ISDN & Frame Relay

by Sophia

WHAT'S COVERED

In this lesson, you will learn about Integrated Services Digital Network and Frame Relay.

Specifically, this lesson will cover the following:

1. Integrated Services Digital Network

Integrated Services Digital Network (ISDN) is a digital, point-to-point WAN technology capable of maximum transmission speeds of about 1.5 Mbps for the **Primary Rate Interface (PRI)**, although speeds of 128 Kbps for the **Basic Rate Interface (BRI)** are more common within a SOHO environment. ISDN is a type of dial-up connection that must be initiated. ISDN is another form of high-speed internet access that delivers digital services (on 64-Kbps channels) over conditioned telephone copper pairs.

KEY CONCEPT

ISDN uses the same UTP wiring as the Plain Old Telephone Service (POTS), yet it can transmit data at higher speeds. But that's where the similarity ends. The main thing that makes ISDN different from a regular POTS line is how it utilizes the copper wiring. Instead of carrying an analog voice signal, it carries digital signals, which also happens to be key for several more vital differences.

STEP BY STEP

1. First, a computer connects to the 128-Kbps ISDN line via an ISDN **terminal adapter (TA)** that is sometimes incorrectly referred to as an ISDN modem. An ISDN TA is not a modem because it does not convert a digital signal from the computer to an analog signal on the subscriber line; ISDN signals are

digital on the subscriber line. A TA is technically an ISDN-compatible device that has one or more non-ISDN ports for devices like computer serial interfaces and RJ-11 analog phones, which work to give these non-ISDN devices access to the ISDN network.

2. Second, an ISDN line has two types of channels. The data are carried on special Bearer channels, or **B channels**, each of which can carry 64 Kbps of data. A BRI ISDN line has 2 B channels, and a PRI has 23 B channels. One channel can be used for a voice call while another can be used for data transmissions, and it is all made possible by time-division multiplexing (TDM) on one pair of copper wires. The other type of channel in ISDN is also multiplexed (combined) onto only one copper pair. It's used for call setup and link management and is known as the signaling channel, **D channel**, or Delta channel. This channel has only 16 Kbps of bandwidth in BRI and 64 Kbps in PRI.
3. To maximize throughput, the two B channels are often combined into one data connection for a total bandwidth of 128 Kbps. This is known as **Bandwidth ON Demand INteroperability Group (BONDING)**.

Some of the main advantages of ISDN are as follows:

- It offers higher bandwidth than POTS. BONDING yields a bandwidth of 128 Kbps.
- There is no conversion from digital to analog.

ISDN has the following disadvantages:

- It is more expensive than POTS.
- Specialized equipment is required both at the phone company and at the remote computer.
- DSL or cable is often more efficient.
- It is just outdated technology.

ISDN is only capable of changing between digital transmission formats. The TA device itself is about the size of a modem and happens to look pretty similar to one. And also like DSL modems, it has a phone jack and an Ethernet jack. You connect a phone cord from the phone jack to the wall jack where your ISDN services are being delivered, and then you connect an Ethernet cable from your PC to the ISDN TA's Ethernet jack.

ISDN is a cost-effective way to have on-demand dialup backup connectivity for a WAN connection.

Integrated Services Digital Network (ISDN)

A set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the digitalized circuits of the public switched telephone network.

Primary Rate Interface (PRI)

Twenty-three B channels plus one D channel.

Basic Rate Interface (BRI)

Two B channels plus one D channel.

Terminal Adapter (TA)

A device that connects a computer to an ISDN network.

B Channel

A 64-Kbps bearer channel.

D Channel

A 64-Kps data channel for PRI and 16-Kbps data channel for BRI.

Bandwidth ON Demand INteroperability Group (BONDING)

Enables ISDN channel aggregation.

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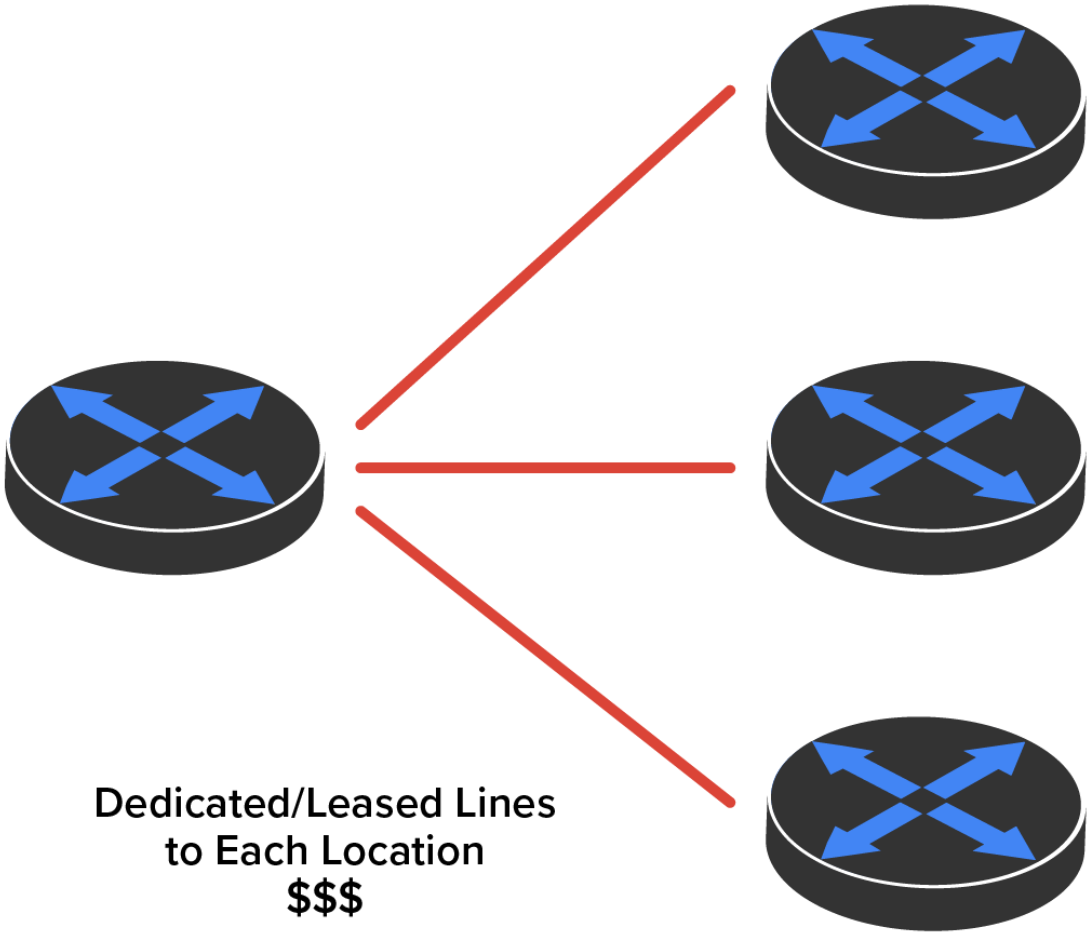
2. Frame Relay Technology

Frame Relay is a WAN technology in which variable-length packets are transmitted by switching. Packet switching involves breaking messages into chunks at the sending device. Each packet can be sent over any number of routes on its way to its destination. The packets are then reassembled in the correct order at the receiving device. Because they are packet-switched and the exact path is unknown, we use a cloud when creating diagrams to illustrate how data travel throughout this type of service.

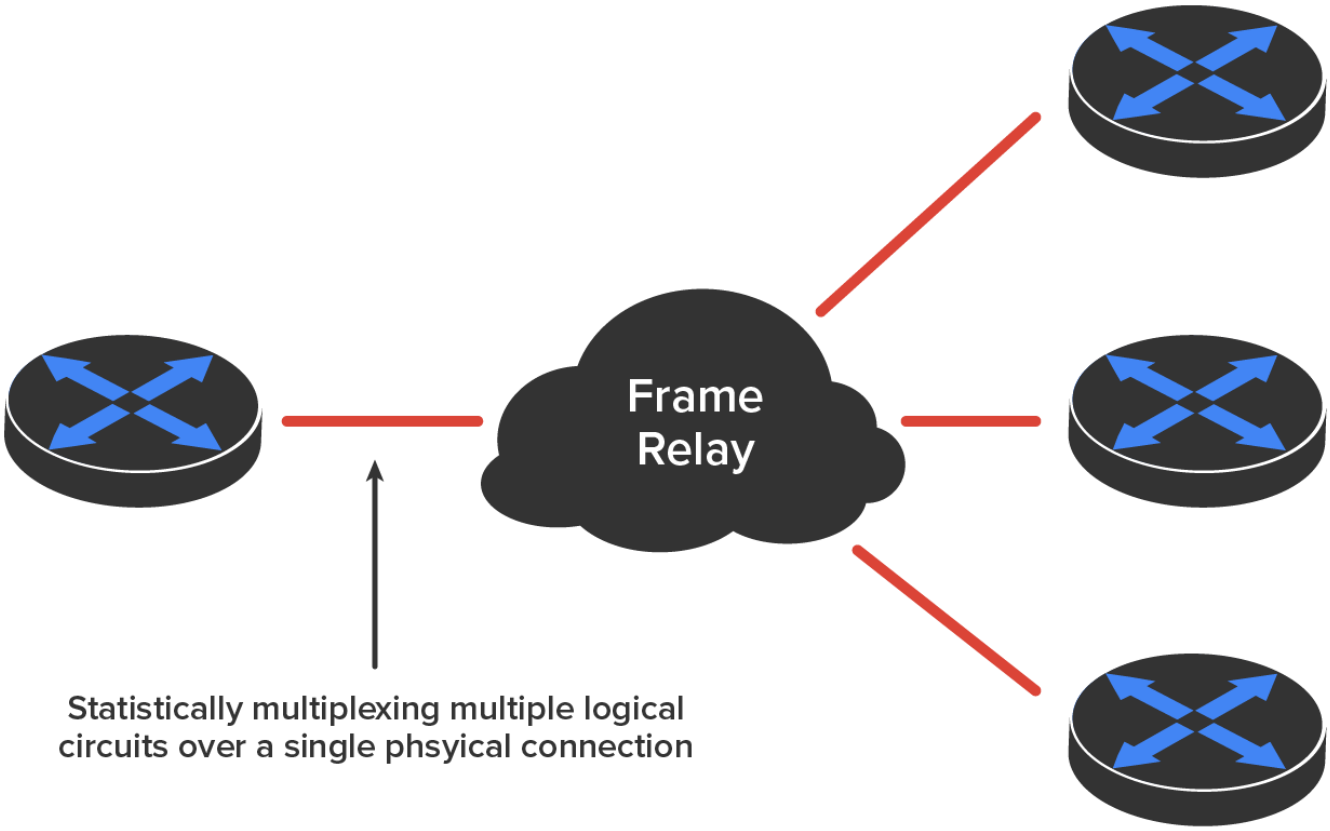
Frame Relay is a packet-switched technology. It has the following characteristics:

- Frame Relay does not work like a point-to-point leased line (although it can be made to look and act like one).
- Frame Relay is usually less expensive than leased lines are, but there are some sacrifices that have to be made to get those savings.

The diagram below demonstrates what a network looked like before Frame Relay:



Now, take a look at the Frame Relay diagram below. You can see that there's now only one connection between the corporate router and the Frame Relay switch. This significantly reduces the operating expenses paid to the telecommunications provider.



Imagine that you need to add seven remote sites to the corporate office and you have only one free serial port on your router. Frame Relay can scale to enable a solution.

KEY CONCEPT

Frame Relay is a much less expensive way to construct a WAN than using dedicated leased lines like T1s.

TERM TO KNOW

Frame Relay

A wide area network (WAN) technology that specifies the physical and data link layers of digital telecommunications channels using a packet switching methodology.

2a. Frame Relay Bandwidth

Frame Relay allows many different customers to share a packet-switched network. This spreads out the cost of the switches. But remember, Frame Relay is based on the assumption that all customers will not need to transmit data constantly or simultaneously.

Frame Relay works by providing a portion of dedicated bandwidth to each user, and it also allows the user to exceed their guaranteed bandwidth if resources on the Telco network happen to be available. So basically, Frame Relay providers allow customers to buy a lower amount of bandwidth than they really use. There are two separate bandwidth specifications with Frame Relay:

Access rate is the maximum speed at which the Frame Relay interface can transmit, while the **Committed Information Rate (CIR)** is the maximum bandwidth of data guaranteed to be delivered. In reality, it is the average amount that the service provider will allow you to transmit, based on what you purchased.

HINT

If these two values are the same, the Frame Relay connection is pretty much just like a leased line. But they can actually be set to different values.

EXAMPLE Let us say that you buy an access rate of T1 (1.544 Mbps) and a CIR of 256 Kbps. By doing this, you are guaranteed that the first 256 Kbps of traffic you send will be delivered. Anything beyond that is called a **burst**, which is a transmission that exceeds your guaranteed 256-Kbps rate and can total any amount up to the T1 access rate. If your combined committed burst, which is the basis for your CIR, and excess burst sizes, known as the **maximum burst rate (MBR)**, exceed the access rate, any packets that exceed the MBR will be dropped.

TERMS TO KNOW

Access Rate
The bandwidth capacity of a connection to an ISDN network.

Committed Information Rate (CIR)
The minimum bandwidth guaranteed by an ISDN provider.

Burst
Transmission of packets above the committed information rate (CIR).

Maximum Burst Rate (MBR)
The upper bandwidth limit of burst packets allowed by the ISDN provider.

2b. Virtual Circuits

Frame Relay operates using **virtual circuits** as opposed to the actual physical circuits that leased lines use. These virtual circuits are what link together the thousands of devices connected to the provider's Frame Relay "cloud." Frame Relay provides a virtual circuit between your two DTE devices, making them appear to be connected via a circuit when, in reality, they are transmitting their frames into a large, shared packet-switched infrastructure. The Frame Relay customer never sees the complexity of what is actually happening inside the cloud because they only have a virtual circuit.

There are two types of virtual circuits—permanent and switched.

- **Permanent virtual circuits (PVCs)** are by far the most common type in use today. What "permanent" means here is that Telco creates the mappings inside its gear, and as long as you pay the bill, it will remain permanently in place.
- **Switched virtual circuits (SVCs)**, unlike PVCs, are more like phone calls. The virtual circuit is established when data need to be transmitted, and it is taken down when the data transfer is complete.

TERMS TO KNOW

Virtual Circuit

A means of transporting data over a packet-switched network in such a way that it appears as though there is a dedicated physical link between the source and destination end systems of these data.

Permanent Virtual Circuits (PVCs)

A virtual circuit established for continuous use.

Switched Virtual Circuits (SVCs)

A virtual circuit that is dynamically established on demand and is torn down when the transmission is complete.

2c. Data Link Connection Identifiers

Frame Relay PVCs are identified to data terminal equipment (DTE) end devices by **Data Link Connection Identifiers (DLCIs)**. A Frame Relay service provider typically assigns DLCI values, which are used on Frame Relay interfaces to distinguish between different virtual circuits. Because many virtual circuits can be terminated on one multipoint Frame Relay interface, many DLCIs are often affiliated with it.

EXAMPLE Suppose you have a central HQ with three branch offices. If you were to connect each branch office to HQ using a T1, you would need three serial interfaces on your router at HQ, one for each T1, which is an expensive solution. Now, suppose you use Frame Relay PVCs instead. You could have a T1 at each branch connected to a service provider and only a single T1 at HQ, which will save a lot of money. There would be three PVCs on the single T1 at HQ—one going to each branch. And even though you'd have only a single interface and a single CSU/DSU, the three PVCs would function as three separate circuits.

TERM TO KNOW

Data Link Connection Identifier (DLCI)

A Frame Relay 10-bit-wide link-local virtual circuit identifier used to assign frames to a specific PVC or SVC.

SUMMARY

In this lesson, you learned about two WAN protocols: **Integrated Services Digital Network** (ISDN) and **Frame Relay**. ISDN uses either dialup BRI or PRI to provide WAN connectivity. Frame Relay is a packet-switched WAN technology that is significantly less expensive than traditional leased lines. We discussed **Frame Relay's bandwidth**, access rate, committed information rate (CIR), permanent and switched **virtual circuits**, and **data link connection identifiers**.

Source: This content and supplemental material has been adapted from CompTIA Network+ Study Guide: Exam N10-007, 4th Edition. Source Lammle: CompTIA Network+ Study Guide: Exam N10-007, 4th Edition - Instructor Companion Site (wiley.com)

TERMS TO KNOW

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The bandwidth capacity of a connection to an ISDN network.

B Channel
A 64-Kbps bearer channel.

Bandwidth ON Demand INteroperability Group (BONDING)
Enables ISDN channel aggregation.

Basic Rate Interface (BRI)
Two B channels plus one D channel.

Burst
Transmission of packets above the committed information rate (CIR).

Committed Information Rate (CIR)
The minimum bandwidth guaranteed by an ISDN provider.

D Channel
A 64-Kps data channel for PRI and 16-Kbps data channel for BRI.

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A virtual circuit that is dynamically established on demand and is torn down when the transmission is complete.

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Virtual Circuit

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