Lesson: TANDBERG and H.320 (ISDN)

Learning Objectives
On successful completion of this lesson, you will demonstrate an understanding of the technologies and network protocols with respect to ISDN. You will be able to describe:

- The ISDN requirements for a video system (eg. PRI, BRI, E1, T1)
- Channel bonding and related failures
- ISDN alarms and failure messages
- ISDN ordering
- Other circuit switched network technologies that can be used for video conferencing
As we have seen in earlier modules, video conferencing relies on a digital communication channel between each point. In fact, the development of video conference technology was dependent on the availability of an inexpensive and reliable communications infrastructure. Traditionally, this communication channel has been provided by a telecommunications infrastructure called ISDN. ISDN stands for Integrated Services Digital Network. It is basically a digital circuit-switched telephone network system, designed to allow digital transmission of voice and data over ordinary telephone copper wires, resulting in better voice quality than an analog phone.

Why digital?
Digital communications are faster and more accurate than analogue connections. Almost all, modern telecommunications networks are now digital, although many domestic connections are still analogue from the home to the local telephone exchange.
ISDN is a circuit-switched network. In circuit-switched networks, electronic signals pass through several switches before a connection is established. These electronic signals travel along a fixed path. During a call, no other network traffic can use those switches. Once an ISDN call is established through to the other end the bandwidth is reserved for the duration of the call. How each end knows which bit of information means what is determined by the timing. The advantage of this type of connection is that the bandwidth is constant and the bandwidth is only used for your call and not shared. Also, there is very little overhead. The main disadvantage is that if the clock signal is disrupted then the call fails.

ISDN does differ slightly depending on where you are located. These differences are important when we set up equipment but it is not something that a user is aware of when they use a video conference system.
ISDN comes in two sizes. BRI (Basic Rate Interface) and PRI (Primary Rate Interface). A BRI ISDN installation contains 2 channels of ISDN, each capable of carrying 64Kbps of data which is 64 kilobits per second. This means each second a channel is sending and receiving 65536 bits of information. Digital information is represented by a 1 or a 0.

A PRI ISDN installation contains 24 or 30 channels, depending on where you are located. The United States, Canada and Japan have 24 channel PRI’s while the rest of the world has 30 channel PRI’s.

Most endpoints use BRIs while network equipment tends to use PRIs. There are exceptions. For example, the 6000 Codec can have a PRI which is mainly utilized when the system has the multipoint option installed. A BRI ‘line’ is the term used to describe a single BRI containing 2 channels equaling 128Kbps of data. Most channels in the same BRI line have the same number but they can sometimes be different. PRI’s can have as many numbers you want associated with it – it usually just costs more for more numbers.

PRI can come in two types depending on where you are located. An E1 PRI has 30 channels equaling 1920Kbps of data and is found in most places around the world where a T1 PRI has 24 channels equaling 1472Kbps and is found in North America and Japan.
We often draw a network as a ‘cloud’ but what is really inside the cloud? ISDN runs across the same network as analog phones. Once the signal leaves your premises it’s first stop is the local telephone exchange. The signal is then sent across the world from telephone switch to telephone switch. It may go through international switches, across transatlantic cables or even satellite links before it reaches the local telephone exchange for the remote location.

In larger companies it may go through an internal telephone exchange first. An internal telephone exchange is often referred to as a Private Branch Exchange or PBX.

TANDBERG video conference systems have the ability to dial a normal telephone call as well as an ISDN call, provided the system has ISDN capabilities and has an ISDN connection.
In order for video conferencing to be a success, it has to be built around standards so that systems from different manufacturers can communicate with each other. There is a huge range of standards within video conferencing and it is important to be aware of some of these.

H.320 is the ‘umbrella’ standard that dictates how video conference traffic runs over Circuit Switched Networks which include ISDN networks. An umbrella standard is basically a group of standards that when working together achieve the end goal. In this case the H.320 standard is a group of standards that govern all the parts of our video conference, for example how we compress our video signal or how we display our video picture.

H.320 has a number of standards which are required in order for a system to be standards compliant and a number of standards that are considered optional. Since most of the optional standards are later developments and improvements to the original required standards they are not really optional if you want to produce a market-leading product. However, it is essential that the required standards are also present so that new equipment can still communicate with old equipment.

Within the H.320 umbrella standard we have standards for how we combine our ISDN channels together. Like all of the standards in H.320 there are some that are required and some that are optional. Where standards are concerned there are some we need to look at because knowing how they work can help resolve errors, even if the actual error is not with the equipment.
How Many Channels Do We Need?

More channels = better quality

A single Channel is insufficient

Video conference calls use multiple channels of ISDN because one channel isn’t enough to send all the data we need to have a reasonable quality image. How we combine the channels we need together is crucial for video conferencing to work.
H.221 Clear Channel Dialing (terminal adapter dialing)

When a video conference system connects to another both systems have to decide on exactly how they are going to communicate. For example they have to decide on which video and audio mode to use. This ‘capabilities exchange’ happens regardless of what type of network is being used.

H.221 dialing requires the dialing system to know all the ISDN numbers of the receiving system. It works by first connecting one ISDN channel through a piece of equipment called a terminal adapter, then using that channel to exchange video and audio capabilities with the other site. Further channels can then be added to the call to increase the bandwidth by the calling site. H.221 calls are often referred to as the number of channels multiplied by the channel rate. The most common is a 2x64 call. To dial a 2x64 call from a TANDBERG unit select bandwidth 128 and network type ISDN, two boxes will appear, one for each number.

The ability for a system to connect using H.221 up to 128Kbps (2 channels) is a ‘required’ standard within the H.320 standard. It is possible to use H.221 dialing above 128Kbps but it isn’t a ‘required’ standard and most manufacturers don’t support it.
BONDING Mode 1 (Bandwidth ON Demand INteroperability Group)

Most video conference calls use a standard called BONDING to connect multiple channels together. One of the main benefits over H.221 is the calling system only needs to know the first ISDN number of the system it is calling. Secondly call set up is quicker and thirdly a bonded call uses less bandwidth for call set up than an H.221 call. Bonding calls are often called by their total bandwidth such as a ‘384 call’ or a ‘128 call’.

Bonding requires an IMUX to be installed. All TANDBERG H.320 capable systems have an IMUX built into the main Codec box where you plug in the ISDN lines. An IMUX basically combines the streams of digits arriving from a number of ISDN channels into a single stream for the Codec to deal with.

In this example we will dial a 384Kbps call.

Step 1 – the IMUX dials the first number (the number the user has dialed). Once connected the two IMUX components go through a capabilities exchange to determine how they will work together.

If a system can connect a call above 128Kbps then BONDING Mode 1 is a ‘required’ standard within H.320.

Step 2 – The receiving IMUX passes back to the calling IMUX the rest of the numbers required to dial the call. In this case 4573 374, 4573 375, 4573 375, 4573 376 and 4573 376.
Bonding Mode 1

Step 3 – The calling system then dials the rest of the ISDN numbers – 5 in this example.

Step 4 – Once all 6 channels are connected, the IMUX connects to the Codec and a second capabilities exchange takes place between the Codecs to determine audio and video modes.
Why is all this Important?

Understanding what is going on during call set up on ISDN can help you fault find any connection problems you may have. In addition knowing how to dial an H.221 call can help when testing a possible network connection error.

In the above example, the receiving system doesn’t have the correct ISDN numbers programmed into the system. The first channel connects because the user has dialed the correct number but the call goes no further. The quickest way around this problem is to have the far end dial you. This gets the call up and running until you can sort out the problem. In a worst case scenario you can also dial an H.221 call and at least get a 2 channel call up and running.

To sort out the problem you need to establish the numbers on each line. The Codec always dials out of line 1 so by switching the cables around and making calls to somewhere where you can see the number dialed you can work out which is which. Once you know you can then correct the configuration on the system.

Also a system will answer on line 2 or line 3 if you dial an H.221 call into any of the numbers. This can be useful when trying to find out what is going wrong from a remote site.

Another variant on this problem is when a system cannot receive calls from international numbers. In this case the full ISDN number including the dialing code, is probably in the system. You can just program in the numbers that change but it is good practice to program in the whole local number.
Why is all this Important?

In the above example the 3 BRI cables have been plugged into the wrong sockets on system B - line 2 and 3 have been switched over. Again the call will not connect as the stream of digits is in the wrong order.

As before have the far end call you to establish the call. When the call is over you can use the same method as before to locate the problem. However, prevention is better than cure so make sure your cables and sockets are labeled!
When an ISDN call ceases, the network will report an ISDN Cause Code. Most video conference equipment, including TANDBERG equipment can report an ISDN Cause Code. In some cases this can help you determine where a potential fault lies. The most common ISDN Cause Code is 16 which means “normal call clearing” and usually indicates that one end hung up the call.

To find out an ISDN Cause code use your TANDBERG remote to go to the control panel, diagnostics, channel status.

A web search on ‘ISDN Cause Code’ brings up multiple web sites with lists of these codes. There is also a full list on the TANDBERG white paper accessible from the end of this section and a list of common ones in the MXP Administrators Guide on page 287.

Another easy fault finding tip is to look at the NT1 box. Most have a power light of some sort. If it appears that you don’t have an ISDN connection and the light is out then you need to contact your ISDN provider.
TANDBERG Intelligent Call Management

- Down speeds a call should a line drop during a call (TANDBERG to TANDBERG)
- Redials at a lower rate automatically if a call fails
- Can auto negotiate a lower speed during IMUX setup (TANDBERG to TANDBERG)

TANDBERG Intelligent Call Management System does help to eliminate some of the common dialing issues.

1. When two TANDBERG systems are in a call they are able to down-speed the call themselves if the network loses a line without the call-dropping and you having to re-dial. A Bonding call would just fail.
2. When dialing a non-TANDBERG system which cannot support the requested bandwidth, the TANDBERG system will automatically redial the call at a lower bandwidth.
3. When two TANDBERG systems are connecting and the calling system requests a bandwidth that the other cannot support then the systems can auto negotiate a lower speed.
Ordering ISDN

1. Order ISDN ‘point-to-multipoint’

2. Ask for each pair of lines to have its own number

3. Avoid ordering ISDN lines with different switches, numbers or formats

ISDN is available in most parts of the world. There are areas in most countries where ISDN services are not available due to the remoteness of a location but in general ISDN is readily available where we may need to put video conference units. Where you live also impacts what you need to consider when ordering ISDN.

1. Make sure you order ISDN point-to-multipoint and not ISDN point-to-point. Point-to-point ISDN is used to connect one fixed point with another fixed point and has no dial up capabilities. The most common use of this is for an internet connection where broadband isn’t available. Point-to-multipoint provides the dial up service we need to call anywhere.

2. It is possible to have multiple ISDN lines with the same number on all channels. In most cases it is because the lines are point-to-point so you have a problem anyway. However there have been occasions where I have come across several point-to-multipoint lines with the same number. Where this happens customers do notice an increase in the number of failed incoming calls. Having done some testing it appears that in about 20% of cases the lines connect in the wrong order because line 3 reaches the destination before line 2. To avoid this, I would ask for each pair of lines to have its own number.

3. In some countries it is possible to order multiple ISDN lines and have these come from different switches and have numbers in different formats. This mainly occurs where countries are making changes over a period of time to the telecoms infrastructure. This is again something to be avoided. Countries where this may be an issue include Italy, Spain and Russia.
Ordering ISDN

1. Order ISDN ‘point-to-multipoint’

2. Ask for each pair of lines to have its own number

3. Avoid ordering ISDN lines with different switches, numbers or formats

4. Having problems with International Gateways? Use advanced ISDN settings and change the ‘parallel dial’ setting to ‘off’

5. Verify who and how Line termination units are provided

4. International gateways can also cause a problem. When dialling internationally from within Italy to the UK for example the call failure rate is quite high. It seems to be an issue with the system dialling 5 channels simultaneously. However there is a setting on the TANBERG systems that forces the Bonding call to dial each line one at a time. This does slow down the call set up rate but it can help resolve some of these issues. Look under control panel, networks, ISDN, ISDN BRI settings, advanced ISDN settings and change the ‘parallel dial’ setting to off. If you are having problems with ISDN call set up this setting is always worth a try. Remember it is the system making the call you need to change.

5. In most places when you order a BRI or PRI line, the telephone company provide all the boxes and all you have to do is plug the equipment in. However there are some exceptions such as North America where the termination boxes are not provided and you will need to arrange for these to be installed. The following two slides explain what is needed within these areas.
The telephone company provides a T1 or E1 carrier with PRI signalling. In North America, the customer needs to provide the Channel Service Unit or CSU. In other parts of the world, the CSU may or may not be provided by the telephone company. The CSU provides several functionalities including:

- powered termination of the PRI line,
- prevents red alarms when the videoconferencing system is turned off,
- diagnostic capabilities including loopback testing for the telephone company,
- and the CSU regenerate the signal so it can be driven a longer distance.
For a single ISDN BRI line, the telephone company provides two wires called the "U" interface. The "U" interface enters the Network Termination or NT box. The NT-1 is a relatively simple device that converts the 2-wire U interface into the 4-wire S/T interface. The TANDBERG equipment has an RJ-45 S/T interface.

In North America, the customer needs to provide the NT box. In rest of most of the world, the NT is provided by the telephone company.

NT boxes come in different shapes and sizes. Some take in one line, others take in more. The NT384 takes in three ISDN BRI lines for a total bandwidth of 384 Kbps. Two of these can used together as shown for a total bandwidth of 768Kbps for 6 lines.