Teldat Router

ATM

Doc. *DM740-I* Rev. *10.10*
June, 2003

INDEX

Chapter 1
The ATM protocol

1. Introduction

This chapter describes the ATM protocol and software and consists of the following sections:

- General overview of the ATM protocol.
- Transmitting frames through the ATM network.
- ATM service categories.

2. General Overview of ATM protocol

The *ATM* protocol has arisen to become the base technology for the new generation of communication systems; *ATM* possesses the capability of meeting the demands for real time communication for the emerging multimedia applications and also to meet the increasing demands for a wider bandwidth for the current installations.
The current bottleneck in communications is no longer the physical medium but the processing speed of the network nodes which require quick and simple protocols. *ATM* has emerged in response to this need and has evolved from the *Frame Relay* protocol (*ATM* is also known on occasions as *Cell Relay*).

	Circuit switching	Message switching	Packet switching
P R O S	- Fixed delay - Sequence is not lost	- Fixed Overhead	- As the packet size is fixed, the switches can be simplified - Reduces end-to-end delay
C O N S	- Preset bandwidth	- Variable delay - As the message size is variable, the switches need to be more complex	- Require reassembling - Variable Overhead Datagram: - each packet through a path - sequencing is required Virtual Circuit: - requires establishing - Does not require sequencing

Table 1 Transfer modes

ATM can be viewed as a transfer mode for virtual circuit packet switching with the following characteristics:

- The packet has a fixed size of 53 bytes (5 making up the header and 48 dedicated to the payload) known as a cell.
- Transfer is carried out in asynchronous mode i.e. at irregular intervals.

These characteristics produce the following:

- Enormous flexibility when assigning bandwidth (in order to achieve the widest bandwidth for a communication, greater number of cells per time unit).
- Maximum use of the bandwidth (as this is asynchronous, if the resources are not used by one communication, they can be used by another).
- Quality of Service (QoS is the subjective view that the user has of the service offered i.e. the combined effect of the service performance determining the degree of satisfaction): based on **statistics multiplexing** this permits responding to a petition for a wider bandwidth than is actually available (provided that the traffic has a certain discontinuity – bursty traffic).

2.1. Reference Model

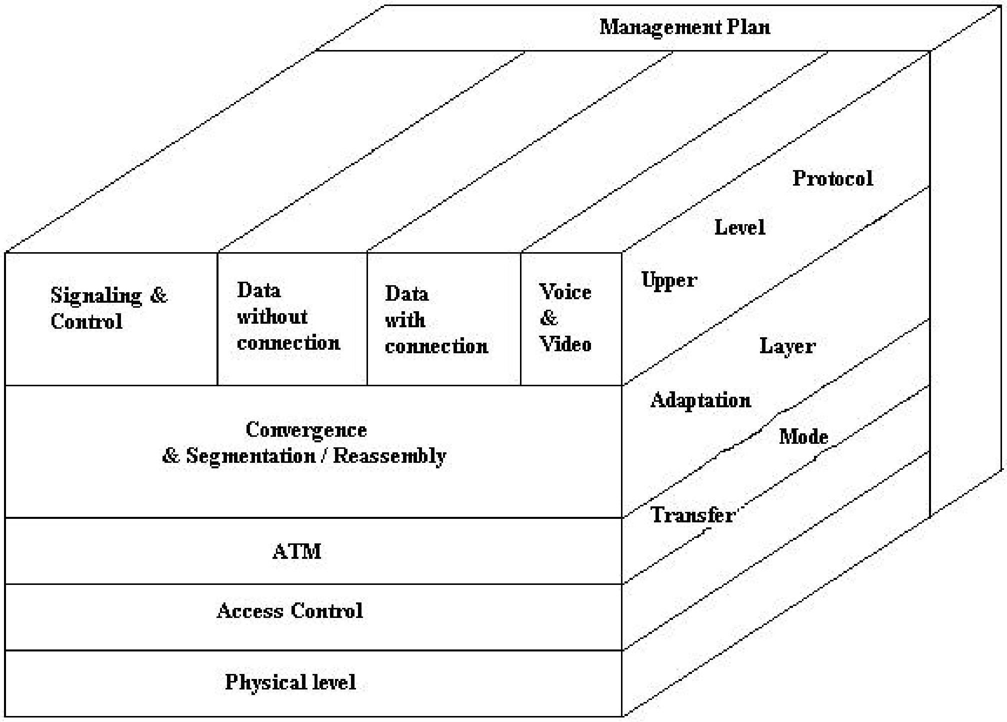


Figure 1 ATM reference model

2.2. Physical Layer

This is responsible for relaying the cells between two entities guaranteeing, to a certain degree, the header integrity. It is also responsible for the specific functions at the physical layer (connectors, electric layers etc.).

This is subdivided into two parts:

- Physical media dependent or PMD (timer at a bit layer and line codification).
- Transmission convergence or TC (generation and verification of the HEC, cell and frame synchronization and insertion / extraction of idle cells to guarantee continuous bits stream in the physical media).

The international organizations have proposed diverse physical layers, grouped as:

- Pure ATM, where there is a continuous cell stream between the ATM layer and the physical layer (DS3, 155/100Mbps multimode fiber, etc.).
- SDH (Synchronous digital hierarchy), the cells are embedded in SDH frames (e.g. SONET STS-3).

2.3. ATM Layer

This is independent to the physical layer and common to all higher layer services; this manages cell multiplexation and routing through the VPI/VCI and handles cell sequencing.

This does not execute any retransmission task for lost or erroneous cells. This task falls to the higher layers.

Given that the service is orientated to an inherent ATM connection, the end-to-end connections must be established before initializing the cell stream between both entities.

The ATM layer has a management layer associated to it whose information unit is made up of **OAM cells** grouped in streams; this provides fault management (alarms, connection verification, detection of cells with incorrect VPI/VCI) and traffic monitoring (guaranteeing proficient use of the resources and protecting them from abuse from a connection).

a) ATM Cell

An ATM cell is made up of a header and a payload, both fixed-size. Table 2 shows the ATM cell format.

Octet	8	7	6	5	4	3	2	1
1	GFC				VPI			
2	VPI				VCI			
3	VCI							
4	VCI				PTI			CLP
5	HEC							

Cell header

Octet	8	7	6	5	4	3	2	1
6	Data							
7	Data							
52	Data							
53	Data							

Data

Table 2. ATM cell format

· GFC (Generic Flow Control)

This is used for flow control between the user and network; therefore this is only implemented in the UNI [(1)].

· VPI (Virtual Path Identifier)

This is an 8 bits identifier (or 12 bits if it is not UNI). Together with the VCI, this provides routing information. This only has local significance, it has no end-to-end value.

The ITU defines a "**virtual path**" as **unidirectional** transport of cells between two nodes pertaining to "**virtual channels**" associated to the same VPI.

There is a predefined route associated to each VPI in the physical network and each "virtual path" has a determined bandwidth available divided between its different "virtual channels".

[(1)] User Network Interface

Various interfaces are defined in ATM: UNI, NNI, PNNI, … whose characteristics vary according to their different locations and functions within the ATM network; the UNI is the interface specification for the ATM network in terminal or user devices.

· *VCI (Virtual Channel Identifier)*

The ITU defines a "**virtual channel**" as the unidirectional transport of cells between two nodes associated to a common VCI; i.e. each VCI identifies a distinct connection between two ends.
This only has local significance but no end-to-end value.

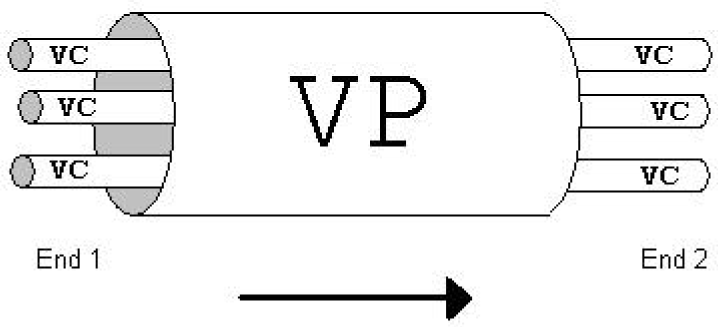


Figure 2. Grouping of VCs in a VP

Type	VPI	VCI
Inactive	0	0
Invalid	>0	0
Reserved	Any	1 to 31
User	Any	>31

Table 3. VPI/VCI en el UNI

The real number of VPI and VCI bits used for routing is negotiated between the user device and the network. However these are always, within the VPI and the VCI, the least significant contiguous bits.

· *PTI (Payload Type Indicator)*

This field indicates the type of information transported by the cell.

Codification	Cell content
000	User data The cell has not experienced congestion Without user-user indication
001	User data The cell has not experienced congestion With user-user indication
010	User data The cell has experienced congestion Without user-user indication

011	User data The cell has experienced congestion With user-user indication
100	OAM F5 Cell segment [1]
101	OAM F5 Cell end-to-end [1]
110	Resource Management Cell
111	Reserved

Table 4. Meaning of the PTI field

[1] The OAM flows (**Operation And Maintenance**) consist of a special type of information used to detect errors in the ATM network, monitoring etc.

· *CLP (Cell Loss Priority)*

This bit indicates whether the nodes processing the cell can discard the cell when the congestion conditions require this (the nodes must discard marked cells before unmarked cells).

· *HEC (Header Error Control)*

This byte represents a cell header CRC-8 (x^8+x^2+x+1) and has two important functions:

- detection of erroneous cells (permits bit error correction and reduces the possibility of accepting erroneous cells i.e. it is a powerful tool for detecting errors).
- simplifies cell synchronization in the receptors or "cell delineation" (this can be made available by applying the so called "**coset rules**". This consists of adding an eight bit format ("0101 0101" is recommended) to the calculated test bits). We need to bear in mind that ATM is characterized by a **continuous** cell stream be they data or idle cells in such a way that there is always activity on the line.

To increase the robustness of the system, there is an option of randomizing the cell thus avoiding excessively long 0 or 1 sequences.

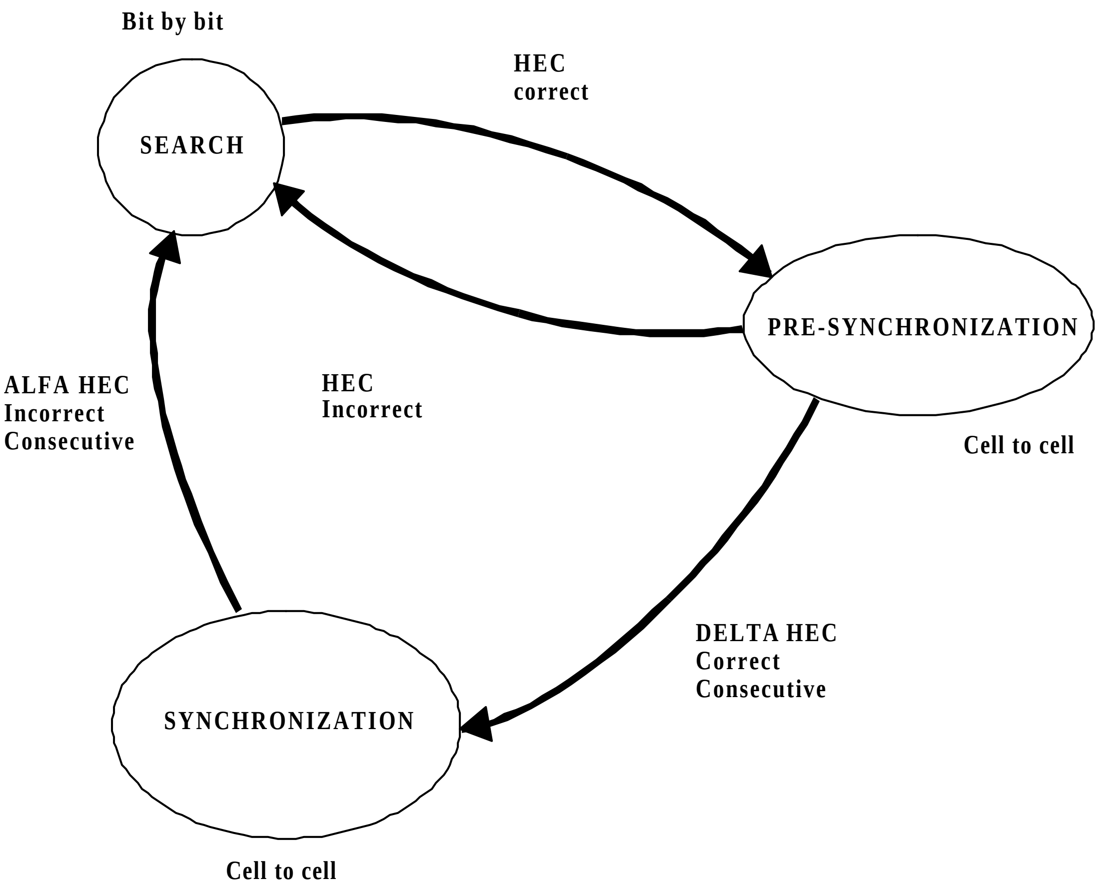


Figure 3. Cell synchronization process complying with the ITU-T 1.432 recommendation

· *Data*

This field is made up of 48 octets and does not have, at the cell layer, any type of error protection /detection. (The current transmission methods offer very low error rates therefore permitting you to save information for detection / correction of errors and avoid the confirmation between intermediate nodes making the protocols more agile and less redundant).
In the specific case of an OAM cell, the payload portion has the following structure:

Octet	8	7	6	5	4	3	2	1
6	OAM Type				Function			
7	Depends on the function							
52	Reserved						CRC-10	
53	CRC-10							

Table 5. OAM cell format

2.4. Adaptation Layer (AAL)

The ATM layer does not provide nor manage any type of information relating to the service clock frequency, nor detects cells incorrectly inserted (cells, which did not originally pertain to a connection, become part of the cell stream for this), nor lost cells or what information is being transported etc. It does not do this simply because not all the services require this information; we need to remember that the ATM layer is a **layer common** to all possible services. Therefore the operations required by the different types of services are grouped in small groups of classes that provide the source for the distinct **ATM Adaptation Layers** (or **AAL**) which in turn provide the services demanded by each type. Four basic service classes are defined (ITU and ATM Forum define distinct classes that have few differences):

	Class A	Class B	Class C	Class D
Connection orientated	Yes	Yes	Yes	No
Bounded delay	Yes	Yes	No	No
Binary rate	Constant	Variable	Variable	Variable
AAL	1	2	3	4 and 5
Example	Voice and video	Compressed Video	Transfer of data with connection	LAN to LAN over WAN

Table 6. Service classes

The adaptation layers most commonly used are AAL 5 and AAL 2.
The adaptation layers are in turn subdivided into a series of layers:

- **SAR** or **Segmentation And Reassembly** sublayer

  This handles information fragmentation provided by the higher layer in segments of 48 octets (cell payload) and reassembly of the 48 octet segments provided by the ATM layer in a unit that can be understood by the higher layer.

- **CS** or **Convergence Sublayer**
  - Common part (**CPCS** or **Common Part Convergence Sublayer**)
  - Specific part for the service (**SSCS** or **Service Specific Convergence Sublayer**)

    The SSCS in turn can subdivide into new layers.

<table>
<tr><td colspan="3">Layer 3 Protocol</td></tr>
<tr><td rowspan="3">ATM Adaptation Layer</td><td rowspan="2">Convergence Sublayer</td><td>SSCS</td></tr>
<tr><td>CPCS</td></tr>
<tr><td colspan="2">SAR</td></tr>
<tr><td colspan="3">ATM Layer</td></tr>
</table>

Table 7. AAL structure

a) AAL5

· CPCS

The CPCS AAL5 provides the higher layer data transport (in units known as **CPCS-SDU** or Service Data Unit, which are encapsulated in **CPCS-PDU** or Protocol Data Unit) from one CPSC entity to another. If AAL5 operates in a **non-assured** mode (a secure mode should be provided by the SSCS or higher layers), this can establish a CPCS entity communication to more than one remote entity through the ATM network (i.e. a point-multipoint ATM layer connection is required).
Two service modes are defined:

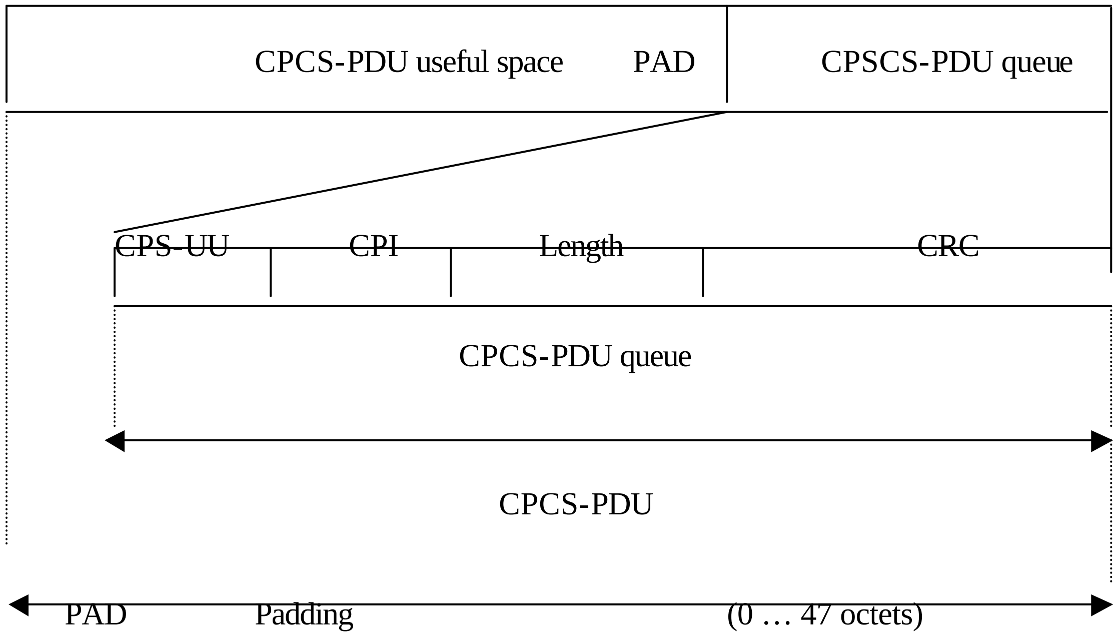
- **message**: The layer above CPCS must provide a complete CPCS-SDU before the CPCS initiates transmission, and in a similar way in the opposite direction.
- **stream**: The higher level can provide the CPCS with CPCS-SDU fragments for transmission and must indicate which is the last fragment. This occurs in the same way in reverse, CPCS / higher layer. The functionality includes the possibility to "**abort**" (ABORT service) transmission or reception of a partially processed CPCS-SDU. This service mode has not been completely defined by the ITU.

Non-assured service for both modes implicate:

- A CPCS-SDU can be: delivered without errors, delivered with errors or lost.
- Lost or incorrect CPCS-SDU are not retransmitted. There also exists the possibility that a portion of the CPCS-SDU received with errors is delivered to the higher layer (**Corrupted data delivery option**).

The CPCS service has the following characteristics:

- Variable CPCS-SDU size from 1 to 65535 octets.
- Correct delimitation and sequencing of the CPCS-SDU within a connection.
- Optional detection of errors and notification.
  - error in the CPCS-SDU field size includes reception buffer overflow.
  - CPCS-SDU encapsulated in a CPCS-PDU with incorrect format.
  - error in the CPCS-SDU CRC.
- inclusion of a pad field in order to guarantee the total length for the CPCS-PDU in multiples of 48 (the CPCS-PDU format is explained further on).
- bi-directional handling of the congestion and priority information.



PAD	Padding	(0 … 47 octets)
CPCS-UU	CPCS user to user Indicator	(1 octets)
CPI	Common part Indicator	(1 octet)
Length	CPCS-SDU length	(2 octets)
CRC	Cyclical redundancy verification	(4 octets)

Figure 4. CPCS-PDU format

Data

This contains the higher layer data and can vary from 1 to 65535 octets.

Pad

This field can vary from 0 to 47 octets with the aim that the complete frame has a multiple length of 48 bytes i.e. (data + pad + trailer) = n*48

Any codification is valid for pad octets.

CPCS-UU (CPCS User to User Indication)

1 octet sized field which is the first of the “CPCS trailer”. This is used to transparently transfer information between CPCS entities at both ends.

CPI (Common Part Indicator)

1 octet in length, this field’s main task to ensure that the trailer has a multiple length of 64 bits; if this does not carry out any other function (future functions are being studied by the ITU) this value should be 0x00.

Length

This four octet field indicates the data field length only.

The following should be noted. Given that the receiver does not know the true length of the data field, length error will only be detected in the following cases:

- if the indicated length is greater than the length of the received frame less 8 octets (the trailer octets).
- if the indicated length is less than the length of the received frame less 8 octets (trailer) and less 47 octets (maximum pad length).

Length error cannot be detected outside of these margins as the receptor does not know the real length of the pad (and cannot know it as codification is free).

This field also serves to indicate the “abort” event when the value is 0.

CRC-32

Contains the CRC-32 value calculated over the whole of the AAL5 frame i.e. including the pad and the first four octets of the trailer.

The AAL5-CPCS configurable parameters are:

- significant end-to-end, the maximum CPCS-SDU length going to be exchanged between CPCS entities.
- With local significance and only at reception:
  - Enabling “corrupted delivery”
  - Enabling and value of **reassembly timeout**.

3. Relaying frames over the ATM network

The Service Access Point or SAP offered by the ATM protocol is identified with a number known as "*AAL connection id*" and its properties are configurable: type of circuit (permanent or switched), VPI and VCI going to be used, type of adaptation layer, configuration of the adaptation layer itself, transmission and reception rates etc. The higher layers request an identifier and packet transmission and reception is executed through this identifier. ATM encapsulates the data provided by the higher layers in adaptation layer frames which are subsequently segmented in ATM cells. Over the said encapsulation, the RFC1483 defines two modes to send traffic for diverse protocols through the ATM5 adaptation layer:

- Each type of higher layer traffic is transported in a different AAL connection without adding any type of header. This mode is known as ***VC-multiplexing***.
- Diverse types of higher layer traffic share the same AAL connection in order to transport the data, inserting an LLC header to indicate the type of traffic contained in the said frame. This operation mode is known as ***LLC-multiplexing***.

When the ATM protocol receives a packet for encapsulating (a CPCS_SDU), it compares the network address of this with the ARP (Address Resolution Protocol) cache entries. If the ARP cache contains the AAL connection number that coincides with the network address, then the packet is encapsulated in a frame and transmitted via the specified AAL connection. If the ARP does not coincide with any of the cache values, the frame is dropped, except when the connection is point-to-point. In this case the ARP table is not checked.

3.1. Protocol addresses

The protocol addresses can be statically or dynamically assigned to the AAL connection identifiers through ARP. (The identifier significance is strictly local).

> ***Note :*** ***The static protocol addresses can also be known as static entries in the ARP. A static address is added to the ARP through the PROTOCOL_ADDRESS command.***
>
> ***Dynamic assignation is carried out through the Inverse ARP protocol.***

3.2. ATM Subinterfaces

The transmission of higher protocol frames is carried out by the subinterfaces, leaving the ATM "base" interfaces to handle the connection and the sending of the AAL frames themselves.
The subinterfaces permit diverse connection groups from the same ATM interface behave as completely distinct interfaces, which means for example in the case of IP, they must pertain to different subnets. This fact gives the ATM configuration enormous flexibility and greatly simplifies the implementation of "Logical IP Subnetworks" according to those defined in the RFC 2225.

Therefore all the higher layer data will be processed by the subinterfaces, which use the base interface services to transport the said data through the corresponding AAL connection.

4. ATM service categories

This section describes the different ATM service categories (known as ATM Forum) or ATM transfer capacity (known as ITU-T).
Apart from those mentioned below, there are more types however these are less important.

4.1. Constant Bit Rate (CBR)/Deterministic Bit Rate (DBR)

The CBR service is characterized by offering a constant rate for the configured value whatever the congestion conditions of the ATM network might be, i.e. this offers a guaranteed rate so that the network resources are used even when there is no available information to transmit.
This can be understood as a conventional circuit where a portion of the physical medium capacity is taken and remains permanently assigned to the said communication.
The configurable parameter is the circuit rate, represented by the Peak Cell Rate (PCR).
This type of service is orientated towards real time applications i.e. those that require delays and variations in low delays such as voice, video and circuit emulation.

4.2. Variable Bit Rate (VBR) / Statistical Bit Rate (SBR)

The VBR service is characterized by offering two speeds that are adequate for traffic whose rate requirements are variable. Two types are defined, one for real time applications (with restrictions in delay and variation) such as voice with silence suppression and compressed video and another one for applications with transmission bursts without bounded delay.
The configurable parameters are those for the PCR (Peak Cell Rate), sustained cell rate (SCR) and the maximum burst size (MBS) which determine, after a long period of silence, the device can transmit at PCR for determined time (this time is determined by the PCR, SCR and the MBS), to subsequently transmit at SCR; during periods of silence, the device gains "credit" so when it needs to transmit, it can again transmit at PCR for a determined time.

4.3. Available Bit Rate (ABR)

The ABR service is characterized by its adaptation to the available bandwidth conditions in the line and therefore is aimed at applications that can dynamically increase or diminish their needs and whose requirements can be expressed in acceptable ranges (maximum or minimum). The ATM network dynamically varies the resources assigned to this type of circuit through a closed loop control protocol using **Resource Management** cells.

4.4. Unspecified Bit Rate (UBR)

The UBR service is a service known as "**best effort**", oriented to applications that do not have bounded delay or a variation of this, do not require determined QoS parameters, which lower the cost of the contract. This is aimed at applications generating non-continuous bursty traffic, which permits a high level of statistic multiplexing.

The UBR service usually has a single configurable parameter, the PCR, which determines the speed that the circuit using this service must not exceed.
Typical applications are data transfer, messaging etc.

Chapter 2
ATM Protocol Configuration

1. ATM Interface Configuration

Access the configuration menu through the **NETWORK** command indicating the interface identifier in the following way:

```
*p 4

Config>LIST DEVICES

 Interface       Con    Type of interface            CSR      CSR2  int
 ethernet0/0     LAN1   Quicc Ethernet           FA200A00 FA203C00   5E
 serial0/0       WAN1   Async Line               FA200A20 FA203D00   5D
 atm0/0          DSL1   ATM                      FA200A60 FA203F00   55
 x25-node        ---    Router->Node                    0             0

Config>NETWORK atm0/0

-- ATM interface configuration --
atm0/0 config>
```

We are going to describe how to configure the distinct possibilities offered by the ATM interface.
The commands are defined according to the following nomenclature.

PVC	Mandatory part.
`<vpi>`	Mandatory part to be determined by the user.
`[NO]`	Optional part.

1.1. Configuring an AAL connection

Information at the ATM layer is transmitted and received through an AAL connection.
Currently the number of simultaneous AAL connections is limited to 31.
The command to create an AAL connection is as follows:

```
atm0/0 config>AAL-CONNECTION <id> PVC <vpi> <vci>
                                MONITORING OAM-LOOPBACK <success-up> <fail-down>
                                                        &lt;SEGMENT | END-TO-END&gt;
```

It is always necessary to associate the AAL connection to a PVC.

If an already defined AAL connection is unnecessary, you can delete it through the following command:

```
atm0/0 config>NO AAL-CONNECTION <id>
```

id Identifier number used in reference to this connection. This cannot be repeated in the same ATM interface.

PVC Associates a permanent VCC, identified by its VPI and VCI, to the AAL connection.

Monitoring Permits you monitoring for a determined AAL connection, independently of the state of the physical interface. Currently, the only type of available monitoring is through OAM LOOPBACK cells. The parameters to define the OAM LOOPBACK monitoring are:

<SEGMENT-END-TO-END> Indicates the type of loopback cell used for monitoring, segment type or end to end.

Success-up Consecutive number of loopback cells that must be answered by the end (segment or final destination) in order to consider the virtual circuit active after a loss of connectivity.

Fail-down Consecutive number of loopback cells detected without response in order to consider the virtual circuit inactive.

The following example configures an AAL connection with identifier 2 over PVC 8 32 with monitoring through OAM LOOPBACK end-to-end where 5 consecutive cells are required with response to declare the AAL connection active and 3 consecutive cells without response to declare the AAL connection down:

```
atm0/0 config>aal-connection 1 pvc 8 32 monitoring oam-loopback 5 3 end-to-end
```

The next example disables monitoring for the said connection:

```
atm0/0 config>aal-connection 1 no monitoring
```

The subsequent example modifies the PVC over which an AAL connection is based:

```
atm0/0 config>aal-connection 1 pvc 8 33
```

1.2. Configuring a permanent virtual circuit, type VCC

The aim of PVC configuration is to permit packet transmission and reception through the ATM interface over a permanent VCC.
The command used to configure a PVC with the default values (AAL5 and UBR without speed limitation, i.e. this adjusts to the physical speed) is as follows:

```
atm0/0 config>PVC <vpi> <vci> DEFAULT
```

VPI VPI going to use the PVC.
VCI VCI going to use the PVC.

If you are going to configure additional parameters, you can do it in the same command without needing to indicate **`default`*****.***

The command used to eliminate a PVC is as follows:

```
atm0/0 config>NO PVC <vpi> <vci>
```

Two PVCs in the same interface cannot have identical VPI and VCI.

Only the PVCs associated to an AAL connection are really active.

1.3. Configuring the traffic type

A PVC can operate according to distinct types of traffic, each one with its characteristics.

```
atm0/0 config>PVC <vpi> <vci> TX-TRAFFIC CBR <pcr-kbps>
                                    UBR <pcr-kbps>
                                    VBR-RT <pcr-kbps> <scr-kbps> <mbs-cells>
                                    VBR-NRT <pcr-kbps> <scr-kbps> <mbs-cells>
```

- CBR | UBR | VBR-RT | VBR-NRT
  Configures the behavior of the PVC according to that described in section 4 “ATM service categories”.
- *<pcr-kbps>*
  Determines the peak rate in Kpbs.
- *<scr-kbps>*
  Determines the sustained rate in Kpbs (VBR only).
- *<mbs-cells>*
  Determines the transmittable maximum burst size to peak rate in cells (VBR only).

The subsequent example configures the PVC 8 32 with VBR-RT traffic peak rate 512 kbps, sustained speed 64 kbps and an MBS with 64 cells.

```
atm0/0 config> pvc 8 32 tx-traffic vbr-rt 512 64 64
```

The following example configures the PVC with the default traffic profile:

```
atm0/0 config>pvc 8 32 no tx-traffic
```

Depending on the SAR used, it's possible that some profiles won't be available (VBR, etc.) or that they are only available apart from a determined release. In cases where you configure a profile which is not supported, you can opt for the most similar profile available.

1.4. Accessing the physical layer configuration

This permits you to access the specific configuration options for the physical interface depending on the type of card installed in the device. These commands are described in the manual corresponding to the type of xDSL interface used.

```
atm0/0 config>PHY
--- ADSL Configuration ---
atm0/0 ADSL config>
```

1.5. Exit the configuration menu

Returns to the *`Config>`* prompt.

```
atm0/0 config>EXIT
Config>
```

1.6. Configuring the line rate

Configures the physical interface speed in Kpbs. The configured value may be less that that available. In this case the device will operate as if it only has the configured rate available.
The value **0** is reserved to indicate that the interface is dynamic and therefore the speed should be detected each time the interface is established.
Please see the appendix 1 "*Transmission rate Management*".

```
atm0/0 config>LINE-RATE <kbps>
```

The default value is 0. This can be restored through the following command:

```
atm0/0 config>NO LINE-RATE
```

1.7. Configuring the maximum circuit rate

Configures the highest speed that permits any circuit pertaining to the interface to operate at. Value **0** is reserved to indicate that this parameter must take the value of the *LINE-RATE*

parameter (if this is dynamically configured, then it takes the speed value available on restarting the interface).
Any circuit involving transmission rates higher than that configured through this parameter, will not be created in effective mode.
Please see the appendix 1 “*Transmission rate Management*”.

```
atm0/0 config>MAX-CIRCUIT-RATE <kbps>
```

The default value is 0. This can be restored through the following command:

```
atm0/0 config>NO MAX-CIRCUIT-RATE
```

1.8. Configuring the number of circuits

Configures the maximum number of circuits that can be simultaneously established in this interface; please note that you can have many PVCs configured, however only those linked to the AAL connections will really establish. The maximum limit is currently 31 PVCs.

```
atm0/0 config>MAX-NUMBER-OF-CIRCUITS <1..31>
```

The default value is 1. This can be restored through the following command:

```
atm0/0 config>NO MAX-NUMBER-OF-CIRCUITS
```

1.9. Configuring the speed ratio

Configures the speed ratio between the fastest and the slowest virtual circuit permitted in the device. This parameter is only significant if the *MIN-CIRCUIT-RATE* parameter is set to zero.
Please see the appendix 1 “*Transmission rate Management*”.

```
atm0/0 config>MAX-TO-MIN-RATIO <ratio>
```

The default value is 25. This can be restored through the following command:

```
atm0/0 config>NO MAX-TO-MIN-RATIO
```

1.10. Configuring the minimum circuit rate

Configures the lowest speed that permits any circuit pertaining to the interface to operate at. Value **0** is reserved to indicate that this parameter must take the value of the *MAX-CIRCUIT-RATE* parameter divided by the value of the *MAX-TO-MIN-RATIO* parameter.
Any circuit involving lower transmission rates than that configured through this parameter, will not be created in effective mode and will remain in "*transmission stopped*" status with the corresponding ATM event if these are enabled.
Please see the appendix 1 "*Transmission rate Management*".

```
atm0/0 config>MIN-CIRCUIT-RATE <kbps>
```

The default value is 0. This can be restored through the following command:

```
atm0/0 config>NO MIN-CIRCUIT-RATE
```

1.11. Configuring the number of priorities

Determines if this is going to operate with one (real-time or no-real-time) or two traffic priority levels (real-time and no-real-time).

```
atm0/0 config>PRIORITY-LEVELS <1|2>
```

The default value is 1. This can be restored through the following command:

```
atm0/0 config>NO PRIORITY-LEVELS
```

1.12. Configuring the MTU

Determines the maximum length of the frames to be transmitted without considering the possible headers or trailers which the ATM adaptation layer (AAL) or the ATM layer introduce.

```
atm0/0 config>MTU <bytes>
```

The default value is 1532. This can be restored through the following command:

```
atm0/0 config>NO MTU
```

1.13. Configuring the OAM-TO-DATA parameter

Determines the maximum number of OAM cells that are inserted for each hundred user cells in cases where the user traffic is consistent.
The value of this parameter should not be modified except when expressly indicated by Teldat.

```
atm0/0 config>OAM-TO-DATA-COEFFICIENT <1..100>
```

1.14. Configuring the UTOPIA bus frequency

In cases where the hardware permits this, this parameter allows you to configure the UTOPIA bus clock frequency.
The value of this parameter should not be modified except when expressly indicated by Teldat.

```
atm0/0 config>UTOPIA-CLOCK-FREQUENCY <5..25>
```

1.15. Configuring the UTOPIA bus level

In cases where the hardware permits this, this parameter allows you to configure the UTOPIA bus compatibility level, i.e. level 1 or level 2.
The value of this parameter should not be modified except when expressly indicated by Teldat.

```
atm0/0 config>UTOPIA-LEVEL <1..2>
```

2. ATM interface commands summary

```
NO PVC <vpi> <vci>
   PVC <vpi> <vci> DEFAULT
   PVC <vpi> <vci> NO TX-TRAFFIC
   PVC <vpi> <vci> TX-TRAFFIC CBR <pcr-kbps>
   PVC <vpi> <vci> TX-TRAFFIC UBR <pcr-kbps>
   PVC <vpi> <vci> TX-TRAFFIC <VBR-RT | VBR-NRT> <pcr-kbps> <scr-kbps> <mbs>

NO AAL-CONNECTION <id>
   AAL-CONNECTION <id> PVC <vpi> <vci>
   AAL-CONNECTION <id> NO MONITORING
   AAL-CONNECTION <id> MONITORING OAM-LOOPBACK <up> <down> &lt;SEGMENT | END-TO-END&gt;

NO PRIORITY-LEVELS
   PRIORITY-LEVELS <levels>

NO LINE-RATE
   LINE-RATE <kbps>

NO MAX-CIRCUIT-RATE
   MAX-CIRCUIT-RATE <kbps>

NO MIN-CIRCUIT-RATE
   MIN-CIRCUIT-RATE <kbps>

NO MAX-TO-MIN-RATE-RATIO
   MAX-TO-MIN-RATE-RATIO <ratio>

NO MAX-NUMBER-OF-CIRCUITS
   MAX-NUMBER-OF-CIRCUITS <num>

NO OAM-TO-DATA-COEFFICIENT
   OAM-TO-DATA-COEFFICIENT <coeff>

NO MTU
   MTU <bytes>

NO UTOPIA-CLOCK-FREQUENCY
   UTOPIA-CLOCK-FREQUENCY <Mhz>

NO UTOPIA-LEVEL
   UTOPIA-LEVEL <1..2>
```

The default configuration is AAL5 with UBR without rate limitation (this adjusts to the physical rate).

3. Configuring the ATM subinterface

Before configuring an interface, you need to create it through the following command:

```
Config>ADD DEVICE ATM-SUBINTERFACE <base interface id> <subinterface id number>
```

- base interface
  ATM interface identifier on which the subinterface depends (requested AAL connections will be connections from this interface).
- subinterface id number
  Subinterface identifier number . (Two subinterfaces depending on the same physical interface cannot have the same identifier).

The following example creates the subinterface 1 over the atm/0 interface.

```
Config>ADD DEVICE ATM-SUBINTERFACE atm0/0 1
Added ATM Sub-interface atm0/0.1
```

The following command is used to eliminate an ATM subinterface:

```
Config>NO DEVICE <subinterface id>
```

- subinterface
  ATM subinterface identifier.

The next example deletes the subinterface 1 over the atm/0 interface.

```
Config>NO DEVICE atm0/0.1
```

An ATM subinterface is a grouping of one or more AAL connections which behave to all effects as any router interface as it is possible to assign IP addresses to it, monitor the state etc.
The interfaces may be point-to-point or point-to-multipoint. In cases of point-to-point these have a direct connection with a single remote device therefore a single AAL connection is used. If the subinterface is point-to-multipoint then there are various devices that can be directly reached through it. This means it is necessary to establish a mechanism to resolve which AAL connection should be used to reach each possible remote device. This is achieved by configuring *protocol addresses* through the **PROTOCOL-ADDRESS** command or activating the inverse ARP protocol.
Access the configuration menu through the **NETWORK** command in the following way:

```
*p 4


Config>LIST DEVICE

 Interface       Con    Type of interface              CSR      CSR2  int
 ethernet0/0     LAN1   Quicc Ethernet            FA200A00 FA203C00    5E
 serial0/0       WAN1   Async Line                FA200A20 FA203D00    5D
 atm0/0          DSL1   ATM                       FA200A60 FA203F00    55
 x25-node        ---    Router->Node                     0              0
 atm0/0.1        ---    ATM subinterface                 0              0
 atm0/0.3        ---    ATM subinterface                 0              0

Config>NETWORK atm0/0.1

-- ATM subinterface configuration --
atm0/0.1 config>
```

Subsequently, we are going to describe how to configure the distinct possibilities offered by the ATM subinterface.

3.1. Associating an AAL connection to the subinterface

In order to associate an AAL connection to the list of connections, use the following command:

```
atm0/0.1 config>AAL-CONNECTION-REQUESTED <aal connection id> DEFAULT
```

AAL connection id AAL connection identification number within the ATM base interface over which the subinterface is mounted.

In order to dissociate an AAL connection, use the following command:

```
atm0/0.1 config>NO AAL-CONNECTION-REQUESTED <aal connection id>
```

3.2. Configuring INVERSE-ARP

The INVERSE-ARP permits dynamic learning of which address is reached by a determined AAL connection.

> ***Inverse ARP only operates over AAL connections operating in LLC multiplex mode.***
>
> ***(Please see section "Multiplexation configuration")***

INVERSE-ARP protocol configuration has two parts: one which defines the behavior at the subinterface layer and the other which defines the behavior of each AAL connection associated to the subinterface.

a) *Configuring INVERSE-ARP at the subinterface layer*

```
atm0/0.1 config>INVERSE-ARP DEFAULT-VALUE <ENABLE | DISABLE>

atm0/0.1 config>INVERSE-ARP GLOBAL-VALUE <ENABLE | DISABLE | DEFAULT>
```

- DEFAULT-VALUE
  Determines the default value that those Inverse-ARP configurations configured with DEFAULT take.
  - DISABLE
  - ENABLE (default value)
- GLOBAL-VALUE
  Determines the state of the INVERSE-ARP for the subinterface in this group.
  - DISABLE
    All the associated connections have the INVERSE-ARP deactivated irrelevant of the individual configuration.
  - ENABLE
    The associated connections will have the INVERSE-ARP in the state indicated by the individual configurations.
  - DEFAULT (default value)
    The status for the subinterface is that defined by the value configured in DEFAULT-VALUE.

b) *Configuring INVERSE-ARP at the associated AAL connection level*

```
atm0/0.1 config>AAL-CONNECTION-REQUESTED <aal connection id>
                           INVERSE-ARP <ENABLE | DISABLE | DEFAULT>
```

- ENABLE
  The connection has INVERSE-ARP activated provided that this is globally enabled.
- DISABLE
  The connection has INVERSE-ARP deactivated.
- DEFAULT
  The connection will have INVERSE-ARP activated or deactivated depending on the value of the DEFAULT-VALUE Inverse-ARP configuration variable.

3.3. Configuring the ARP static entries

In order to add a static association between the AAL connection identifier and the address of the higher layer directly reached through the said connection, use the following command:

```
atm0/0.1 config>PROTOCOL-ADDRESS <IP host address> <aal connection id>
```

- IP host address
  IP address reachable through the AAL connection.
  Normally this is the address of a gateway which permits access to a subnet.
- AAL connection id
  Identifier of an AAL connection associated to the subinterface.

In order to delete an entry, use the following command:

```
atm0/0.1 config>NO PROTOCOL-ADDRESS <IP host address>
```

NOTE. In cases of point-to-point subinterfaces, where there is only one AAL connection, it is unnecessary to establish an entry in this section as all the packets leaving the interface must exit through the only existing connection.

3.4. Configuring the type of subinterface (PtP or PtMP)

Configures the type of link constituted by the subinterface. A point-to-multipoint subinterface has more than one AAL connection associated, each one being permitted to access distinct destinations.

```
atm0/0.1 config>LINK-TYPE <POINT-TO-POINT | POINT-TO-MULTIPOINT>
```

To reestablish the default link type, use the following command:

```
atm0/0.1 config>NO LINK-TYPE
```

3.5. Configuring multiplexation

The traffic forwarded by a subinterface can be encapsulated in two ways: LLC mode and VC mode; the first permits distinct traffic types over the same subinterface as the LLC header permits these to be differentiated; the second only permits one type of traffic over the subinterface and this traffic must be specified as IP, PPP or PPPoE.

```
atm0/0.1 config>MULTIPLEXATION <LLC | VC-IP | VC-PPP | VC-PPPOE>
```

To restore the default multiplexation (LLC), use the following command:

```
atm0/0.1 config>NO MULTIPLEXATION
```

3.6. LIST

Lists the current configuration of the ATM subinterface.

```
atm0/0.1 config>LIST ?
  aal-connection-requested    Lists requested AAL connections
  all
  configuration               Lists subinterface configuration
  protocol-address            Lists configured protocol addresses
```

a) *LIST CONFIGURATION*

Displays the subinterface configuration.

```
atm0/0.1 config>LIST CONFIGURATION
General configuration
---------------------
Link type:               Point to point
Multiplexing method:     LLC
Inverse ARP
 State:                  default
 Default value:          on
```

b) *LIST AAL-CONNECTION-REQUESTED*

Displays the list of AAL connections requested by the subinterface on startup.

```
atm0/0.1 config>LIST AAL-CONNECTION-REQUESTED
AAL id  InARP
------ -------
1      default
```

c) *LIST PROTOCOL-ADDRESS*

Displays the list of translations between AAL connection and the higher layer address which is directly reached through the said connection.

```
atm0/0.1 config>LIST PROTOCOL-ADDRESS
Protocol     Address     AAL id
-------- --------------- ------
   IP      192.168.1.2       1
```

4. Summary of the ATM subinterface commands

```
NO AAL-CONNECTION-REQUESTED  <id>
   AAL-CONNECTION-REQUESTED  <id> DEFAULT
   AAL-CONNECTION-REQUESTED  <id> INVERSE-ARP <ENABLED | DISABLED | DEFAULT>

   INVERSE-ARP DEFAULT-VALUE <ENABLE | DISABLE>
   INVERSE-ARP GLOBAL-VALUE <ENABLE | DISABLE | DEFAULT>

NO PROTOCOL-ADDRESS <IP address>
   PROTOCOL-ADDRESS <IP address> <aal connection id>

NO MULTIPLEXATION
   MULTIPLEXATION <LLC | VC-IP | VC-PPP | VC-PPPoE>

NO LINK-TYPE
   LINK-TYPE <POINT-TO-POINT | POINT-TO-MULTIPOINT>
```

Chapter 3
Monitoring ATM interfaces

1. Introduction

The ATM interface and subinterface monitoring commands are described in this chapter. The following sections are included here:

- Displaying the ATM interface monitoring prompt.
- ATM interface monitoring commands.
- ATM subinterface own monitoring commands.
- ATM interfaces and the GWCON interface command.

Should you require further information on the ATM protocol, please see Chapter 1 “The ATM interface”.

2. Displaying the ATM monitoring prompt

To access the ATM monitoring commands and to be able to monitor ATM, carry out the following steps:

1. At the OPCON (*) prompt, enter PROCESS 3
2. At the GWCON (+), prompt, enter NETWORK **#,** where # is the interface number over which ATM is being used.
3. At the `atm0/0  monitor+` prompt enter the required control commands.
4. Please see the section on "ATM monitoring commands" for a description of these commands.

3. AMT monitoring commands

The ATM monitoring commands are numerated and described in this section. Use these commands to obtain information on the ATM interface.

Command	Function
? (HELP)	Displays the available commands or their options.
ATM-PING	Permits you to send OAM LOOPBACK cells.
CLEAR	Deletes the statistics.
LIST	Displays different aspects of the ATM interface.
PHY	Permits you to access the physical layer monitoring.
EXIT	Returns to the GWCON (+) prompt.

3.1. ? (HELP)

Displays a list of the available commands or their options.

```
atm0/0 monitor+ ?
ATM-PING
CLEAR
LIST
PHY
EXIT
atm0/0 monitor+
```

3.2. ATM-PING

This permits you to generate OAM LOOPBACK cells at the VCC or VPC layer, both segment as well as end-to-end. The cell generation can be detained by striking a key or when the requested cells have been transmitted.

```
atm0/1 monitor+ATM-PING &lt;SEGMENT | END-TO-END&gt; &lt; VCC vpi vci | VPC vpi &gt; &lt;number&gt;
```

```
atm0/1 monitor+atm-ping segment vcc 8 32 2
VPI=8 VCI=32 Segment OAM F5 loopback successful: 14 ms
VPI=8 VCI=32 Segment OAM F5 loopback successful: 16 ms

                         OAM Loopback VCC (8..32) statistics
 ----------------------------------------------------------------------------
 Successful segment loopbacks 2/2
 Time in ms (min 14/avg 15/max 16)
```

3.3. CLEAR

Use the **CLEAR** command to delete statistics.

```
atm0/0 monitor+CLEAR ?
AAL-CONNECTION
ALL
INTERFACE
```

a) *CLEAR AAL-CONNECTION*

Permits you to delete the statistics for an AAL connection.

```
atm0/0 monitor+CLEAR AAL-CONNECTION <aal id>
```

b) *CLEAR ALL*

Permits you to delete the statistics for all the AAL connections and the interface.

```
atm0/0 monitor+CLEAR ALL
```

c) *CLEAR INTERFACE*

Permits you to delete the interface statistics.

```
atm0/0 monitor+CLEAR INTERFACE
```

d) *CLEAR RAW*

Permits you to delete the Raw channel statistics.

```
ATM monitor+CLEAR RAW
RAW statistics cleared
ATM monitor+
```

3.4. LIST

Use the **LIST** command to display information on the ATM interface, the AAL connections and the ATM protocol.

```
atm0/0 monitor+LIST
ALL
AAL-CONNECTION
INTERFACE
```

a) *LIST ALL*

Displays statistics for the AAL connections and the interface.

b) *LIST AAL-CONNECTION*

· *list aal-connection <aal id> all*

Displays all the information on the AAL connection.

· *list aal-connection <aal id> global*

Displays detailed information on the AAL connection statistics.

```
atm0/0 monitor+list aal 1 global

AAL connection id: 1
AAL type:           AAL5 NULL SSCS
VCC assigned:       PVC PHY:0 VPI:8 VCI:32

Status:           LOCAL UP      for     0/01:41:26 (days/hh:mm:ss)
Flags:            0x00000000

---- AAL statistics ----
Tx SDU ok            =     202631         Rx SDU ok            =     216619
  with CI            =          0           with CI            =          0
  with LP            =          0           with LP            =          0
  payload bytes      =   78180204           payload bytes      =   84385130
Tx SDU err           =          0         Rx SDU err           =          0
  payload bytes      =          0           payload bytes      =          0
Tx SDU drop          =      57975         Rx SDU drop          =          0
  payload bytes      =   22092241
Tx ok/err/drop       =   77/ 0/22         Rx ok/err/drop       =   99/ 0/ 0
Tx max resource use =           2         Rx max resource use =           5
Tx last 5 min (kbps)=         102         Rx last 5 min (kbps)=         180
Tx deferrals         =    7131215         Rx buffer denies     =          0
Tx SDU in soft queue=           0
Tx SDU in phy queue =          19
```

Status: indicates the status of the AAL connection. The possible values are:

- LOCAL DOWN → Local problems (physical layer down, etc.)
- LOCAL UP → Capable of transmitting and receiving.
- END TO END DOWN → Some type of monitoring indicates problems at the ATM layer (connection not available for transmission.)
- END TO END UP → Capable of transmitting and received with ATM layer guarantees.

Flags: Flags indicating status and cause of the said status.

- 0x00000001 → Physical down
- 0x00000002 → Monitoring based on OAM loopback detects error
- 0x00000004 → AIS End to End status declared
- 0x00000008 → AIS Segment status declared
- 0x00000010 → RDI End to End status declared
- 0x00000020 → RDI Segment status declared
- 0x00000040 → RDI End to End at VP layer status declared
- 0x00000080 → RDI Segment at VP layer status declared

Tx SDU err: frames where a local error in transmission has occurred and consequently do not arrive at the destination correctly.

Rx SDU err: frames where an error has been detected at reception (CRC, etc.)

Tx SDU drop: transmission requests which have been denied due to lack of resources (the lower layer is saturated and cannot queue more frames for this layer.)

Rx SDU drop: lower layer reception indications which could not be met due to lack of resources.

Tx deferrals: transmission petitions that have not been dropped but have been delayed until the lower layer resources are available.
Rx buffer denies: buffer petitions for reception which could not be answered as the resources
are being used.

Tx SDU in phy queue: frames in the physical transmission queue.

You can obtain more in-depth information on the frames (errors in the frames received with error etc.) The counters may vary slightly from the previous screen given that some time would have lapsed in the interval between showing one list and this one.

```
More detail about data(Yes/No)? y
---- AAL5 CPCS statistics ----
Tx ok               =     202744        Rx ok               =     216726
Tx err              =          0        Rx err              =          0
  purged            =          0          protocol aborts   =          0
  user aborts       =          0          remote aborts     =          0
                                          CRC32 errors      =          0
Tx drop             =          0          length errors     =          0
  too long          =          0          too long          =          0
  by SAR            =          0          reassembly tout   =          0
                                          invalid CPI       =          0
                                          corrupted deliver =          0
Tx ok/err/drop (%)  =   99/ 0/ 0        Rx ok/err (%)       =      99/ 0
```

You can also view information on the hardware level (depending on the SAR used.)

```
---- MPC860SAR dependent stats ----
   Tx underruns                =          0
   Tx deferred header blocked  =          0
   Tx APC bypass deferred      =          0
   Uncompleted TX stop commands =         0
   Uncompleted RX stop commands =         0
```

· *list aal-connection <aal id> management*

Displays information on the management plan (OAM layer) for the AAL connection, both at the VCC and the VPC layers.

"***Seg***" represents "segment"
"***E2E***" represents "end to end"
"***drops***" indicates transmission attempts which could not be executed.

```

VCC:    PVC PHY:0 VPI:8 VCI:32

---- GLOBAL statistics ----
Rx unexpected user cells                                =          0
Rx future VC function cells                             =          0
Rx VC resource management cells                         =          0

```

```
---- OAM errors statistics ----
Rx OAM CRC10 errored cells                                      =         0
Rx OAM unknown Fault Management function cells                  =         0
Rx OAM unknown Performance Monitoring function cells            =         0
Rx OAM unknown ACT/DEACT function cells                         =         0
Rx OAM unhandled System Management function cells               =         0
Rx OAM unknown type                                             =         0

---- AIS ----
Seg tx cells        =          0        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg rx cells        =          0        E2E rx cells        =         0
Seg defect          =       NONE        E2E defect          =      NONE

---- RDI ----
Seg tx cells        =          0        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg rx cells        =          0        E2E rx cells        =         0

---- LOOPBACK ----
Seg tx cells        =          2        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg tx loop request =          2        E2E tx loop request =         0
Seg failed loop     =          0        E2E failed loop     =         0
Seg rx cells        =          2        E2E rx cells        =         0
Seg rx loop request =          0        E2E rx loop request =         0
Seg rx uncorrelated =          0        E2E rx uncorrelated =         0
Seg rx unexpected   =          0        E2E rx unexpected   =         0


Virtual Path management information(Yes/No)? y

VPC:    PVP PHY:0 VPI:8

---- GLOBAL statistics ----
Rx future VP function cells                                       =         0
Rx VP resource management cells                                   =         0
Rx meta signalling cells                                          =         0
Rx general broadcast signalling cells                             =         0
Rx point to point signalling cells                                =         0

---- OAM errors statistics ----
Rx OAM CRC10 errored cells                                      =         0
Rx OAM unknown Fault Management function cells                  =         0
Rx OAM unknown Performance Monitoring function cells            =         0
Rx OAM unknown ACT/DEACT function cells                         =         0
Rx OAM unhandled System Management function cells               =         0
Rx OAM unknown type                                             =         0

---- AIS ----
Seg tx cells        =          0        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg rx cells        =          0        E2E rx cells        =         0
Seg defect          =       NONE        E2E defect          =      NONE

---- RDI ----
Seg tx cells        =          0        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg rx cells        =          0        E2E rx cells        =         0

---- LOOPBACK ----
Seg tx cells        =          0        E2E tx cells        =         0
Seg tx drops        =          0        E2E tx drops        =         0
Seg tx loop request =          0        E2E tx loop request =         0
Seg failed loop     =          0        E2E failed loop     =         0
Seg rx cells        =          0        E2E rx cells        =         0
Seg rx loop request =          0        E2E rx loop request =         0
Seg rx uncorrelated =          0        E2E rx uncorrelated =         0
Seg rx unexpected   =          0        E2E rx unexpected   =         0
```

· *list aal-connection <aal id> historic*

Displays a history on the changes in the connection status, indicating the time the state was entered, the connection flags (previously detailed) and the status description.

```
 Id   Timestamp     Flags      Status     Id   Timestamp     Flags      Status
 -- -------------- -------- ------------ -- -------------- -------- -----------
  0 05/09 17:50:09 00000001   LOCAL DOWN  1 05/09 17:50:33 00000000 L UP/E2E UNK
```

· *list aal-connection <aal id> bit-rate*

Offers an average throughput calculation per second at the ATM layer. Strike any key in order to detain this.

```
atm2/0 monitor+list aal-connection 1 bit-rate

 Tx rate (bps)   =          0     Rx rate (bps)   =          0
```

c) LIST INTERFACE

· *list interface all*

Displays all information on the ATM interface.

· *list interface global*

Displays detailed information on all the ATM interface statistics.

```
atm0/0 monitor+list int

Description: ADSL over ISDN Annex B (ADI Eagle) over Motorola MPC860 SAR

---- Status ----
Transmission:       ENABLED     Phy rate:        128 kbps
Reception:          ENABLED     Phy rate:        512 kbps
Status:                  UP     for       0/02:10:49 (days/hh:mm:ss)

---- Statistics ----
Tx user cells        =    2316332         Rx user cells        =    2260247
Tx no user cells     =          2         Rx no  user cells    =          2
                                          Rx HEC errored       =          0
                                          Rx invalid           =          0
                                          Rx missinserted      =          8
                                          Rx future functions  =          0
Tx bytes             =  122765702         Rx bytes             =  119793621
Tx last 5 min (kbps) =        125         Rx last 5 min (kbps) =         96
```

Status: interface status
(INTERNAL DOWN, ADMIN DOWN, DOWN and UP)
Tx/Rx user cells: transmitted/received user cells
Tx/Rx no user cells: OAM cells, reserved VPI/VCI etc.
Rx missinserted: user cells that do not pertain to any configured VCC.

· *list interface aal*

Statistics at the interface layer, grouped by AAL type. Check the information on AAL connection monitoring for further information.

```
---- AAL5 statistics ----
Tx SDU ok           =     256440         Rx SDU ok           =     271220
Tx SDU err          =          0         Rx SDU err          =          0
Tx SDU drop         =      75994         Rx SDU drop         =          0
Tx deferrals        =    9587579         Rx buffer denies    =          0
Tx ok/err/drop      =   77/ 0/22         Rx ok/err/drop      =   99/ 0/ 0
```

· *list interface hardware*

Statistics depending on the SAR, these are less important.

```
---- MPC860SAR dependent statistics ----
  RAW channel reception buffers =         10
  APC Level 1 overruns          =          0
  APC Level 2 overruns          =          0
  Received cells with HEC error =          0
  UTOPIA INT queue overflows    =          0
  UTOPIA cell sync changes      =          0
  UTOPIA cell sync locks        =          0

---- FireStream dependent statistics ----
Confirm pending Packets   =        0
Available RX buffers      =       64
Available Raw buffers     =       64
Tx interrupt unknown      =        0
Rx interrupt unknown      =        0
Tx interrupt simultaneous =        0
Rx interrupt simultaneous =        0
```

· *list interface historic*

ATM interface history where the start and end time for a connection is indicated. (The "*Rs*" field is reserved for future use.)

```
 Id Connection str Connection end Rs  Id Connection str Connection end Rs
 -- -------------- -------------- --  -- -------------- -------------- --
  0 05/09 17:50:33
```

· *list interface bit-rate*

Offers an average throughput calculation per second at the ATM layer. Strike any key in order to detain this.

```
atm2/0 monitor+list int  bit
 Tx rate (bps)   =          0     Rx rate (bps)   =          0
```

3.5. PHY

Physical interface monitoring consists of a series of commands described in the manual corresponding to the XDSL interface installed in the device.

```
atm0/0 monitor+PHY
--- ADSL Monitor ---
atm0/0 ADSL monitor+
```

```
atm0/0 monitor+PHY
--- SHDSL Monitorization ---
atm0/0 SHDSL monitor+
```

3.6. EXIT

Returns to the monitoring prompt.

```
atm0/0 monitor+EXIT
+
```

4. ATM subinterface monitoring commands

The ATM subinterface monitoring commands are numerated and described in this section.
Use these commands to obtain information on the ATM subinterface.

Command	Function
? (HELP)	Displays the available commands or their options.
CLEAR	Deletes the statistics.
EXIT	Returns to the GWCON (+) prompt.
LIST	Displays the different aspects of the ATM subinterface.

4.1. ? (HELP)

Displays a list of available commands or their options.

```
atm0/0.1 monitor+ ?
CLEAR
EXIT
LIST
```

4.2. CLEAR

Use the **CLEAR** command to delete statistics.

```
atm0/0.1 monitor+CLEAR
```

4.3. EXIT

Returns to the monitoring prompt.

```
atm0/0.1 monitor+EXIT
+
```

4.4. LIST

Use the **LIST** command to display information on the ATM subinterface.

```
atm0/0.1 monitor+ LIST

---- Status ----
Status:     DOWN for     0/00:00:00 (days/hh:mm:ss)

---- Statistics ----
Tx packets          =          0        Rx packets           =          0
Tx bytes            =          0        Rx bytes             =          0
Tx errors           =          0        Rx errors            =          0
                                        Rx bad encap or prot =          0
```

Chapter 4
ATM interface Events

1. Introduction

The ATM interface events are described in this chapter.

In order to activate the ATM interface events:

From the monitoring:

```
*PROCESS 3

+EVENT

-- ELS Monitor --
ELS>ENABLE TRACE SUBSYSTEM ATM ALL
ELS>
```

From the configuration:

```
*PROCESS 4


Config>EVENT

-- ELS Config --
ELS config>ENABLE TRACE SUBSYSTEM ATM ALL
ELS config>
```

So that these remain stored in the device configuration, the user must save the configuration and if necessary restart the device.

2. ATM Events

ATM.001

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.001 ATM/*index* ATM cell RX (*vpi*..*vci*) data=*data_ptr*: *buffer*

Long Syntax:

ATM.001 ATM/*index* ATM cell received (*vpi*..*vci*) data=*data_ptr*: *buffer*

Description:

An ATM cell has been received.

ATM.002

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.002 ATM/*index* AAL5 CPCS frm RX (*vpi*..*vci*) data=*data_ptr* len=*len*: *buffer*

Long Syntax:

ATM.002 ATM/*index* AAL5 CPCS frame Received (*vpi*..*vci*) data=*data_ptr* len=*len*: *buffer*

Description:

An AAL5 CPCS frame has been received.

ATM.003

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.003 ATM/*index* ATM cell TX (*vpi*..*vci*) data=*data_ptr*: *buffer*

Long Syntax:

ATM.003 ATM/*index* ATM cell transmission (*vpi*..*vci*) data=*data_ptr*: *buffer*

Description:

An ATM cell has been transmitted.

ATM.004

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.004 ATM/*index* AAL5 CPCS frm TX (*vpi*..*vci*) data=*data_ptr* len=*len*: *buffer*

Long Syntax:

ATM.004 ATM/*index* AAL5 CPCS frame transmission (*vpi*..*vci*) data=*data_ptr* len=*len*: *buffer*

Description:

An AAL5 CPCS frame has been transmitted.

ATM.005

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.005 ATM/*index* ATM cell RX (*vpi*..*vci*) data=*data_ptr descr*

Long Syntax:

ATM.005 ATM/*index* ATM cell received (*vpi*..*vci*) data=*data_ptr descr*

Description:

Detailed info about cell reception.

ATM.006

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.006 ATM/*index* AAL5 CPCS frm RX (*vpi*..*vci*) data=*data_ptr descr*

Long Syntax:

ATM.006 ATM/*index* AAL5 CPCS frame received (*vpi*..*vci*) data=*data_ptr descr*

Description:

Detailed info about AAL5 CPCS frame reception

ATM.007

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.007 ATM/*index* ATM cell TX (*vpi*..*vci*) data=*data_ptr descr*

Long Syntax:

ATM.007 ATM/*index* ATM cell transmission (*vpi*..*vci*) data=*data_ptr descr*

Description:

Detailed info about cell transmission

ATM.008

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.008 ATM/*index* AAL5 CPCS frm TX (*vpi*..*vci*) data=*data_ptr descr*

Long Syntax:

ATM.008 ATM/*index* AAL5 CPCS frame transmission (*vpi*..*vci*) data=*data_ptr descr*

Description:

Detailed info about AAL5 CPCS frame transmission

ATM.009

Level: Per packet trace, P-TRACE

Short Syntax:

ATM.009 ATM/*index* Tx rejected (*vpi*..*vci*) data=*data_ptr* len=*len* rsn=*descr*

Long Syntax:

ATM.009 ATM/*index* Transmission rejected (*vpi*..*vci*) data=*data_ptr* len=*len* rsn=*descr*

Description:

A transmission request has been rejected

ATM.010

Level: Unusual internal error, UI-ERROR

Short Syntax:

ATM.010 Unexpected *soft_descr* soft ev Num=*instance* code=*event_code*

Long Syntax:

ATM.010 Unexpected *soft_descr* software event Num=*instance* code=*event_code*

Description:

Unexpected software behaviour

ATM.011

Level: Unusual external error, UE-ERROR

Short Syntax:

ATM.011 *subifc_descr* rx err rsn=*rsn_descr*

Long Syntax:

ATM.011 *subifc_descr* reception with error Reason=*rsn_descr*

Description:

The frame received has been detected as errored at subinterface level

ATM.012

Level: Common informational comment, C-INFO

Short Syntax:

ATM.012 ATM/*index event_descr*

Long Syntax:

ATM.012 ATM/*index event_descr*

Description:

Event at ATM interface level: up, down

ATM.013

Level: Common informational comment, C-INFO

Short Syntax:

ATM.013 ATM/*index* VPI=*vpi* VCI=*vci event_descr*

Long Syntax:

ATM.013 ATM/*index* VPI=*vpi* VCI=*vci event_descr*

Description:

Event at ATM VCC level

Appendix 1
Transmission rate management

1. Transmission rates (MPC860SAR only)

The ATM characteristics make a control in the transmissions in distinct circuits essential in order to offer and manage the quality of the service.

The transmission controller must be configured with a range of transmission rates which it is able to handle in an interface [(1)] : any circuit implying a rate higher than the *MAX-CIRCUIT-RATE* parameter or less than the *MIN-CIRCUIT-RATE*, cannot be efficiently configured and will remain in "*transmission stopped*" state. (An ATM event is produced when a circuit is not created due to this cause). I.e. if you set a maximum of 1000 kbps and a minimum of 250 kbps, configure a CBR whose PCR is out of the said ranges, or a VBR whose PCR and/or SCR are out of these ranges or a UBR whose PCR is below the minimum (due to the "best effort" there will be no problems with rates higher than the maximum as this will be limited to the maximum) the circuits will not be created.

The most important parameter is the relation between *MAX-CIRCUIT-RATE* / *MIN-CIRCUIT-RATE* as the said relation implies a determined resource reserve in the system: given that the system resources are scarce and that they must be shared among the rest of the interfaces, protocols etc., not all the configurations are possible. A high value for this ratio may mean the interface will not start up, as the controller has not been able to allocate the necessary resources to handle this range.

In the cases where the minimum rate is not configured in an absolute form, there is a *MAX-TO-MIN-RATIO* parameter available which will configure the said rate with respect to the speed configured in the *MAX-CIRCUIT-RATE* (which in turn can be configured in a relative form to the physical interface).

In short, the *MAX-CIRCUIT-RATE / MIN-CIRCUIT-RATE* relation determines the range of transmission rates that the ATM controller is able to manage. This range is:

- **This can be possible or impossible (high values for the said relation increase the possibilities that this cannot be handled).**
- **In cases where this is possible, any circuit which implies out of range rates will not be created.**

(1) Different interfaces may have distinct ranges

Appendix 2
Configuration Example

1. Configuration Example

This section displays an illustrative example of a possible configuration for the ATM protocol, explaining the configuration process step by step.
Suppose we have a network configuration such as that shown in Figure 1: example scenario where three subnets are shown (A, B and C), the first of these is made up of three devices and the other two with two devices. One of the devices, which will be used for the configuration example, pertains to the three subnets.

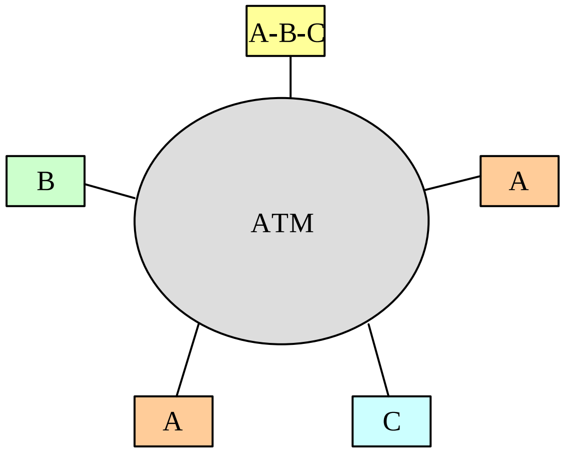


Figure 1: Example scenario

In addition to the above explanation, the network configuration has the following characteristics:

- All the devices are connected at the ATM layer with all those in its subnet through PVCs.
- Network A uses IP over ATM with LLC encapsulation. At the ATM layer, PVCs are used in UBR mode, with a maximum rate of 300 kbps.
- Network B is an IP point-to-point connection over ATM in VC-based mode, linked through a PVC that behaves in VBR mode with a PCR at 256 kbps, an SCR at 128 kbps and a 50 cell MBS.
- Network C is a point-to-point connection which uses PPP over ATM also without encapsulation, i.e. in VC-based mode, over a PVC in CBR mode at 128 kbps.

In the following, only the configuration of the device pertaining to the three subnets is shown as this is the most complete and therefore sufficient for the aims of this example.
The device configuration includes the following steps:

- Configuring the parameters for the ATM interface going to be used.
- Configuring the ATM global parameters.
- Creating the pertinent connections.
- Creating and configuring the necessary subinterfaces.

1.1. Configuring the ATM Interface

The interface configuration includes the following steps:

- Accessing the interface configuration menu.
- Configuring the speed and the line.
- Configuring the maximum rate for a circuit.
- Configuring the minimum rate for a circuit.
- Configuring the maximum number of circuits.
- Configuring the ratio between the maximum and minimum rate of a circuit.

Subsequently we configure the interface parameters bearing the following in mind:

- The xDSL interface does not have a set rate, it can use different rates which are selected by the network operator, and the user device cannot decide what rate is required. Therefore it is a good idea to leave this rate as dynamic and that the interface is configured to the rate available on the line (value 0) (default configuration).
- Unless you have a particular reason for not doing this, we suggest that you allow the channels to use the whole of the line speed. Therefore we recommend for the majority of cases to configure the maximum speed of the channels to the line speed (value 0) (default configuration).
- It is also recommendable to leave the minimum channel speed depending on the maximum, particularly if the maximum rate is variable. If this is not done, on configuring a variable maximum speed and a fixed minimum one, invalid configurations could arise as for example, that the minimum rate is above the maximum; therefore configure value 0 (default configuration).
- The maximum number of circuits must be sufficient in order to communicate with all the devices in the environment. In this case, the necessary value is 4.
- The ratio between the maximum and minimum speed for the circuits is a value that is only significant when the minimum speed is configured as dynamic – as is our case. This value is critical so great care needs to be taken when changing it. We recommend reading Appendix 1. By default the value is 25 which for example in a 2048 kbps ADSL line permits speeds from 2048 kbps up to 2048/25 = 82 kbps.

```
ATM config>MAX-NUMBER-OF-CIRCUITS 4
```

NOTE: It is very important to note that the speed configuration has a series of aspects to keep in mind given the restrictions of each traffic category and those for the line. We strongly recommend that you CAREFULLY READ Appendix 1.

1.2. Creating the Connections

For subnet A, 2 connections over two UBR 300 kbps PVCs (VPI 0 and VCIs 32 and 33) are required.

Subnet B only requires one connection over a VBR-NRT 256 / 128 / 50 PVC (VPI 1 and VCI 32) and monitoring through OAM loopback ends-to-end.
Finally, subnet C requires a connection over a PVC (VPI 2 and VCI 32).

```
ATM config>pvc 0 32 tx-traffic ubr 300
ATM config>pvc 0 33 tx-traffic ubr 300

ATM config>aal-connection 1 pvc 0 32
ATM config>aal-connection 2 pvc 0 33
```

```
ATM config>pvc 1 32 tx-traffic vbr-nrt 256 128 50

ATM config>aal-connection 3 pvc 1 32 monitoring oam-loopback 3 6 end-to-end
```

```
ATM config>pvc 2 32 tx-traffic cbr 128

ATM config>aal-connection 4 pvc 2 32
```

1.3. Creating and Configuring the Subinterfaces

The last step in the ATM configuration is creating the subinterfaces. The general rule is to create one subinterface for each distinct subnet that you wish to support, while there are exceptions to this rule, they are not the object of this example.
Let's take a look at how to create the subinterfaces for each of the networks in the example:

- Network A. This network is made up of three devices where the two remote devices are accessible through the AAL 1 and 2 connections. Consequently a point-to-multipoint subinterface will be necessary. Encapsulation is LLC.

```
Config>add dev atm-subinterface atm/0 1
Added ATM Sub-interface atm0/0.1


ATM Subinterface config>aal-connection-requested 1 default
ATM Subinterface config>aal-connection-requested 2 default
ATM Subinterface config>link-type point-to-mutipoint
ATM Subinterface config>protocol-address 192.168.1.3 1
ATM Subinterface config>protocol-address 192.168.1.4 2



Config>add dev atm-subinterface atm/0 2
Added ATM Sub-interface atm0/0.2

ATM Subinterface config>aal-connection-requested 3 default
ATM Subinterface config>multiplexation vc-ip


Config>add dev atm-subinterface atm/0 3
Added ATM Sub-interface atm0/0.3
```

```
ATM Subinterface config>aal-connection-requested 4 default
ATM Subinterface config>multiplexation vc-ppp
```

- Network B. This is made up of two devices joined by a point-to-point IP connection through the AAL 3 connection, VC-IP encapsulation.

- Network C. Made up of two devices joined by a PPP connection through the AAL 4 connection, VC-PPP encapsulation.

NOTE: Please note that it is very important that the subinterface is defined as POINT-TO-POINT if it is going to carry PPP traffic. Contrariwise, the connection between PPP and the subinterface will not function.

NOTE: You need to bear in mind that each AAL connection can only be used by one subinterface i.e. it is incorrect to configure the same connection in two subinterfaces.

Appendix 3
Bibliography and glossary

1. Bibliography

I.150 — ITU-T
B-ISDN ASYNCHRONOUS TRANSFER MODE FUNCTIONAL CHARACTERISITICS

I.361 — ITU-T
B-ISDN ATM LAYER SPECIFICATION

I.610 — ITU-T
B-ISDN OPERATION AND MAINTENANCE PRINCIPLES AND FUNCTIONS

I.363.5 — ITU-T
B-ISDN ATM ADAPTATION LAYER SPECIFICATION: TYPE 5 AAL

AF-NM-0122.000 — ATM FORUM
AUTO-CONFIGURATION OF PVCS

AF-ILMI-0065.000 — ATM FORUM
ILMI SPECIFICATION VERSION 4.0

RFC 1483 — Juha Hienanen – Telecom Finland
Network Working Group
Multiprotocol Encapsulation over ATM Adaptation Layer 5

RFC 2225 — M. Laubach – Com21, Inc.
J. Halpern – Newbridge Networks, Inc.
Network Working Group
Classical IP and ARP over ATM

2. Glossary

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

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

AAL ATM Adaptation Layer
The standards layer that allows multiple applications to have data converted to and from the ATM cell. A protocol used that translates higher layer services (PDU) into the size and format of an ATM cell and vice versa.

AAL-1 ATM Adaptation Layer Type 1
Specialized AAL functions in support of constant bit rate (CBR), time-dependent traffic such as voice and video

AAL-2 ATM Adaptation Layer Type 2
Specialized layer for variable bit rate (VBR) traffic (mainly for video).

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

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

ABR Available Bit Rate
ABR is an ATM layer service category for which the limiting ATM layer transfer characteristics provided by the network may change subsequent to connection establishment. A flow control mechanism is specified which supports several types of feedback to control the source rate in response to changing ATM layer transfer characteristics. Cell delay variation (CDV) is not controlled in this service.

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

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

ADSL Asymmetric Digital Subscriber Line
Technology permitting modems attached to twisted pair copper wiring to transmit from 1.5 Mbps to 9 Mbps downstream (to the subscriber) and from 16 kbps to 800 kbps upstream (or to the network), depending on line distance.

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

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

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

APON ATM Passive Optical Network
Passive optical network transporting ATM.

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

ATM Asynchronous Transfer Mode
Very high speed data transmission protocol based on cells and can be established over ADSL. ATM is capable of transporting and switching voice, data, images and video over the same infrastructure.

ATM25
ATM Forum defined 25.6Mbit/s cell based user interface based on IBM token ring network.

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

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

ATM Peer-to-Peer Connection
A virtual channel connection (VCC) or a virtual path connection (VPC).

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

ATU-C / ATU-R ADSL Transmission Unit, Central or Remote
Device located at the end of the ADSL line between the line itself and the first user device or the first telephone switch device. The ATU-C can be integrated in the access node.

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

B-ISDN Broadband Integrated Digital Network
A digital network with ATM switch operating at speeds above 1.544 or 2.048 Mbps.

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

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

CDV Cell Delay Variation
CDV is a component of cell transfer delay, induced by buffering and cell scheduling.

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

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

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

Semi-permanent connection
A connection established via a service order or via network management.

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

CPI Centro Proveedor de Internet
See ISP.

CRC Cyclic Redundancy Check
A mathematical algorithm that computes a numerical value based on the bits in a block of data. This number is transmitted with the data and the receiver uses this information and the same algorithm to insure the accurate delivery of data by comparing the results of algorithm and the number received.

CS Convergence Sublayer
The general procedures and functions that convert between ATM and non-ATM formats (FR, SMDS etc), executed above the ATM layer.

CTD Cell Transfer Delay
This is defined as the elapsed time between a cell exit event at a determined point and the corresponding cell entry event at a determined point for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

DS0 Digital Signal 0
The 64 kbps rate that is the basic building block for both the North American and European digital hierarchies.

DS1 Digital Signal 1
Twenty-four voice channels packed into a 193 bit frame and transmitted at 1.544 Mbps. The unframed version or payload is 192 bits at a rate of 1.536 Mbps.

DS2 Digital Signal 2
Four T1 frames encapsulated in a higher layer frame transmitted at 6.312 Mbps.

DSLAM Digital Subscriber Line Access Multiplexer
Device which concentrates a determined number of ADSL lines in a single ATM line.

E1
The 2.048 Mbps rate used by European CEPT carrier to transmit 30 64 kbps digital channels for voice or data calls, plus a 64 kbps signaling channel and a 64 kbps channel for framing and maintenance.

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

ETSI European Telecommunications Standards Institute
The primary telecommunications standards organization.

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

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

FEXT Far End CrossTalk
Interference between two signals at the remote end of a telephone switch.

FTTCab Fibre To The Cabinet
Network architecture where an optical fiber connects the telephone switch to a street-side cabinet where the signal is converted to feed the subscriber over a twisted copper pair.

FTTH Fibre To The Home
Network architecture where an optical fiber runs from the telephone switch to the subscriber's premises or home.

FTTK or FTTC Fiber To the Kerb
Network architecture where an optical fiber runs from the telephone switch to a kerbside distribution point close to the subscriber where it is converted to a copper pair.

GFC Generic Flow Control
GFC is a field in the ATM header which can be used to provide local functions (e.g., flow control).

HDSL High data rate Digital Subscribe Line
Technology permitting E1/T1 transmission rates over a twisted pair.

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

HFC Hybrid Fibre Coax
A system (usually CATV) where fiber is run to a distribution point close to the subscriber and then the signal is converted to run to the subscriber's premises over coaxial cable.

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

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

IEEE 802.3
A LAN protocol suite commonly known as Ethernet. Ethernet has either a 10 Mbps or 100 Mbps throughput and uses Carrier Sense Multiple Access bus with Collision Detection CSMA/CD and bus topology.

IEEE 802.5
A Local Area Network protocol suite commonly known as Token Ring. A standard originated by IBM for a token passing ring network that can be configured in a star topology. Versions supported are 4 Mbps and 16 Mbps.

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

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

ISO International Organization for Standardization
An international organization for standardization, based in Geneva, Switzerland, that establishes voluntary standards (not binding but recommendable).

ITU-T International Telecommunications Union Telecommunications
ITU-T is an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry.
This was previous known as CCITT.

ISP Internet Service Provider
Organization offering and providing Internet services to the public and that have their own servers to provide these services.

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

LAN Local Area Network
A network designed to move data between stations within a campus.
Typical technologies are Ethernet, FastEthernet and Token Ring.

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

LAPD Link Access Procedure D
A layer 2 protocol defined by ITU-T. This protocol reliably transfers blocks of information across a line.

LOC Loss of Cell Delineation
A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost cell delineation.

LOF Loss of Frame
A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost frame delineation.

Loop Qualification
Process through which you can establish if a line can supply a determined type of DSL transmission at a determined rate.

LOS Loss of Signal
A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost the received signal.

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

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

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

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

NEXT Near End CrossTalk
The interference between pairs of lines at the telephone switch end.

N-ISDN Narrowband ISDN
See ISDN.

NNI Network Node Interface
Interface between ATM switches.

Access Node
Points on the access network boundary that concentrate individual access lines into a lesser number than the trunk lines.
The access nodes can carry out various types of protocol transformation. Typical access nodes are: Digital Loop Carrier which concentrates individual voice lines in T1/E1 lines, mobile phone antenna centers, PBXx and Optical network Units.

NSP (Network Service Provider)
Term used to describe an organization that provides value-added network services in a telecommunications network.

nx64K
This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels.

OAM Operations Administration and Maintenance
A group of network management functions that provide network fault indication, performance information, and data and diagnosis functions.

OC3 Optical Carrier 3
Name given to the optical fiber line transporting 155 Mbps.

OSI Open Systems Interconnection
A seven (7) layer architecture model for communications systems developed by the ISO for the interconnection of data communications systems.

PBX Private Branch eXchange
PBX is the term given to a device which provides private local voice switching and voice-related services within the private network.

PCR Peak Cell Rate
The Peak Cell Rate, in cells/sec, is the cell rate which the source may never exceed.

PDU Protocol Data Unit
A PDU is a message of a given protocol comprising payload and protocol-specific control information, typically contained in a header.
PDUs pass over the protocol interfaces which exist between the layers of protocols (per OSI model).

PLL Phase Lock Loop
Phase Lock Loop is a mechanism whereby timing information is transferred within a data stream and the receiver derives the signal element timing by locking its local clock source to the received timing information.

PMD Physical Media Dependent
This sublayer defines the parameters at the lowest level, such as speed of the bits on the media.

PNNI Private Network-Network Interface
A routing information protocol that enables extremely scalable, full function, dynamic multi-vendor ATM switches to be integrated in the same network.

POTS Plain Old Telephone Service
Name given to the analog telephone basic service which occupies the lowest bandwidth, 4KHz, over a twisted pair. Any service sharing the line with POTS must use frequencies above POTS or convert POTS into a digital signal and carry out multiplexing with other digital signals.

PTI Payload Type Indicator
Payload Type Indicator is the Payload Type field value distinguishing the various management cells and user cells.

PTT
Acronym used in Europe used to indicate public telephone companies.

PVC Permanent Virtual Circuit
This is a link with static route defined in advance, usually by manual setup.

PVCC Permanent Virtual Channel Connection
A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

PVPC Permanent Virtual Path Connection
A Permanent VPC is one which is provisioned through some network management function and left up indefinitely.

QoS Quality of Service
Quality of Service: Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection: CLR (Cell Loss Ratio), CTD (Cell Transfer Delay) and CDV(Cell Delay Variation).

RADSL Rate Adaptive ADSL
Version of ADSL where the modems test the line and adjust their rate to the highest possible.

Access Network
Portion of the switched public network which communicates the access nodes with the individual subscribers. Currently the access network mainly consists of twisted copper passive pair.

RFC Request For Comment
The development of TCP/IP standards, procedures and specifications is done via this mechanism. RFCs are documents that progress through several development stages, under the control of IETF, until they are finalized or discarded.

RISC Reduced Instruction Set Computing
A computer processing technology in which a microprocessor understands a few simple instructions thereby providing fast, predictable instruction flow.

RM-Cell Resource Management Cell
ATM cell for the exchange of information on the network state such as the available bandwidth, congestion etc.

Router
A physical device that is capable of forwarding packets based on network layer information.

SAAL Signaling ATM Adaptation Layer
This resides between the ATM layer and the Q.2931 function. The SAAL provides reliable transport of Q.2931 messages between Q.2931 entities (e.g., ATM switch and host) over the ATM layer; two sublayers: common part (CPCS) and service specific part (SSCS).

SAP Service Access Point
A SAP is used for the following purposes:

1. When the application initiates an outgoing call to a remote ATM device, a destination_SAP specifies the ATM address of the remote device, plus further addressing that identifies the target software entity within the remote device.
2. When the application prepares to respond to incoming calls from remote ATM devices, a local_SAP specifies the ATM address of the device housing the application, plus further addressing that identifies the application within the local device.

SAR Segmentation and Reassembly
Method through which two entities with distinct PDU sizes can communicate.

SCR Sustainable Cell Rate
The SCR is an upper bound on the conforming average rate of an ATM connection over time scales which are long relative to those for which the PCR is defined.

SDH Synchronous Digital Hierarchy
The ITU-TSS International standard for transmitting information over optical fiber.

SDT Structured Data Transfer
An AAL1 data transfer mode in which data is structured into blocks which are then segmented into cells for transfer.

SDU Service Data Unit
A unit of interface information whose identity is preserved from one end of a layer connection to the other.

SDSL Symmetric Digital Subscriber Line
HDSL and POTS over an individual telephone line.

SHDSL Symmetric High Bit Rate Digital Subscriber Line
Technology permitting connection of a modem to a twisted copper pair and symmetrically transmit from 192K to 2304 depending on the distance of the line.

Segment
A single ATM link or group of interconnected ATM links of an ATM connection.

SN Sequence Number
SN is a 4 octet field in a Resource Management cell to sequence such cells.

SNA Systems Network Architecture
IBM's seven layer, vendor specific architecture for data communications.

SNMP Simple Network Management Protocol
SNMP is the IETF standard management protocol for TCP/IP networks.

SONET Synchronous Optical Network
An ANSI standard for transmitting information over optical fiber. This standard is a variation of the SDH International standard.

Splitter
Filter used to separate the ADSL and POTS signals to prevent mutual interference.

SRTS Synchronous residual Time Stamp
A clock recovery technique in which difference signals between source timing and a network reference timing signal are transmitted to allow reconstruction of the source timing at the destination.

SSCF Service Specific Coordination Function
SSCF is a function defined in Q.2130 for Support of Signaling at the User-to- Network Interface (UNI).

SSCOP Service Specific Connection Oriented Protocol
An adaptation layer protocol defined in ITU-T Specification: Q.2110.

SSCS Service Specific Convergence Sublayer
The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

STM Synchronous Transfer Module
STM is a basic building block used for a synchronous multiplexing hierarchy defined by the ITU-T.

STM-1 Synchronous Transport Module 1
SDH standard for transmission over OC-3 optical fiber at 155.52 Mbps.

STM-n Synchronous Transport Module "n"
SDH standards for transmission over optical fiber (OC-'n x 3) by multiplexing "n" STM-1 frames, (e.g., STM-4 at 622.08 Mbps and STM-16 at 2.488 Gbps).

STP Shielded Twisted Pair
A cable containing one or more twisted pair wires with each pair having a shield of foil wrap.

STS-1
SONET standard for transmission at 51.84 Mbps.

SVC Switched Virtual Circuit
A connection established via signaling. The user defines the endpoints when the call is initiated.

SVCC Switched Virtual Channel Connection
A Switched VCC is one which is established and taken down dynamically through control signaling.

SVPC Switched Virtual Path Connection
A Switched Virtual Path Connection is one which is established and taken down dynamically through control signaling.

Switch ATM
Device executing ATM switch functions based on the cell VPI.

T1
See DS1.

TC Transmission Convergence
The TC sublayer transforms the flow of cells into a steady flow of bits and bytes for transmission over the physical medium. On transmit, the TC sublayer maps the cells to the frame format, generates the Header Error Check (HEC), sends idle cells when the ATM layer has none to send. On reception, the TC sublayer delineates individual cells in the received bit stream, and uses the HEC to detect and correct received errors.

TCP Transmission Control Protocol
A layer 4 protocol which provides end-to-end, connection-oriented, reliable transport layer functions over IP controlled networks. TCP performs the following functions: flow control between two systems, acknowledgements of packets received and end-to-end sequencing of packets.

TDM Time Division Multiplexing
A method in which a transmission facility is multiplexed among a number of channels by allocating the facility to the channels on the basis of time slots.

Traffic Management
Set of ATM procedures for traffic and congestion control; the ATM traffic control consists of a set of actions executed by the network to avoid congestion conditions as well as intensity, reach and duration.

Trailer
Protocol control information located at the end of a PDU.

Transit Delay
The time difference between the instant at which the first bit of a PDU crosses one designated boundary and the instant at which the last bit of the same PDU crosses a second designated boundary.

Traffic Shaping
Traffic Shaping is a mechanism that alters the traffic characteristics of a stream of cells on a connection to achieve better network efficiency, while meeting the QoS objectives, or to ensure conformance at a subsequent interface.
Traffic shaping must maintain cell sequence integrity on a connection.

Time Stamp
Time Stamping is used on OAM cells to compare time of entry of cell to time of exit of cell to be used to determine the cell transfer delay of the connection.

UBR Unspecified Bit Rate
UBR is an ATM service category which does not specify traffic related service guarantees. Specifically, UBR does not include the notion of a per-connection negotiated bandwidth. No numerical commitments are made with respect to the cell loss ratio experienced by a UBR connection, or as to the cell transfer delay experienced by cells on the connection.

UDP User Datagram Protocol
This protocol is part of the TCP/IP protocol suite and provides a means for applications to access the connectionless features of IP. UDP operates at layer 4 of the OSI reference model and provides for the exchange of datagrams without acknowledgements or guaranteed delivery.

UME UNI Management Entity
The software residing in the ATM devices at each end of the UNI circuit that implements the management interface to the ATM network.

Unassigned Cell
A cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which has been generated and does not carry information from an application using the ATM Layer service.

UNI User-Network Interface
An interface point between ATM end users and a private ATM switch, or between a private ATM switch and the public carrier ATM network; defined by physical and protocol specifications per ATM Forum UNI documents.

UTOPIA Universal Test & Operations Interface for ATM
Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

UTP Unshielded Twisted Pair
A cable having one or more twisted pairs, but with no shield per pair.

VADSL (Very high speed ADSL)
See VDSL.

VBR Variable Bit Rate
An ATM Forum defined service category which supports variable bit rate data traffic.

VC Virtual Channel
A communications channel that provides for the sequential unidirectional transport of ATM cells.

VCC Virtual Channel Connection
A concatenation of VCLs that extends between the points where the ATM service users access the ATM layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATM-entity) for processing signify the endpoints of a VCC. VCCs are unidirectional.

ATM connection where switching is carried out based on the VPI and VCI of each cell.

VCI Virtual Channel Identifier
A unique numerical tag as defined by a 16 bit field in the ATM cell header that identifies a virtual channel, over which the cell is to travel.

VCL Virtual Channel Link
A means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

VCO Voltage Controlled Oscillator
An oscillator whose clock frequency is determined by the magnitude of the voltage presented at its input.

VDSL Very high data rate Digital Subscriber Line
Technology permitting operations over a twisted pair at rates between 12.9 and 52.8 Mbps with a maximum reach between 900 and 1.500 m over AWG24.

Virtual Channel Switch
A network element that connects VCLs. It terminates VPCs and translates VCI values.

Virtual Path Switch
A network element that connects VPLs. It translates VPI (not VCI) values.

VLAN Virtual Local Area Network
Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

VP Virtual Path
A unidirectional logical association or bundle of VCs.

VPC Virtual Path Connection
A concatenation of VPLs between Virtual Path Terminators (VPTs).
ATM connection where switching is only carried out based on the VPI of each cell.
VPCs are unidirectional.

VPI Virtual Path Identifier
An eight bit field in the ATM cell header which indicates the virtual path over which the cell should be routed.

VPL Virtual Path Link
A means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

VPT Virtual Path Terminator
A system that unbundles the Vcs of a VP for independent processing of each VC.

VTOA Voice and Telephony Over ATM
The ATM Forum voice and telephony over ATM service interoperability specifications address three applications for carrying voice over ATM networks; desktop (or LAN services), trunking (or WAN services), and mobile services.

WAN Wide Area Network
This is a network which spans a large geographic area relative to office and campus environment of LAN (Local Area Network). WAN is characterized by having much greater transfer delays due to laws of physics.