What Is an ISDN?

Integrated Services Digital Network, commonly known as ISDN, is a telephone network system that marked a significant shift from the traditional analog Public Switched Telephone Network (PSTN) to the digital age.

It utilizes circuit-switching to transmit both voice and data over a digital line.

These digital lines consist of copper wires, with the original intention of developers being to replace analog landline technology with digital technology.

Components of an ISDN

The ISDN system utilizes two main types of channels:

B Channels (Bearer)

The B channel, abbreviated for Bearer Channel, carries user data, such as voice, video, or computer data. It’s like the information pipeline transporting conversations and file data in digital packets.

Each B channel operates at a rate of 64 kbps. The number of B channels available depends on the type of ISDN service.

D Channels (Data)

The D channel serves the primary function of transporting signaling information and control messages between the user’s terminal equipment (such as an ISDN device or telephone) and the central office or exchange in the telecommunications network.

The bandwidth of the D channel depends on the type of ISDN service but typically operates at a speed of 16 kbps.

The combination of B channels and D channels allows an ISDN to support various services simultaneously over a single digital connection. This division of channels is a key feature of ISDN, enabling the efficient and flexible transmission of voice, data, video, and other services.

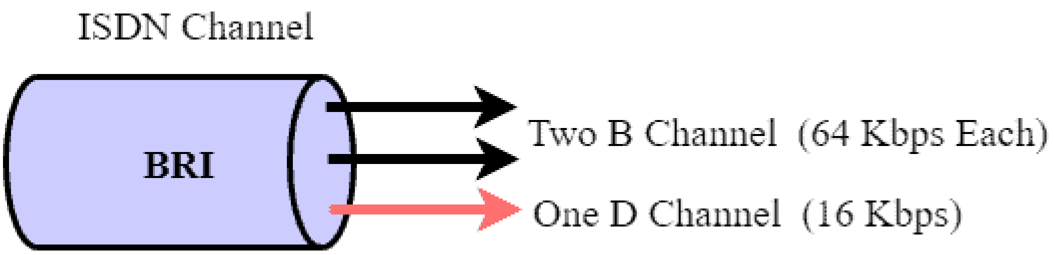
Types of ISDNs

ISDN (Integrated Services Digital Network) lines come in two primary types:

- Basic Rate Interface (BRI)
- Primary Rate Interface (PRI).

Basic Rate Interface (BRI)

Designed for residential and small business use, BRI provides a digital communication service over traditional telephone lines. It offers a more versatile and efficient alternative to traditional analog phone lines:

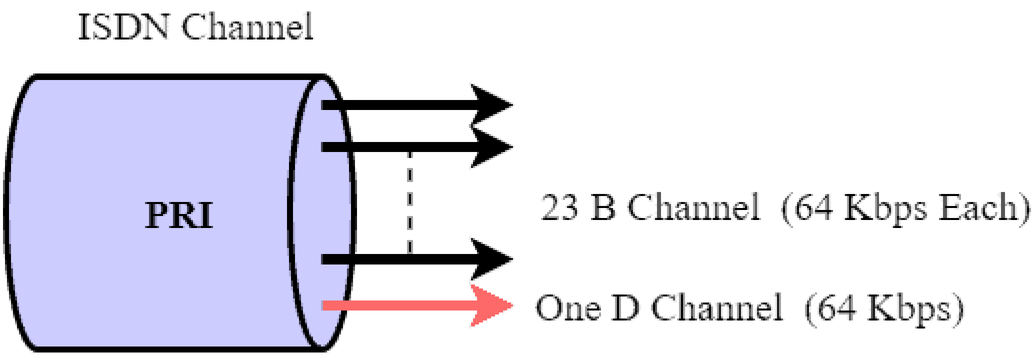


BRI consists of two B (Bearer) channels and one D (Data) channel. The two B channels carry user data, such as voice, data, or video. The D channel handles signaling and controlling information. It provides a total bandwidth of 144 kbps (64 kbps + 64 kbps + 16 kbps).

Primary Rate Interface (PRI)

PRI offers an enhanced communication service designed for larger organizations and businesses with higher communication demands. It provides a higher capacity and more channels compared to BRI, making it suitable for scenarios with greater data and voice traffic.

PRI comprises 23 B channels (sometimes 30 B channels depending on region) for carrying user data and one D channel for signaling:



The total bandwidth of PRI depends on the number of B channels. For example, in the U.S., a PRI provides a total bandwidth of 1.544 Mbps (23 B channels + 1 D channel), while in Europe, a PRI provides a total bandwidth of 2.048 Mbps (30 B channels + 1 D channel).

B (Broadband) ISDN

Broadband ISDN expands on traditional ISDN, providing higher data rates and increased flexibility for diverse services to meet the growing demand for advanced multimedia applications like high-speed internet, video conferencing, and other broadband services.

B-ISDN boasts significantly higher data rates than the original ISDN, which typically offers data rates ranging from 64 Kbps to 128 Kbps. In contrast, B-ISDN can provide notably faster speeds, often reaching into the Mbps range.

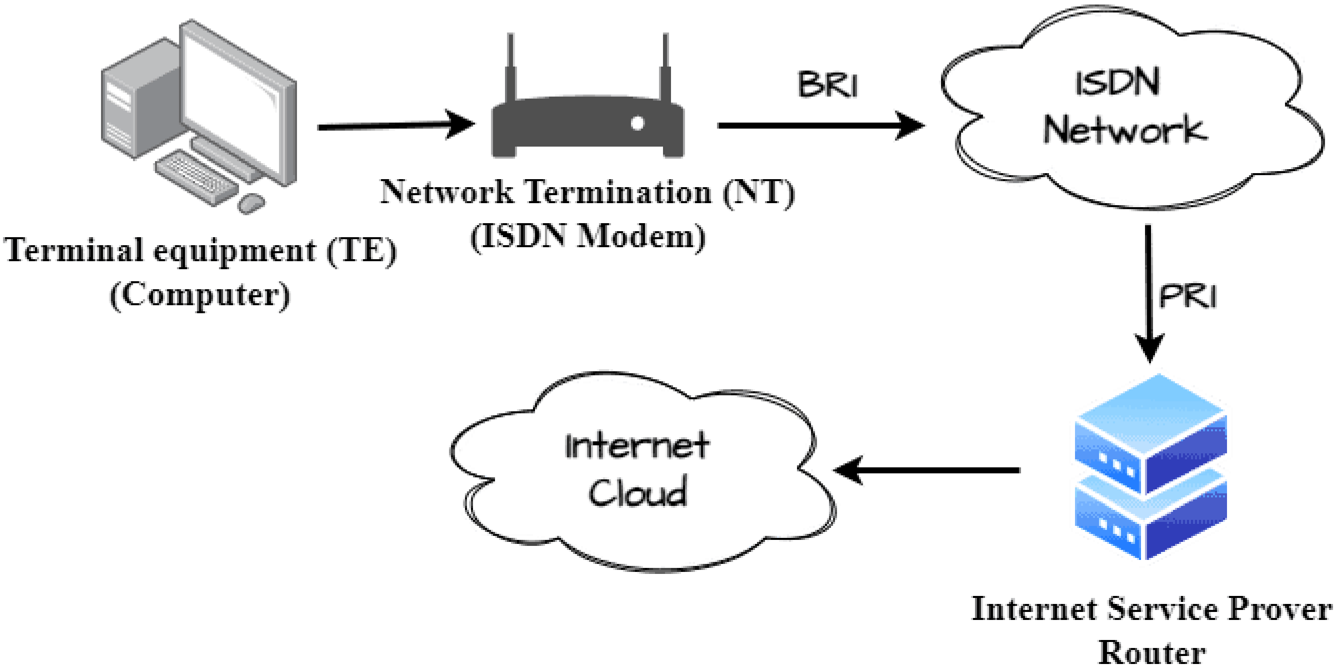
Broadband ISDN employs ATM switching technology and operates over fiber-optic cables, representing an advanced iteration of ISDN.

Core Principles and Architecture

ISDN divides the conventional copper telephone line into several digital channels, enabling multiple phones to make incoming and outgoing calls simultaneously on a single copper line. Achieving this involves operating these channels concurrently on the same physical line.

When we speak or send data on an ISDN phone, translating the voice into digital data packets occurs through pulse code modulation (PCM). Similarly, the system packages data files into data packets. The architecture of ISDN comprises several key components:

Terminal equipment (TE) is the user's device or equipment that connects to the ISDN network. It can be a telephone, computer, fax machine, or any other device capable of digital communication called TE1, and for higher bandwidth connections, terminal equipment is called TE2:



The Network Termination (NT) links the user's equipment to the ISDN network, carrying out tasks like line coding, ensuring electrical compatibility, and interfacing with the user's device.

The User-Network Interface (UNI) delineates the connection point between the customer's equipment (TE1 or TE2) and the network, encompassing the essential physical and electrical characteristics for effective communication.

At the core of the ISDN architecture is the ISDN switch, tasked with establishing, managing, and terminating connections among various ISDN users. This switch exhibits the capability to manage both voice and data traffic.

Applications

Various applications have utilized the Integrated Services Digital Network (ISDN), which provides a versatile platform for digital communication. Here are several applications of ISDNs:

ISDN supports high-quality digital voice communication. It provides clear and reliable voice connections, making it suitable for traditional telephone calls.

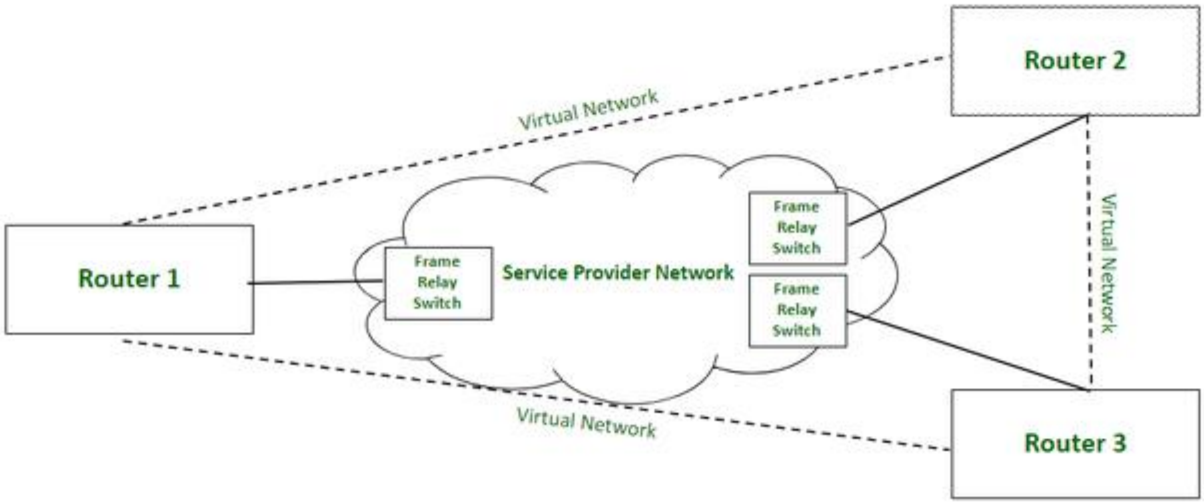
The digital nature of ISDN makes it well-suited for video conferencing applications. It can transmit and receive video signals, facilitating real-time communication between individuals or groups in different locations.

Users have employed ISDN for internet access, obtaining higher data rates than traditional dial-up connections. While it has been largely surpassed by broadband technologies like DSL and cable modems, ISDN was an early solution for achieving faster internet speeds.

ISDN has played a role in establishing Virtual Private Networks, offering secure and encrypted communication over public networks.

Frame Relay

- Frame Relay is a packet-switching network protocol that is designed to work at the data link layer of the network.
- It is used to connect Local Area Networks (LANs) and transmit data across Wide Area Networks (WANs).
- It is a better alternative to a point-to-point network for connecting multiple nodes that require separate dedicated links to be established between each pair of nodes.
- It allows transmission of different size packets and dynamic bandwidth allocation.
- Also, it provides a congestion control mechanism to reduce the network overheads due to congestion. It does not have an error control and flow management mechanism.



Frame Relay Network

Working:
Frame relay switches set up virtual circuits to connect multiple LANs to build a WAN.

Frame relay transfers data between LANs across WAN by dividing the data in packets known as frames and transmitting these packets across the network.

It supports communication with multiple LANs over the shared physical links or private lines.

Frame relay network is established between Local Area Networks (LANs) border devices such as routers and service provider network that connects all the LAN networks. Each LAN has an access link that connects routers of LAN to the service provider network terminated by the frame relay switch. The access link is the private physical link used for communication with other LAN networks over WAN. The frame relay switch is responsible for terminating the access link and providing frame relay services.

For data transmission, LAN’s router (or other border device linked with access link) sends the data packets over the access link.

The packet sent by LAN is examined by a frame relay switch to get the Data Link Connection Identifier (DLCI) which indicates the destination of the packet. Frame relay switch already has the information about addresses of the LANs connected to the network hence it identifies the destination LAN by looking at DLCI of the data packet. DLCI basically identifies the virtual circuit (i.e. logical path between nodes that doesn’t really exist) between source and destination network. It configures and transmits the packet to frame relay switch of destination LAN which in turn transfers the data packet to destination LAN by sending it over its respective access link. Hence, in this way, a LAN is connected with multiple other LANs by sharing a single physical link for data transmission.

Frame relay also deals with congestion within a network. Following methods are used to identify congestion within a network:

1. **Forward Explicit Congestion Network (FECN) – FECN is a part of the frame header that is used to notify the destination about the congestion in the network.** Whenever a frame experiences congestion while transmission, the frame relay switch of the destination network sets the FECN bit of the packet that allows the destination to identify that packet has experienced some congestion while transmission.
2. Backward Explicit Congestion Network (BECN) – **BECN is a part of the frame header that is used to notify the source about the congestion in the network.** Whenever a frame experiences congestion while transmission, the destination sends a frame back to the

source with a set BECN bit that allows the source to identify that packet that was transmitted had experienced some congestion while reaching out to the destination. Once, source identifies congestion in the virtual circuit, it slows down to transmission to avoid network overhead.

3. **Discard Eligibility (DE) –**

DE is a part of the frame header that is used to indicate the priority for discarding the packets. If the source is generating a huge amount of traffic on the certain virtual network then it can set DE bits of less significant packets to indicate the high priority for discarding the packets in case of network overhead. Packets with set DE bits are discarded before the packets with unset DE bits in case of congestion within a network.

Types:

1. **Permanent Virtual Circuit (PVC) –**
   These are the permanent connections between frame relay nodes that exist for long durations. They are always available for communication even if they are not in use. These connections are static and do not change with time.
2. **Switched Virtual Circuit (SVC) –**
   These are the temporary connections between frame relay nodes that exist for the duration for which nodes are communicating with each other and are closed/ discarded after the communication. These connections are dynamically established as per the requirements.

Advantages:

1. High speed
2. Scalable
3. Reduced network congestion
4. Cost-efficient
5. Secured connection

Disadvantages:

1. Lacks error control mechanism
2. Delay in packet transfer
3. Less reliable

Frame relay vs. ATM: What is the difference?

The main difference between asynchronous transmission mode and frame relay is that ATM provides error correction, management and packet flow management. Frame relay does not perform any of those tasks.

Frame relay and ATM also have different data rates. Frame relay circuits have a data rate of between 64 Kbps and 45 Mbps. ATM has a data rate of between 155 and 622 Mbps, depending on the media being used.