Frame Relay Protocol Overview

GL Communications Inc.
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: https://www.gl.com

Frame Relay – A Brief Overview

- Frame Relay is a synchronous HDLC protocol-based network; defined by various ANSI and ITU standards
- Relays packets at the data link layer (layer 2) and physical layer (layer 1) of the OSI model
- Connection-oriented packet switching
- Provides a fast and efficient data transmission from a user device to LAN bridges and routers
- Data packets or frames are passed from one or many start-points to one or many destinations via a series of intermediate node points
- Transmits the frame to its destination point through Virtual Circuits (logical paths from an originating point in the network). Virtual circuits may be permanent (PVCs) or switched (SVCs)

Why use Frame Relay?

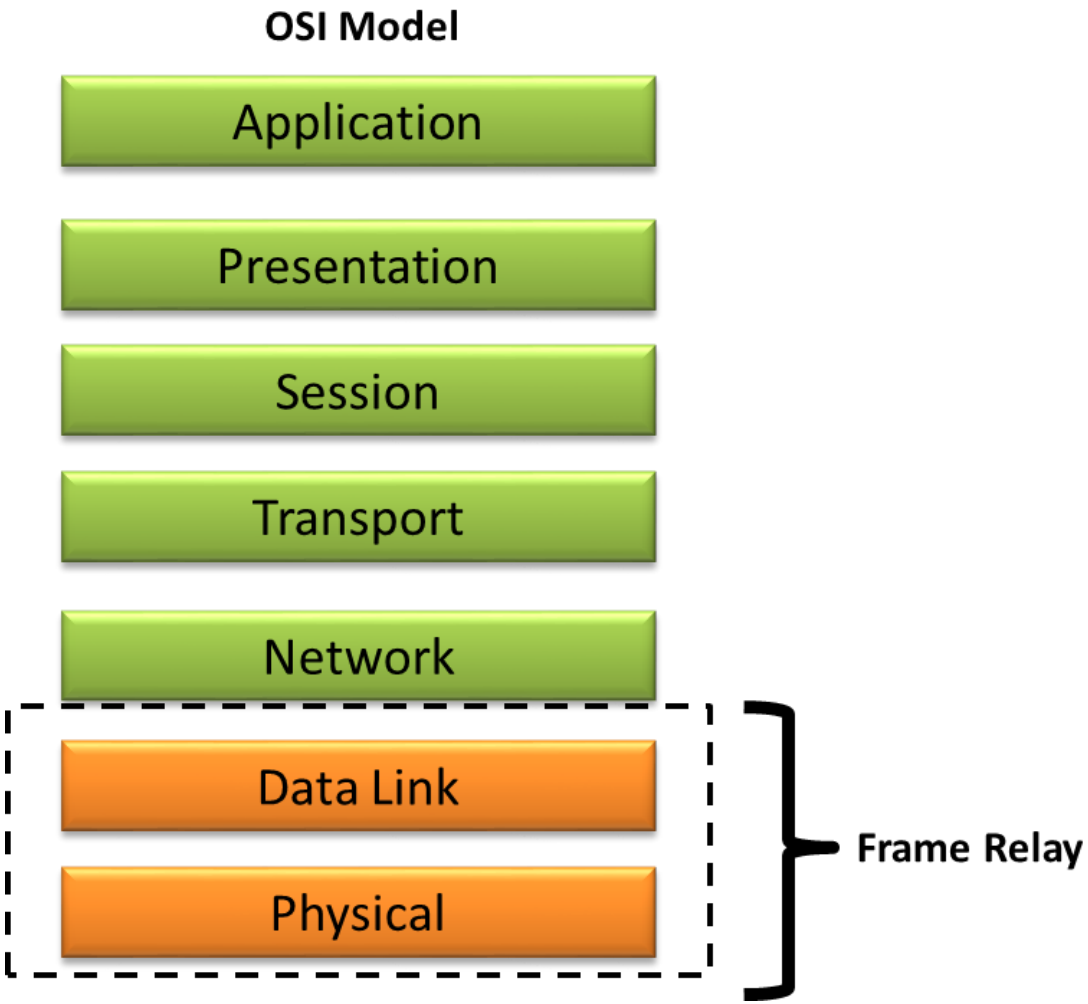
- Reduced Overhead –
  - Much faster
  - Lower delays
  - Requires reliable links
- Outband signaling
- Good for busty and variable traffic
- Cost effective multiplexed communications interface
- Congestion control

GL Communications

Protocol Features

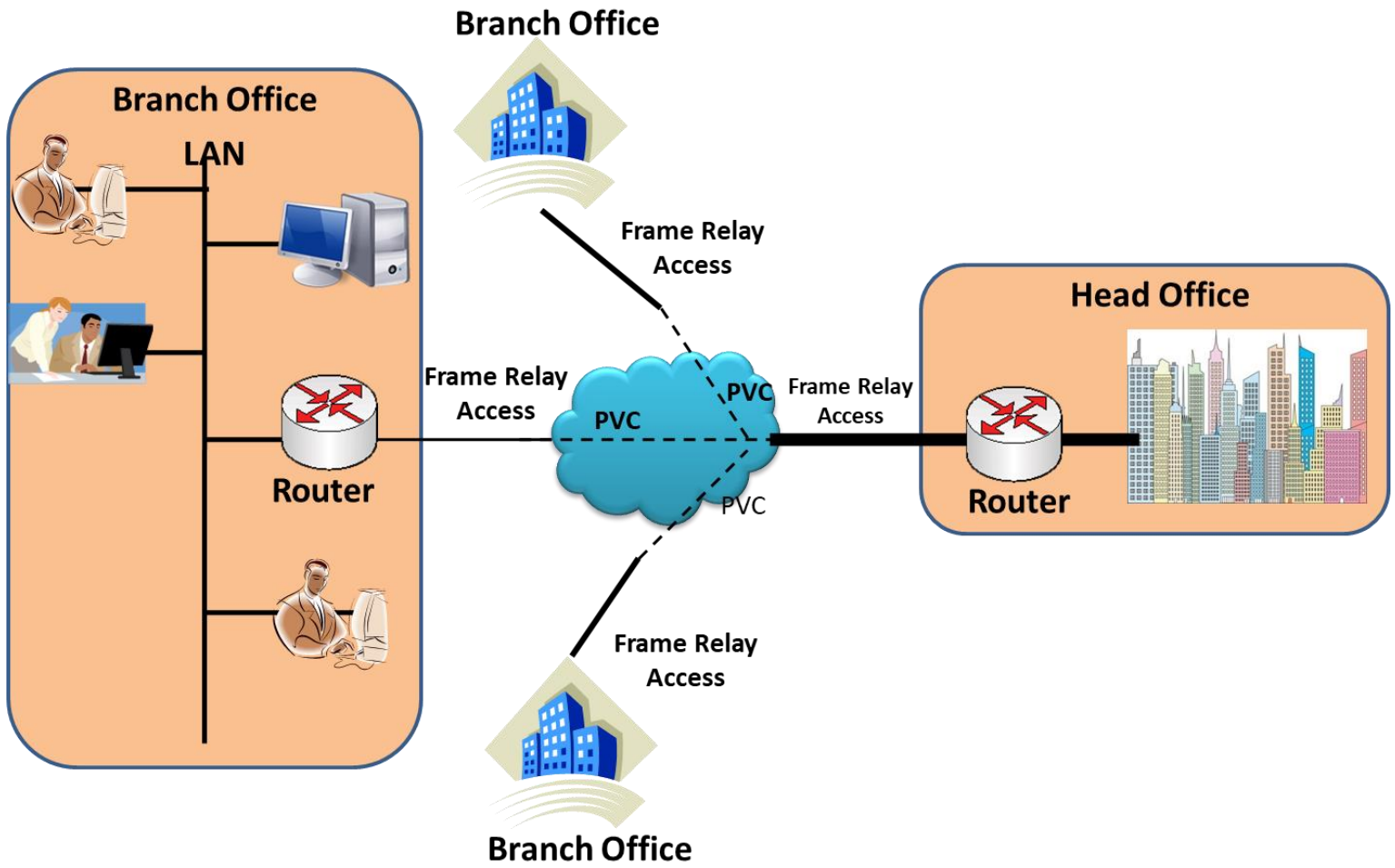
- Connection –oriented WAN technology based on packet (frame) switching
- Frames of variable length (up to 4096 bytes, typically 1600 bytes)
- High data rates at user-network interfaces (2Mbps, ultimately up to 45 Mbps)
- Bandwidth on demand
- No flow control mechanisms (nearly)
- No error control (but FCS) or retransmission mechanisms
- All protocol functions implemented at 2nd level (data link) of OSI model
- No standards for physical interface: can be X.21, V.35, G.703, G.704

Frame Relay in OSI Layer



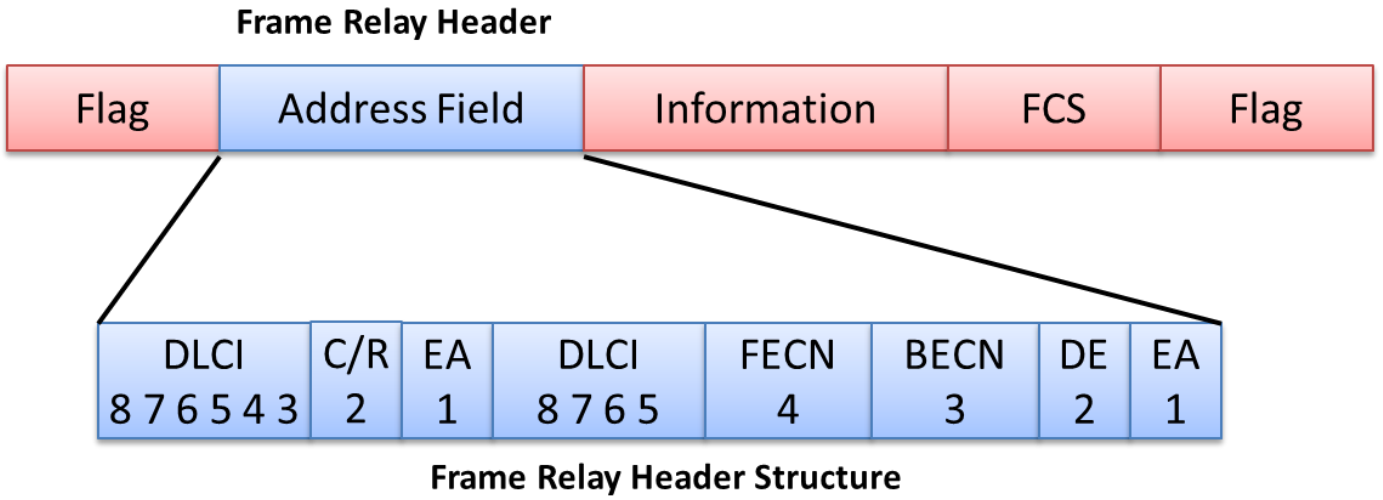
Frame Relay Network

- Equipment (DTE) – User device and the logical frame relay end-system
- Data Terminal Communication Equipment (DCE) – Comprises of modems and packet switches



Frame Relay Structure

- Frame Relay structure is based on the LAPD protocol
- Frame Relay header consists of DLCI, C/R, EA, FECN, BECN, and DE



Frame Relay Header Structure

DLCI – Datalink Connection Identifier
C/R – Command/Response
EA – Extended Address field
FECN – Forward Explicit Congestion Notification
BECN – Backward Explicit Congestion Notification
DE – Discard Eligibility

Frame Relay Structure (Contd.)

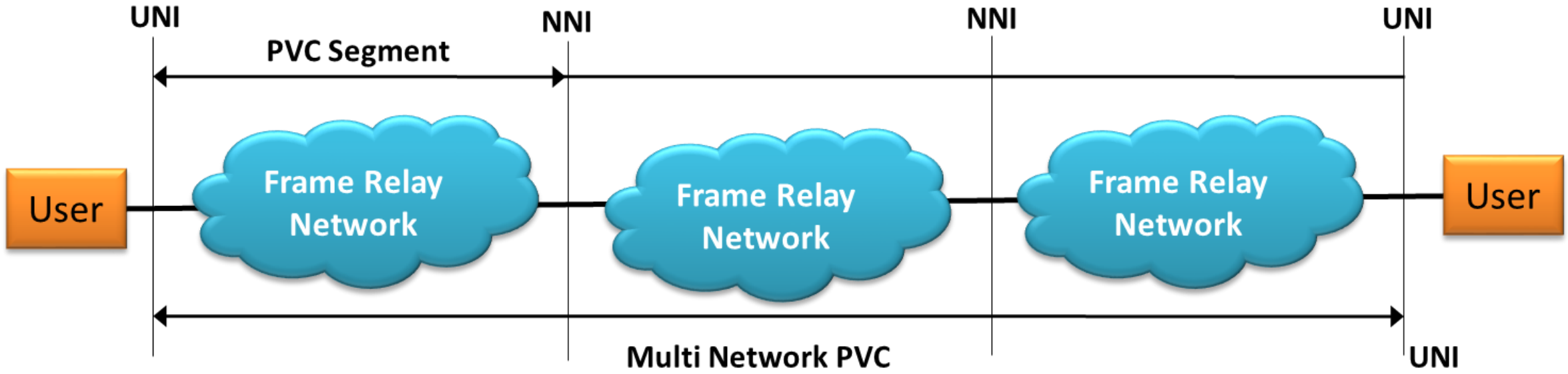
- Flag Field - Perform high-level data link synchronization which indicates the beginning and end of the frame with the unique pattern 01111110
- Information Field - System parameter defines the maximum number of data bytes that a host can pack into a frame
- Frame Check Sequence (FCS) Field - Since one cannot completely ignore the bit error-rate of the medium, each switching node needs to implement error detection to avoid wasting bandwidth due to the transmission of erred frames

Frame Relay Structure (Contd.)

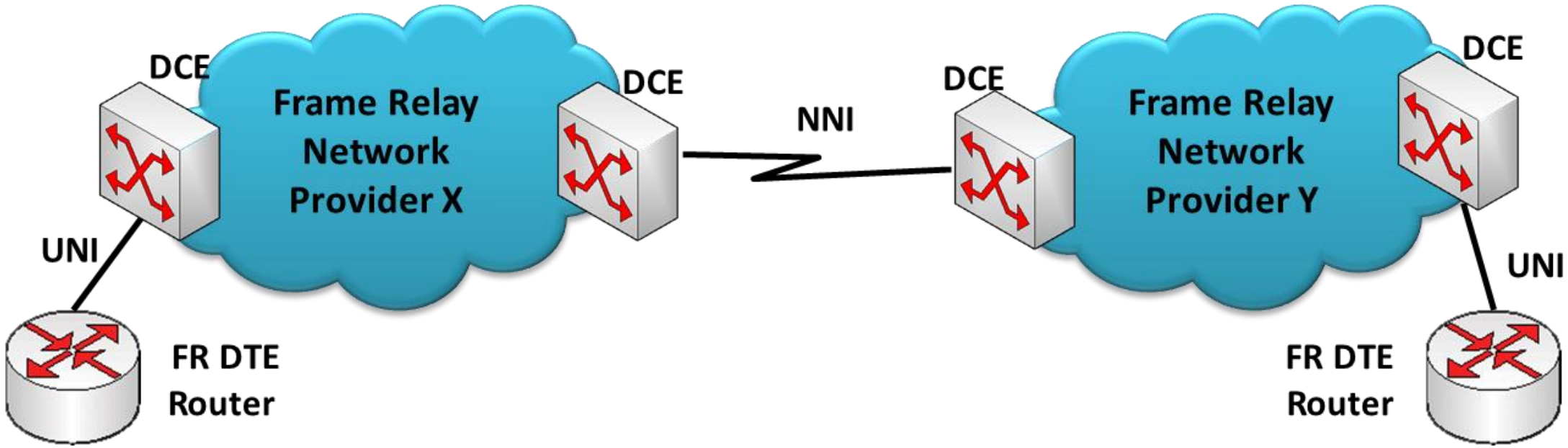
- Address Field - Each address field may occupy either octet 2 to 3, octet 2 to 4, or octet 2 to 5, depending on the range of the address in use. A two-octet address field comprises of –
  - EA - Address Field Extension Bits
  - C/R - Command/Response Bit: Designates whether the frame is a command or response.
  - DLCI-Data Link Connection Identifier Bits - Serves to identify the virtual connection so that the receiving end knows which information connection a frame belongs to.
  - FECN, BECN, DE bits - These bits report congestion:
    - FECN - Forward Explicit Congestion Notification bit
    - BECN - Backward Explicit Congestion Notification bit
    - DE - Discard Eligibility bit

Frame Relay Interface Types

- Interface types –
  - User –to –Network Interface (UNI)
  - Network-to-Network Interface (NNI)

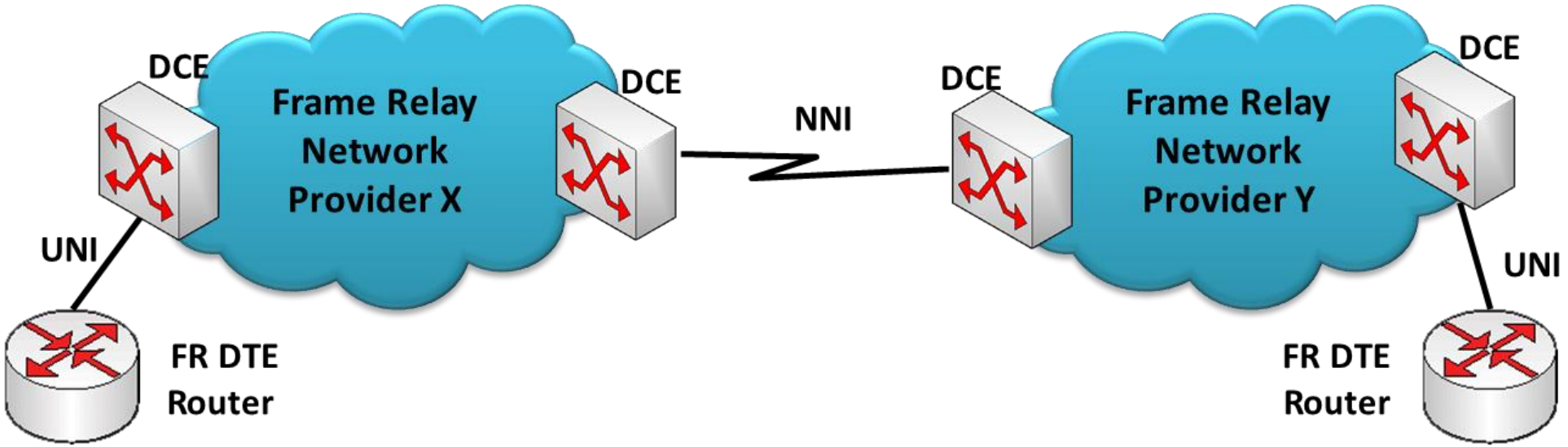


Network-to-Network Interface (NNI)



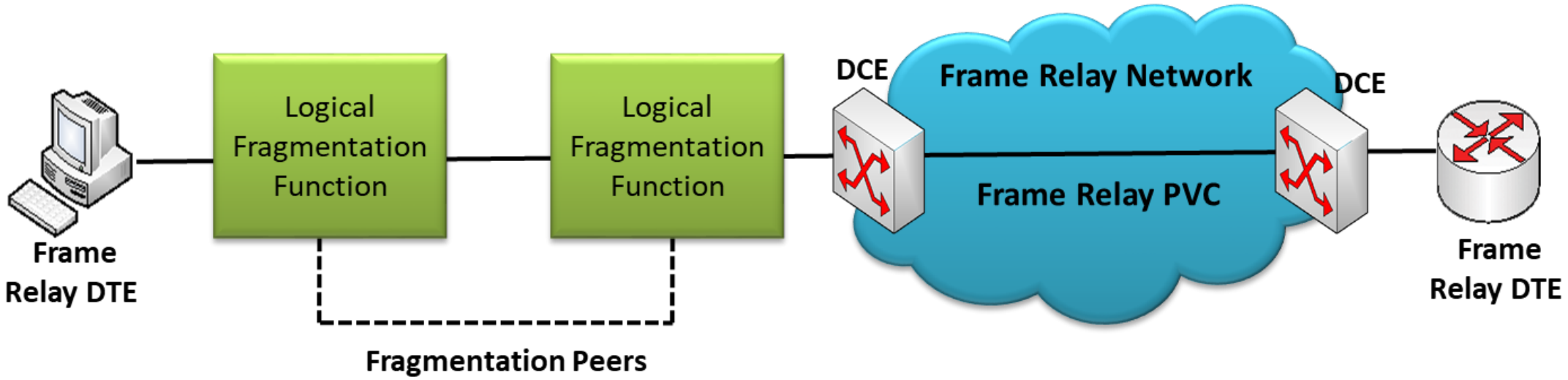
Fragmentation

- Fragmentation allows to fragment long data frames into a sequence of shorter frames that are then reassembled into the original frame by the receiving peer DTE or DCE
- FRF.12 supports three fragmentation applications:
  - Locally across a Frame Relay UNI interface between the DTE/DCE peers
  - Locally across a Frame Relay NNI interface between DCE peers
  - End-to-End between two Frame Relay DTEs interconnected by one or more Frame Relay networks



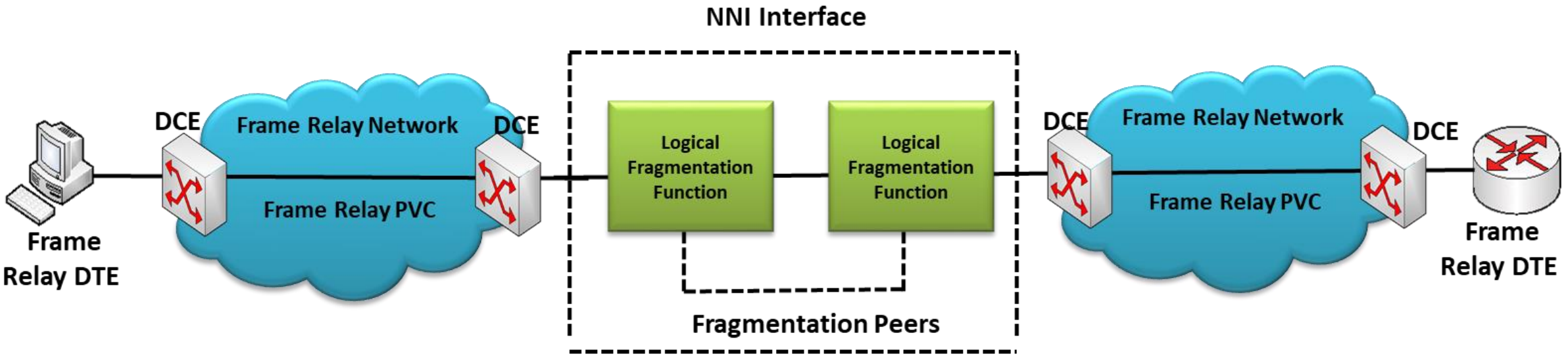
UNI Fragmentation

- The DTE and DCE interfaces act as fragmentation and reassembly peers
- UNI (DTE-DCE) fragmentation is used in order to allow real-time and data frames to share the same UNI interface between a DTE and the Frame Relay Network



NNI Fragmentation

- NNI interfaces may also act as fragmentation and reassembly peers



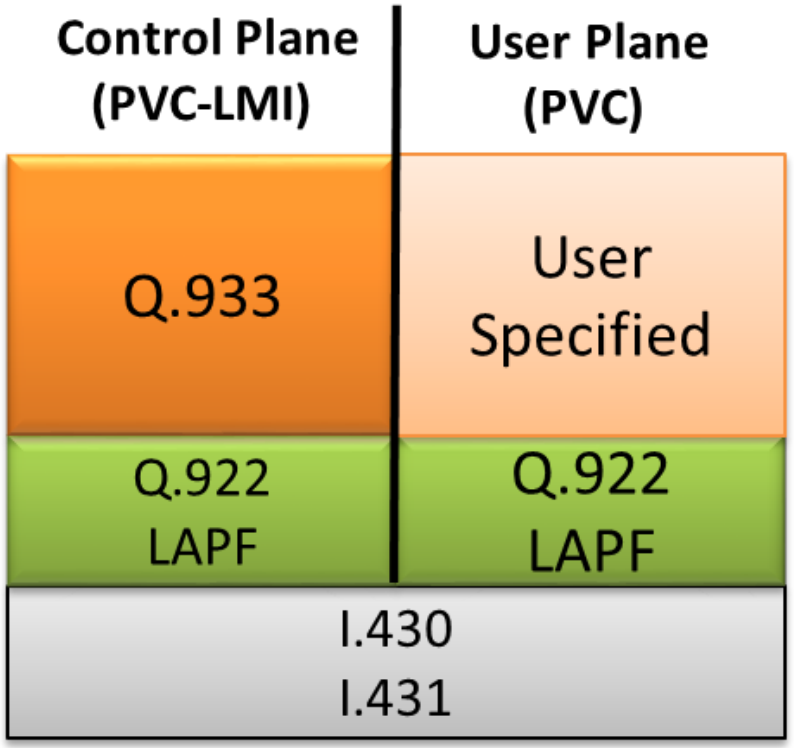
Frame Relay Virtual Circuits

- A logical connection established between two DTE devices across a Frame Relay Packet Switched Network. Can pass through any number of intermediate DCE devices (switches) located within the Frame Relay network.
- They are uniquely identified by a data-link connection identifier (DLCI) to connect multiple DTE devices
- Frame Relay virtual circuits fall into two categories –
  - Switched Virtual Circuits (SVCs)
  - Permanent Virtual Circuits (PVCs)

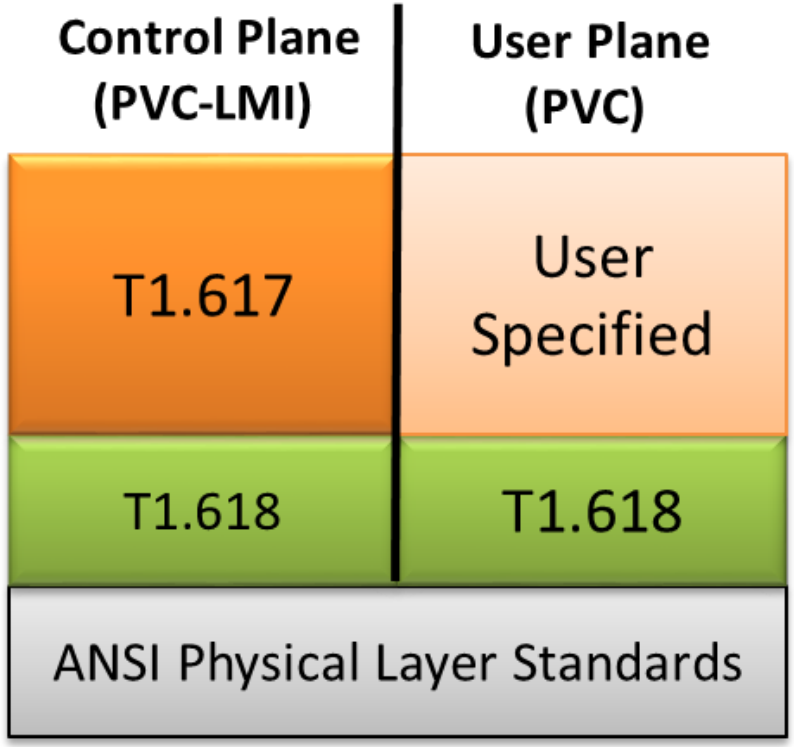
Permanent Virtual Circuits (PVC)

- Permanently established connections between DTE devices across the Frame Relay networks
- Does not require call setup and termination states
- PVCs always operate in one of the following two operational states –
  - Data transfer — Data is transmitted between the DTE devices over the virtual circuit
  - Idle—The connection between DTE devices is active, but no data is transferred

PVC Service Model



ITU-T PVC Model

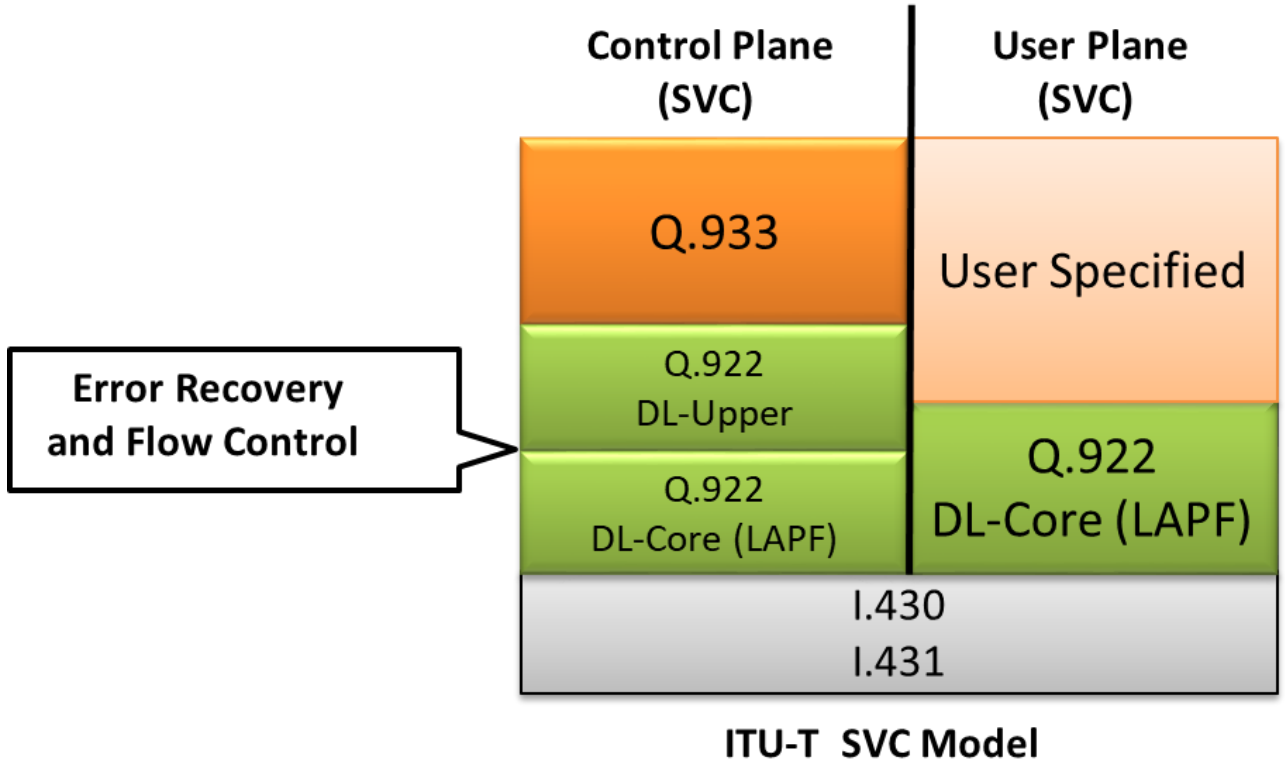


ANSI PVC Model

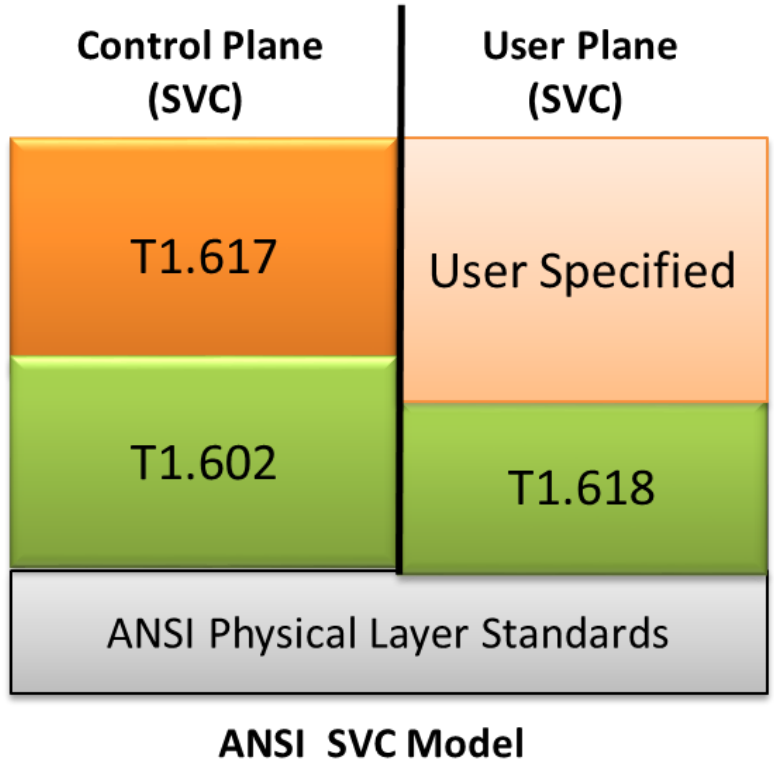
Switched Virtual Circuits (SVC)

- These are temporary connections
- Minimal deployment; SVCs save money in the end as the circuit is not open all the time
- A communication session across an SVC consists of the following four operational states:
  - Call setup — Establishes virtual circuit between two Frame Relay DTE devices
  - Data transfer — Data is transmitted between the DTE devices over the virtual circuit
  - Idle — No data transfer between two DTE devices. If an SVC remains in an idle state for a defined period, the call can be terminated
  - Call termination — Terminates the virtual circuit between DTE devices

SVC Service Model



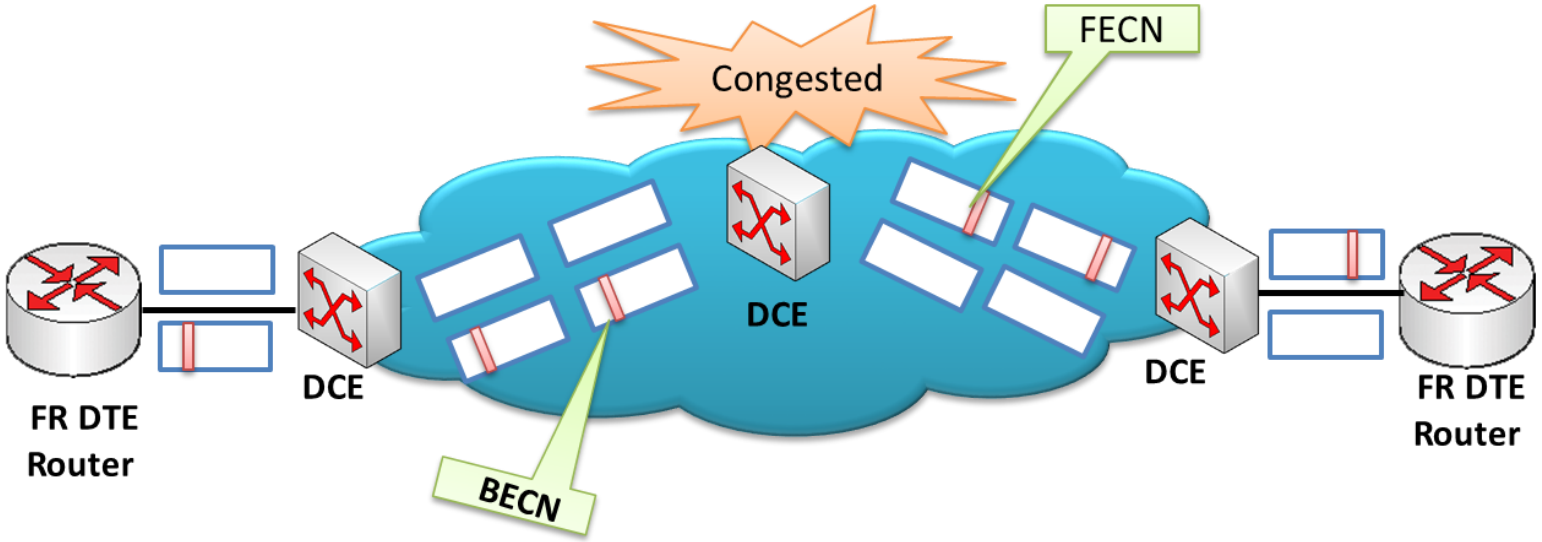
ITU-T SVC Model



ANSI SVC Model

Congestion Control

- Frame Relay reduces overhead by congestion notification mechanisms frames are discarded from overflowed buffers of switching devices
- Frame Relay implements two congestion-control mechanisms:
  - FECN - Forward Explicit Congestion Notification
  - BECN - Backward Explicit Congestion Notification

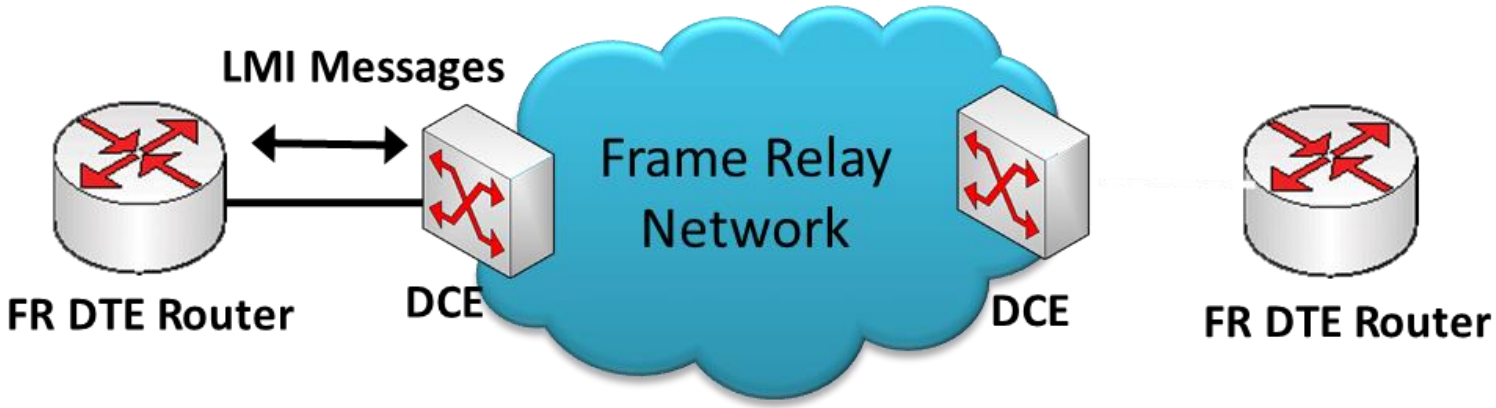


Congestion Control (Contd.)

- Congestion control in Frame Relay networks include following elements –
- Admission Control - Provides the principal mechanism used in frame relay to ensure the guarantee of resource requirement once accepted. It also serves generally to achieve high network performance. The traffic descriptor consists of three elements:
  - Committed Information Rate (CIR)
  - Committed Burst Size (BC)
  - Excess Burst Size (BE)

Local Management Interface (LMI)

- Signaling protocol used on an interface: end user - network
- Optional Implementation
- Usage:
  - Notification about creation, deletion, existence of PVCs on a given port
  - Notification about status and availability of PVCs
  - Verification of the link integrity

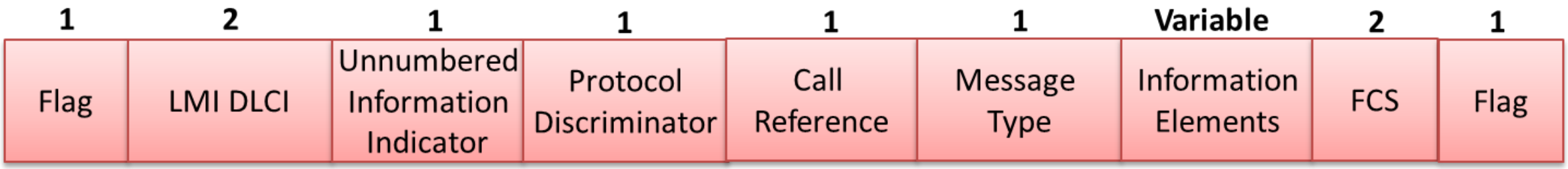


LMI Standards

- Three types of LMI standards –
  - ANSI - Annex D defined by ANSI standard T1.617
  - ITU-T (Q.933A) - Annex A defined by Q933A
  - Cisco (default) - LMI defined by the gang of four

LMI Frame Format

- LMI contains the following fields –
  - Flag
  - LMI DLCI
  - Unnumbered Information Indicator
  - Protocol Discriminator
  - Call Reference
  - Message Type
  - Information Elements
  - FCS

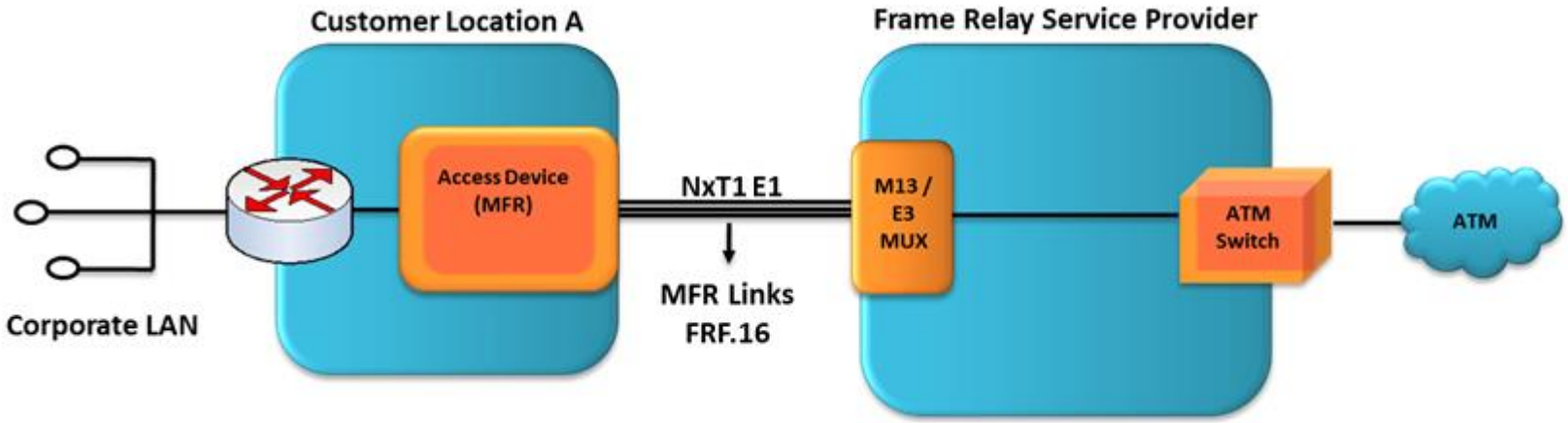


Multi-protocol Over Frame Relay

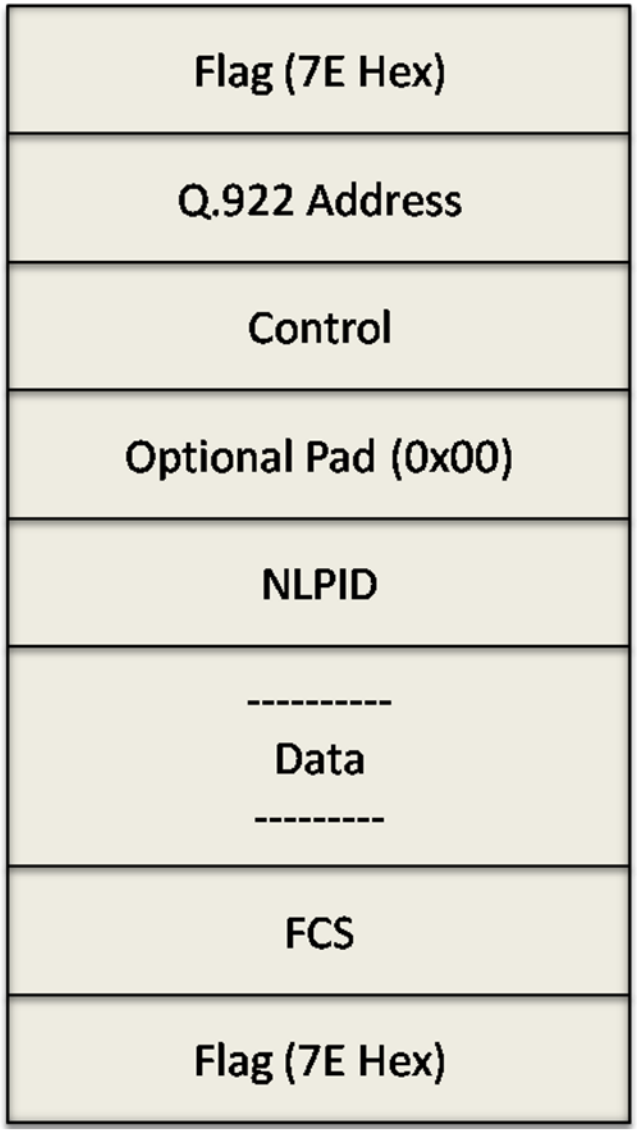
- Standardized in RFC1490
- Not only IP, also other protocols, as well as remote bridging over Frame Relay
- Can be used with LLC, SNAP, IPX, IP
- Can be used for ARP, RARP, IARP
- Re-defines the data part of the frame and not the address header

Multilink Frame Relay (MFR)

- Supports variable frame sizes and fragmentation
- Low latency
- Minimal management bandwidth overhead of 2-3%
- Provides for standards-based Service Level Agreements using FRF.13



Multi-protocol Over Frame Relay Frame Format



Multiprotocol Over Frame Relay frame

GL Communications

Advantages

- Multiple virtual circuits can exist simultaneously across a given transmission line. since virtual circuits consume bandwidth only when they transport data
- Each device can use more of the bandwidth as necessary, and thus operate at higher speeds
- Discard erroneous frames and eliminate time-consuming error-handling processing

GL Test Tools for Frame Relay

- For T1
  - FR and MFR Emulation
  - Frame Relay Analyzer
- For T3
  - Frame Relay Analyzer
- For Datacom
  - Frame Relay Analyzer

GL Communications

Thank you