18-1 FRAME RELAY

Frame Relay is a virtual-circuit wide-area network that was designed in response to demands for a new type of WAN in the late 1980s and early 1990s.

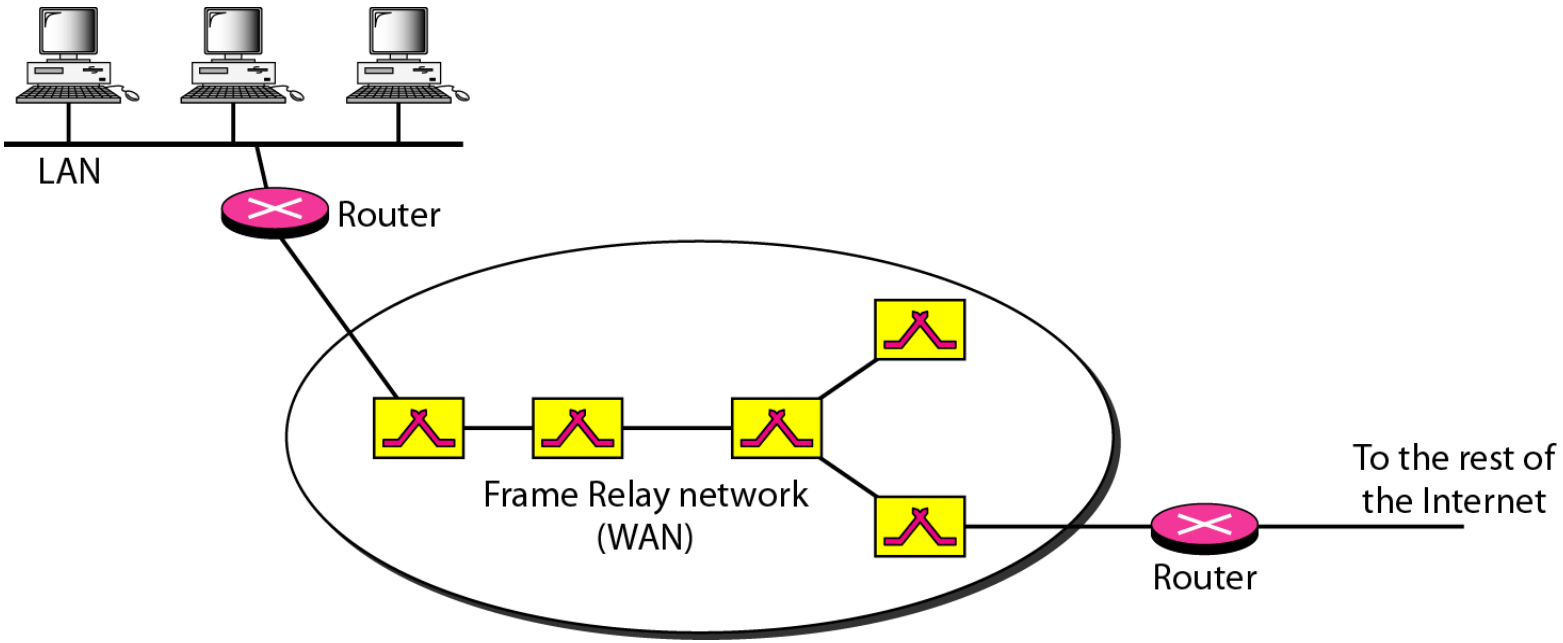
Topics discussed in this section:

Architecture
Frame Relay Layers
Extended Address
FRADs
VOFR
LMI

Frame relay

- Frame Relay is a wide area network with the following features:
  - Frame Relay operates at a higher speed (1.544 Mbps and recently 44.376 Mbps).
  - Frame Relay operates in just the physical and data link layers. This means it can easily be used as a backbone network to provide services to protocols that already have a network layer protocol, such as the Internet.
  - Frame Relay allows bursty data.
  - Frame Relay allows a frame size of 9000 bytes, which can accommodate all local area network frame sizes.
  - Frame Relay is less expensive than other traditional WANs.
  - Frame Relay has error detection at the data link layer only.
  - There is no flow control or error control. There is not even a retransmission policy if a frame is damaged; it is silently dropped.
  - Frame Relay was designed in this way to provide fast transmission capability for more reliable media and for those protocols that have flow and error control at the higher layers.

Figure 18.1 *Frame Relay network*



Frame Relay provides permanent virtual circuits and switched virtual circuits

Note

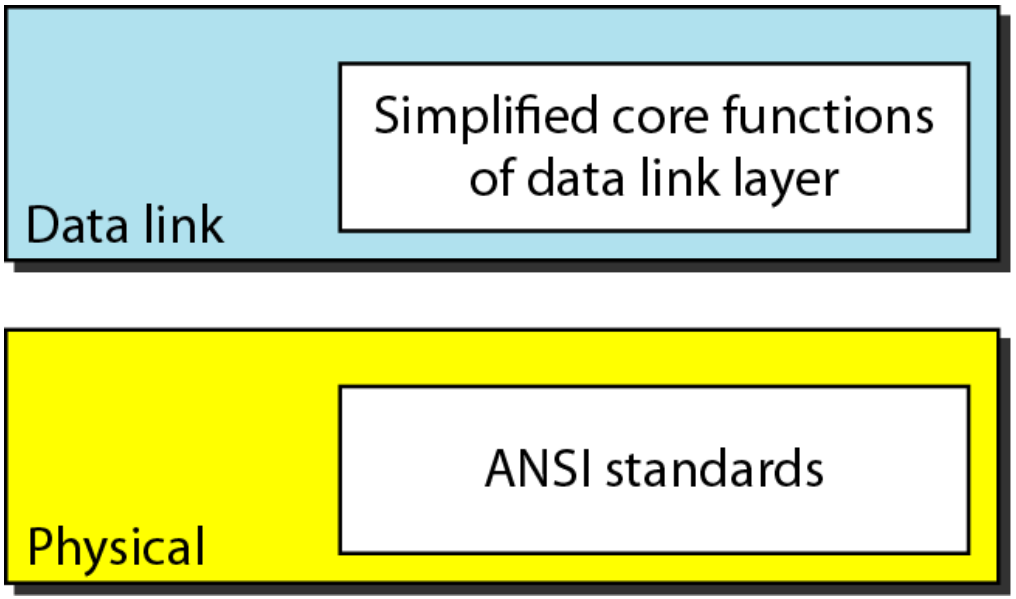
VCIs in Frame Relay are called data link connection identifier (DLCIs).

Permanent Versus Switched Virtual Circuits:

PVC: The corresponding table entry is recorded for all switches by the administrator. An outgoing DLCI is given to the source, and an incoming DLCI is given to the destination.

Drawback:costly because two parties pay for the connection all the time even when it is not in use. Second, a connection is created from one source to one single destination.

Figure 18.2 *Frame Relay layers*



Note

Frame Relay operates only at the physical and data link layers.

Figure 18.3 *Frame Relay frame*

frame check sequence (FCS) is an error-detecting code

C/R: Command/response
EA: Extended address
FECN: Forward explicit congestion notification

BECN: Backward explicit congestion notification
DE: Discard eligibility
DLCI: Data link connection identifier

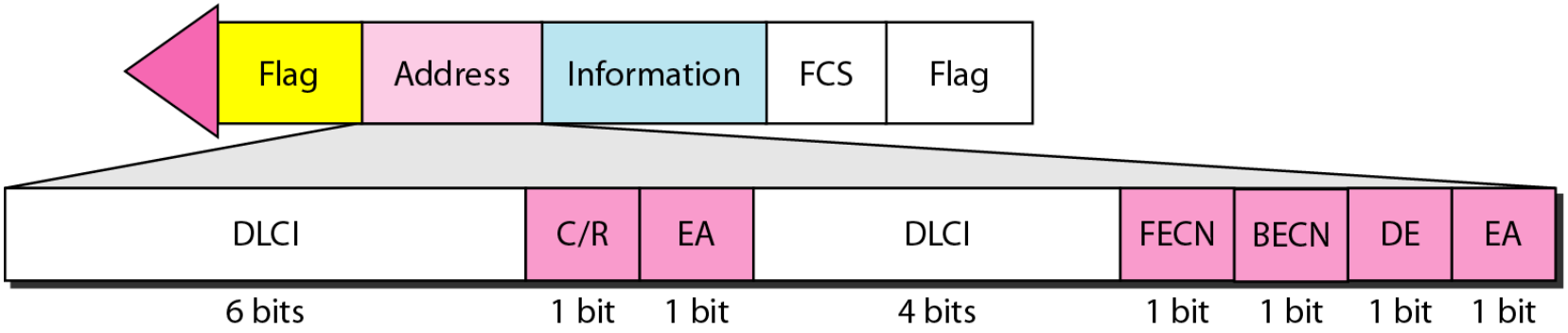
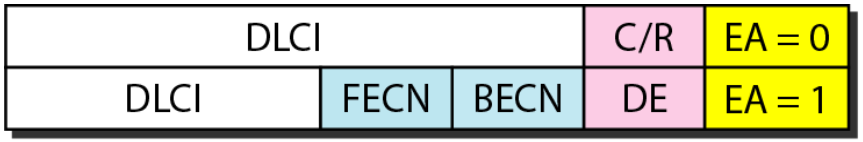
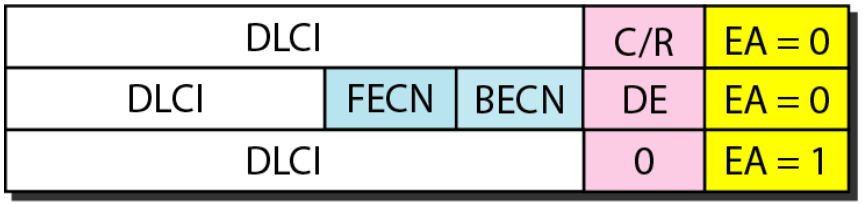


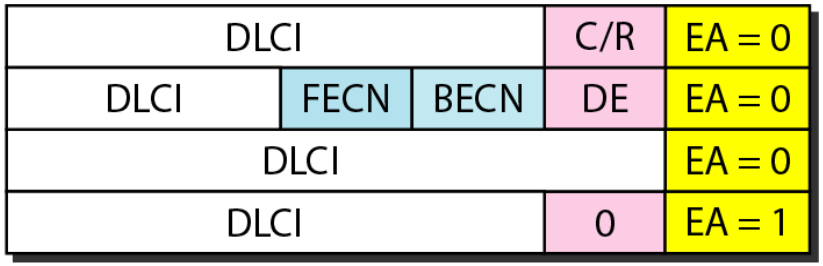
Figure 18.4 *Three address formats*



a. Two-byte address (10-bit DLCI)

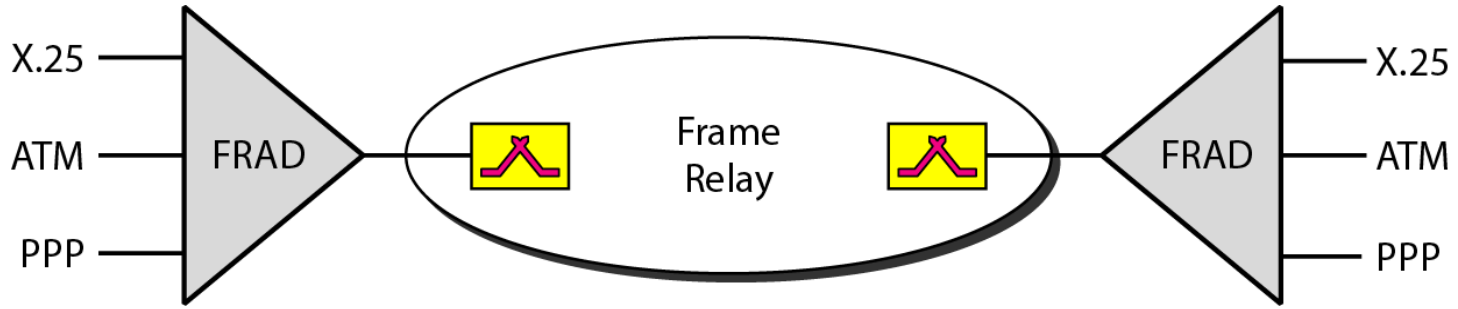


b. Three-byte address (16-bit DLCI)



c. Four-byte address (23-bit DLCI)

Figure 18.5 *FRAD*



VOFR

- **Frame Relay networks offer an option called Voice Over Frame Relay (VOFR) that sends voice through the network.**
- **Voice is digitized using PCM and then compressed.**
- **The result is sent as data frames over the network. This feature allows the inexpensive sending of voice over long distances.**

LMI

Frame Relay was originally designed to provide PVC connections. There was not, therefore, a provision for controlling or managing interfaces. Local Management Information (LMI) is a protocol added recently to the Frame Relay protocol to provide more management features. In particular, LMI can provide

- **A keep-alive mechanism to check if data are flowing.**
- **A multicast mechanism to allow a local end system to send frames to more than one remote end system.**
- **A mechanism to allow an end system to check the status of a switch (e.g., to see if the switch is congested).**

18-2 ATM

Asynchronous Transfer Mode (ATM) is the cell relay protocol designed by the ATM Forum and adopted by the ITU-T.

Topics discussed in this section:

Design Goals
Problems
Architecture
Switching
ATM Layers

18-2 ATM

Design Goals:

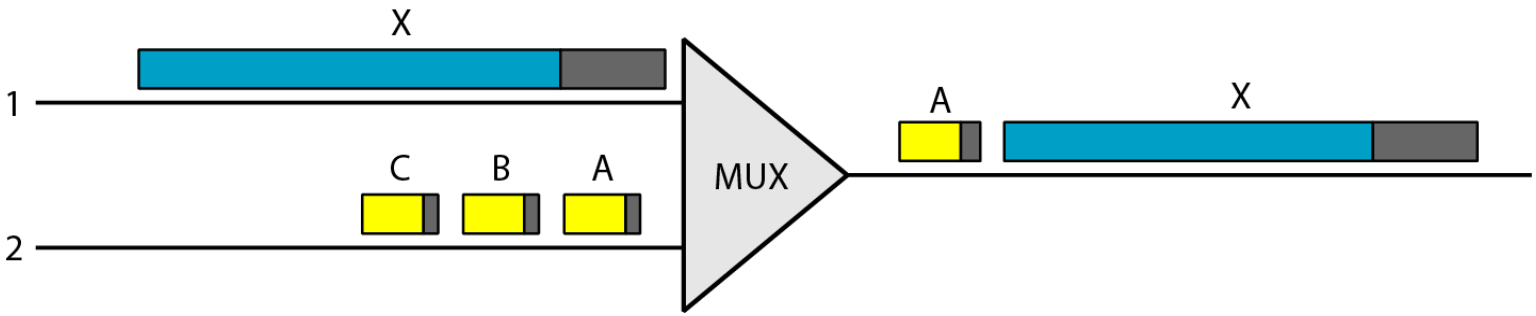
- **High-data-rate transmission media, in particular optical fiber.**
- **interface with existing systems**
- **implemented inexpensively**
- **connection-oriented to ensure accurate and predictable Delivery.**
- **move as many of the functions to hardware as possible (for speed) and eliminate as many software functions as possible (again for speed).**

18-2 ATM

Frame Networks: variable length frames, large header frames

Mixed Network Traffic: unpredictable traffic , unpredictable data delivery rates

Figure 18.6 *Multiplexing using different frame sizes*



Note

A cell network uses the cell as the basic unit of data exchange.
A cell is defined as a small, fixed-size block of information.

Figure 18.7 *Multiplexing using cells*

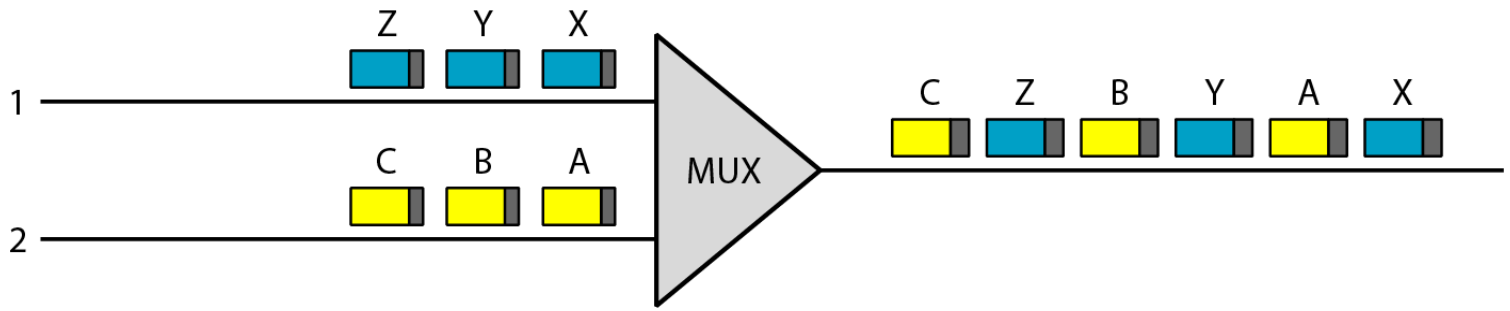


Figure 18.8 *ATM multiplexing*

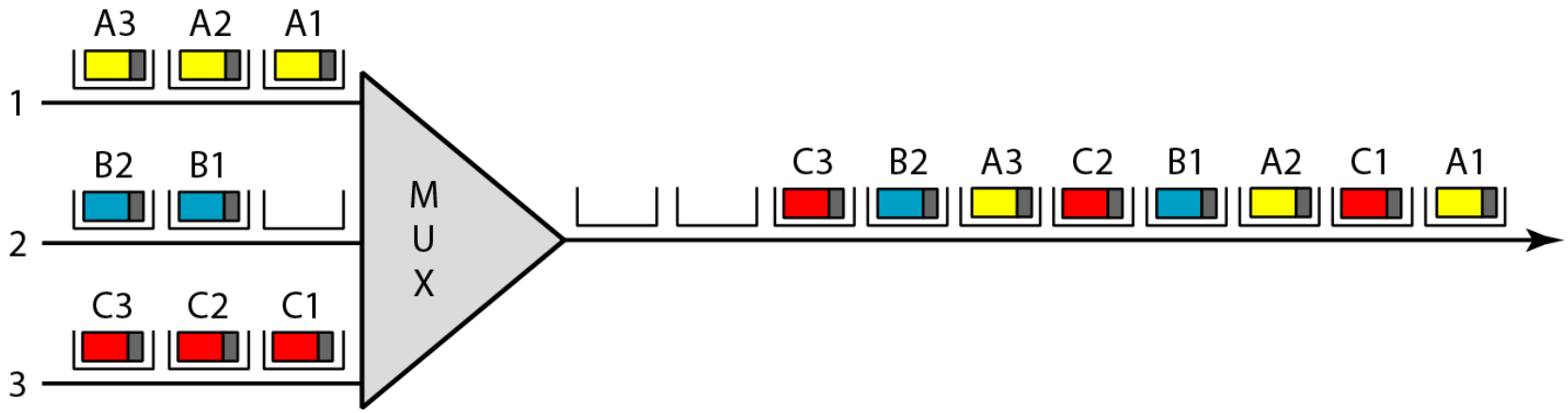


Figure 18.9 *Architecture of an ATM network*

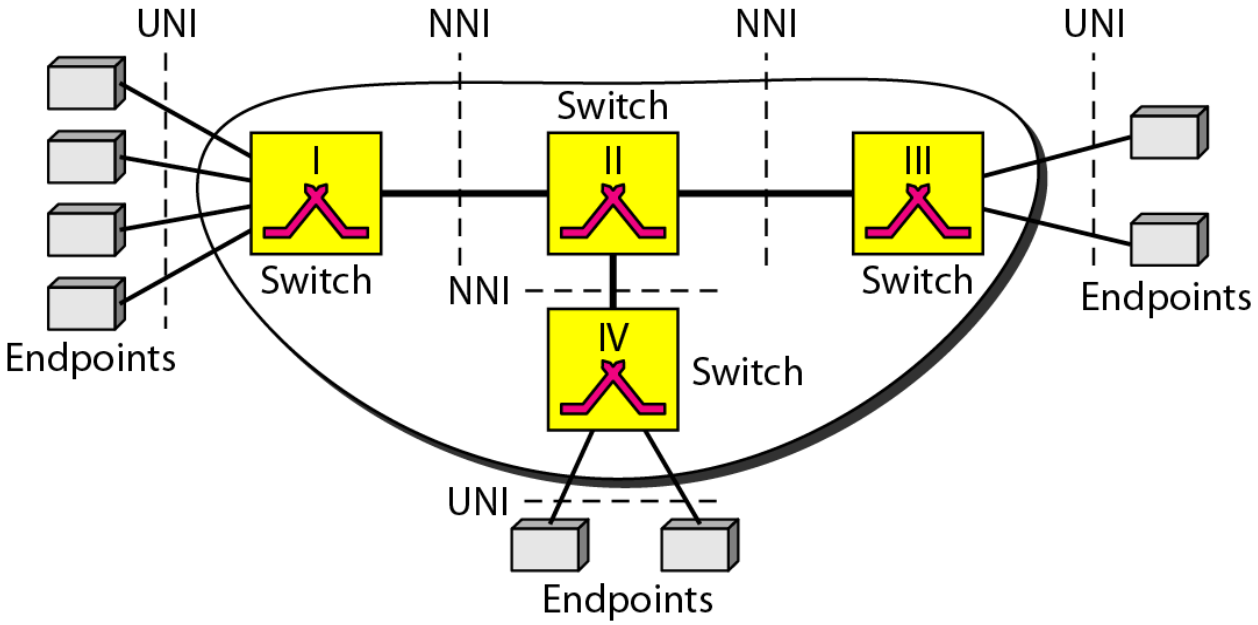
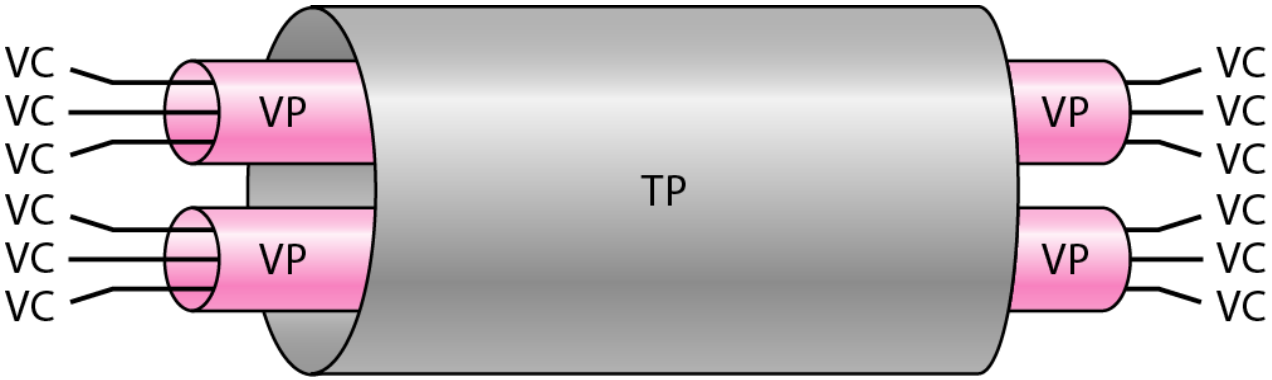
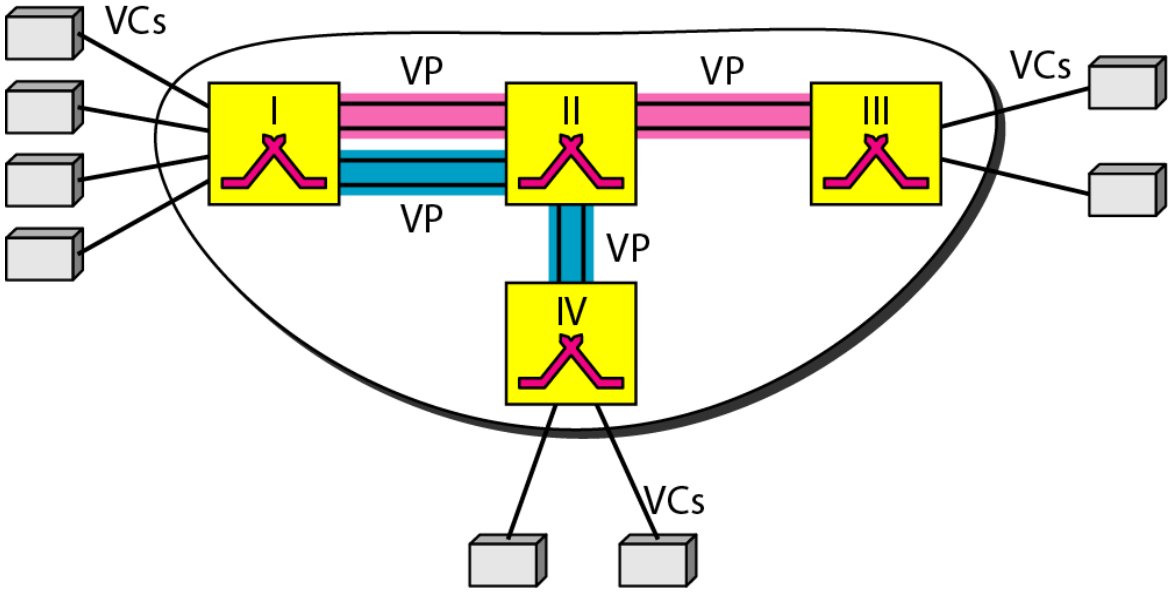


Figure 18.10 *TP, VPs, and VCs*



Transmission path=Physical connection

Figure 18.11 *Example of VPs and VCs*



Note

Note that a virtual connection is defined by a pair of numbers: the VPI and the VCI.

Figure 18.12 *Connection identifiers*

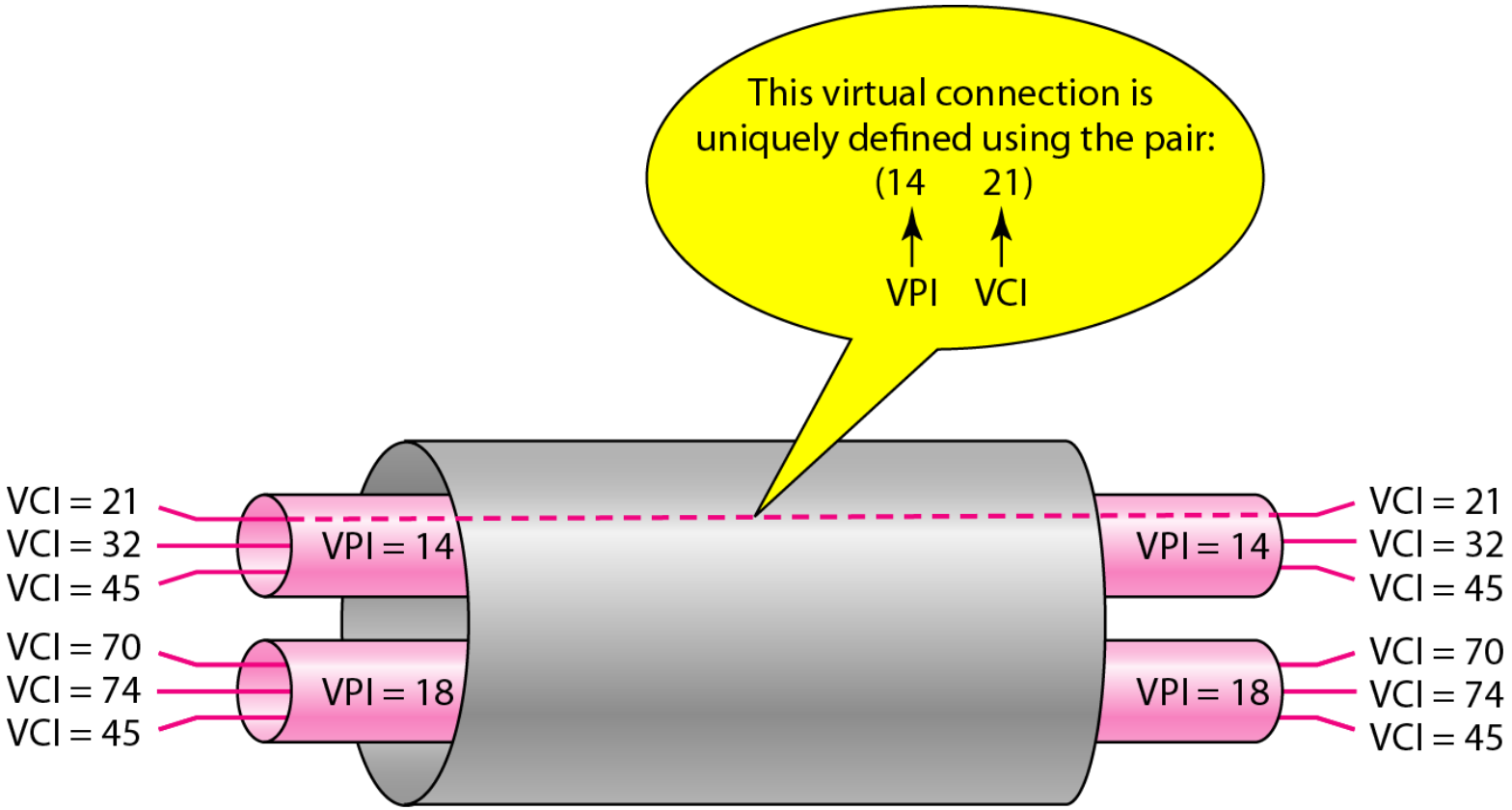
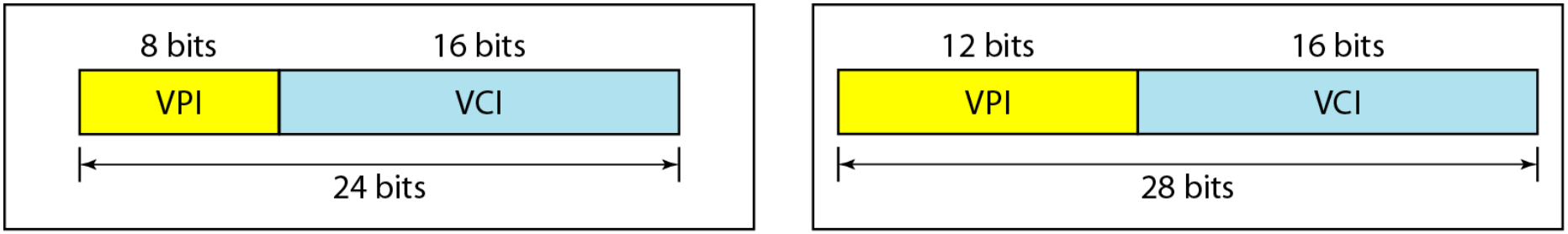


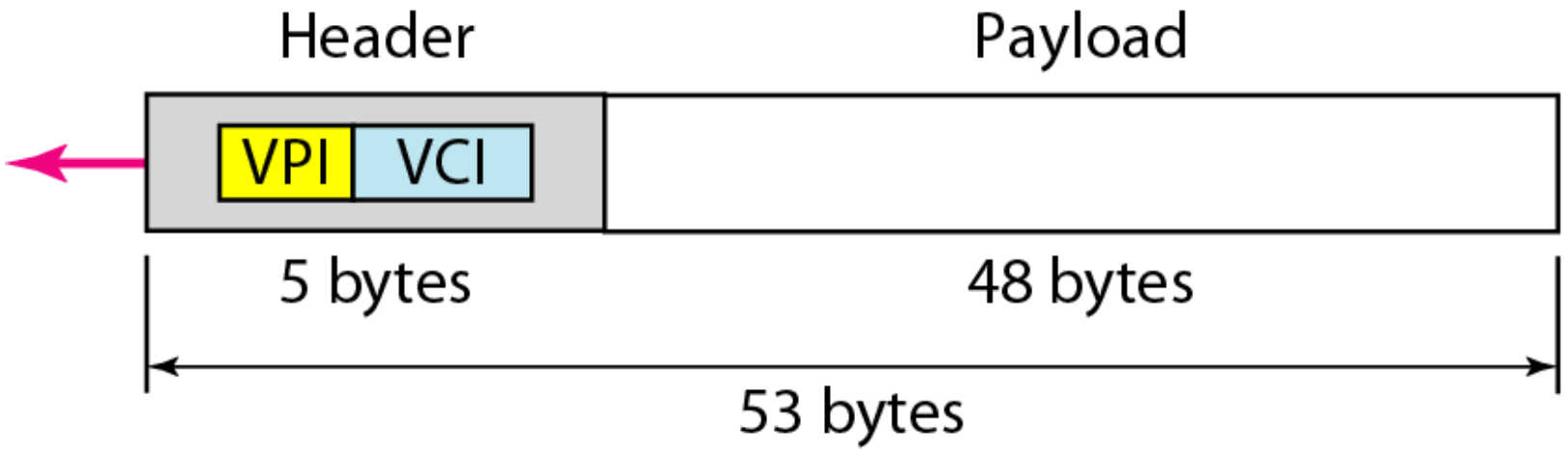
Figure 18.13 *Virtual connection identifiers in UNIs and NNIs*



a. VPI and VCI in a UNI

b. VPI and VCI in an NNI

Figure 18.14 *An ATM cell*

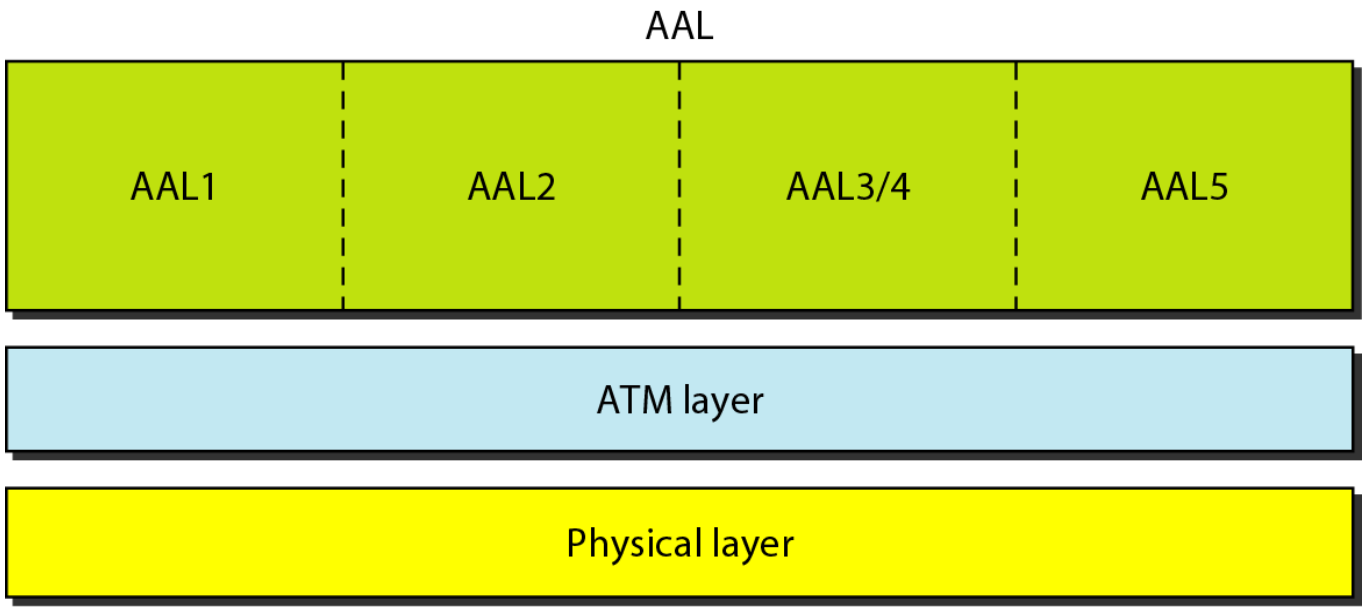


Connection Establishment and Release
PVC
SVC

Switching:

arrival interface number, incoming VPI, incoming VCI, corresponding outgoing interface number, the new VPI, and the new VCI

Figure 18.16 *ATM layers*



ATM Layer: provides routing, traffic management, switching, and multiplexing services. It processes outgoing traffic by accepting 48-byte segments from the AAL sublayers and transforming them into 53-byte cells by the addition of a 5-byte header

Figure 18.17 *ATM layers in endpoint devices and switches*

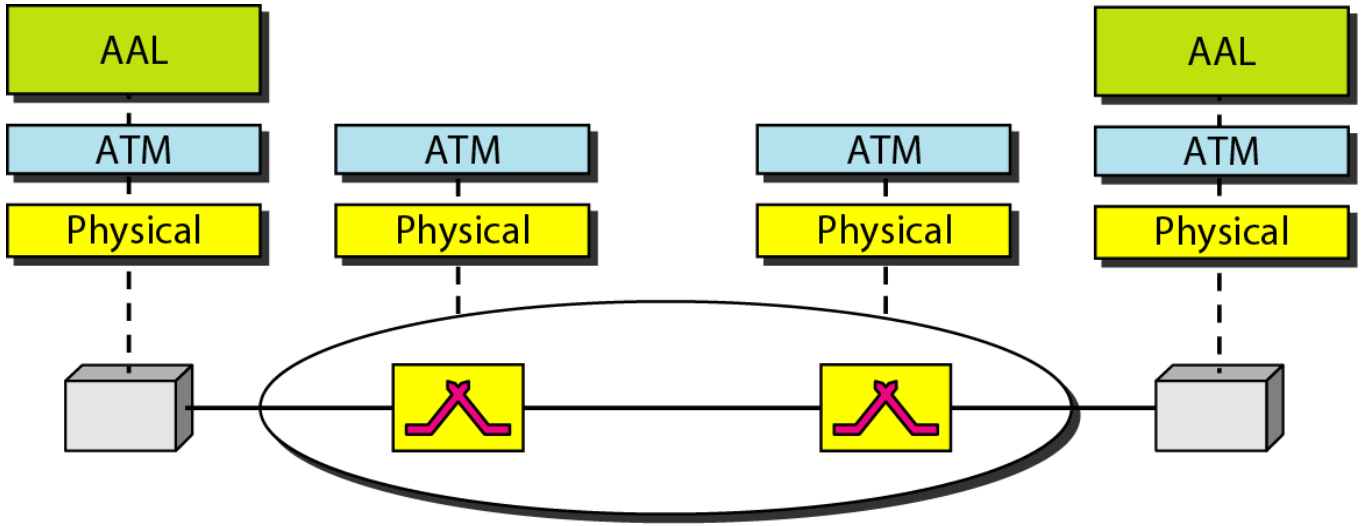


Figure 18.18 *ATM layer*

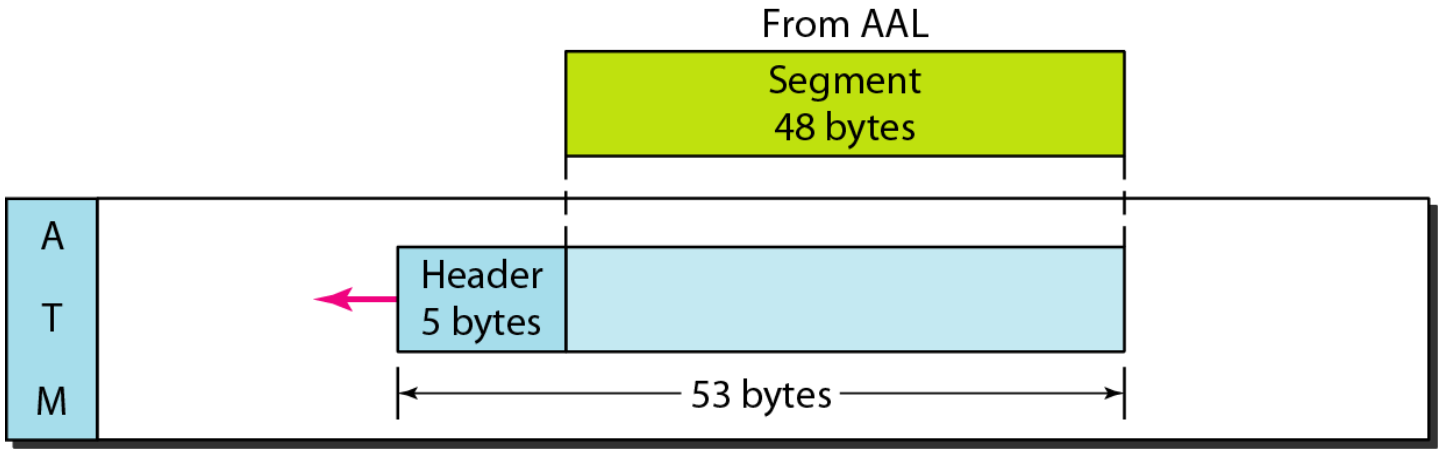
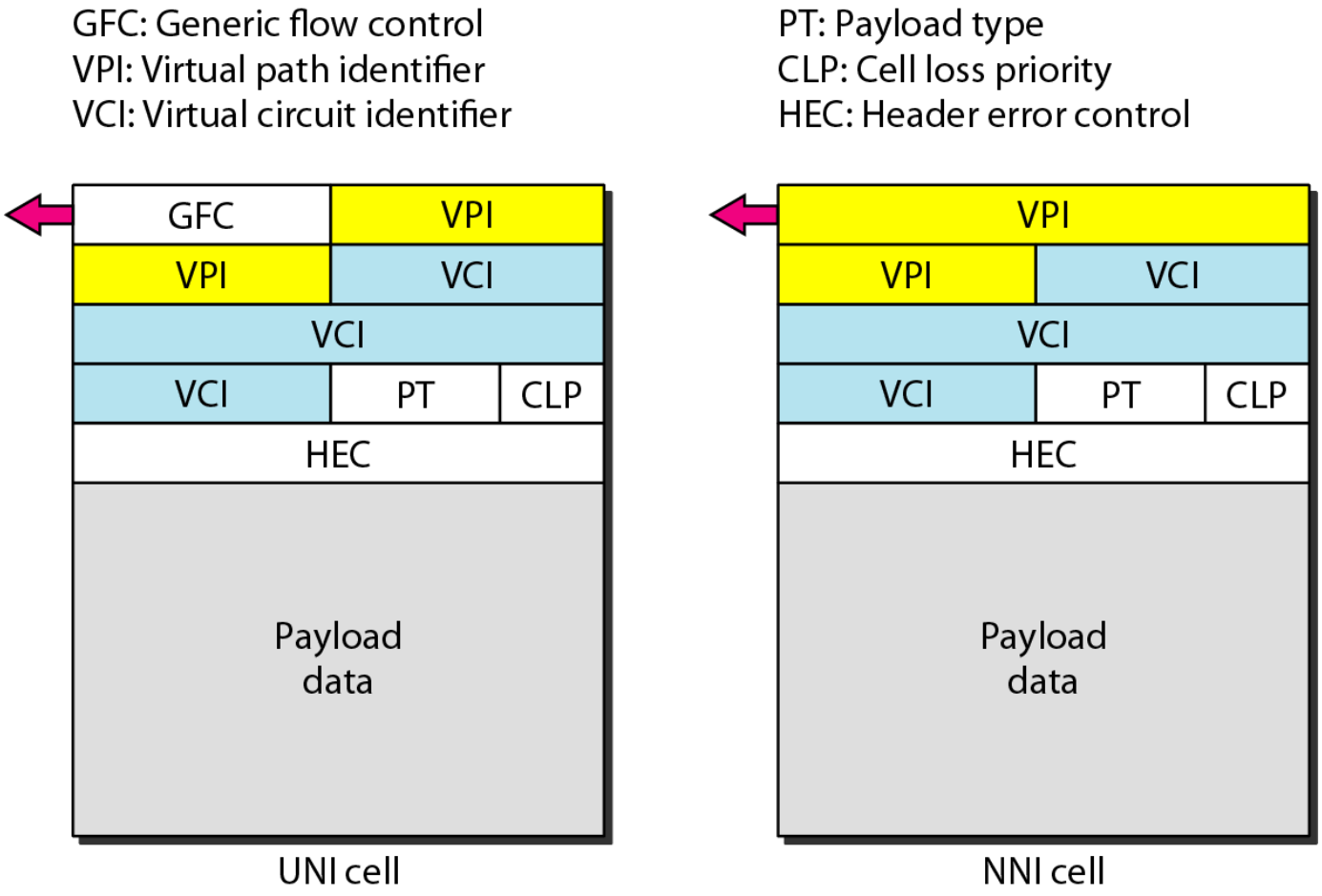


Figure 18.19 *ATM headers*



ATM headers

Generic flow control (GFC). The 4-bit GFC field provides flow control at the UNI level.

The VPI is an 8-bit field in a UNI cell and a 12-bit field in an NNI cell
Virtual circuit identifier (VCI). The VCI is a 16-bit field in both frames.

Payload type (PT). In the 3-bit PT field, the first bit defines the payload as user data or managerial information. The interpretation of the last 2 bits depends on the
first bit.

Cell loss priority (CLP). The I-bit CLP field is provided for congestion control.

Header error correction (HEC). The HEC is a code computed for the first 4 bytes of the header. It is a CRC with the divisor x8 + x2 + x + 1 that is used to correct single-bit errors and a large class of multiple-bit errors.

Application Adaptation Layer

AAL1 supports applications that transfer information at constant bit rates, such as video and voice. It allows ATM to connect existing digital telephone networks

AAL2 was intended to support a variable-data-rate bit stream, but it has been redesigned. It is now used for low-bit-rate traffic and short-frame traffic such as audio (compressed or uncompressed), video, or fax.

AAL3 was intended to support connection-oriented data services and AAL4 to support connectionless services.

AAL 5: simple and efficient adaptation layer (SEAL). AALS assumes that all cells belonging to a single message travel sequentially and that control functions are included in the upper layers of the sending application.

Routing in ARPANET

References:

https://www.youtube.com/watch?v=dmS1t2twFrI

Reference Chapter 18

Virtual-Circuit Networks: Frame Relay and ATM