relay device communicating with an ATM device, where neither device knows that the other device is connected using a different protocol.

Note: Service interworking is limited to the set of higher-layer protocols currently supported by RFC 1483 and RFC 1490, while network interworking is transparent to higher-layer protocols. This means, for example, that voice packets carried over Frame Relay could be handled by the NIWF, but not by the SIWF.

Network Interworking

Two scenarios are defined in ITU-T Recommendation I.555 for the network interworking function (NIWF):

Scenario 1
Where two Frame Relay CPEs (Customer Premises Equipment) are connected across an ATM network.

Scenario 2
Where a Frame Relay network or terminal is connected to an ATM terminal across an ATM network.

These scenarios are described in the following sections.

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NIWF: Two Frame Relay Devices

In this scenario, the use of the ATM network is invisible to the two Frame Relay CPEs. The NIWF provides all mapping and encapsulation functions necessary to ensure that the service prived to the Frame Relay CPEs is unaffected by the presence of ATM transport. Figure 15 shows a typical configuration using this scenario, and illustrates the protocol suites associated with the corresponding user plane.

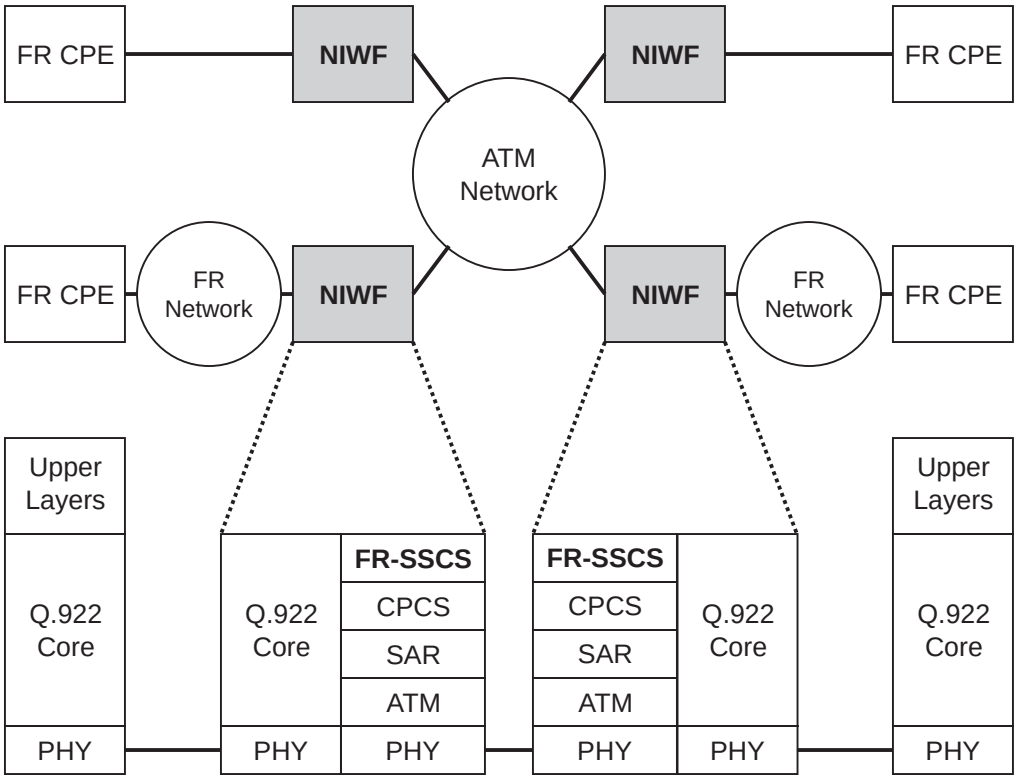

Figure 15. Network Interworking with Two Frame Relay Devices

NIWF: Frame Relay and ATM Devices

In the second scenario, the Frame Relay CPE is unaware of the use of the ATM network, as shown in Figure 16. The ATM CPE must support the Frame Relay Service Specific Convergence Sublayer (FR-SSCS) in its protocol stack. The NIWF is the same as in the first scenario.

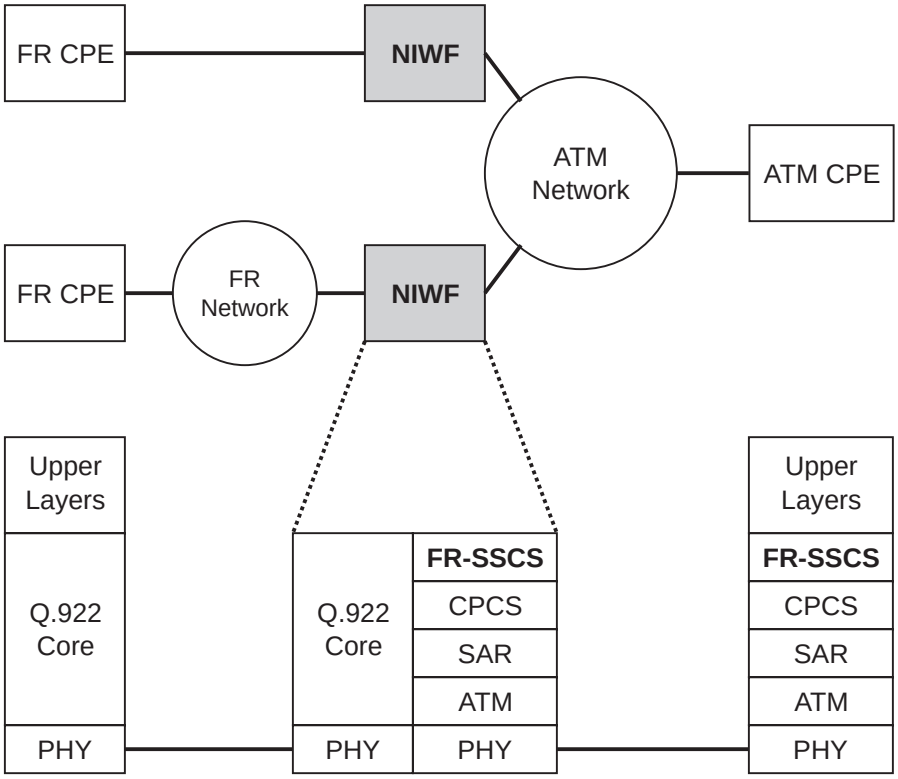

Figure 16. Network Interworking with a Frame Relay Device and an ATM Device

NIWF Example

The example shown in Figure 17 shows a network configuration where network interworking is used to connect Frame Relay terminal equipment through heterogeneous networks. In this case compliance to the FRF.5 standard allows interoperation with equipment from other manufacturers.

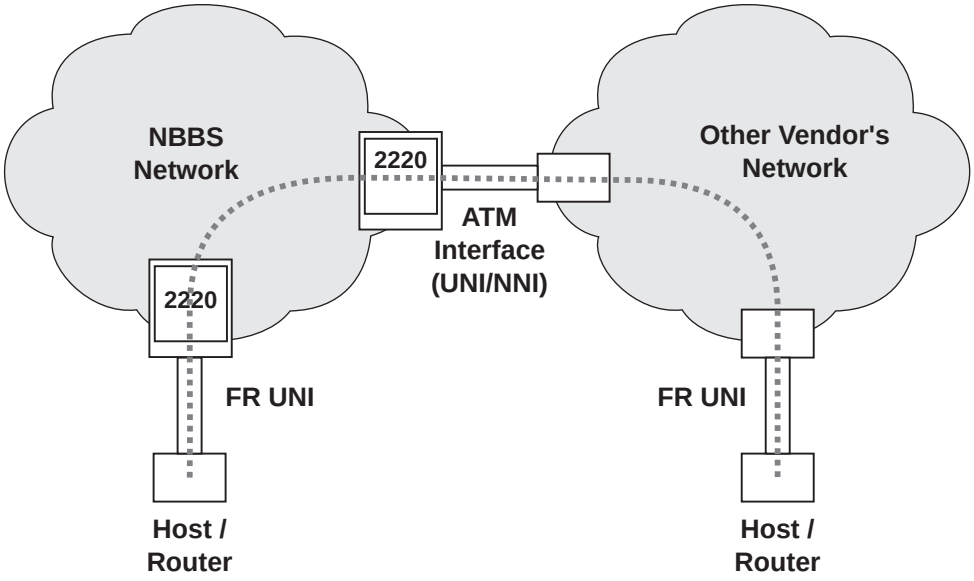

Figure 17. Network Interworking Function Example

Service Interworking

In service interworking, a Frame Relay network or CPE interworks with an ATM CPE. The ATM CPE performs no Frame Relay-specific functions, and the Frame Relay CPE performs no ATM-specific functions. All interworking functions are performed by the Service Interworking Function (SIWF). Since multiprotocol encapsulation schemes are different over Frame Relay (RFC 1490) than over ATM AAL5 (RFC 1483), some protocol translation may need to be performed by the SIWF.

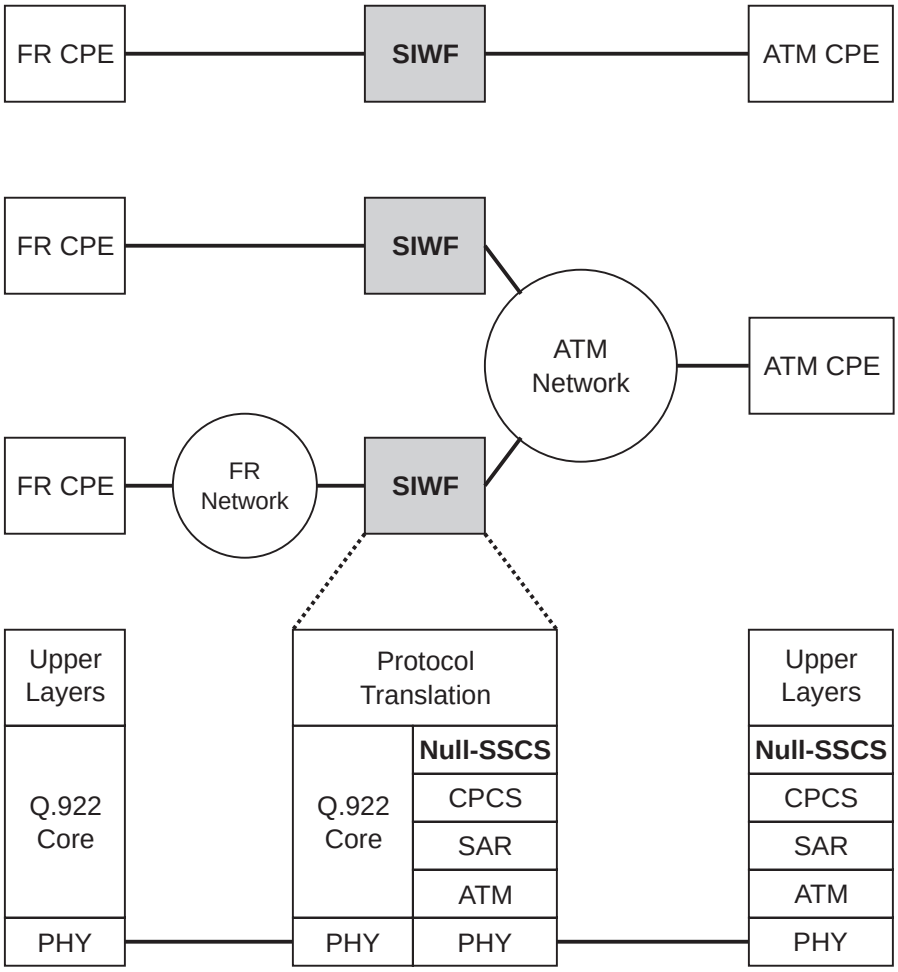

Figure 18. Service Interworking

SIWF Example 1

Figure 19 shows an IP router connected to an NBBS network through a Frame Relay UNI. A Web server supporting Classical IP is connected to the same network through an ATM UNI. From an IP point of view, they appear adjacent.

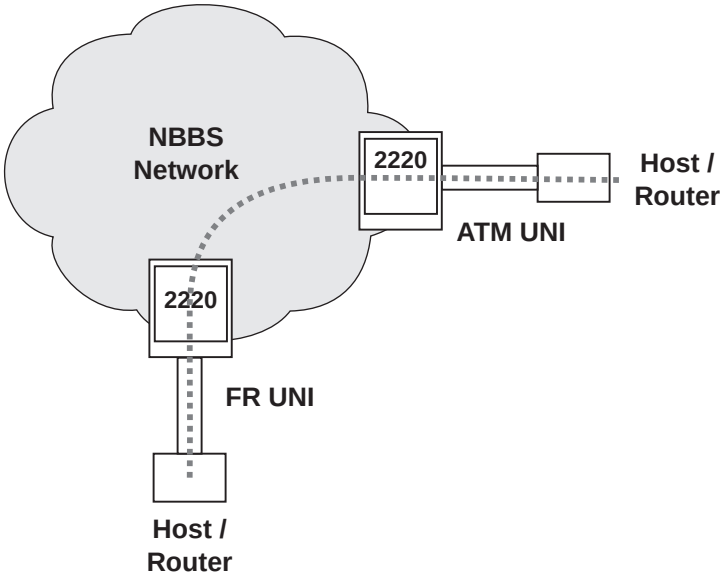

Figure 19. SIWF Example 1

SIWF Example 2

Since the SIWF is compliant with the FRF.8 standard, either the Frame Relay DTE or the ATM DTE could be connected to equipment from a different manufacturer, as shown in Figure 20.

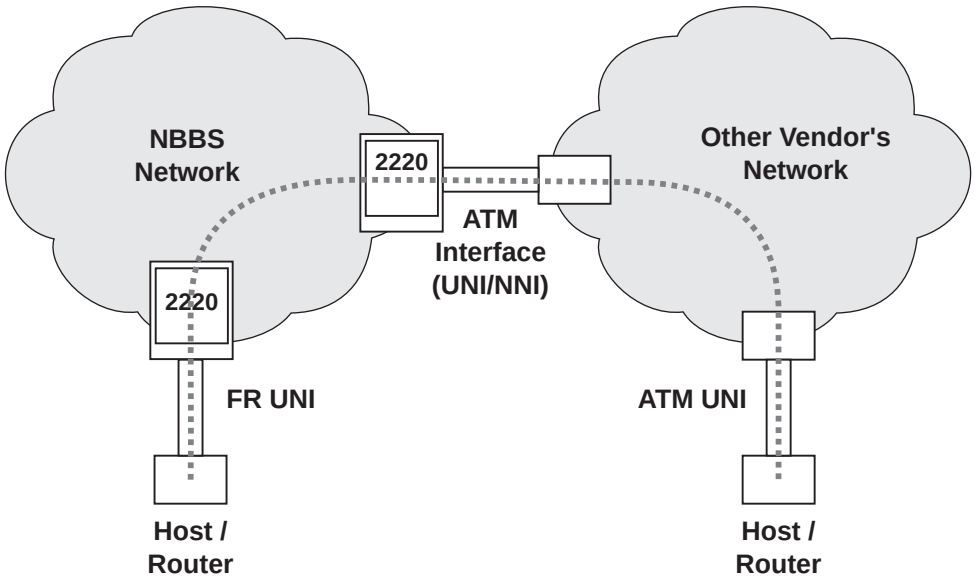

Figure 20. SIWF Example 2

Interworking Specifications

- Interworking (both NIWF and SIWF) run only on the LSA3 adapter.
- The Nways Switch Frame Relay access agent only supports 2-byte Q.922 core header (i.e., 10-bit DLCI values).
- The Network Interworking and the Service Interworking functions are part of the Frame Relay Access Agent located in the Frame Relay port adapter.
- NIWF and SIWF comply with the corresponding FRF.5 and FRF.8 Implementation Agreements.
- Connection multiplexing is limited to one-to-one mapping in both Network Interworking and Service Interworking.
- A Frame Relay port can simultaneously support NBBS FR transport, NIWF, and SIWF. The mode of transport is selected at FR PVC level according to configuration parameters.
- For both network and service interworking connections the FR Access Agent appears as an ATM Access Agent to its remote partners.
- ATM Frame Relay interworking connections are PVC only.
- Connections are configured on the Frame Relay side.
- CBR , VBR and UBR traffic are supported.
- Only standard Frame Relay traffic parameters are supported for configuring interworking connections. The use of NBBS traffic parameters is restricted to connections configured for NBBS transport.
- The SIWF supports higher layer protocol conversion (i.e., 1490/1483 conversion). The following protocols are supported: IP, IPX, Q.933, ISO SNAP, bridged PDUs, X25 , ISO 8208 PDUs and FRF.9 compressed PDUs.
- 'Frame Relay ATM Interworking' is also available in 'Frame relay over ISDN' mode.
- Bandwidth adaptation is not supported in 'Frame Relay ATM Interworking'

Appendix. Notices

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Glossary

The following are the abbreviations and technical terms used in the 2220 Nways Switch library.

2220. The IBM 2220 Nways BroadBand Switch (also called Nways Switch) is a fast packet switch enabling high-speed communications over a broadband network. It implements the functions of the IBM Networking BroadBand Services (NBBS) architecture.

2220-300. 2220 Nways Switch Model 300.

2220-500. 2220 Nways Switch Model 500.

2220-501. 2220 Nways Switch Model 501.

2220 NSM. 2220 Nways Switch Manager

AAL. ATM adaptation layer.

ABR. Availability bit rate. A best effort service with a minimum bit rate and a maximum cell loss value.

ac. Alternating current.

access services. Functions that are performed by a port adapter of the IBM 2220 Nways BroadBand Switch to:

- Support the attachment of external user devices through port lines
- Prepare user data packets
- Control the input traffic on port lines
- Manage line protocols.

active remote connector (ARC). A connector that supplies the electrical and physical interfaces between a line interface coupler type 511 (LIC511) in an Nways Switch subrack and data circuit-terminating equipment (DCE) or data terminal equipment (DTE). ARCs are housed in line connection boxes (LCBs).

adapter. An Nways Switch module that can be used, depending on its hardware type and the code that it runs, as:

Control point adapter

Port adapter

Trunk adapter

Voice server adapter.

A trunk or port adapter is associated with a line interface coupler (LIC). A voice server adapter can be associated with a voice server extension (VSE).

ADPCM. Adaptive differential pulse code modulation.

AIS. Alarm indicator signal.

AIX. Advanced Interactive Executive.

alarm and power control (APC). In an Nways Switch, a module that connects the NAS, reports alarms, and controls the power supplies.

Alert Manager. An application that processes the SNA alerts received from IBM 3746s operating in IP mode.

AMI. Alternate mark inversion.

ANSI. American National Standards Institute.

APC. Alarm and power control (module).

AR. Access rate.

ARC. Active remote connector.

asynchronous transfer mode (ATM). A high-speed, connection-oriented switching and multiplexing protocol that transmits different types of traffic (voice, video, and data) simultaneously.

ATM. Asynchronous transfer mode.

ATMAn. ATM adapter type n (module).

ATM adaptation layer (AAL). In ATM devices, a set of protocols that adapt non-ATM devices to an ATM network. There are several classes of ATM adaptation layers which represent the main traffic types (for example, data, voice, and video).

ATM network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical ATM port or trunk line. An ATM network interface sets up and maintains predefined ATM virtual connections.

AT&T. American Telephone & Telegraph (Company).

B8ZS. Bipolar eight-zero substitution.

Bc. Burst committed.

Be. Burst in excess.

bearer service profile (BSP). A set of parameters that defines a type of ISDN traffic (speech, audio, data, or video). One BSP is associated with each ISDN numbering plan table.

BECN. Backward explicit congestion notification.

B-ICI. Broadband inter-carrier interface.

BMI. Byte multiplexer interface.

BNC. Bayonet Niell-Concelman.

bps. Bit per second.

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bridge. A functional unit that interconnects two local area networks. A bridge works at the data link level (layer 2) of the OSI reference model.

broadband network. A network that uses a large frequency band to transport different kinds of traffic (such as coded voice, video, and data) at the same time.

BS. Bearer services.

BSC. Binary synchronous communication.

BSP. Bearer service profile.

BT. Burst tolerance.

bursty. Refers to transmission at variable bit rate where the time between data transmissions is not always the same.

CAC. Connection admission control.

CAS. Channel associated signaling.

CBR. Constant bit rate.

CCS. (1) Common channel signaling (2) Change control server (also called CC server).

CDB. Configuration database.

CDV. Cell delay variation.

CDVT. Cell delay variation tolerance.

cell loss priority (CLP). A priority bit in the ATM cell header. When set, it indicates that the cell can be discarded during traffic congestion.

centralized configuration database. A database prepared with the Nways Switch Configuration Tool Version 2 (NCT2) on a configuration station. It stores the parameters of a 2220 network.

CES. Circuit emulation services.

change control server (CCS or CC server). A station that runs the IBM NetView Distribution Manager for AIX to store the Nways Switch Control Program and to manage code changes.

CIR. Committed information rate.

circuit emulation services (CES). An access service that emulates a leased line. It transports information with a constant bit rate at the source and destination. The traffic can be PCM voice, video, fax, multimedia, or real-time synchronous data (such as BSC).

CLIP. Calling line identification presentation.

CLIR. Calling line identification restriction.

CLK. Clock (module).

CLKRD. Clock redrive (module).

clock module (CLK). A module of the 2220 Model 300 or 500 that transmits clock signals to the line interface couplers (LICs). It is optional and can have a backup.

clock redrive (CLKRD). A module of the 2220 Model 501 that drives the signals from the Model 500 clock module to the adapters of the Model 501. The clock redrive is optional and can have a backup.

clock references. In an Nways Switch, the software function that controls the transmission of clock signals to the LICs where they are used for bit synchronization.

CLP. Cell loss priority.

CMIP. Common management information protocol.

CMIS. Common management information services.

CMOT. CMIP over TCP/IP.

CNM. Communication network management.

code file. A named set of records stored as a unit in a change control server. An Nways Switch code file can include data or internal code.

COLP. Connected line identification presentation.

COLR. Connected line identification restriction.

configuration station. See Nways Switch configuration station.

control point (CP). In an Nways Switch, a logical resource that provides network control functions. It can have a backup.

CP. Control point.

CPA. Control point adapter (module).

CPE. Customer premises equipment.

CP spanning tree. In a 2220 network, a distribution tree that connects the Nways Switch control points through trunk lines. The CP spanning tree supplies a very fast and efficient way to multicast control messages such as network topology data.

CRC. Cyclic redundancy check.

CSU. Channel access unit.

CTD. Cell transfer delay.

data circuit-terminating equipment (DCE). An equipment installed on a user premises that provides all the functions required to establish, maintain, and terminate a connection, and to do the signal conversion

and coding between a data terminal equipment (DTE) and a line. A DCE can be separate piece of equipment or part of other equipment.

data terminal equipment (DTE). That part of a data station that serves as data source, data sink, or both, and provides the data communication control function depending on the type of protocol used.

dB. Decibel.

dBm. Decibel based on 1 milliwatt.

DC48. Dc power input type -48V

dc. Direct current.

DCD. Dc distribution (module).

DCE. Data circuit-terminating equipment.

DDI. Direct dialing-in.

DE. Discard eligibility.

decibel (dB). (1) One tenth of a bel. (2) A unit that expresses the ratio of two power levels on a logarithmic scale. (3) A unit for measuring relative power. The number of decibels is 10 times the logarithm (base 10) of the ratio of the measured power levels; if the measured levels are voltages (across the same or equal resistance), the number of decibels is 20 times the log of the ratio.

decibel based on 1 milliwatt (dBm). A unit of absolute power measurement that is scaled such that 0 dBm equals 1 milliwatt.

dialog box. On the screen of a station, an area with entry fields and push buttons. (Also called dialog.)

DLCI. Data link connection identifier.

DNPT. Destination numbering plan table.

DSP. Digital service processor.

DSU. Data service unit.

DTE. Data terminal equipment.

DTMF. Dual-tone modulation frequency.

DTR. Data terminal ready.

dummy module. In an Nways Switch, a cover inserted in the place of a module to ensure correct air cooling inside a logic subrack. During normal operation, the dummy modules must not be removed.

E1 standard. A European standard for TDM digital transmission service at 2.048 Mbps.

E3 standard. A European standard for TDM digital transmission service at 34.368 Mbps. An E3 line can transport up to 16 E1 circuits.

E&M. Earth & mark.

ECMA. European Computers Manufacturers Association.

EIA. Electronics Industries Association.

equivalent capacity. The minimum amount of bandwidth needed by a connection to ensure that the packet loss ratio is below a specified threshold.

ESF. Extended status flags.

ETS. European telecommunication standard.

FANB. Fan box.

FAT. File allocation table.

fax. Document received from a facsimile machine. Synonym for telecopy.

FCS. Frame check sequence.

FDDI. Fiber Distributed Data Interface.

FE1. Fractional E1.

FECN. Forward explicit congestion notification.

FEP. Front-end processor.

fiber. Synonym for optical fiber.

fiber budget. The optical power loss as result of the number of connections in the optical fiber link subtracted from the working budget. The loss as a result of connections includes connector loss and splice loss. The fiber budget is expressed in decibels.

Fiber Distributed Data Interface (FDDI). A U.S. standard for 100 Mbps token-ring LANs using optical fiber cables over distances of several kilometers.

fiber optic cable. Synonym for optical fiber.

FR. Frame relay.

FRAD. Frame-relay access device.

frame relay (FR). A connection-oriented protocol to transport data frames over a fast packet-network with guaranteed end-to-end quality of service.

FRFH. Frame-relay frame handler.

front-end processor (FEP). A processor, such as the IBM 3745, 3746 Model 900 or 950, or 3174, that relieves a main frame from communication control tasks.

FRTE. Frame-relay terminal equipment.

FRU. Field replaceable unit.

FT1. Fractional T1.

FTP. File transfer protocol.

Gbps. Gigabit per second (10 to the power of 9 bits per second).

GCRA. Generic cell rate algorithm.

GFP. Generic function protocol.

GFT. Generic function transport.

GSM. Group special mobile.

GUI. Graphical user interface.

HDB3. High-density bipolar 3.

HDLC. High-level data link control.

high-level data link control (HDLC). A data network protocol.

hot pluggable. Refers to a hardware component that can be installed or removed without disturbing the operation of any other resource that is not connected to, or dependent, on this component.

HPFS. High-performance file system.

HPRI. High priority.

HSAn. High-speed adapter type n (module).

HSDS. High-speed digital services.

HSSI. High-speed serial interface.

hub (intelligent). A wiring concentrator, such as the IBM 8260, that supplies bridging and routing functions for LANs with different cables and protocols.

hunt group. See X.25 hunt group.

IDNX. Integrated Digital Network Exchange.

IE. Information element.

ILMI. Interim local management interface.

IMU. Inverse multiplexing unit

Integrated Digital Network Exchange (IDNX). A processor integrating voice, data, and image applications. It also manages transmission resources and connects to multiplexers and network management support systems. It permits integration of equipment from different vendors.

integrated services digital network (ISDN). A digital end-to-end public or private network that supports multiple services including, but not limited to, voice and data.

IP. Internet Protocol.

IP gateway adapter. In an Nways Switch, a port adapter that routes the IP control between the NAS and the network management station.

ISDN. Integrated services digital network.

ISDN network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical ISDN or QSIG port line. An ISDN network interface sets up and maintains connections between calling ISDN terminal equipments and called terminal equipments attached through other Nways Switches.

ISO. International Organization for Standardization.

isochronous. Refers to transmission at a constant bit rate where there is a clock relationship between source and destination. The bit rates are the same on the destination and source.

ITU-T. International Telecommunication Union - Telecommunication (replaces CCITT).

jitter. Undesirable variations in the transmission delay of a digital signal. Also called cell delay variation (CDV).

KB. Kilobyte (storage capacity, 1024 bytes).

kbps. Kilobit per second (1000 bits per second).

LAN. Local area network.

LAPB. Link access procedure for B-channel.

LAPD. Link access procedure for D-channel.

LCB. Line connection box.

LCBB. Line connection box, base (LCEB and LCPB).

LCBE. Line connection box, expansion (LCEE and LCPE).

LCEB. Line connection enclosure, base.

LCEE. Line connection enclosure, expansion.

LCPB. Line connection power, base.

LCPE. Line connection power, expansion.

LCR. Least cost routing.

LED. Light-emitting diode.

LICn. Line interface coupler type n (module).

line. In a 2220 network, any physical medium, such as a telephone wire, microwave beam, or optical fiber, that transmits information. A line can be a trunk line or a port line.

line connection box (LCB). A metallic box that:

- Multiplexes up to 15 low-speed lines. There can be up to four LCBs per LIC type 511 for a total of 60 lines (two LCBs and 30 lines per LIC connector).
- Reduces cable lengths between Nways Switch and DCE or DTE locations.

An LCB fits in a standard 19-inch rack. Each one houses up to 15 active remote connectors (ARCs).

line interface coupler (LIC). In an Nways Switch, a module that physically attaches trunk or port lines. Each line interface coupler is associated with a trunk or port adapter, and supports specific line interfaces.

LIV. Link integrity verification.

LMI. Local management interface.

local area network (LAN). A computer network located on a user premises in a limited geographical area.

logical port. (Also called NBBS port.) A logical resource generated by the Nways Switch Control Program to provide access services to a physical port line (or channel of a TDM port line) using HDLC, FR, or CES protocol. A logical port sets up and maintains its predefined connections.

logical trunk. (Also called NBBS trunk.) A logical resource generated by the Nways Switch Control Program to provide transport services to a physical trunk line (or channel of a TDM trunk line). A logical trunk is mainly responsible for optimizing bandwidth and maintaining the CP spanning tree.

LSAn. Low-speed adapter type n (module).

MA/SR. Multi-access/sub-rate.

management access. Refers to an Nways Switch that connects a network management station or a change control server to a 2220 network through its service bus, which is a dedicated Ethernet LAN.

MB. Megabyte (storage capacity, 1 048 576 bytes).

Mbps. Megabit per second (10 to the power of 6 bits per second).

MBS. Maximum burst size.

MLT. Multiple logical trunks.

module. In an Nways Switch, a hardware unit plugged in a slot of the logic subrack. It houses, for example, an adapter, a line interface coupler, or a voice server extension. All modules are hot pluggable.

ms. Millisecond (1/1000 second).

NAS. Nways Switch administration station.

NBBS. Networking BroadBand Services (architecture).

NBBS architecture. See Networking BroadBand Services.

NBBS connection. See potential connection and virtual connection.

NBBS network. A network built with IBM 2220 Nways BroadBand Switches and conforming to the IBM Networking BroadBand Services (NBBS) architecture.

NBBS port. See logical port.

NBBS trunk. See logical trunk.

NCT2. Nways Switch Configuration Tool Version 2.

NDPS. Non-disruptive path switching.

NEM. Nways Enterprise Manager (see 2220 Nways Switch Manager).

network control. Functions that are performed by an Nways Switch control point to:

- Allocate and control the Nways Switch resources
- Provide topology and directory services
- Select routes
- Control congestion.

network management station (NMS). A station that runs IBM NetView for AIX and the 2220 Nways Switch Manager. It is used to manage network topology, accounting, performance, configuration, and error reporting.

network node interface (NNI). An interface between nodes in a communication network.

Network Support Center (NSC). A location from which IBM remotely supports 2220 networks.

Networking BroadBand Services (NBBS). An IBM architecture for high-speed networking that complements ATM standards and provides access services, transport services, and network control to user traffic.

NIC. Network Information Center.

NMS. Network management station.

NNI. Network node interface.

NPT. Numbering plan table.

NR. Non-reserved.

NRT. Non-real-time.

NRZI. Non-return-to-zero inverted recording.

NRZ-1. Non-return-to-zero change-on-ones recording.

NSAP. Network service address point.

NSC. Network Support Center.

NSM. (See 2220 Nways Switch Manager)

NVDM. NetView Distribution Manager for AIX.

NTT. Nippon Telegraph & Telephone (Corporation).

numbering plan table (NPT). A set of parameters, organized in origin NPT and destination NPT, that defines a type of called ISDN numbers. A numbering plan table is associated with each ISDN network interface.

Nways 2220 Switch Manager (2220 Switch Manager). An IBM licensed program that runs under NetView for AIX to manage the 2220 Nways Switch operation and configuration from a network management station. It replaces the Nways Enterprise Manager (NEM) which is no longer available.

Nways BroadBand Switch. Synonym for 2220 Nways BroadBand Switch.

Nways Enterprise Manager (NEM). An IBM licensed program that was used under NetView for AIX in a network management station to manage Nways Switches, routers, and bridges in a 2220 network (see 2220 Nways Switch Manager).

Nways Switch. Synonym for 2220 Nways BroadBand Switch.

Nways Switch administration station (NAS). A station attached to each 2220 to run the Control Program, and control and service the Nways Switch locally.

Nways Switch configuration station. A mandatory OS/2 or AIX station that runs a stand-alone version of the Nways Switch Configuration Tool Version 2 (NCT2) and stores the centralized configuration database of the NBBS network. An OS/2 station can be used as a remote user console.

Nways Switch Configuration Tool Version 2 (NCT2). A component of the Nways Switch Control Program that is used to configure physical and logical resources. It is also used in stand-alone version under OS/2 or AIX .

Nways Switch Control Program. The IBM licensed program that runs in the NAS and adapters of the 2220 Nways Switch. It includes a CMIP agent to work with the 2220 Switch Manager.

Nways 2220 Switch Manager for AIX. (See Nways 2220 Switch Manager)

Nways Switch Resource Control. A component of the Nways Switch Control Program. It is used from the NAS of an Nways Switch or from a remote user console to control resources and configuration files.

OAM. Operation, administration, and maintenance.

OC3. Optical carrier level 3.

ONPT. Origin numbering plan table.

operation, administration, and maintenance (OAM). A group of functions coded in specific ATM cells to handle alarms and loopback tests on ATM connections.

optical fiber. In fiber optics technology, a wave guide that propagates optical signals from light-generating transmitters to light-detecting receivers.

OSI. Open systems interconnection.

packet loss ratio. The probability that a packet will not reach its destination or not reach it in a specified time. It is obtained by dividing the number of packets lost in transmission by the total number transmitted.

packet transfer mode (PTM). The native transfer mode of the NBBS architecture. PTM divides the traffic into packets of variable length.

PBX. Private branch exchange.

PCM. Pulse code modulation.

PCR. Peak cell rate.

PDH. Plesiochronous digital hierarchy.

permanent virtual circuit (PVC). A virtual circuit that has a logical channel permanently assigned to it at each item of data terminal equipment. It is activated by a program or by a network operator request.

plesiochronous. Refers to transmission at a nominal bit rate where the source and destination are controlled by different clocks. The bit rates are nearly the same.

PLP. Packet layer protocol.

PNP. Private numbering plan.

port. See logical port.

port adapter. In an Nways Switch, a module that provides access services to one or more port lines. Each port adapter is associated with a line interface coupler (LIC).

port line. A communication line that connects a device on user premises to an Nways Switch and serves as a port to the 2220 network. Port lines have different protocols and interfaces.

position. When configuring an Nways Switch, the position parameter indicates the line attachment number on the LIC module (1 to 8, depending on the LIC type).

potential connection. A predefined connection through a 2220 network between two HDLC, CES, or frame-relay devices.

PPP. Point-to-point protocol.

PRA. Primary Rate Access.

private branch exchange (PBX). A switching system located on a user premises that relays inside lines (extensions) and provides access to the public telephone network.

PRS. Primary reference source.

PSDN. Packet switched data network.

PSN. Public switched network.

PSTN. Public switched telephone network.

PTF. Program temporary fix.

PTM. Packet transfer mode.

PTNX. Private telecommunications network exchange.

pulse code modulation (PCM). A standard adopted for the digitalization of analog voice signals. In PCM, voice is sampled at a rate of 8 kHz and each sample is coded in an 8-bit frame.

PVC. Permanent virtual circuit.

Q signaling (QSIG). An international standard for signaling procedures in private telecommunication networks. It applies to the PBX-to-Nways Switch interface, which is called the Q reference point.

QoS. Quality of service.

QSIG. Q signaling.

quality of service (QoS). In a 2220 network, a set of parameters that guarantees the characteristics of a connection, mainly its end-to-end delay, delay variation, and packet loss tolerance.

RABM. Router and Bridge Manager.

rack. A metallic structure, with a standard 19-inch width, that houses the hardware elements of an Nways Switch, that is, logic subrack with modules, fan boxes, and power units. When configuring an Nways Switch, the rack parameter indicates the 2220 Model (rack A is the Model 300 or 500, and rack B is the Model 501).

RDI. Remote defect indication.

real-time processing. Refers to the manipulations of data that are required, or generated, by certain process while the process is in operation. Usually, the results influence the process and, perhaps, related processes.

remote user console. A station running OS/2, TCP/IP, and Nways Switch Resource Control. It can be connected to the NAS of an Nways Switch to remotely control and service it.

resource. In an Nways Switch, a hardware element or a logical entity created by the Control Program. Adapters, modules, and line attachments are examples of physical resources. Control points, logical trunks, logical ports, and network interfaces are examples of logical resources.

resource profile. A record of the characteristics of an Nways Switch resource. It includes (for example) the part number or module name, the change level, and the name and phone number of the person to contact when a problem occurs.

RETAIN. Remote Technical Assistance Information Network

RIP. Route Information Protocol.

router. An attaching device that connects two LAN segments of the same or different architectures. It can also be connected to a wide area network. A router works at the network level (layer 3) of the OSI reference model by determining the best paths for network traffic flows.

Router And Bridge Manager. An application that provides distributed management for routers such as the IBM 2210 or 2216, bridges such as the IBM 8229, and communication controllers such as the IBM 3746 in IP mode.

RS. Recommended specification.

RSF. Remote support facility.

RSN. Receive sequence number.

RT. Real-time.

RVX. RS/EIA-232, V.24/V.35, X.21.

s. Second.

SCR. Sustainable cell rate.

SDH. Synchronous digital hierarchy.

SDLC. Synchronous data link control.

SDT. Structured data transfer.

serial line internet protocol (SLIP). A TCP/IP protocol used on a point-to-point connection between two IP hosts over a serial line (for example, an RS/EIA-232 connection to a modem over a telephone line).

SLA. Serial link architecture.

SLIP. Serial line internet protocol.

slot. When configuring an Nways Switch, the slot parameter indicates the module location (1 to 12) in the logic subrack.

SNA. Systems Network Architecture.

SNMP. Simple Network Management Protocol.

SONET. Synchronous optical network.

spanning tree. See CP spanning tree.

SRC. System reference code.

SSN. Send sequence number.

station. A microcomputer that is connected to a host or a network and at which a user can run applications.

STM-1. Synchronous transport module type 1.

STS-3c. Synchronous transport signal type 3 concatenated.

SUB. Subaddress.

subrack. A metallic structure installed in an Nways Switch rack. A logic subrack holds modules. A power subrack holds power supply components.

SVC. Switched virtual circuit.

SW. Switch (module).

switch module (SW). A module of the 2220 Model 300 or 500 that interconnects the adapters through an ATM cell switch. It can have a backup.

switch redrive (SWRD). A module of the 2220 Model 501 that drives the signals from the switch module in the Model 500 to the adapters of the Model 501. It can have a backup.

SWRD. switch redrive (module)

switched virtual circuit (SVC). A connection set up from a calling address to a called address following a call establishment protocol. It is released when a clear request signal is received.

synchronous digital hierarchy (SDH). A international recommendation for the internal operation of carrier optical networks.

synchronous optical network (SONET). A U.S. standard for transmitting digital information over optical interfaces. It is closely related to the international recommendation for synchronous digital hierarchy (SDH).

T1 standard. A TDM digital transmission service with a basic rate of 1.544 Mbps. Also called DS-1.

T3 standard. A TDM digital transmission service with a basic rate of 44.736 Mbps. A T3 line can transport up to 28 T1 circuits. Also called DS-3.

TCPA. Trunk and control point adapter.

TCP/IP. Transmission Control Protocol/ Internet Protocol.

TDM. Time division multiplexing.

TE. Terminal equipment.

Telnet. In TCP/IP, an application protocol that allows a user at one site to access a remote system as if the display station were locally attached. Telnet uses the Transmission Control Protocol (TCP) as the underlying protocol.

time division multiplexing (TDM). The process of breaking the bandwidth on a communication line into a number of channels, possibly of different size.

TME. Tivoli Management Environment.

TMN. Telecommunication Management Network.

TPA. Trunk or port adapter.

Transmission Control Protocol/ Internet Protocol (TCP/IP). A set of communication protocols that support peer-to-peer connections over both local and wide area networks.

transport services. Functions that are performed by a trunk adapter of an Nways Switch to:

- Support the attachment of trunk lines
- Maximize bandwidth utilization
- Guarantee the quality of service of a connection
- Transfer packets between Nways Switches
- Manage logical queues and schedule transmission.

trunk. See logical trunk.

trunk adapter. In an Nways Switch, a module that provides transport services to one or more trunk lines. Each trunk adapter is associated with a line interface coupler (LIC).

trunk line. In a 2220 network, a high-speed line connecting two Nways Switches. It can be, for example, a copper cable, optical fiber, or radio wave guide and can be leased from telecommunication companies.

UBR. Unspecified bit rate. A best effort service with no quality commitment.

UNI. User network interface.

UPC. Usage parameter control.

URL. Uniform resource locator.

user network interface (UNI). A standardized interface between a user and a communication network.

UTC. Universal time, coordinated.

UUS. User-user signaling.

VBR. Variable bit rate.

VC. Virtual channel.

VCC. Virtual channel connection.

VCI. Virtual channel identifier.

VCN. Virtual circuit number.

virtual channel (VC). In ATM, a unidirectional route between two ATM devices. Virtual channels always come in pairs, one in each direction. They follow virtual paths.

virtual channel connection (VCC). In ATM, a unidirectional connection established over a virtual channel. Virtual channel connections always come in pairs, one VCC in each direction.

virtual channel identifier (VCI). In ATM, the unique numeric tag that identifies every channel. It is defined by a 16-bit field in the ATM cell header.

virtual connection. In frame relay, the return path of an FR potential connection.

virtual path (VP). In ATM, a group of virtual channels that are switched together as one unit. (Also called VC service.)

virtual path connection (VPC). In ATM, a connection established over a virtual path. Virtual path connections always come in pairs, one VPC in each direction. (Also called VP service.)

virtual path identifier (VPI). In ATM, an 8-bit field in the ATM cell header that indicates the virtual path over which the cell is to be routed.

voice server adapter (VSA). In an Nways Switch, a module that supplies additional voice functions to voice connections operating in pulse code modulation at 64 kbps. It can attach a voice server extension (VSE).

voice server extension (VSE). In an Nways Switch, a module associated with a voice server adapter (VSA) to supply voice functions to an extended number of PCM voice connections.

VP. Virtual path.

VPC. Virtual path connection.

VPD. Vital product data.

VPI. Virtual path identifier.

VPN. Virtual private network.

VSA. Voice server adapter (module).

VSEn. Voice server extension type n (module).

WAN. Wide area network.

wide area network (WAN). A network that provides communication services to a large geographic area. It can use or provide public communication facilities.

window. On the screen of a station, an area with a title bar, a menu bar, and scroll bars.

X.25 hunt group. A group of X.25 network interfaces associated with one common subscriber address. If an interface is busy, the connection searches (hunts) for the other interfaces of the group until a free one is found.

X.25 network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical X.25 port line. An X.25 network interface sets up and maintains connections between calling X.25 subscribers and called subscribers attached to other Nways Switches.

X.25 Recommendation. An international standard for the interface between data terminal equipments and packet-switched networks.

X.25 subscriber. An X.25 end-user connected to an X.25 network interface through a DTE. A subscriber is defined by an address and a logical name.

Bibliography

This section lists prerequisite and related publications.

Nways Switch Publications

- *2220 Nways BroadBand Switch At a Glance, an Overview*, GA33-0292
- *2220 Nways BroadBand Switch Planning Guide*, GA33-0293
- *2220 Nways BroadBand Switch Configuration Guide*, GA33-0474
- *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References*, GA33-0379
- *2220 Nways BroadBand Switch Frame Relay Interface Specifications*, GA33-0374
- *2220 Nways BroadBand Switch HDLC Interface Specifications*, GA33-0375
- *2220 Nways BroadBand Switch CES Interface Specifications*, GA33-0376
- *2220 Nways BroadBand Switch ATM Interface Specifications*, GA33-0378
- *2220 Nways BroadBand Switch X.25 Interface Specifications*, GA33-0413
- *2220 Nways BroadBand Switch ISDN Interface Specifications*, GA33-0447
- *How to use the NAS*, online tutorial[1]

Nways 2220 Switch Manager Publications

- *IBM Nways 2220 Switch Manager for AIX Installation Guide*, SH11-3088
- *IBM Nways 2220 Switch Manager for AIX: Performance Monitoring and Accounting*, GA33-0366
- *IBM Nways 2220 Switch Manager User's Guide*, online manual[2]

TME 10 NetView for AIX Version 5 Publications

- *NetView for AIX Installation and Configuration* , SC31-8163
- *NetView for AIX V4R1 User's Guide* , SC31-8158

TMN 2.2 Publications

- *TMN 2.2 General Information* , GT01-0458
- *TMN 2.2 Agent User's Guide* SC31-8157

TME 10 Software Distribution Publications

- *Software Distribution for AIX Concepts* , GH19-4161
- *Software Distribution for AIX Getting Started* , GH19-4162
- *Software Distribution for AIX User's Guide* , GH19-4163
- *Software Distribution for AIX Installation and Customization* , GH19-4164
- *NetView Distribution Management Agent/2 User's Guide* , SH19-4084

OSI System Management Standards for CMIP

OSI stands for Open Systems Interconnection

OSI Management Framework and Overview

- *OSI Basic Reference Model Part 4: Management Framework* ISO 7498-4
- *Systems Management Overview* ISO 10040

CMIP/CMIS

- *Common Management Information Service Definition* ISO 9595

Systems-Management Functions

- *Part 1: Object Management Function* , ISO 10164-1
- *Part 2: State Management Function* , ISO 10164-2
- *Part 3: Attributes for Representing Relationships* ISO 10164-3
- *Part 4: Alarm Reporting Function* , ISO 10164-4
- *Part 5: Event Report Management Function* , ISO 10164-5

1. Online documentation delivered with the 2220 Nways Switch Control Program.
2. Online documentation delivered with the Nways 2220 Switch Manager product.

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- *Part 9: Objects and Attributes for Access Control* ISO 10164-9
- *Accounting Management* , SC 21 N 4971
- *OSI Software Management* , SC 21 N 6040
- *General Relationship Model* , SC 21 N 6041
- *Performance Management* , SC 21 N 6306

Management Information Model

- *Part 1: Management Information Model* , ISO 10165-1
- *Part 2: Definition of Management Information* , ISO 10165-2
- *Part 5: Generic Managed Information* , ISO 10165-5

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2220 Nways BroadBand Switch
Models 300, 500, and 501
Planning Series
ATM Interface Specifications

Publication No. GA33-0378-06

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