Lecture 21

ISDN is an acronym for Integrated Services Digital Network. ISDN was developed to cater the needs of users who want high data rate, since conventional telephone line is not capable of providing the necessity infact requested bandwidth. Besides that ISDN is a digital standard, and digital signaling is done, that insulates the medium or in a way makes the transmission much better, as digital signals are less prone to noise, and it is easy to extract the noise part from the digital signal than from the analog signal.

As 'I' stands for Integrated, ISDN can simultaneously transfer image, voice and text data. 'D', I already explained is because ISDN provides digital medium. ISDN consist of multiple channels, infact two types of channels, one is data channel and other one is control channel. There may be 'n' data channel and may be 'm' control channel in a single ISDN medium. We will talk in more detail about this.

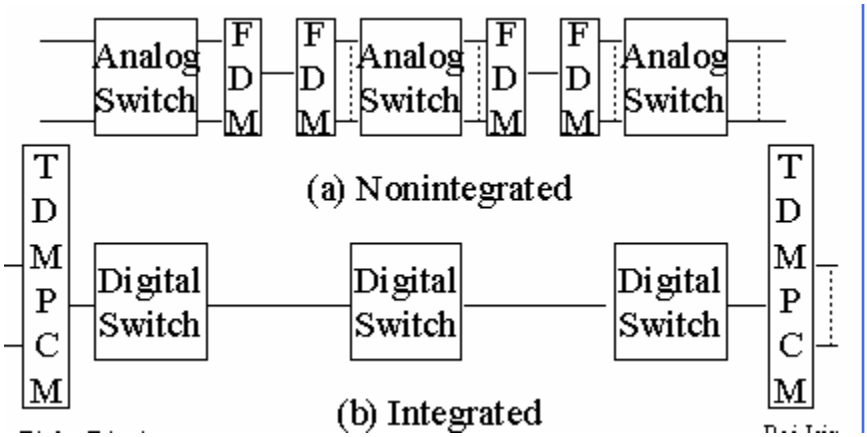
ISDN comes in two flavors, one is narrowband ISDN and the other one is broadband ISDN. Narrowband ISDN is based on the use of 64 Kbps channel and has a circuit switched orientation. Broadband ISDN is based on the use of 100s of Mbps channel and has a packet switched orientation. Broadband is still in its infancy. It is based on the concepts of ATM and will be deployed in future.

ISDN is one of the most common methods of digital communication today; other methods are X.25 or T1. But ISDN is most favorable for home users. Before ISDN was IDN, and before IDN there were analog networks. In earlier days, everything was analog, access was analog, switching was analog, backbone was analog, and multiplexing was FDM.

In FDM, a single communication channel can carry signals of multiple frequencies, so each of the n available users who want to transmit, are allocated to a particular frequency, and only on that frequency they can transmit data. This is non-integrated, since users have nothing in common, they are transmitting at their respective frequencies; obviously there are lots of drawbacks with FDM.

And now a days thing are going digital, In IDN, every user will be put on the same frequency and the frequency will be multiplexed among them, i.e. we will divide the frame which is to be transmitted among 'n' users, each users will get a particular slot of the frame for placing its data.

Voice which comes from the phone is analog, and this analog voice signal is converted into digital signal using PCM. And then this PCM signal is multiplexed using TDM, and given to the digital switches inside the Telephone company. So in a way switch in one telephone company connects with the switch in another telephone company, and this connection is established till the destination switch is reached. All these switches are digital. So these switches form a digital backbone for communication called as **Integrated Digital Network.**



So IDN is simply a digital back bone. Then local loop was also made digital, local loop is the copper wires running between the telephone subscriber's home or business and the phone company switch. After incorporating local loop, the new term is ISDN.

So everything is digital end-to-end, and one set of interfaces for all kinds of speed. It supports both circuit switching and packet switching. Also there is out-of band signaling. They developed some very sophisticated technique for signaling.

ISDN line is charged on the basis of amount of data that communicates not on the amount of data, so people at residence can connect and keep it open for always. In Canada the pricing policy is on amount of data and in Europe it is on the basis of

ISDN Channels

ISDN line consists of multiple channels, as told above. The can be categorized into three types, data channel and control channel and Hybrid Channel. How many data channels are there and how many control channels are there, that depends upon the kind of ISDN line.

When you subscribe ISDN line for your phone, you get 3 channels, 2 B Channels and 1 D channel. B channels are used for transfer of data and D channels are used for transfer of control information. Since there are different channels for data information and control information, this concept is called as **out-of-band signaling**. For example: one of the B channel can be used with telephone line, and other one also can be used with another telephone line, or second one can be used for internet connection. There are two phone numbers available, so if one of the phone numbers is busy, the control line will be used to send a beep signal, if some-one calls up in between. This is one of the benefits of separate control line.

B channel is the basic channel, as told above can be used for data and voice and image. It supports data rate of 64 Kbps. So 2 B channels means 128 Kbps for data signal. D-channel is delta channel, is generally used for sending control signal. It operates at 16 or 64 Kbps. Since for a home subscriber there are 2 D channels and 1 B channel, that makes a total of 144 Kbps, but due to effective coding done i.e. signaling method chosen is so

effective that total data rate available is 192 Kbps. D channel can also be used for data if required.

Then there are Hybrid channels (H channels), with data rates of 384 Kbps (H0), 1536 Kbps (H11) and 1920 Kbps (H12)

User Interfaces

Basic Rate Interface: 2B+D (16) i.e. BRI is a digital pipe consisting of 2 B channels and 1 D channel, The D channel is 16 Kbps and B channel is 64 Kbps, that makes total of 144 Kbps, In addition to all this, BRI service, requires an overhead of 448 Kbps, thus total data rate provided by BRI is 192 Kbps.

Primary Rate Interface: 23B+D (64) i.e. PRI is a digital pipe consisting of 23 B channels and one 64 Kbps D channel. 23 B channels of 64 Kbps each plus 1 D channel of 64 Kbps makes a total of 1.544 Mbps equivalent to data rate of T1 line. It also takes into consideration the 8 kbps required for overhead.

Or 30B+D

Functional Grouping

In ISDN world there are two kinds of equipments, one that understands ISDN and the other that don't understand ISDN. Those who understand ISDN are called as **Terminal Equipment 1 (TE1)** and those who don't understand ISDN are called as **Terminal Equipment 2 (TE2)**. Example is plain old telephone.

To put TE2 equipments, say phones that are not compatible with ISDN line, if one wants to use that phone, then another equipment is required called as **TA (Terminal Adapter)**. In other words, Terminal Adapter is required to make non-ISDN equipments compatible with ISDN line.

Network Termination 1(NT 1), is a physical layer device or interface that separates user premises from Phone Company. In some companies NT1 is owned by users in USA, and in some countries by Phone Company. And if a layer 2-3 device is required to separate the user premises from Phone Company, then **Network Termination 2 (NT 2)** is required.

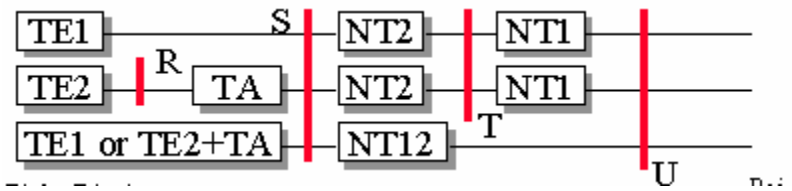
Network Terminal NT1

- is a physical and electrical terminal of ISDN at user.
- Isolates the user from the transmission topology of the subscriber loop and line maintenance function, which can now be conducted by Phone Company through NT1.
- It also bit multiplexes various B and D channels. Since signal is send on multiple B channel or also in D channels, that needs to be multiplexed, this job is done by NT1.
- On ISDN lines you can put multiple phones, as told above.

Network Termination 2 (NT 2)

- is a layer2 or layer 3 device, also separates user premises from the network premises.

ISDN Reference Points



There are four reference points, happens to be in alphabetically order.

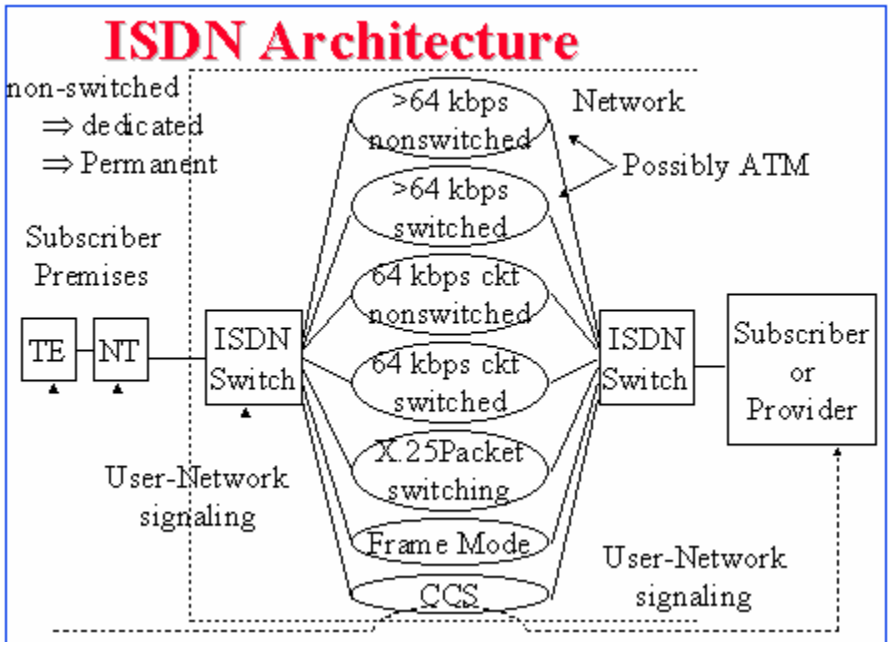
U interface is the User interface, and they define what the bit pattern should be.

T interface is a digital interface, known as **Terminal interface**, which separates the phone company from the user. So this is phone company equipment, i.e. NT1. In other words it separates network from the user

If the user is using non-ISDN phone, i.e. TE2, then he require TA, as shown in figure, and TE2 and TA are separated by R interface called as **Rate interface**. If the user is using ISDN phone, then no need of TA.

Then we have the System interface, which is present between ISDN equipment and NT2

ISDN Architecture

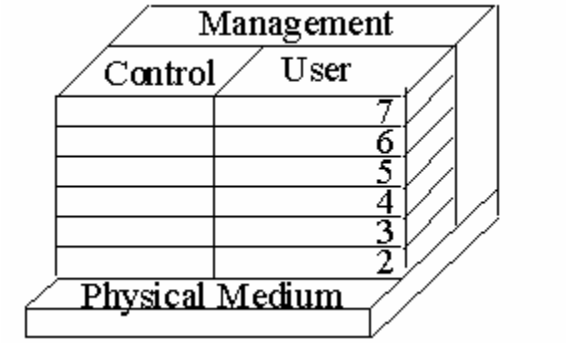


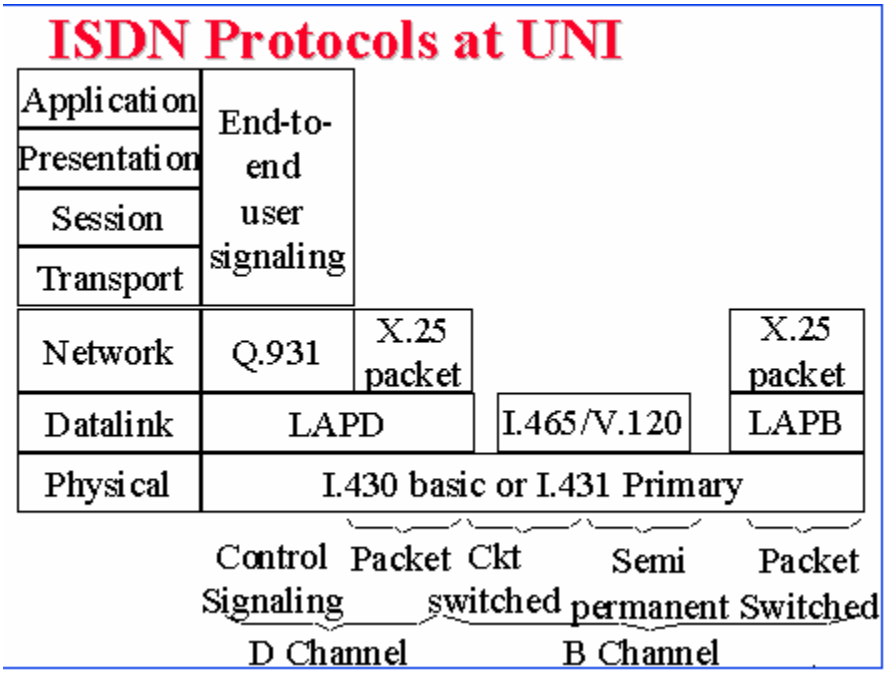
B channels are for user to user communication, whereas D channels are for user to network communication. The subscriber uses the D channel to connect to the network, then the B channel to send information to another user. The two channels required different handling by the layers. So we define 7 layers for Data channel and 7 layers for the Control channel. Infact only three layers are defined, because ISDN functionality is up to the network layer only.

So 7 layers for Data channel form User plane and 7 layers for Control channel form Control plane. There is another plane called as management plane.

Protocol Reference Model

There are three planes User Plane, Control Plane and management Plane.





Layer 1 defined in I.430 and I.431 specifies the physical interface for both basic and primary access. Because B and D channel are multiplexed over the same physical

interface, these standards apply to both the channels. Above this layer protocol structure differ for the two channels.

At the Data Link Layer, for the D channel, a new link layer standard, LAPD (Link Access Protocol for D channel) is defined, which is actually a variation of HDLC. All transmission on D channel is in the form of LAPD frames that are exchanged b/w the subscriber equipment and an ISDN switching element. It supports three application

1. Control Signaling
2. Packet Switching
3. Telemetry