

## Integrated Services Digital Network (ISDN)

ISDN was developed by ITU-T in 1976. It is a set of protocols that combines digital telephony and data transport services. The whole idea is to digitize the telephone network to permit the transmission of audio, video, and text over existing telephone lines. The purpose of the ISDN is to provide fully integrated services to users.

### History:

#### Voice Communication over Analogue Networks:

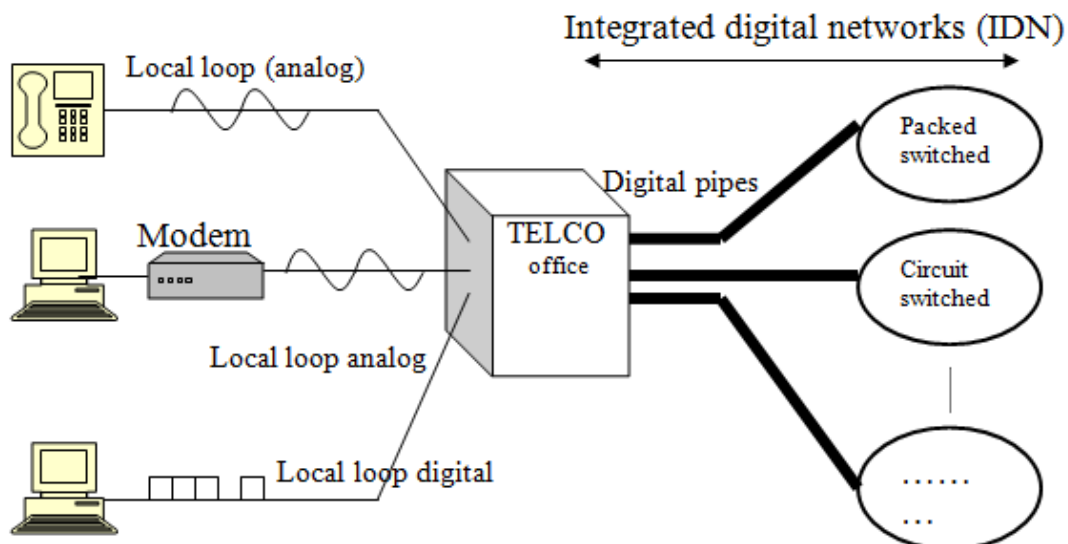
Initially, telecommunications networks were entirely analogue networks and were used for the transmission of analogue information in the form of voice.

#### Voice and Data Communication over Analogue Networks:

With the advent of digital processing, subscribers needed to exchange data as well as voice. Modems were developed to allow digital exchanges over existing analogue lines.

#### Integrated Digital Networks (IDN):

Next, customers began to require access a variety of networks, such as packet switched networks. To meet these needs, the telephone companies created Integrated Digital Networks (IDNs). An IDN is a combination of networks available for different purposes as shown in figure below:

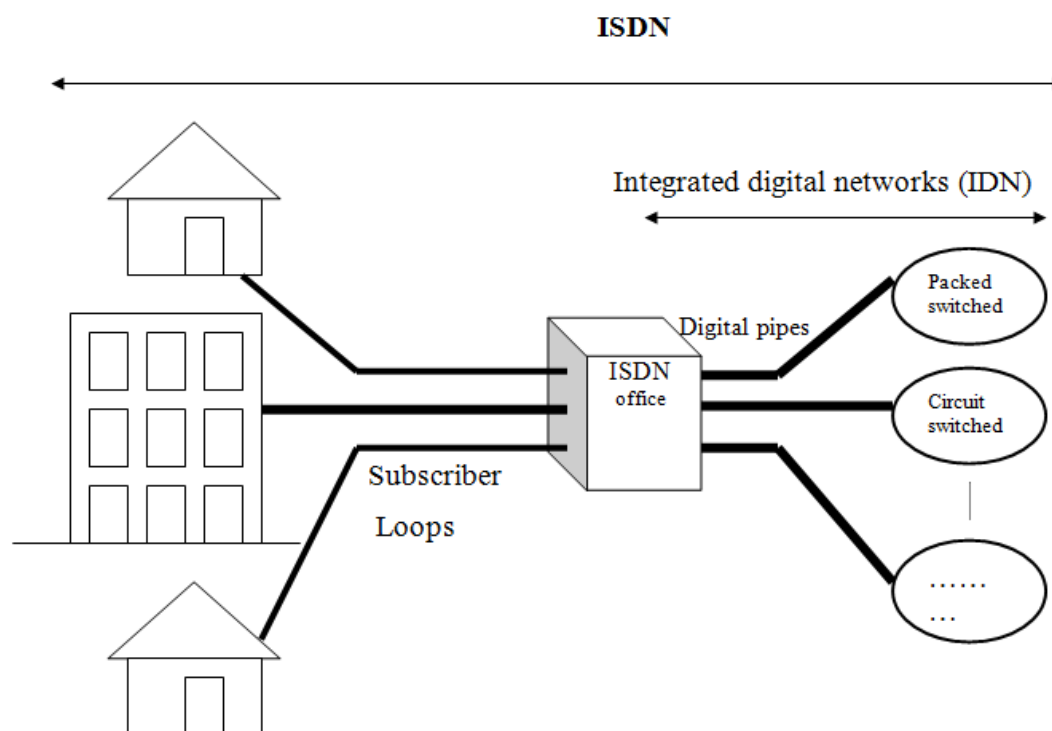


Access to these networks is by digital pipes, which are time multiplexed channels sharing very high speed paths.

### Integrated Services Digital Network (ISDN):

The ISDN integrates customer services with the IDN. Fully digital services are much more efficient and flexible than analogue services. With ISDN all customer services will become digital rather than analogue.

The following figure gives a conceptual view of the connection between users and an ISDN central office. Each user is linked to the central office through a digital pipe. These pipes can be of different capacities to allow different rates of transmission and support different subscriber needs.



### Subscriber Access to the ISDN:

To allow flexibility, digital pipes between customers and the ISDN office (the subscriber loops) are organized into multiple channels of different sizes. ISDN standard defines three channel types, each with a different transmission rate: bearer channels, data channels, and hybrid channels as shown in table below:

Channel	Data Rate (Kbps)
Bearer(B)	64
Data(D)	16,64
Hybrid(H)	384,1536,1920

## B Channels:

A bearer channel (B channel) is defined as a rate of 64 kbps. It is the basic user channel and can carry any type of digital information in full-duplex mode as long as the required transmission rate does not exceed 64 Kbps.

## D Channels:

A data channel (D channel) can be either 16 or 64 Kbps, depending on the needs of user. Although the name says data, the primary function of a D channel is to carry control signaling for the B channel.

## H channels:

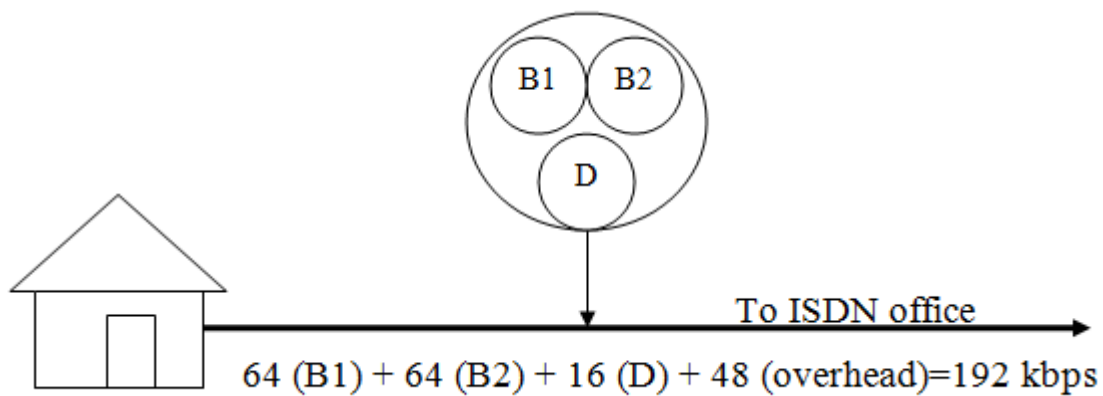
Hybrid channels (H channels) are available with data rate of 384 Kbps (H0), 1536 Kbps (H11), or 1920 Kbps (H12). These rates suit H channels for high data rate applications such as video, teleconferencing, and so on.

## User Interfaces:

Digital subscriber loops are of two types:

### 1- Basic Rate Interface (BRI):

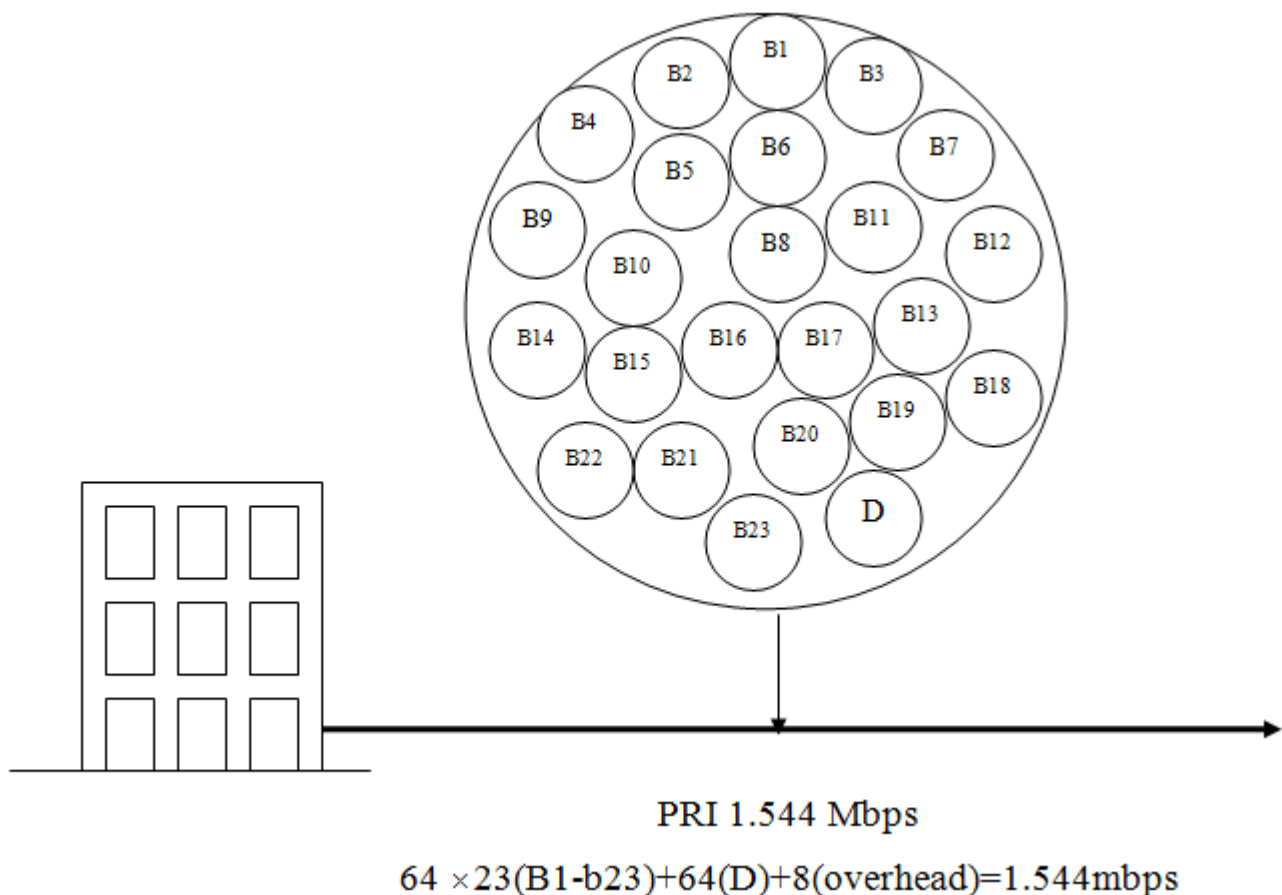
BRI specifies a digital pipe consisting of two B channels and one 16 Kbps D channel as shown in figure below:



The BRI is designed to meet the needs of residential and small office customers. In most cases, there is no need to replace the existing local loop cable. The same twisted pair local loop that delivers analogue transmission can be used to handle digital transmission.

## 2- Primary Rate Interface (PRI):

The usual primary rate interface (PRI) specifies a digital pipe with 23 B channels and one 64 Kbps D channel, as shown in figure below:

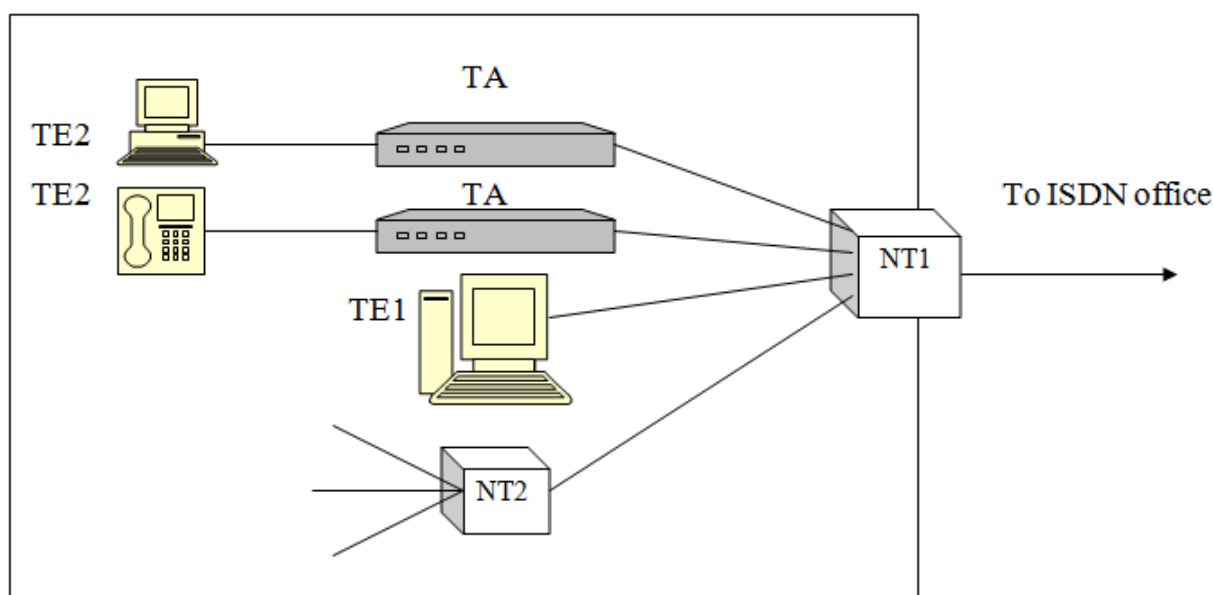


## Functional Grouping:

In the ISDN standard, the devices that enable users to access the services of the BRI or PRI are described by their functional duties and collected in functional grouping. Subscribers choose the specific devices best suited to their needs from these groupings. Functional groupings used at the subscriber's premises include network terminations (type 1 and 2), terminal equipment (types 1 and 2), and terminal adapters.

## Network Termination1 (NT1):

A network termination 1 (NT1) device (shown in figure below) controls the physical and electrical termination of the ISDN at the user's premises and connects the user's internal system to the digital subscriber loop. These functions are comparable to those defined for the OSI physical layer.



## Network Termination2 (NT2):

A network termination2 (NT2) device (shown in above figure) performs functions at the physical, data link, and network layers of the OSI model (layer1,2,and 3). NT2 provide multiplexing (layer1), flow control (layer2), and packetizing (layer3). NT2 provides intermediate signal processing between the data generating devices and NT1.

**Terminal Equipment1(TE1):**

It refers to digital subscriber equipment. Terminal equipment1 (TE1) (shown in above figure) is any device that supports the ISDN standard. Examples of TE1 are digital telephones, and digital facsimiles.

**Terminal Equipment2(TE2):**

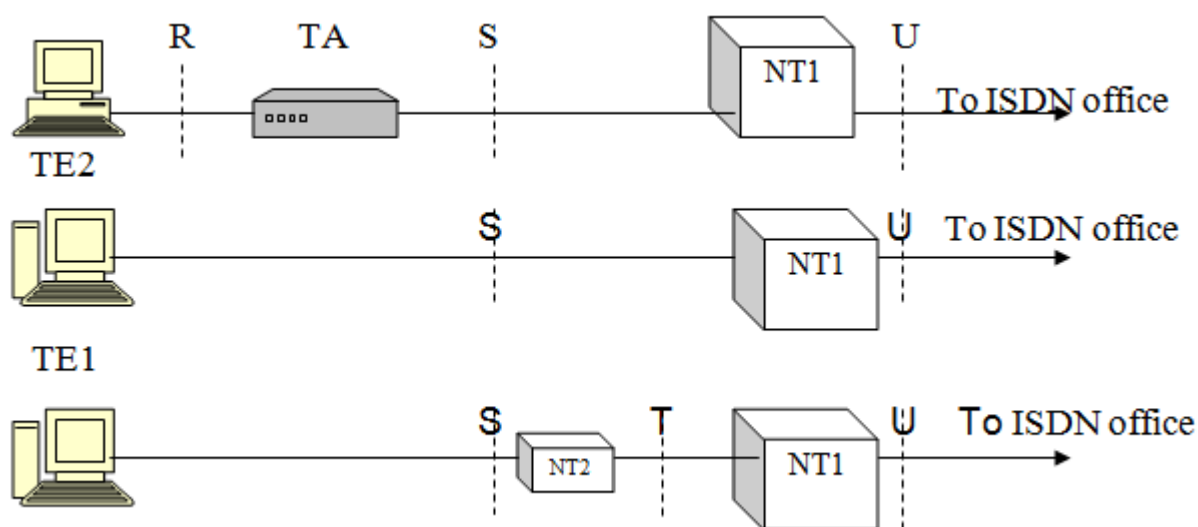
TE2 equipment is any non ISDN device, such as a terminal, workstation, host computer or regular telephone. TE2 devices are not immediately compatible with an ISDN network but can be used with help of another device called terminal adapter (TA).

**Terminal Adapter (TA):**

A terminal adapter (TA) converts information received in non ISDN format from TE2 into a format capable of being carried by the ISDN, as shown in figure before).

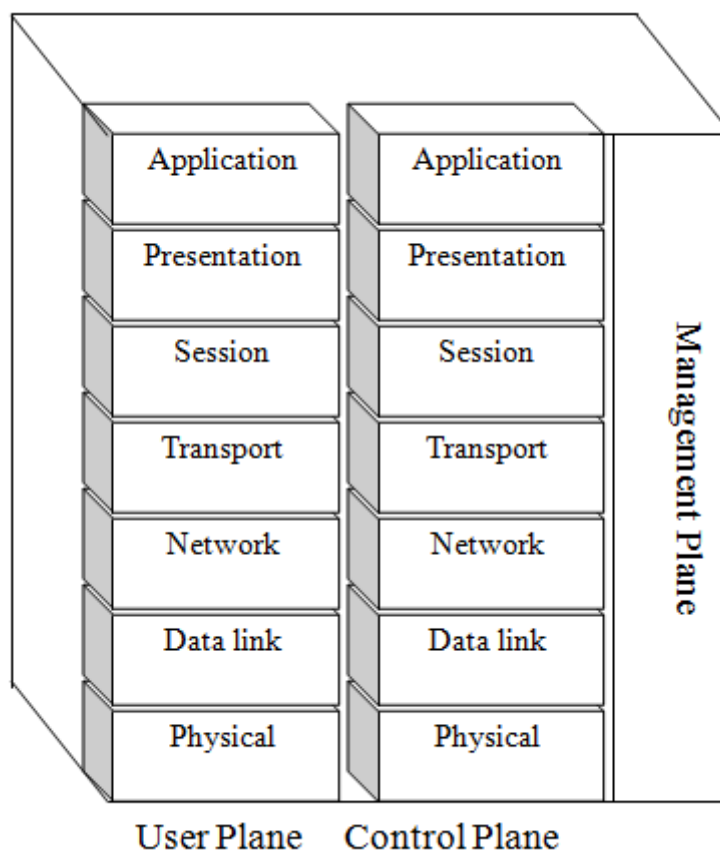
**Reference Points:**

The term reference point refers to the label used to identify individual interfaces between two elements of ISDN installation. Reference point defines the functions of the connection between the equipments used in the ISDN. Reference points R, S, T, and U (as shown in figure below) define the interfaces between subscriber's equipment and the network.



## ISDN Layers:

It is difficult to apply the simple seven layer architecture specified by the OSI to the ISDN. One reason is that the ISDN specifies two different channels (B and D) with different functionalities. ITU-T has devised an expanded model for the ISDN layers. Instead of a single seven layer architecture like the OSI, the ISDN is defined in three separate planes: the user plane, the control plane, and the management plane as shown in figure below:



## Broad Band ISDN:

When the ISDN was originally designed, data rates of 64 Kbps to 1.544 Mbps were sufficient to handle all existing transmission needs. The figure shown below shows the bit rates required by a variety of applications. As you can see, several are beyond the capacities of both the BRI and PRI.

Telex			Text				
	Video			HiFi			
		Video Phone		Video		TV	HDTV
				Conferencing			
			File				
			transfer	CAD			
		Fax					
100 bps	1 kbps	10 kbps	100 kbps	1 Mbps	10 Mbps	100 Mbps	1 10 Gbps

To provide the needs of the next generation of technology, an extension of ISDN, called Broad Band ISDN (B-ISDN), is under study. The original ISDN is now known as narrow band ISDN (N-ISDN), B-ISDN provides subscribers to the network with data rates in the range of 600 Mbps, almost 400 times faster than the PRI rate

**The Future of ISDN:**

The N-ISDN was designed to replace the analogue telephone system with a digital one for both voice and data transmission.

In fact, N-ISDN has replaced the normal telephone line in some European countries in response to the demand of users. In the united States, however, this replacement was delayed and new technologies (such as cable modem and ASDL) evolved that make the use of ISDN questionable. However; we believe that ISDN can still be considered a good solution for several reasons:

- 1- ISDN can be brought to subscriber premises with minimum cost.
- 2- New equipment has appeared on the market that allows subscriber to use the entire band width of ISDN line. This makes it competitive with some other technologies.
- 3- The protocol is flexible enough to be upgraded to higher data rates using new technology.