

# ATM Services and Traffic Management

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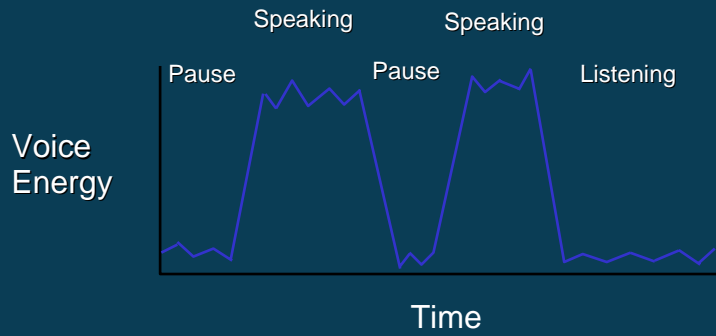


## Topics

- Introduction to ATM Technology
- ATM Service Categories
- ATM Traffic Contract and Parameters
- ATM Traffic Management

## ATM Fundamental Concept

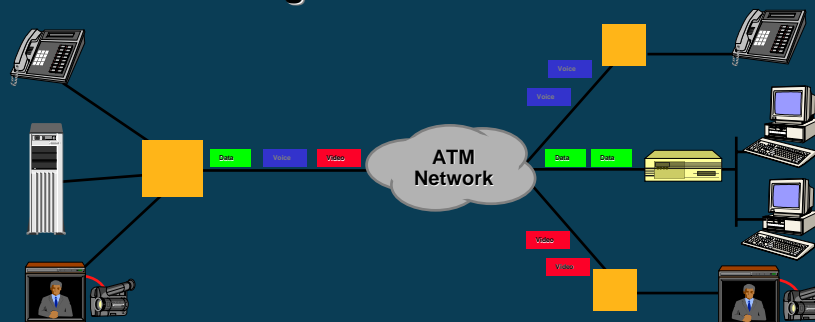
All communications are bursty.



Therefore, a high performance packet switching network can carry all communications.

## ATM Vision

The Ultimate Integrated Services Network

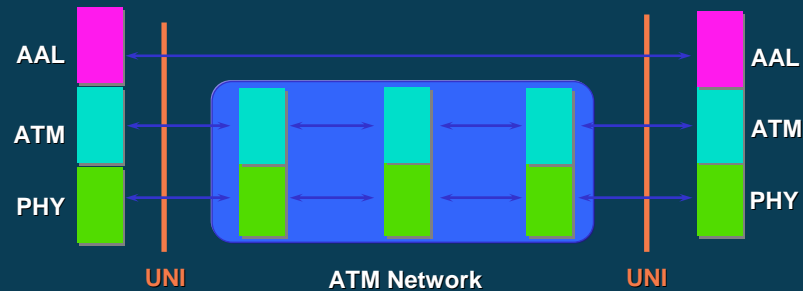


- ATM network moves cells (fixed length packets) with low delay and low delay variation at high speeds
- Devices at ends translate (e.g., segment and reassemble) between cells and original traffic

## Broadband-ISDN

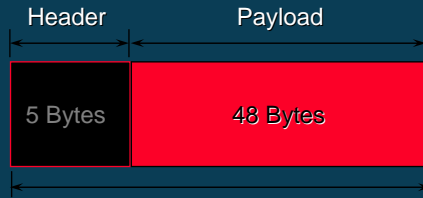
- ATM is the foundation technology for Broadband-ISDN
- B-ISDN is the universe of services that will be made possible by the use of ATM technology
  - Voice
  - Data
  - Video

## Layered Architecture



- PHY = Physical Layer
- UNI = User Network Interface
- AAL = ATM Adaptation Layer
- Different AAL Protocols for Different Traffic Types (e.g., data, voice, video)

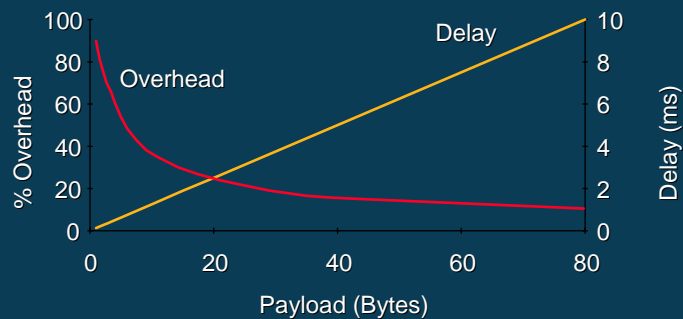
## The ATM Cell



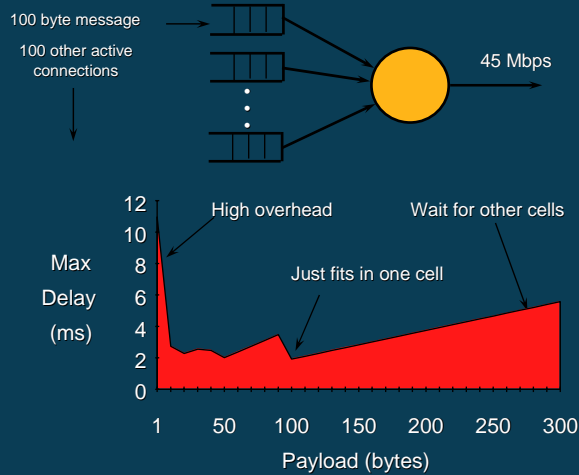
- Small Size
  - 5 Byte Header
  - 48 Byte Payload
- Fixed Size
- Header contains virtual circuit information
- Payload can be voice, video or other data types

## Packetization Delay Advantage of Small Cells

Percent Overhead and Packetization Delay for 64 Kbps Voice



## Queuing Advantage of Small Cells

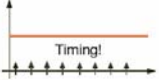
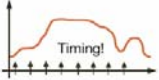





Delay and delay variation are small for small messages e.g., a digitized voice sample

## ATM Service Categories

- CBR
  - Constant Bit Rate
  - Continuous flow of data with tight bounds on delay and delay variation
- rt-VBR
  - Real-Time Variable Bit Rate
  - Variable bandwidth with tight bounds on delay and delay variation
- nrt-VBR
  - Non-Real-Time Variable Bit Rate
  - Variable bandwidth with tight bound on cell loss
- UBR
  - Unspecified Bit Rate
  - No guarantees (i.e., best effort delivery)
- ABR
  - Available Bit Rate
  - Flow control on source with tight bound on cell loss

## ATM Service Categories

ATM-Forum	ITU-T	Possible traffic profile	Description/ Applications
Constant Bit Rate <b>CBR</b>	Deterministic Bit Rate <b>DBR</b>		Constant bit rate with time reference (real-time) Speech, video
Realtime Variable Bit Rate <b>rt-VBR</b>	under study		Variable bit rate with time reference (real-time) Compressed video/audio
Non realtime Variable Bit Rate <b>nrt-VBR</b>	Statistical Bit Rate <b>SBR</b>		Variable bit rate without time reference File transfer
Available Bit Rate <b>ABR</b>	Available Bit Rate <b>ABR</b>		Resource-dependent bandwidth-allocation, network has interactive control
Unspecific Bit Rate <b>UBR</b>	-		No guarantee for traffic and QoS parameters

## ATM Service Categories and Applications

	CBR	rt-VBR	nrt-VBR	ABR	UBR
Critical data	●●	●	●●●	●	○
LAN interconnect	●	●	●●	●●●	●●
WAN transport	●	●	●●	●●●	●●
Circuit emulation	●●●	●●	○	○	○
Telephony, Video-conferencing	●●●	○○	○○	○	○
Compressed audio	●	●●●	●●	●●	●
Video distribution	●●●	●●●	●	○	○
Interactive multimedia	●●●	●●●	●●	●●	●

●●● Optimum; ●● Good; ● Fair; ○ Not suitable; ○○ Under review

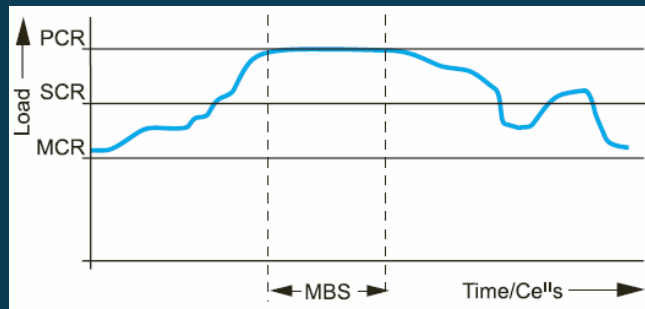
## Traffic Contract

- ATM services are classified according to various criteria:
  - Type of service, characterized by the traffic parameters
  - Service quality, characterized by the QoS parameters
- The primary characteristics must be agreed upon in the form of a traffic
- contract before communication starts.

## Traffic Parameters

- The traffic parameters define the type of service:
  - **Peak Cell Rate (PCR):** This defines the maximum bit rate that may be transmitted from the source.
  - **Cell Delay Variation Tolerance (CDVT) peak:** This is the tolerance in cell delay variation referred to the peak cell rate.
  - **Sustainable Cell Rate (SCR):** This is the upper limit for the average cell rate that may be transmitted from the source.
  - **Cell Delay Variation Tolerance (CDVT) sustained:** CDVT referred to the sustainable cell rate.
  - **Maximum Burst Size (MBS)/Burst Tolerance (BT):** Maximum time or number of cells for which the source may transmit the PCR.
  - **Minimum Cell Rate (MCR):** Minimum cell rate guaranteed by the network (for ABR).

## ATM Traffic Parameters



## ATM Service Categories and Parameters

Attributes	CBR	rt-VBR	nrt-VBR	UBR	ABR	Parameter class
CLR	defined	defined	defined	not defined	defined	QoS
CTD and CDV	CDV and Mean CTD	CDV and Max CTD	only Mean CTD	not defined	not defined	QoS
PCR and CDTV	defined	defined	defined	defined	defined	Traffic
SCR and BT	not usable	defined	defined	not usable	not usable	Traffic
MCR	not usable	not usable	not usable	not usable	defined	Traffic

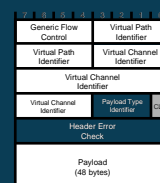


## Quality of Service (QoS) Classes

- The QoS classes are independent of the service. The following classes have so far been defined:
  - Class 0: Unspecified
  - Class 1: Circuit emulation, CBR video
  - Class 2: VBR audio and video
  - Class 3: Circuit-switched data traffic
  - Class 4: Circuitless data traffic
- The classes are differentiated by specifying different values for the following parameters:
  - CTD
  - CDV
  - CLR (differ for cells with CLP-0 and CLP-1)

## Traffic Management

- Problem: Providing quality of service
  - How should ATM network resources be allocated to ensure good performance including preventing congestion, e.g., how many virtual channels should be assigned to a particular transmission link?
- Solution: Traffic Management
  - Specify the traffic "contract" on each virtual channel/path
  - Route (including rejecting setup request) each virtual channel/path along a path with adequate resources (Admission Control)
  - Mark (via Cell Loss Priority bit) for loss all cells that violate the contract (Traffic Policing)



## Traffic Management

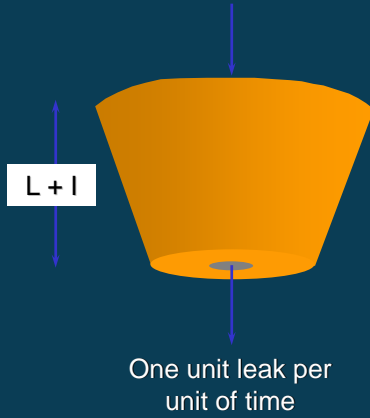
- To ensure that a given quality of service is maintained for all ATM services, it is important that the network does not become overloaded.
- The individual connections must also not influence each other to the extent that a reduction in quality occurs.
- Control and regulation mechanisms have been introduced to allow the different virtual channels to work together smoothly.

## Traffic Management

- Traffic management functions
  - **Connection admission control (CAC):** Checks during the signaling procedure whether a connection can maintain the requested QoS and does not adversely affect the QoS of existing established connections within the framework of the traffic contract.
  - **Usage parameter control (UPC) or policing:** This monitors that the parameters agreed to in the traffic contract are being adhered to. Cells that do not conform are tagged accordingly (CLP-1).
  - **Cell loss priority control:** Ensures that tagged cells (CLP-1) are rejected if the need arises.
  - **Traffic shaping:** This is performed by terminal equipment and some network elements to ensure that the transmitted cell stream conforms to the traffic contract at all times.
  - **GCRA (generic cell rate algorithm):** also known as the "leaky bucket" algorithm. This algorithm is employed by UPC as well as traffic shaping. The PCR, SCR and MBS parameters are controlled with the aid of the GCRA. The principle can be illustrated by a leaky bucket. Assume that the bucket is full of ATM cells. The leak in the bucket is just large enough to ensure that the bucket does not overflow when ATM cells conforming to the standard are received.

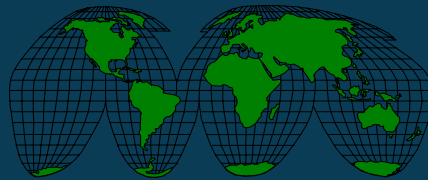
# Generic Cell Rate Algorithm

I for each cell arrival



- For a sequence of cell arrival times,  $\{t_k\}$ , determines which cells conform to the traffic contract
- A counter scheme based on two parameters denoted GCRA(I,L)
  - Increment parameter: I
    - affects cell rate
  - Limit parameter: L
    - affects cell bursts
- “Leaky bucket”
  - A cell that would cause the bucket to overflow is non-conforming

Generic Flow Control	Virtual Path Identifier
Virtual Path Identifier	Virtual Channel Identifier
Virtual Channel Identifier	
Virtual Channel Identifier	Payload Type Identifier CLP
Header Error Check	
Payload (48 bytes)	



Thank you

Questions & Comments

