X.25 over TCP/IP

Advanced Relay is frequently asked to help integrate legacy equipment into modern TCP/IP networks (e.g. X.25 over TCP/IP).

The legacy systems use some type of synchronous signaling (e.g. bit synchronous or byte synchronous). They use physical interfaces defined by standards such as RS-232, RS-422, EIA-530, X.21, V.35.

And they use outdated protocols such as X.25.

Gateways that convert from an old protocol to a new one are the solution. But a gateway can be implemented in different ways and at different levels of complexity. A gateway can be used to convert the physical layer, or it can also be used to convert the protocols at upper layers.

For instance, people have often heard of XOT and imagine this is the best way to solve the problem of integrating legacy X.25 equipment to TCP/IP networks. Actually, this is not the best solution as we will explain in the following sections.

We will discuss how Cisco's XOT works, how our LayGO® XOT client can be used to interface to legacy equipment through Cisco XOT routers, and then how this solution can be greatly improved by using the PXSe as an X.25 to TCP/IP gateway. We also show an even higher level solution where the PXSe autonomously extracts data from higher level protocols (e.g. FTAM) and acts as a client to a file server to deposit the data in a remote file server.

Cisco XOT HW Server to Cisco XOT HW Client

XOT (X.25 Over TCP/IP) or RFC 1613 is a possible solution when all ends, both central and branch offices, use X.25 equipment and the Internet/intranet replaces an X.25 Packet Switching Data Network (PSDN) or point-to-point X.25 leased line connections. PSDNs are more expensive, slower, and often charge for traffic and number of virtual circuits. Most important, maintenance and support are ever increasing. For that very reason, they are fast disappearing. Most companies using PSDNs already have alternative Internet/intranet or TCP/IP WAN connections. Prior to XOT, X.25 over Frame Relay (Annex G) was used for the same reason.

Cisco, the major supporter of RFC 1613, addressed the need by tunneling X.25 data through a TCP/IP connection without changing the existing X.25 connections, provided they use CCITT Recommendation X.25 1984 or later.

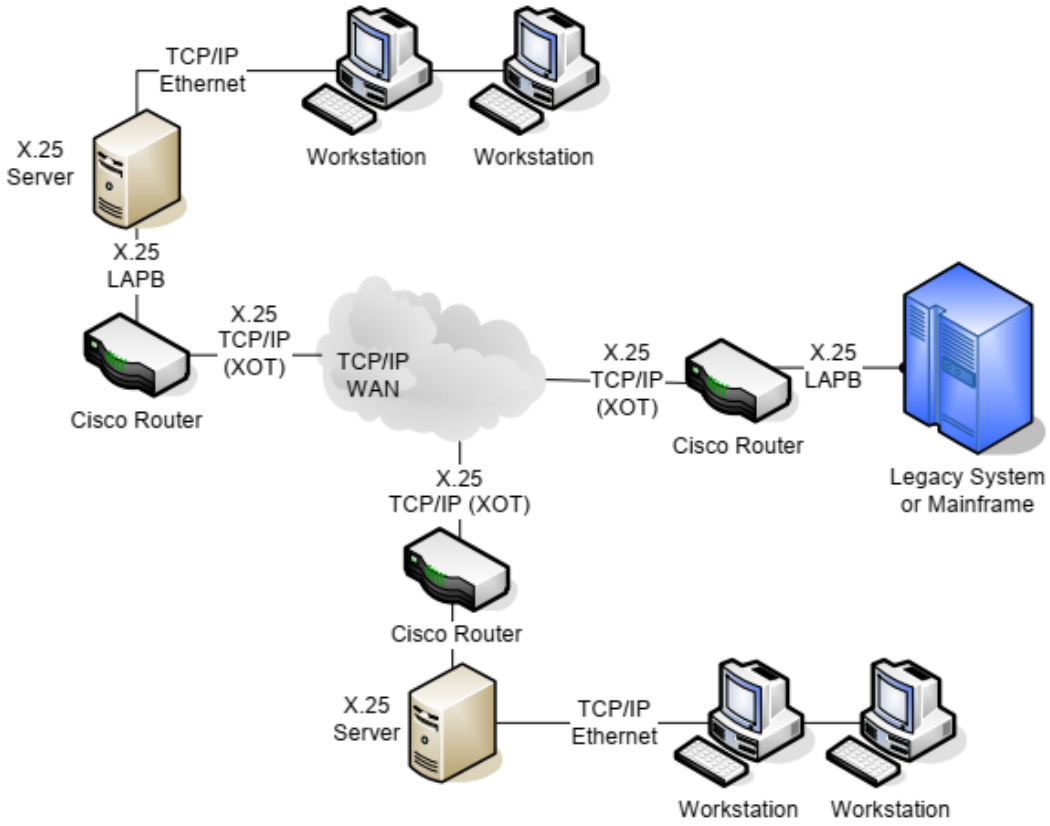


Figure 1 XOT Cisco - Cisco Topology

Under RFC 1613, only the X.25 Packet Level Protocol (PLP) or packets are encapsulated into a TCP/IP stream. Because X.25 uses packets, but TCP/IP is a character stream protocol, the second 2 bytes of a 4 byte header define the size of a following packet. There is no LAPB layer traffic, and there is no LCN0 traffic. SVCs are established via Call Request/Call Accepted Packets, facilities for packet and window size are mandatory. Each VC uses one TCP/IP connection. To ensure proper point-to-multipoint LCN mapping, client and host map TCP/IP sockets to their X.25 LCNs. PVC connections are badly implemented, using a Call Establishment emulation to establish the mapping of socket to LCN.

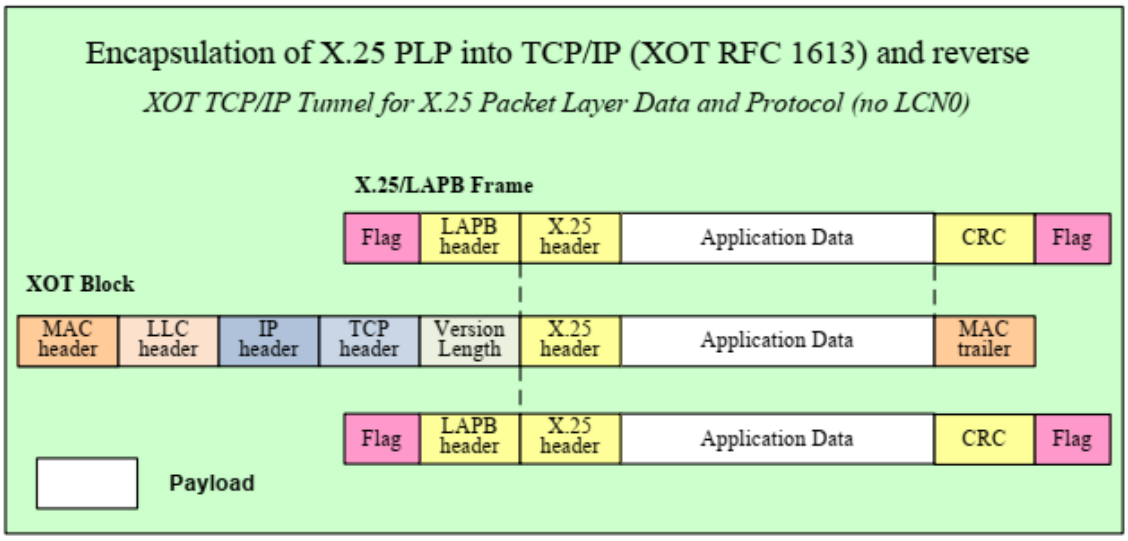


Figure 2 XOT Cisco - Cisco Encapsulation

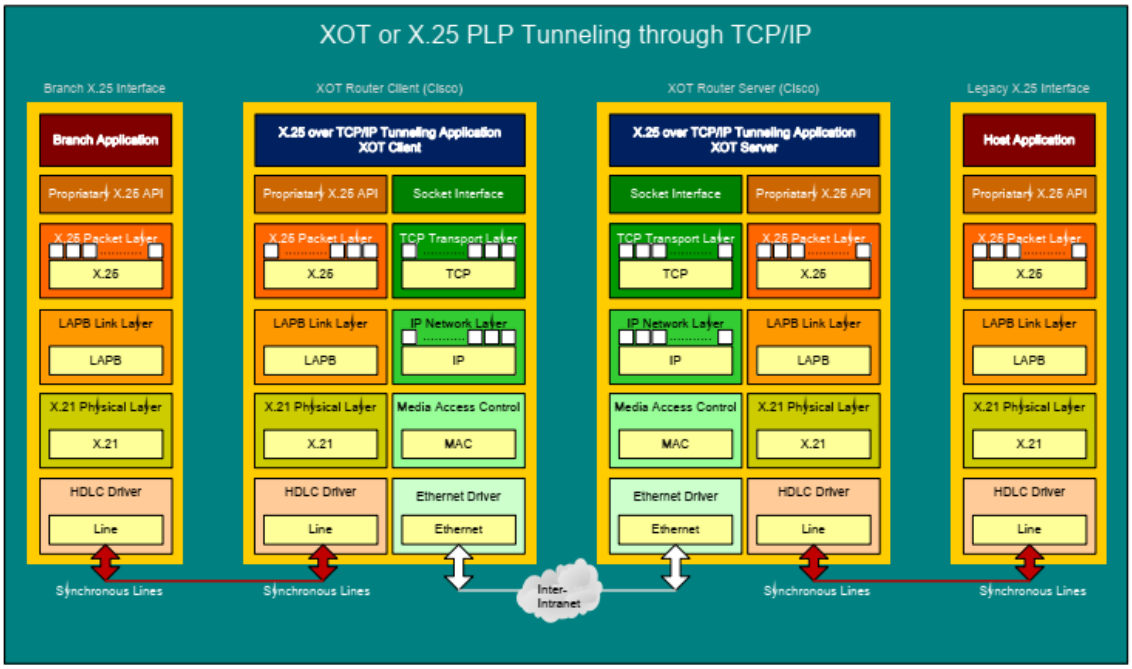


Figure 3 XOT Cisco - Cisco Stacks

Cisco XOT HW Server - LayGO XOT SW Client

Since branch offices are far more numerous than the mainframe sites, the elimination of the X.25 hardware at the branches results in the largest cost savings and increased line speed. Since the X.25 PLP data are encapsulated into TCP/IP, the X.25 packets can be extracted and processed by an X.25 PLP module.

At the receiver, the X.25 packet is routed to the lower edge of the packet layer using the Lay*GO* Return Layer. They are then decoded as if they had arrived from the LAPB or LAPD layer. At the transmitter, the X.25 packets are routed from the lower edge of the X.25 packet layer to the XOT client using the Lay*GO* Return Layer. The XOT client also emulates the LCN0 traffic. The Lay*GO* application is unaware that XOT is used. In addition to XOT, RPC can be used to support multiple local or remote simultaneous processes.

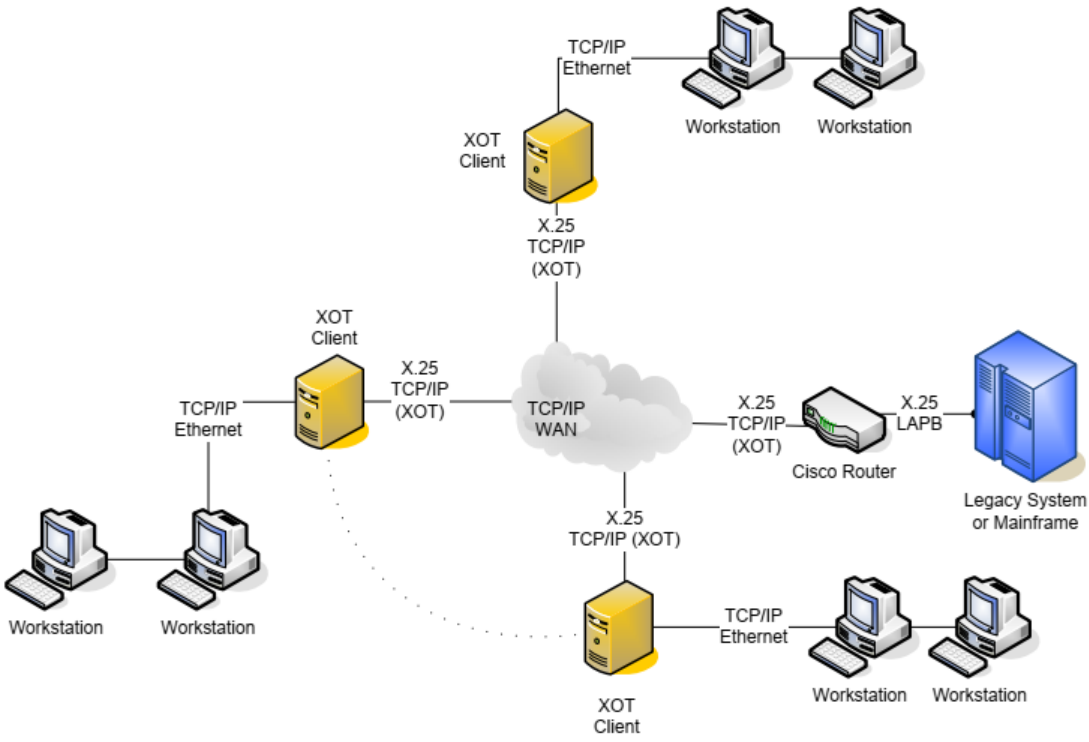


Figure 4 XOT Cisco - LayGO Topology

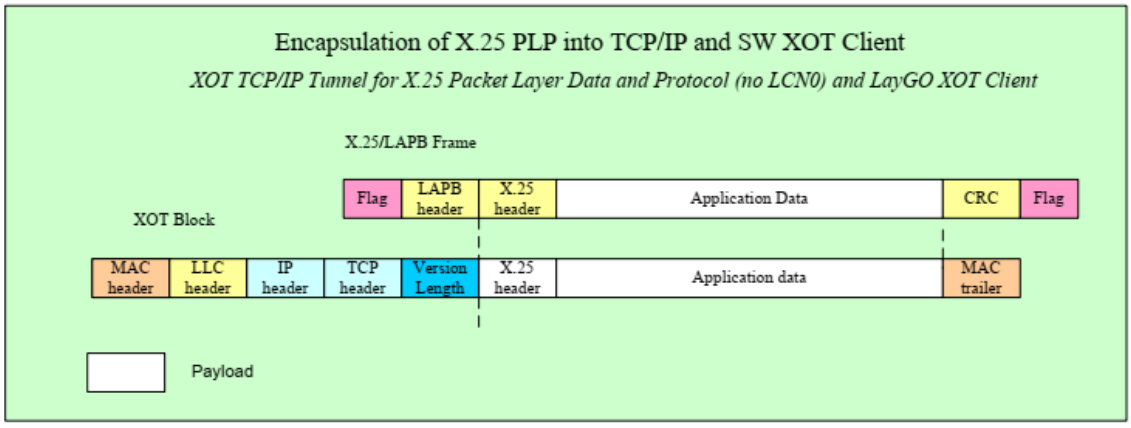


Figure 5 XOT Cisco - LayGO Encapsulation

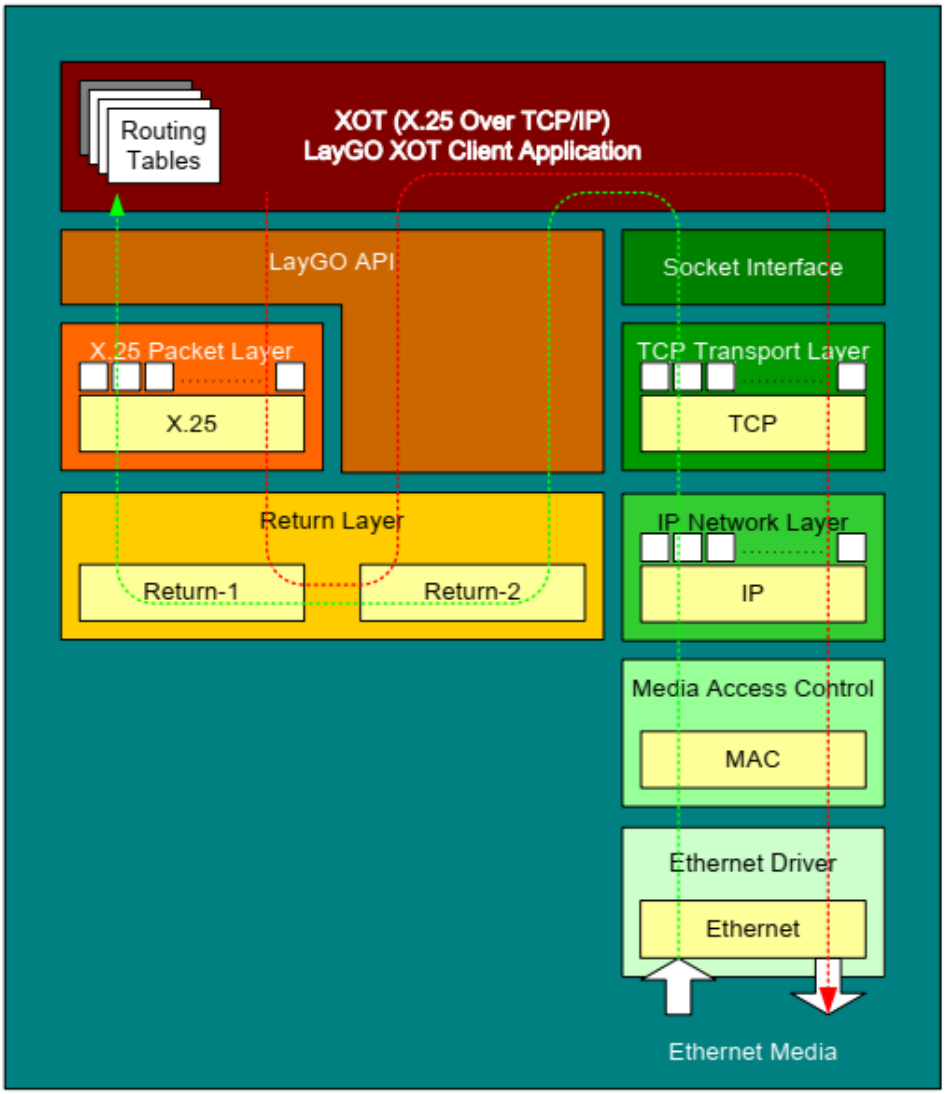


Figure 6 XOT Cisco - LayGO Stacks

X.25 to TCP/IP Gateway (PXSe XGate)

XOT and all other options have one disadvantage: the X.25 protocol spans across the Internet/intranet. There is an overhead in the protocol headers, and there are timing issues caused by latency of the X.25 protocol. The application at the branch offices is still burdened using a proprietary X.25 API. This may be a temporary solution to replace at least the X.25 PSDN with a TCP/IP WAN. Even if legacy X.25 hardware in the branch offices cannot be eliminated, the X.25-to-TCP/IP gateway is still the better option, because the X.25 does not have to traverse the Wide Area Network (WAN). Our solution is the PXSe XGate
(X.25↔TCP/IP).

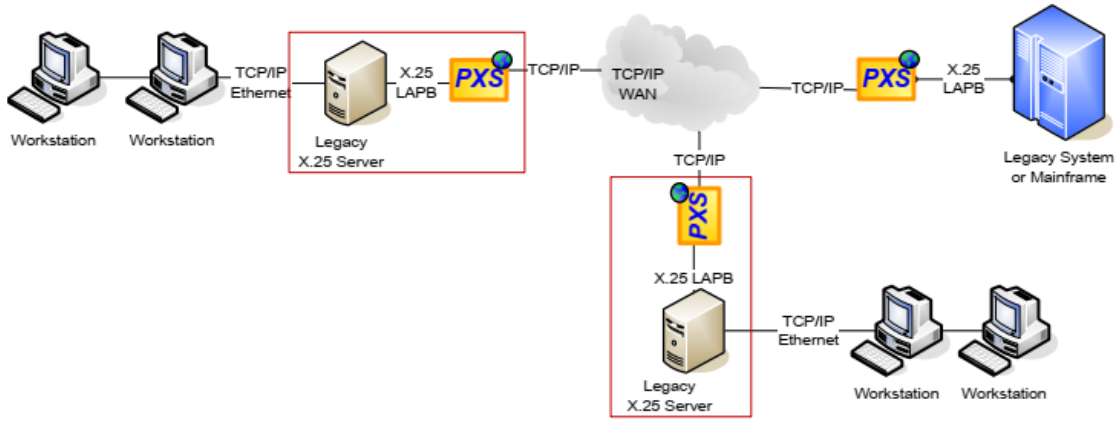


Figure 7 ARC's X.25 to TCP/IP Gateway

If the legacy hardware in the branch offices is already an X.25-to-TCP/IP gateway (depicted above) and can be removed, this is the most cost effective option. The PXSe can terminate the X.25 connection directly at the legacy system. Data received from the TCP/IP WAN, is forwarded via X.25 to the legacy mainframe. As in XOT, a 2 byte header defines the length of the data.

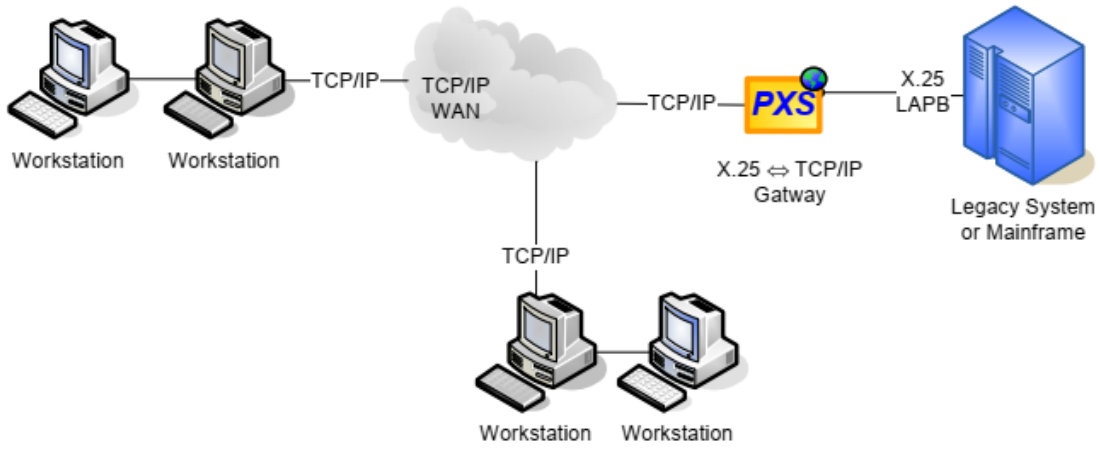
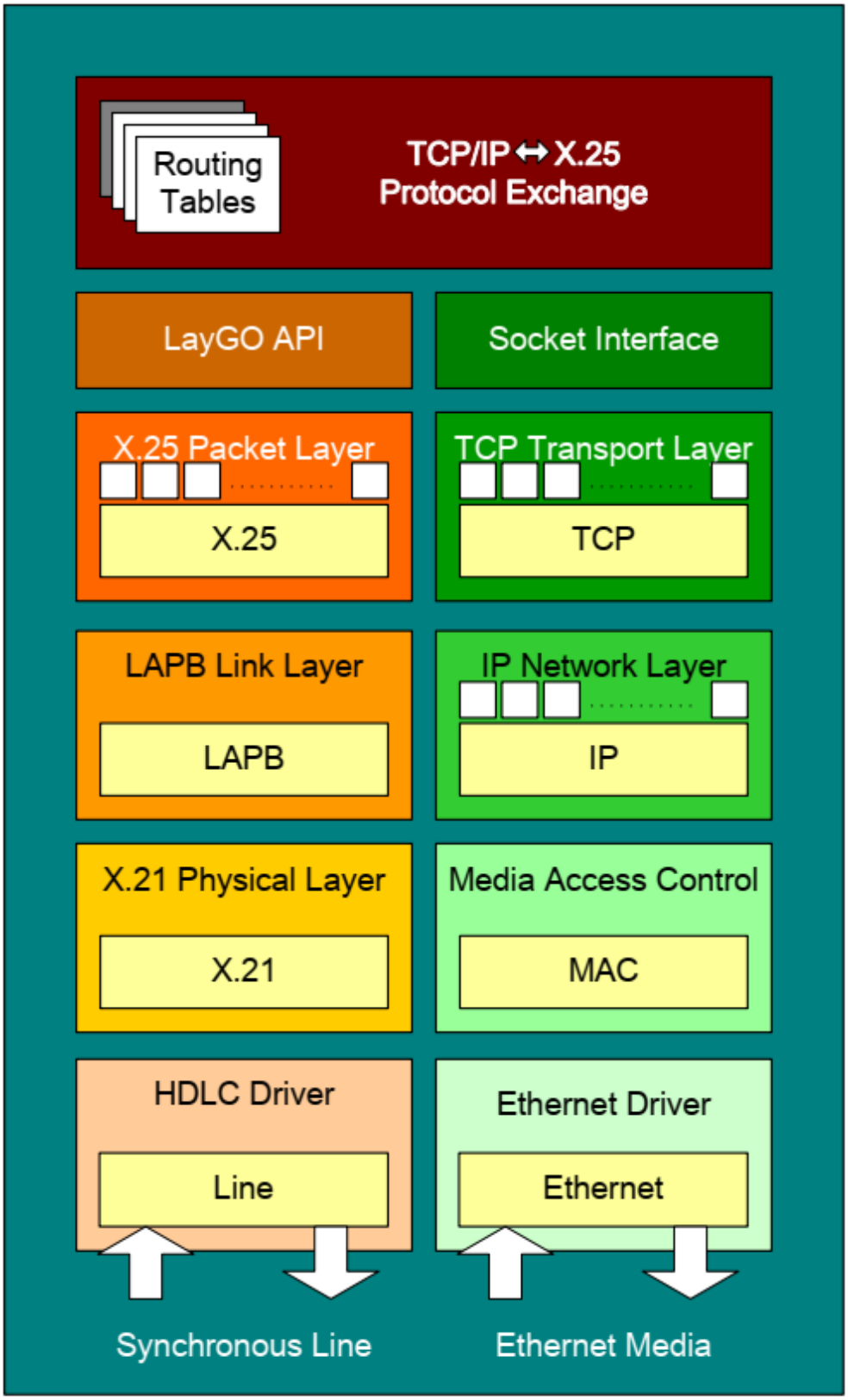


Figure 8 ARC's X.25 to TCP/IP Gateway Only at the Mainframe


Routing Tables
TCP/IP ↔ X.25 Protocol Exchange
LayGO API
Socket Interface
X.25 Packet Layer
X.25
TCP Transport Layer
TCP
LAPB Link Layer
LAPB
IP Network Layer
IP
X.21 Physical Layer
X.21
Media Access Control
MAC
HDLC Driver
Line
Ethernet Driver
Ethernet
Synchronous Line
Ethernet Media

X.25 to TCP/IP & File Transfer Gateway

There are many legacy systems that use X.25 as an underlying transport to higher layer application protocols, mainly for file transfer. This is particularly true for telecoms. In these cases, the topology is reversed: the *branches* are expensive legacy phone switches, connected to a lower cost gateway which communicates to a central host. To transfer billing records or CDRs (Call Detail Records) to a centralized billing collector, most of these switches use a file transfer protocol on top of X.25. Typically, Nortel switches use their proprietary XFER, AFT or AFTEIU. Lucent switches use Bellcor's AMATPS, while Alcatel, Ericsson and Siemens use ISO FTAM. But there is no fixed rule regarding which switches use which protocol.

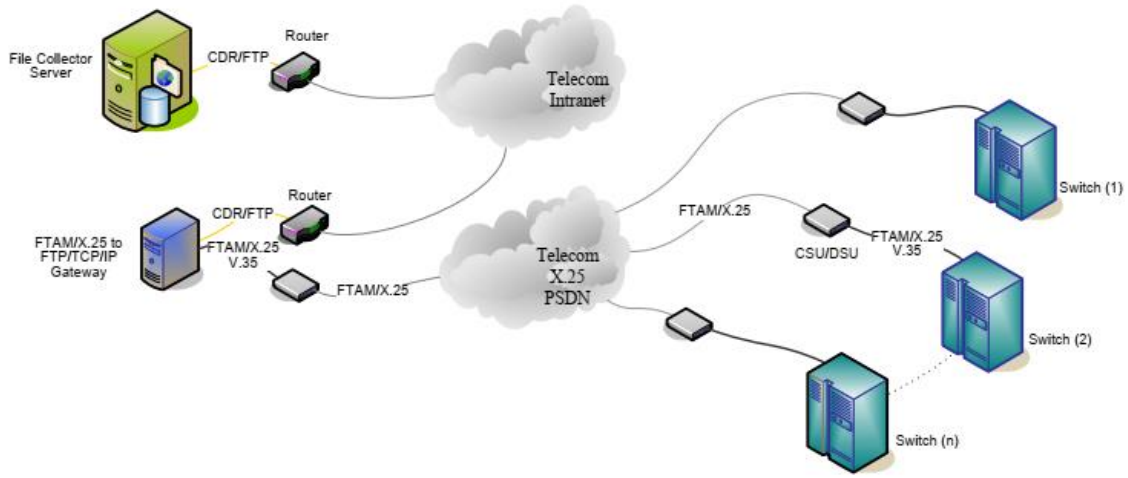


Figure 10 CDR Retrieval - Old Topology

Cisco XOT Client/Server Solution

This XOT topology shows multiple switches using Cisco XOT clients converting to FTAM/X.25/TCP/IP through the telecom's intranet to a Cisco XOT server that converts FTAM/X.25/TCP/IP back to FTAM/X.25/V.35.

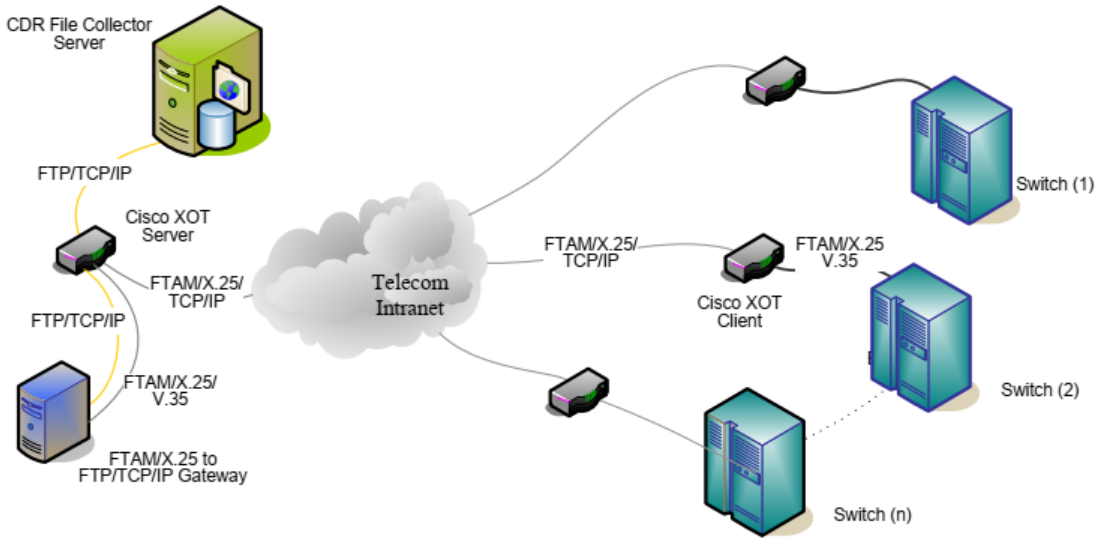


Figure 11 CDR Retrieval - XOT Solution

The centralized FTAM/X.25 to FTP/TCP/IP gateway uses the FTAM/X.25 protocol to communicate to the switches, and the FTP/TCP/IP protocol to communicate to the CDR file collector.

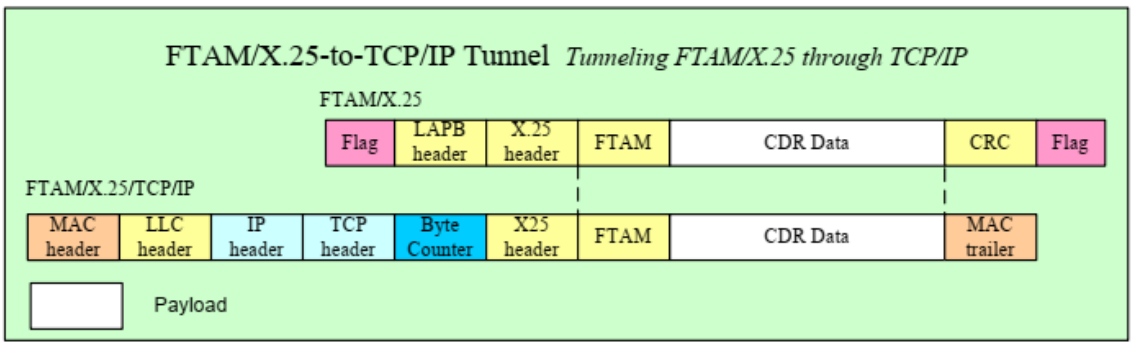


Figure 12 CDR Retrieval - Encapsulation Using XOT

PXSe FTAM/X.25 to (S)FTP Gateway Solution

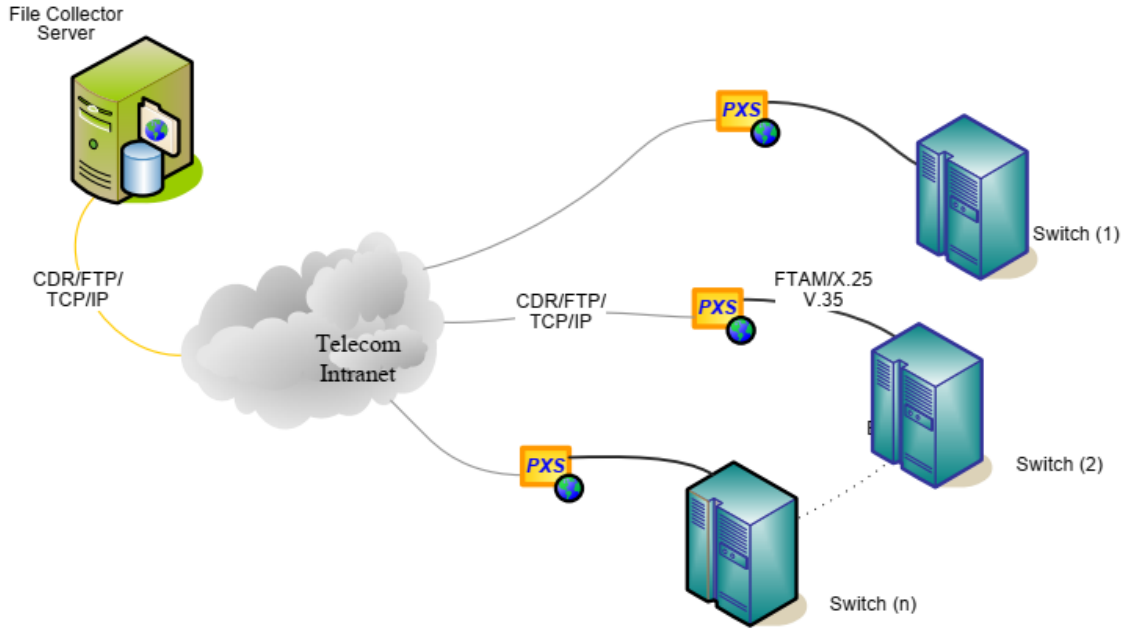


Figure 13 CDR Retrieval - PXSe Gateway Solution

The PXSe gateway at the phone switch exchanges not only X.25 for TCP/IP, but also the file transfer protocol for (S)FTP. The termination of all legacy protocols at the switch simplifies the interface to the centralized host or a dedicated (S)FTP server, which is already connected to the telecom's intranet. No special application interface is required: the PXSe operates as an (S)FTP client and transfers the CDR files directly to the collector, the (S)FTP server.

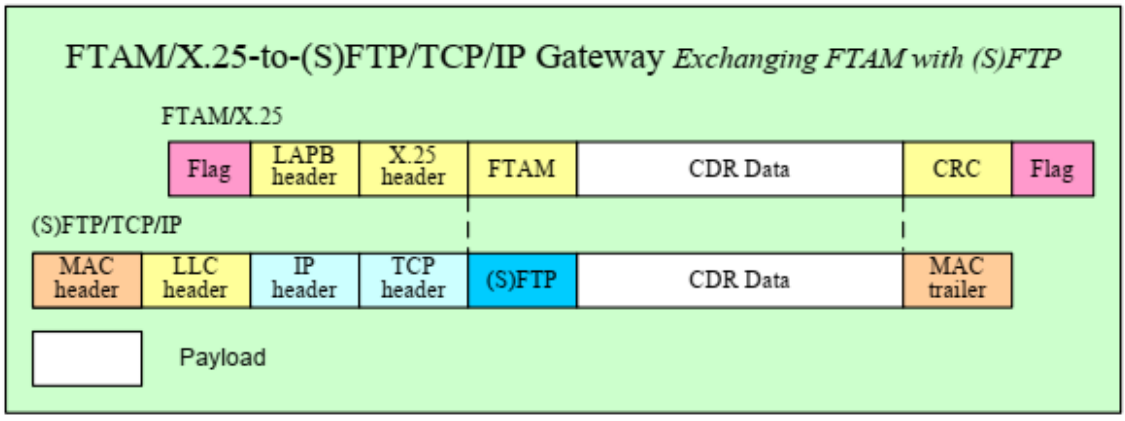


Figure 14 CDR Retrieval. PXSe Encapsulation Diagram