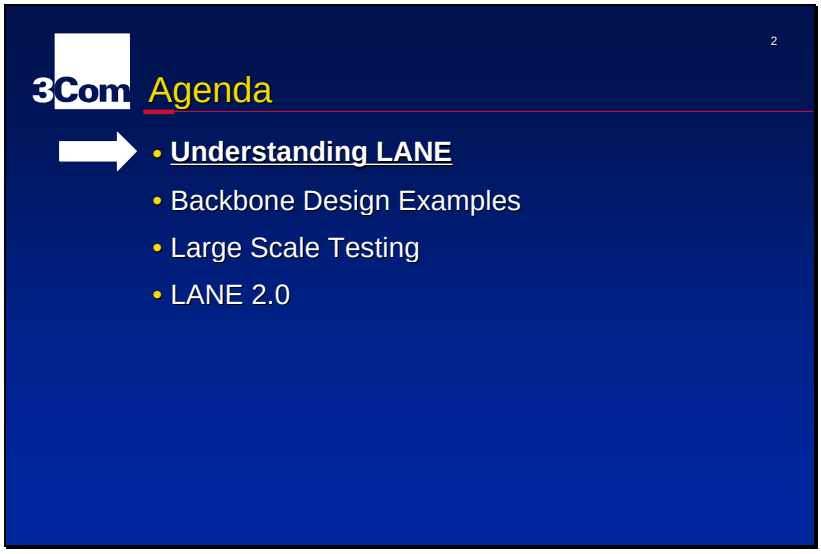
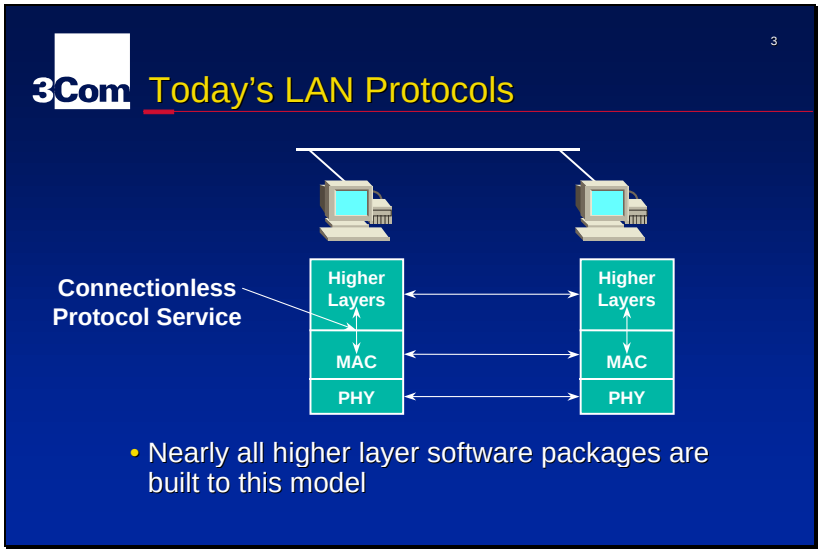
Slide 1


3Com
Building Campus Backbones with ATM LANE
David O'Connor
HP World Conference
August 1997

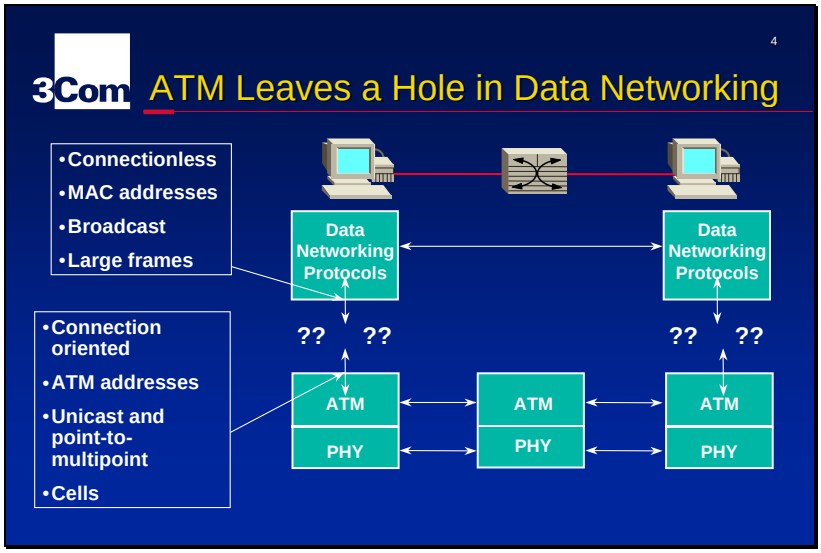
Slide 2


2
3Com
Agenda
• Understanding LANE
• Backbone Design Examples
• Large Scale Testing
• LANE 2.0

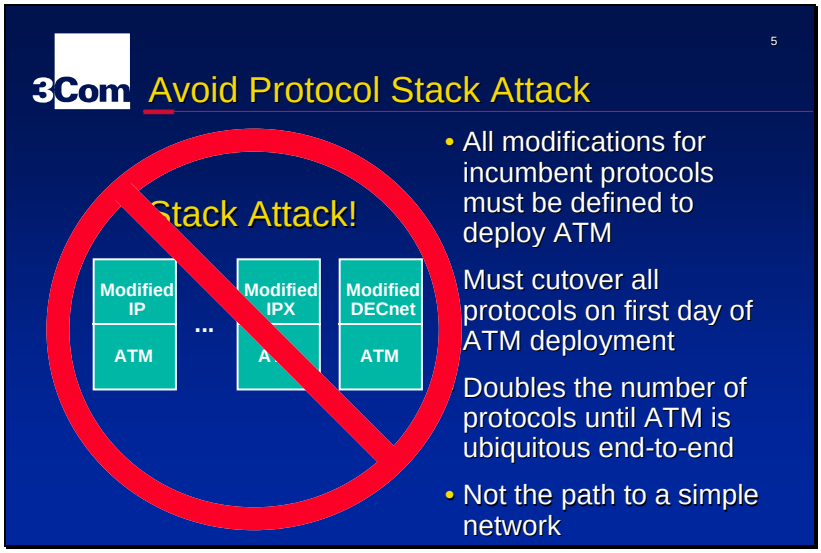
Slide 3


3
3Com
Today's LAN Protocols
Connectionless
Protocol Service
Higher
Layers
MAC
PHY
Higher
Layers
MAC
PHY
• Nearly all higher layer software packages are
built to this model

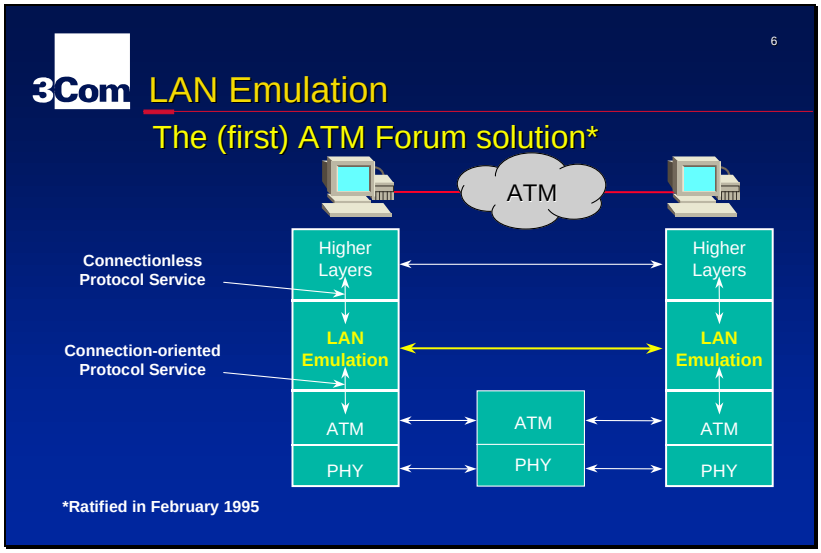
Slide 4


4
3Com
ATM Leaves a Hole in Data Networking
•Connectionless
•MAC addresses
•Broadcast
•Large frames
Data Networking Protocols
Data Networking Protocols
??
??
??
??
•Connection oriented
•ATM addresses
•Unicast and point-to-multipoint
•Cells
ATM
PHY
ATM
PHY
ATM
PHY

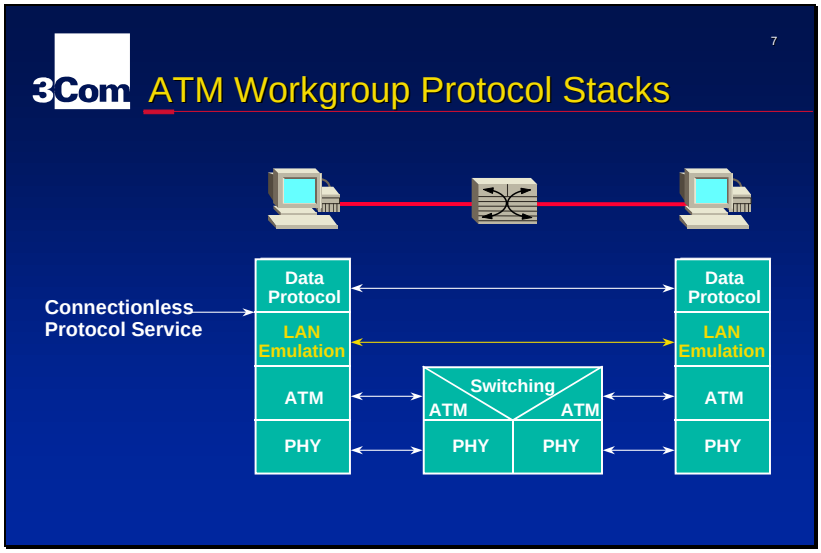
Slide 5


5
3Com
Avoid Protocol Stack Attack
Stack Attack!
Modified IP
ATM
...
Modified IPX
ATM
Modified DECnet
ATM
• All modifications for incumbent protocols must be defined to deploy ATM
Must cutover all protocols on first day of ATM deployment
Doubles the number of protocols until ATM is ubiquitous end-to-end
• Not the path to a simple network

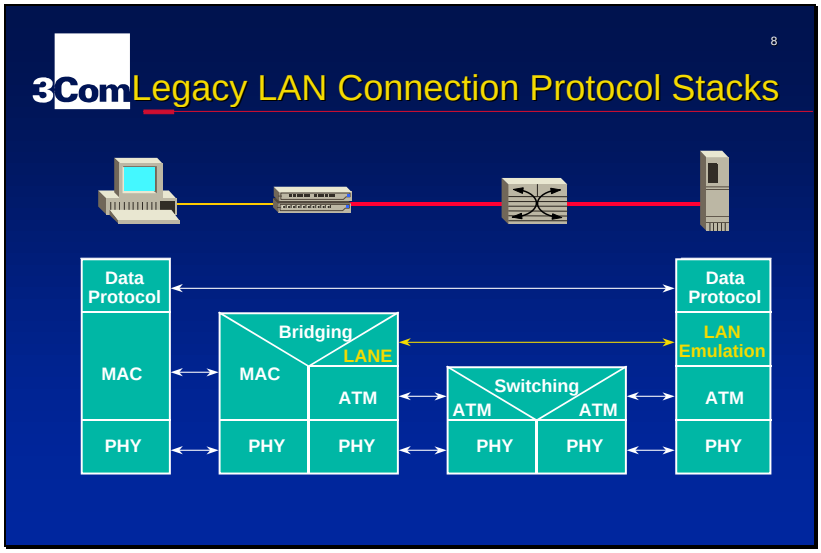
Slide 6


6
3Com
LAN Emulation
The (first) ATM Forum solution*
ATM
Higher Layers
Higher Layers
Connectionless Protocol Service
LAN Emulation
LAN Emulation
Connection-oriented Protocol Service
ATM
ATM
ATM
PHY
PHY
PHY
*Ratified in February 1995

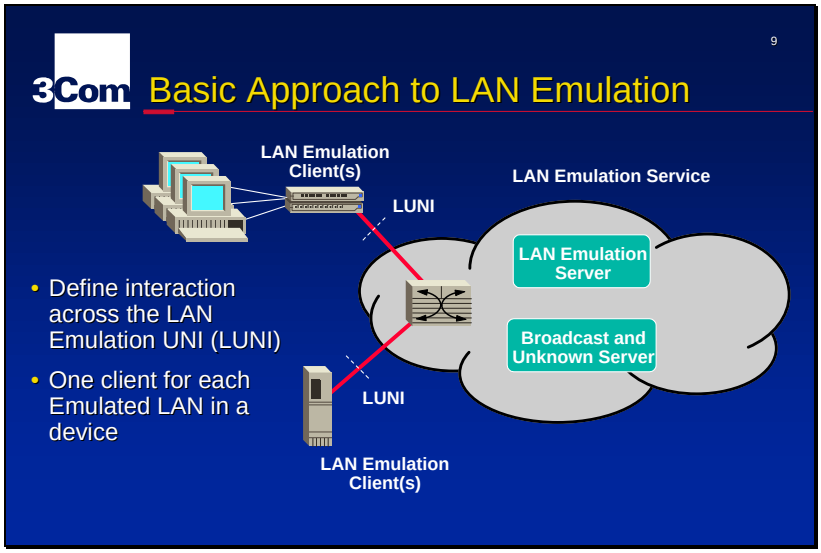
Slide 7


7
3Com
ATM Workgroup Protocol Stacks
Connectionless
Protocol Service
Data
Protocol
LAN
Emulation
ATM
PHY
Switching
ATM
ATM
PHY
PHY
Data
Protocol
LAN
Emulation
ATM
PHY

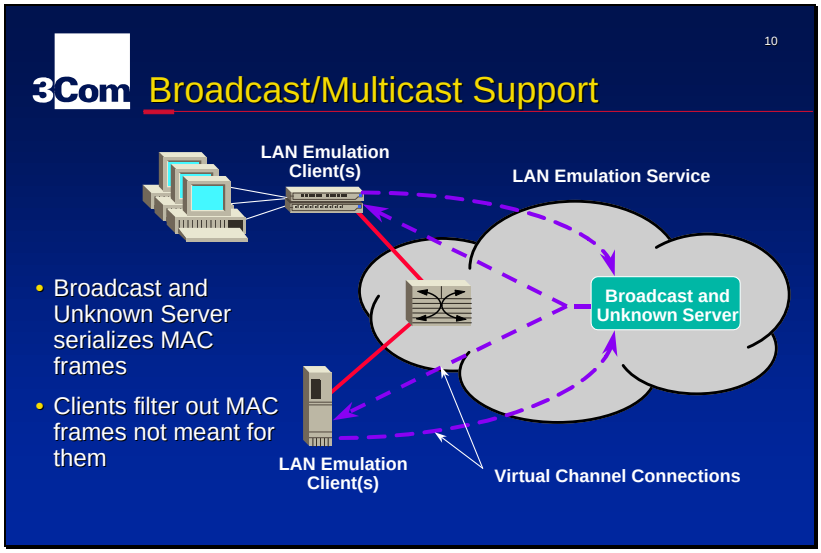
Slide 8


8
3Com
Legacy LAN Connection Protocol Stacks
Data Protocol
MAC
PHY
Bridging
LANE
MAC
ATM
PHY
PHY
Switching
ATM
ATM
PHY
PHY
Data Protocol
LAN Emulation
ATM
PHY

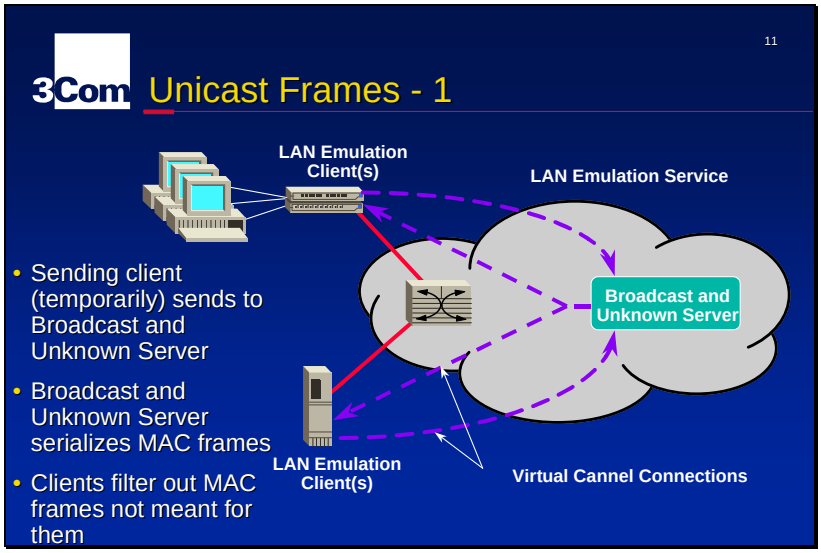
Slide 9


9
3Com
Basic Approach to LAN Emulation
LAN Emulation Client(s)
LUNI
LAN Emulation Service
LAN Emulation Server
Broadcast and Unknown Server
LUNI
LAN Emulation Client(s)
• Define interaction across the LAN Emulation UNI (LUNI)
• One client for each Emulated LAN in a device

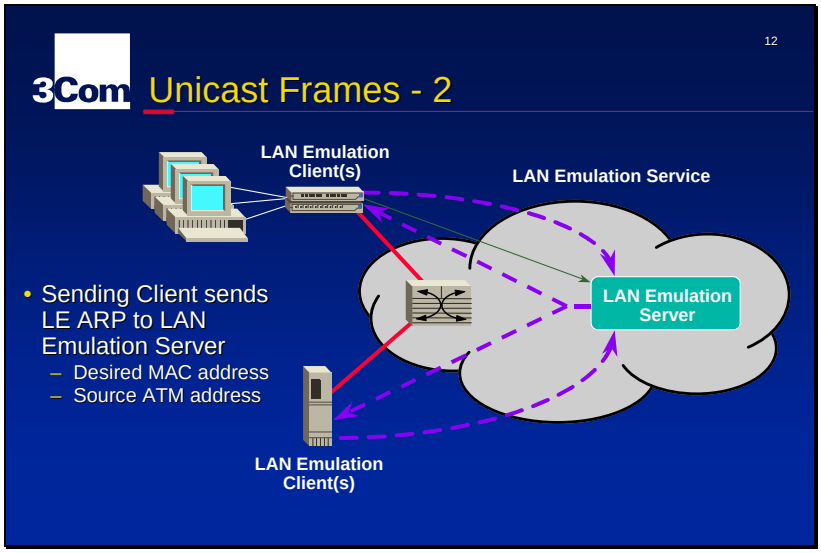
Slide 10


10
3Com
Broadcast/Multicast Support
LAN Emulation Client(s)
LAN Emulation Service
Broadcast and Unknown Server
• Broadcast and Unknown Server serializes MAC frames
• Clients filter out MAC frames not meant for them
LAN Emulation Client(s)
Virtual Channel Connections

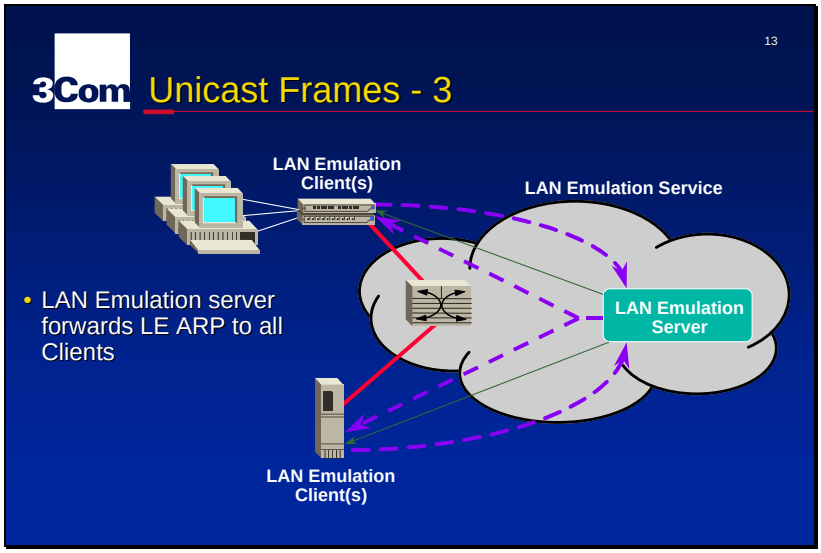
Slide 11


11
3Com
Unicast Frames - 1
LAN Emulation Client(s)
LAN Emulation Service
Broadcast and Unknown Server
• Sending client (temporarily) sends to Broadcast and Unknown Server
• Broadcast and Unknown Server serializes MAC frames
• Clients filter out MAC frames not meant for them
LAN Emulation Client(s)
Virtual Cannel Connections

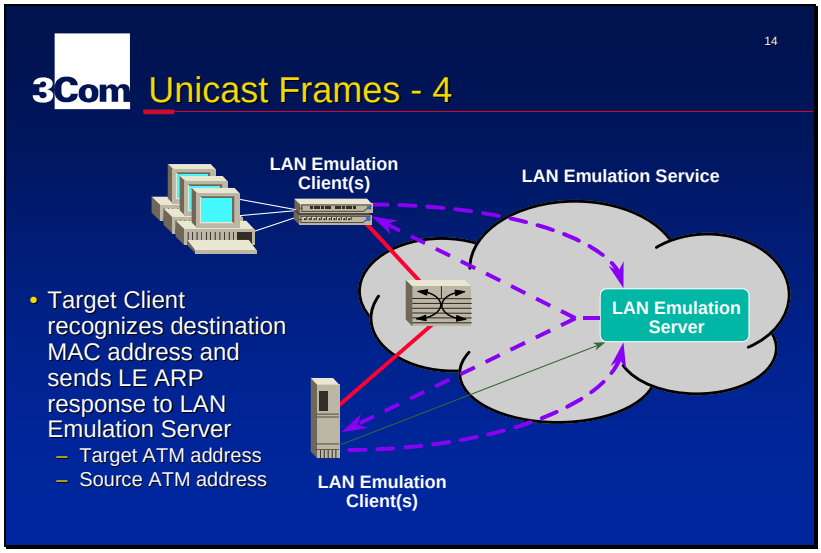
Slide 12


12
3Com
Unicast Frames - 2
LAN Emulation Client(s)
LAN Emulation Service
LAN Emulation Server
• Sending Client sends LE ARP to LAN Emulation Server
– Desired MAC address
– Source ATM address
LAN Emulation Client(s)

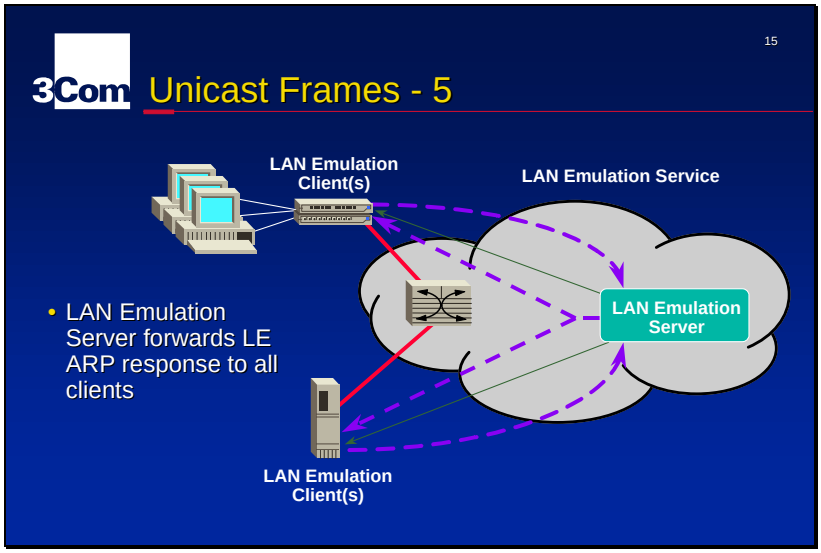
Slide 13


13
3Com
Unicast Frames - 3
LAN Emulation Client(s)
LAN Emulation Service
LAN Emulation Server
• LAN Emulation server forwards LE ARP to all Clients
LAN Emulation Client(s)

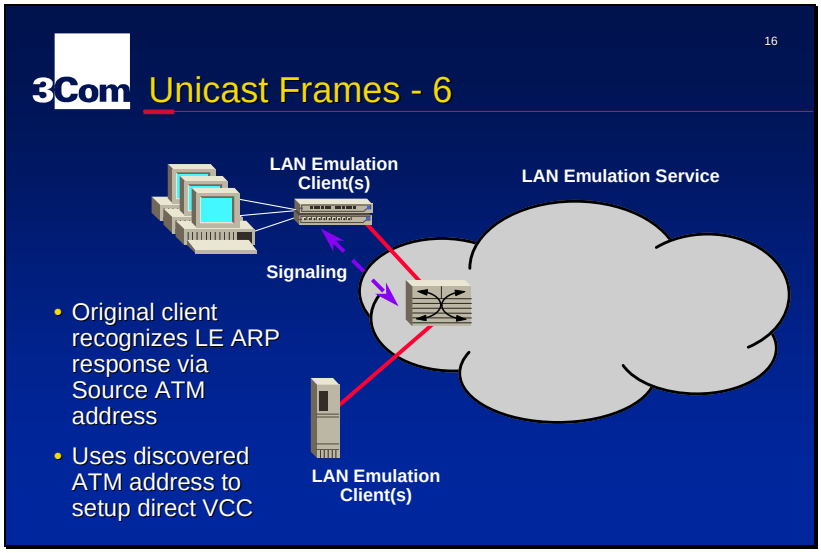
Slide 14


14
3Com
Unicast Frames - 4
LAN Emulation Client(s)
LAN Emulation Service
LAN Emulation Server
• Target Client recognizes destination MAC address and sends LE ARP response to LAN Emulation Server
– Target ATM address
– Source ATM address
LAN Emulation Client(s)

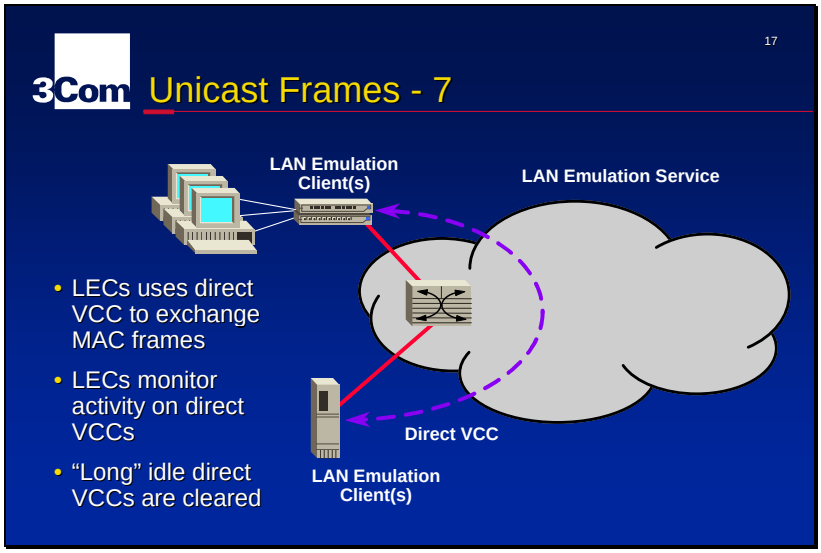
Slide 15


15
3Com
Unicast Frames - 5
LAN Emulation Client(s)
LAN Emulation Service
LAN Emulation Server
• LAN Emulation Server forwards LE ARP response to all clients
LAN Emulation Client(s)

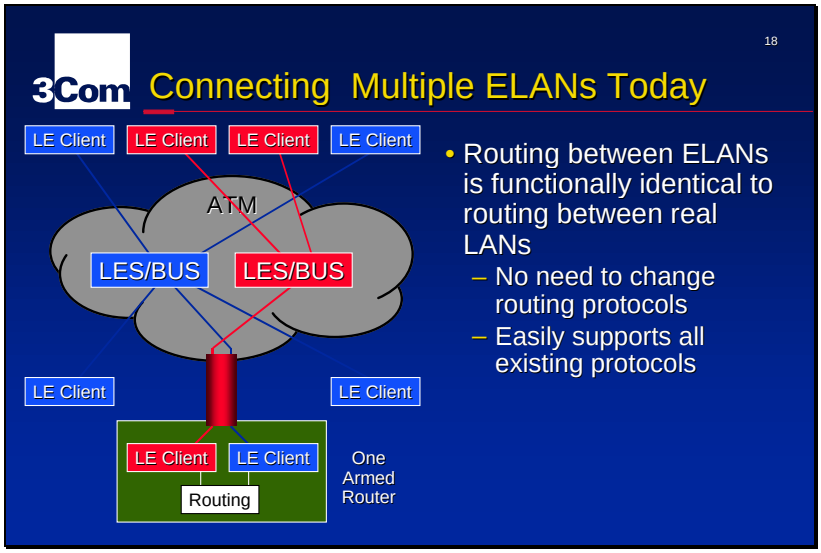
Slide 16


16
3Com
Unicast Frames - 6
LAN Emulation Client(s)
LAN Emulation Service
Signaling
• Original client recognizes LE ARP response via Source ATM address
• Uses discovered ATM address to setup direct VCC
LAN Emulation Client(s)

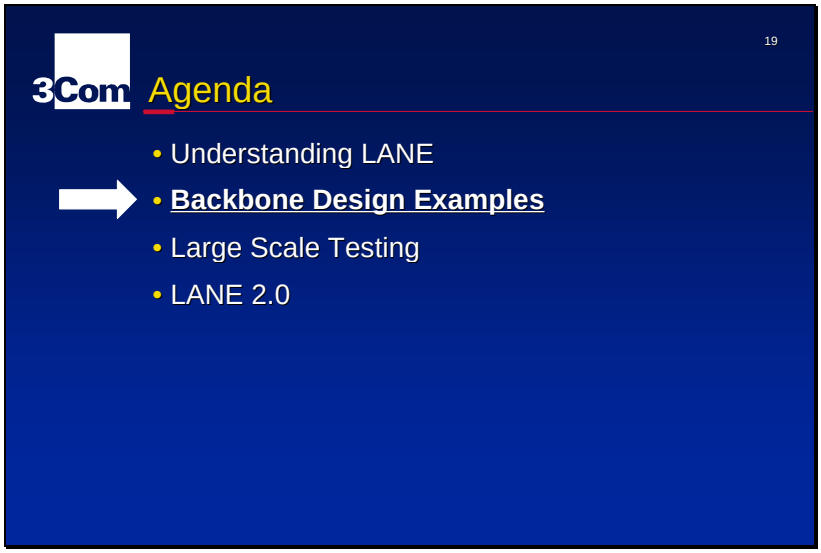
Slide 17


17
3Com
Unicast Frames - 7
LAN Emulation Client(s)
LAN Emulation Service
• LECs uses direct VCC to exchange MAC frames
• LECs monitor activity on direct VCCs
• “Long” idle direct VCCs are cleared
Direct VCC
LAN Emulation Client(s)

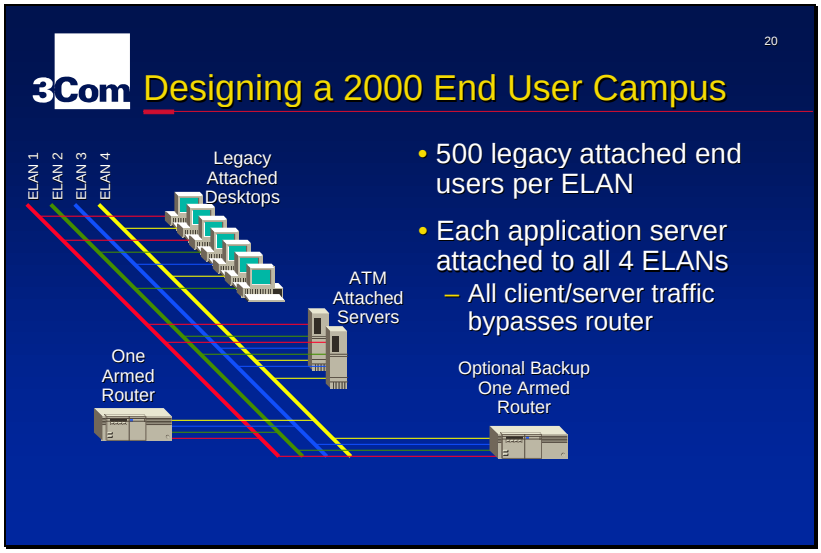
Slide 18


18
3Com
Connecting Multiple ELANs Today
LE Client
LE Client
LE Client
LE Client
ATM
LES/BUS
LES/BUS
LE Client
LE Client
LE Client
LE Client
Routing
One Armed Router
• Routing between ELANs is functionally identical to routing between real LANs
– No need to change routing protocols
– Easily supports all existing protocols

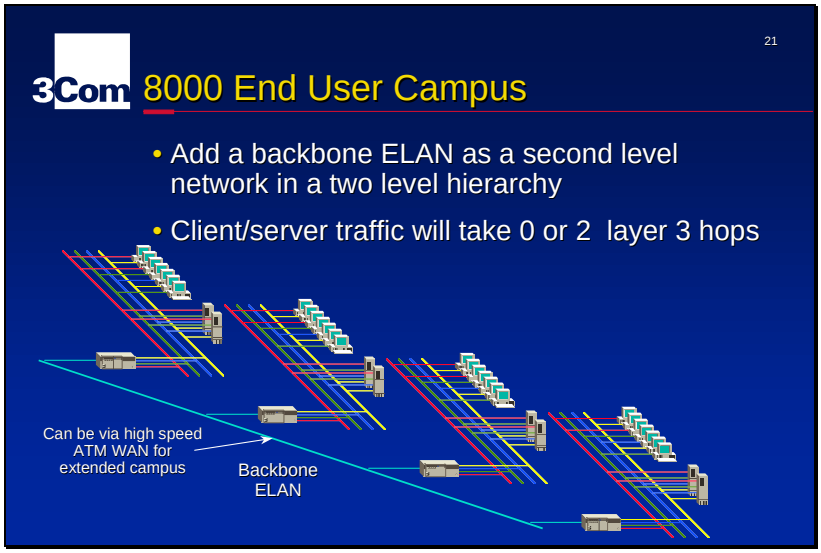
Slide 19


19
3Com
Agenda
• Understanding LANE
• Backbone Design Examples
• Large Scale Testing
• LANE 2.0

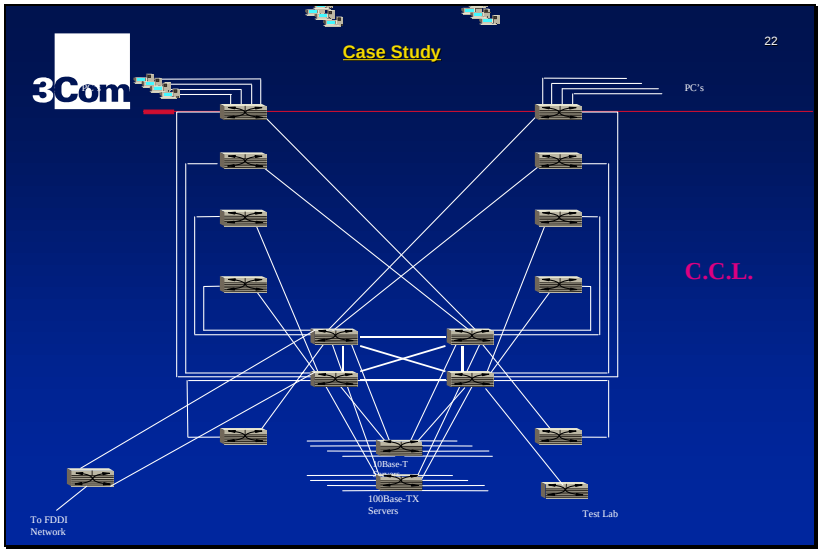
Slide 20


20
3Com
Designing a 2000 End User Campus
ELAN 1
ELAN 2
ELAN 3
ELAN 4
Legacy Attached Desktops
ATM Attached Servers
One Armed Router
Optional Backup One Armed Router
• 500 legacy attached end users per ELAN
• Each application server attached to all 4 ELANs
– All client/server traffic bypasses router

Slide 21


21
3Com
8000 End User Campus
• Add a backbone ELAN as a second level network in a two level hierarchy
• Client/server traffic will take 0 or 2 layer 3 hops
Can be via high speed ATM WAN for extended campus
Backbone ELAN

Slide 22


Case Study
22
3Com
PC's
C.C.L.
10Base-T
100Base-TX
Servers
To FDDI
Network
Test Lab

Slide 23


23
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Agenda
• Understanding LANE
• Backbone Design Examples
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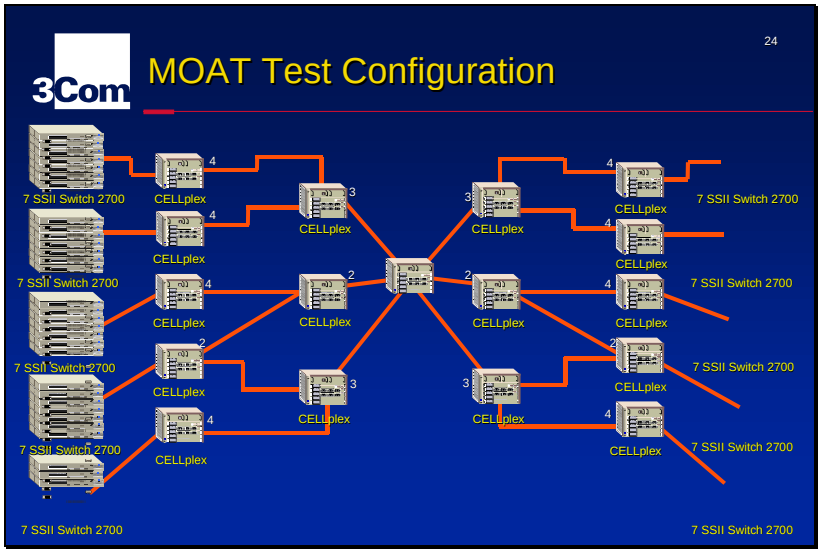
• LANE 2.0

Slide 24


24
MOAT Test Configuration
7 SSII Switch 2700
CELLplex
7 SSII Switch 2700
CELLplex
7 SSII Switch 2700
CELLplex
7 SSII Switch 2700
CELLplex
7 SSII Switch 2700
CELLplex
CELLplex
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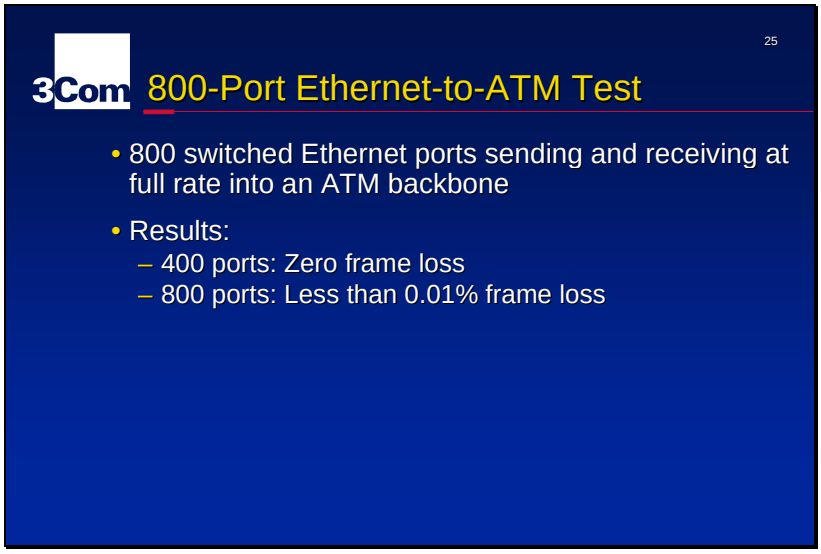
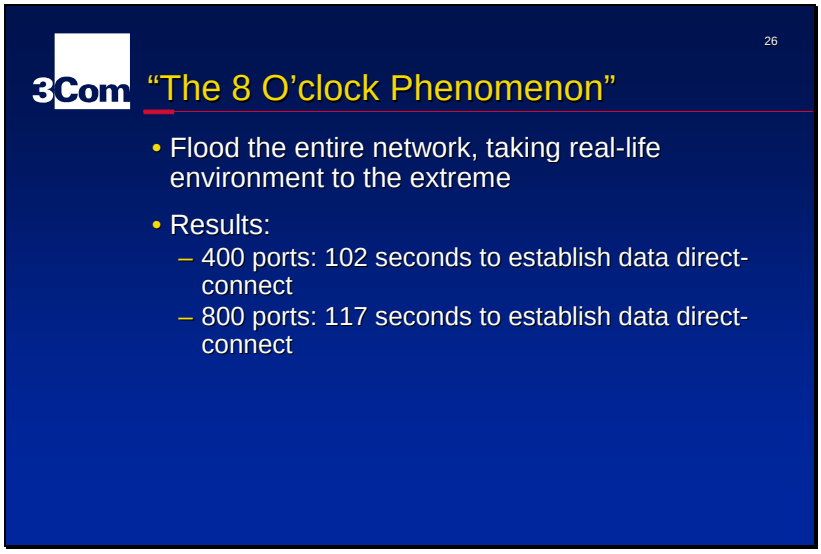
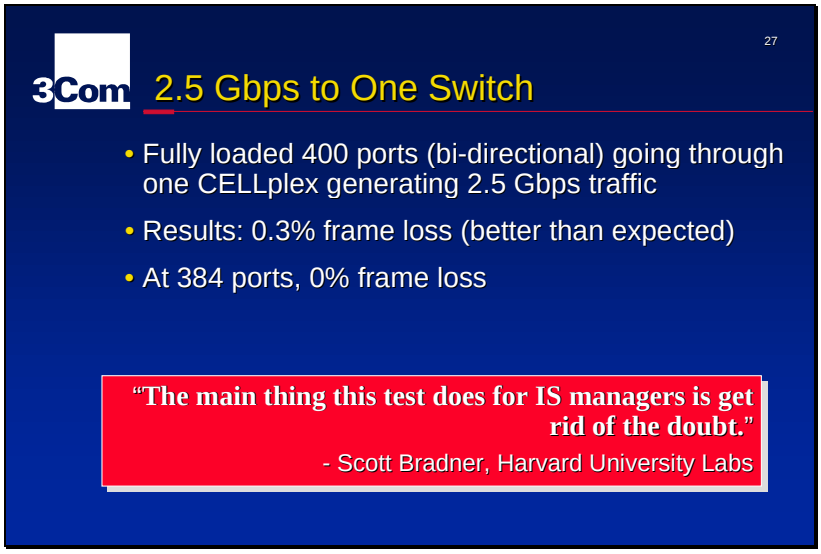
7 SSII Switch 2700
7 SSII Switch 2700
7 SSII Switch 2700
7 SSII Switch 2700
7 SSII Switch 2700
7 SSII Switch 2700


25
3Com
800-Port Ethernet-to-ATM Test
• 800 switched Ethernet ports sending and receiving at full rate into an ATM backbone
• Results:
– 400 ports: Zero frame loss
– 800 ports: Less than 0.01% frame loss

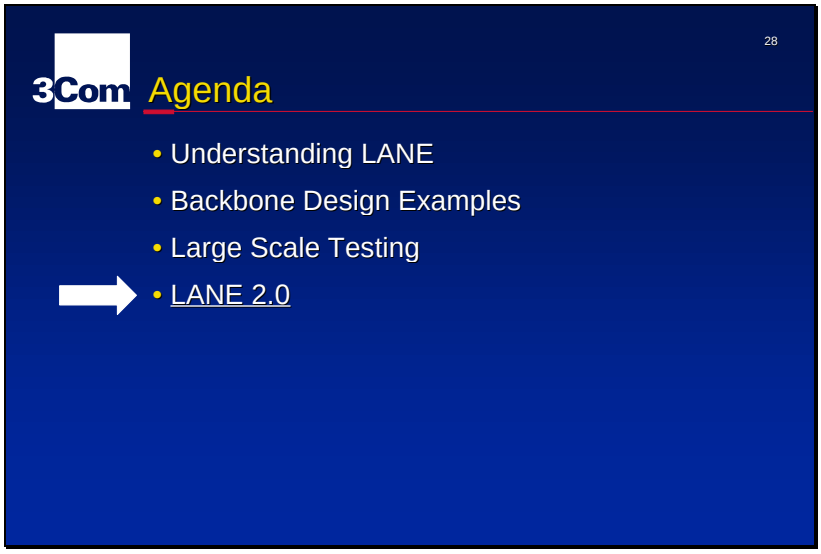
Slide 26


26
3Com
"The 8 O'clock Phenomenon"
• Flood the entire network, taking real-life environment to the extreme
• Results:
– 400 ports: 102 seconds to establish data direct-connect
– 800 ports: 117 seconds to establish data direct-connect

Slide 27


27
3Com
2.5 Gbps to One Switch
• Fully loaded 400 ports (bi-directional) going through one CELLplex generating 2.5 Gbps traffic
• Results: 0.3% frame loss (better than expected)
• At 384 ports, 0% frame loss
"The main thing this test does for IS managers is get rid of the doubt."
- Scott Bradner, Harvard University Labs

Slide 28


28
3Com
Agenda
• Understanding LANE
• Backbone Design Examples
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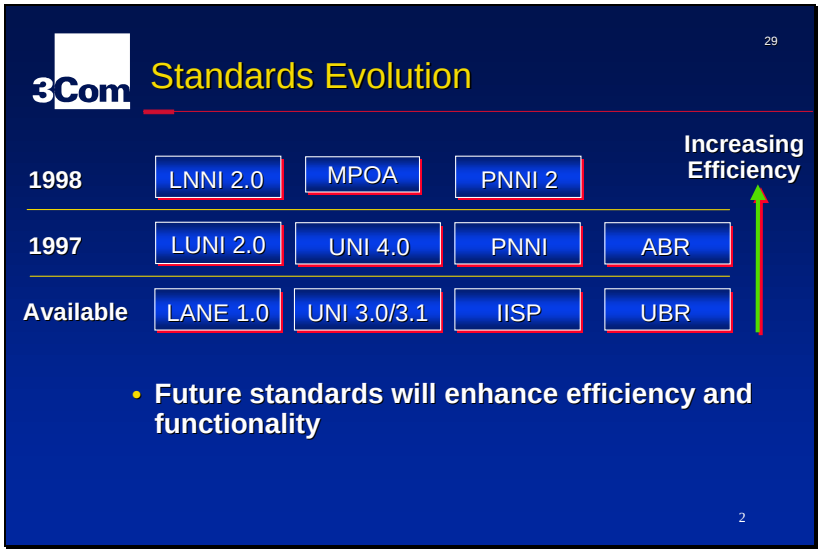
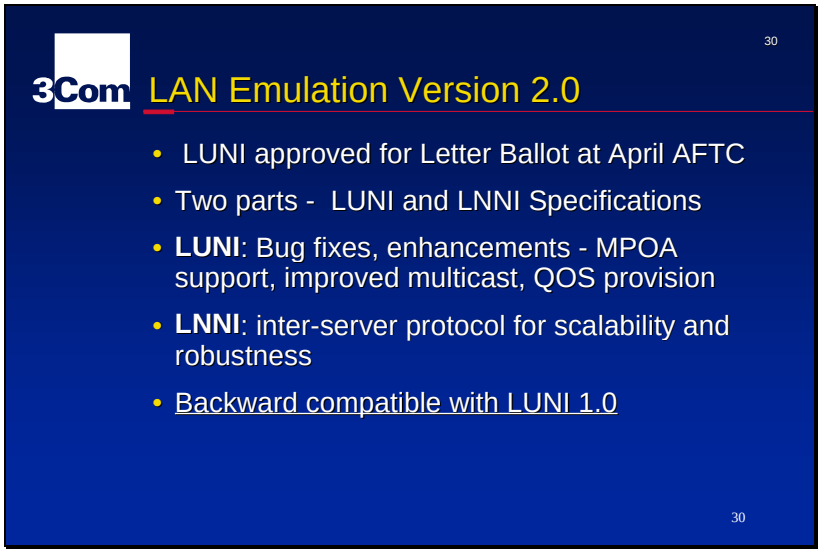
• LANE 2.0

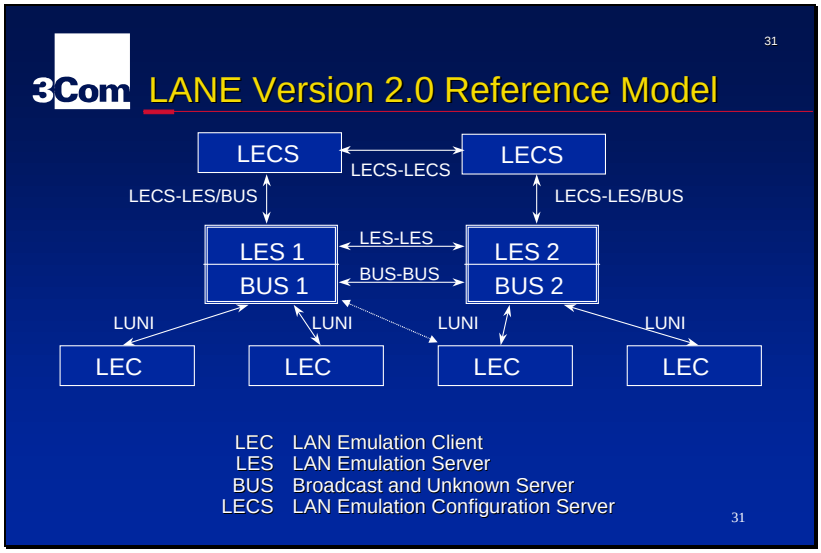
Slide 29


29
3Com
Standards Evolution
Increasing Efficiency
1998
LNNI 2.0
MPOA
PNNI 2
1997
LUNI 2.0
UNI 4.0
PNNI
ABR
Available
LANE 1.0
UNI 3.0/3.1
IISP
UBR
• Future standards will enhance efficiency and functionality
2

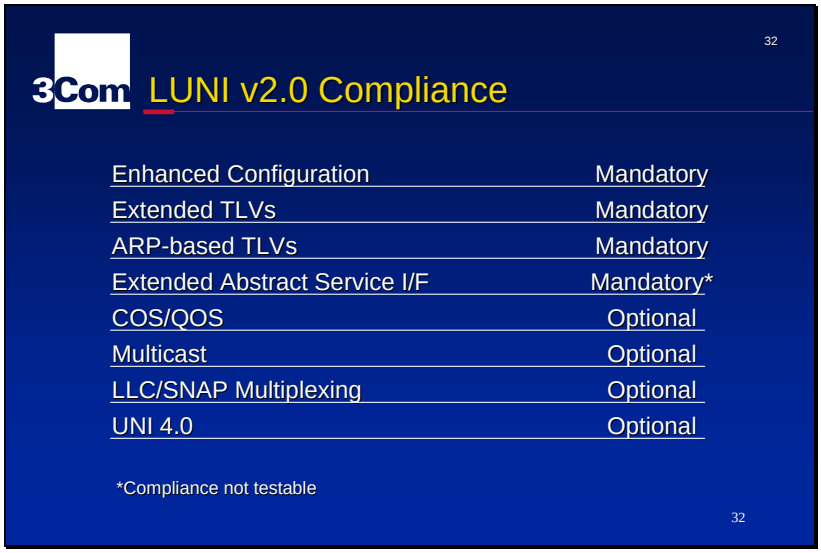
Slide 30


30
3Com
LAN Emulation Version 2.0
• LUNI approved for Letter Ballot at April AFTC
• Two parts - LUNI and LNNI Specifications
• LUNI: Bug fixes, enhancements - MPOA support, improved multicast, QOS provision
• LNNI: inter-server protocol for scalability and robustness
• Backward compatible with LUNI 1.0
30

Slide 31


31
3Com
LANE Version 2.0 Reference Model
LECS
LECS-LECS
LECS
LECS-LES/BUS
LECS-LES/BUS
LES 1
BUS 1
LES-LES
BUS-BUS
LES 2
BUS 2
LUNI
LUNI
LUNI
LUNI
LEC
LEC
LEC
LEC
LEC LAN Emulation Client
LES LAN Emulation Server
BUS Broadcast and Unknown Server
LECS LAN Emulation Configuration Server
31

Slide 32


32
3Com
LUNI v2.0 Compliance
Enhanced Configuration Mandatory
Extended TLVs Mandatory
ARP-based TLVs Mandatory
Extended Abstract Service I/F Mandatory*
COS/QOS Optional
Multicast Optional
LLC/SNAP Multiplexing Optional
UNI 4.0 Optional
*Compliance not testable
32