# Introduction to ATM

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# Introduction

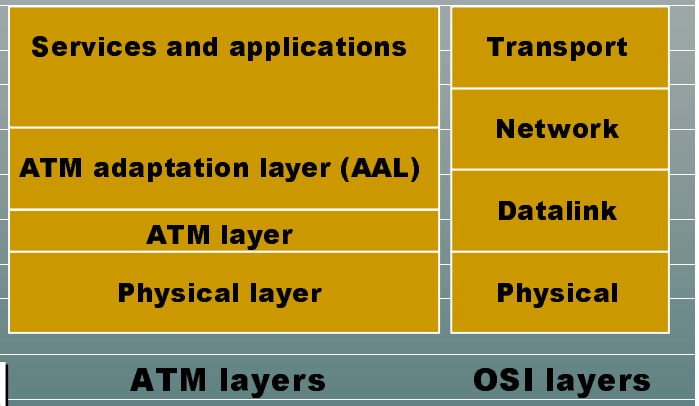
This talk is a basic introduction to ATM technology. We will introduce the key concepts of ATM technology, present ATM terminology such as LAN Emulation (LANE), Classical IP, Virtual LANs (VLANs), and Quality of Service (QoS). Finally, the Pros and Cons of ATM networks are presented to give a basic understanding of TCP/IP LANs built using ATM.

# What is ATM?

*"Asynchronous Transfer Mode is a communications networking technology that carries information in 53-byte chunks known as cells"*

# ATM Reference Model

- ATM is independent of any specific transmission medium
- ATM layer defines cell format, how cells are transported, and how to treat congestion. It also defines virtual circuit creation and termination.
- ATM adaptation layer defines the process of converting information from upper layers into ATM cells.



# Physical Layer

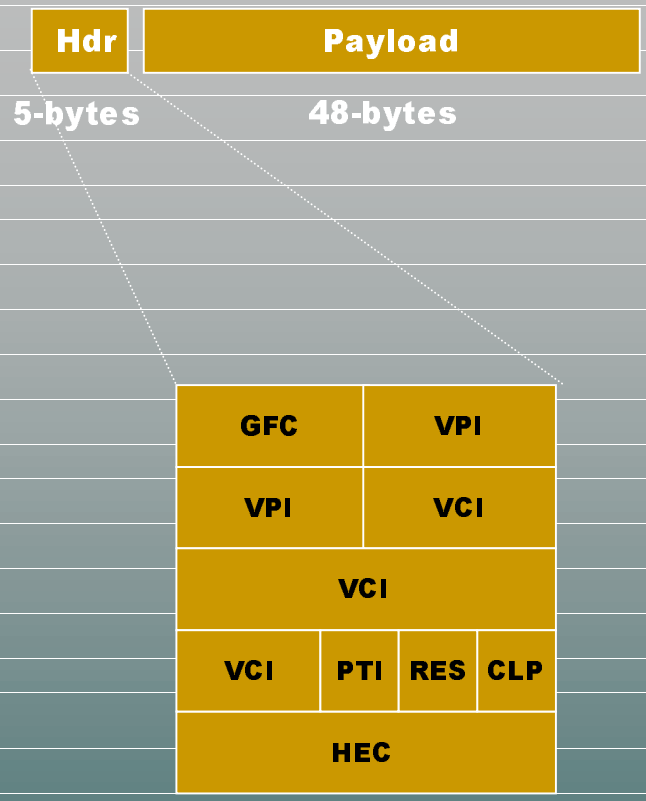
- Industry experts endorse SONET for both LAN and WAN
- ATM Forum recommends FDDI (100Mb/s), Fibre Channel (155Mb/s), OC3 (155Mb/s) and T3 (45Mb/s)
- Most carriers are providing T3 links to their ATM networks

| OC Level | Data Rate (Mbits/sec) |
|---|---|
| OC-1 | 51.84 |
| OC-3 | 155.52 |
| OC-6 | 311.04 |
| OC-9 | 466.56 |
| OC-12 | 622.08 |
| OC-18 | 933.12 |
| OC-24 | 1244.16 |
| OC-36 | 1866.24 |
| OC-48 | 2488.32 |
| OC-96 | 4976 |
| OC-192 | 9952 |

# ATM Layer

- Defines structure of the ATM cell
  - UNI (User Network Interface)
  - NNI (Network-to-Network Interface)
- Defines virtual channel and path routing
  - Cell address translation
  - Cell header generation/removal
- Transmission/Switching/Reception
- Congestion Control/Buffer Management
- Sequential delivery

# ATM Cell



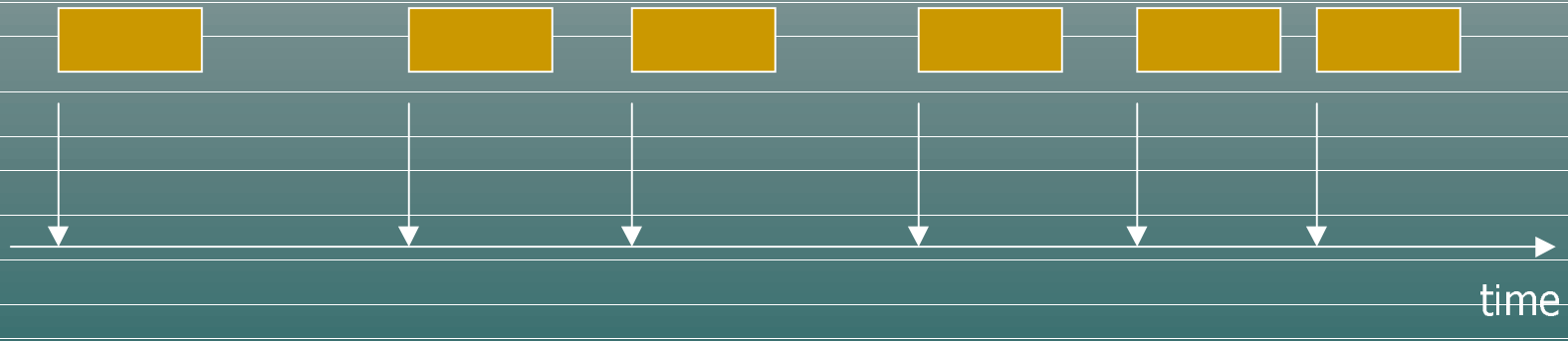

- Fixed cell size
- Overhead is ~10%
- Able to time the flow of cells
- Cell switching is fast & efficient
- Traffic flow is predictable
- Can guarantee time-sensitive info
- NNI cell does not have GFC field

| | |
|---|---|
| GFC | Generic Flow Control |
| VPI | Virtual Path Identifier |
| VCI | Virtual Channel Identifier |
| PTI | Payload Type Indicator |
| RES | Reserved |
| CLP | Cell Loss Priority |
| HEC | Header Error Control |

# Frame vs Cell

**Frames are variable length**

**ATM cells are always 53-bytes**



# ATM Adaptation Layer

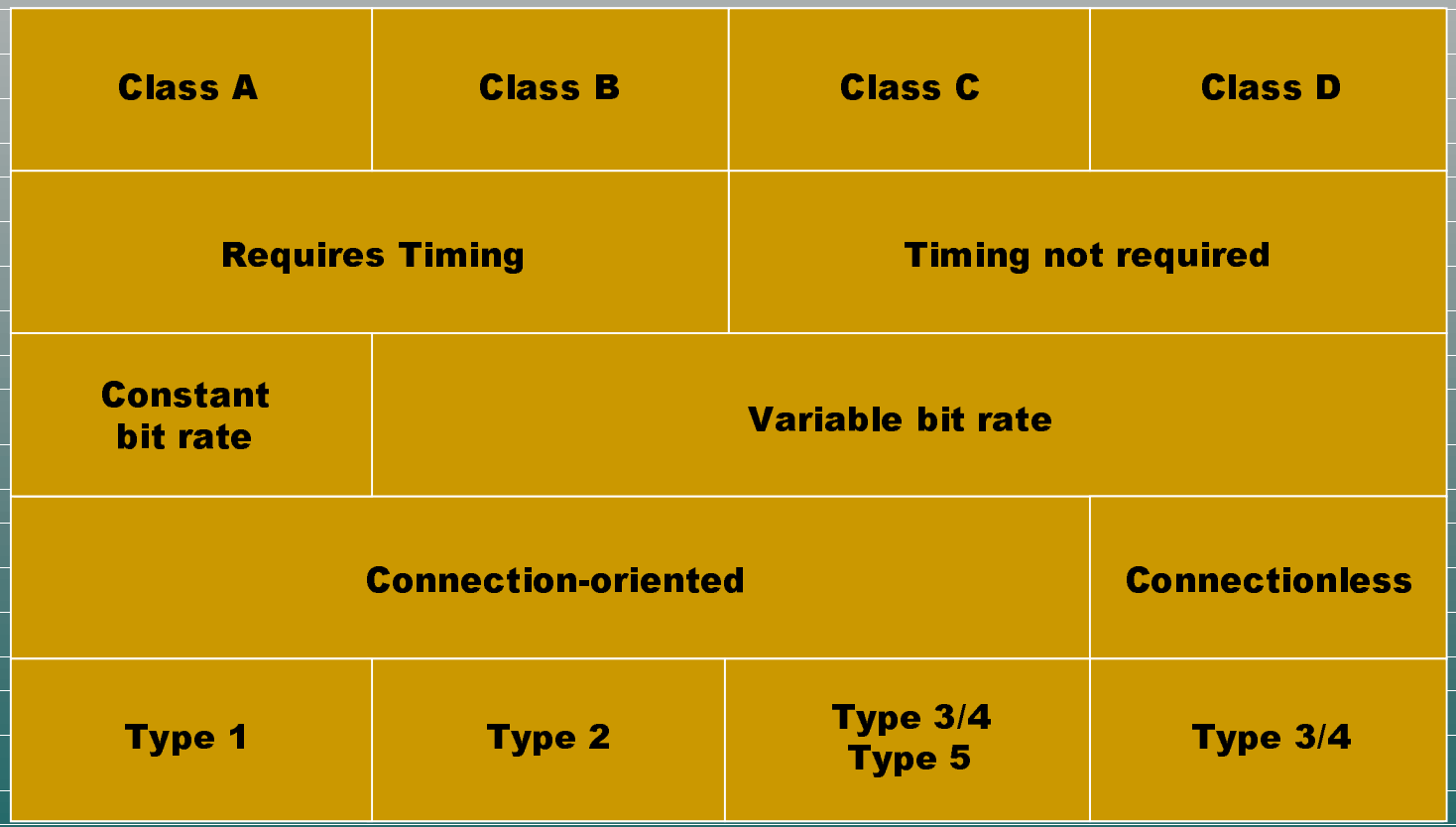
Adaptation defines how higher-layer information such as voice, data and video are inserted into the payload of the 53-byte ATM cells

| Layer | Used for |
|---|---|
| AAL1 | Traditional Voice |
| AAL2 | Packet Video |
| AAL3/4 | Multiplexed data |
| AAL5 | Data |

# AAL Service Types

- Type 1: A connection-oriented CBR (constant bit rate) service with timing for audio and video applications
- Type 2: A connection-oriented VBR (variable bit rate) service for real-time applications where minor loss is acceptable, and for non-real-time VBR, such as transaction processing
- Type 3/4: An ABR (available bit rate) service for non-time-critical applications such as LAN internetworking and LAN emulation
- Type 5: A UBR (unspecified bit rate) service that provides spare bandwidth to noncritical services such as file transfers

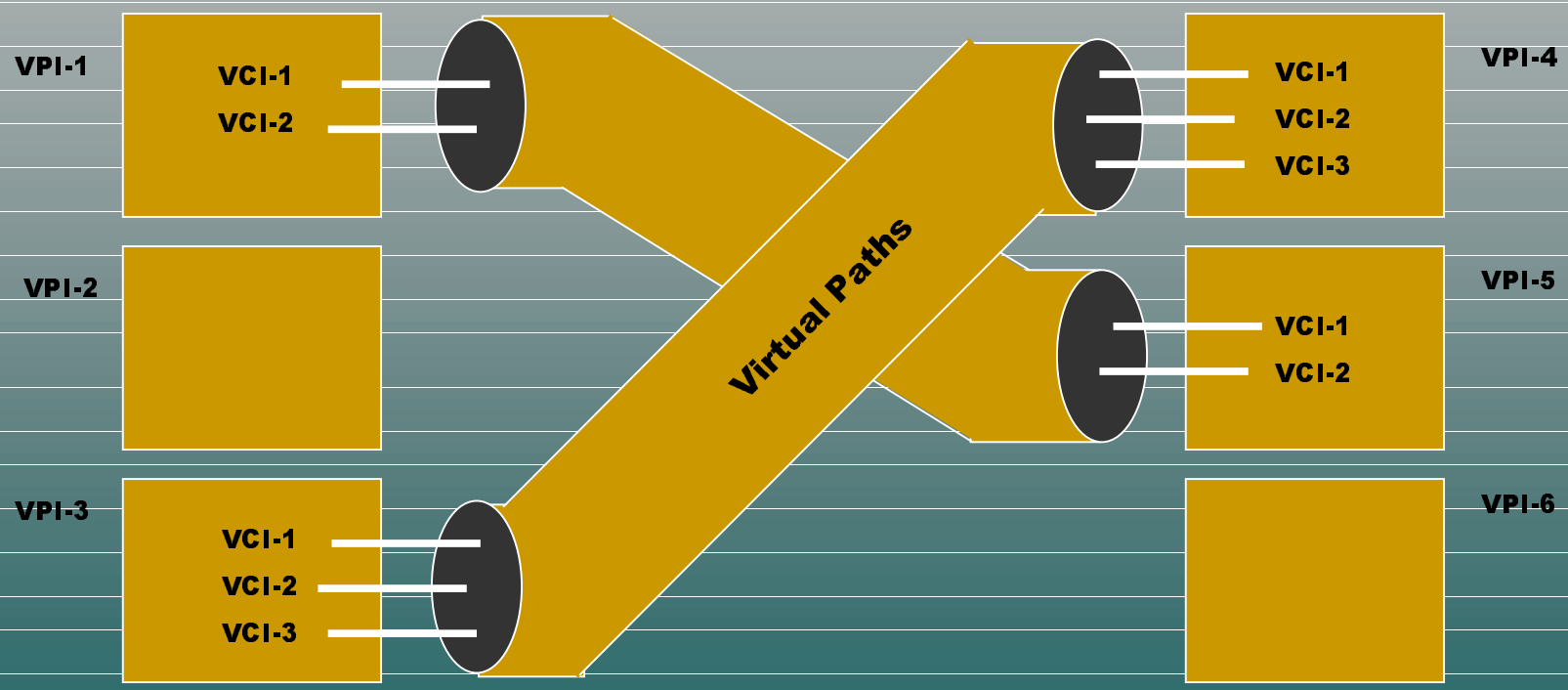
# ATM Service Classes



# Virtual Connections

- ATM is connection-oriented
- Connections are bidirectional and full duplex
- Two types of VCs
  - Virtual Channel Connection (VCC)
    - Logical connections between end stations
  - Virtual Path Connection (PVC)
    - A bundle of Virtual Channels (VCCs)

# Virtual Paths & Channels



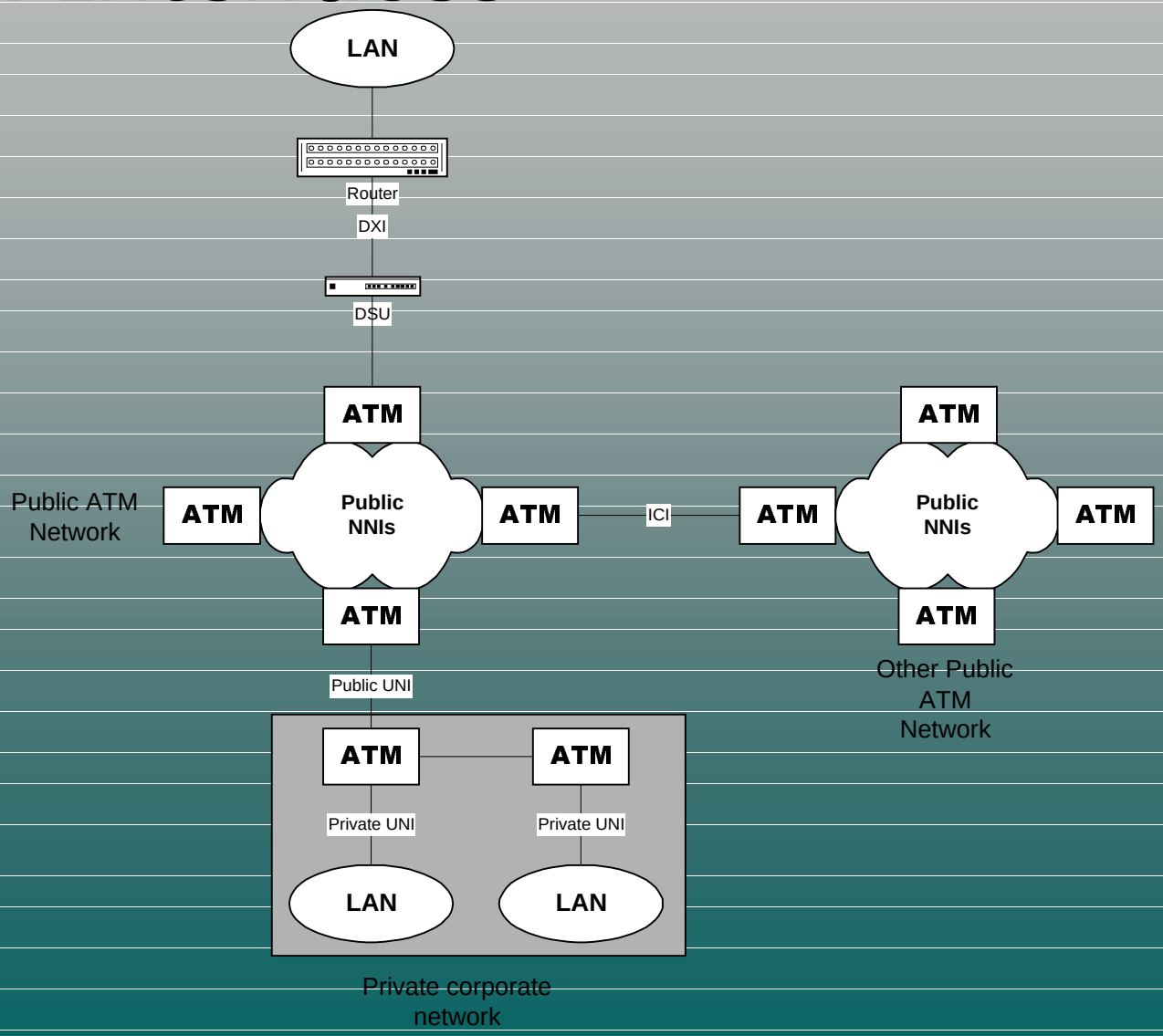
# Virtual Circuits

- Two types of virtual circuits
  - Permanent Virtual Circuit (PVC)
    - A VCC or VPC that is predefined and left in place all the time. If information is not being transmitted, it doesn't use any bandwidth
  - Switched Virtual Circuit (SVC)
    - A VCC that is setup at the instant that information needs to be sent between communication endpoints, and then taken down after the transmission is finished

# ATM Interfaces

- UNI (User Network Interface)
  - Defines the connection between user equipment and ATM equipment (e.g. a workstation and the ATM switch)
- NNI (Network-to-Network Interface)
  - The interface between ATM devices
- ICI (Intercarrier Interface)
  - The interface between different ATM carriers
- DXI (Data Exchange Interface)
  - Interface from ATM into legacy equipment (such as routers into ATM using HDLC)

# ATM Interfaces



# ATM for LANs

- IP LANs are connectionless
- ATM is connection-oriented
- Can you integrate the two?

# A Look at IP

- When one station transmits, all stations hear the message, but only the station to which the message is addressed responds (one-to-one)
- Broadcasts are transmitted to all stations (one-to-many)
- IP networks use ARP to determine which circuit to use when sending a message
- IP is stateless

# A Look at ATM

- ATM sets up virtual circuites between endpoints (one-to-one)
- ATM does not support broadcasts
- ATM is state-full

# IP-over-ATM

- Encapsulation (RFC-1483)
- Classic IP (RFC-1577)
- LAN Emulation (LANE)
- MultiProtocol Over ATM (MPOA)

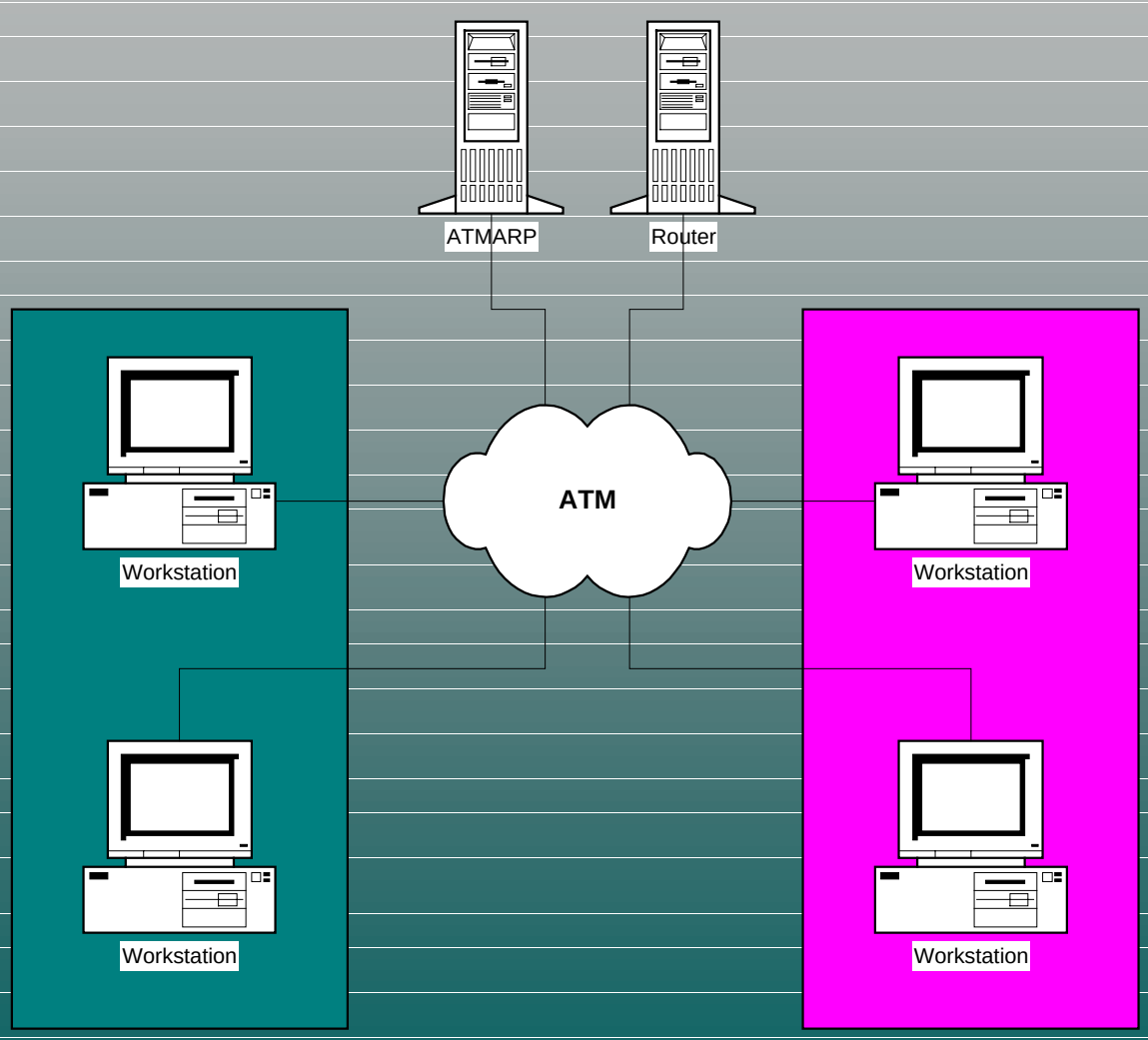
# Encapsulation

- RFC-1483 is *Multiprotocol Encapsulation over ATM*
- Generally used for WANs
- Two encapsulation methods supported:
  - LLC/SNAP (Logical Link Control/Sub-Network Access Protocol)
    - A single connection to support multiple packet types
  - VC multiplexing
    - carries a single protocol

# Classical IP

- Analogous to Ethernet MAC
- Uses ATM as a high-speed backbone
- A VCI for a “virtual wire” is used for cell transmission
- Implements the concept of a LIS (Logical IP subnet)
- Each LIS includes a ATMARP server (resolves IP to ATM addresses)
- Must use a “one armed” router to communicate with hosts in another LIS

# Classical IP Network



# LAN Emulation

- A method to connect *legacy* LANs to ATM
- LANE provides translation services between:
  - variable length frames on shared connectionless networks
  - fixed length, connection-oriented networks with virtual circuits

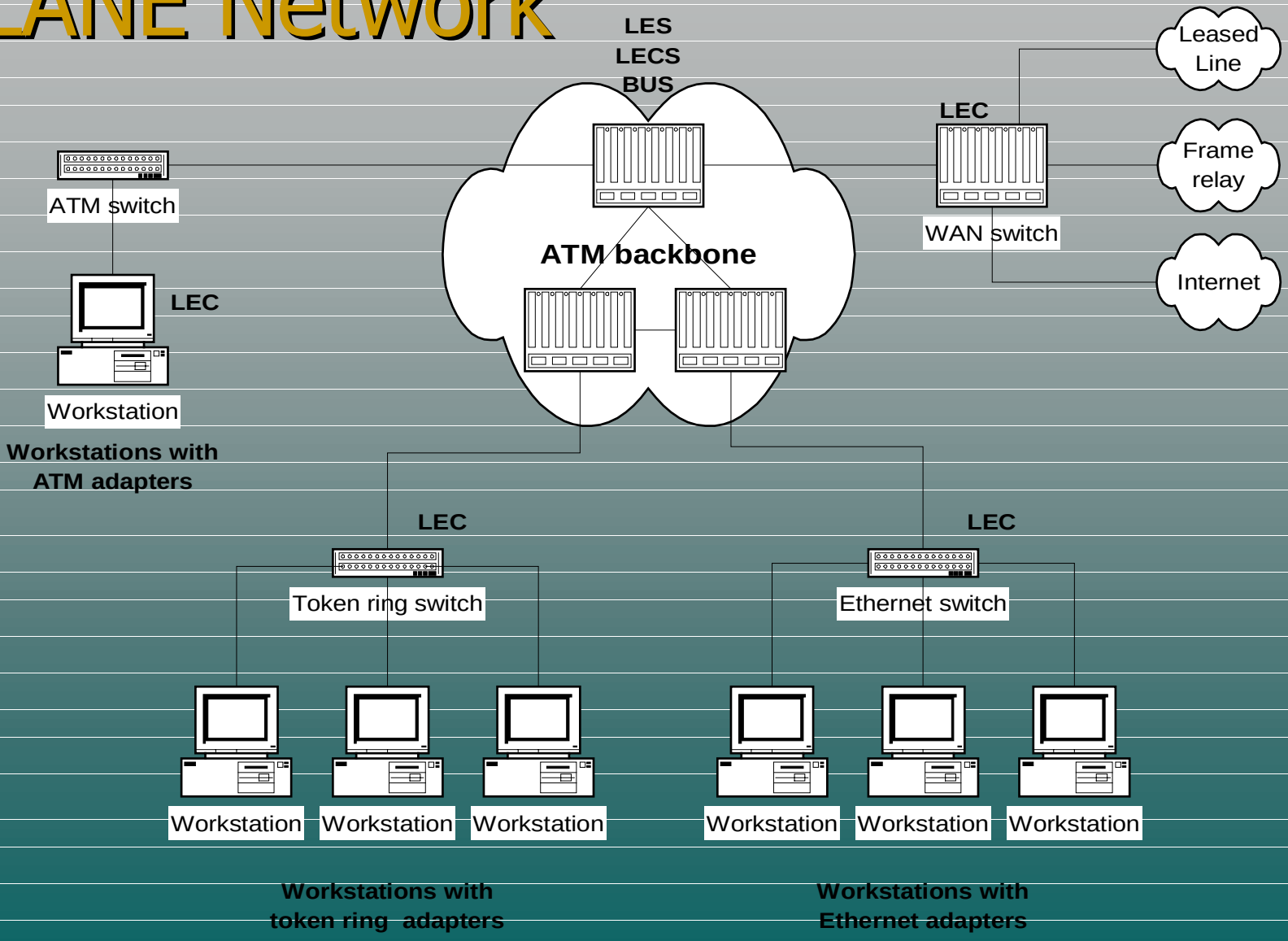
# LANE Components

- LEC (LAN Emulation Client)
  - devices that run LANE software to perform translation between legacy LANs and ATM
- LES (LAN Emulation Server)
  - resolves legacy LAN (MAC) addresses to ATM addresses within the ELAN (Emulated LAN)

# LANE Components

- LECS (LAN Emulation Configuration Server)
  - Not to be confused with LECs
  - Responsible for assigning, managing and tracking membership of LECs in ELANs
- BUS (Broadcast and Unknown Server)
  - Simulates the broadcast and multicast functions normally present on shared LANs by sending messages individually to all devices in an ELAN

# LANE Network



# LANE Summary

- Basically creates a bridged LAN network across the ATM fabric
- To send data to another system, a workstation only needs to know the MAC address of the destination system
- LANE handles the ATM addressing and virtual circuit connections (LEC)
- LECs request MAC-to-ATM address resolution from the LES
- Routers are required to move packets from one ELAN to another
- LANE “hides” ATM from applications
- IP has no way to talk to the network to specify QoS

# MPOA

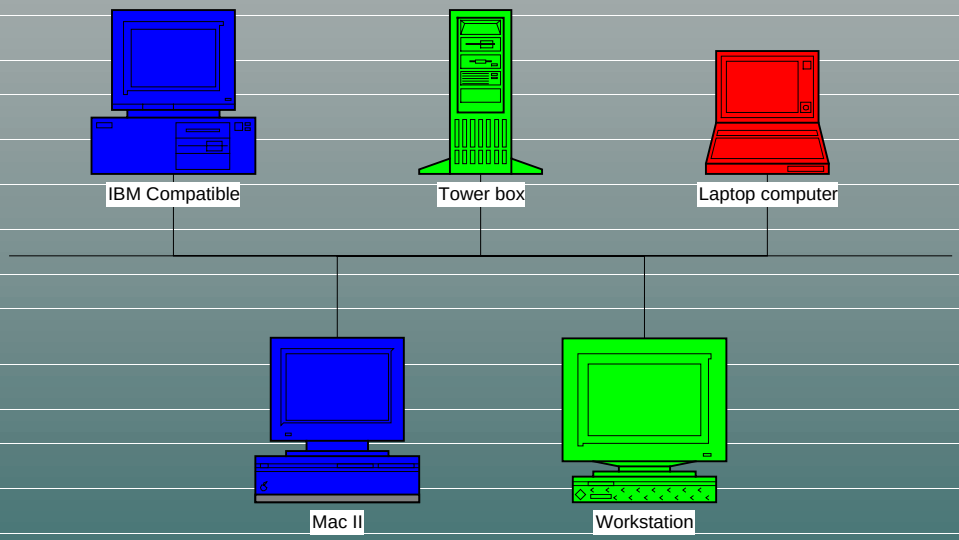
- Requires LANE
- Takes advantage of ATM switching speeds
- Allows end devices attached to ATM to communicate directly instead of through a router
- Uses NHRP (Next Hop Routing Protocol) to establish a “cut-through” route to the destination
- Clients use LANE to resolve addresses within the same Virtual LAN (VLAN)
- Use MPOA for inter-VLAN addressing
- LANE is for layer 2 switching
- MPOA effectively performs layer 3 switching
- MPOA can use ATM’s QoS

# Virtual LANs

- A LAN is a broadcast domain; you know them as “subnets”
- Switched networks are flat, i.e. one broadcast domain
- Virtual LANs are “logical” groupings of machines to form subnets in switched networks

# VLANs

- VLANs can be based on:
  - Switch port address
  - MAC address
  - IP address
  - IP multicast
  - Protocol Type
  - Policy or rules



# Quality of Service

- AAL service categories:
  - CBR, VBR-RT, VBR-nRT, ABR, UBR
- Bandwidth attributes:
  - Peak Cell Rate (PCR)
  - Cell Delay Variation Tolerance (CDVT)
  - Sustained Cell Rate (SCR)
  - Minimum Cell Rate (MCR)
  - Maximum Burst Size (MBS)
  - Cell Loss Ratio (CLR)
  - Cell Transfer Delay (CTD)

# ATM's Benefits

- Data, Voice, Video Integration
- Seamless (LAN, MAN, WAN)
- QoS (Quality of Service)
- Automatic Load Balancing
- Automatic Failover
- Fast and Efficient
- Highly Scalable

# ATM's Drawbacks

- Cost
- Lack of exposure
- Standards are still evolving
- IP applications can't talk to the network
- Requires emulation to integrate with legacy LANs

# Summary

- Excellent technology for backbone networks
- Integrates well with other WAN & LAN technologies
- Can combine corporate voice and data networks for economics
- Not appropriate in all situations
- Requires a significant amount of time & expertise for implementation, maintenance & on-going operation

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