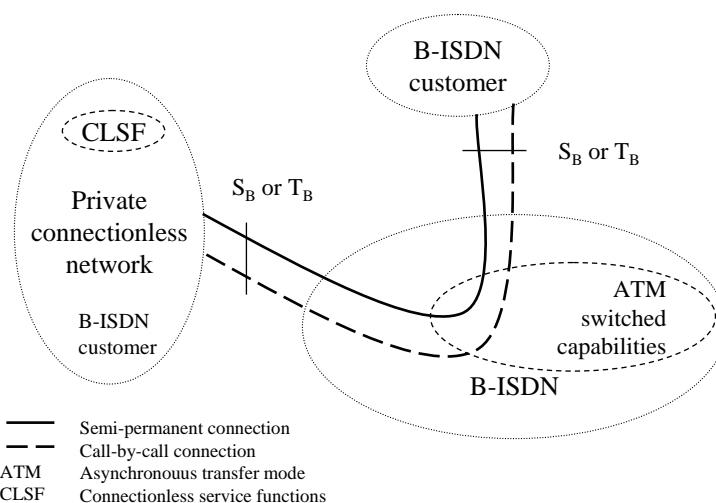


Connectionless Services in ATM Networks

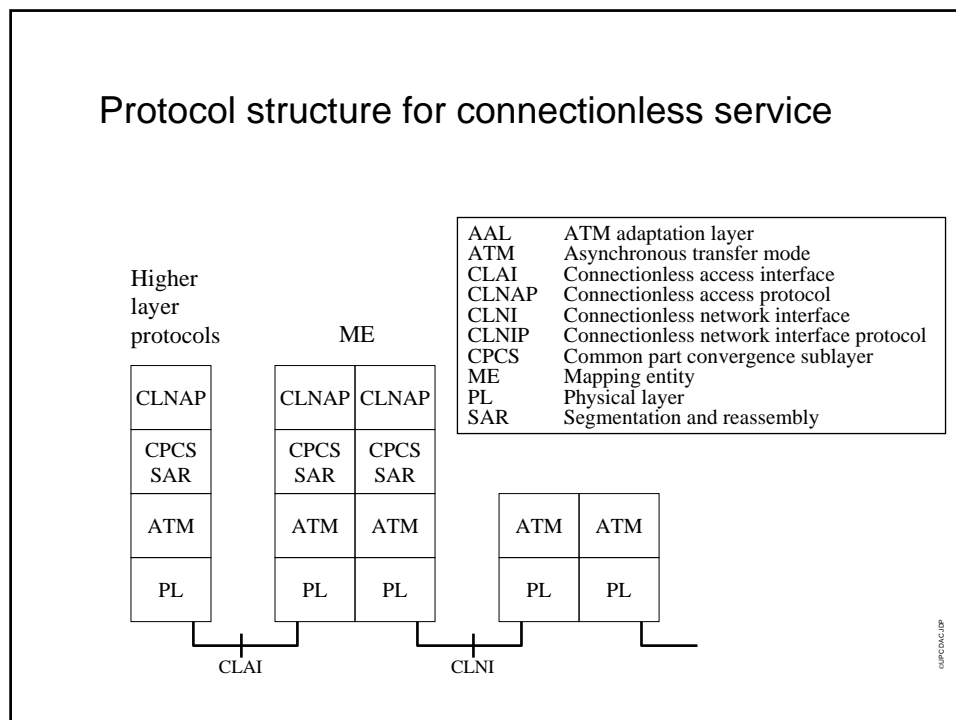
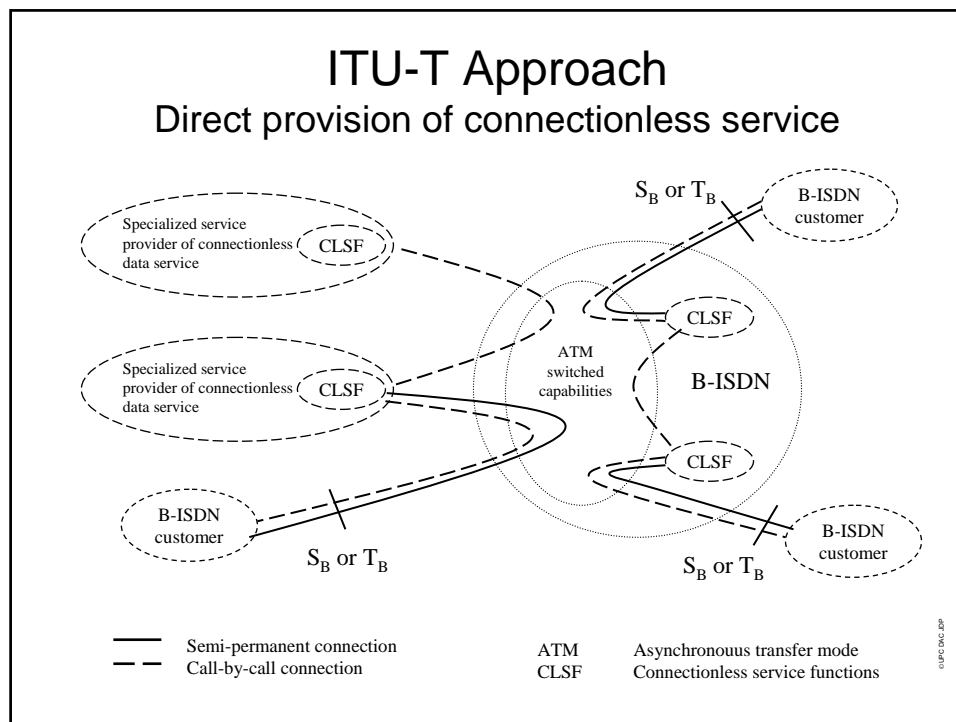
- ITU-T approach
 - Indirect connectionless service
 - Direct connectionless service
- IETF approach
 - Classical IP over ATM
- ATM Forum approach
 - LAN Emulation

UPC/DAC_DP

ITU-T Approach Indirect provision of connectionless service

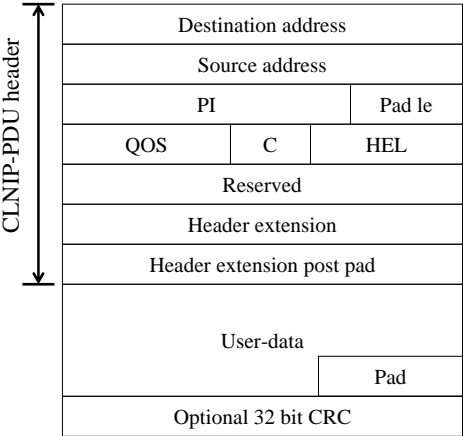


UPC/DAC_DP



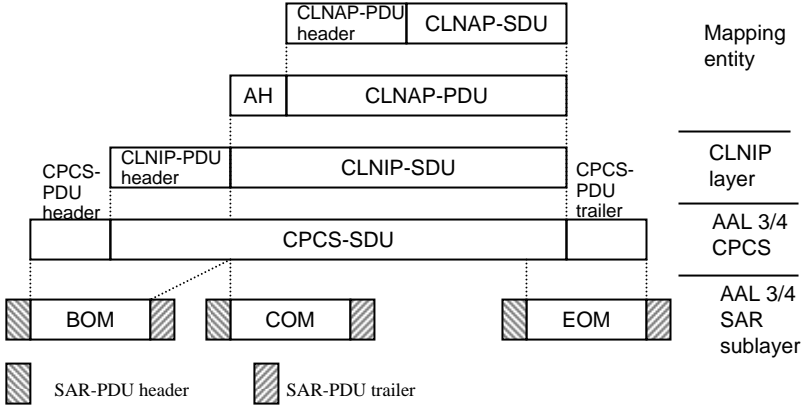
Structure of the CLNIP-PDU

- C CRC indication bit
- CLNIP Connectionless network interface protocol
- HEL Header extension length
- Pad le Pad length
- PDU Protocol data unit
- PP Post pad
- PI Protocol identifier
- QOS Quality of service



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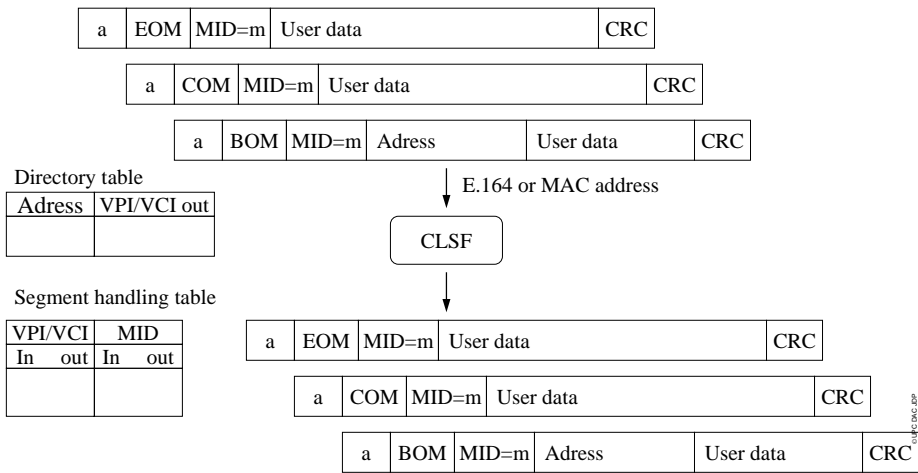
CLNAP-PDU encapsulation



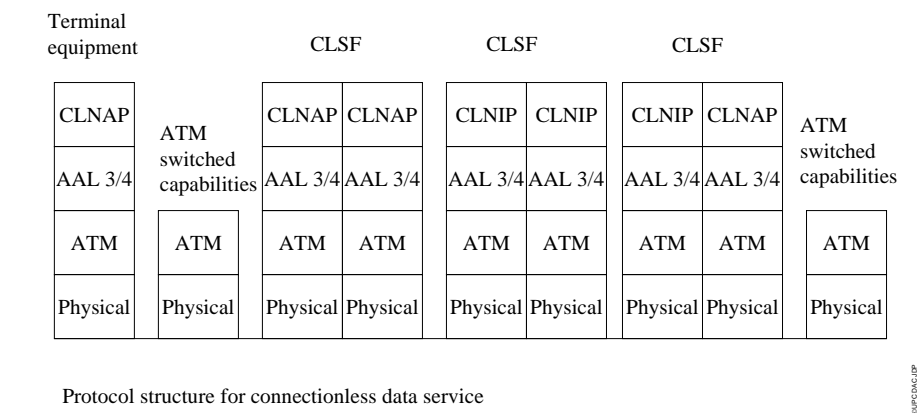
- | | | | |
|-------|---|------|-------------------------------|
| AAL | ATM adaptation layer | CPCS | Common part convergence layer |
| AH | Alignment header | EOM | End of message |
| BOM | Beginning of message | PDU | Protocol data unit |
| CLNAP | Connectionless network access protocol | SAR | Segmentation and reassembly |
| CLNIP | Connectionless network interface protocol | SDU | Service data unit |
| COM | Continuation of message | | |

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Connectionless Services in ATM Networks



Connectionless Services in ATM Networks



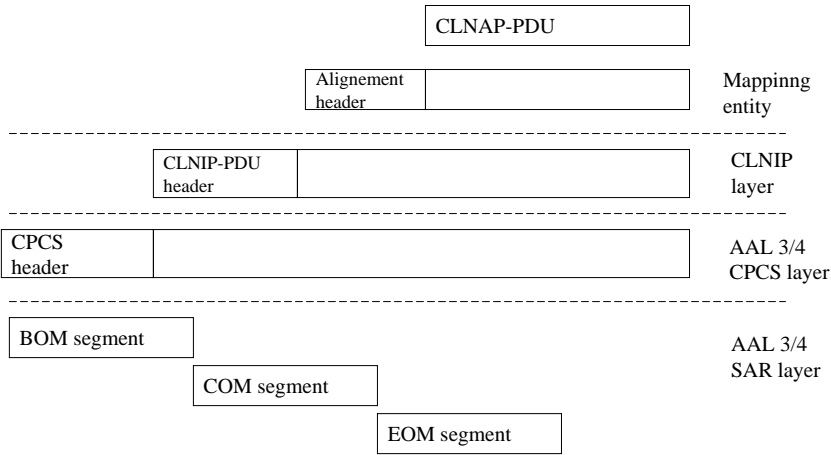
Connectionless Services in ATM Networks

Bit	32	1
Word	1	Destination address
	2	Destination address
	3	Source address
	4	Source address
	5	PI 6b PAD length 2b QoS 4b CIB 1b HEL 3b Reserved 16b
	6	Header extension
		Header extension post pad
	11	User information
	N	Optional 32 bit CRC

CLNAP-PDU structure.

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Connectionless Services in ATM Networks



Encapsulation of a CLNAP-PDU within a CLNIP-PDU

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IETF Approach

- IP over ATM

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Classical IP over ATM

- RFC 1577 Classical IP and ARP over ATM
- “direct substitution of cables, LAN segments, dedicated circuits, etc.
- AAL5 (best performance)
- ATM-ARP and In-ATM-ARP
- VCCs between pairs of WS within a LIS
- ATM-ARP server (well known address)

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Classical IP over ATM

- RFC 1483 Multiprotocol Encapsulation over ATM AAL5
- LLC/SNAP (SubNetwork Attachment Point)
- LLC header indicates the protocol
- Several protocols (LAN bridging, LAN routing exist on a single VCC)

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Classical IP over ATM

- RFC 1626 Default IP MTU for use over ATM AAL5
- Maximum Transmission Unit (IP segment):
TCP, UDP, LLC, RPC/XDR: 8300 bytes
NFS: 8192 bytes
SMDS: 9180 bytes
- Default MTU: 9180 bytes

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Multicast IP

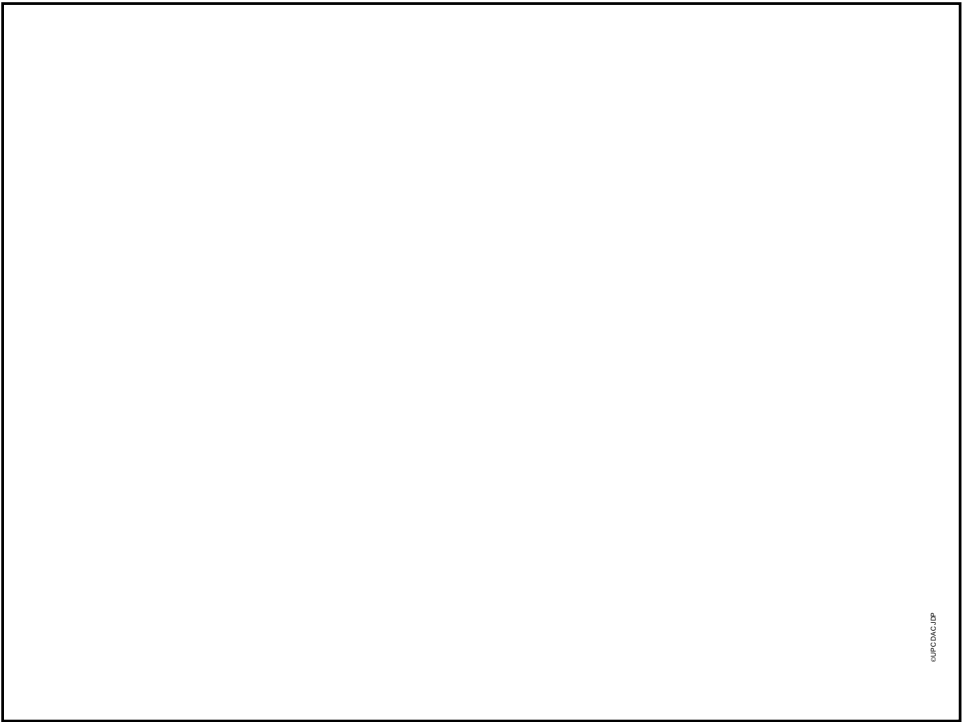
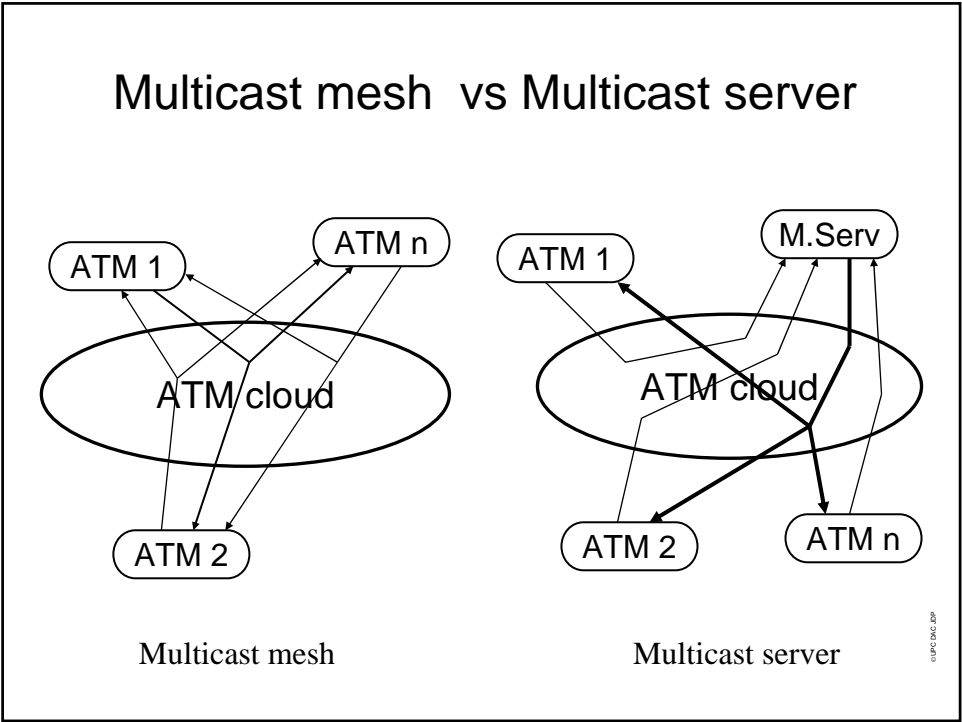
- RFC 1112
- Encapsulation of multicast IP datagrams into IP datagrams
- “tunneling”
- IP multicast address: Class D
224.x.y.z - 239.x.y.z
session address (not host address)

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Multicast IP over ATM

- IP over ATM
- Multicast IP
- Two alternatives
 - Full mesh of VCCs
 - Multicast server
- ATM switches with point-to-multipoint connections (replication of cells)

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ATM Forum Approach

- LAN Emulation over ATM
 - LANE v1, January 1995
 - LANE v2, July 1997
 - UNI 3.0, UNI 3.1, UNI 4.0

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LAN Emulation over ATM

KEY ISSUES:

- Complete Multivendor Interoperability
- Scalability
- Seamless Connectivity
- Transitional Support for “Current LAN’s”
- Provide a complete long term solution for “Current LAN technology” integration & support
- Robustness & Redundancy
- Coherent Integrated Multivendor Network Management

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Business case issues. Why LANE/ATM?

- *Virtual work groups*: The ability to create virtual workgroups using workstations, file servers & other equipment regardless of location
- *Virtual networks*: The ability to create virtual networks using a common infrastructure.
- *Manageable bandwidth*: The ability to provide a certain quality of service and bandwidth.
- Reduced operations cost through simplified moves & changes process.

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User Site Requirements Rationale

- Provide a transitional path for existing deployed workstations, file servers, and network equipment.
- Replace the existing Campus MAN FDDI backbone with an ATM enterprise network infrastructure.
- Migrate the existing corporate WAN to an ATM enterprise network infrastructure.
- Increase throughput and performance & reduce latency for applications such as desktop video conferencing

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LAN Characteristics

- Connectionless Service
- Multicast MAC Address
- MAC driver Interface (APPN, NETBIOS, IPX, AppleTalk, IP)
- Standardized MAC interfaces:
 - NDIS (Network Driver Interface Specification)
 - ODI (Open Data-Link Interface)
 - DLPI (Data Link Provider Interface)

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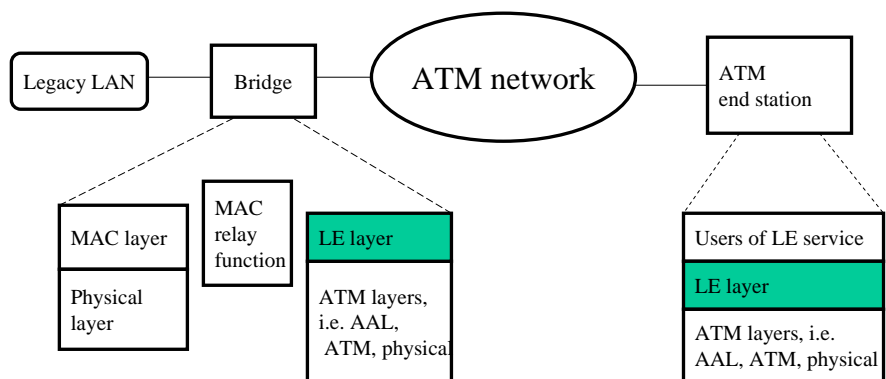
Emulated LANs over ATM

- Several emulated LANs (ELANs) within an ATM network
- Multiple ELANs over a single ATM network are logically independent
- Interconnection with existing LANs (bridging mechanisms: Transparent Bridging and Source Routing Bridging)

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LAN emulation over ATM

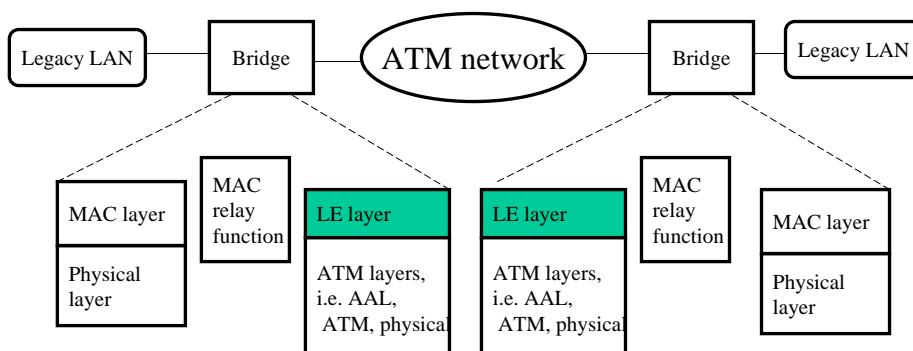
Configuration 1: ATM and a legacy LAN station



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LAN emulation over ATM

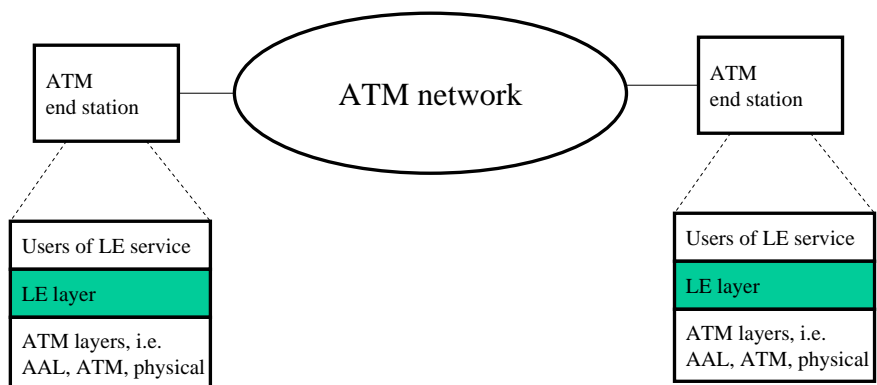
Configuration 2: legacy LAN to legacy LAN over ATM



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LAN emulation over ATM

Configuration 3: ATM to ATM



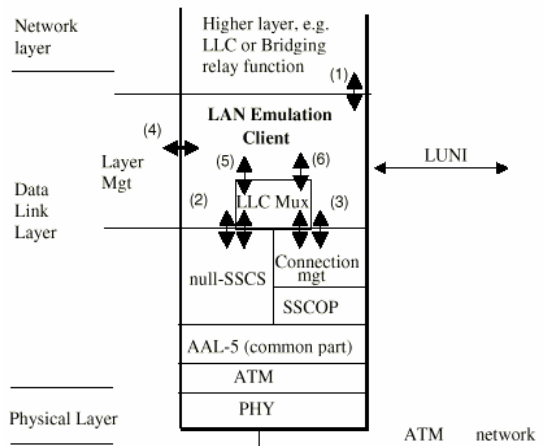
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LANE Service

- Types:
 - Ethernet / IEEE802.3
 - IEEE802.5 (Token Ring)
- Components:
 - Set of LANE Clients (LECs)
 - LAN Emulation Service (LE Service)
 - LECS (LE Configuration Server)
 - LES (LE Server)
 - BUS (Broadcast and Unknown Server)

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LAN Emulation over ATM



Layered Architecture of LAN Emulation Client

LEC Interfaces

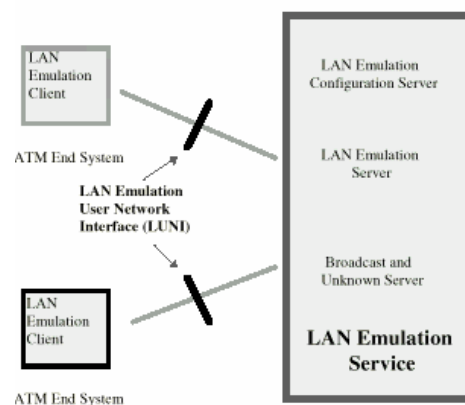
- (1) Higher Layers (user data frames)
- (2) AAL5 (user data frames)
- (3) Connection Management (VCCs)
- (4) Initialization and control
- (5) LLC-multiplexed frames (LANEv2)
- (6) LLC-multiplexed flows management

LANE UNI (LUNI)

- LUNlv2 provides enhanced capabilities (LLC multiplexing, support for ABR, enhanced multicast and MPOA support)

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LAN Emulation over ATM



The LAN Emulation User to Network Interface (LUNI)

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LANE Server (LES)

- Control for ELAN
- Registering and resolving unicast and multicast addresses and/or route descriptors to ATM addresses (ATMARP)
- One LEC is connected with one LES

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LE Configuration Server (LECS)

- Assign individual LECs to different ELANs
- Configuration DB
- LECS gives the LES ATM address to LECs
- LECs obtain information from an LECS

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Bcast and Unkn Server (BUS)

- Provides the connectionless service:
 - Handles MAC Broadcast Addresses
 - Handles multicast data
 - Handles initial unicast data sent by an LEC before the target ATM address has been resolved
- BUS serializes frames (avoid AAL5 frame interleaving)
- Participates in LE_ARP so that a LEC may locate its BUS

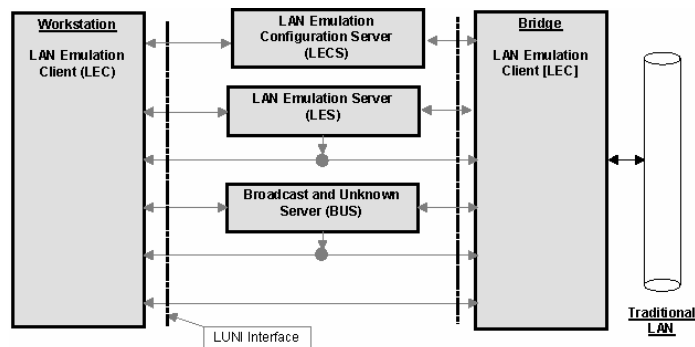
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LANE Components

- LECs are typically implemented in ATM end stations
 - ATM Host, ATM PC, ATM WS
 - Bridges, Routers (ATM interfaces)
- LE Service may be implemented in ATM switches and ATM end stations

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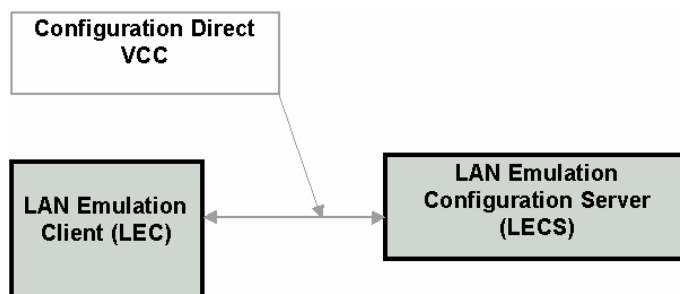
LAN Emulation over ATM



Basic LAN Emulation Client Connections across LUNI

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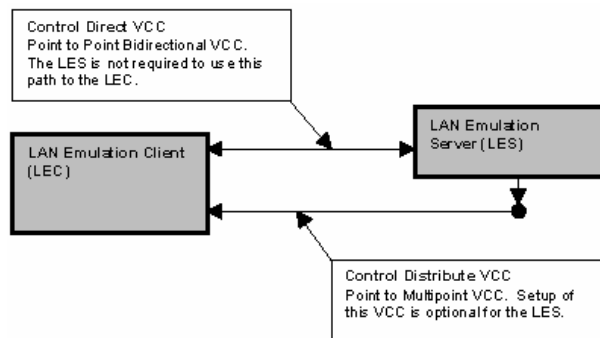
LAN Emulation over ATM



LE Client to LAN Emulation Configuration Server (LECS) Control Connection
Bi-directional VCC.
Obtain configuration information and LES address

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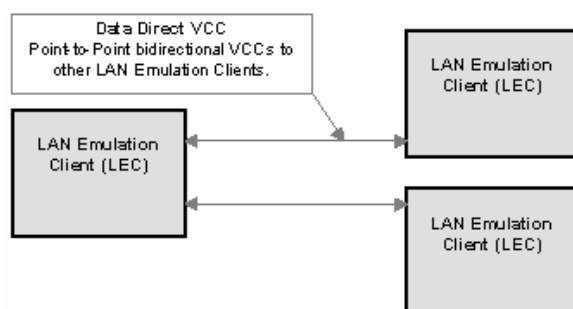
LAN Emulation over ATM



LAN Emulation Client to LAN Emulation Server (LES) Control Connections

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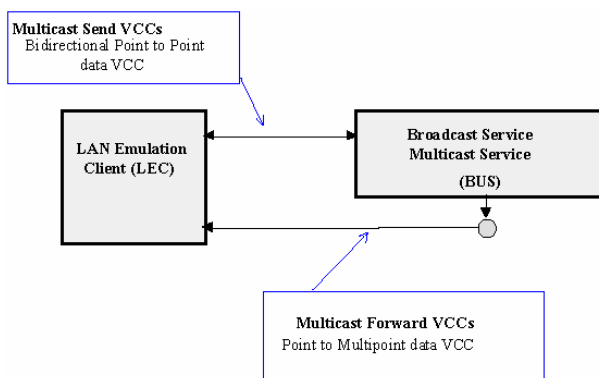
LAN Emulation over ATM



LAN Emulation Client to Client Data Connections

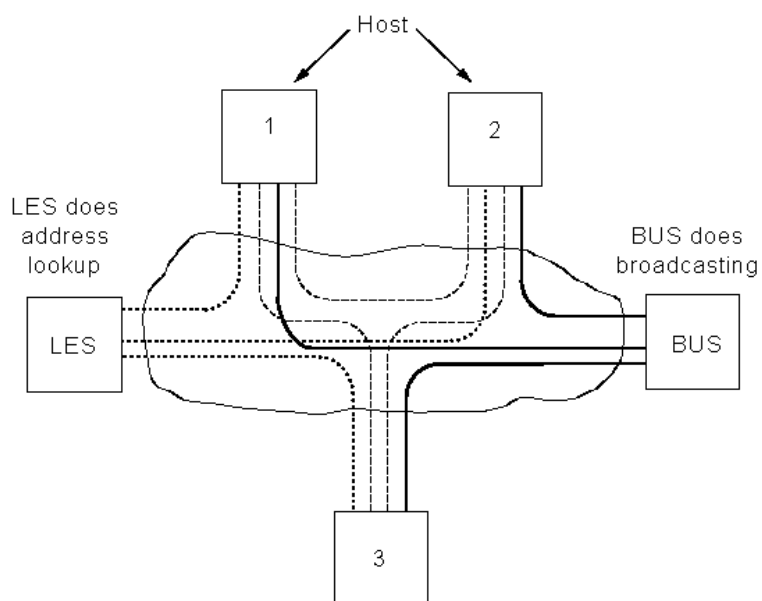
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LAN Emulation over ATM



LAN Emulation Client to BUS Connections

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LAN Emulation over ATM

LAN Emulation Non-multiplexed Data Frame Format for IEEE 802.3/Ethernet Frames

0	LE HEADER	DESTINATION ADDR
4	DESTINATION ADDRESS	
8	SOURCE ADDRESS	
12	SOURCE ADDR	TYPE/LENGTH
16 and on	INFO	

LAN Emulation LLC-multiplexed Data Frame Format for IEEE 802.3/Ethernet Frames

0	LLC-X"AA"	LLC-X"AA"	LLC-X"03"	OUI-X"00"	
4	OUI-X"A0"	OUI-X"3E"	FRAME-TYPE		
8	ELAN-ID				
12	LE HEADER	DESTINATION ADDR			
16	DESTINATION ADDRESS				
20	SOURCE ADDRESS				
24	SOURCE ADDR	TYPE/LENGTH			
28 and on	INFO				

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LAN Emulation over ATM

Control Frame

0	MARKER = X"FF00"		PROTOCOL = X"01"	VERSION = X"01"
4	OP-CODE		STATUS	
8	TRANSACTION-ID			
12	REQUESTER-LECID		FLAGS	
16	SOURCE-LAN-DESTINATION			
24	TARGET-LAN-DESTINATION			
32	SOURCE-ATM-ADDRESS			
52	LAN-TYPE	MAXIMUM-FRAME-SIZE	NUMBER-TLVs	ELAN-NAME-SIZE
56	TARGET-ATM-ADDRESS			
76	ELAN-NAME			
108	TLVs BEGIN			

LANE Control Frame

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Three approaches to converting Legacy LANs to ATM Emulated LANs

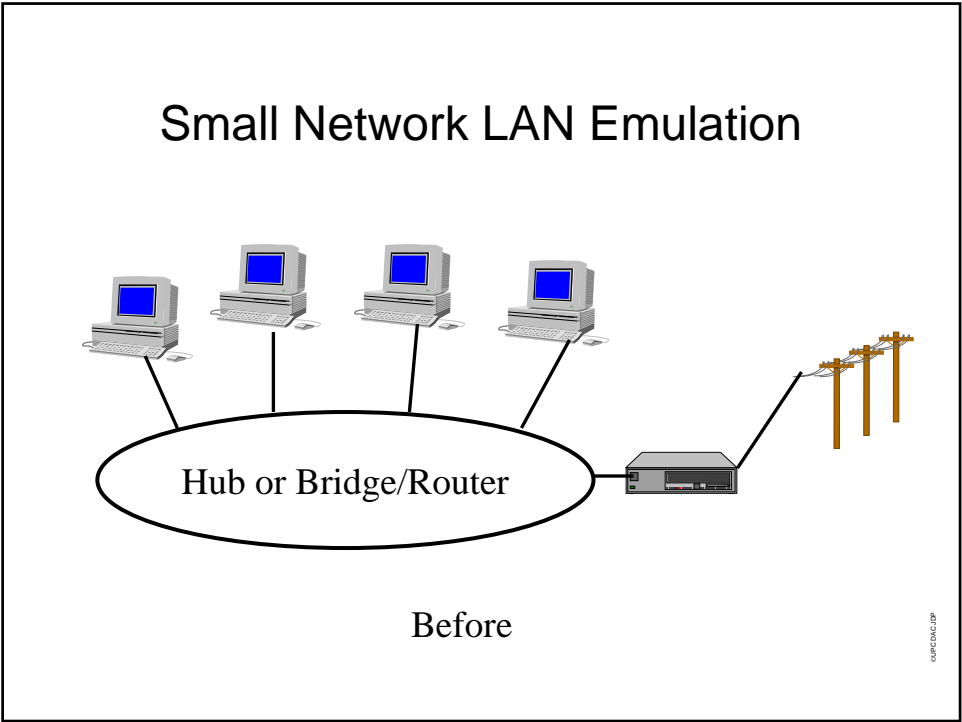
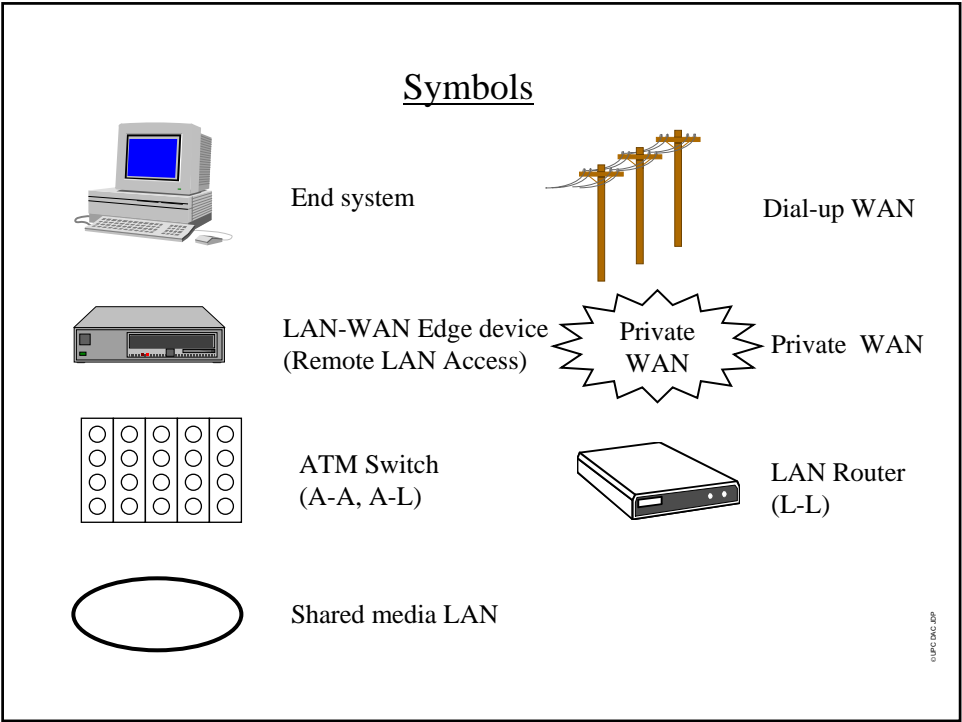
- **“ATM Workgroup”**
Attach End Systems to ATM Network
- **“ATM Backbone”**
Attach Hub/Bridge/Routers to ATM Network
- **Hybrid (ATM Workgroups & Backbone)**

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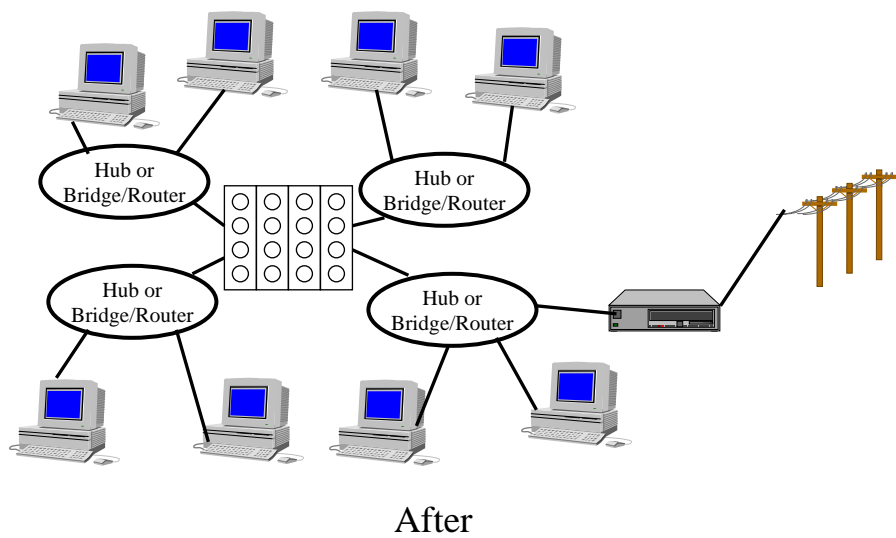
Small & Large Networks

- **“Small Network”**
 - 50 or less users
 - Usually *one* site
 - LAN & *dial-up* public WAN
- **“Large Network”**
 - 500 or more users
 - *Many* sites
 - LANs, private WAN & public dial-up WAN

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ATM Backbone Solution



ATM Workgroup Solution

