

WAN Network Solution for Cleveland to Pittsburg Branch Offices

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NETW208: Accessing the WAN

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Implementation Policy

Consideration of Frame-Relay as Connectivity Possibility

I am to provide a detailed report as to the possibility of utilizing a frame-relay encapsulated WAN for our Pittsburg and Cleveland offices. I am to also compare other WAN solutions for the same WAN. I will first provide a brief description of frame-relay encapsulation and list some pros and cons for its implementation.

History: Frame-relay is a protocol that offers high-performance and cost-effectiveness. It operates at the physical and data layers of the OSI model. A Sprint International engineer named

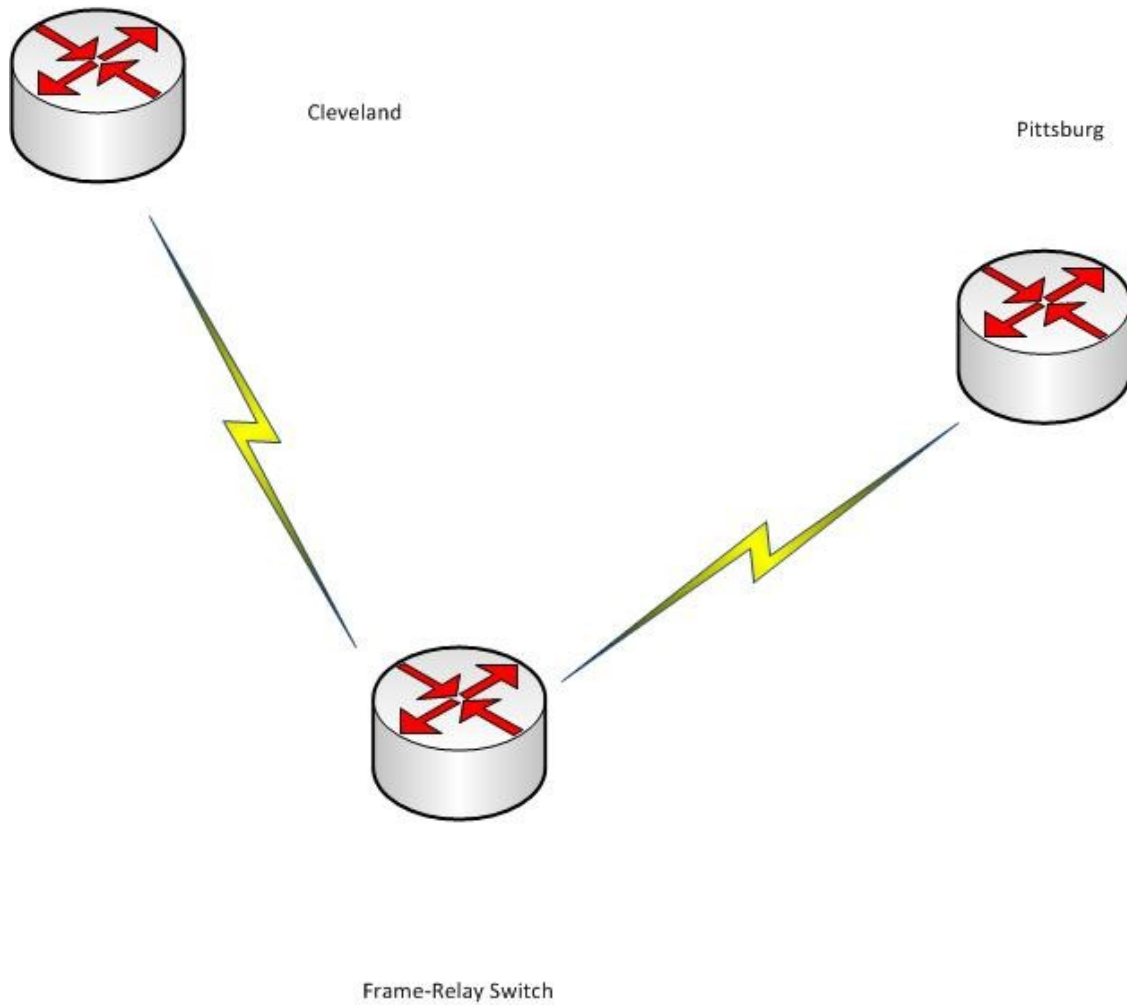
Eric Scace created frame-relay as a simpler version of x.25 to move data across an Integrated Digital Services Network (ISDN). When Cisco purchased StrataCom in 1996, this marked Cisco's entry into the carrier market. StrataCom switches were used by Sprint when they first utilized frame-relay. Frame-relay is now used on various network interfaces.

Encapsulation: The frame-relay protocol uses a frame that uses a 2 byte frame-relay header field, This header field contains a user-specified Data Link Connection Identifier (DLCI). The DLCI is the destination of the frame. The header field also contains congestion and status data fields in the second byte of the 16 bit address field. These three, one bit fields contain the Forward Explicit Congestion Notification (FECN), the Backward Explicit Congestion Notification (BECN) and the Discard Eligibility (DE). The three fields are set at the frame-relay switch and are used to avoid congestion and set priorities to drop low-priority frames. A 1 in the FECN or the BECN fields notifies devices upstream or downstream of congestion. A 1 in the DE field, makes the frame eligible to be discarded in cases of congestion.

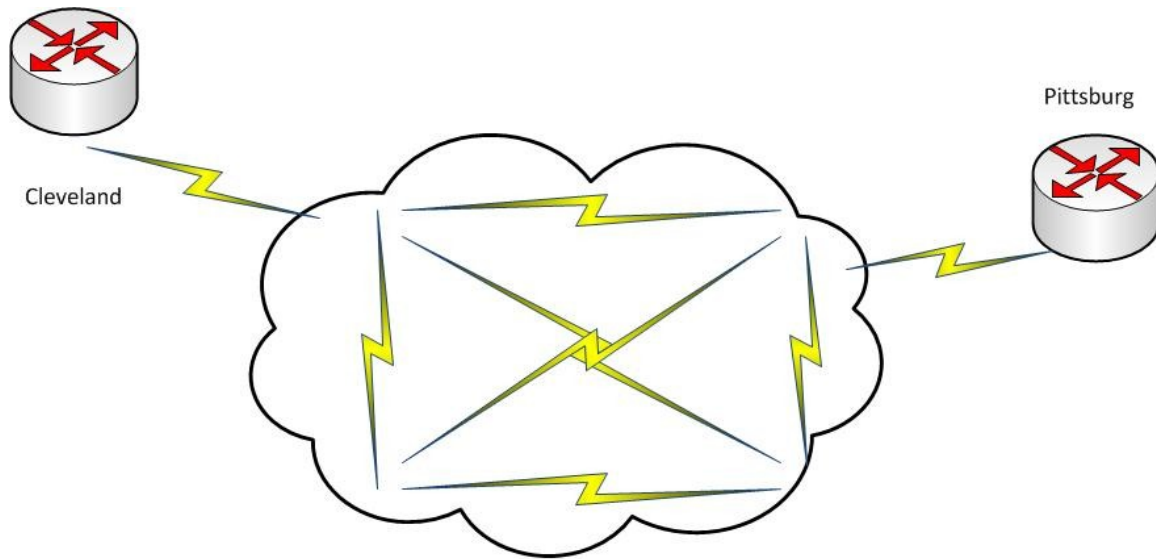
The frames are sent to their intended destinations with the use of logical paths, known as virtual circuits (VC). Virtual circuits can be either switched virtual circuits (SVC) or permanent virtual circuits (PVC). PVC's are configured by the network administrator for a dedicated point-to-point connection. SVC's are temporary connections for connections that have intermittent data transfer. There are four operational states for SVC's: call setup, data transfer, idle and call termination. With PVC's there are only two: data transfer and idle mode.

Topologies: The simplest frame-relay WAN topology is the star topology, with the frame-relay switch in the center and the connections to the remote sites being the spokes.

Star Topology



In more advanced topologies, a full-mesh topology can help build multiple connections simply by utilizing and configuring additional VC's for each link.-



Frame-Relay Full Mesh Topology

Configuring: With Cisco IOS command line interface, configuration of a frame-relay WAN is relatively simple. The operation consists of first enabling frame-relay encapsulation on an interface and then configuring either static or dynamic mapping. Optional tasks include: configuring LMI, configuring SVC's, configuring traffic shaping, customizing for individual networks and monitoring and maintaining connections. A routing sample configuration script looks like this:

```
# Interface s0/0/0
# ip address 10.1.1.2 255.255.255.0
# Encapsulation frame-relay
# Bandwidth 64
```

These steps involve: 1) setting the IP address on the interface 2) configuring the encapsulation 3) optionally setting the bandwidth and 4) optionally setting the Local Management Interface (LMI) type. Frame-relay encapsulation options are cisco or ietf. Setting the bandwidth parameter in kbps helps in the determination of a metric in routing protocols OSPF and EIGRP. Cisco supports three LMI types: Cisco, ANSI Annex D and Q933-A Annex A. An example of the frame-relay static mapping configuration command:

```
# frame-relay map ip 10.1.1.2 102 broadcast
```

“102” is the DLCI identifier number supplied by service provider. The broadcast variable allows broadcast or multicast over the VC. This statement allows for the use of dynamic routing protocols because frame-relay, ATM and X.25 are all nonbroadcast multi-access (NBMA) networks (only allowing data transfer from one device to another over a VC).

Advantages

Functionality: Because VC's only use data when they are being utilized, many VC's can exist at the same time on a frame-relay WAN.

Performance: Each device, on a frame-relay network, can use more of the available bandwidth and utilize higher operation speeds.

Scalability: The use of multiple virtual circuits for frame-relay encapsulated data transfers and the possibility of using logical subinterfaces for individual WAN connected interfaces makes scalability relatively simple and efficient to configure and utilize.

Availability: Nearly 100 percent availability is required for most enterprise data networks. (Critical applications may be required to meet a standard of availability approaching 99.999 Percent: "five nines").

Manageability: Cisco frame-relay encapsulated WAN's are managed by a keepalive mechanism known as local management interface (LMI). This mechanism provides constant information about frame-relay between frame-relay DTE devices and the frame-switch (a DCE device). Using the *show frame-relay lmi* command will show the LMI type and the counters for the LMI status exchange sequence with errors.

Cost-effectiveness: Cost-effectiveness is a key concern for most enterprises, given limited budgets. With the use of frame-relay, network costs are reduced because it uses less equipment, it's easier to manage and maintain and much easier and cheaper to implement than other comparable WAN protocols.

Disadvantages

The one possible drawback to the utilization of frame-relay on a Cisco implemented WAN is with the area of congestion and dropped traffic. Although, frame-relay utilizes congestion notification and discard eligibility for low priority traffic, these mechanisms provide flow control techniques. There is no guarantee that they will be implemented. However, these issues are normally vendor specific and address individual protocols that frame-relay can operate on.

Comparisons

X.25 is an outdated protocol designed to connect over ISDN lines. It provides error checking and utilizes layers 1,2 and 3 of the OSI model. Because frame-relay does not utilize layer 3, it can provide significant improvement with switch performance over X.25. Asynchronous Transfer Mode (ATM) is a network switching technology that uses fixed sized cells of 53 bytes. Of this, 48 bytes is the size of the payload for each cell. ATM provides quality services for data and voice. ATM networks can achieve speeds of up to 10 gbps. Costs are higher than frame-relay. The cost difference between frame-relay and a dedicated T1 is quite significant. Dedicated T1 line costs surpass frame-relay costs because of distance-sensitive fees. Even with a frame-relay service tariff of \$300 monthly, a dedicated T1 line's monthly subscription rate can exceed a frame-relay rate by \$10,000/mo. at a distance of over 15 miles of separation.

Conclusion

Although, frame-relay has some congestion issues due to its use of multiple VC's and subinterfaces, it can more than pay for itself simply by cost savings from low-overhead and ease of implementation and manageability. I believe that frame-relay is a viable possibility for a WAN encapsulation protocol for data transfer from Cleveland to Pittsburg.

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