

Virtual Circuits

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The connection through a Frame Relay network between two DTEs is called a virtual circuit (VC). The circuits are virtual because there is no direct electrical connection from end to end. The connection is logical, and data moves from end to end, without a direct electrical circuit. With VCs, Frame Relay shares the bandwidth among multiple users and any single site can communicate with any other single site without using multiple dedicated physical lines.

There are two ways to establish VCs:

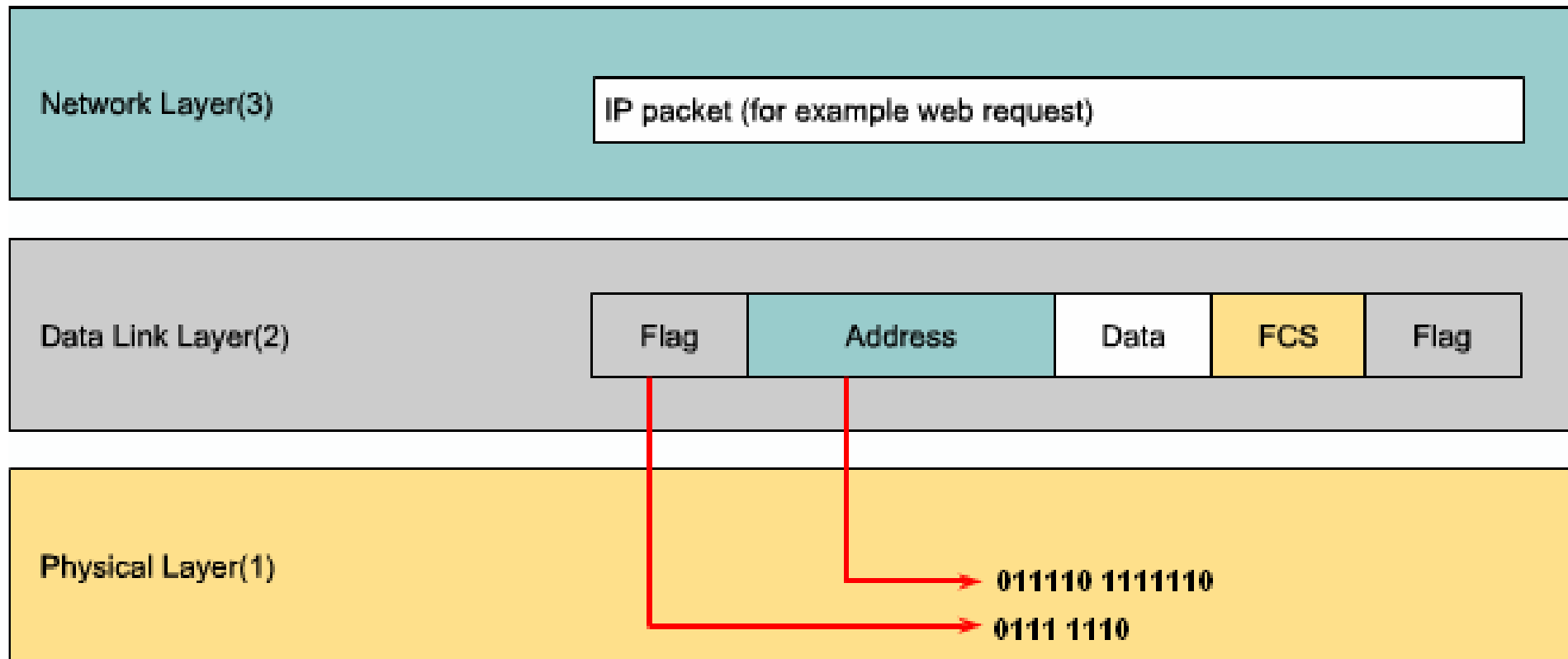
- SVCs, switched virtual circuits, are established dynamically by sending signaling messages to the network.
- PVCs, permanent virtual circuits, are preconfigured by the carrier, and after they are set up, only operate in DATA TRANSFER. Note that some publications refer to PVCs as private VCs.

In the figure, there is a VC between the sending and receiving nodes. The VC follows the path A, B, C, and D. Frame Relay creates a VC by storing input-port to output-port mapping in the memory of each switch and thus links one switch to another until a continuous path from one end of the circuit to the other is identified. A VC can pass through any number of intermediate devices (switches) located within the Frame Relay network.

The Frame Relay Encapsulation Process

Frame Relay takes data packets from a Network layer protocol, such as IP or IPX, encapsulates them as the data portion of a Frame Relay frame, and then passes the frame to the Physical layer for delivery on the wire.

FR Encapsulation and the OSI Model



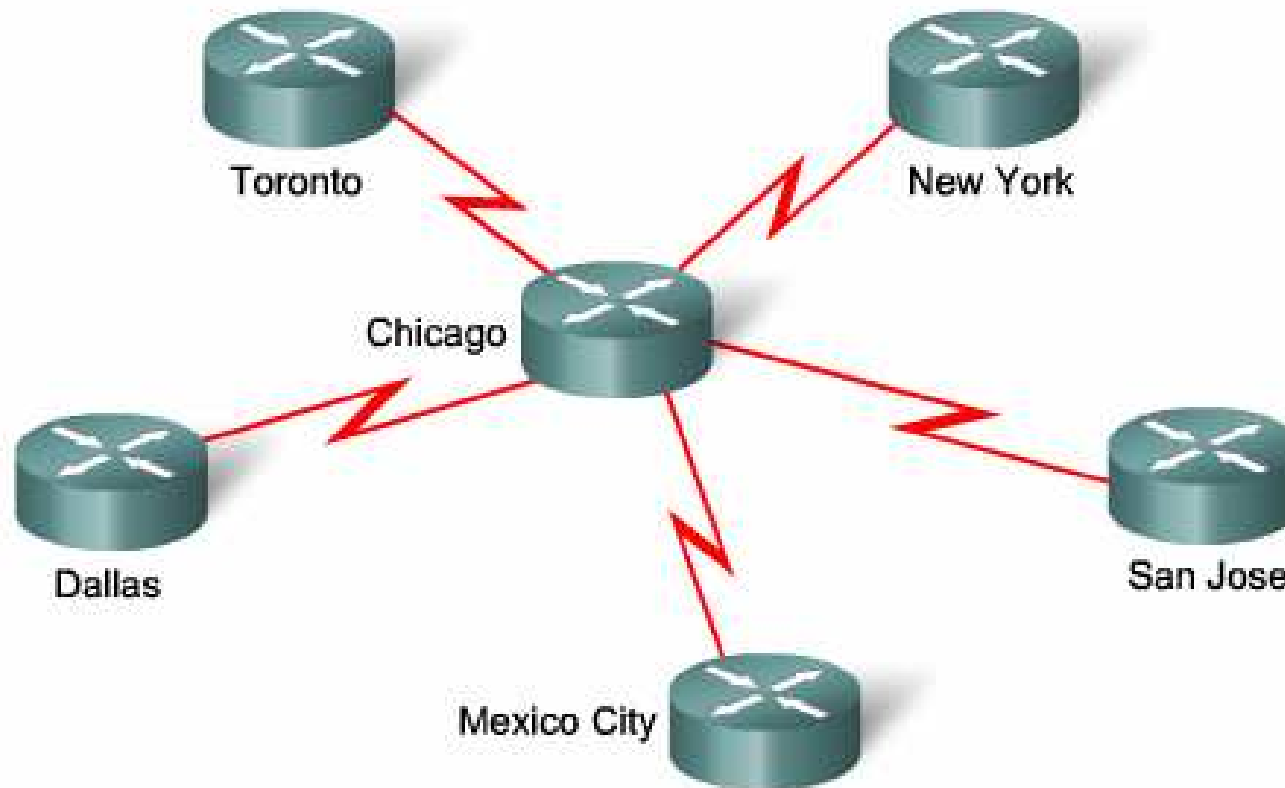
Frame Relay Topologies

When more than two sites are to be connected, you must consider the topology of the connections between them. A topology is the map or visual layout of the Frame Relay network. You need to consider the topology from several perspectives to understand the network and the equipment used to build the network.

There are three topology types: star, full mesh, or partial mesh.

Star Topology (Hub and Spoke)

Star (Hub and Spoke) Topology

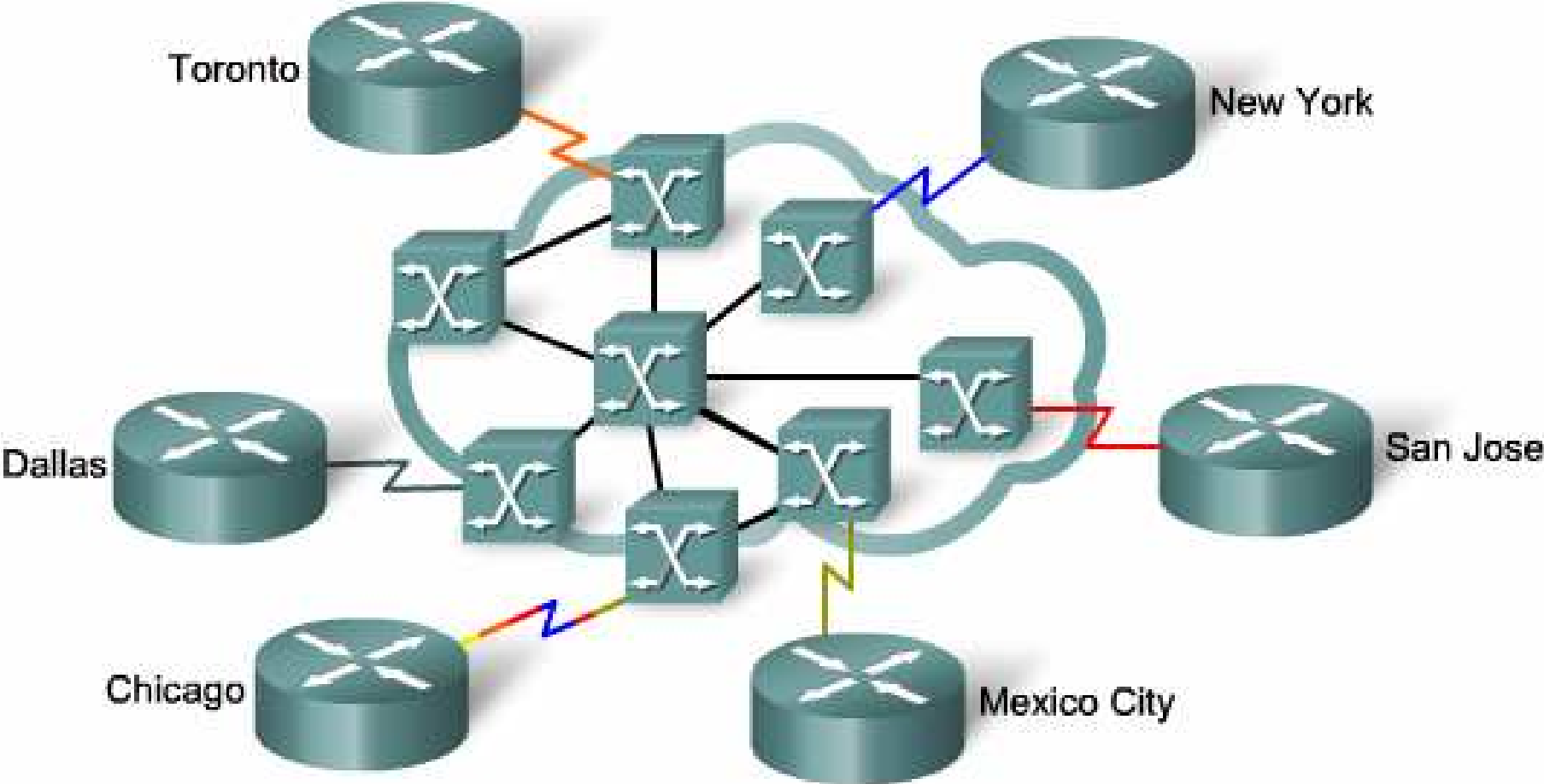


Star Topology - hub with 5 physical links (spokes)

The simplest WAN topology is a star, as shown in the figure. In this topology, Span Engineering has a central site in Chicago that acts as a hub and hosts the primary services.

Connections to each of the five remote sites act as spokes. In a star topology, the location of the hub is usually chosen by the lowest leased-line cost. When implementing a star topology with Frame Relay, each remote site has an access link to the Frame Relay cloud with a single VC.

Frame Relay Star Topology

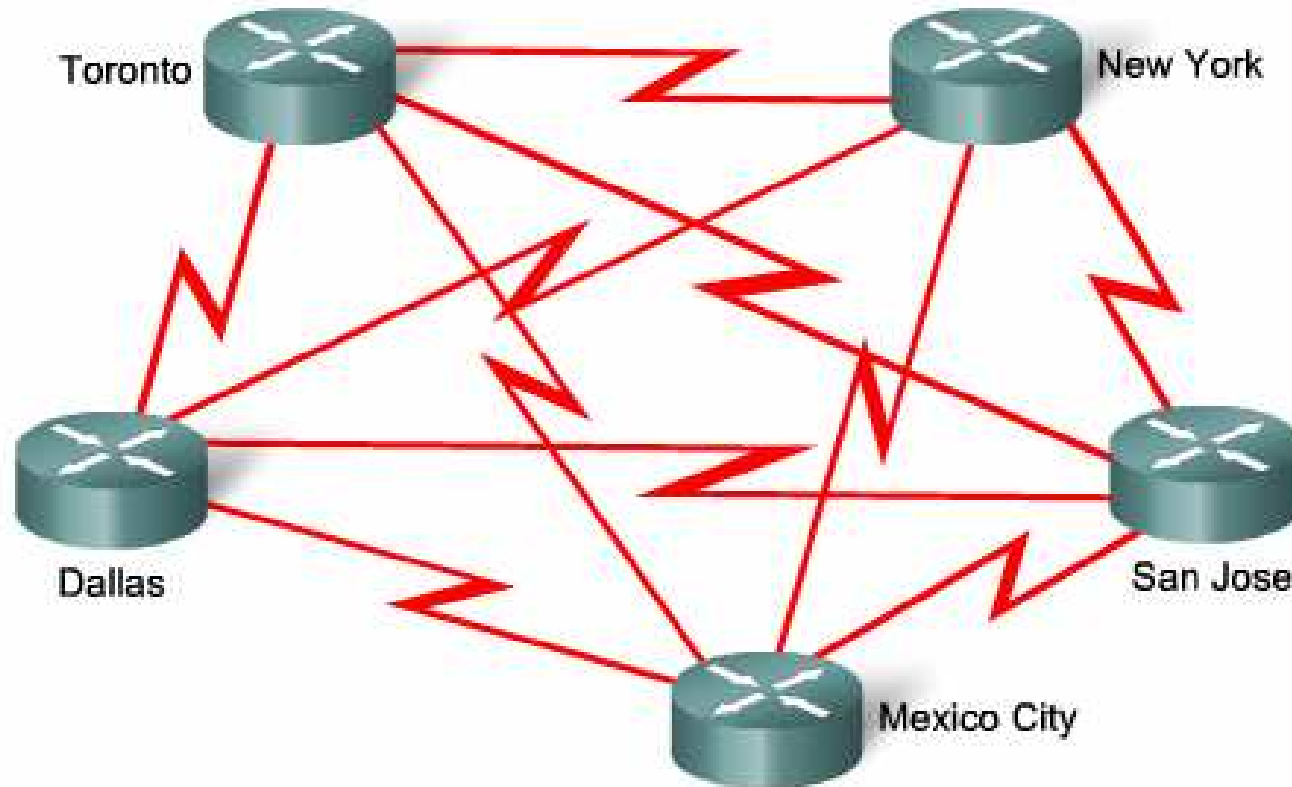


Frame Relay Star - hub with one physical link carrying 5 VCs

This shows the star topology in the context of a Frame Relay cloud. The hub at Chicago has an access link with multiple VCs, one for each remote site. The lines going out from the cloud represent the connections from the Frame Relay service provider and terminate at the customer premises. Because Frame Relay costs are not distance related, the hub does not need to be in the geographical center of the network.

Full Mesh Topology

Full Mesh Topology

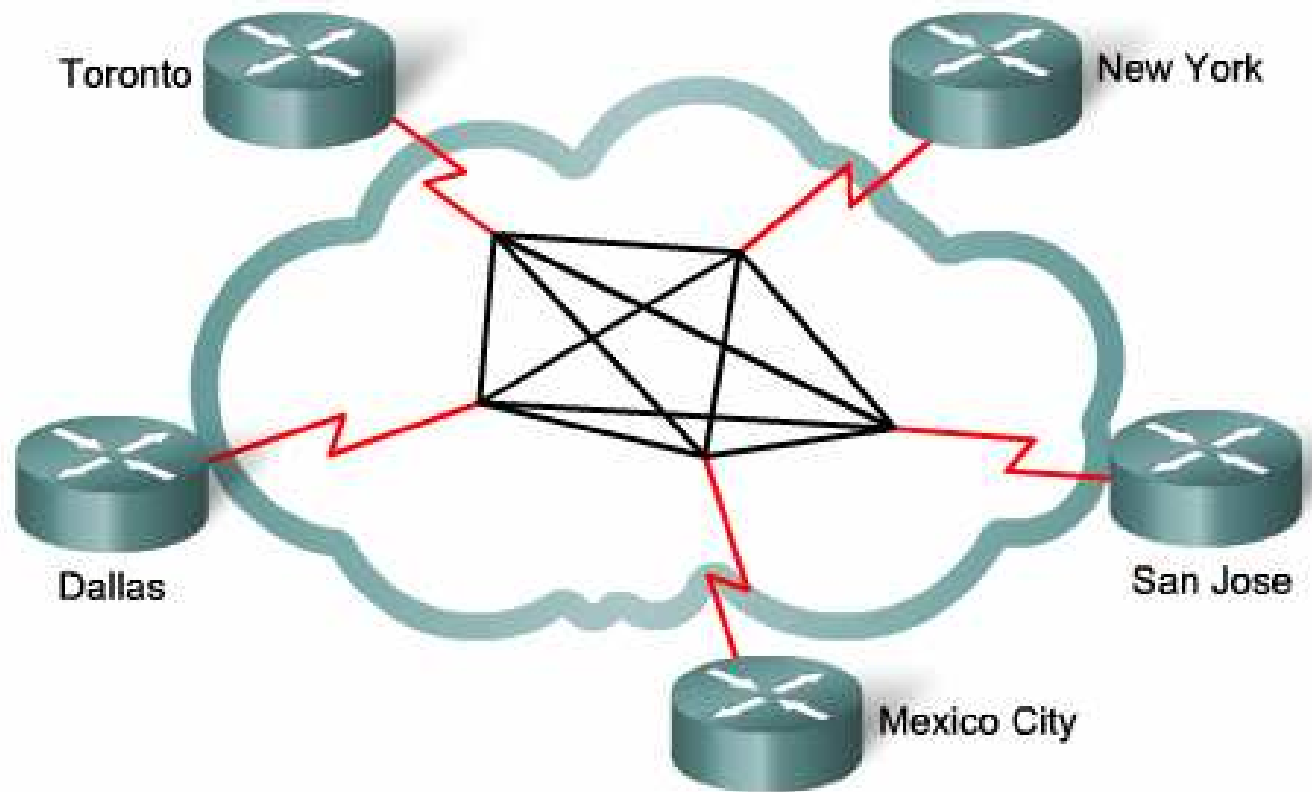


Full Mesh

This figure represents a full mesh topology using dedicated lines. A full mesh topology suits a situation in which the services to be accessed are geographically dispersed and highly reliable access to them is required. A full mesh topology connects every site to every other site. Using leased-line interconnections, additional serial interfaces and lines add costs. In this example, 10 dedicated lines are required to interconnect each site in a full mesh topology.

FR Full Mesh

Frame Relay Mesh



Mesh Topology - each DTE has one physical link carrying 4 VCs

Using Frame Relay, a network designer can build multiple connections simply by configuring additional VCs on each existing link. This software upgrade grows the star topology to a full mesh topology without the expense of additional hardware or dedicated lines. Since VCs use statistical multiplexing, multiple VCs on an access link generally make better use of Frame Relay than single VCs. The figure shows how Span has used four VCs on each link to scale its network without adding new hardware. Service providers will charge for the additional bandwidth, but this solution is usually more cost effective than using dedicated lines.

Partial Mesh Topology

For large networks, a full mesh topology is seldom affordable because the number of links required increases dramatically. The issue is not with the cost of the hardware, but because there is a theoretical limit of less than 1,000 VCs per link. In practice, the limit is less than that.

For this reason, larger networks are generally configured in a partial mesh topology. With partial mesh, there are more interconnections than required for a star arrangement, but not as many as for a full mesh. The actual pattern is dependant on the data flow requirements.