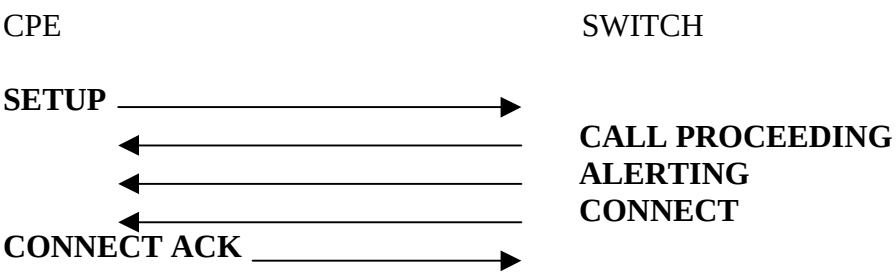
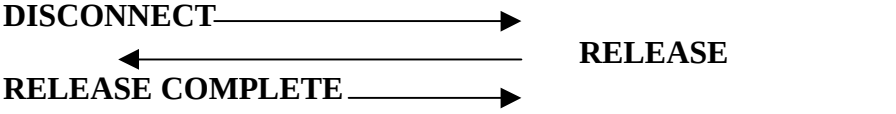
Tech Tip

ISDN D Channel Analysis - The Basics of ISDN call setup

ISDN utilizes an out-of-band data channel to coordinate all call setup and teardown activity between the customer CPE equipment and the service provider's switch. Whether the service is BRI or PRI, the basic steps remain the same though there may be minor differences with some fields. The following message exchange is an example of a typical ISDN call setup sequence.



In this example the CPE originated the call, but the same basic message types would have been exchanged for a incoming call from the network. The same holds true for the disconnect process as well. In the following example, the CPE happens to terminate the call though the sequence would be the same had the disconnect originated from the network. Alerting is not always required and may not always be present. The Call Proceeding and Alerting are indications that the SETUP message has been received and that the network is attempting to process the call. The CONNECT message is the final indication that the call has completed and the calling party is connected with the called party. The one exception to this being a good complete call sequence would be the instance when the customer call is routed to a recorded voice announcement.



These messages are formed by grouping together various different information elements. Some elements of the message may be required (such as called number) and some may be optional (such as calling party number). The following is an example of a PRI SETUP message. Some fields may vary with BRI decodes.

TE>NT:R SAPI:000 TEI:000 TIME 09:35:00
PD=08…….CALL REFERENCE: **00100**
M 05 **SETUP**
I 04 **BEARER CAPABILITY**…….Len=3
80 Coding Standard……..CCITT
Transfer Capa…….SPEECH
90 Transfer Mode…….CIRCUIT
Transfer Rate……..64kbp/s
A2 Layer 1 Protocol…….u-law
I 18 **CHANNEL ID**…….Len=4
E9 Indicated Channel…….Exclusive

80 Interface ID……..0
Channel Selection……B23
Channel Identifier……..Not D-CH
I 6C **CALLING PARTY NUMBER**……Len = 9
41 Type of Addess…….....Subscriber
Numbering Plan ID……..ISDN
80 Presentation Ind……..Allowed
Screen Ind……user-not screened
9561712
I 70 **CALLED PARTY NUMBER**…….Len = 8
C1 Type of Number……Local Number
Numbering Plan ID…….……ISDN
9730020

The first thing this message tells us is that it was sent by the customer. The customer is represented, in the decodes, as the TE and the network as the NT. This message is coded as TE>NT indicating that the direction is from the TE to the NT. Messages sent by the network, to the CPE, would be coded as NT>TE (consult the specific testset being used for the D channel capture to see if specific configuration is required to properly determine message originator). The next important field is the call reference number. The call originator assigns the call reference number. All other messages that are exchanged in reference to this call will have the call reference number set to this value. When viewing a very active D channel, with messages for various different calls all intermingled, this field allows you to "match up" which message is for which call. Do not assume that the next message in the decode pertains to the same call. Always check the call reference value for a match.

On the next line, SETUP identifies the type of message being sent. As shown in the first example, SETUP is the first message sent when attempting to place an ISDN call. Bearer Capability, Channel ID, Calling Party Number and Called Party Number are all information elements. Each element contains some type of information pertinent to the call. Fields of interest are: Transfer capability, Interface ID, Channel Selection, calling party number and called party phone number. Transfer capability identifies whether it is a voice call or a data call. In this example the call is coded as SPEECH (voice). The Interface ID gives the T1 number, assigned in the switch, that the call is to be routed over. For NFAS lines, where multiple T1's are controlled by the same D channel, this number will vary with the T1 selected for the call. Channel Selection identifies the B channel that will be used to route the call. Calling party number is an optional field that may not always be present and is used to identify the party that is placing the call (9561712 in the above example). Called party is a mandatory field and provides the phone number that the calling party is attempting to reach (9730020 in the above example). These fields, within the setup message, give you the basics about what type of call is being attempted.

The next most valuable message types, when analyzing decodes, are the DISCONNECT and RELEASE messages. The following is an example of a DISCONNECT message.

TE>NT:R SAPI:000 TEI:000 TIME 09:35:00
PD=08…….CALL REFERENCE: **00100**
M 45 **DISCONNECT**
I 08 CAUSE…….Len = 02
82 Coding Standard……CCITT
Location…….Public Network
90 Class……..Normal Event
Normal Clearing

The Disconnect message contains the CAUSE or reason for the call being disconnected. If the call never makes it to the CONNECT stage, but is immediately rejected by the network, the DISCONNECT step may be skipped and the RELEASE message will contain the cause information. In the above example, the cause was Normal Clearing. This is what is sent during a normal call when one of the users simply hangs up the phone. No fault occurred, the call is simply over. When calls are not completing properly, the CAUSE field can provide valuable clues as to why the call did not complete. There are dozens of cause codes but the following are some of the codes seen for common problems.

16 Normal Call Clearing : No fault detected, the call is finished.
18 No User responding : No response to the call attempt within the allowed time.
21 Call Rejected : The receiving equipment refuses to accept the call. This is most commonly seen on BRI lines when the SPID information is not correct. Typically off of a 5ESS switch.
28 Invalid Number Format : Call can't be complete because the number is incomplete or in a format not considered valid by the receiving equipment. This can occur when the number sent does not match the dialing plan. Numbers sent as subscriber plan are normally expected to be 7 digits or less and numbers sent as national dialing plan are normally expected to be more than 7.
31 Normal Unspecified : The preverbal catch all but often seen when the call is terminating into something like a fast busy.
50 Requested Facility not Subscribed : Normally seen on BRI when SPID information is incorrect. Typically off of a DMS switch.
57 Bearer Capability not Authorized : The caller has asked for a call type or service that is not implemented in the receiving equipment for this line. Usually seen when trying to place voice calls on data only lines or vice versa.
88 Incompatable Destination : Destination is not capable of supporting the call type requested. Usually seen when trying to place data calls to a voice phone.
100 Invalid Information Element Contents : Protocol problem where the receiving equipment does not understand one of the fields inside of the call setup message. Verify the call control is correct (National or Custom). Normally would require a Tier II or Tier III technican or switch vendor to isolate and resolve.
102 Recovery on timer expiry : No response to generated messages. Can be seen on PRI NFAS circuits when equipment is trying to generate call activity on the backup D channel and not on the currently active D channel.

These are the basic message types and basic elements within those messages that can help to isolate and resolve call setup problems. Fields and exact message contents will vary depending on type of ISDN, type of call control and the type of call being placed but the basic principles of call setup will remain the same. To be successful, try to limit the D channel capture time to cut down on the volume of messages that have to be screened. Ignore all message types codes as **RR** as they are merely keep alive messages and contain no call information. Try to get a detailed description of the failures being reported. Are they just to one phone number? Perhaps all long distance calls or all international calls? Inbound versus outbound? This information can help give you an idea on what to look for in your decodes or what you can ignore. Busy PRI lines can generate an enormous amount of D channel messages in a short period of time. Sometimes knowing what you can ignore can help as much as knowing what to look for.