Asynchronous Transfer Mode (ATM) Networks

Andreas Prodromou

The Network

- Cell-switching and multiplexing technology
- Combines the benefits of:
  - Circuit switching (Virtual Circuits):
    - Guaranteed capacity and constant transmission delay
  - Packet switching
    - Flexibility and efficiency
- Can be used for high-speed LANs, voice and video data
- Utilizes fixed length cells for routing information

The Cell

- Fixed size of 53 Bytes
    - 5 bytes for header
    - 48 bytes payload

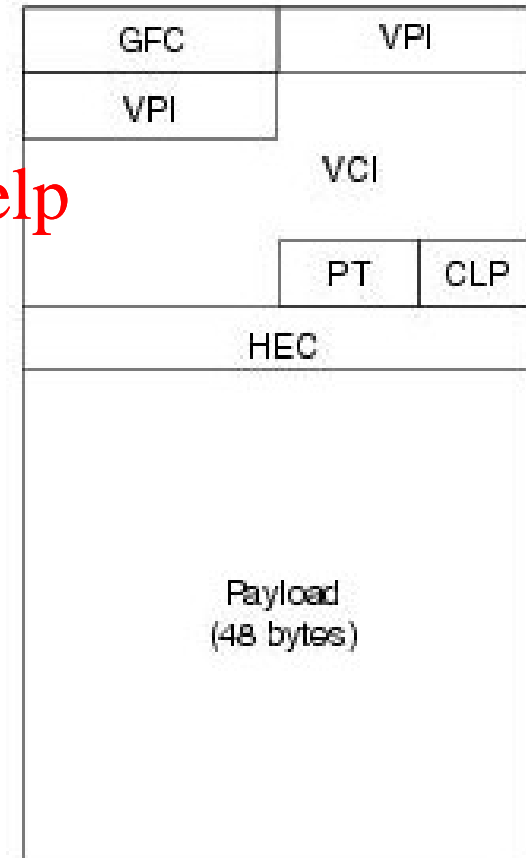   Assignment Project Exam Help

- Advantages: https://powcoder.com
    - Latency is significantly reduced
    - Easier to switch data across multiple networks

Add WeChat powcoder

The Cell

- Generic Flow Control (GFC):
  - Provides local functions
  - Typically not used
- Virtual Path Identifier (VPI):
  - Identifies next destination (with VCI)
- Virtual Channel Identifier:
  - Used with VPI
- Payload Type (PT):
  - User/Control data
  - The last cell
- Header Error Control (HEC):
  - Checksum of the header
  - Can correct single bit corruption

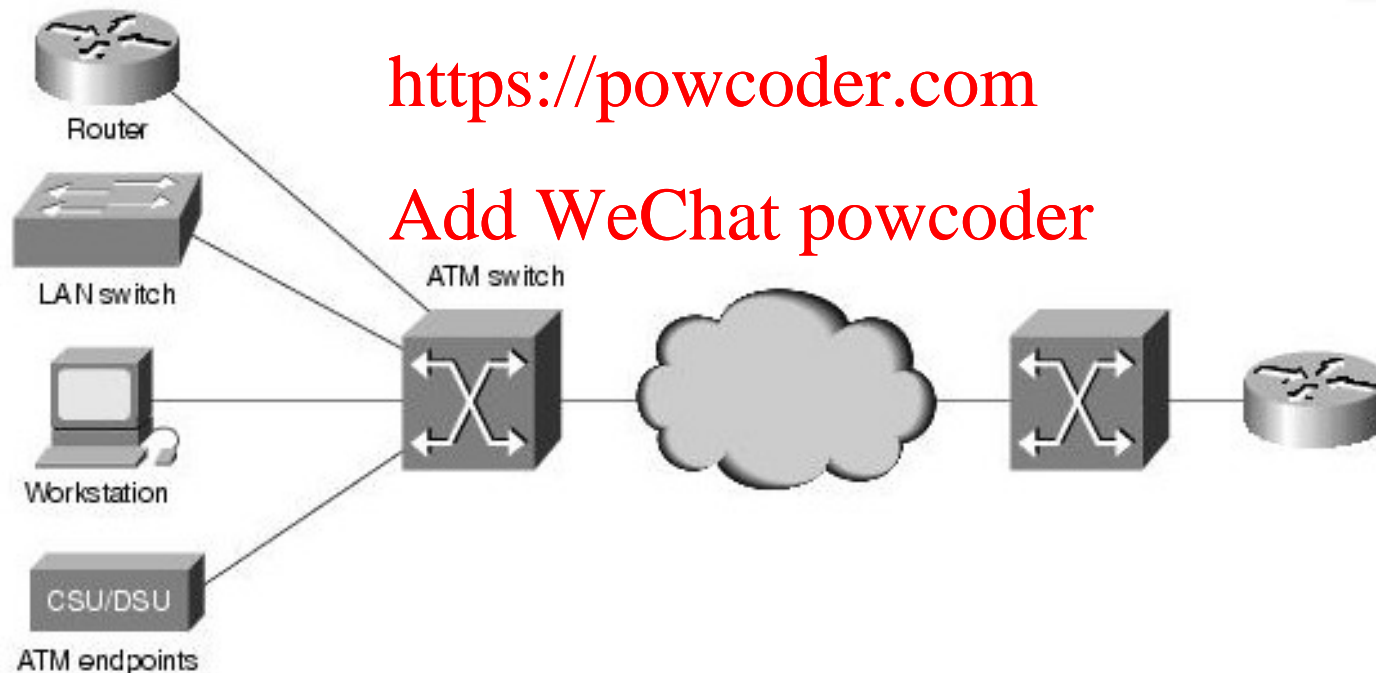| GFC	VPI
VPI	
VCI	
	PT	CLP
HEC	
Payload (48 bytes)	

Devices

- ATM networks are build around
  - ATM Switches
  - ATM end-points
- An ATM switch can be connected either to another switch or an end-point

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

Router

LAN switch

Workstation

CSU/DSU

ATM endpoints

ATM switch

Switches and Interfaces

- ATM switch supports two types of interfaces
    - User-Network Interface (UNI)
        - Connects ATM end-point to a switch
    - Network-Network Interface (NNI)
        - Connects two switches

- UNI and NNI can be divided in private and public

- Third type: Broadband Inter-Carrier Interface (BICI)
    - Connects two public switches from different service providers

Private and Public Interfaces

- User-Network Interface (UNI)
  - Private: Connects end-point to a private switch
  - Public: Connects end-point or private switch to a public switch
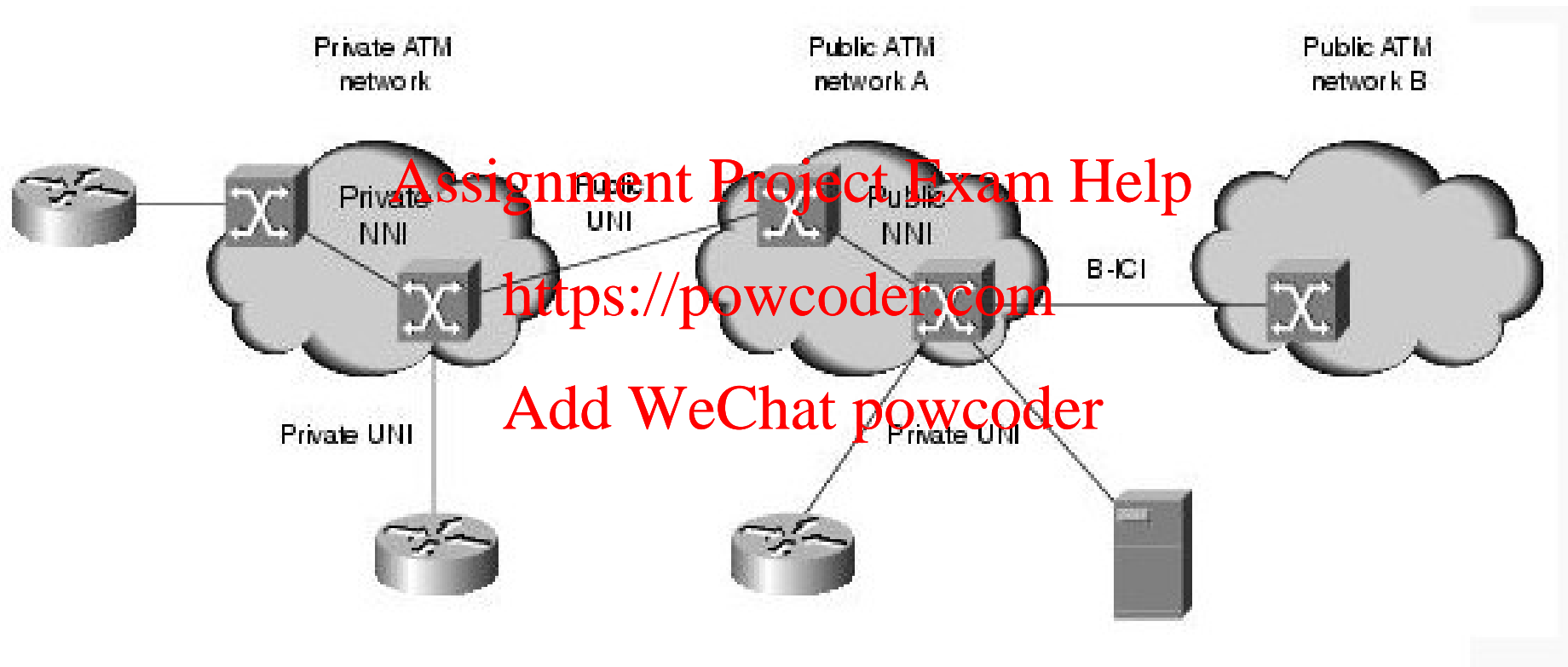
- Network-Network Interface (NNI)
  - Private: Connects two switches within the same private organization
  - Public: Connects two switches within the same public organization

Private and Public Interfaces

Services and Virtual Connections

- Three types of services
  - Permanent Virtual Circuits (PVC)
  - Switched Virtual Circuits (SVC)
  - Connectionless service
  - SVC is the most widely used
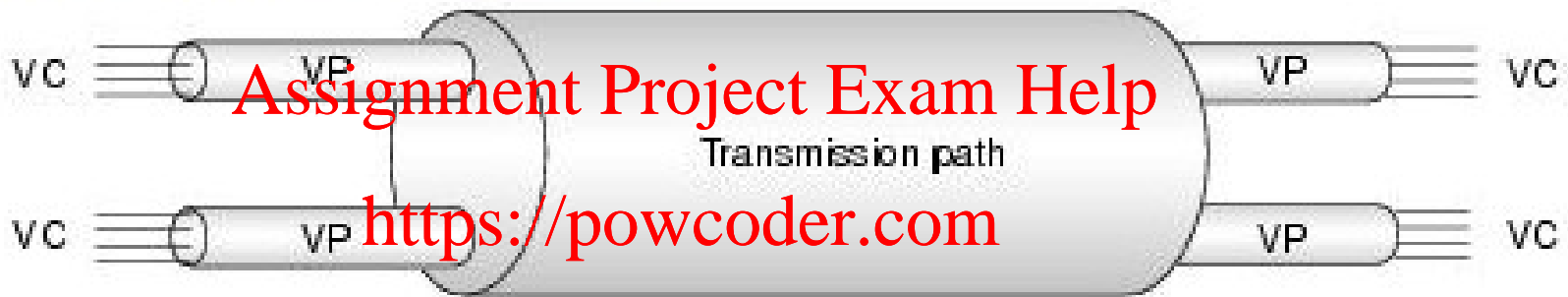
- Two types of connections
  - Virtual Circuit (VC)
  - Virtual Path (VP)

- There can be a number of VPs along a physical connection
- There can be a number of VCs within a VP

Virtual Circuits and Paths

Figure: VCs Concatenate to Create VPs

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

- There can be a number of VPs along a physical connection
- There can be a number of VCs within a VP

ATM Physical Layer

- Basic functions:
  - Convert cells to bit streams
  - Control transmission and receipt of bits
  - Package cells in appropriate types of frames for the medium
- Physical medium standards to carry ATM include:
  - Synchronous Digital Hierarchy/Synchronous Optical Network (SDH/SONET)
  - DS3/E3
  - Over Multi-Mode Fiber (MMF) at 155 Mbps
  - Over Shielded Twisted Pair (STP) at 155 Mbps

ATM Adaptation Layers

- Adaptation Layer converts user data into cell payloads

- AAL 1
  - Connection oriented
  - Suitable for Constant Bit Rates (CBR) sources
  - Requires timing synchronization (SONET)
  - Voice and Video-Conferencing

- AAL 2
  - Has timing requirements
  - Variable Bit Rate (VBR) traffic (Bursty)
  - Supports Real-Time and Non-Real-Time VBR

ATM Adaptation Layers

- AAL 3/4
  - Both connection-oriented and connectionless data
  - Designed for network service providers to transmit SDMS packets (Switched Multimegabit Data Service)

- AAL 5
  - Primary AAL for data
  - a.k.a Simple and Efficient Adaptation Layer (SEAL)
  - Supports CRC checking
  - Last cell is marked with one bit

ATM Connections

- Point-to-point
  - Connects two ATM end systems
  - Unidirectional (one-way)

Assignment Project Exam Help

https://powcoder.com

- Point-to-multipoint
  - Connects one node (root) to multiple destination end-systems (leaves)
  - Leaves cannot transmit to root
  - Cell replication is done in the ATM switches

Add WeChat powcoder

- No multipoint-to-multipoint communication

Quality of Service

- ATM Supports QoS guarantees
  - Traffic contract: Intended data flow
    - Peak Bandwidth
    - Avg sustained bandwidth
  - Traffic shaping
    - Constrain data bursts (with queues)
    - Limit peak data rate
    - Smooth jitters

  - Traffic policing
    - The switch measures the actual traffic and compares to the "contract"
    - Notifies other switches that the package can be dropped in periods of congestion

Connection Establishment Process

- Uses one-pass method of connection setup

- Process:
  - Source end system sends a connection-signaling request
  - Request is propagated in the network
  - Connection request reaches destination which accepts or rejects

- Private Network-Network Interface (PNNI)
  - Routes connection requests
  - Routing is based on source and destination addresses, traffic and QoS parameters

HMY 654 - Advanced Computer Networks

Connection Establishment Process

Figure: ATM Devices Establish Connections Through the One-Pass Method
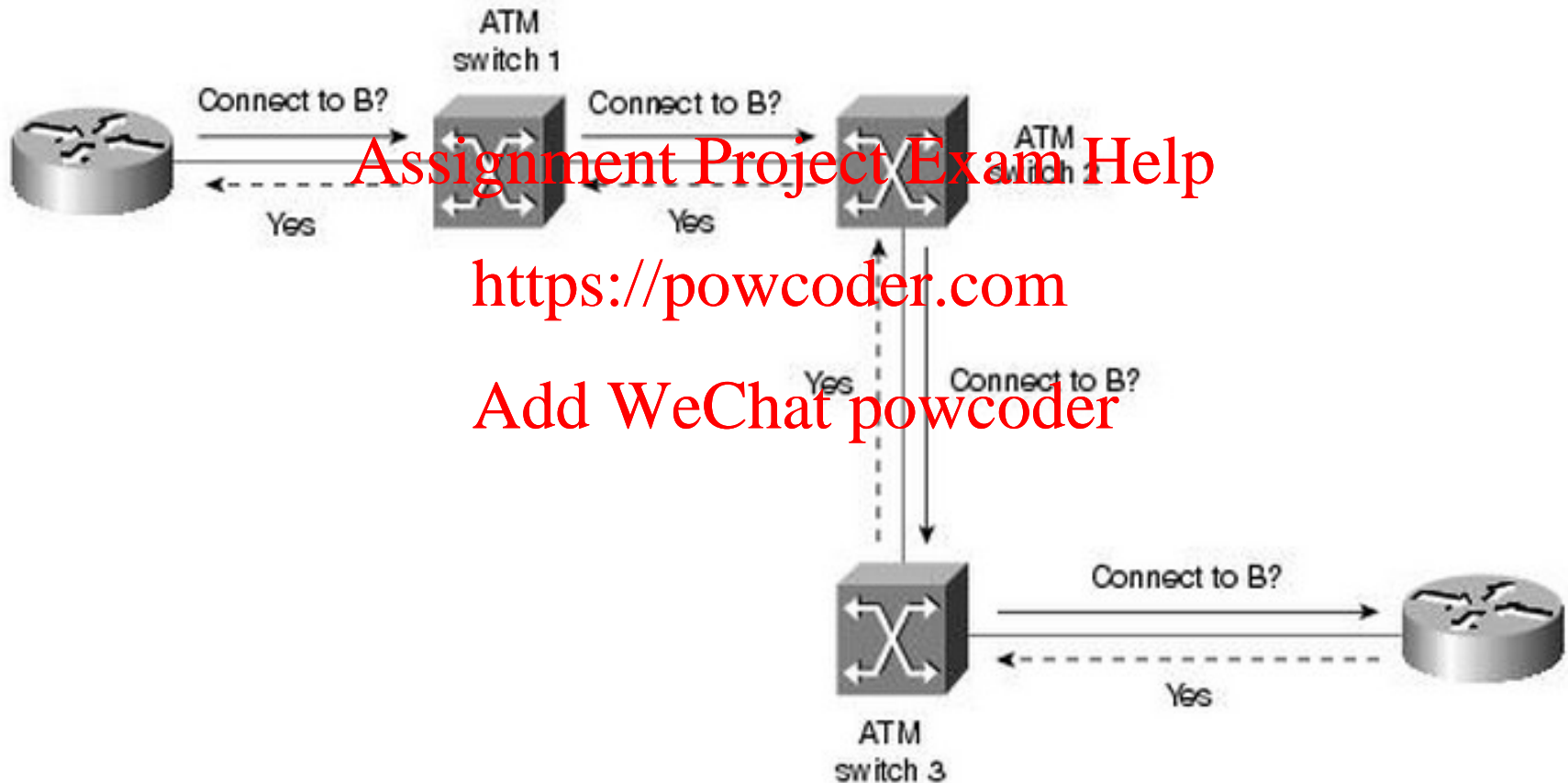
Private Network-Network Interface (PNNI)

- Services
    - ATM topology discovery
    - Call establishment

- Enables the switches to automatically discover the topology and characteristics of the links

- On significant events PNNI announces it to other switches

LAN Emulation

- Standard defined by the ATM forum

- Emulates a LAN on top of ATM network
  - IEEE 802.3 Ethernet
  - IEEE 802.5 Token Ring LAN
  - Fast Ethernet (100BaseT) and 802.12 (100VG-AnyLAN) can be mapped unchanged (same packet formats)

- Lane Components
  - LAN Emulation Client (LAC)
  - LES
  - Broadcast and Unknown Server (BUS)
  - LAN Emulation Configuration Server (LECS)

LAN Emulation

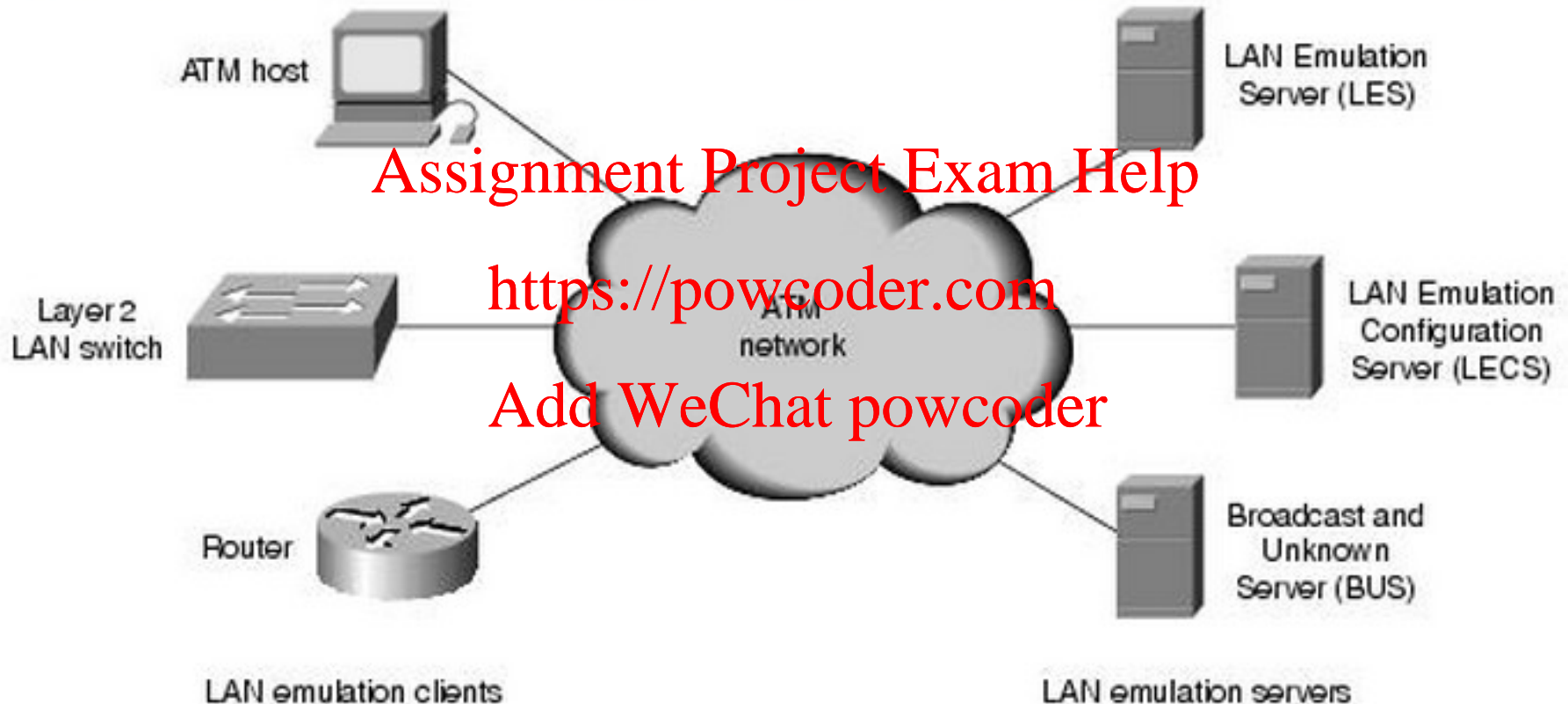Figure: An ELAN Consists of Clients, Servers, and Various Intermediate Nodes

ATM host

LAN Emulation Server (LES)

Layer 2 LAN switch

ATM network

LAN Emulation Configuration Server (LECS)

Router

Broadcast and Unknown Server (BUS)

LAN emulation clients

LAN emulation servers

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder

Assignment Project Exam Help

Thank you

https://powcoder.com

Add WeChat powcoder

Questions?

References

- Introduction to Asynchronous Transfer Mode (ATM), N.Ganesan

Assignment Project Exam Help

https://powcoder.com

Add WeChat powcoder