

BROADBAND AND HIGH SPEED NETWORKS

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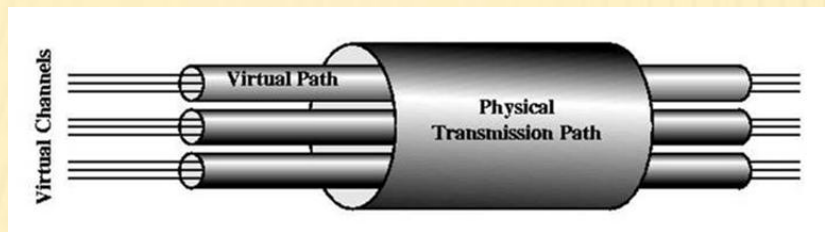
Asynchronous Transfer Mode (ATM)

INTRODUCTION

- ❑ **ATM** stands for **A**synchronous **T**ransfer **M**ode
- ❑ ATM is a flexible high bandwidth, low delay network technology that is:
 - ❑ Capable of handling voice, video and data on a single network
- ❑ Major advantages of ATM include:
 - ❑ Bandwidth management capabilities; and
 - ❑ Support for Quality of Service (QoS) features.
- ❑ SONET/SDH was defined for the transport of ATM cells

ATM CONNECTIONS

- ❑ **ATM is a connection oriented technology.**
 - ❑ (A connection must be set up across the ATM network prior to data transfer)
- ❑ **There are two types of ATM connections.**
 - ❑ Virtual path connections – identified by virtual path identifiers (VPI).
 - ❑ Virtual channel connections – identified by a combination of virtual path and circuit identifiers (VPI and VCI).



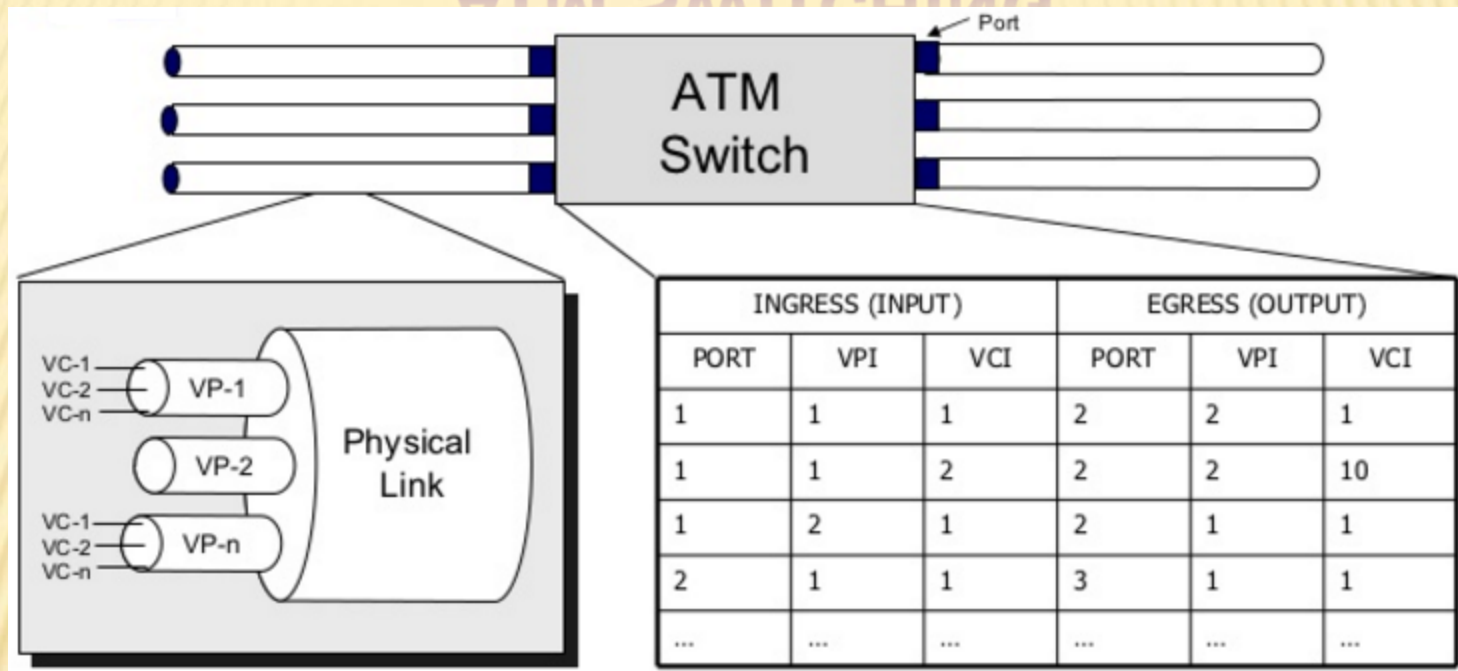
❑ Virtual Channels (VC)

- ❑ The basic unit that carry a stream of ATM cells from one user to another.
- ❑ Identified by a virtual channel identifier.
- ❑ Can be concatenated.
- ❑ Can be configured statically and dynamically.
 - ❑ Statically as PVCs (Permanent Virtual Circuits) that are setup at network configuration time.
 - ❑ Dynamically as SVCs (Switched Virtual Circuits) that are dynamically configured on demand.
- ❑ Can be bundled together into virtual path connections.

❑ Virtual Paths (VP)

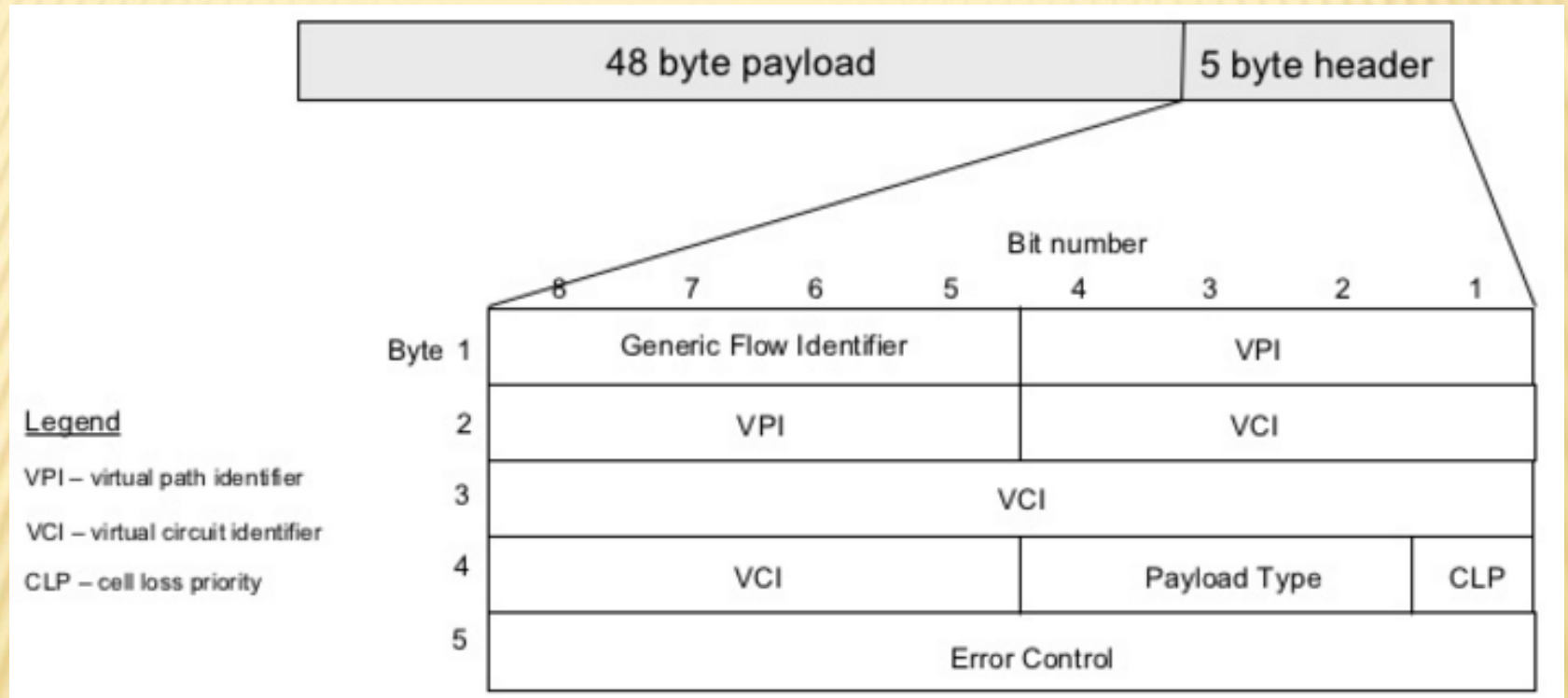
- ❑ Contain one or more virtual channels.
- ❑ Identified by a virtual path identifier.
- ❑ Routed through a network as a single entity.
- ❑ Can be used internally for bundling virtual circuits between switches.

ATM SWITCHING



- ❑ ATM switch receives ATM cell from a specific virtual channel on a particular input port.
- ❑ Each ATM cell header contains VPI and VCI information.
- ❑ The combination of port, VPI and VCI is unique within a switch.
- ❑ Switch checks its internal routing table to determine corresponding outgoing VPI and VCI that should be assigned to the cell and the output port on which the cell should be forwarded.
- ❑ The switch replaces the incoming VPI/VCI header info with the outgoing VPI/VCI info and sends the cell through the output port to the next device.
- ❑ The process is repeated across multiple devices until the cell reaches its destination.

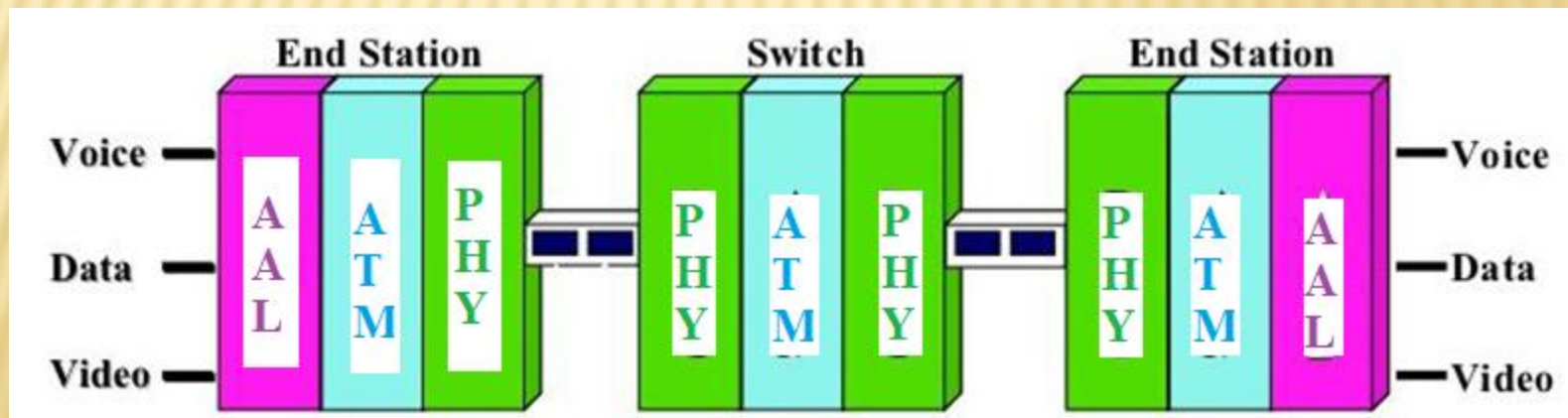
ATM CELL STRUCTURE



- ❑ Each physical link can support 2^8 virtual paths = 256 VPIs.
- ❑ Each VPI can support 2^{16} virtual circuits = 65,536 VCIs.
- ❑ Each VPI/VCI combination is unique per physical link = 16,777,216 VPI/VCIs.

ATM SYSTEM ARCHITECTURE

- ATM has a layered architecture.
- The ATM layers are :
 - Physical layer – Provides connectivity between network elements (e.g. SONET). Converts to appropriate electrical or optical format.
 - ATM layer – Provides for the transparent transfer of fixed-size (48 octet) data units. Add/Remove 5 byte header to payload.
 - ATM adaptation layer – Enhances the services and performance provided by the ATM layer to meet the needs of higher layer applications. Inserts/extracts information into/from 48 byte payload.
 - Higher layers – Represents various end-user applications (e.g. TCP/IP).



ATM ADAPTATION LAYER (AAL)

- ❑ AAL maps higher-level data onto ATM cells making the data suitable for transport through the ATM network and isolates higher layers from the ATM layer. These functions are performed on the user side.
- ❑ The concept of **Service Classes** is used to define traffic corresponding to specific combinations of:
 - ❑ *Timing relations between source and destination (required/not required).*
 - ❑ *Constant vs. Variable Bit Rate*
 - ❑ *Connection mode (Connection vs. Connectionless Oriented).*
- ❑ Defined Service Classes are :
 - ❑ **Class A-** Synchronous, Connection Oriented, Constant Bit Rate (e.g. DS, DS3 circuit emulation).
 - ❑ **Class B-** Synchronous, Connection Oriented, Variable Bit Rate (e.g. packet video).
 - ❑ **Class C-** Asynchronous, Connection Oriented, Variable Bit Rate (e.g. frame relay).
 - ❑ **Class D-** Asynchronous, Connectionless, Variable Bit Rate (e.g. SMDS).

AAL PROTOCOLS

- ❑ AAL protocols are defined to handle one or more of the above service classes and create properly formatted ATM cells.
 - ❑ AAL type 1 – Meets the needs of class A services.
 - Provides for the acceptance of user info at a fixed rate and delivery of this info at the destination at the same fixed rate and indication of loss or error information.
 - ❑ AAL type 2 – Meets the needs of class B services.
 - Designed to carry low bit rate, variable-length, delay sensitive packets.
 - ❑ AAL type 3/4 – Meets the needs of class C & D services.
 - Designed to carry variable bit rates with no timing relationship.
 - ❑ AAL type 5 – Meets the needs of class C services.
 - Similar to AAL type 3/4 with a simplified information header scheme.

ATM LAYER

□ The ATM Layer :

- Provides services to higher layers (e.g. multiplexing ATM connections on to a single connection) and setting parameters in the ATM cell header (traffic management).
 - Delivers ATM cells to the physical layer for transport.
 - A number of parameters are set at ATM layer that determine quality of service and traffic management
- **Quality of Service (QoS)** : refers to a collection of performance parameters whose values have to do with the speed and accuracy/reliability of ATM connection.
- **Traffic Parameters** : define characteristics of the traffic to be offered over the ATM connection

ATM LAYER

- Service Categories : represent particular combinations of traffic parameters and QoS parameters. These parameters are determined by users for a connection to meet the needs of higher-level applications.
 - CBR (Constant Bit Rate) support real-time applications requiring constrained delay variation (voice, video).
 - RT-VBR (Real Time Variable Bit Rate) support real time applications with bursty traffic.
 - NRT-VBR (Non-Real Time Variable Bit Rate) support non-real time applications with bursty traffic.
 - UBR (Unspecified Bit Rate) Represents a “best-effort service” intended for a non-real time applications that don’t require tightly constrained delay or delay variation and are tolerant to cell rate.
 - ABR (Available Bit Rate) similar to UBR but enhanced to handle applications that require minimum bandwidth requirement.

PHYSICAL LAYER

- ❑ The physical layer is responsible for placing and removing cells from the physical transport medium.
- ❑ Standards for physical interfaces to various media exist.
- ❑ SONET/SDH based transmission media are the most common for transmission of ATM.
- ❑ The physical layer performs two types of functions :
 - ❑ Functions associated with the structure or format of the info to be transmitted and other specific functions (e.g. multiplexing). These functions are independent of the transmission medium.
 - ❑ Functions associated with the transmission of signals over a particular medium (e.g. line coding for a particular medium). These functions are dependent on the transmission medium.

ATM INTERFACES

- ❑ **Private UNI** (user-network interface) – interface between a user's device (e.g. a workstation) and a private ATM switch.
- ❑ **Private NNI** (network-network interface) – interface between private ATM switches needed to support the ATM infrastructure.
- ❑ **Public UNI** – interface between the user's device and a provider of a public ATM service.
- ❑ **Public NNI** – interface between ATM switches in public carrier networks.
 - ❑ Also referred to as B-ISSI (broadband inter-switching system interface) when applied to the connection between two public switches of the same carrier.
 - ❑ Also referred to as B-ICI (broadband inter-carrier interface) when applied to the connection between two carriers networks.