Unit 3

ISDN- Integrated Services Digital Network.

Motivation and History

A long time ago, the entire telephone network was analog. This was bad, because as a voice went farther down the line, and through more switches, the quality became worse and worse as noise crept in. And there was no way to eliminate the noise, no way to know what the signal was supposed to be. Digital encoding promised a way to encode the audio such that you'd know what the signal was supposed to be. As noise crept in, you could eliminate it through the phone network, assuming it wasn't worse than the variation between different digital encoding levels. With the transistor revolution, this theory became possible, and the phone companies began converting their own networks over to digital. Today, you have to search pretty hard to find a phone company switch that isn't digital. They call their network the Integrated Digital Network, or IDN. This solved many of the phone company's problems. However for a variety of reasons, it has been attractive to make the phone network completely digital, from end to end. For computer users, this is ideal, because we can eliminate those clumsy modems, and will hopefully benefit from higher speed. For the phone companies, they can eliminate the last of the noise and loss from the audio data. And for dreamers, this will enable a wide variety of different services to be delivered to the customer over a single interface.

What is ISDN?

ISDN stands for Integrated Services Digital Network. It is a design for a completely digital telephone/telecommunications network. It is designed to carry voice, data, images, video, everything you could ever need. It is also designed to provide a single interface (in terms of both hardware and communication protocols) for hooking up your phone, your fax machine, your computer, your videophone, your video-on-demand system (someday), and your microwave. ISDN is about what the future phone network, and information superhighway, will look like (or would have looked like).

Integrated Service Digital Network, or ISDN, is the original high-speed internet service. It set the standard for telephone data service.

ISDN internet service was the improvement upon dial-up. It can be considered the step of internet evolution that lies between dial-up and DSL/Cable. Modernizing internet use and bringing high-speed access inside the home, Although ISDN internet service still exists, like the dial-up connection it is being replaced by faster and cheaper services that the broadband companies are providing.

ISDN internet service is basically a telephone-based network system that operates by a circuit switch, or dedicated line. It can transmit data and phone conversations digitally over normal telephone wires. This makes it both faster and of higher quality than dial-up internet service. During the 1990's this revolutionized the way people did business. No longer would you have to miss a call in order to access your internet, or shut down the internet to make a telephone call. As such, ISDN internet service made video teleconferencing not only possible, but very popular at this time as well..

ISDN internet serviced also allows for multiple data transmission, so telephone calls and data downloading are no longer mutually exclusive. The disadvantages, however, is that the digital clarity of ISDN voice communication and its speedy data transmission come at an extra cost. ISDN is billed like a phone line, but with an added cost for service. And although its operational distance from the ISDN central office is greater than that for DSL, its terminal adaptor (similar to a modem) is more expensive than DSL or cable modems. While this equipment and service continue to remain costly, it is leaving the way open for other internet services, like broadband, to quickly replace ISDN's share of the marketplace.

ISDN was *originally* envisioned as a very fast service, but this was a long time ago when it was hoped to have fiber all the way to your house. It turned out that running all that fiber would be too expensive, so they designed ISDN to run on the copper wiring that you already have. Unfortunately, that slowed things down considerably - too slow for quality video, for instance. ISDN has been very slow in coming. The standards organizations have taken their time in coming up with the standards. In fact, many people consider them to be out of date already. But on the other side of the coin, the phone companies (especially in the U.S.) have been very slow at designing products and services, or marketing them with ISDN in mind. Things are starting to pick up, but still very slowly. ISDN is available now in many places, but it is not widely used. Further most of the products and services that

people have forecast for ISDN still aren't available. For this reason many people say that ISDN also stands for "It Still Does Nothing".

B-ISDN

That brings is to B-ISDN. B-ISDN is Broadband ISDN. (The older ISDN is often called Narrowband ISDN.) This is *not* simply faster ISDN, or ISDN with the copper to your home finally upgraded to fiber. B-ISDN is a *complete* redesign. It is still capable of providing all the integrated services (voice, data, video, etc.) through a single interface just like ISDN was supposed to. But it will do it a lot faster than ISDN could. Of course, that copper to your house will still have to be replaced with fiber.

The copper between the houses won't last forever. Eventually higher speed transmission media will be available. Narrowband ISDN was basically a stopgap measure. But it's development allowed time for the design of Broadband ISDN to be even more ambitious.

Broadband ISDN (B-ISDN) is similar to Narrowband ISDN only in the most basic aspects. The reference configurations are largely the same, but every bit of the underlying design will be replaced. The S/T bus will by necessity have to be a much faster network, as will the network at the U reference point. The signaling will be changed, as will most other details. The house will most likely need to be rewired yet again, and all the physical connectors are likely to change.

B-ISDN is very strongly related to ATM. This is because ATM will provide a consistent data encapsulation scheme that can be used throughout the network, starting with your TE1 or TA equipment, and covering every piece of telecommunications equipment in use.. ATM is so important to B-ISDN that many people believe it's the same thing. It's most of what is new over Narrowband ISDN, but it isn't all of it.

Services Planned By B-ISDN

The planned Broadband ISDN services can broadly be categorized as follows:

Interactive services: These are services allowing information flow between two end users of the network, or between the user and the service provider. Such services can be subdivided:

Conversational services: These are basically end-to-end, real-time communications, between users or between a user and a service provider, e.g. telephone-like services. Indeed,B-ISDN will support N-ISDN type services. (Note also that the user-to-user signaling, user-to-network signaling, and inter-echange signaling are also provided but outside our scope.) Also the additional bandwidth offered will allow such services as video telephony, video conferencing and high volume, high speed data transfer.

Messaging services: This differs from conversational services in that it is mainly a store-and-forward type of service. Applications could include voice and video mail, as well as multi-media mail and traditional electronic mail.

Retrieval services: This service provides access to (public) information stores, and information is sent to the user on demand only. This includes things like tele-shopping, videotex services, still andmoving pictures, telesoftware and entertainment.

Distribution services: These are mainly broadcast services, are intended for mainly one way interaction from a service provider to a user

Fitting things together

There are two parts of a telephone network: the phone company's part, and the customer's part. The customer's part today is largely just the telephone, some house wiring, and some connectors. The phone company's part is lots more wire, fiber, switches, computers, and lots of expensive and complicated stuff.

ISDN is concerned (almost) entirely with the customer's part of the network. ISDN gets the data from you, to the phone company in a standard way. What they do with it in order to get it to its destination is entirely up to them.

Access Interfaces Provided

You might be tempted to call these the "services" provided by the phone company, but you have to be careful using the word service with ISDN, because it means things like audio, video, etc. - higher level services. What you can get from the phone company in terms of service are varying data rates, and various combinations of separate channels for data and signaling. These are *access interfaces*.

ISDN was designed around the notion of separate channels at 64Kbps. This number springs from the fact that that is essentially the data rate at which the analog lines are sampled at (8000 samples per second, 8 bits per sample) for the phone company's IDN. ISDN is essentially combinations of these channels, and also slower 16Kbps channels used only for signaling. The 64Kbps channels are called B channels. The 16Kbps channels are called D channels.

There are two main interfaces, Basic Rate, and Primary Rate. The Basic Rate Interface is intended for home use, and Primary Rate is intended for businesses.

The Basic Rate Interface (BRI) is designed to carry the most data you can possibly send to the home through existing copper phone lines. It turns out that they found you could reasonably squeeze about 160Kbps into those lines. With this, the phone company can provide two B channels, one D channel, and still have 16Kbps for the overhead (data framing, maintenance, and control) of communicating with your house's phone network.

Basic rate ISDN without being upgraded. In addition, many locations within the U.S. Offer B channels that are only 56Kpbs. This is because much of the older equipment phone companies are using assumes that there is only analog data. Under purely analog days, extra bits were pulled out from the higher frequencies of the audio in order to do out-of-band signaling. This signaling now belongs on the D channel, but it will take some time for all of the phone equipment to catch up.

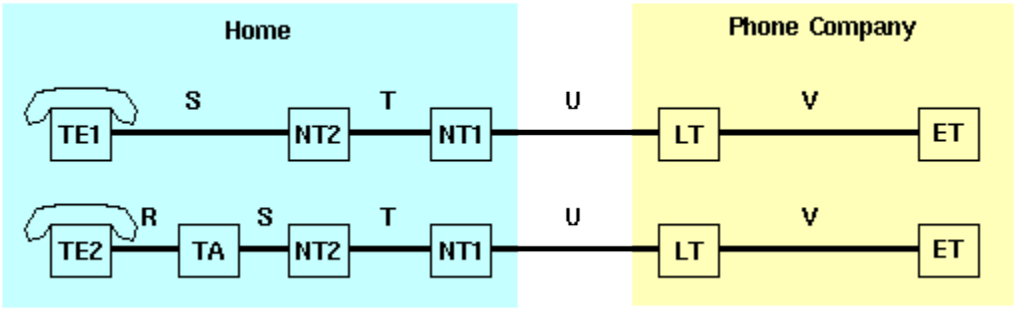
The Primary Rate Interface is designed for businesses with larger data needs, or with the need to set up their own local phone system. It is generally just a much faster connection to the phone company, with several B channels. In the U.S. the most common Primary Rate Interface (PRI) is designed for 23 B channels and 1 D channel, which is the equivalent of a U.S. DS1 service. In Europe, the most common PRI is 30 B channels, and one D,

With a PRI, you also have the option of combining several B channels into one bigger fatter channel called an H channel. There are several different speeds of H channel. The most common, H0, is 384Kbps, or 6 B channels. H11 is 24 B channels, or the equivalent of DS1 service. H12 is 30 B channels, Above that, H21 provides 32Mbps (512 B channels); H22 provides 44Mbps (690 B channels); and H4 provides 135Mpbs (2112 B channels), and is anticipated for use with compressed HDTV. In practice, the phone company will probably be able to provide any combination of B, D, and H channels that it thinks it can make a buck off of.

The ISDN Reference Configurations

You can't talk about ISDN without knowing about the reference configurations. This gives you the basic vocabulary for talking about all of the pieces of ISDN. There are reference configurations for all different pieces of the ISDN network, and lots of different configurations. The following diagram shows two of the most commonly referred to configurations. The networks will actually look more complicated than this; the diagram just serves to apply standard labels to the different parts of the network you'll encounter.

Figure1.CommonReferenceConfigurations



Here's a quick glossary of some of the things shown:

- TE1: Terminal Equipment type 1. This is the ISDN telephone. Or computer. Or ISDN FAX machine. Or whatever it is that you've hooked up to the ISDN phone line.
- TE2: Terminal Equipment type 2. This is the old analog telephone. Or old-style fax machine. Or modem. Or whatever you used to hook up to the analog phone line. It can also be other communications equipment that is handled by a TA (see below).

- TA: Terminal Adaptor. This lets old, TE2 stuff talk to the ISDN network. It also adapts other kinds of equipment, like ethernet interfaces , to ISDN.
- NT1: Network Termination type 1. This is the end of the line for the local phone company, and the beginning of your house's phone network.
- NT2: Network Termination type 2. In most homes, this won't exist. If you were a big company with your own private telephone system, then this would be the guts of that telephone system.
- LT: Line Termination. This is the physical connection to the phone company.
- ET: Exchange Termination. This is the local phone company's logical connection from your telephones to "the phone network".

Note the letters, R, S, T, U, and V in the diagram. These are *reference points* that everyone uses to talk about each of these parts of the network. For instance, the R reference point is the interface between an old-style telephone and Terminal Adaptor equipment. Since most homes won't have any NT2 equipment, the S and T reference points are usually one and the same, and are sometimes called the S/T bus.

The point to all of this is that different things happen in different parts of the network. What goes on along reference point U is completely different that at the S/T reference point - different wiring requirements, different data speeds, different encoding, etc.

Notice that reference point V, and the LT and ET equipment are in the phone company's domain. I lied when I told you that ISDN defines only the customer's part of the phone network, but I only lied a little. This portion of ISDN is seldom discussed, and still largely left up to the telephone companies.

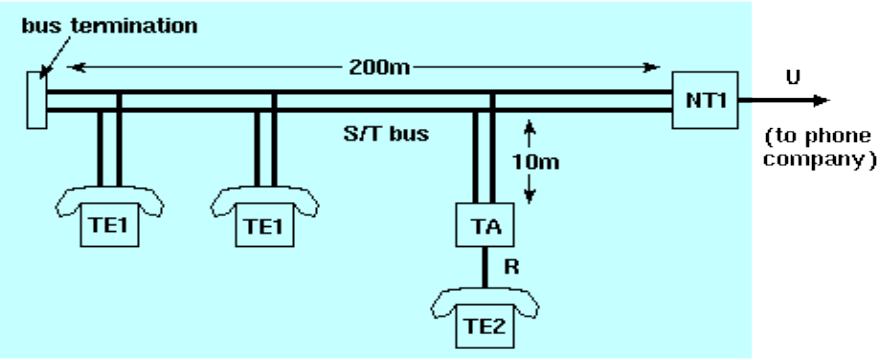
House's network (S/T reference points)

The phone "network" inside of your house will be somewhat more complicated with ISDN than it is today, in that it will be a true data network. This network is often called the *customer-premises installation* or CPI. This network will typically consist of telephones, computers, fax machines, videophones, and an endless list of pie-in-the-sky applications, like controlling your thermostat thru ISDN.

Hardware

This is layer 1 (the physical layer) of the S/T bus. This defines the physical network in your home. The most obvious things this defines, as far as a customer is concerned, are wiring, connectors, and power. ISDN uses a phone jack that looks just like the standard phone jacks in use today, except that it is a bit wider. Instead of the older 4-pin jacks (which only used two wires), ISDN uses an 8-pin jack (which only uses four wires). The CPI is based on a four wire scheme, two wires for transmitting, and two for receiving (which means you'll probably have to rewire your house). These wires are typically copper wiring of some sort, and can be longer than most users will ever need.

Figure.2.TypicalCPI



(Note that each connection shown is a two-wire pair.)

If you are using ISDN with a single device (for instance, your computer is hooked up to ISDN, and your phones are still hooked up the old way), then you can have up to a kilometer (thereabouts) in your home for typical copper wiring. This is called a *point-to-point* configuration. But in most cases, you'll be using ISDN to hook up several devices, as shown in Figure 2, above. This is a *multipoint configuration*. With the standard ISDN equipment, up to eight different devices can be hooked up to the S/T bus. With this configuration the total length can be about 200 meters, and each device can be connected to the bus with up to 10 meters of wire. Devices can be placed anywhere on the bus under this setup.

This can also be modified somewhat, to extend the S/T bus up to about 500 meters. To do this, all of the devices must be connected close to the bus termination end of the bus. Further, each device on the bus must be 25-50 meters apart.

Eight devices might seem a bit low if you have an active imagination, but some of these devices could actually be brokers for other things -- for instance it is more

likely that you'd have a single device that could simultaneously control your microwave, furnace, A/C, alarm clock, and house lights. Even though you can only hook up eight devices, you have an almost unlimited number of addresses (i.e. phone number extensions) for each of those devices, so it is likely that one ISDN TE1 would be used for several different purposes. On the other hand, you can't simultaneously use more devices than the available number of B-channels; for most customers this means only 2 devices can be in operation at once. In fact, with some ISDN provider's switches, you can only hook up two devices period, one assigned to each B-channel. This isn't the way things are supposed to work, but that's how a particular piece of phone company equipment works (specifically, the DMS-100 switch)(actually, it's more complicated than that - DMS-100s can work (almost) correctly with the right software, but sometimes they still use older software).

Abbreviation of *integrated services digital network*, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. ISDN supports data transfer rates of 64 Kbps (64,000 bits per second).

There are two types of ISDN:

- Basic Rate Interface (BRI) the basic ISDN configuration, which consists of two B-channels that can carry voice or data at rate of 64Kbps, and one D-channel, which carries call-control information. Another type of ISDN configuration is called *Primary-Rate Interface (PRI)*, which consists of 23 B-channels (30 in Europe) and one D-channel
- Primary Rate Interface (PRI) a type of ISDN service designed for larger organizations. PRI includes 23 B-channels (30 in Europe) and one D-Channel. In contrast, BRI (Basic-Rate Interface), which is designed for individuals and small businesses, contains just two B-channels and one D-channel.
- D Channel Short for *Delta-channel*, the channel in an ISDN connection that carries control and signaling information. Basic Rate ISDN (BRI) service consists of two 64 Kbps B-channels, and one D-channel for transmitting control information. Primary ISDN service consists of 23 B-channels (in the U.S.) or 30 B-channels (in Europe).
- B Channel Short for *Bearer-channel*, the main data channel in an ISDN connection. Basic Rate ISDN (BRI) service consists of two 64 Kbps B-channels, and one D-channel for transmitting control information. Primary

ISDN service consists of 23 B-channels (in the U.S.) or 30 B-channels (in Europe).