UNIT 4 ASYNCHRONOUS TRANSFER MODE (ATM)

Structure **Page Nos.**

4.0 INTRODUCTION

Asynchronous Transfer Mode (ATM) is a form of data transmission that allows voice, video and data to be sent along the same network. In contrast to ATM, in the past, voice, video and data were transferred using separate networks. For example, voice was transmitted over the phone, video over cable networks and data over an internetwork. ATM is the ultimate culmination of all the developments in switching and transmission in the last twenty years and has the best of circuit switching and packet switching (discussed in the previous block).

Asynchronous transfer mode (ATM) is a technology that has its history in the development of broadband ISDN in the 1970s and 1980s. In this unit first we will have a re-look at different type of switching techniques (technologies) and then we will examine how ATM is compatible with the existing technologies and then compare the architectural difference between ATM and the OSI model and finally spend some tim e on how ATM protocol works.

4.1 OBJECTIVES

After going through this unit, you should be able to:

- explain the term ATM;
- discuss the compatibility of ATM as technology;
- compare ATM layered architecture with OSI Model;
- describe how ATM protocol works;
- describe the structure of ATM cell;
- identify the various ATM classes of services;
- define the various ATM classes of services;
- discuss the approach and tools used for ATM traffic control;
- discuss the benefits of ATM technology, and
- explain the various applications of ATM technology.

4.2 SWITCHING TECHNIQUES

In this section we will discuss different type of switching techniques.

Circuit Switching

This was the first type of data transfer mechanism used. Circuit switching is used in the telephone networks to transmit voice and data signals. In a synchronous transmission, which involves transmission of voice, a synchronised connection must be made between the sender and receiver because there must be a constant time interval between each successive bit, character, or event. To enable synchronised transmission, circuit switching establishes a dedicated connection between the sender and receiver involved in the data transfer over the network. As a result, the connection consumes network capacity whether or not there is an active transmission taking place; for example the network capacity is used even when a caller is put on hold. For different applications, utilisation of the line can vary enormously. However, there is little delay and effective transparency for the user. It is very efficient for Constant Bit Rate (CBR) data transfer.

Packet Switching

In contrast to circuit switching, packet switching ensures that the network is utilised at all times. It does this by sending signals even in the small unused segments of the transmission — for example, between the words of a conversation or when a caller is put on hold. However, in packet switching, there can be variations in the timing when the digital bits are received. For normal voice and data communications this is not a problem — for broadband signals, such as television, it is a huge problem that causes the picture to jerk and the audio to be out of synchronisation with the picture. Data to be sent is broken down into chunks or packets. Each packet contains data and header information for control e.g., routing. At each node the packet is received, stored briefly and passed on. At each node the packets may be put on a queue for further movement into the network.

There are two approaches to the above kind of transport –

1. ***Datagram***, where each packet can take any path through the network as long as they all reach the destination.

2. ***Virtual Circuit***, where all the packets are routed through the same path without having the path dedicated. The path segments may carry many virtual circuits.

Datagram allows for dynamic handling of congestion and no call setup is necessary. Virtual circuits allow for sequencing, error and flow control.

Though, Packet switching is much more efficient than Circuit switching, Packet-switched networks have been slow. The public data networks that use the X.25 standard for public switching allow users to operate typically at speeds of 9.6 kbps. The standard leased line that large companies use for their high-speed data communications operates at 56 kbps. ATM can transmit bits through the network at speeds up to about 10 Gbps.

Multirate Circuit Switching

This is an enhancement of the synchronous **Time-Division Multiplexing (TDM)** approach used initially in circuit switching. In circuit switching a station must operate at a fixed data rate which must be used regardless of application. In multirate switching, multiplexing is introduced. A station attaches to the network by means of a single physical link which carries multiple fixed data-rate channels (B-channel @

64kbps). Traffic on each channel can be switched independently through the network to various destinations. This is used for simple ISDN. So the user has a number of data rate choices but they are fixed. Hence Variable Bit Rate (VBR) is difficult to accommodate efficiently.

Frame Relay

Frame relay is essentially identical to packet switching. Frame relay saw its development as a result of high data rates and low error rates on links in modern high speed communications systems. In old packet switching, there was considerable overhead involved in error recovery, redundancy enhancement and routing information. With Frame relay the packets are now of variable length with low overheads, meaning that they were designed to operate at up to 2Mbps. This was very good for VBR. Here end-to-end error checks are performed.

Cell Relay

This is an evolution from frame relay and multirate circuit switching. Cell relay uses fixed sized packets called cells. Multirate circuit switching also had fixed channels. Cell relay allows for the definition of virtual channels with data rates dynamically defined. Using a small cell size allows almost constant data rate even though it uses packets.

From frame relay, cell relay takes improved error control into account, and allows more errors to be handled at a higher logical level.

So, in the evolution of switching technology there has been a change from two areas – circuit switching for CBR, and packet switching for VBR.

4.3 HOW COMPATIBLE IS ATM AS TECHNOLOGY?

ATM has emerged as a viable technology. Some of its applications are:

- ATM is used in many networks today including both private and public environments. ATM is used extensively by most public service providers today to integrate all different types of traffic into one network.
- ATM can be used in existing twisted pair, fiber-optic, coaxial, and hybrid fiber/coax (HFC) networks for local area network (LAN) and wide area network (WAN) communications. Because ATM was developed to have such a wide range of compatibility with existing networks, its implementation does not require replacement or over-building of telephone, data, or cable networks.
- ATM is also compatible with wireless and satellite communications.

4.4 ATM LAYERED ARCHITECTURE IN COMPARISON WITH OSI MODEL

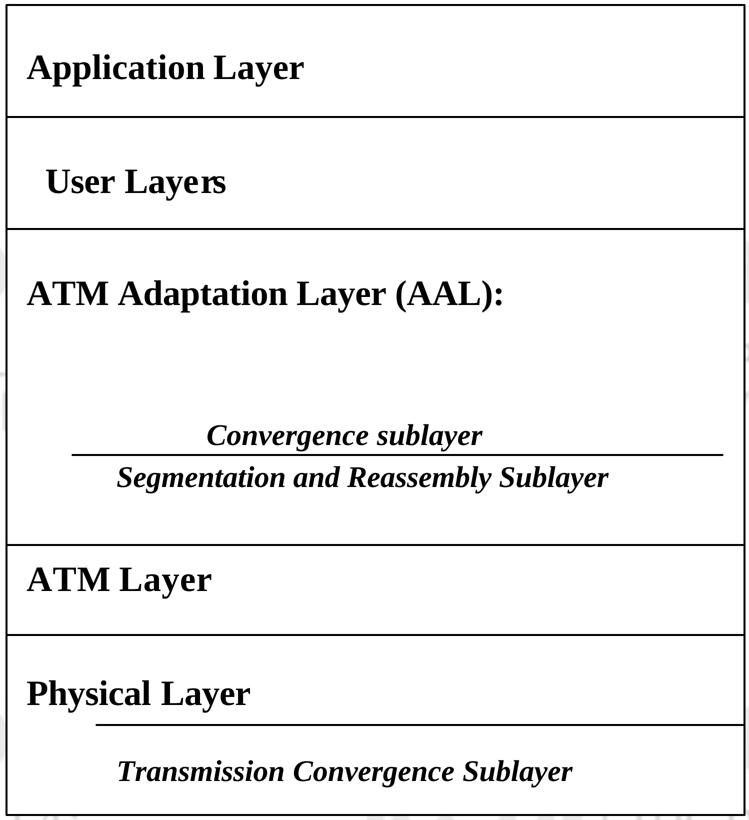
ATM is a connection invented protocol.

ATM has a layered structure that is similar to the 7-layerd OSI model. However, ATM only addresses the functionality of the two lowest layers of the OSI model, i.e.;

- The physical layer, and
- The data link layer.

Apart from these two layers, all other layers of the OSI model are irrelevant in ATM, as these layers are only part of the encapsulated information portion of the cell which is not used by the ATM network.

In ATM, the functionality of the two lower OSI layers are handled by three layers.



ATM Protocol Model

i) **Physical Layer:** The physical layer defines the specification of a transmission medium (copper, fiber optic, coaxial, HFC, wireless) and a signal encoding scheme and electrical to optical transformation. It provides convergence with physical transport protocols, such as SONET as well as the mechanism for transforming the flow of cells into a flow of bits.

The ATM form has left most of the specification for this level to the implementer.

ii) The ATM layer deals with cells and cell transport. It defines the layout of a cell and tells what the header fields mean. The size of a cell is 53 bytes (5 bytes of header and 48 bytes of payload). Because each cell is the same size and all are relatively small, delay and other problems with multiplexing different sized packets are avoided.

It also deals with establishment and release of virtual circuits. Congestive control is also located here. It resembles the network layer of the OSI model as it has got the characteristics of the network layer protocol of OSI model like;

- Routing

- Switching
- End to end virtual circuit set up
- Traffic management.

Switches in ATM provides both switching and multiplexing Cell format of ATM Layer are distinguished as

- UNI (User Network Interface)
- NNI (Network-Network Interface)

In both cases the cell consists of a 5 byte header followed by a 48 bytes pay-load but the two headers are slightly different.

iii) **ATM Adaptation Layer:** The ATM Adaptation Layer (AAL) maps the higher-level data into ATM cells to be transported over the ATM network, i.e., this layer segments the data and adds appropriate error control information as necessary. It is dependent on the type of services (voice, data, etc.) being transported by the higher layer.

The adaptation layer that divides all types of user data into 48-byte cells, the ATM layer that adds the five-byte header information to direct the user data to its destination.

Depending on the type of data, several type of AAL layers have been defined. However, no AAL is restricted to a specific data class or type; all types of data could conceivable be handled by any of the AALs. The various AAL protocols defined are:

1. AAL 1
2. AAL 2
3. AAL 3/4
4. AAL 5

It is divided into two sublayers

- SAR (Segmentation and Reassembly)
- CS (Convergence Sublayer)

Segmentation & Reassembly: This is the lower part of the AAL. The SAR sublayer breaks packets up into cells on the transmission side and put them back together again at the destination. It can add headers and trailers to the data units given to it by the CS to form payloads. It is basically concerned with cells.

Convergence Sublayer: The CS sublayer makes it possible to have ATM systems offer different kind of services to different applications. The CS is responsible for accepting bit streams or arbitrary length messages from the application and breaking them units of 44 or 48 bytes for transmission.

4.5 HOW ATM PROTOCOL WORKS?

When a user sends data over the ATM network, the higher-level data unit is passed down to the Convergence Sublayer of the AAL Layer, which prepares the data for the ATM Layer according to the designated AAL protocol. The data is then passed down to the Segmentation and Reassembly Sublayer of the AAL Layer, which divides the data unit into appropriately sized segments.

These segments are then passed down to the ATM Layer, which defines an appropriate cell header for each segment and encapsulates the header and payload segment into a 53-byte ATM cell. The cells are then passed down to the Physical Layer, which streams the cells at an appropriate pace for the transmission medium being used, adding empty cells as needed.

ATM circuit connections are of two types:

1. Virtual Paths and,
2. Virtual Channels.

A virtual channel is a unidirectional pipe made up from the concatenation of a sequence of connection elements.

A virtual path consists of a set of these virtual channels.

Each virtual channel and virtual path has an identifier associated with it. Virtual path is identified by Virtual Path Identifiers (VPI) and a virtual channel is identified by a

Virtual Channel Identifier (VCI): All channels within a single path must have distinct channel identifiers but may have the same channel identifier as channels in different virtual paths.

An individual channel can therefore be uniquely identified by its virtual channel and virtual path number. Cell sequence is maintained through a virtual channel connection.

ATM connections can be categorised into two types:

i) ***Point-to-point connections:*** These are the connections which connect two ATM end-systems. Such connections can be unidirectional or bidirectional.

ii) ***Point-to-multipoint connection:*** These are the connections which connects a single source end-system known as the root node) to multiple destination end-systems (known as leaves).

The basic operation of an ATM switch is very simple to understand.

1. The ATM switch receives a cell across a link on a known VCI or VPI value.

2. The ATM switch looks up the connection value in a local translation table to determine the outgoing port (or ports) of the connection and the new VPI/VCI value of the connection on that link.

3. The ATM switch then retransmits the cell on that outgoing link with the appropriate connection identifiers.

The manner in which the local translation tables are set up determine the two fundamental types of ATM connections:

- ***Permanent Virtual Connections (PVC):*** A PVC is a connection set up by some external mechanism, typically network management, in which a set of switches between an ATM source and destination ATM system are programmed with the appropriate VPI/VCI values.

- ***Switched Virtual Connections (SVC):*** An SVC is a connection that is set up automatically through a signalling protocol. SVCs do not require the manual interaction needed to set up PVCs and, as such, are likely to be much more widely used.

4.6 THE ATM NETWORK

An ATM network consists of a set of ATM switches interconnected by point-to-point ATM links or interfaces. ATM switches support three kinds of interfaces:

- user-network interfaces (UNI)
- network-node interfaces (NNI)
- Inter-Carrier Interface (ICI).

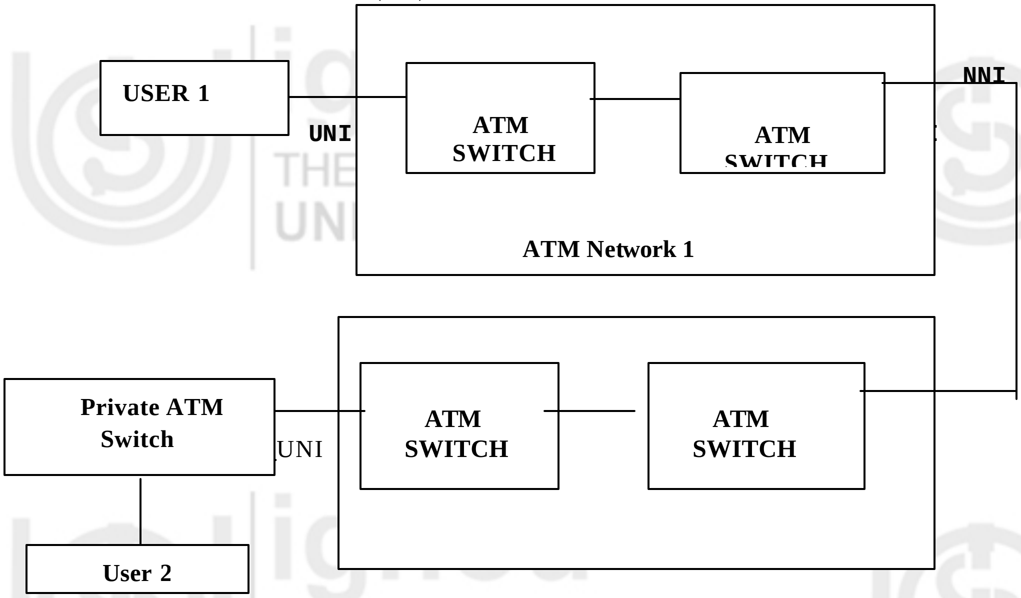


Figure 1: ATM Network

- The UNI exists between a single end user and a public ATM network, between a single end user and a private ATM switch, or between a private ATM switch and the public ATM network.
- The NNI exists between switches in a single public ATM network. NNIs may also exist between two private ATM switches.
- The ICI is located between two public ATM networks.

The major differences between these types of interfaces are administrative and signalling related. The only type of signalling exchanged across the UNI is that required to set up a *Virtual Channel* for the transmission.

Communication across the NNI and the ICI will require signalling for virtual-path and virtual-channel establishment together with various exchange mechanisms for the exchange of information such as routing tables, etc.

Let's take an example to understand as to how the ATM network works

- Let there be a user 1 in Delhi who wishes to transfer a data file to user 2 in Bangalore. A virtual channel is created and a virtual path is established from switch to switch within the public ATM network in Delhi (ATM Network 1) which, in turn, establishes contact with the public ATM network in Bangalore (ATM Network 2).

- ATM Network 2 also establishes a virtual path from switch to switch within the network and with the Private ATM Switch at the destination. The private ATM network completes the virtual path by establishing a virtual channel with User 2 in Bangalore.
- At each interface in this network, a unique virtual path identifier (VPI) and virtual channel identifier (VCI) is established for this transmission. These identifiers are significant only for a specific switch and the two nodes adjacent to it in the virtual path. Each node within the virtual path (including both the end users and the switches) maintain a pool of inactive identifiers to be used as needed.
- User 1 or User 2 terminates the call and the virtual path is discontinued. The VCI and VPI values are returned to the pool of available values for each switch.

Notice that only the users at either end of the transmission deal with the 48-byte information load within the cell. At each stage of the transmission, the switch is only concerned with accepting the cell from one port, changing the VPI/VCI according to its tables, and routing the cell out the appropriate switch port.

4.7 THE ATM CELL

ATM transmits all the information in small, fixed-size packets called Cells. Each individual ATM cell consists of a 5-byte cell header and 48 bytes of data. The ATM network uses the header to support the virtual path and the virtual channel routing, and to perform a quick error check for corrupted cells.

Bytes

5	48
Header	User data

Figure 2: An ATM Cell

The Header Format

The structure of header is different in UNI and NNI. In the network-network interface, the virtual path identifier field is expanded from 8 to 12 bits.

8	7	6	5	4	3	2	1
Generic Flow Control*				**Virtual Path Identifier**			
Virtual Path Identifier				**Virtual Channel Identifier**			
Virtual Channel Identifier							
Virtual Channel Identifier				**Payload Type ID**			**CLP**
Header Error Control							
INFORMATION PAYLOAD (48 Bytes)							

Figure 3 : User-network Interface

8	7	6	5	4	3	2	1
Virtual Path identifier							
Virtual Path Identifier				**Virtual Channel identifier**			
Virtual Channel Identifier							
Virtual Channel Identifier				**Payload Type ID**			**CLP**
Header Error Control							
INFO RMATION PAYLOAD (48 Bytes)							

Figure 4: Network-network interface

Let's now look at the characteristics of each of the fields of the header format of an ATM cell.

Generic Flow Control (GFC)

The GFC field of the header is only defined across the UNI and does not appear in the NNI.

Function

- It controls the traffic flow across the UNI.

Virtual Path Identifier (VPI)

The VPI is an 8-bit field for the UNI and a 12-bit field for the NNI.

Function

- It constitutes a routing field for the network and is used to identify virtual paths. In an idle cell, the VPI is set to all 0's.
- Together with the Virtual Channel Identifier, the VPI provides a unique local identification for the transmission.

Virtual Channel Identifier (VCI)

It is a 16-bit field used to identify a virtual channel. For idle cells, the VCI is set to all 0's.

Function:

- It functions as a service access point and it is used for routing to and from the end user.
- Together with the Virtual Path Identifier, the VCI provides a unique local identification for the transmission.

Payload Type Identifier (PTI)

The PTI field indicates the type of information in the information field. The value in each of the three bits of PTI indicate different conditions.

Bit 1 is set to 1 to identify operation, administration, or maintenance cells (i.e., anything other than data cells).

Bit 2 is set to 1 to indicate that congestion was experienced by a data cell in transmission and is only valid when bit 4 is set to 0.

Bit 3 is used to convey information between end users.

Cell Loss Priority (CLP)

The 1-bit CLP field is used for indication of the priority of the cell. It is used to provide guidance to the network in the event of congestion. When set to value 1, it indicates that the cell is subject to discard within the network when congestion occurs. When the CLP value is set to 0, it indicates that the cell is of relatively high priority and should be discarded only in situations when no alternative is available.

Header Error Control (HEC)

Each ATM cell includes an 8-bit HEC that is calculated based on the remaining 32 bits of the header.

Function:

- It detects all single-bit errors and some multiple-bit errors. As an ATM cell is received at a switch, the HEC of the cell is compared and all cells with HEC discrepancies (errors) are discarded. Cells with single-bit errors may be subject to error correction if supported or discarded. When a cell is passed through the switch and the VPI/VCI values are altered, the HEC is recalculated for the cell prior to being passed out the port.

Advantages of small, fixed sized cells

Here is a list of some advantages of a cell.

1. Reduced queuing delay for a high priority cell;

2. Easy to implement the switching mechanism in hardware;

3. The fixed cell size ensures that time-critical information such as voice or video is not adversely affected by long data frames or packets;

4. The header is organised for efficient switching in high-speed hardware implementations and carries payload-type information, virtual-circuit identifiers, and header error check.

4.8 ATM CLASSES OF SERVICES

ATM is connection oriented and allows the user to specify the resources required on a per-connection basis (per SVC) dynamically. There are the five classes of service defined for ATM (as per ATM Forum UNI 4.0 specification).

ATM Service Classes

Service Class	Quality of Service Parameter
Constant bit rate (CBR)	CBR class is used for emulating circuit switching. The cell rate is constant with time. CBR applications are sensitive to cell-delay variation. Examples of applications that can use CBR are telephone traffic (i.e., nx64 kbps), videoconferencing, and television.
Variable bit rate–non-real time (VBR–NRT)	VBR-NRT class allows users to send traffic at a rate that varies with time depending on the availability of user information. Statistical multiplexing is provided to make optimum use of network resources. Multimedia e-mail is an example of VBR–NRT.
Variable bit rate–real time (VBR–RT)	This class is similar to VBR–NRT but is designed for applications that are sensitive to cell-delay variation. Examples for real-time VBR are voice with speech activity detection (SAD) and interactive compressed video.
Available bit rate (ABR)	ABR class provides rate-based flow control and is aimed at data traffic such as file transfer and e-mail. Although the standard does not require the cell transfer delay and cell-loss ratio to be guaranteed or minimized, it is desirable for switches to minimize delay and loss as much as possible. Depending upon the state of congestion in the network, the source is required to control its rate. The users are allowed to declare a minimum cell rate, which is guaranteed to the connection by the network.
Unspecified bit rate (UBR)	UBR class is the catch-all, other class and is widely used today for TCP/IP.

The ATM Forum has identified certain technical parameters to be associated with a connection.

ATM Technical Parameters

Technical Parameter	Definition
Cell loss ratio (CLR)	CLR is the percentage of cells not delivered at their destination because they were lost in the network due to congestion and buffer overflow.
Cell transfer delay (CTD)	The delay experienced by a cell between network entry and exit points is called the CTD. It includes propagation delays, queuing delays at various intermediate switches, and service times at queuing points.
Cell delay variation (CDV)	CDV is a measure of the variance of the cell transfer delay. High variation implies larger buffering for delay-sensitive traffic such as voice and video.
Peak cell rate (PCR)	The maximum cell rate at which the user will transmit. PCR is the inverse of the minimum cell inter-arrival time.
Sustained cell rate (SCR)	This is the average rate, as measured over a long interval, in the order of the connection lifetime.
Burst tolerance (BT)	This parameter determines the maximum burst that can be sent at the peak rate. This parameter is used to control the traffic entering the network.

ATM Technical Parameters

Finally, there are a number of ATM classes of service. These classes are :

ATM Classes of Services

Class of Service	CBR	VBR–NRT	VBR–RT	ABR	UBR
CLR	yes	yes	yes	yes	no
CTD	yes	no	yes	no	no
CDV	yes	yes	yes	no	no
PCR	yes	yes	yes	no	yes
SCR	no	yes	yes	no	no
BT @ PCR	no	yes	yes	no	no
flow control	no	no	no	yes	no

Its extensive class-of-service capabilities make ATM the technology of choice for multimedia communications.

4.9 ATM TRAFFIC CONTROL

An ATM network needs efficient Traffic Control mechanisms to allocate network resources in such a way as to separate traffic flows according to the various service classes and to cope with potential errors within the network at any time. The network should have the following traffic control mechanisms.

- Network Resource Management
- Connection Admission Control
- Usage Parameter Control and Network Parameter Control
- Priority Control
- Congestion Control.

Network Resource Management: Network Resource management deals with allocation of network resources in such a way that traffic is separated on the basis of the service characteristics. A tool of network resource management which can be used for Traffic Control is the **virtual path technique**. A virtual path connection (VPC) groups several virtual channel connections (VCC)s together such that only the collective traffic of an entire virtual path has to be handled. In this type of setup, priority control can be supported by reaggregating traffic types requiring different qualities of service through virtual paths. Messages for the operation of traffic control can be more easily distributed, a single message referring to all the virtual channels within a virtual path will do.

Connection Admission Control: Connection Admission Control is the set of actions taken by the network in protecting itself from excessive input loads. When a user requests a new virtual path connection or virtual channel connection, the user needs to specify the traffic characteristics in both directions for that connection. The network establishes such a connection only if sufficient network resources are available to establish the end-to-end connection with the required quality of service. The agreed quality of service for any of the existing channels must not be affected by the new connection.

Usage Parameter Control and Network Parameter Control: After a connection is accepted by the Connection Admission Control function, the UPC function of network monitors the connection to check whether the traffic conforms to the traffic contract.

The main purpose of UPC/NPC is to protect the network resources from an overload on one connection that would affect the quality of service of other already established connections.

Usage Parameter Control (UPC) and Network Parameter Control (NPC) do the same job at different interfaces. The UPC function is performed at the UNI, while the NPC function is performed at the NNI.

Functions performed by the Usage parameter control include:

- Checking the validity of VPI/ VCI values.
- Monitoring the traffic volume entering the network from all active VP and VC connections to ensure that the agreed parameters are not violated.
- Monitoring the total volume of the accepted traffic on the access link.
- Detecting violations of contracted (agreed) parameter values and taking appropriate actions.

Priority Control: Priority control is important function as its main objective is to discard lower priority cells in order to protect the performance of higher-priority cells.

Congestion Control: Congestion is a state of network where in the network resources are overloaded. This situation indicates that the network is not able to guarantee the negotiated quality of service to the established connections and to the new connection requests. ATM Congestion control refers to the measures taken by the network to minimize the intensity, spread and duration of network congestion.

4.10 BENEFITS OF ATM

1. As a high-bandwidth medium with low delay and the capability to be switched or routed to a specific destination, ATM provides a uniformity that meets the needs of the telephone, cable television, video, and data industries. This universal compatibility makes it possible to interconnect the networks — something that is not currently possible because of the various transmission standards used by each industry.

2. One of the key advantages of ATM is its ability to transmit video without creating a jittery picture or losing the synchronisation of the sound and picture. This is possible due to proper resource allocation and admission control.

3. ATM is also provides dynamic bandwidth for bursty traffic.

4. Telephone networks connect every telephone to every other telephone using a dedicated path, but carry narrow bandwidth signals. Cable networks carry broadband signals, but only connect subscribers to centralised locations. To build a network that would provide a dedicated connection between sender and receiver for broadband communications would be prohibitively expensive. For this reason, ATM seems to be the best hope since it can use existing networks to deliver simple voice and data as well as complex and time-sensitive television signals. ATM can also handle bi-directional communications easily.

5. Unlike packet switching, ATM is designed for high-performance multimedia networking.

4.11 ATM APPLICATIONS

ATM technologies, standards, and services are being applied in a wide range of networking environments.

- **ATM services:** Service providers globally are introducing or already offering ATM services to their business users.
- **ATM workgroup and campus networks:** Enterprise users are deploying ATM campus networks based on the ATM LANE standards. Workgroup ATM is more of a niche market with the wide acceptance of switched-Ethernet desktop technologies.
- **ATM enterprise network consolidation:** A new class of product has evolved as an ATM multimedia network-consolidation vehicle. It is called an ATM enterprise network switch. A full-featured ATM ENS offers a broad range of in-building (e.g., voice, video, LAN, and ATM) and wide-area interfaces (e.g., leased line, circuit switched, frame relay, and ATM at narrowband and broadband speeds) and supports ATM switching, voice networking, frame-relay SVCs, and integrated multiprotocol routing.
- **Multimedia virtual private networks and managed services:** Service providers are building on their ATM networks to offer a broad range of services. Examples include managed ATM, LAN, voice and video services.
- **Frame-relay backbones:** Frame-relay service providers are deploying ATM backbones to meet the rapid growth of their frame-relay services to use as a networking infrastructure for a range of data services and to enable frame relay to ATM service interworking services.
- **Internet backbones:** Internet service providers are likewise deploying ATM backbones to meet the rapid growth of their frame-relay services, to use as a networking infrastructure for a range of data services, and to enable Internet class-of-service offerings and virtual private intranet services.
- **Residential broadband networks:** ATM is the networking infrastructure of choice for carriers establishing residential broadband services, driven by the need for highly scalable solutions.
- **Carrier infrastructures for the telephone and private-line networks:** Some carriers have identified opportunities to make more-effective use of their SONET/SDH fiber infrastructures by building an ATM infrastructure to carry their telephony and private-line traffic.

However, it is reworked that ATM is costly technology.

☞ Check Your Progress 1

1) Fill up the blanks:

   (i) ATM cells are ……………………with ………….header formats.

   (ii) Asynchronous Transfer Mode (ATM), is also known as…………….

   (iii) ATM is fundamentally a ………..switching technology

   (iv) Multirate circuit switching is an enhancement of…………

   (v) The two main approaches to packet switching are…………..and ………….

2) What is ATM?

………………………………………………………………………………………

………………………………………………………………………………………

3) Differentiate between Datagram and Virtual circuit.

………………………………………………………………………………………

………………………………………………………………………………………

4) List the types of ATM connections.

………………………………………………………………………………………

………………………………………………………………………………………

5) ATM switches support three kinds of interfaces. List and explain each of them.

………………………………………………………………………………………

………………………………………………………………………………………

6) Draw and explain the structure of an ATM cell.

………………………………………………………………………………………

……………………………………………………………………………………...

4.12 SUMMARY

1. Asynchronous transfer mode (ATM) is a high-performance, cell-oriented switching and multiplexing technology that utilises fixed-length packets to carry different types of traffic.

2. ATM is a technology defined by protocol standards created by the ITU-T, ANSI, ETSI and the ATM Forum.

3. ATM is asynchronous because cells are not transferred periodically. Cells are given time slots on demand.

4. ATM is a technology that will enable carriers to capitalise on a number of revenue opportunities through multiple ATM classes of services; high-speed local-area network (LAN) interconnection; voice, video, and future multimedia applications in business markets in the short term; and in community and residential markets in the longer term.

5. ATM reduces infrastructure costs through efficient bandwidth management, operational simplicity, and the consolidation of overlay networks.

4.13 SOLUTIONS/ANSWERS

Check Your Progress 1

1)

(i) Fixed-sized, fixed
(ii) Cell relay

(iii) Packet
(iv) TDM-Time-Division Multiplexing
(v) Datagram, virtual circuit

2) ATM is a cell switching technology that allows voice, video and data to be sent along the same network.

3)

1. Datagram: It is a transport technique used in packet switching where each packet can take any path through the network as long as they all reach the destination.

2. Virtual Circuit is a transport technique used in packet switching where all the packets are routed through the same path without having the path dedicated.

3. Datagram allows for dynamic handling of congestion and no call setup is necessary. Virtual channels allow for sequencing, error and flow control.

4) The two types of ATM connections are:

1. point-to-point connection
2. point-to-multipoint connection

5) ATM switches support three kinds of interfaces. These are:

- user-network interfaces (UNI)
- network-node interfaces (NNI).
- Inter-Carrier Interface (ICI)

Explanation:

- The **UNI** exists between a single end user and a public ATM network, between a single end user and a private ATM switch, or between a private ATM switch and the public ATM network of an RBOC.
- The **NNI** exists between switches in a single public ATM network. NNIs may also exist between two private ATM switches.
- The **ICI** is located between two public ATM networks (an RBOC and an inter-exchange carrier).

6) ATM transmits all the information in small, fixed-size packets called Cells. Each individual ATM cell consists of a 5-byte cell header and 48 bytes of data. The ATM network uses the header to support the virtual path and the virtual channel routing, and to perform a quick error check for corrupted cells.

Bytes

5	48
Header	User data