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Nortel Multiservice Switch 7400/15000/20000

ATM Traffic Management Fundamentals

NN10600-705

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Contents

What's new

There were no new features added to this document.

Attention: To ensure that you are using the most current version of an NTP, check the current NTP list in NN10600-000 *Nortel Multiservice Switch 7400/15000/20000 What's New*.

Multiservice Switch ATM traffic management

The objective of traffic management is to optimize network resources to achieve an acceptable quality of service for all of the traffic types that the network supports. The service provider implements traffic management strategies as an integral part of sound ATM network engineering practices and processes.

Navigation

Introduction

Nortel Multiservice Switch ATM networks support many applications, such as voice, video, multimedia, file transfer, and interactive communication. Each application has unique traffic characteristics (rate and density variation) and performance needs (acceptable levels of delay and cell loss).

The service provider defines the service requirements for each subscriber according to the applications that the network must support. This definition involves translating the communications needs of subscriber applications into a set of traffic characteristics. The required ATM service category and traffic descriptor type define these characteristics.

Traffic management encompasses two objectives that you must bring into balance:

- ensure that the network meets quality of service objectives for each subscriber, thereby satisfying the communication requirements at the application level
- maximize the allocation and use of network resources so that the service offering is cost effective

The traffic contract is the basis for traffic management controls. The contract defines of the ATM service category and traffic descriptor parameters that the service provider and subscriber agree upon for the connection.

Overview of ATM traffic management controls

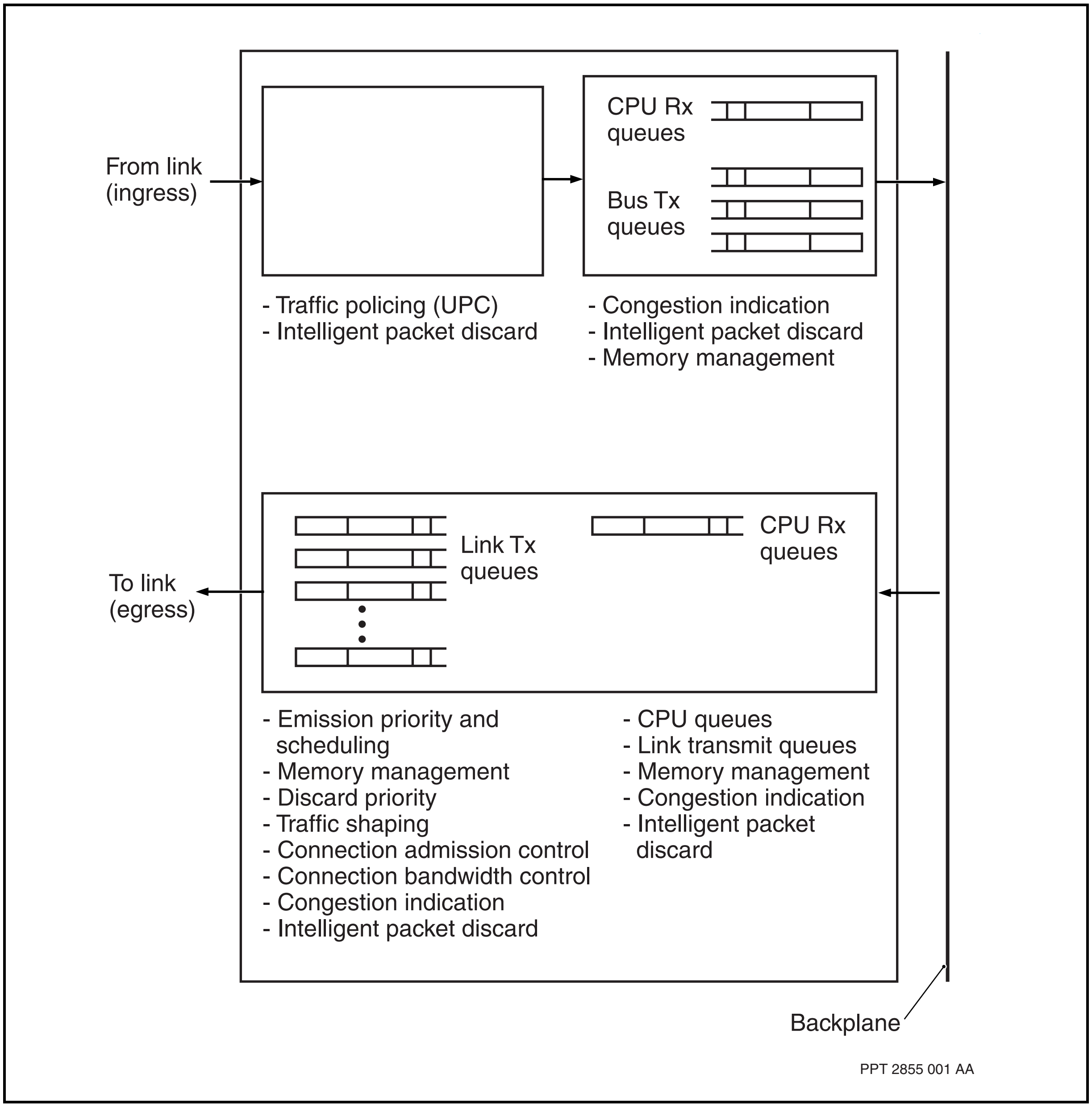
Traffic management controls on Nortel Multiservice Switch include:

- route management
- traffic shaping
- traffic policing through usage parameter control (UPC)
- cell queuing, queue scheduling, packet-wise discard
- connection admission control (CAC) and dynamic bandwidth management

In support of these controls, there are requirements for memory management (for queuing) and bandwidth pool management (for CAC). Traffic management controls also include network routing to support bearer capabilities, traffic parameters, and the ATM service category. Lastly, sound network engineering ensures that each node in the network is properly configured to handle the expected traffic loads.

The figure Overview of application points for traffic management controls (page 9) shows where these controls apply along the data path from link ingress to link egress.

Overview of application points for traffic management controls



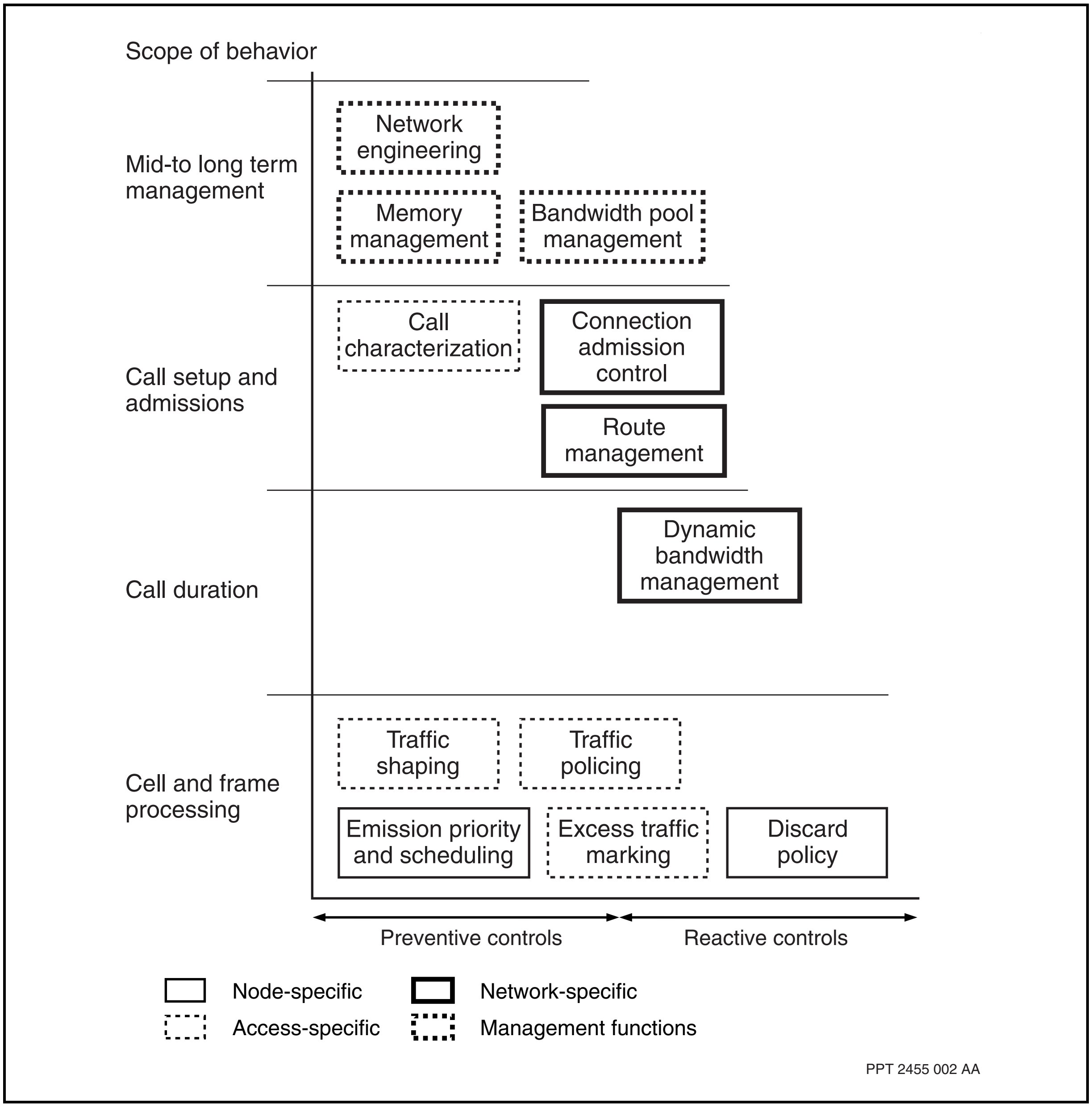
Each traffic management control and its associated resource management requirements fall into one of the following three categories:

- Access-specific controls (page 11)
- Node-specific controls (page 12)
- Network-specific controls (page 12)

When the service provider sets up a Multiservice Switch network, traffic management controls are built into node configurations as defaults. That is, some traffic management controls are always active by default, while others are inactive by default. The service provider can reconfigure these defaults to truly maximize network resources depending on the traffic mix.

The figure Relationships between controls, resource management, and network engineering (page 11) shows that each control is either preventive or reactive, and summarizes the scope of behavior. This figure also shows the relationship to network engineering and resource management.

Relationships between controls, resource management, and network engineering



Access-specific controls

Access-specific controls rely on call characterization. These controls ensure that source traffic adheres to the specified contract once the connections have been set up. Access-specific controls include

- call characterization (traffic contract and routing requirements for PNNI and UNI/IISP/AINI connections)
- traffic shaping
- traffic policing

- excess traffic marking (EFCI and CLP0 to CLP 1 marking)

Excess traffic marking allows the subscriber to exceed the allowed bandwidth for a connection up to a specific maximum rate. The node at the network access point tags excess traffic as a lower discard priority. Where congestion occurs, nodes along the route discard this tagged traffic before untagged traffic.

Node-specific controls

Node-specific controls ensure that nodal resources can support the connection requirements. These controls focus on:

- emission priority and queuing, which involves
  - queue and free list management
  - resource (memory) management
- scheduling
- discard policy

Node-specific controls make up a considerable portion of the traffic management effort. Discard policy works with emission priority, queuing, and scheduling to ensure that traffic requirements do not chronically overload memory and link resources.

Network-specific controls

Network-specific controls ensure that network resources continue to support the traffic requirements for admitted connections. These controls rely on mechanisms such as call admission and route selection, including

- connection admission control (CAC)
- adaptive-reactive mechanisms for congestion control
- overflow routing (crankbacks)
- route management (PNNI and UNI/IISP/AINI requirements)

Adaptive-reactive controls limit the connection load offered into the network when congestion is detected. In Nortel Multiservice Switch networks, each packet travelling over a Multiservice Switch node carries congestion indication bits. Each end point monitors the congestion indicators and limits its offered load upon receiving congestion indication.

Management functions

Management functions are not traffic management controls in the strictest sense, but are essential for controls to work.

Network engineering is a high-level function that encompasses traffic characterization across the entire network and how nodes are implemented to support traffic. Memory management ensures that memory allocation is properly balanced to support connection space in relation to free lists and queues. Bandwidth pool management is a necessary component of CAC.

Summary of Multiservice Switch traffic management features

Most traffic management features apply to both permanent and switched connections. Some features do not apply on a per-connection basis. The following sections summarize the common features and the features that are specific to function processor (FP) types:

- Summary of common features for FPs (page 13)
- Summary of features for CQC-based FPs (page 15)
- Summary of features for ATM IP FPs (page 15)
- Summary of features for APC/PQC-based FPs (page 16)
- Summary of features for GQM-based FPs (page 17)

Summary of common features for FPs

All Nortel Multiservice Switch nodes and FPs support the following traffic management features.

- engineering and configuration
  - — configurable buffer sizes and queue limits
  - — configure traffic policing, traffic shaping, and common or per-VC queuing independently for each service category
- routing and signaling
  - — define quality of service (QOS) classes, broadband bearer capability information element (BBC-IE) parameters, and service categories through configuration or signaling for each virtual channel connection (VCC) (in accordance with ATM Forum UNI specification versions 3.0, 3.1, and 4.0, and in PNNI specification version 1.0)
  - — define traffic descriptor types and traffic descriptor parameters for each connection (in accordance with ATM Forum UNI specification versions 3.0, 3.1, and 4.0, and in PNNI specification version 1.0)
  - — set cell delay variation tolerance (CDVT) at the ATM interface level (for each service category for both switched and permanent connections) or at the connection level (for PVC)
  - — set cell loss ratio (CLR) at the ATM interface for each service category
- traffic shaping and policing

- — enable or disable UPC at the network access point for an ATM interface, for each PVC associated with that interface, and for each service category
- — shaping to comply with traffic policing controls on the network side
- — UPC monitoring

- congestion management and intelligent discard
  - — configure priority discard at the processor, the free list, the backplane, and the transmit link
  - — congestion management on shaped connections, with three thresholds available for each connection queue (35 percent, 75 percent, and 90 percent)
  - — partial packet discard (PPD) and early packet discard (EPD) at ATM adaptation points
  - — configure partial packet discard (PPD) in both the receive and transmit directions for relay points that carry AAL5 frames
  - — set the explicit forward congestion indication (EFCI) for both per-VC and common queuing
  - — EFCI to forward congestion indication (FCI) mapping for trunks over Multiservice Switch ATM
- connection admission control and bandwidth management
  - — set CAC overbooking to a value of up to 64 times the link rate for each bandwidth pool
  - — apply enhanced CAC to guarantee QOS objectives for established connections with more efficient use of link bandwidth
  - — five bandwidth pools, one per service category
  - — configure the connection administrator for the maximum number of VCCs without a critical change to the ATM interface (UBR only)
  - — configure shared link bandwidth capacity between service categories, where you assign each category to a bandwidth pool and a percentage of total capacity to each pool
  - — configure over- and under-subscription of port capacity through the bandwidth pools
- statistics
  - — collect discard statistics at the connection level

Summary of features for CQC-based FPs

In addition to the common features described under Summary of common features for FPs (page 13), CQC-based FPs also have the following features.

- enhanced bandwidth protection using traffic shaping is available for 1, 2 or 3 ports on each FP, with unshaped ports also available for carrying traffic
- configure ATM FP shared resources, including cell queue memory (CQM), traffic shaping stacks, and shaping stack scaling factor
- enable queuing fairness at the ATM interface level for low- and medium-priority emission connections (per connection queuing)
- additional statistics for transmit and receive CLP1 for each ATM interface

Summary of features for ATM IP FPs

In addition to the common features described under Summary of common features for FPs (page 13), ATM IP FPs also have the following features.

- services and traffic descriptors
  - support for ITU I.371 deterministic bit rate 2 (DBR2), which defines aggregate separate traffic descriptor for user cells and OAM cells
  - no support for ITU I.371 DBR1, which defines separate traffic descriptors for user cells and OAM cells
  - no support for ITU I.371 ATM block transfer with delayed transmission (ABT/DT) or ATM block transfer with immediate transmission (ABT/IT)
- advanced queuing and scheduling
  - flexible configuration of QOS, minimum bandwidth guarantee (MBG), starvation avoidance, and efficient use of bandwidth provided by MBG for multiple classes
  - fairness and protection against greedy connections provided by per-VC queuing, available on all service categories
  - bandwidth allocation flexibility and fairness among connections provided by weighted fair queuing (WFQ)
  - improved cell loss ratio and burst tolerance provided by increased buffer size, up to 57K cell blocks
  - improved engineering feedback provided by high water marks for free list usage
  - better NRT-VBR service guarantees compared to UBR service (NRT-VBR and UBR can be served on different emission priorities)
- traffic shaping and policing
  - the full capacity of VBR.1 and VBR.2 traffic contract achieved using “Dual leaky bucket” traffic shaping

    - improved conformance to carrier contract through linear and dual leaky bucket policing
    - granularity of shapers is increased to the order of 1.0% of the requested rate
    - multi-port traffic shaping with no restrictions in rates
    - traffic shaping support for VBR.1 and VBR.2, shaping CLP0 or CLP0+1 traffic
    - adjustable CDV for compliance with ITU I.371 at all cell rates
    - ability to use CBR VP or VC carrier service: can shape all service categories including CBR
    - improved configuration flexibility: per-VC queuing does not affect traffic shaping on other virtual circuits
    - allows optional monitoring of generic cell rate algorithm (GCRA) violations
    - protection against misbehaving sources: UPC policing over an expanded range of traffic descriptors
    - compliance with ITU I.371 for UPC accuracy
- congestion management and intelligent discard
    - improved frame goodput for frame services provided by the packet-wise discard mechanisms at each CC level: late packet discard (LPD), partial packet discard (PPD), and early packet discard (EPD)
    - automatic detection of AAL5 traffic for packet-wise discard can be enabled for VCCs
    - improved frame goodput for frame services within a VP (packet-wise discards can be enabled for eligible virtual circuits within a VP)
    - expanded coverage of congestion detection at the ATM interface level by setting EFCI thresholds on both free lists and per-VC queues
- statistics
    - additional statistics: transmit and receive CLP1, EFCI, and discards for each ATM interface

Summary of features for APC/PQC-based FPs

In addition to the common features described under Summary of Multiservice Switch traffic management features (page 13), APC/PQC-based FPs also have the following features.

- buffer management at both ingress and egress for conforming cells
- queue limits that are specific to the 4-port OC12/STM4 and 16-port OC3/STM1 ATM APC/PQC-based FPs

- use of sub-port scheduler, class scheduler, and connection scheduler

Summary of features for GQM-based FPs

The generic queue manager (GQM) ASIC handles cell buffering and frame traffic management on ATM cells, AAL5 frames, and true frames contained within the data stream at OC-48 transmission rates. The FPs with GQM have enhanced ATM traffic management capabilities.

In addition to the common features described under Summary of Multiservice Switch traffic management features (page 13), GQM-based FPs also have the following traffic management feature enhancements.

- Congestion controls and discard priorities include
  - using a four-level discard priority mechanism to control the queue length per congestion for each of the buffer domains (global, link, class, and queue)
  - user-controlled packet discards on the transmission direction
- Policing by usage parameter control (UPC) is the same as other 16-port OC-3/STM-1 ATM FPs except it
  - adds up to two generic cell rate algorithm (GCRA) enforcers in tandem for each connection so that up to two rates can be monitored and enforced upon the connection
  - polices OAM cells with user cells
  - has a minimum policed rate of one cell per second
  - has a maximum permitted delay variation of 17.18 seconds
- OAM performance monitoring has the proprietary Nortel Multiservice Switch cell transfer delay (CTD) measurement apply to only SPVC and SPVP connections
- Handling operations, administration, and maintenance (OAM) ATM cells includes:
  - supporting the standardized OAM cells for end-to-end AIS, end-to-end RDI, segment loopback, and end-to-end loopback
  - not supporting the standard OAM cells for performance monitoring (FPM and BR), congestion control, segment AIS, and segment RDI by only transparently passing them through non-flow end points
  - supporting the non-standardized OAM cells for the proprietary end of transmission (EOT) cell used by rerouting connections on flow end points and transparently passes this cell on the non-flow end points and trace
  - not supporting the non-standardized OAM cells for the O.151 cell used by the NTHW24 FP (the 16-port OC-3/STM-1 FP with customized

O.151 cells) by only transparently passing them through non-flow end points

- not supporting the non-standardized OAM cells for the proprietary cell discards used for performance monitoring of cell loss ratio (CLR) calculations by only transparently passing them through non-flow end points

- Queuing disciplines include:
  - common queuing for up to 45,000 connections in any ATM service category
  - per-VC queuing of up to 32,000 connections
- Scheduling includes link, class, and connection (described for GQM in NN10600-707 *Nortel Multiservice Switch 7400/15000/20000 ATM Queuing and Scheduling Fundamentals*)
- Traffic shaping includes:
  - linear shaping which shapes each connection with a single rate
  - dual-rate inverse usage parameter control (UPC) shaping which uses both peak cell rate (PCR) and a sustained cell rate (SCR) with maximum burst size (MBS) on each connection and inverse UPC serving the cells of the connection consecutively at its PCR rate up to its MBS provided that the service on average remains below its SCR
  - up to four emission priorities (EPs) so that any or all ATM service categories can be shaped while maintaining a separate EP for each ATM service category
  - supporting the existing shaping options of minimizing cell delay variation (CDV) or maximizing bandwidth use per ATM service through the attribute *shapeRecoupPolicy*
- Congestion due to network-level engineering can occur on the ingress side of the FP in the FWD ASIC, however, all ASICs on the FP can handle all ports line rate with ATM traffic.
- Congestion due to network-level engineering can occur in the GQM on the egress side of the FP, when the FP receives traffic for an egress link from the fabric at a rate which exceeds the egress port bandwidth.

Traffic management for virtual interfaces

For a virtual interface, Nortel Multiservice Switch nodes apply traffic management controls at the virtual path (VP) layer and the virtual circuit (VC) layer. You apply controls through the virtual path termination (VPT). At the VP layer of the VPT, the traffic management techniques are similar to those that the Multiservice Switch node applies to a virtual path connection (VPC). Connection admission is based on the bandwidth available to the associated VPT.

Traffic contracts

A traffic contract defines the traffic characteristics of a connection in the ATM network. It is the definition of the level of service that each connection must support, as agreed upon by the ATM network service provider and the subscriber. With the traffic contract as a starting point, the service provider ensures that the network provides the agreed level of service for each connection. The subscriber at the ATM end-station ensures that transmitted traffic does not exceed the defined limits.

Navigation

Traffic contract parameters

You define the traffic contract with the following parameters:

- the ATM service category that the network must provide (one specification for both directions)
- quality of service (QOS)
- the broadband bearer capability (BBC) parameters (one specification for both directions)
- the connection traffic description (one specification for each direction), which includes:
  - — source traffic descriptor parameters, which specify the characteristics of the connection cell stream, including peak cell rate (PCR), sustained cell rate (SCR), and maximum burst size (MBS)
  - — cell delay variation tolerance (CDVT)
  - — conformance definition (traffic descriptor type), which the network uses to interpret traffic parameters

— best effort requirement

— frame and cell discard policies

The relationship between these parameters is shown in the figure Parameters used in the traffic contract (page 21).

Traffic characteristics for a connection form the basis upon which you apply traffic management strategies. Traffic characteristics are also the fixed standard against which you measure the success of traffic management implementation.

Signaled parameters for switched connections

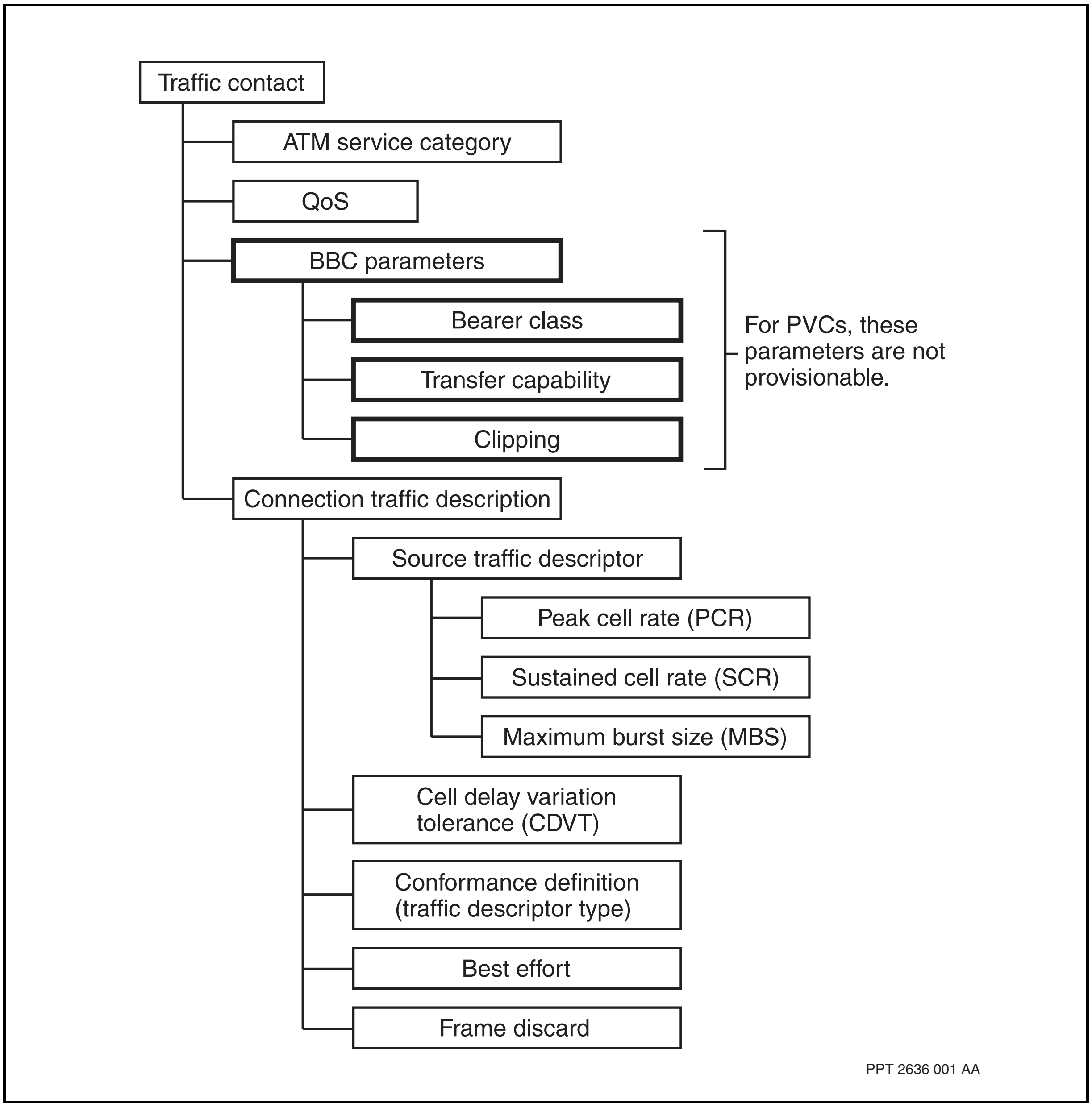
For switched connections, the network extracts the traffic characteristics from the following signaled information elements (IE):

- quality of service IE (QOS-IE)
- broadband bearer capability IE (BBC-IE)
- traffic descriptor IE (TD-IE)

The traffic contract parameters are configured for PVC and SPVC connections. For SVCs, most traffic contract descriptors are signaled by the originating end station. These parameters are used to define the traffic characteristics of ATM connections established within a Nortel Multiservice Switch network.

The ATM service category is defined as part of the traffic contract at the interface. It affects allowable cell loss ratio, cell transfer delay, and delay variance. It is linked to the service’s desired performance and, ultimately, to the user’s degree of satisfaction with the service.

Parameters used in the traffic contract



Non-signaled parameters for switched connections

Other parameters that are integral to defining the traffic characteristics of a connection are

- CDVT
- per-VC queuing
- traffic shaping
- traffic policing

For switched connections, these parameters cannot be signaled, and for that reason, can only be specified at the service category level. All switched VCCs under the same service category use the same values for these parameters.

ATM service category

The ATM service category defines the service requested or provided by an ATM connection. The supported service categories are

- constant bit rate (CBR)
- real-time variable bit rate (RT-VBR)
- non-real-time variable bit rate (NRT-VBR)
- unspecified bit rate (UBR)
- derived from BBC

On Nortel Multiservice Switch nodes, you can explicitly configure the service category for each ATM connection. Alternately, you can have the node derive the service category from the broadband bearer capability. There is no distinction between the transmit and receive directions.

For permanent connections, the service category sets the traffic type for the connection. For SPVC connections, if you explicitly configure the service category, it sets the BBC-IE parameters. If the service category is derived from the broadband bearer capability, the BBC parameters determine the ATM service category.

Cell loss ratio

Cell loss ratio (CLR) is defined for a connection as the number of lost cells divided by the total number of transmitted cells.

Connection admission control (CAC) uses the CLR to determine the required cell rate for the connection. There is a trade-off between the ATM service category CLR and the achievable link utilization. To guarantee excellent category, the CLR is as small as possible (for example, 10^{-15}). However, a smaller CLR results in a larger equivalent cell rate (ECR) for a given connection. A larger ECR consumes more bandwidth which in turn lowers link utilization.

Cell loss ratio configuration

CLR is specified at the level of the ATM interface for each supported ATM service category: CBR, RT-VBR, and NRT-VBR. CLR is not required for UBR connections.

For each ATM service category except UBR, 10^{-15} is the minimum value since it is the typical target for the physical link. The default values and range of permitted values for each ATM service category are summarized in the table CLR ranges and defaults by ATM service category (page 23).

CLR ranges and defaults by ATM service category

Service Category	Minimum CLR	Maximum CLR	Default
CBR	10^{-15}	10^{0}	10^{-10}
RT-VBR	10^{-15}	10^{0}	10^{-10}
NRT-VBR	10^{-15}	10^{0}	10^{-7}
UBR	n/a	n/a	n/a
CLR is defined for a connection as the number of lost cells divided by the total number of transmitted cells.			

Cell loss ratio and QOS class configuration

For information on configuring QOS for SPVCs and SPVPs, see the Quality of service requirements (page 23).

Cell loss ratio for ATM service category configuration

For PVCs and SPVCs, the ATM service category is configured through the virtual channel descriptor (VCD) and virtual path descriptor (VPD). You can explicitly specify the ATM service category or have it derived from the BBC parameters. A derived value is possible only for virtual channel connections (VCC); the service category cannot be derived for virtual path connections (VPC). The ATM service category that you specify for each connection applies to both directions.

Quality of service requirements

QOS is the cumulative effect of traffic characteristics which determines the degree of satisfaction that the user experiences with the specific service.

Based on connection admission control (CAC) in an ATM-based network, the network accepts a connection request only when sufficient resources are available to establish the connection from end to end. Further, the network must be able to maintain the required QOS for the new connection and the agreed QOS of existing connections. The QOS class is part of the traffic contract at the user-network interface (UNI). The connection requests the QOS class during call setup using the following required parameters:

- cell loss ratio (CLR)
- cell transfer delay (CTD)
- cell transfer delay variance (CTDV)

The ATM Forum specifies five QOS classes. The service provider may support more than the specified QOS classes. However, the performance that the network provides must meet or exceed performance parameter objectives of the QOS class that the end-point requests.

Both permanent and switched ATM VPCs and VCCs indicate the requested QOS by a particular class definition, class 0 through 4. The table Service categories and QOS classes (page 24) shows how QOS classes map to service categories.

Service categories and QOS classes

ATM forum QOS class	Service category	B-ISDN bearer service class	Examples
1	CBR	A	circuit emulation, PBX, constant bit rate video
2	CBR or VBR	B	packetized audio and video in teleconferencing and multimedia applications
3	VBR	C	frame relay and X.25
4	VBR	D	IP protocols
0	UBR		Best effort service

For permanent connections, the network uses PVC management to report QOS classes across the UNI. For switched connections, the information element (IE) of the signaling protocol communicates the QOS class across the UNI. Attributes for forward and backward QOS classes apply to SPVCs and SVCs only. These attributes specify the QOS values that the network signals in the call setup request packet data unit (PDU).

Forward and backward QOS

You specify QOS for both the forward and backward directions of a connection. The values are:

- 1 (QOS class 1)
- 2 (QOS class 2)
- 3 (QOS class 3)
- 4 (QOS class 4)
- 0 (unspecified QOS class)

Forward and backward QOS apply only to SPVCs, SVCs, or SPVPs. They do not apply to PVCs or PVPs. These parameters specify the QOS values that the network signals in the call setup request PDU. For details, see QOS class for UNI, IISP, and AINI (page 66) and Mapping QOS class to individual QOS parameters for PNNI 1.0 and UNI 4.0 (page 47).

QOS and cell loss ratio

The CLR for a connection is the number of lost cells divided by the total number of transmitted cells.

For SPVCs and SPVPs, configure the QOS class for the virtual channel descriptor. Nortel Multiservice Switch nodes include QOS attributes in the quality of service information element (QOS-IE) for both SPVCs and SPVPs. QOS attributes do not influence the CAC selection algorithm.

Broadband bearer capability parameters

In addition to the forward and backward QOS parameters, you configure the fields of the broadband bearer capability information element (BBC-IE) and the best effort indicator in the traffic descriptor information element (TD-IE). These attributes are

- bearer capability
- transfer capability
- clipping susceptibility
- best effort
- forward and backward frame discard

Bearer class

This parameter defines bearer capability. The values for this parameter are A (class A), C (class C), X (class X), and VP (class VP). The UNI 3.x, UNI 4.0, and IISP 1.0 protocols support all classes. The PNNI 1.0 protocol supports only class X and class VP.

Class A service is a connection-oriented, CBR ATM transport service. Class A service has end-to-end timing requirements and can require stringent cell loss, cell delay, and cell delay variation performance. With Class A service, the end station requests more than an ATM-only service. The network can look at the AAL to provide interworking based upon its contents.

Class C service is a connection-oriented, variable bit rate (VBR) ATM transport service. Class C service has no end-to-end timing requirements. With Class C service, the end station requests more than an ATM-only service. The network interworking function can look at the ATM adaptation layer (AAL) and provide a service based on it.

Class X service is a connection-oriented ATM transport service. To establish this service, define the AAL, traffic type (VBR or CBR), and timing requirements (transparent to the network). With Class X service, the end station requests an ATM-only service from the network. In this case, the network does not process higher layer protocols.

Class VP service specifies a transparent VP service and applies to SPVPs only. When you set the bearer class BBC parameter to VP, the end station requests an ATM-only service from the network. In this case, the network does not process higher level protocols. In Class VP service, the network transparently transports the VPI field (except for VCI values 0, 3, 4, and 6 through 15 inclusive) and the payload type field. This transport characteristic is the difference between Class X service and Class VP service.

The difference between the classes depends on the service that the user requests from the network. For example:

- For a VBR user who wants only an ATM cell relay service, specify Class X and traffic type VBR.
- For a user who places a DS1 circuit emulation call without interworking, specify Class X and traffic type CBR.
- For a user who requires service interworking over SVCs, specify Class A or Class X service.

Transfer capability

This parameter consolidates the BBC-IE traffic type and timing requirements fields. The traffic type values are

- constant bit rate (CBR)
- variable bit rate (VBR)
- no indication (when no traffic type is indicated)

The timing requirements values are

- end-to-end timing required
- end-to-end timing not required
- no indication

Clipping susceptibility

The BBC clipping parameter defines traffic susceptibility to clipping. Clipping is an impairment in which the first fraction of a second of information to be transferred is lost. Clipping occurs after an end station answers a call, but before the node switches through an associated connection. The BBC clipping parameter has no effect on how the Nortel Multiservice Switch node establishes the connection. It is used for interworking with networks that can clip data.

Best effort

The best effort parameter defines the best effort that the node attempts for the traffic. Best effort means that the network does not guarantee the QOS of the connection.

Forward frame discard

The forward frame discard parameter specifies activation of frame discard functionality in the forward direction of the connection.

Backward frame discard

The backward frame discard parameter specifies activation of frame discard functionality in the backward direction of the connection.

Connection traffic description

The ATM connection traffic description is the generic list of parameters and service conformance definitions that are used to capture the traffic characteristics of an ATM connection. A connection traffic description includes three components: source traffic descriptor types, CDVT, and conformance definitions. These components are described in the following sections.

Source traffic descriptor type

The source traffic descriptor type is defined as a set of traffic parameters that specify the traffic characteristics and the quantitative bandwidth requirements requested by the source. These parameters include

- Peak cell rate (PCR). This source traffic parameter specifies the highest bandwidth requirements available for traffic on the ATM connection.
- Sustained cell rate (SCR). This source traffic parameter specifies the average cell rate that can be submitted to the network over an extended period of time.
- Maximum burst size (MBS). This source traffic parameter determines an upper bound on the length of a burst transmitted in compliance with the connection’s PCR.
- Minimum cell rate (MCR). This optional UBR connection parameter determines a minimum bandwidth objective guarantee for traffic on ATM connections. The MCR parameter differs from the parameters associated with other ATM service categories in that its semantics are intentionally implementation and/or network specific. For more information about MCR, refer to AF-TM-0150.000 page 3-4.

Nortel Multiservice Switch uses these parameters to determine connection admission, select traffic shaping rates (when enabled), and enforce policing (when enabled).

Conformance definitions and traffic descriptor types

Conformance definitions are part of the ATM traffic contract parameters which the ATM Forum has defined. These definitions precisely define the conforming cell traffic for the ATM connection.

The ATM Forum specifications for UNI 3.0, UNI 3.1, and UNI 4.0 define a set of traffic descriptor types that serve as packaged traffic conformance definitions. Each type includes up to three of the source traffic descriptor parameters, where the setting of each parameter depends on the traffic descriptor type.

Parameter settings include the following for each direction of the connection:

- PCR for CLP=0+1 traffic
- PCR for CLP=0 traffic
- SCR for CLP=0+1 traffic
- SCR for CLP=0 traffic
- MBS for CLP=0+1 traffic
- MBS for CLP=0 traffic
- tagging of excess CLP=0 traffic
- MCR for CLP=0+1 traffic. MCR is an optional parameter of a UBR connection. The value of MCR for CLP=0+1 applicable to each of a UBR connection may be different. For more information about MCR, refer to page 5 in AF-TM-0150.000.

These traffic descriptor parameters are summarized in columns 1, 2, and 3 in the table Multiservice Switch traffic descriptor types and common configurable parameter rule (page 29).

Nortel Multiservice Switch ATM includes requested shaping rate (RSR), which is used in traffic shaping. RSR is an additional traffic descriptor parameter beyond those defined in the ATM Forum standards. This traffic descriptor parameter is summarized in column 5 of the table Multiservice Switch traffic descriptor types and common configurable parameter rule (page 29). RSR is optional and does not need to be defined for a connection. RSR is defined for the transmit direction only.

Multiservice Switch traffic descriptor types and common configurable parameter rule

Traffic descriptor types	Traffic parameters				
	1	**2**	**3**	**4**	**5**
1 (no traffic management)	n/a	n/a	n/a	n/a	n/a
2 (no traffic management)	n/a	n/a	n/a	n/a	n/a
3	PCR CLP=0+1	n/a	n/a	CDVT	RSR
4	PCR CLP=0+1	PCR CLP=0 (with discard)	n/a	CDVT	RSR
5	PCR CLP=0+1	PCR CLP=0 (with tagging)	n/a	CDVT	RSR
6	PCR CLP=0+1	SCR CLP=0+1 (with discard)	MBS CLP=0+1	CDVT	RSR
7	PCR CLP=0+1	SCR CLP=0 (with discard)	MBS CLP=0	CDVT	RSR
8	PCR CLP=0+1	SCR CLP=0 (with tagging)	MBS CLP=0	CDVT	RSR
9	PCR CLP=0+1	CDVT	MCR CLP=0+1	n/a	RSR
CDVT and RSR are optional (they do not need to be defined for a connection). RSR is not defined for the receive direction. MCR is an optional parameter of a UBR connection.					

Configuring traffic descriptor parameters

Traffic descriptor parameters are configured through vector-type attributes. Application of parameters varies, depending on whether the traffic descriptor type is receive or transmit.

The transmit traffic descriptor type has the following parameters and characteristics:

- Specify values for PCR, SCR, MBS, and MCR (traffic parameters 1 to 3), CDVT (parameter 4), RSR (parameter 5).
- Parameter 3 (the MBS value) must be greater than zero for traffic descriptor types 6, 7, and 8.
- Parameter 1 (the PCR value) must be greater than or equal to parameter 2 (either the PCR0 or the SCR value) and must be greater than parameter 3 for traffic descriptor type 9 (the MCR value).

- Where traffic shaping is enabled, PCR, SCR, and RSR are used to determine the PCR/SCR shaping rate.
- CAC uses the values of PCR, SCR, MBS, MCR and CDVT. The configured transmit CDVT value is only for CBR connections. For all other ATM service categories CAC ignores CDVT. CDVT is specified through the ATM service category for all connections at the connection administrator level for the ATM interface. A CDVT value may also be specified in the connection traffic descriptor to override the defaults set at the connection administrator.
- When parameter 5 (the RSR value) is non-zero, PCR is replaced by the RSR value which is then used in CAC and traffic shaping. When traffic shaping is enabled, shaping is set at the highest available shaping rate that is below PCR.
- The switch first attempts to shape transmit traffic at the highest available rate between SCR and PCR. However, if there is no available shaping rate between SCR and PCR (that is, SCR and PCR are close in value), the switch shapes traffic at the next highest rate, even if that rate is above the PCR value. See the sections on traffic shaping in NN10600-706 *Nortel Multiservice Switch 7400/15000/20000 ATM Traffic Shaping and Policing Fundamentals* for information on shaping rates.

The receive traffic descriptor type has the following parameters and characteristics:

- Specify values for PCR, SCR, MBS, and MCR (traffic parameters 1 to 3), and CDVT (parameter 4). RSR (parameter 5) is not used.
- If the receive traffic descriptor type is defined as the same as the transmit descriptor type, the transmit parameters are used (except for RSR).
- If CDVT is zero, the CDVT value defined by the specific service category under the connection administrator is used.
- The receive CDVT value is used in UPC (traffic policing).

In summary, for all traffic descriptor types except for types 1 and 2, the PCR parameter for CLP=0+1 traffic must be specified and must be equal to or greater than any other bandwidth parameter including PCR for CLP=0 or SCR for CLP=0+1 traffic. The traffic parameters are defined for each direction for each ATM connection.

Traffic descriptor operational parameters

The operational transmit and receive traffic descriptor parameters indicate the actual value that applies to a connection.

These parameters are available to display the actual setting for each connection. The actual settings used in the various traffic management strategies may be different from the configured settings due to granularity in how parameter values are used or to system limitations. Nortel Multiservice Switch nodes make a best effort to provide capability that is equivalent to or better than the configured traffic descriptor parameters.

The operational transmit and receive traffic descriptor parameters are also required for inter-operability with the incoming ATM SVCs. In this case, the operator does not have access to the configured transmit and receive traffic descriptor parameters for setting UPC, CAC, and traffic shaping. However, the operator can still query the values applied to the system.

Operational transmit parameters are summarized in the table Multiservice Switch traffic descriptor types and operational transmit parameters (page 31). Operational receive parameters are summarized in the table Multiservice Switch traffic descriptor types and operational receive parameters (page 32). Compare these tables to the table Multiservice Switch traffic descriptor types and common configurable parameter rule (page 29), which defines the configurable traffic descriptor parameters.

Multiservice Switch traffic descriptor types and operational transmit parameters

Traffic descriptor types	**Traffic parameters**				
	1	**2**	**3**	**4**	**5**
1 (no traffic management)	n/a	n/a	n/a	n/a	n/a
2 (no traffic management)	n/a	n/a	n/a	n/a	n/a
3	PCR CLP=0+1	n/a	n/a	actual shaping rate (see [1])	ECR (see [1] and [3])
4	PCR CLP=0+1	PCR CLP=0 (with discard)	n/a	actual shaping rate	ECR
5	PCR CLP=0+1	PCR CLP=0 (with tagging)	n/a	actual shaping rate	ECR
6	PCR CLP=0+1	SCR CLP=0+1 (with discard)	MBS CLP=0+1	PCR or SCR shaping rate (see [2])	ECR
7	PCR CLP=0+1	SCR CLP=0 (with discard)	MBS CLP=0	PCR or SCR shaping rate	ECR
8	PCR CLP=0+1	SCR CLP=0 (with tagging)	MBS CLP=0	PCR or SCR shaping rate	ECR
(1 of 2)					

Multiservice Switch traffic descriptor types and operational transmit parameters (continued)

Traffic descriptor types	Traffic parameters				
	1	**2**	**3**	**4**	**5**
9	PCR CLP=0+1	n/a	MCR CLP=0+1	actual shaping rate	ECR (should be same value as MCR)
[1] ECR = equivalent cell rate. [2] See the section on UPC operating characteristics in NN10600-706 *Nortel Multiservice Switch 7400/15000/20000 ATM Traffic Shaping and Policing Fundamentals*. [3] For traffic descriptor type 9, traffic parameter 5 indicates the ECR values in the case of UBR connections that use an MCR. It should be noted that if an MCR is specified, traffic descriptor 9 should be used for proper operation.					
(2 of 2)					

Multiservice Switch traffic descriptor types and operational receive parameters

Descriptor types	Traffic parameters				
	1	**2**	**3**	**4**	**5**
1 (no traffic management)	n/a	n/a	n/a	n/a	n/a
2 (no traffic management)	n/a	n/a	n/a	n/a	n/a
3	PCR CLP=0+1	n/a	n/a	CDVT	n/a
4	PCR CLP=0+1	PCR CLP=0 (with discard)	n/a	CDVT	n/a
5	PCR CLP=0+1	PCR CLP=0 (with tagging)	n/a	CDVT	n/a
6	PCR CLP=0+1	SCR CLP=0+1 (with discard)	MBS CLP=0+1	CDVT	n/a
7	PCR CLP=0+1	SCR CLP=0 (with discard)	MBS CLP=0	CDVT	n/a
8	PCR CLP=0+1	SCR CLP=0 (with tagging)	MBS CLP=0	CDVT	n/a
9	PCR CLP=0+1	CDVT	MCR CLP=0+1	n/a	n/a

Cell delay variation tolerance

CDVT defines the tolerance to cell clumping that results from the accumulating amount of cell delay variation or jitter in the network or customer premises equipment (CPE).

A connection with a large CDVT provides better service in terms of improved cell loss rate. However, a large CDVT requires more buffering resources from the transport network and is therefore more costly to the service provider.

You can set CDVT for both transmit and receive directions. The value is applied according to these rules:

- In the transmit direction, CAC uses CDVT for CBR traffic only (not for UBR or VBR traffic).
- In the receive direction, CDVT is used by UPC for all ATM service categories for traffic descriptor types 3, 4, 5, 6, 7, 8, and 9 (see the table Multiservice Switch traffic descriptor types and common configurable parameter rule (page 29), column 4).

For more information on the relationship between UPC and CDVT, see the section on additional considerations for UPC in NN10600-706 *Nortel Multiservice Switch 7400/15000/20000 ATM Traffic Shaping and Policing Fundamentals*.

For more information on the relationship between CBR CAC and CDVT, see the sections on CBC and the relationship between CBR CAC and CDVT in NN10600-708 *Nortel Multiservice Switch 7400/15000/20000 ATM CAC and Bandwidth Fundamentals*.

Selection of CDVT

The CDVT value may affect the allocation of network resources for a particular connection. It is therefore recommended that the CDVT (at both private and public interfaces) be upper bounded. As an implementation guideline, the receiver CDVT is defined to handle situations in which a connection traverses three networks, each having three switches in tandem.

The table Recommended CDVT values by service category and function processor (page 34) shows the recommended settings of the service category CDVT values depending on the physical link interface type. The values are in microseconds. Ranges and default values are summarized in the table CDVT ranges and defaults by ATM service category (page 35). The values are also in microseconds.

Recommended CDVT values by service category and function processor

ATM service category	DS1/E1	JT-2	DS3/E3	OC-3
CBR	700	500	250	150
RT-VBR	700	500	250	150
NRT-VBR	800	700	500	250
DS3/E3 and OC-3 values apply to both ATM IP and CQC-based function processors. DS1/E1 and JT-2 values apply to CQC-based function processors only. The values are in microseconds. For UBR and UBR with MDCR, the CDVT values are applicable if the PCR is not equal to zero. In this case, they would have the same values at NRT-VBR.				

Configuring CDVT

Configure CDVT values for all switched and permanent connections for the following service categories under the ATM interface connection administrator:

- CBR
- RT-VBR
- NRT-VBR
- UBR

For configuration requirements at the connection level, note the following points:

- For PVCs, CDVT can be configured per connection in both the receive and transmit directions through the VCD and VPD. When configured per connection, a connection's CDVT value overrides the CDVT value defined per service category. The service category CDVT value is defined in the specified service category under the ATM interface connection administrator.
- The configuring requirements defined for PVCs also apply to SPVCs, but only for the source node.
- SVCs cannot be explicitly configured for CDVT. For SVCs, the CDVT configuring for the ATM service category under the ATM interface connection administrator is used instead.

When the CDVT values are not configured at the connection level, the transmit and receive values are internally set to the corresponding CDVT value for both directions. Ranges and values are summarized in the table CDVT ranges and defaults by ATM service category (page 35) and are in microseconds.

CDVT ranges and defaults by ATM service category

Service category	CDVT range	Default
CBR	1 - 10 000	250
RT-VBR	1 - 1 200 000	250
NRT-VBR	1 - 1 200 000	250
UBR	1 - 1 200 000	250
traffic descriptor parameter 4 under connection (see Note)	1 - 10 000 OR 1 - 1 200 000	0
The CDVT values set for the ATM service categories (first 4 rows of this table) are the defaults that are set at the connection administration level. Traffic descriptor parameter 4 is the override value that you can configure at the connection level for PVCs and SPVCs at the source node. The values are in microseconds. The CDVT parameter is taken from parameter 2 for traffic descriptor type 9.		

The following rules also apply when setting the CDVT:

- The CDVT is configurable with a granularity of 1.0 microseconds.
- The CDVT ranges are as specified in CDVT ranges and defaults by ATM service category (page 35) for all function processor (FP) types, with a default CDVT value of 250 microseconds for all ATM service categories for all function processor types.

For all function processor types, use the CDVT value of the service category under the ATM interface to determine the default of the CDVT value at the connection level.

Attention: CDVT for NRT-VBR and UBR connections is relevant only when UPC enforcement is enabled. CDVT is not used for CAC.

Per-VC traffic shaping

Traffic shaping smooths out traffic bursts by regulating the cell emission interval in the transmit direction. It is useful for ensuring conformance of transmitted traffic to subscribed traffic parameters, or to ensure conformance at a subsequent interface.

While you can enable traffic shaping either for each ATM interface or for each connection under an interface, you must define a shaping rate for each connection. The traffic descriptor parameters of traffic descriptor types 3 to 8 determine the shaping rate. Traffic shaping does not apply to the receive direction.

For more information on traffic shaping, see NN10600-706 *Nortel Multiservice Switch 7400/15000/20000 ATM Traffic Shaping and Policing Fundamentals*.

Relationship between traffic characteristics and traffic management

Traffic characteristics serve two purposes:

- define the level of service that the subscriber can expect
- help the service provider plan resource allocation within the network by defining the load that will be placed on the network

You define the level of service through the ATM service category and the traffic descriptor type selections. Traffic management strategies help ensure that this level of service is maintained for the subscriber as well as ensuring that the network does not suffer if the subscriber uses more resources than the service provider has allocated. Traffic management is also used by the network administrator to develop strategies that further efficient delivery of services to subscribers.

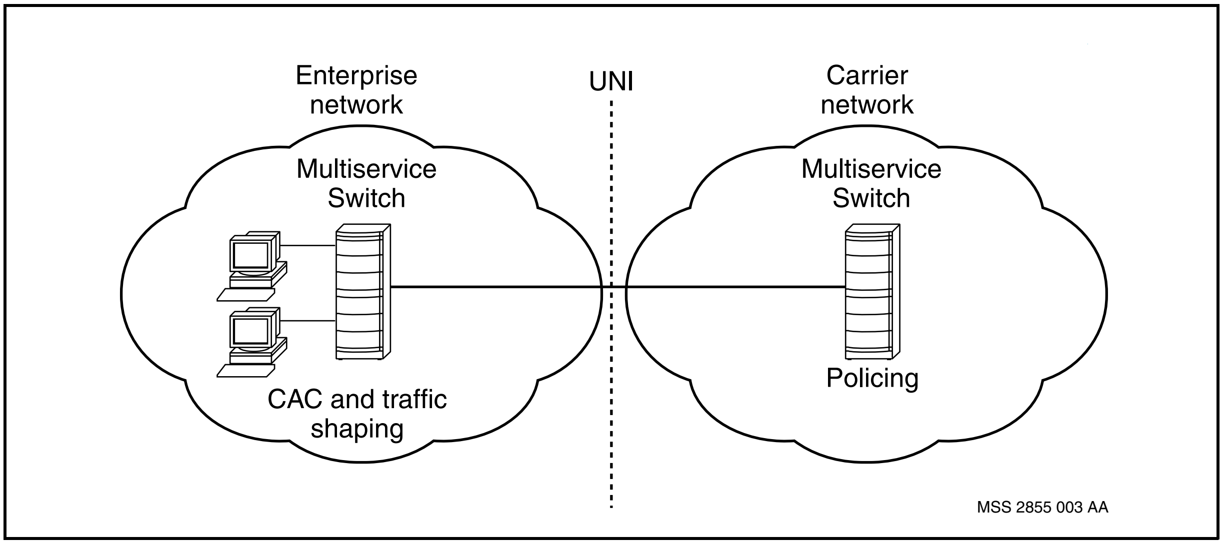
The application of ATM service category and traffic descriptor type definitions in ATM traffic management are summarized in the following points:

- CLR associated with the ATM service category is used in CAC to determine traffic priority in terms of emission and discard priorities.
- The node uses traffic descriptor parameters to specify conformance definitions in a traffic contract. You configure this parameter for each ATM connection.
- Transmit traffic descriptor parameters are used by CAC to determine the ECR for a connection.
- Transmit traffic descriptor parameters are used in traffic shaping.
- Receive traffic descriptor parameters are used by UPC in the algorithms that enforce negotiated traffic characteristics.
- CAC and UPC mechanisms take into account the conformance definition as input to their algorithms.

The figure Typical relationship between CAC, shaping, and policing (page 37) shows the relationship between CAC, shaping, and UPC. For more information on traffic shaping, traffic policing, and CAC, see the following documents:

- NN10600-706 *Nortel Multiservice Switch 7400/15000/20000 ATM Traffic Shaping and Policing Fundamentals*
- NN10600-708 *Nortel Multiservice Switch 7400/15000/20000 ATM CAC and Bandwidth Fundamentals*

Typical relationship between CAC, shaping, and policing



Route management for PNNI

Use the following sections to learn more about strategies for route management over PNNI.

Navigation

Overview

The routing system operates in conjunction with the connection admission control (CAC) function. Routing selects the optimal path between source and destination points, where this path meets quality of service (QOS) objectives for the connection. Routing is both dynamic and adaptive. These characteristics simplify network administration, optimize resources, and permit the network to react quickly to changes in traffic patterns and resource availability.

Route management over PNNI involves the following strategies:

- PNNI link state information
- link characteristics in path selection
- computed administrative weight (CAW) for UBR

- ATM connection QOS requirements
- mapping QOS class to individual QOS parameters
- connection traffic parameters for PNNI
- traffic characteristics of PNNI control channels over physical links

PNNI link state information

For PNNIs, Nortel Multiservice Switch nodes use the resource availability information group (RAIG) to originate and maintain link state information. Through the PNNI protocol, the node defines a RAIG for each service category (CBR, RT-VBR, NRT-VBR, or UBR).

The node advertises link state parameters for the outgoing (transmit) direction of the link. The RAIG identifies the node by

- the local node ID
- local port ID that is associated with the link

The neighboring peer node advertises link state parameters for the incoming (receive) direction of the link. The RAIG identifies the neighboring peer node by its node ID and the local port ID associated with the link.

The RAIG includes topology metrics and topology attributes. A topology metric is a topology state parameter that requires the value of the state parameters of all links and nodes along a given path. The node combines these values to determine if the path is acceptable for a given connection. The topology metrics are

- administrative weight
- cell delay variation (CDV)
- maximum cell transfer delay (maxCTD)

A topology attribute is a topology state parameter that the node uses to determine if a specific link or node is acceptable or desirable for carrying a given connection. The topology attributes are

- cell loss ratio (CLR)
- available cell rate (AvCR)
- maximum cell rate (maxCR)

The table PNNI resource availability information group (page 40) summarizes the attributes that the PNNI protocol includes in the RAIG.

PNNI resource availability information group

Description	Unit	Configurable/Operational
administrative weight		configurable
cell delay variation (CDV)	microsecond	configurable / operational
maximum cell transfer delay (maxCTD)	microsecond	configurable / operational
CLR for CLP=0 flow	n in range [1-15 or 255] where CLR=10^{-n}; the default is 255 255 indicates that any CLR is acceptable	configurable / operational
CLR for the aggregate CLP=0+1 flow	n in range [1-15 or 255] where CLR=10^{-n}; the default is 255 255 indicates that any CLR is acceptable	configurable / operational
AvCR	cells/second	operational
maxCR	cells/second	system supplied
cell rate margin (CRM)	cells/second	not supported
variance factor (VF)		not supported

The CRM and the variance factor (VF) are optional RAIG parameters for complex GCAC. Multiservice Switch nodes do not generate, maintain, or advertise CRM and VF as part of the transmit RAIG. However, if other nodes support these values and include them in the RAIG, Multiservice Switch nodes store the values in the topology database and includes these values in the PNNI topology state elements (PTSE) that it sends to neighboring nodes.

The table ATM service categories and applicable RAIG metrics (page 40) summarizes the RAIG attributes by applicability to ATM service categories on Multiservice Switch nodes.

ATM service categories and applicable RAIG metrics

	CBR	RT-VBR	NRT-VBR	UBR
Administrative weight	x	x	x	x
CDV	x	x		
maxCTD	x	x		
CLR 0 (see Note)		x	x	
CLR 0+1	x	x	x	
AvCR	x	x	x	x

ATM service categories and applicable RAIG metrics (continued)

	CBR	RT-VBR	NRT-VBR	UBR
maxCR	x	x	x	x
Only one CLR attribute is configurable per service category. See Cell loss ratio (page 43).				

The following subsection describe the RAIG attributes:

Administrative weight

Nortel Multiservice Switch nodes assign the administrative weight topology metric to a link for each service category. Administrative weight represents the operational cost of the link in a given service category. For example, cost can indicate the cost for a leased line.

Four new configured attributes, one for each ATM service category (CBR, RT-VBR, NRT-VBR, and UBR) are available under PNNI configuration.

Delay QOS parameters: CDV and maxCTD

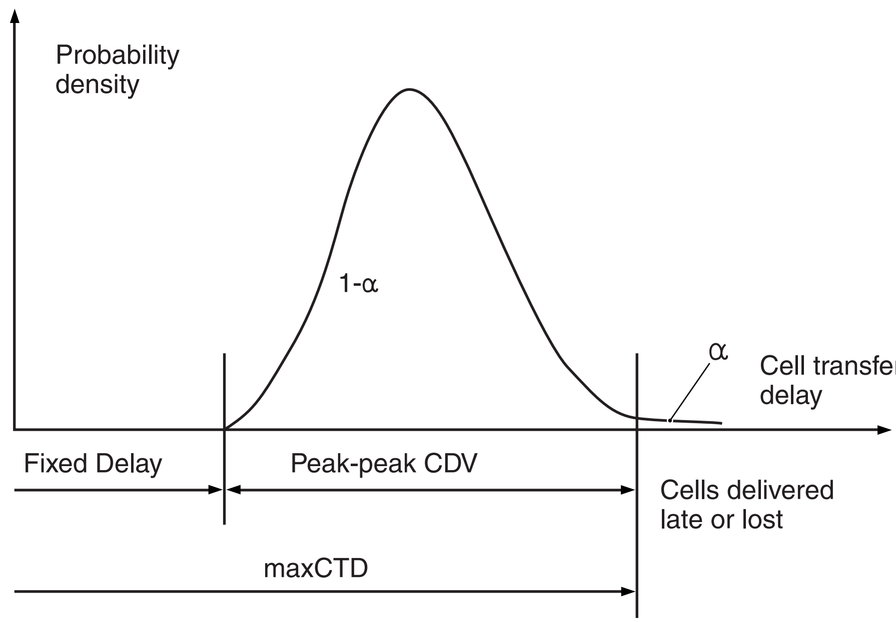
Cell delay variation and maximum cell transfer delay are two QOS parameters that characterize the delay metrics of an ATM interface for the real-time ATM service categories (CBR and RT-VBR). The figure Cell transfer delay probability density model for CBR and RT-VBR (page 42) shows the definition of and relationship between CDV, maxCTD, and fixed delay.

The factors involved in the fixed delay include

- propagation delay through the physical media
- delays induced by the transmission system
- fixed components of switch processing delay

The CDV indicates the amount of delay jitter that traffic buffering and scheduling introduces. To determine the amount of CDV that a node introduces for a given service category, the node needs the buffer size and the link rate.

Cell transfer delay probability density model for CBR and RT-VBR



The peak-to-peak CDV consists of the difference between the minimum and maximum delay that a cell can experience. You can derive the minimum delay when a cell arrives and there is no other cell ahead of it in the queue. You can derive the maximum delay when a cell arrives and the queue is full. Therefore, you can use the following equation to derive the worst-case CDV in seconds:

CDV = maximum queue size / service rate

where maximum queue size is in cells and service rate is equal to the link rate for CBR traffic in cells per second. However, for RT-VBR the

service rate = link rate - Σ(PCR for all CBR connections)

To configure the CDV value for CBR, you can use the results of any appropriate equation, but the results of the first equation are recommended. The network advertises this value in the RAIG.

The maxCTD is the sum of the fixed delay and the CDV. See the figure Cell transfer delay probability density model for CBR and RT-VBR (page 42). Configure the maxCTD (for RT-VBR) based on your knowledge of the expected fixed delay (mostly the propagation delay) and the CDV that you derive through the first equation or any configured value. In this release, the operational values for CDV and maxCTD for CBR and RT-VBR do not change to reflect the traffic mix and its intensity.

Route computation and bandwidth reservation

During call setup, Nortel Multiservice Switch nodes handle cumulative maxCTD differently for SVCs and SVPs, and for SPVCs and SPVPs.

For SPVCs and SPVPs, the cumulative maxCTD is ignored at the source and destination nodes for bandwidth reservation (the cumulative value is 0).

For SVCs and SVPs, each node along the route includes the cumulative value as part of the bandwidth allocation for the connection. Each node updates the PNNI cumulative forward maxCTD to account for the maxCTD for the link, based on the service category (CBR of RT-VBR only) for the connection.

Cell loss ratio

The cell loss ratio (CLR) topology for the supported ATM service categories that are configurable under the ATM interface connection administrator do not explicitly refer to a particular cell flow (that is, cell flow defined as CLP=0 or CLP=0+1).

For non-PNNI networking and traffic management, Nortel Multiservice Switch nodes associate the meaning of CLR with the compliance definition (or traffic descriptor type) of the connection. For CBR.1 (TDT=3), and VBR.1 (TDT=6), the CLR applies for the CLP=0+1 aggregate flow. For VBR.2 (TDT=7) and VBR.3 (TDT=8), the CLR applies to the CLP=0 cell flow.

For PNNI networking and related traffic management strategies, the network advertises two different CLR link values in the RAIG: one for the CLP=0 cell flow, and another for the CLP=0+1 cell flow.

These CLR values are the same. The system derives the values from the existing single CLR for a given ATM service category.

Available cell rate

Available cell rate (AvCR) is a measure of the effective available capacity for a given ATM service category. Nortel Multiservice Switch nodes derive the value of this attribute from the respective bandwidth pool under the ATM interface connection administrator parameters.

Maximum cell rate

The maximum cell rate (maxCR) defines the cell rate that a connection within a specific service category can use. This topology parameter applies to all service categories. Nortel Multiservice Switch nodes use maxCR as a distinguished value to indicate inability to accept new connections in the corresponding service category.

Multiservice Switch nodes do not implement a specific attribute to represent a value for maxCR. The value of the pool bandwidth capacity for each service category is used to initialize the value of maxCR for that service category. When the maximum number of connections (including both VCCs and VPCs) under the ATM interface connection administrator is reached, maxCR for all service categories is set to zero. This setting indicates that connections of all service categories cannot route through the link. When the maximum number of UBR connections (including both VCCs and VPCs) under the ATM interface connection administrator is reached, maxCR for the UBR service category is set to zero. This setting indicates that UBR connections cannot route through the link.

Use of link characteristics in path selection

Call establishment consists of the following operations:

- the selection of the path, which the node bases on
  - — the QOS and bandwidth that a connection requests
  - — the current available information on the various network links
- the set up of the connection state at each point along the path to confirm the resource availability

The table ATM service categories and applicable RAIG metrics (page 40) defines the service category characteristics that PNNI routing uses to allow or disallow user calls on a particular link, based on call setup requirements. If the network steers a call to a given link (based on least-cost routing), the node inspects the ATM service category for the call. If the network does not define a RAIG for that ATM service category on the link, the call cannot use the link. Otherwise, the node inspects the call requirements (which the call setup packet specifies) against the resource availability that the network advertises for the link in each direction. If the call requirements are not compatible with the advertised resource availability, the call cannot use the link.

Nortel Multiservice Switch keeps the advertised RAIG metrics for each link. The network uses the RAIG metrics during call setup processing to update the cumulative QOS metrics such as peak-to-peak CDV and end-to-end transit delay. See ATM connection QOS requirements (page 45).

The PNNI routing code includes an implementation of the Dijkstra least-cost algorithm based on a single metric out of the following possible metrics:

- forward administrative weight
- forward CDV
- forward CTD
- backward administrative weight
- backward CDV
- backward CTD

Under the route selector component, you can configure the metric that the Dijkstra least-cost algorithm uses in the path search.

ATM connection QOS requirements

In PNNI 1.0 and UNI 4.0 signaling, Nortel Multiservice Switch nodes use two quality of service information elements (QOS-IE) in the SETUP and CONNECT messages to supplement the QOS parameter information element (IE) in UNI 3.x. The table QOS parameter IE (as defined in UNI 3.1) (page 45) summarizes the UNI 3.1 QOS parameter IEs.

QOS parameter IE (as defined in UNI 3.1)

Direction	Attributes	Value
forward	QOS class	0, 1, 2, 3, or 4
backward	QOS class	0, 1, 2, 3, or 4

By maintaining the UNI QOS parameter IE, Multiservice Switch supports backwards compatibility for interworking with equipment that does not support UNI 4.0. The new QOS-IEs for PNNI are

- extended QOS parameter IE
- end-to-end transit delay IE

The extended QOS parameter IE specifies individual QOS parameter requirements for the call (acceptable forward/backward peak-to-peak CDV, and acceptable forward/backward CLR). It also indicates the cumulative QOS parameter values (cumulative forward/backward peak-to-peak CDV). This QOS-IE is mandatory when the UNI QOS parameter IE is absent. The table Extended QOS parameter IE for PNNI (page 46) summarizes this QOS-IE.

Extended QOS parameter IE for PNNI

Direction	Attributes	Unit
Forward	acceptable peak-to-peak CDV	microsecond; default is 16 777 215 The default value indicates that any forward peak-to-peak CDV is acceptable
	cumulative peak-to-peak CDV	microsecond
	acceptable CLR	n in range [1-15 or 255] where CLR=10^{-n}; the default is 255 255 indicates that any CLR is acceptable
Backward	acceptable peak-to-peak CDV	microsecond; default is 16 777 215 The default value indicates that any backward peak-to-peak CDV is acceptable
	cumulative peak-to-peak CDV	microsecond
	acceptable CLR	n in range [1-15 or 255] where CLR=10^{-n}; the default is 255 255 indicates that any CLR is acceptable

The QOS parameter IE, as defined in the ATM Forum specification for UNI 3.1, is mandatory only when the extended QOS-IE is absent. However, you can include the QOS parameter IE in addition to the extended QOS-IE for interworking with networks that do not support the extended QOS-IE.

The end-to-end transit delay IE specifies the end-to-end transit delay requirement for the connection. This IE includes the end-user delay (for example, AAL handling delay) in addition to the forward maxCTD. This IE is available only for CBR or RT-VBR service categories. The table End-to-end transit delay IE for PNNI (page 46) summarizes the end-to-end transit delay.

End-to-end transit delay IE for PNNI

Direction	Attributes	Unit
Forward	Acceptable end-to-end transit delay	milliseconds 16 777 215 means any end-to-end delay is acceptable, delivery is cumulative
	Cumulative end-to-end transit delay	milliseconds

Attributes under the VCD define the QOS parameters for an SPVC connection. However, Multiservice Switch nodes support the extended QOS-IE and the end-to-end transit delay IE for PNNI 1.0 and UNI 4.0 only (both

SPVCs and SVCs). Multiservice Switch nodes do not support these IEs over interfaces governed by the UNI 3.x protocol. If the QOS parameter IE is not present, UNI clears the call.

Mapping QOS class to individual QOS parameters for PNNI 1.0 and UNI 4.0

In compliance with the PNNI 1.0 and UNI 4.0 standards, a UNI 3.1 call SETUP message must map to a PNNI 1.0 or UNI 4.0 SETUP message. QOS class maps to an extended QOS parameter IE, or to an end-to-end transit delay IE. When the SETUP message does not include an extended QOS parameter IE, the node generates an IE based on a local mapping from the forward and backward QOS class sub-fields in the QOS parameter IE.

The table QOS-IE to extended QOS-IE and end-to-end transit delay IE mapping (page 47) summarizes the mapping scheme.

QOS-IE to extended QOS-IE and end-to-end transit delay IE mapping

QOS Class	CDV	maxCTD	CLR
0	16 777 215	16 777 215	255
1	x	x	x
2	x	x	x
3,4	16 777 215	255	x
255 indicates that any value is acceptable. An “x” indicates that the operator configures the value.			

The mapping from QOS class to individual QOS parameters is configurable for each interface. QOS class 0 does not require any mapping. QOS classes 1 and 2 require configuration of the CDV, maxCTD, and CLR parameters. QOS classes 3 and 4 require configuration of the CLR parameter.

You cannot configure the values for the extended QOS and the end-to-end transit delay IEs when translating from UNI3.x to PNNI 1.0 if these IEs are not present in the UNI3.x request. Nortel Multiservice Switch nodes use any acceptable value as the default values for CTD, maxCTD, and CLR when generating the extended QOS and the end-to-end transit delay IEs.

Connection traffic parameters for PNNI 1.0 and UNI 4.0

The network signals the traffic characteristics (for example, PCR, SCR, MBS, and so on) of an ATM connection in the TD-IE. This section describes the TD-IEs that are specific to PNNI 1.0.

In addition to the TD parameter IE for UNI 3.1, PNNI 1.0 and UNI 4.0 introduce two optional TD-IEs in the SETUP message. To initiate connection establishment, the calling user sends the SETUP message to the network and the network forwards the message to the called user. The new TD-IEs are the alternative ATM TD-IE and the minimum acceptable ATM TD-IE. Nortel Multiservice Switch nodes do not support these optional TD-IEs.

Frame discard indication in the TD-IE

PNNI 1.0 and UNI 4.0 introduce two new bits to the traffic management options identifier of the TD-IE. These bits indicate whether the connection allows forward or backward frame discard.

When a node needs to discard cells, discard at the frame level is more efficient than at the cell level. Frame discard helps avoid congestion collapse and optimizes network performance (the term frame refers to the AAL protocol data unit). The network can examine the SDU-type in the payload type field of the ATM cell header and detect the frame boundaries.

The UNI 3.1 to PNNI 1.0 signaling interworking function maps the frame discard indication. See NN10600-702 *Nortel Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals* for details on signaling interworking.

Combinations of bearer capability, traffic parameters, and QOS

Nortel Multiservice Switch supports the allowed combinations of bearer capability, traffic parameters, and QOS (classes, extended QOS, and end-to-end delay) as defined in the ATM Forum *Private Network-Network Interface (PNNI) Specification Version 1.0* (af-pnni-0055.000) and *User-Network Interface Signalling Specification Version 4.0* (af-sig-0061.000).

ATM transfer capability for PNNI 1.0 and UNI 4.0

The table ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (page 48) shows the mapping between the ATM transfer capability and the BBC-IE traffic type and timing requirements fields for SPVCs, SVCs, and SPVPs under PNNI 1.0 and UNI 4.0.

ATM transfer capability mapping for PNNI 1.0 and UNI 4.0

Input	Output		Applies to		
ATM TC	**Traffic type**	**Timing requirements**	**SPVC**	**SPVP**	**SVC**
0	No indication	No indication	yes	no	yes
1	No indication	End-to-end timing required	yes	no	yes
(1 of 2)					

ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (continued)

Input	Output		Applies to		
ATM TC	**Traffic type**	**Timing requirements**	**SPVC**	**SPVP**	**SVC**
2	No indication	End-to-end timing not required	yes	no	yes
3	Not supported	Not supported	yes	no	yes
4	CBR	No indication	yes	no	yes
5	CBR	End-to-end timing required	yes	yes	yes
6	CBR	Not required	yes	no	yes
7	Not supported	Not supported	yes	no	yes
8	VBR	No indication	yes	no	yes
9	VBR	End-to-end timing required	yes	yes	yes
10	VBR	End-to-end timing not required	yes	yes	yes
11	NRT-VBR with CLR 0+1 commitment		no	no	yes
19	RT-VBR with CLR 0+1 commitment		no	no	yes
When receiving PNNI setup requests, the Multiservice Switch node applies to the following mappings: • TM combinations with ATM TC = 4, 6, and 7 map to ATM TC = 5 • TM combinations with ATM TC = 11 map to ATM TC = 10 • TM combinations with ATM TC = 19 map to ATM TC = 9					
(2 of 2)					

Traffic characteristics of PNNI control channels over physical links

The PNNI functionality relies on two VCCs between any given pair of neighboring nodes:

- the signaling channel, at VPI.VCI=0.5 (default VCI)
- the routing control channel (RCC), at VPI.VCI=0.18 (default VCI)

This section defines the traffic characteristics of each of these channels according to the relevant ATM Forum standards.

Signaling VCC traffic characteristics

The PNNI 1.0 signaling protocol is sensitive to delay and message loss. According to the PNNI 1.0 standard, the signaling channel has the following QOS requirements:

- CLR is 10^{-6} or better

- end-to-end transit delay is 500 milliseconds or less
- only CLP=0 cells traverse the signaling VCC

The standard assumes that these parameters are compatible with the traffic contract for the signaling channel. The table Default PNNI signaling VCC traffic characteristics (page 50) summarizes the default values that Nortel Multiservice Switch nodes assign to this contract.

Default PNNI signaling VCC traffic characteristics

Attribute	Default Value
ATM service category	RT-VBR
QOS class	2
TDT	6
PCR (CLP=0+1)	250 cells/s
SCR (CLP=0)	160 cells/s
MBS (CLP=0)	5 cells
frame discard	PPD and EPD on
traffic shaping	disabled on all channels
traffic policing	disabled on all channels

These traffic parameters are the default values. You can change these values through configuring the VCS under PNNI signaling (see NN10600-710 *Nortel Multiservice Switch 7400/15000/20000 ATM Configuration Management*). When you enable traffic shaping and traffic policing, ensure that the channel has sufficient bandwidth by raising the value for PCR.

RCC traffic characteristics

The PNNI 1.0 standard indicates that the RCC between two lowest level nodes through a physical link must have a specific traffic contract. The table Default PNNI signaling VCC traffic characteristics (page 50) summarizes the default values that Nortel Multiservice Switch nodes assign to this contract.

Default PNNI RCC traffic characteristics

Attribute	Value
ATM Service Category	RT-VBR (see Note)
QOS Class	2
TDT	8 (tagging requested)

(1 of 2)

Default PNNI RCC traffic characteristics (continued)

Attribute	Value
PCR (CLP=0+1)	906 cells/s
SCR (CLP=0)	453 cells/s
MBS (CLP=0)	171 cells
frame discard	PPD and EPD on
traffic shaping	disabled on all channels
traffic policing	disabled on all channels
The PNNI 1.0 ATM Forum Specification indicates that the ATM service category is NRT-VBR. However, if NRT-VBR is not available, use RT-VBR instead. To provide the RCC VCC with a better QOS (higher emission and lower discard), Multiservice Switch nodes use RT-VBR.	
(2 of 2)	

These traffic parameters are the default values. You can change these values by configuring the VCD under PNNI routing control channel (RCC). See NN10600-710 *Nortel Multiservice Switch 7400/15000/20000 ATM Configuration Management*. When you enable traffic shaping and traffic policing, ensure that the channel has sufficient bandwidth by raising the value for PCR.

Combinations of BBC, traffic parameters, and QOS

The parameters that the networking protocol defines in the call setup message must be consistent across all information elements. This criteria for consistency involves the following information elements:

- BBC-IE
- TD-IE
- extended QOS parameter IE
- end-to-end transit delay IE

If a Nortel Multiservice Switch node receives a call setup message that contains a combination of BBC, ATM transfer capability, and best effort indicator, and the combination is not allowed, Multiservice Switch nodes clear the call with cause code #65, “Bearer capability not implemented”. If the combination of traffic parameters, force tagging parameters, QOS parameters, and QOS class in a call setup message is not allowed for the ATM service category, the node clears the call with cause code #73, “Unsupported combination of traffic parameters”.

The following tables describe the permitted combinations of BBC, traffic descriptor parameters, extended QOS parameters, the end-to-end transit delay, and QOS classes in call setup messages.

- Allowable parameter combinations in the call setup message: CBR (page 52)
- Allowable parameter combinations in the call setup message: RT-VBR (UNI 3.x legacy) (page 55)
- Allowable parameter combinations in the call setup message: NRT-VBR (page 56)
- Allowable parameter combinations in the call setup message: NRT-VBR (UNI 3.1 legacy) (page 57)
- Allowable parameter combinations in the call setup message for UBR (page 58)

In each of these tables, a blank entry indicates an unspecified parameter. For optional parameters, the call setup message may specify the parameter using:

- an individual QOS parameter encoded in the extended QOS parameter IE or the end-to-end transit delay IE, or
- objectives implied from the QOS class

If an extended QOS parameter IE is present and this parameter is not present in the message, then the Multiservice Switch node accepts any value of this parameter. If neither the parameter nor the extended QOS parameter IE is present in the message, then the Multiservice Switch node determines the objective for this parameter from the QOS class in the QOS parameter IE.

Allowable parameter combinations in the call setup message: CBR

ATM service category	**CBR**								
Conformance	**CBR.1**			**UNI 3.x**			**UNI 3.x**		
Bearer capability									
Broadband bearer class	A	X	VP	A	X	VP	A	X	VP
ATM transfer capability	7			absent	4, 5, or 6	5	absent	4, 5, or 6	5
TD for a given direction	TD type 3			TD type 3			TD type 4 or 5		
PCR (CLP=0)							specified		
PCR (CLP=0+1)	specified			specified			specified		
SCR, MBS (CLP=0)									
(1 of 2)									

Allowable parameter combinations in the call setup message: CBR (continued)

ATM service category	CBR		
Conformance	**CBR.1**	**UNI 3.x**	**UNI 3.x**
SCR, MBS (CLP=0+1)			
Best effort			
Tagging	no	no	yes for TD type 5; no for TD type 4
Frame discard	yes or no	yes or no	yes or no
QOS classes	see note	see note	see note
Transit delay	optional	optional	optional
Peak-to-peak CDV	optional	optional	optional
CLR (CLP=0)		optional	optional
CLR (CLP=0+1)	optional		

[1] Multiservice Switch nodes use this combination only when the connection requires the CLR commitment on CLP=0+1 traffic required as opposed to the CLR commitment on CLP=0 traffic, since UNI 3.x and ITU-T Q.2931 do not support these combinations. CLR (CLP=0) maps to CLR (CLP=0+1) in all SVCs and SPVCs (CQC hardware only). Multiservice Switch nodes map SVC call setup requests for this conformance. See the table ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (page 48) for mapping information.

[2] Supports backward compatibility with UNI 3.1 and ITU-T recommendations. With these conformance definitions, the CLR commitment applies to the CLP=0 traffic stream only.

[3] Multiservice Switch nodes do not use the values 4, 6, 7, 11, and 19 for transmission but can process these values from incoming setup messages.

[4] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[5] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

[6] Allowed QOS values are a network option. The network always supports Class 0 for alignment with ITU-T.

[7] VP allows SVPs to use the UNI 3.1 conformance definition.

(2 of 2)

Allowable parameter combinations in the call setup message: RT-VBR

ATM service category	RT-VBR								
Conformance	**VBR.1**			**VBR.2**			**VBR.3**		
Bearer capability									
Broadband bearer class	C	X	VP	C	X	VP	C	X	VP

(1 of 2)

Allowable parameter combinations in the call setup message: RT-VBR (continued)

ATM service category	**RT-VBR**								
Conformance	**VBR.1**			**VBR.2**			**VBR.3**		
ATM transfer capability	19			9	1 or 9	9	9	1 or 9	9
TD for a given direction									
PCR (CLP=0)									
PCR (CLP=0+1)	specified			specified			specified		
SCR, MBS (CLP=0)				specified			specified		
SCR, MBS (CLP=0+1)	specified								
Best effort									
Tagging	no			no			yes		
Frame discard	yes or no			yes or no			yes or no		
QOS classes	see note			see note			see note		
Transit delay	optional			optional			optional		
Peak-to-peak CDV	optional			optional			optional		
CLR (CLP=0)				optional			optional		
CLR (CLP=0+1)	optional								

[1] Multiservice Switch nodes use this combination only when the connection requires the CLR commitment on CLP=0+1 traffic required as opposed to the CLR commitment on CLP=0 traffic, since UNI 3.x and ITU-T Q.2931 do not support these combinations. CLR (CLP=0) maps to CLR (CLP=0+1) in all SVCs and SPVCs (CQC hardware only). Multiservice Switch nodes map call setup requests for this conformance. See the table ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (page 48) for mapping information.

[2] Multiservice Switch nodes map call setup requests for this conformance. See the table ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (page 48) for mapping information.

[3] Multiservice Switch does not use the values 4, 6, 7, 11, and 19 for transmission but can process these values from incoming setup messages.

[4] Allowed QOS values are a network option. The network always supports Class 0 for alignment with ITU-T.

[5] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[6] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

(2 of 2)

Allowable parameter combinations in the call setup message: RT-VBR (UNI 3.x legacy)

ATM service category	**RT-VBR (UNI 3.x legacy)**			
Conformance	**UNI 3.x**	**UNI 3.x**	**UNI 3.x**	
Bearer capability				
Broadband bearer class	X	X	X	C or VP
ATM transfer capability	1 or 9	1 or 9	1 or 9	9
TD for a given direction	TD type 4 or 5	TD type 3	TD type 6	
PCR (CLP=0)	specified			
PCR (CLP=0+1)	specified	specified	specified	
SCR, MBS (CLP=0)				
SCR, MBS (CLP=0+1)				
Best effort				
Tagging	yes for TD type 5; no for TD type 4	no	no	
Frame discard	yes or no	yes or no	yes or no	
QOS classes	see note	see note	see note	
Transit delay	optional	optional	optional	
Peak-to-peak CDV	optional	optional	optional	
CLR (CLP=0)	optional	optional	optional	
CLR (CLP=0+1)				

[1] Supports backward compatibility with UNI 3.1 and ITU-T recommendations. With these conformance definitions, the CLR commitment applies to the CLP=0 traffic stream only.

[2] Multiservice Switch nodes handle this combination as if the received PCR (CLP=0) parameter is an SCR (CLP=0) parameter where the MBS (CLP=0) parameter has a value of 1.

[3] Multiservice Switch nodes handle this combination as if it receives an additional SCR (CLP=0) with the same value as the received PCR (CLP=0+1) parameter where the MBS (CLP=0) parameter has a value of 1.

[4] VP allows SVPs to use the UNI 3.1 conformance definition.

[5] Allowed QOS values are a network option. The network always supports Class 0 for alignment with ITU-T.

[6] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[7] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

Allowable parameter combinations in the call setup message: NRT-VBR

ATM service category	**NRT-VBR**								
Conformance	**VBR.1**			**VBR.2**			**VBR.3**		
Bearer capability									
Broadband bearer class	C	X	VP	C	X	VP	C	X	VP
ATM transfer capability	11			absent	absent, 0, 2, 8, or 10	absent, 10	absent	absent, 0, 2, 8, or 10	absent, 10
TD for a given direction	TD type 6			TD type 7			TD type 8		
PCR (CLP=0)									
PCR (CLP=0+1)	specified			specified			specified		
SCR, MBS (CLP=0)				specified			specified		
SCR, MBS (CLP=0+1)	specified								
Best effort									
Tagging	no			no			yes		
Frame discard	yes or no			yes or no			yes or no		
QOS classes	see note			see note			see note		
Transit delay	see note			see note			see note		
Peak-to-peak CDV									
CLR (CLP=0)				optional			optional		
CLR (CLP=0+1)	optional								

[1] Multiservice Switch nodes use this combination only when the connection requires the CLR commitment on CLP=0+1 traffic required as opposed to the CLR commitment on CLP=0 traffic, since UNI 3.x and ITU-T Q.2931 do not support these combinations. CLR (CLP=0) maps to CLR (CLP=0+1) in all SVCs and SPVCs (CQC hardware only).

[2] Multiservice Switch nodes do not use the values 4, 6, 7, 11, and 19 for transmission but can process these values from incoming setup messages.

[3] Allowed QOS values are a network option. The network always supports Class 0 for alignment with ITU-T.

[4] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[5] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the NRT-VBR ATM service category. This approach supports backward compatibility with ITU-T recommendations.

[6] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

Allowable parameter combinations in the call setup message: NRT-VBR (UNI 3.1 legacy)

ATM service category	NRT-VBR (UNI 3.1 legacy)								
Conformance	**UNI NRT-VBR,**			**UNI NRT-VBR,**			**UNI NRT-VBR**		
Bearer capability									
Broadband bearer class	C	X		C	X		C	X	VP
ATM transfer capability	absent	absent, 0, 2, 8, or 10		absent	absent, 0, 2, 8, or 10		absent	absent, 0, 2, 8, or 10	absent, 10
TD for a given direction	TD type 4 or 5			TD type 3			TD type 6		
PCR (CLP=0)	specified								
PCR (CLP=0+1)	specified			specified			specified		
SCR, MBS (CLP=0)									
SCR, MBS (CLP=0+1)							specified		
Best effort									
Tagging	yes for TD type 5; no for TD type 4			no			no		
Frame discard	yes or no			yes or no			yes or no		
QOS classes	see note			see note			see note		
Transit delay (note)	see note			see note			see note		
Peak-to-peak CDV									
CLR (CLP=0)	optional			optional			optional		
(1 of 2)									

Allowable parameter combinations in the call setup message: NRT-VBR (UNI 3.1 legacy) (continued)

ATM service category	NRT-VBR (UNI 3.1 legacy)		
Conformance	**UNI NRT-VBR,**	**UNI NRT-VBR,**	**UNI NRT-VBR**
CLR (CLP=0+1)			

[1] Supports backward compatibility with UNI 3.1 and ITU-T recommendations. With these conformance definitions, the CLR commitment applies to the CLP=0 traffic stream only.

[2] Multiservice Switch nodes handle this combination as if the received PCR (CLP=0) parameter is an SCR (CLP=0) parameter where the MBS (CLP=0) parameter has a value of 1.

[3] Multiservice Switch nodes handle this combination as if it receives an additional SCR (CLP=0) with the same value as the received PCR (CLP=0+1) parameter where the MBS (CLP=0) parameter has a value of 1.

[4] VP allows SVPs to use the UNI 3.1 conformance definition.

[5] Multiservice Switch nodes do not use the values 4, 6, 7, 11, and 19 for transmission but can process these values from incoming setup messages.

[6] Allowed QOS values are a network option. The network always supports Class 0 for alignment with ITU-T.

[7] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[8] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the NRT-VBR ATM service category. This approach supports backward compatibility with ITU-T recommendations.

[9] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

(2 of 2)

Allowable parameter combinations in the call setup message for UBR

ATM service category	UBR					
Conformance	**UBR.1**			**UBR.2[3]**		
Bearer capability						
Broadband bearer class	C	X	VP	C	X	VP
ATM transfer capability[1]	absent	absent, 0, 2, 8, or 10	absent, 10	absent	absent, 0, 2, 8, or 10	absent, 10
TD for a given direction	TD type 3 or 9			TD type 3 or 9		
PCR (CLP=0)						
PCR (CLP=0+1)	specified			specified		
SCR, MBS (CLP=0)						
SCR, MBS (CLP=0+1)						

(1 of 2)

Allowable parameter combinations in the call setup message for UBR (continued)

ATM service category	**UBR**	
Conformance	**UBR.1**	**UBR.2**[3]
Best effort	specified[4]	specified[4]
Tagging	no	yes[6]
Frame discard	yes or no	yes or no
QOS classes	0	0
Transit delay[3]		
Peak-to-peak CDV		
CLR (CLP=0)[5]		
CLR (CLP=0+1)[5]		
MDCR	yes for TD type 9; no for TD type 3	yes for TD type 9; no for TD type 3

[1] Multiservice Switch nodes do not use the values 4, 6, 7, 11, and 19 for transmission but can process these values from incoming setup messages.

[2] Multiservice Switch nodes map call setup requests for this conformance. See the table ATM transfer capability mapping for PNNI 1.0 and UNI 4.0 (page 48) for mapping information.

[3] Multiservice Switch nodes specify the maximum end-to-end transit delay objectives for the forward direction only.

[4] The best effort indication applies to both forward and backward directions.

[5] In this table, the CLR parameter has two entries to indicate explicitly if the connection requires the CLR commitment for CLP=0 or CLP=0+1 cells.

[6] UNI 3.1 did not permit tagging for UBR.2.

(2 of 2)

PNNI SPVC and SPVP traffic combinations

Nortel Multiservice Switch nodes signal SPVCs for broadband bearer class X and SPVPs for broadband bearer class VP. In this release, Multiservice Switch nodes cannot generate ABR traffic.

Multiservice Switch nodes also place conditions on the BBC values that are allowed for switched permanent connections. If an SPVC signals a BBC of X, Multiservice Switch nodes route the connection as an SVC. If an SPVP signals a BBC of VP, Multiservice Switch nodes route the connection as an SVP. For other BBC values in these scenarios, Multiservice Switch nodes reject the call with cause code #65, “Bearer capability not implemented”. These routing characteristics occur, for example, when non-Multiservice Switch nodes generate SPVCs and SPVPs that route through the Multiservice Switch network.

The table Combinations of signaled TM parameters for SPVCs and SPVPs under PNNI 1.0 (page 60) summarizes the SPVC and SPVP combinations that you can configure on Multiservice Switch PNNI links.

Combinations of signaled TM parameters for SPVCs and SPVPs under PNNI 1.0

Input															Out-put
ATC	BBC-IE			QOS-IE	TD-IE									TDT	ATM Serv. Cat.
	Bearer Class	Traffic Type	Timing Req	Class	PCR CLP 0	PCR CLP 0+1	SCR CLP 0	SCR CLP 0+1	MBS CLP 0	MBS CLP 0+1	Best Effort	Tagging	MDCR		
5	X	CBR	end-to-end	do not care [2]	yes	yes						Y/N		4,5	CBR
						yes						No		1,2,3	
	VP				yes	yes						Y/N		4,5	
						yes						No		1,2,3	
	X	no indica-tion or VBR	end-to-end	do not care [2]	yes	yes						Y/N		4,5	RT-VBR
1						yes	yes		yes			Y/N		1,2,3	
9						yes		yes		yes		No		7,8	
						yes						No		6	
9	VP	VBR				yes	yes		yes			Y/N		8	
						yes		yes		yes		No		6	
8	X	no indica-tion or VBR	not re-quired	do not care [2]		yes						No		4,5	NRT-VBR
					yes	yes						Y/N		1,2,3	
10						yes	yes		yes			Y/N		7,8	
						yes		yes		yes		No		6	
10	VP	VBR				yes	yes		yes			Y/N		8	
						yes		yes		yes		No		6	

(1 of 2)

Combinations of signaled TM parameters for SPVCs and SPVPs under PNNI 1.0 (continued)

Input															Output
ATC	**BBC-IE**			**QOS-IE**	**TD-IE**									**TDT**	**ATM Serv. Cat.**
	Bearer Class	**Traffic Type**	**Timing Req**	**Class**	**PCR CLP 0**	**PCR CLP 0+1**	**SCR CLP 0**	**SCR CLP 0+1**	**MBS CLP 0**	**MBS CLP 0+1**	**Best Effort**	**Tagging**	**MDCR**		
8	X	no indication or VBR	not required	0		yes					Yes	No		1,2, 3, 9	UBR
10	VP	VBR													

[1] A blank entry in the table indicates that the IE does not specify the parameter. When configuring the ATM transfer capability, set these parameters to not applicable.

[2] Allowing a particular QOS is a network option except for Class 0. PNNI 1.0 on Multiservice Switch nodes always supports Class 0.

(2 of 2)

Route management for UNI, IISP, and AINI

Nortel Multiservice Switch nodes permit specific combinations of parameters for bearer capabilities, traffic parameters, and the ATM service category.

While these combinations govern the parameters that work together for effective traffic management, there are also Multiservice Switch-specific rules. These Multiservice Switch-specific rules determine the ranges of actual values that you can configure for these parameters.

Navigation

See the following specifications for details on traffic management standards.

- *ATM Inter-Network Interface (AINI) Specification Version 1.0,* (af-cs-0125.000), ATM Forum Technical Committee, 1999
- *Interim Inter-switch Signaling Protocol (IISP) Specification Version 1.0,* (af-pnni-0026.000), ATM Forum Technical Committee, 1994
- *User-to-Network Interface Specification Version 3.0* (af-uni-0010.001)
- *User-to-Network Interface Specification Version 3.1* (af-uni-0010.002)

- *User-Network Interface Signalling Specification Version 4.0* (af-sig-0061.000)
- *Traffic Management Specification Version 4.0* (af-tm-0056.000)

Information element processing

Through the call setup request, the networking protocol conveys the traffic characteristics of a switched connection through three mandatory information elements (IE).

- broadband bearer capability information element (BBC-IE)
- quality of service information element (QOS-IE)
- traffic descriptor information element (TD-IE)

The ATM Forum specifications *User-to-Network Interface Specification Version 3.0* (af-uni-0010.001), *User-to-Network Interface Specification Version 3.1* (af-uni-0010.002), and *User-Network Interface Signalling Specification Version 4.0* (af-sig-0061.000) define the subset of allowed combinations of these mandatory IEs. Any signaled combination that is not allowed according to UNI specifications listed above results in call rejection. An illegal combination of parameters clears the call with cause code #63, “service or option not available, unspecified”.

A node rejects a call because of traffic-related IE processing for these reasons:

- missing mandatory IE
- invalid IE combination (for example, tagging requested when only PCR01 is specified)
- invalid IE content (for example, PCR01 < PCR0)
- TD-IE parameters outside the usage parameter control (UPC) hardware range

Mapping of TD-IEs to attributes at the receive port

At the port where the node receives the call setup request (the receive port), a Nortel Multiservice Switch node maps the backward traffic descriptor values in the signaled TD-IE to the transmit traffic descriptor parameters and transmit traffic descriptor type. The interpretation of the values that the node signals in the backward parameters is independent of the UPC state.

Attention: When processing traffic parameters in a call setup request, the traffic descriptor type will be converted internally from 1, 2, or 3 to 9 if the derived service category is UBR and there is a configured minimum cell rate for the UBR service category under the interface. An MDCR IE will be added to the Setup message using the minimum cell rate as the MDCR value for both forward and backward directions. This only applies to call setups received at a UNI4.0 interface.

The table Derived traffic descriptor type from the TD-IE and MDCR IE (when UPC is disabled) (page 64) summarizes this interpretation.

Derived traffic descriptor type from the TD-IE and MDCR IE (when UPC is disabled)

Input								Output
PCR clp 0	**PCR clp 0+1**	**SCR clp 0**	**SCR clp 0+1**	**MBS clp 0**	**MBS clp 0+1**	**Tagging**	**MDCR clp 0+1**	**Traffic Descriptor Type**
0	0					do not care	0	1
	0						0	1
	0	0		0		do not care	0	1
	0		0		0		0	1
0	>0					do not care	0	3
	>0						0	3
>0	>0						0	4
>0	>0					Yes	0	5
	>0		>0		>0		0	6
	>0	>0		>0			0	7
	>0	>0		>0		yes	0	8
	>0						0	9

A blank entry in the table indicates that the IE does not specify the parameter. When configuring the ATM transfer capability, set these parameters to not applicable.

If present, PCR 0 must be less than or equal to PCR 0+1. If present, SCR must be less than or equal to PCR 0+1. If values do not meet these conditions, the node rejects the call with cause code 100.

MDCR is not part of the TD IE. The MDCR value is derived from the MDCR IE. It is only applicable to UBR traffic.

The forward traffic descriptor parameters in the signaled TD-IE map to the receive traffic descriptor parameters and receive traffic descriptor type. In this case, the interpretation of the forward traffic parameters depends on the state of UPC. If the UPC is disabled, use the table Derived traffic descriptor type from the TD-IE and MDCR IE (when UPC is disabled) (page 64) to interpret the forward traffic descriptor parameters and values.

If UPC is enabled, use the table Derived traffic descriptor type from TD-IE and MDCR IE (when UPC is enabled) (page 65).

Derived traffic descriptor type from TD-IE and MDCR IE (when UPC is enabled)

Input								**Output**
PCR clp 0	**PCR clp 0+1**	**SCR clp 0**	**SCR clp 0+1**	**MBS clp 0**	**MBS clp 0+1**	**Tagging**	**MDCR clp 0+1**	**TD Type**
	0[3]							3
	>0[3]							3
	0[3]	0		0		do not care		3
	0[3]		0		0			3
0[3]	0[3]							4
0[3]	>0[3]							4
>0[3]	>0[3]							4
0[3]	0[3]					yes		5
0[3]	>0[3]					yes		5
>0[3]	>0[3]					yes		5
	>0[3]		>0[3]		>0			6
	>0[3]	>0[3]		>0				7
	>0[3]	>0[3]		>0		yes		8
(1 of 2)								

Derived traffic descriptor type from TD-IE and MDCR IE (when UPC is enabled) (continued)

Input								Output
PCR clp 0	**PCR clp 0+1**	**SCR clp 0**	**SCR clp 0+1**	**MBS clp 0**	**MBS clp 0+1**	**Tagging**	**MDCR clp 0+1**	**TD Type**
>0							0	9

A blank entry in the table indicates that the IE does not specify the parameter. When configuring the ATM transfer capability, set these parameters to not applicable.

If present, PCR 0 must be less than or equal to PCR 0+1. If present, SCR must be less than or equal to PCR 0+1. If values do not meet these conditions, the node rejects the call with cause code 100.

When PCR and SCR are less than 3, the Multiservice Switch node sets these values to 3 cells/s. This treatment ensures that values are within UPC hardware range and that the node transfers a maximum of 3 cells/s in the forward direction. The operational attributes for the VCD store the overridden values. This overriding action does not affect the signaled TD-IE parameters.

MDCR is not part of the TD IE. The MDCR value is derived from the MDCR IE. It is only applicable to UBR traffic.

(2 of 2)

Mapping of TD-IEs to attributes at the transmit port

At the port where the call setup exits the node (the transmit port), Nortel Multiservice Switch nodes map the traffic descriptor information elements (TD-IE) in a way that is similar to the mapping at the receive port. The difference is that the forward fields in the IEs map to the transmit attributes, and the backward fields in the IEs map to the receive attributes on Multiservice Switch nodes. The mapping of the following IEs are included:

- BBC-IE
- TD-IE
- QOS-IE

QOS class for UNI, IISP, and AINI

Nortel Multiservice Switch nodes accept the standard QOS classes specified in UNI 3.1.

- 0: Unspecified QOS Class
- 1: QOS Class 1
- 2: QOS Class 2
- 3: QOS Class 3
- 4: QOS Class 4

Because a Multiservice Switch node uses ATM service categories instead of QOS classes, it verifies QOS classes only to ensure compliance with UNI signaling standards.

The QOS on Multiservice Switch nodes comply to ATM standards. Therefore, the node verifies the following restrictions to SPVCs, SVCs, and SPVPs:

- for UBR connections, the QOS class must be set to class 0 in both directions
- for UNI 3.1 and UNI 4.0 signaling, if QOS class 0 is selected in one direction, it must also be selected in the other direction

Configure SPVCs and SPVPs with these restrictions in mind. PVCs and PVPs do not use signaling and therefore are not affected by QOS classes.

ATM service category

On Nortel Multiservice Switch nodes, the ATM service category is either directly configured or derived from the TD-IEs.

- For PVCs and PVPs, the ATM service category is always directly configured.
- For SVCs, the ATM service category is always derived from the signaled TD-IEs.

  The permitted ATM service categories under the connection administrator let the operator allow or disallow SVCs of a given service category on a given interface. At the same time, the attribute maintains control over the admission of permanent connections.
- For SPVCs and SPVPs, the ATM service category is either
  - — directly configured
  - — derived from the configured TD-IEs (for more flexibility)

TD-IE parameters derived from ATM service category

When you directly configure the service category for an SPVC or SPVP, the node derives the BBC-IE parameters and the TD-IE best-effort parameter. See the table TD-IE parameters derived from ATM service category (page 68).

Nortel Multiservice Switch nodes do not implicitly derive the QOS class parameter, therefore you must configure this parameter.

TD-IE parameters derived from ATM service category

Input	Output			
ATM service category	**BBC-IE**			**TD-IE**
	Bearer class	**Traffic type**	**Timing required**	**Best effort**
CBR	X	see [1]		
	VP	CBR	end-to-end	
RT-VBR	X	VBR	end-to-end	
	VP	VBR	end-to-end	
NRT-VBR	X			
	VP	VBR	not required	
UBR	X			yes
	VP	VBR	not required	yes

[1] A blank entry in the table indicates that the IE does not specify the parameter. When configuring the ATM transfer capability, set these parameters to not applicable.

[2] The RT-VBR combination of traffic parameters is invalid according to the UNI 3.x specifications. It is supported as an enhancement for Nortel Networks ATM switches.

ATM service category derived from TD-IEs

The table ATM service category derived from TD-IEs (page 69) shows how Nortel Multiservice Switch nodes derive the ATM service category from the TD-IEs. Nortel Multiservice Switch nodes derive the CBR and RT-VBR service categories from the value of BBC-IE parameters.

The NRT-VBR and UBR service categories share the same BBC-IE values, but the network distinguishes them through the value of the best-effort field in the TD-IE. The node ignores the QOS-IE except to check for valid combinations.

ATM service category derived from TD-IEs

Input					**Output**
BBC-IE			**TD-IE**	**QOS-IE**	**ATM service category**
Bearer class	**Traffic type**	**Timing required**	**Best effort**	**Class**	
A				do not care	CBR
X	CBR	end-to-end			
VP					
X	not CBR [2]	end-to-end		do not care	RT-VBR [3]
VP	VBR				
C				do not care	NRT-VBR
X	not CBR [2]	not required [4]			
VP	VBR				
C			Yes	0	UBR
X	not CBR [2]	not required [4]			
VP	VBR				

[1] A blank entry in the table indicates that the IE does not specify the parameter. When configuring ATM transfer capability and best effort, set these parameters to not applicable.

[2] When the Traffic Type column has an entry of not CBR, the BBC-IE traffic type parameter is either not provided or, if provided, is set to no indication or variable bit rate (that is, it is not set to constant bit rate).

[3] The RT-VBR combination of traffic parameters is invalid according to the UNI 3.x specifications. It is supported as an enhancement for Nortel Networks enterprise network products.

[4] When the Timing Required column has an entry of not required, the BBC-IE timing requirements parameter is either not provided or, if provided, is set to no indication or end-to-end timing not required (that is, it is not set to end-to-end timing required).

The way in which the ATM service category is derived implies that:

- Multiservice Switch, Vector, and Concorde interwork properly. However, they cannot interwork properly with other UNI equipment.
- The Multiservice Switch node implicitly derives only three service categories from valid combinations of the BBC-IE for CBR, VBR, and UBR. Differentiation between RT-VBR and NRT-VBR is not possible without the use of non-standard combinations of traffic parameters.
- Since signaling does not specify the BBC-IE for each direction of the connection (forward and backward), both directions of a given connection

must have the same service category (Multiservice Switch nodes implicitly derive only one service category for a given ATM connection).

ATM transfer capability

Nortel Multiservice Switch nodes consolidate the BBC-IE traffic type and timing requirements the transfer capability BBC. The table ATM TC mapping for UNI 3.x and IISP 1.0 (page 70) shows the mapping between the ATM transfer capability and the BBC-IE traffic type and timing requirements fields for switched connections under UNI 3.x and IISP 1.0.

ATM TC mapping for UNI 3.x and IISP 1.0

Input	Output		Applies to		
ATM TC	**Traffic type**	**Timing requirements**	**SPVC**	**SPVP**	**SVC**
0	no indication	no indication	yes	no	yes
1	no indication	end-to-end timing required	yes	no	yes
2	no indication	end-to-end timing not required	yes	no	yes
3	no indication	not supported	yes	no	yes
4	no indication	not supported	yes	no	yes
5	CBR	end-to-end timing required	yes	yes	yes
6	not supported	not supported	yes	no	yes
7	not supported	not supported	yes	no	yes
8	VBR	no indication	yes	no	yes
9	VBR	end-to-end timing required	yes	yes	yes
10	VBR	end-to-end timing not required	yes	yes	yes

Processing for signaled TD-IEs

In compliance with the ATM Forum *User-to-Network Interface Specification Version 3.1*, Nortel Multiservice Switch nodes support a subset of the traffic management parameter combinations (BBC-IE, TD-IE and QOS-IE). However, the specification does not include the RT-VBR service category that Multiservice Switch nodes also support.

The table Supported bearer classes by connection and interface types (page 71) shows the bearer classes that the Multiservice Switch network permits for connection types and interfaces under UNI 4.0, IISP 1.0, AINI, and PNNI 1.0.

Supported bearer classes by connection and interface types

Connection type	Interface type	Supported bearer classes
SPVC, SPVP	UNI 4.0, IISP 1.0	A, C, X, VP
SPVC, SPVP	PNNI 1.0, AINI	X, VP
SVC	UNI 4.0, IISP 1.0, PNNI 1.0, AINI	A, C, X

The table Combinations of signaled traffic management parameters for UNI/IISP/AINI (page 71) specifies the detailed traffic parameter combinations that Multiservice Switch nodes support. For each combination, the table also specifies the corresponding service category. When a Multiservice Switch node receives a call setup request, it allows only the specified traffic management parameter combinations. The node rejects the call if it does not support the signaled combination.

Combinations of signaled traffic management parameters for UNI/IISP/AINI

Input												Out-put
BBC-IE			QOS -IE	TD-IE								ATM Serv. Cat.
Bear -er Class	Traf-fic Type	Tim-ing Req	Class	PCR CLP 0	PCR CLP 0+1	SCR CLP 0	SCR CLP 0+1	MBS CLP 0	MBS CLP 0+1	Best Effort	Tagging	
A			do not care	yes	yes						Yes/No	CBR
					yes						No	
X	CBR	end-to-end		yes	yes						Yes/No	
					yes						No	
VP	CBR			yes	yes						Yes/No	
					yes						No	
X	not CBR	end-to-end	do not care	yes	yes						Yes/No	RT-VBR
					yes						No	
					yes	yes		yes			Yes/No	
					yes		yes		yes		No	
VP	VBR				yes	yes		yes			Yes/No	
					yes		yes		yes		No	

(1 of 2)

Combinations of signaled traffic management parameters for UNI/IISP/AINI (continued)

Input												Out-put
BBC-IE			**QOS -IE**	**TD-IE**								**ATM Serv. Cat.**
Bear -er Clas s	**Traf- fic Type**	**Tim- ing Req**	**Clas s**	**PCR CLP 0**	**PCR CLP 0+1**	**SCR CLP 0**	**SCR CLP 0+1**	**MBS CLP 0**	**MBS CLP 0+1**	**Best Effort**	**Tagging**	
C			do not care	yes	yes						yes/no	NRT-VBR
					yes						no	
					yes	yes		yes			yes/no	
					yes		yes		yes		no	
X	not CBR	not re- quire d		yes	yes						yes/no	
					yes						no	
					yes	yes		yes			yes/no	
					yes		yes		yes		no	
VP	VBR				yes	yes		yes			yes/no	
					yes		yes		yes		no	
C			0		yes					yes	no	UBR
X	not CBR	not re- quire d			yes					yes	no	
VP	VBR				yes					yes	no	

[1] A blank entry in the table indicates that the IE does not specify the parameter. When configuring the ATM transfer capability, set these parameters to not applicable.

[2] When the Traffic Type column has an entry of not CBR, the BBC-IE traffic type parameter is either not provided or, if provided, is set to no indication or variable bit rate (that is, it is not set to constant bit rate).

[3] The RT-VBR combination of traffic parameters is invalid according to the UNI 3.x specifications.

[4] When the Timing Required column has an entry of not required, the BBC-IE timing requirements parameter is either not provided or, if provided, is set to no indication or end-to-end timing not required (that is, it is not set to end-to-end timing required).

(2 of 2)

Traffic characteristics of UNI, IISP, and AINI control channels over physical links

The UNI functionality relies on two VCCs between any given pair of neighboring nodes. The IISP interface and AINI rely on the following signaling and ILMI channels because ILMI is not supported:

- the signaling channel, at VPI.VCI=0.5 (default VCI)
- the integrated local management interface (ILMI) channel, at VPI.VCI=0.16 (default VCI)

This section defines the traffic characteristics of each of these channels according to the relevant ATM Forum standards.

Signaling VCC traffic characteristics

The UNI, IISP, and AINI signaling protocols are sensitive to delay and message loss. The ATM Forum specifications assume that these parameters are compatible with the traffic contract for the signaling channel.

The table Default signaling VCC traffic characteristics: UNI, IISP, and AINI (page 73) summarizes the traffic contract.

Default signaling VCC traffic characteristics: UNI, IISP, and AINI

Attribute	Default Value
ATM service category	RT-VBR
QOS class	2
traffic descriptor type (TDT)	6
PCR (CLP=0+1)	250 cells/sec
SCR (CLP=0+1)	160 cells/sec
MBS (CLP=0+1)	5 cells
frame discard	PPD and EPD on
traffic shaping	disabled on all channels
traffic policing	disabled on all channels

These traffic parameters are the default values. You can change these values by configuring the VCD under UNI, IISP, and AINI signaling. When you enable traffic shaping for the signaling channel, ensure that the channel has sufficient bandwidth by raising the value for PCR.

ILMI channel traffic characteristics

The UNI standard indicates that the ILMI channel between two nodes through a physical link must have a specific traffic contract. The table Default ILMI channel traffic characteristics (page 74) summarizes this contract.

Default ILMI channel traffic characteristics

Attribute	Value
ATM service category	RT-VBR
QOS class	2
TDT	6
PCR (CLP=0+1)	180 cells/sec
SCR (CLP=0)	36 cells/sec
MBS (CLP=0)	5 cells
frame discard	allowed or requested
traffic shaping	disabled on all channels
traffic policing	disabled on all channels

You cannot change these traffic parameters through configuring.

Summary of TM configuration settings

In general, you configure traffic management controls and mechanisms for the service category. All connections under the service category then assume that configuration by default. In many instances, you can reconfigure connections to override the default setting at the service category level.

The table Summary of control and mechanism settings (page 75) summarizes the configurations available for the service category and connection levels.

Summary of control and mechanism settings

Control or mechanism	Service category level		Connection level (override)	
	ATM IP	**CQC**	**ATM IP**	**CQC**
transmit queue limit	auto-configure explicit values		same as service category explicit values	same as service category
unshaped transmit queuing	per-VC common auto-configure		no options	same as service category common
weight policy	explicit values		explicit values	ignored
forced tagging	enable disable		same as service category enable disable	no options
packet-wise discard mechanisms	software controlled - no options			
traffic shaping	enable disable inverse UPC	enable disable	disable same as connection administrator	

(1 of 2)

Summary of control and mechanism settings (continued)

Control or mechanism	Service category level		Connection level (override)	
	ATM IP	**CQC**	**ATM IP**	**CQC**
shaped recoup policy	explicit values		software controlled - no options	ignored
UPC	enforce disable monitor (see Note)	enforce disable	enforce disable monitor (see Note) same as connection administrator	enforce disable same as connection administrator
For information on monitoring, see NN10600-715 *Nortel Multiservice Switch 7400/15000/20000 ATM Fault and Performance Management*.				
(2 of 2)				

Weighted fair queuing and weighted round-robin

Both weighted fair queuing (WFQ) and weighted round-robin (WRR) offer the advantages of weighted fairness and segregation between connections. However, WFQ provides advantages in fairness in serving a connection and cell spacing.

This section provides a discussion of the differences between WFQ and WRR.

Weighted round-robin

Using the WRR algorithm, the scheduler serves each connection in a continuous round-robin cycle. When the scheduler serves a connection, it selects a number of cells that is equal to the connection weight and sends those cells to the link in consecutive order. This approach has two disadvantages:

- the round-robin cycle may cause delays in serving a connection
- increased likelihood of cell clumping

The time at which the scheduler serves a connection depends on the relative position of the connection in the current round-robin cycle. The length of time that cells have been waiting does not affect the scheduler. That is, the WRR algorithm is sequential and can be unfair with respect to cell arrival time. For example, one connection can be served just as a cell arrives. Another connection can wait for a long time before being served and cells arrive during the waiting period. If its relative position in the round-robin cycle is last, the connection must wait until the scheduler serves all other connections). The maximum waiting time for service equals the summation of the weights of all active connections. For a configuration in which there is a large number of connections, the waiting time can be quite lengthy.

WRR incurs an increased likelihood of cell clumping, which causes problems if the connection carries real-time services. For example, when the scheduler serves a connection, a potentially large number of cells (up to the connection weight) are scheduled for service back-to-back. There is no spacing between cells or interleaving with cells from other connections.

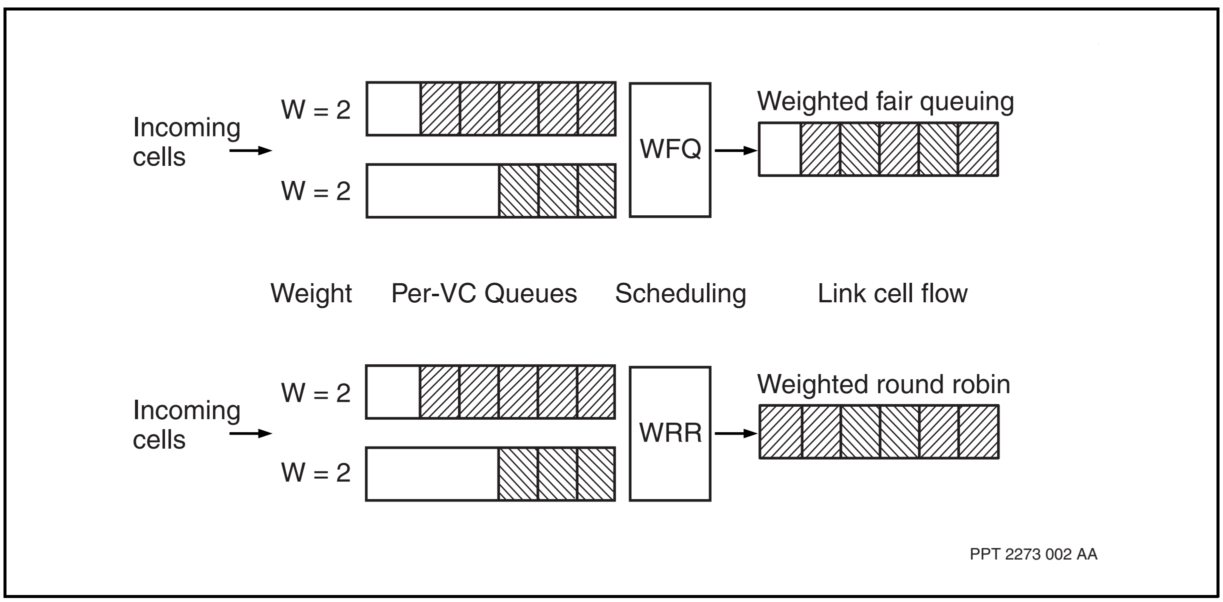
Weighted fair queuing

WFQ resolves these disadvantages in the WRR approach. Cell queuing is based on scheduled departure time, where departure time is a function of cell arrival time and connection weight. For example, when all connections have equal weight, the scheduler selects and interleaves cells from all connections based on cell arrival time. In this case, the position of each connection does not affect the scheduler.

The same principle applies for connections with different weights, except that the higher-weight connections are served more frequently. In both cases, the scheduler achieves enhanced fairness and less cell clumping in a predictable manner.

The figure Weighted fair queuing versus weighted round robin (page 78) illustrates the differences between WFQ and WRR.

Weighted fair queuing versus weighted round robin



ATM traffic management applications

This section provides some application notes on using traffic management in specific configurations. By definition, these notes are not all encompassing, since only specific applications that may not have obvious solutions are presented. Also, the information presented here tends to cross the boundaries of specific traffic management controls as presented in the Nortel Multiservice Switch ATM documentation. These applications are intended as illustrations that show how traffic management can be adapted to various Multiservice Switch network configurations.

Navigation

CBR and UBR PVCs with TDT6

Permanent virtual connections (PVC) that support traffic for the CBR or UBR service categories can be configured for traffic descriptor type 6 (TDT6). While this configuration is not permitted for soft permanent virtual connections (SPVC), it is possible for PVCs for reasons of backward compatibility with connections configured under earlier software releases.

When configuring CBR and UBR PVCs for TDT6, you must take into consideration the shaping applied to the connection and the connection admission control (CAC) requirements. The following sections summarize traffic management considerations for CBR and UBR PVCs.

Guidelines for CBR PVCs

For CBR PVCs, use the following guidelines when the connection is configured for TDT6.

- if the CBR PVC is not shaped:
  - — use PCR+CDVT for CAC
  - — if UPC is enabled, enforce at PCR+CDVT
- if the CBR PVC is linear shaped:
  - — use shaping rate for CAC
  - — use PCR for shaping rate

  - if UPC is enabled, enforce at PCR+SCR+MBS
- if the CBR PVC is inverse UPC shaped:
  - use MIN (PCR, shaping rate) for CAC
  - use PCR, SCR, and MBS for inverse UPC shaping
  - if UPC is enabled, enforce at PCR+SCR+MBS

Guidelines for UBR PVCs

For UBR PVCs, use the following guidelines when the connection is configured for TDT6. For all shaping modes, CAC for UBR PVCs is always based on counting the number of UBR connections (not based on PCR).

- if the UBR PVC is not shaped:
  - use a WFQ weight of 1
  - if UPC is enabled, enforce at PCR+SCR+MBS
- if the UBR PVC is linear shaped
  - use PCR for shaping rate
  - if UPC is enabled, enforce at PCR+SCR+MBS
- if the UBR PVC is inverse UPC shaped
  - use PCR, SCR, MBS for inverse UPC shaping
  - if UPC is enabled, enforce at PCR+SCR+MBS

Attention: When using UBR with MDCR on a PVC when the UPC is enforced, parameter 3 is no longer MBS. In this case, parameter 3 is MDCR. No shaping occurs at this point.

Nortel Multiservice Switch 7400/15000/20000

ATM Traffic Management Fundamentals

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