To: *aidan@highrise.ca*
From: *Aidan Van Dyk <aidan@highrise.ca>*
Subject: *Here's the general bacground information on T1s*
Date: *Tue, 2 Mar 2010 11:26:58 -0500*

Aidan,

I've attached a bunch of information here on the T1 technology.

The Brooktrout TR1034 boards are the leaders in FAX board performance,
supporting all of V.34, V.8 fast answer, and automatically falling back
to slower modulation when the remote phone lines have audio quality
issues.

Combining them with digital PRIs, means you get sub-second turnaround on
placing/answering calls, 100% digital audio quality on your channels,
and great uptime SLAs from your telco.

```
--
Aidan Van Dyk                                    Create like a god,
aidan@highrise.ca                             command like a king,
http://www.highrise.ca/                          work like a slave.
```

Dialogic
Making Innovation Thrive™

Application Note

T1 Technology Overview

Introducing T1 Basics, Planning
for a T1 Line, and Configuring and
Troubleshooting Dialogic® Boards
in a T1 Environment

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Executive Summary

This application note covers a broad range of topics concerning T1 telephony interfaces. It provides a brief introduction to the basics of T1; discusses how to plan for ordering a T1 line; and finally how to configure the T1 hardware and software to interoperate with a T1 line for Dialogic® DM3 Media Boards, Dialogic® JCT Media Boards, and Dialogic® Host Media Processing (HMP) Interface Boards; and also how to troubleshoot Dialogic® boards in a T1 environment.

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Introduction

The T1 (DS-1) standard is a vast topic that includes complex technology and challenging terminology. This application note presents information so that the reader with beginner to intermediate knowledge of the T1 environment can enter the T1 arena with suitable information to plan for (and thus order) a T1 line, and then to be able to configure and troubleshoot the T1 solution for Dialogic® DM3 Media Boards, Dialogic® JCT Media Boards, and Dialogic® HMP Interface Boards.

T1 Technology Basics

T1 is a multiplexing scheme used primarily in North America and Japan that allows 24 individual voice channels to be carried on a common transmission medium. The multiplexing device used by the Public Switched Telephone Network (PSTN) to provide this service is called a channel bank. In a T1 channel bank, 24 analog voice channels are converted to digital voice channels (DS-0 channels), which become 64 kbps digital voice channels. The 24 digital voice channels are then multiplexed onto a single high-speed line, the T1 span, also known as a DS-1 line.

T1 Framing

The basic T1 frame consists of 24 time slots, with each time slot carrying eight bits of data that represent one voice signal digitized at 64 kbps. To denote the beginning of each sequence of 24 DS-0 channels, a special framing bit is inserted at the beginning of each multiplexing cycle.

The data rate of the T1 line is the product of multiplying the speed of an individual DS-0 channel by the number of channels being multiplexed (24).

    64,000 bps X 24 = 1,536,000 bps

In addition to the 24 channels, an extra 8000 bits (1 bit/frame x 8000 frames/sec) are required for control signals and to synchronize the digital data transmitted and received over the T1 span.

    1,536,000 bps + 8000 bps = 1,544,000 bps (1.544 Mbps)

The 8000 extra bits, or framing bits, are used to ensure that the overall signal is being delivered correctly (see Figure 1).
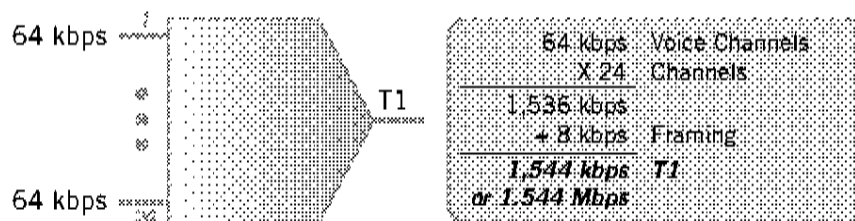
Figure 1. Graphic Representation of T1 Bandwidth Breakdown

The two types of framing are as follows (see Figure 2):

* **D4 Superframe (SF)** — SF consists of 12 consecutive T1 frames. The framing bits in this group of 12 T1 frames form a repetitive pattern that identifies the group as a superframe.

By providing a repetitive pattern in the framing bit, the receiving end is able to identify each frame transmitted in the SF. This is important in robbed-bit signaling (discussed in more detail in the "Robbed-Bit Signaling" section) because bit robbing is performed on the DS-0 channels in Frame 6 and Frame 12 in the D4 SF (see Figure 3).

- **Extended Superframe (ESF)** — ESF extends the number of frames in the framing bit (F-bit) pattern from 12 to 24. Unlike D4 SF, in which the framing bits form a specific repeating pattern, the ESF bit pattern can vary.

The ESF framing bits are used for the following purposes:

- The odd numbered bits are used by the carrier to provide network monitoring, alarm generation, and reconfiguration information.
- Frame bits 2, 6, 10, 14, 18, and 22 are used as a 6-bit Cyclic Redundancy Check (CRC) sum known as CRC-6. These bits are used by the receiving end to measure the Bit Error Rate (BER).
- Frame bits 4, 8, 12, 16, 20, and 24 are used to generate the ESF framing pattern of 001011.

Similar to D4 SF, the ESF framing pattern allows the receiving end to identify each frame transmitted in the ESF for the purpose of robbed-bit signaling. In this case, bit robbing is performed on each DS-0 channel in Frame 6, 12, 18, and 24 (see Figure 3).
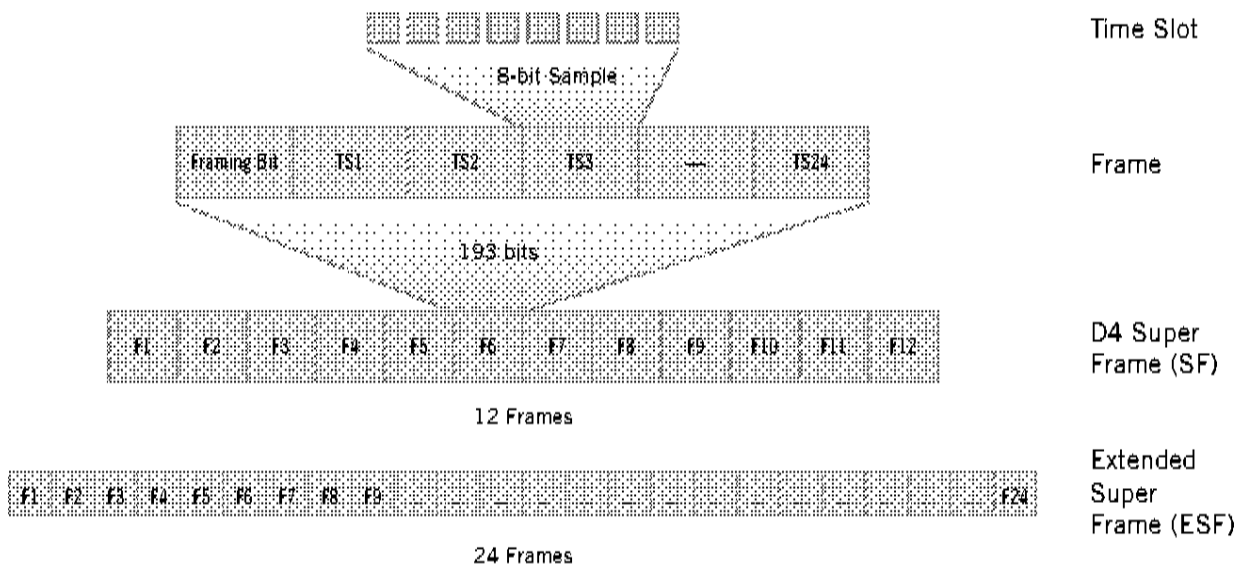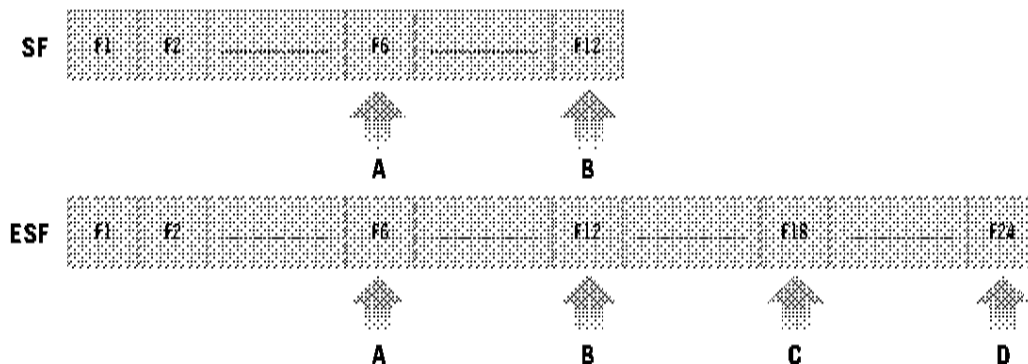

Figure 2. Robbed Bit Framing

Figure 3. A/B/C/D Bit Locations

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T1 Encoding Types

To be understood by the receiving end, data must follow an encoding scheme. T1 lines have two coding types:

- **Alternate Mark Inversion (AMI)** — AMI is a form of bipolar signaling in which each successive mark (digital 1) is of the opposite polarity, and spaces (digital Os) have zero amplitude.

AMI line encoding does not, however, provide a method for maintaining *ones density*. To ensure adequate line synchronization, pulse stuffing may be required, restricting the useful bandwidth of each DS-0 channel to 56 kbps. While satisfactory for digital data, this will not support 64 kbps digital voice.

- **Binary Eight Zero Substitution (B8ZS)** — In B8ZS, each string of eight consecutive zeros in a byte is replaced by the B8ZS code. If the pulse preceding an all-zero byte is positive, the inserted code is 000+-0-+. If the pulse preceding an all-zero byte is negative, the inserted code is 000-+0+-.

Either of these codes results in bipolar violations occurring in the fourth and seventh bit positions. Both ends of the T1 line must recognize these codes and replace a byte containing the coded bipolar violations with the original eight zeros. B8ZS encoding, therefore, provides a method of line coding that permits the full 64 kbps bandwidth of each DS-0 channel to be utilized.

T1 Signaling

In addition to carrying digital voice signals, the T1 line must also convey signaling information for each of the DS-0 channels. Two different signaling methods are used to transmit this information: T1 robbed-bit and PRI ISDN (Primary Rate Interface Integrated Services Digital Network).

Robbed-Bit Signaling

In robbed-bit, signaling information is directly associated with each respective digital voice channel. The method for providing this type of signaling on T1 lines is referred to as robbed-bit signaling. This type of signaling requires that specific frames in the T1 transmission be identified because the least significant bit is "robbed" from each channel in specific frames with the ruling methods.

In the case of the D4 SF, this operation is performed in frames 6 and 12; in ESF, it is performed in frames 6, 12, 18, and 24.

By using only the least significant bit from each channel's digital voice data in every sixth frame for signaling purposes, no discernible change can be detected in the voice signal by the called party. For example, the 8-bit byte 10101101 has a decimal equivalent of 173. If the least significant bit were to be removed, the decimal equivalent would be 172 — a negligible change when conveying digital voice information. If this were digital data other than voice, however, the change would be significant, and could not be tolerated. The bit that is used from frame 6 is called the "A bit" and the bit that is used from frame 12 is called the "B bit". This is also referred to as AB signaling.

In ESF, since bits are robbed from two additional frames, this is referred to as ABCD signaling. In some cases for ESF, however, the C and D bits are used to repeat the A bit and B bit information, respectively. D4 SF is limited to AB signaling, which means that only a limited number of signal conditions can be conveyed (22 = 4). Those conditions include off-hook, on-hook, busy, and dial pulses. In the case of a fully implemented ESF facility, 16 different signal conditions can be conveyed (24), including those supported by AB signaling.

Signaling bits are used to indicate the state of the virtual "hook state" on a digital line. Common uses for the signaling bits include:

- Idle — State of the bits that show the channel is not processing any calls.
- Seizure — Setting the "transmit" bit state to begin the outbound call process.
- Wink — (if used) also known as Seizure Acknowledge. A transition of signaling bits to signal that the receiving end is ready to accept data.
- Disconnect

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These bit states and transitions are used to establish call control protocols. Some common protocols are:

- **E&M Signaling** — E&M signaling uses bit transitions for both answer and disconnect supervision. The two main flavors are wink start and immediate start.
  - In wink start, the called party issues a wink to the calling party to indicate that it is OK to send Dialed Number Identification Service (DNIS) and/or Automatic Number Identification (ANI) digits.
  - In immediate start, a dial tone is supplied as a seizure acknowledge instead of a wink. When the digits are processed, the call is fully established by the called party.

- **FXS (Foreign Exchange Station)** — FXS is a robbed-bit protocol that was designed to most closely emulate an analog phone. When a call is established, the bits are raised and lowered in a pattern that mimics "ringing." The remaining call progress occurs via the voice path instead of bit transitions. FXS is sometimes referred to as loop start.

- **Loop Start Signaling** — Loop start signaling is the simplest protocol. It is similar to how a phone call works in the analog world — go off-hook (seize the line), get a dial tone (seizure acknowledge), and dial a phone number.

- **Ground Start Signaling** — Ground start signaling is an uncommon unidirectional T1 protocol in which call setup requires an inverse wink, lowering the transmit bits from 1 to 0, to start a call. Unlike loop start, ground start offers the ability to seize the line when an incoming call is received, preventing call glare.

PRI ISDN

In PRI ISDN, all of the signaling information is done on a single channel. The channel that carries all of this signaling information is known as the D-channel, or data channel. Since this channel is dedicated to carrying the signaling information, it cannot carry any voice information, thus reducing the ISDN line to 23 available channels for voice, known as B channels, or bearer channels. This configuration of 23 bearer channels and one data channel per span is sometimes denoted as 23B+D.

ISDN signaling does not rely on bit signaling as T1 robbed-bit does, rather it relays messages via the D-channel. This allows ISDN protocols to be much more robust and able to relay information about a call much more quickly than T1 robbed-bit.

The following are the T1 ISDN protocols:

- NI2 (National ISDN 2)
- 4ESS (AT&T protocol)
- 5ESS (AT&T protocol)
- DMS (Nortel protocol)
- NTT (Japan only)

Depending on your switch and the central office you are dealing with, one or more of these protocols may be available for use. For basic call functionality, the four North American protocols are all very similar — they all work according to the same network side protocol (NT1). It is with the specific feature set of each protocol that the differences can show. For example, some protocols and switches can handle call transfers while others cannot.

Figure 4 is a typical message call flow for the ISDN protocol.

Planning for a Suitable T1 Line Type

This section discusses what to consider and plan for after deciding to order a T1 line (or several T1 lines); specifically, what type of T1 line should you get?

The T1 line comes in two types, **robbed-bit** or **ISDN**, and understanding their advantages and disadvantages is useful in determining which one is better suited for your situation. Descriptions of some of those possible situations follow, as well as discussions as to which T1 line type can address the situations.

Speed of Call Setup and Teardown

The major difference in the two T1 types lies in the signaling method (T1 robbed-bit or PRI ISDN) used. The main benefit of using a D-channel (ISDN) for messaging is the speed of call setup and teardown. An entire call setup can be done with one message and a resulting acknowledgement — all information about the call (ANI, DNIS, ISDN channel the call is on, etc.) — can be contained within the one message. This transaction can usually be completed in about 30 to 100 milliseconds. If for some reason the call is unable to be placed, this can be relayed back to the caller instantly with

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Calling Party   **Called Party**

Setup →

← Proceeding (optional)

← Progressing (optional)

← Alerting

← Connect

Connect Acknowledge →

Disconnect* →

← Release

Release Complete →

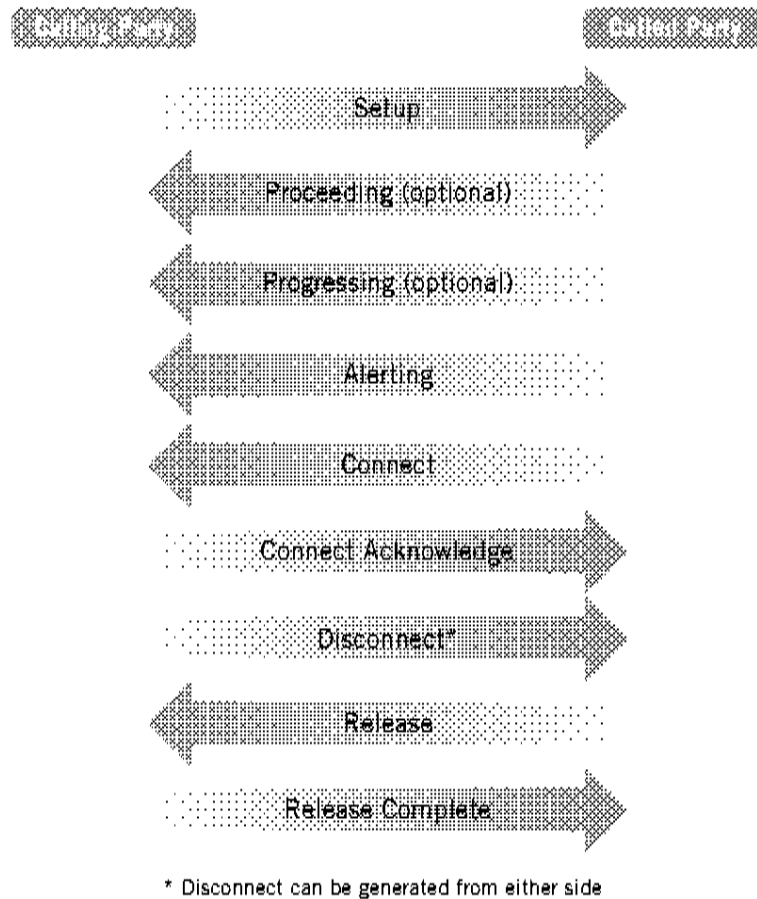* Disconnect can be generated from either side

Figure 4. Typical Message Call Flow for ISDN Protocol

a reason for call failure (SIT, busy, etc.). The line could then be freed to place another call. Call teardown is also quick, requiring just two messages.

For the same call to be set up on a robbed-bit line, there would need to be a series of bit transitions, as well as DTMF dialed digits, which could take 1 to 3 seconds. To determine the end result of the call, the audio path would need to be used to hear whether the call was connected or if it failed (SIT, busy, etc.). This could take several more seconds. Call teardown is relatively quick, usually requiring just one bit change to signal a disconnect.

If speed of call setup and teardown is a notable factor, ISDN has an advantage.

Protocol Configuration

Although the 2 (or 4) bits can hold a limited number of combinations, the variations of robbed-bit protocols is almost infinite. Each central office or PBX can have a slightly different set of bit patterns to distinguish call states. While most are similar (that is, loop start in one site usually is the same as loop start in another site), no set standard exists for robbed-bit protocols, so this must be taken into consideration each time an application is deployed in a new location.

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With ISDN, the protocols are standards-based, and cannot vary from site to site. This means the configuration will not need to be altered from one site to the next. Basic functionality on ISDN will work right out of the box.

If ease of protocol configuration is a notable factor, ISDN has an edge.

Number of Channels Available for Use

Since ISDN uses one channel for signaling, it only offers 23 channels for placing or accepting calls. T1 robbed-bit allows all 24 channels to be used. For sites that require multiple T1 spans, this can be slightly counteracted in ISDN with the use of Network Facility Associated Signaling (NFAS) (see the "NFAS" section), which allows a single D-channel to control more than one ISDN span.

If number of channels available for use is a notable factor, robbed-bit has a slight edge.

Call Transfers

In an analog environment, call transfers are often performed with a hookflash. In robbed-bit, winking one or more bits can mimic this behavior. If the choice is to implement this on Dialogic® boards, just make a configuration change to the Dialogic® Global Call API .cdp file

In ISDN, not all protocols support call transfer. NI2 and 5ESS use Two-B Channel Transfer (TBCT) to implement call transfer. DMS uses Release-Link Trunking (RLT) to implement call transfer. 4ESS does not support call transfer. To implement this on Dialogic boards, the application needs to configure the message to be sent to the switch to initiate the transfer. This makes using call transfer on ISDN more involved.

If call transfers are a notable factor, robbed-bit has an advantage if choosing to use Dialogic boards.

Ease of Application Development

With the Global Call API, a robbed-bit application is nearly identical to an ISDN application (that is, call setup, teardown, call progress analysis). However, some protocol-specific messages in ISDN must be created via the application (like

transfer, as previously discussed in the "Call Transfers" section), so creating an ISDN application is sometimes more complex.

If ease of application development is a notable factor, robbed-bit has a slight edge.

Ability to Send User-Defined Data

ISDN offers the ability to send data over the D-channel that is not related to call control. This data can be used by the application to send any proprietary data.

Robbed-bit does not have any such functionality.

If the ability to send user-defined data is a notable factor, ISDN has an advantage.

Quick Summary Comparison

In general, ISDN is quicker and more powerful than robbed-bit, but because of that it is at times more difficult to implement. ISDN also has the drawback of offering one less channel per T1 span, unless NFAS is used.

If you are still unsure as to which type of line to select, you may want to discuss your situation with personnel at the central office and get their advice as to what will be more suitable for you.

Is a CSU or DSU Necessary?

For most installations, a Channel Service Unit (CSU) is recommended. These can either be sold separately to you by your central office, or may be integrated into the PBX at your site. The CSU performs many functions, the most important of which is signal regeneration. It also can provide loopback capability, yellow alarm signaling, and other functionality that allows the line to stay intact.

While some CSUs have an integrated Digital Service Unit (DSU), a DSU is not required when connecting to a Dialogic® T1 span board. All T1 Dialogic boards provide most of the same functionality as a DSU, including polarity conversions and T1 framing.

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Questions to Consider When Ordering a T1 Line

The information presented up this point should prepare you
to knowledgably plan and order your T1 line. A T1 line can
be ordered through a service provider or through a PBX
administrator. During the ordering process, it is important to
ask and get answers to the following questions (ask the Telco,
if you are unsure of the answer):

1. Should I order a T1 line that is ISDN or robbed-bit?

2. If I order ISDN, what protocol do I choose?

3. If I order ISDN, is CRC checking enabled?

4. If I order robbed-bit, do I want:

    a. Framing — ESF or SF?

    b. Coding — AMI or B8ZS?

    c. Wink or no wink?

    d. A special protocol because it requires it (for example,
       FXS)?

5. What, if any, special features would I like on the line:

    a. Do I require 800 numbers?

    b. Do I want the ability to transfer calls?

6. Would I like to purchase a CSU/DSU?

There may be other topics that arise, but having addressed
these questions upfront can make it more likely that you will
order the appropriate T1 line, which in turn affects being able
to properly configure your Dialogic® hardware later on.

Configuring Dialogic® T1 Boards

Note: Instructions in this document are specific to the
following releases (consult the documentation for your

release for exact configuration instructions; see the *For More
Information* section):

* Dialogic® System Release PCI 6.0 for Windows®

* Dialogic® System Release 6.1 for Linux

* Dialogic® Host Media Processing 3.0 for Windows®

* Dialogic® Host Media Processing 3.1 for Linux

Following the instructions in the Software Installation
Guide that pertains to your Dialogic® release, install the
software. Make sure to install the necessary protocols for
your environment — ISDN protocols for ISDN environments
or Global Call API protocols for robbed-bit environments.
Dialogic boards can be installed before or after software
installation.

Once the boards and software have been installed, the next
thing to do is configure them to work properly for the switch
to which they will be connected.

Dialogic boards have two main architectures, and
configuration depends on the architecture of the board:

* **Dialogic® Springware architecture** — The original
  Dialogic board architecture is sometimes referred to as
  "Springware." If the board name begins with a D/xxx
  (for example, D/480JCT-2T1), it is a Dialogic® JCT Media
  Board based on Springware architecture.

* **Dialogic® DM3 architecture**

    — The second generation Dialogic board architecture
      is referred to as "DM3." If the board name begins
      with DM/xxx (for example, DM/V960A-4T1 or DM/
      V1200BTEP), it is a Dialogic® DM3 Media Board based
      on DM3 architecture.

    — Also based on DM3 architecture is the Dialogic®
      HMP Interface Board, also referred to as the "DNI"
      Board, that begins with DNI/xxx (for example,
      DNI/300TEPHMP), used with Dialogic Host Media
      Processing (HMP) Software releases.

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Configuring Dialogic® JCT Media Boards (Springware-Specific)

Refer to the Springware architecture configuration guide for your Dialogic release for instructions on configuring the JCT Media Boards (see the *For More Information* section). The following is an overview of some notable points.

Protocol

The first thing to consider when configuring a JCT Media Board (T1 board) is to set up correctly for the protocol on the line:

— If the protocol is ISDN, the ISDN protocol must be selected. In Windows*, this is done on the Interface tab of the Dialogic* Configuration Manager (DCM). Select the correct ISDN protocol for each span. In Linux, the config. sh script is used.

— If the protocol is robbed-bit and you are not using Dialogic* Continuous Speech Processing (CSP), no protocol change needs to be done via DCM or config.sh — this is the default configuration. The protocol will be configured via Global Call API .cdp file, which is described in the "Configuring Dialogic* Global Call API Protocol" section.

For CSP configurations, change the firmware file being downloaded to the proper CSP firmware file, and make sure ISDNProtocol is set to NONE for that span. Because of hardware limitations, CSP and ISDN cannot be run on the same span on a JCT Media Board.

Framing/Line Encoding

In ISDN, framing is always set to ESF and encoding to B8ZS, so no changes will need to be made.

If no ISDN protocol is set, JCT Media Boards default to using D4 SF (framing) and AMI line encoding. If these need to be changed, the following lines must be edited in spandti.prm:

1. Change parameter 0020 to 1 and uncomment it (for B8ZS)

2. Add a line for parameter 0014 and set its value to 1 (for ESF)

Note: If any changes are made to spandti.prm, you must specify this as the parameter file used.

In Windows*, set parameter file = spandti.prm in the DCM.

In Linux, add a line for each span. An example for a dual span board:

ParameterFile=spandti.prm

ParameterFile2=spandti.prm

Configuring Dialogic® DM3 Media Boards

Configuring DM3 Media Boards is different than configuring JCT Media Boards. DM3 Media Boards have more configurable functionality than JCT Media Boards, so they have more possible configuration files. However, once you have determined which configuration file to use, that file is the only one used to configure the board.

Protocol

The first step to configuring a DM3 Media Board is to have it auto-detected. In Windows*, this is done by starting the DCM. In Linux, this is done by running config.sh. Once the board is detected, either utility will first ask what .pcd/.fcd files to use. These are the equivalent to the firmware and configuration files used on JCT Media Boards. A list of .pcd files will appear, and this list is all the possible .pcd files that can be used with the board detected. To determine which file to use, first it is important to understand the naming convention.

For DM3 A-series Media Boards, each file is in the format mlx_yyy_zzz.pcd

mlx = media load

yyy = specific for each type of board

zzz = protocol

Note that the middle value, yyy, has already been detected and pre-determined for you. The protocol is the T1 protocol you will be using, whether it is an ISDN protocol or robbed-bit (in which case select CAS). The media load is a concept that is specific to DM3 Media Boards. Each media load offers different functionality, and each DM3 Media Board is capable of downloading one or more media loads. The list that pops up tells you what media loads your board supports. Some common media loads are listed as follows (refer to the appropriate DM3 Configuration Guide for all media loads in a particular release):

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Media Load 1 – Basic Voice

◇ Provides play, record, digit generation, and digit detection

◇ All half duplex voice operations

◇ Supports the following coders:

　– 64 kbps and 48 kbps G.711 PCM VOX and WAV

　– 24 kbps and 32 kbps OKI ADPCM VOX and WAV

　– 64/88/128/176 kbps Linear PCM VOX and WAV

× Speed control on 8 kHz coders

× Volume control

✳ Cached prompts

✳ GTG/GTD

✳ Call progress analysis

◇ Transaction record

Media Load 2 – Enhanced Voice

✳ All Basic Voice features (see Media Load 1)

× Continuous Speech Processing (CSP)

× Enhanced coders:

　– G.726 at 16 kbps, 24 kbps, 32 kbps, and 40 kbps

　– GSM (TIPHON and Microsoft)

　– IMA ADPCM

　– TrueSpeech

✳ Silence Compressed Record (G.711, OKI ADPCM, Linear 8 kHz, and G.726)

◇ IP transcoders (Dialogic® DM/IP Boards only)

　– G.711: 1 frame/packet at 10, 20, or 30 ms (A-law or μ-law)

　– G.723: 1, 2, or 3 frames/packet at 30 ms (silence compression with VAD and CNG)

　– G.729: 1, 2, 3, or 4 frames/packet at 10 ms (silence compression with VAD and CNG)

　– GSM: 1, 2, or 3 frames/packet at 20 ms (silence compression with VAD and CNG)

Media Load 5 – Fax

× All Enhanced Voice Features (see Media Load 2)

◇ V.17 Fax

Media Load 9b – Conferencing Only (Rich Conferencing)

✳ Traditional DCB conferencing plus echo cancellation:

　– No voice channels

　– Conferencing

　– Signal detection

　– Tone clamping

　– Tone generation

　– Echo cancellation (16 ms)

Media Load 10 – Enhanced Voice Plus Conferencing

× All Enhanced Voice features (see Media Load 2)

◇ Conferencing resource (conferencing and voice are independent. This media load provides both enhanced voice as well as DCB DSP conferencing.)

To change the pcd files, you can either re-autodetect the board (use the DCM in Windows* or change config.sh in Linux), or change the .pcd files in the DCM (Windows).

For Dialogic® DM/V-B Media Boards, at first only a default file will be available. Once that is selected, you can go into the DCM tool and select the protocols for each span. When that configuration is done, a gul_xxx_xxx.pcd/.fcd/.config file set will be generated in the data directory specifically for that configuration and the .pcd/.fcd files will be set automatically in the DCM tool.

Once the .pcd file is set, the only file that needs to be configured is the file of the same name, with a .config extension (that is, select ml6_dsa_4ess.pcd, modify ml6_dsa_4ess.config).

Note: For the Dialogic HMP Software releases (check your DM3 Configuration documentation), whenever changes are made to the .config file, the program fcdgen must be run and the board must be redownloaded (Dialogic® services stopped/started) for the changes to take effect. To run fcdgen, simply type fcdgen and the file name.

Example: fcdgen ml6_dsa_4ess.config

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For the System Release for Windows* and Linux operating systems (check your DM3 Configuration documentation), the .fcd file is automatically created when the .pcd file and modified .config file are downloaded to the board.

Framing / Line Encoding

Line framing and line encoding are set within the lineadmin sections of the .config file, with one lineadmin section per trunk on the board. Each trunk must be configured individually (ESF/B8ZS shown):

```
[LineAdmin.1]                    ! Instance 1
SetParm=0x1601,1                 ! LineType (dsx1_D4=0, dsx1_ESF=1)
SetParm=0x1603,7                 ! Coding (B8ZS=7, AMI=8)
;

[LineAdmin.4]
SetParm=0x1601,1                 ! LineType (dsx1_D4=0, dsx1_ESF=1)
SetParm=0x1603,7                 ! Coding (B8ZS=7, AMI=8)
```

ISDN

As is the case with JCT Media Boards, once an ISDN protocol is selected, few changes are needed to be made to the file configuration. In addition to having a lineadmin section for each trunk, ISDN .config files also have a CCS section for each trunk. Here is one parameter that may require changing at times. To run the network version of a T1 protocol (NT1 protocol), set the following parameter accordingly:

```
Setparm=0x17,0                   ! Network Mode: 1=NETWORK 0=USER
```

This parameter can be set on a trunk-by-trunk basis. This parameter will allow for testing in back-to-back mode, with one trunk acting as the network (Telco) side and another trunk acting as the user side. This is discussed in more detail in the "Troubleshooting DM3 Media Boards" section.

NFAS

For information on how to configure DM3 Media Boards to use NFAS, see the following technical note:
http://www.dialogic.com/support/helpweb/dxall/tnotes/new/tn934.htm.

Configuration Procedures Common to Dialogic® JCT Media Boards and Dialogic® DM3 Media Boards

Clocking

It is important to ensure one trunk is set to be the clockmaster. Clocking can be derived from a digital network trunk, if available, rather than from an internal oscillator. Only one T1 trunk in a chassis can be the clockmaster, and all other trunks in the machine take their clocking from that trunk. By default, the first trunk of the first board is set up as the clockmaster. To set up the clockmaster for Windows* and Linux:

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Application Note

In Windows®:

1. To access the clocking settings in the DCM, double-click **Bus-0** under TDM Bus in the DCM tree structure of configured devices in the DCM Main Window.

2. Designate a board as the primary master using the following steps:

    a. Select the **Primary Master FRU (User Defined)** parameter.

    b. In the Value list box, select the name of the board that will provide the clocking to the bus.

    c. Click **Apply.**

3. If the Primary Master board is deriving system clocking from a digital network trunk connected to a Network Reference (NETREF) board, perform the following actions. Otherwise, if using the Primary Master board's internal oscillator as the clocking source, skip to Step 4.

    a. Select the **NETREF One FRU (User Defined)** parameter.

    b. In the Value box, type the name of the board that contains the network interface that will provide a network reference clock to the system. The board name entered should be the same name as displayed in the DCM main window.

    c. Click **Apply.**

    d. Specify the source of the network reference clock (specifically, the trunk on the board containing the digital network interface providing the clock) via the **Derive NETREF One From (User Defined)** parameter.

    e. Click **Apply.**

4. Configure the Primary Master board to use the correct clock reference by setting the **Derive Primary Clock From (User Defined)** parameter to either NETREF_1 or Internal Oscillator.

5. Click **OK.**

6. To set the clocking for the secondary clock master, perform the following steps:

    a. Highlight the **Secondary Master FRU (User Defined)** parameter.

    b. In the Value list box, select the board that will provide the clocking to the bus if the primary master fails. The board name that you enter should be the same name as displayed in the DCM main window.

    c. Click **Apply.**

    d. Configure the Primary Master board to use the correct clock reference by setting the **Derive Primary Clock From (User Defined)** parameter to either NETREF_1 or Internal Oscillator.

    e. Click **OK.**

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Application Note

In Linux (config.sh script):

1. From the TDM Bus Settings screen, type the number 2 and press Enter to select the "TDM Bus Role Settings – Select Primary Master Board" option.

The "TDM Bus Role Settings – Select Primary Master Board' screen is displayed.

2. On the "TDM Bus Role Setting – Select Primary Master Board" screen, type the number corresponding to the board to be used for the Primary Master Clock, and press **Enter**.

The "TDM Bus Role Setting – Select Master Clock Source" screen is displayed.

3. On the "TDM Bus Role Setting – Select Primary Master Clock Source" screen, type the number corresponding to the source you wish to use for the Master Clock, and press **Enter**.

The "TDM Bus Role Setting – Select NetRef Provider Board" screen is displayed.

4. On the "TDM Bus Role Setting – Select NetRef Provider Board" screen, type the number corresponding to the board you wish to use for the NetRef Provider, and press **Enter**.

The "TDM Bus Role Setting - Select NetRef Provider Trunk" screen is displayed.

5. 5. On the "TDM Bus Role Setting - Select NetRef Provider Trunk" screen, type the number corresponding to the trunk you wish to use for the NetRef Provider, and press Enter.

Configuring Dialogic® Global Call API Protocol

Global Call protocols are installed in the .cfg directory. The Global Call API has two different types of protocols:

— ICAPI is the first generation of Global Call protocols.

— PDK is the second generation, and can be identified by the prefix pdk_*. Only PDK protocols are currently supported, so all deployments should use these protocols.

T1 has three file choices (aside from switch-specific protocols):

× pdk_us_ls_fxs_io.cdp — For loop start lines
◇ pdk_sw_t1_gdsls_io.cdp — For ground start lines
× pdk_us_mf_io.cdp — For E&M lines

On JCT Media Boards, the protocol is set via the gc_OpenEx() function and is run at the library level on the host machine. On DM3 Media Boards, the protocol is set via configuration, downloaded to the board, and run at the firmware level.

Note: To switch protocols on a DM3 Media Board, Dialogic® services must be restarted.

To specify the protocol on DM3 Media Boards, a pdk.cfg file must be created. For some older releases, this file needed to be manually created. Whether it is automatically created or not, it is useful to consult the *Global Call Country Dependent Parameters (CDP) for PDK Protocols Configuration Guide* (see the *For More Information* section) to ensure the pdk.cfg file is properly configured.

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Configuring the .cdp File

For most loop start and ground start deployments, selecting the proper protocol will be all that is necessary to make the line work. Thus, this application note will focus mainly on configuring protocols that need to use pdk_us_mf_io.cdp. The PDK *.cdp file is used to configure the robbed-bit protocol. T1 robbed-bit protocols consist of four phases:

1. Seizure
1a. Seizure Acknowledge (optional)
2. Data transfer
3. Connect
4. Disconnect

Phase 1 – Seizure

This is the initial part of the protocol where one side signals to the other side that a call is being generated. Either side can initiate a seizure.

Generally, this is done via a bit transition from the IDLE state to the SEIZURE state.

In PDK, states are defined by both initial and post-change bit states.

Note: For all PDK state parameters, these definitions apply:

```
// CDP_TRANS Settings for bit state transitions
All PATTERN_TRANS CDP_TRANS =
OffCode <ABCD>,      // previous setting
OnCode<ABCD>,        // setting for this state
PreInterval,         // amount of "guard" time expected before this state
PostInterval,        // amount of "guard" time expected after this state
PreIntervalNominal,  // minimum amount of time from any previous state change that DLGC waits before entering this state
PostIntervalNominal  // amount of time DLGC waits after this state before another state change can be made
```

Note: It is generally not necessary to change the timing parameters for state changes, only the OffCode and Oncode.

For seizure definition, **both inbound and outbound**, these parameters must be set properly:

```
/* Pattern to generate (outbound) or receive (inbound) that */
/* signals a line seizure */
All CAS_SIGNAL_TRANS_t CAS_SEIZE = 00xx,11xx,50,50,0,80
```

◇ **Parameter 1 (00xx)** is the previous bit state — This should match the OnCode (second parameter) of the IDLE pattern, in this case:

```
All CAS_SIGNAL_TRANS_t CAS_IDLE = 11xx,00xx,50,50,0,80 // inbound call
All CAS_SIGNAL_TRANS_t CAS_IDLEGENERATE = xxxx,00xx,50,50,0,80 //outbound call
```

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* **Parameter 2 (11xx)** is the seizure definition — In this case, both the A and B bits are raised to indicate seizure.

* **Parameters 3-6** — Are timing parameters that can usually remain the same

Phase 1a — Seizure Acknowledge (optional)

Some protocols, such as wink start, require that a seizure be acknowledged prior to moving to the second phase of the call, data transmission (that is, ANI/DNIS digits). Protocols that do not require seizure acknowledge are referred to as immediate start protocols. This acknowledgement, if required, can arrive in one of two ways, Wink acknowledgement or Tone acknowledgement:

* **Wink acknowledgement** — One or more bits toggle for a specific amount of time. For PDK protocols, the following definition applies to all wink patterns set:

```
// CDP_PULSE Settings for wink definitions
All PATTERN_PULSE CDP_PULSE =
OffCode<ABCD>,          // pre-wink state
OnCode<ABCD>,           // wink pattern
PreInterval,            // amount of "guard" time expected before this state
PostInterval,           // amount of "guard" time expected after this state
PreIntervalNominal,     // amount of time DLGC waits before entering state
PostIntervalNominal,    // amount of time DLGC waits after this state before another change
                        // can be made m_PulseIntervalMin,
                        // shortest allowable wink length – used for received wink definition
m_PulseIntervalNominal, // expected wink length – length of wink Dialogic will send
m_PulseIntervalMax      // longest allowable wink length – used for received wink definition
```

— **For inbound calls:** The following protocol must be set if the switch is expecting a wink acknowledgement. Immediate start protocols would set this parameter to 0:

```
All BOOLEAN_t CDP_IN_WinkStart = 1
```

A wink is generated using the following parameter. In this example, the idle pattern is 00xx, and the A and B bits are raised for 250 ms and then lowered:

```
/* Wink generate signaling pulse (inbound) */
All CAS_SIGNAL_PULSE_t CAS_WINKXMT = 00xx,11xx,50,50,0,80,20,250,300
```

— **For outbound calls:** The following protocol must be set if the Dialogic board is expecting a wink acknowledgement. Immediate start protocols would set this parameter to 0:

```
All BOOLEAN_t CDP_OUT_WinkStart = 1
```

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The expected wink is defined. In this example, only the A bit is monitored. It must transition from 0 -> 1 -> 0 for a duration of 150 ms to 350 ms to be considered a wink:

```
/* Wink receive signaling pulse (outbound) */
All CAS_SIGNAL_PULSE_t CAS_WINKRCV = 0xxx,1xxx,50,50,0,80,150,250,350
```

The following parameter determines how long the Dialogic board will wait to receive the defined wink. In the example, it will wait for 5 seconds. If no wink is detected within 5 seconds, the application will receive a protocol timeout error:

```
/* Timeout waiting for CAS_WINK after line seizure */
All INTEGER_t CDP_OUT_SeizeAck_Timeout = 5000
```

× **Tone acknowledgement** — A tone (that is, Dial Tone) is played to signify acknowledgement.

— **For inbound calls:** The following parameter must be set:

```
All BOOLEAN_t CDP_IN_DialTone_Needed = 1
```

— **For outbound calls:** The following parameters must be set:

```
All BOOLEAN_t CDP_OUT_DialTone_Needed = 1
```

```
/* Timeout waiting for Dial Tone after line seizure */
/* This is normally used if not wink start (units = ms) */
All INTEGER_t CDP_OUT_DialTone_Timeout = 5000
```

Phase 2 – Data Transfer (ANI / DNIS)

Data Transfer is where phone numbers (dialed number and caller ID) are identified. It is very important to know exactly what format is used to transfer digit information (ANI/DNIS). Improper setup in this area of the PDK .cdp file often leads to protocol errors and/or call connection delays.

Use the following questions to determine the information needed for data transfer (the answers are often different for inbound and outbound calls):

1. What type of digit is used (Dual Tone Multi-Frequency [DTMF], Multi-Frequency [MF])?
2. How many ANI digits are sent?
3. How many DNIS digits are sent?
4. What, if any, delimiting digits are sent before ANI (* or #)?
5. What, if any, delimiting digits are sent after ANI (* or #)?
6. What, if any, delimiting digits are sent before/after DNIS?
7. If both ANI and DNIS are being sent, which is sent first?

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Application Note

8. Is an acknowledgement required after ANI?

9. Is an acknowledgement required after DNIS?

These questions do not have a standard set of answers, so the questions (with examples of possible answers) are provided below to show how to set up the parameters in the PDK .cdp file. Note that the PDK .cdp file has many more parameter settings in this area, resulting in much greater flexibility.

Notice that in the PDK .cdp file, that there will be four similar parameters for each setting:

1. DNIS for an inbound call

2. DNIS for an outbound call

3. ANI on an inbound call

4. ANI for an outbound call

It is important to pay close attention to which parameter you are setting.

The following information is used for the examples:

* **Inbound call digit string:** 10 ANI * 7 DNIS * — no digit acknowledgement required

* **Outbound call expected digit string:** 10 DNIS digits — no digit acknowledgement required

1. What type of digits is used (DTMF, MF)?

The following four parameters will usually have the same value.

```
/* 1 for DTMF or 2 for MF */
All INTEGER_t CDP_IN_DNIS_DigitType    = 1
All INTEGER_t CDP_OUT_DNIS_DigitType   = 1
All INTEGER_t CDP_IN_ANI_DigitType     = 1
All INTEGER_t CDP_OUT_ANI_DigitType    = 1
```

2. How many ANI digits are sent?

— **For inbound calls:** If ANI is not sent, the following parameter should be set to 0:

```
All BOOLEAN_t CDP_IN_ANI_Enabled       = 0
```

If ANI is sent, ANI should be enabled and the number of digits to be received set. If the exact number of digits is known, set that value in MaxDigits. If there is a variable number and a "stop" digit is sent, set the maximum number and see question 5 below.

```
All BOOLEAN_t CDP_IN_ANI_Enabled       = 1
All INTEGER_t CDP_IN_ANI_MaxDigits     = 12
```

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— **For outbound calls:** If ANI is not sent, the following parameter should be set to 0:

```
All BOOLEAN_t CDP_OUT_ANI_Enabled        = 0
```

If ANI is sent, ANI should be enabled and the number of digits to be received set. If the exact number of digits is known, set that value in MaxDigits. If there is a variable number and a "stop" digit is sent, set the maximum number and see question 5 below.

```
All BOOLEAN_t CDP_OUT_ANI_Enabled        = 1
All INTEGER_t CDP_OUT_ANI_MaxDigits      = 12
```

Example scenario: 10 inbound ANI, 0 outbound ANI

```
All BOOLEAN_t CDP_IN_ANI_Enabled         = 1
All INTEGER_t CDP_IN_ANI_MaxDigits       = 10

All BOOLEAN_t CDP_OUT_ANI_Enabled        = 0
All INTEGER_t CDP_OUT_ANI_MaxDigits      = 0
```

Note: For DM3 Media Boards, remove feature_ANI from the SYS_FEATURES parameter if ANI is disabled.

3.   *How many DNIS digits are sent?*

— **For inbound calls:** If DNIS is not sent, the following parameter should be set to 0:

```
All BOOLEAN_t CDP_IN_DNIS_Enabled        = 0
```

If DNIS is sent, DNSI should be enabled and the number of digits to be received set. If the exact number of digits is known, set that value in MaxDigits. If there is a variable number and a "stop" digit is sent, set the maximum number and see question 6 below.

```
All BOOLEAN_t CDP_IN_DNIS_Enabled        = 0
All INTEGER_t CDP_IN_DNIS_MaxDigits      = 12
```

— **For outbound calls:** If DNIS is not sent, the following parameter should be set to 0:

```
All BOOLEAN_t CDP_OUT_DNIS_Enabled       = 0
```

If DNIS is sent, DNIS should be enabled and the number of digits to be received set. If the exact number of digits is known, set that value in MaxDigits. If there is a variable number and a "stop" digit is sent, set the maximum number and see question 6 below.

```
All BOOLEAN_t CDP_OUT_DNIS_Enabled       = 0
All INTEGER_t CDP_OUT_DNIS_MaxDigits     = 12
```

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Example scenario: 7 inbound DNIS, 10 outbound DNIS

```
All BOOLEAN_t CDP_IN_DNIS_Enabled        = 1
All INTEGER_t CDP_IN_DNIS_MaxDigits      = 7

All BOOLEAN_t CDP_OUT_DNIS_Enabled       = 1
All INTEGER_t CDP_OUT_DNIS_MaxDigits     = 10
```

Note: For a DM3 Media Board, remove feature_DNIS from the SYS_FEATURES parameter if DNIS is disabled.

4. What, if any, delimiting digits are sent before ANI (* or #)?

A digit sent before the ANI or DNIS string is called a "KP" digit.

If a digit is used to signify the start of the ANI string, the digit used is defined by:

```
All DIGITSTRING_t CDP_IN_ANIKPDigit      = "*"
All DIGITSTRING_t CDP_OUT_ANIKPDigit     = "*"
```

In the case that this digit will be used, the following parameters must be set to let the protocol know it will be used – the prefix digit will be stripped from the digit string:

```
All BOOLEAN_t CDP_IN_ANI_KP_Needed       = 1
All BOOLEAN_t CDP_OUT_ANI_KP_Needed      = 1
```

Example scenario: No digits before inbound ANI string, outbound has no ANI string

— For Inbound calls:

```
All BOOLEAN_t CDP_IN_ANI_KP_Needed       = 0
All DIGITSTRING_t CDP_IN_ANIKPDigit      = "*"
```

— For Outbound calls:

```
All BOOLEAN_t CDP_OUT_ANI_KP_Needed      = 0
All DIGITSTRING_t CDP_OUT_ANIKPDigit     = "*"
```

5. What, if any, delimiting digits are sent after ANI (* or #)?

A digit sent after the ANI or DNIS string is an ST digit.

If a digit is used to signify the end of the ANI string, the digit used is defined by:

```
All DIGITSTRING_t CDP_IN_ANISTDigit      = "*"
All DIGITSTRING_t CDP_OUT_ANISTDigit     = "*"
```

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In the case that this digit will be used, the following parameters must be set to let the protocol know it will be used:

```
All BOOLEAN_t CDP_IN_ANI_ST_Needed     = 1
All BOOLEAN_t CDP_OUT_ANI_ST_Needed    = 1
```

Example scenario: Inbound uses "*" after ANI, outbound has no ANI string

— **Inbound:**

```
All BOOLEAN_t CDP_IN_ANI_ST_Needed     = 1
All DIGITSTRING_t CDP_IN_ANISTDigit    = "*"
```

— **Outbound:**

```
All BOOLEAN_t CDP_OUT_ANI_ST_Needed    = 0
All DIGITSTRING_t CDP_OUT_ANISTDigit   = "*"
```

6. What, if any, delimiting digits are sent before/after DNIS?

See explanations of questions 4 and 5 above for replacing ANI with DNIS.

Example scenario: Inbound used "*" after DNIS, outbound uses DNIS with no delimiter

— **For inbound calls:**

```
All BOOLEAN_t CDP_IN_DNIS_KP_Needed    = 0
All DIGITSTRING_t CDP_IN_DNISKPDigit   = "*"

All BOOLEAN_t CDP_IN_DNIS_ST_Needed    = 1
All DIGITSTRING_t CDP_IN_DNISSTDigit   = "*"
```

— **For outbound calls:**

```
All BOOLEAN_t CDP_OUT_DNIS_KP_Needed   = 0
All DIGITSTRING_t CDP_OUT_DNISKPDigit  = "*"

All BOOLEAN_t CDP_OUT_DNIS_ST_Needed   = 0
All DIGITSTRING_t CDP_OUT_DNISSTDigit  = "*"
```

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7.   If both ANI and DNIS are being sent, which is sent first?

If DNIS is sent first, the following parameters must be set to 1. If ANI is sent first, set to 0:

```
All BOOLEAN_t CDP_IN_DNIS_BeforeANI       = 1
All BOOLEAN_t CDP_OUT_DNIS_BeforeANI      = 1
```

Example scenario: Inbound ANI is first, outbound DNIS is first

```
All BOOLEAN_t CDP_IN_DNIS_BeforeANI       = 0
All BOOLEAN_t CDP_OUT_DNIS_BeforeANI      = 1
```

8.   Is an acknowledgement required after ANI?

Some protocols require a wink to acknowledge that ANI was received.

The following parameters must be set to 1:

```
All BOOLEAN_t CDP_IN_ANI_WINK_Needed  = 1
All BOOLEAN_t CDP_OUT_ANI_WINK_Needed = 1
```

Example scenario: no wink required after ANI inbound, no ANI outbound

```
All BOOLEAN_t CDP_IN_ANI_WINK_Needed  = 0
All BOOLEAN_t CDP_OUT_ANI_WINK_Needed = 0
```

9.   Is an acknowledgement required after DNIS?

Some protocols require a wink to acknowledge that DNIS was received.

The following parameters must be set to 1:

```
All BOOLEAN_t CDP_IN_DNIS_WINK_Needed  = 1
All BOOLEAN_t CDP_OUT_DNIS_WINK_Needed = 1
```

Example scenario: No wink required after DNIS inbound or outbound

```
All BOOLEAN_t CDP_IN_DNIS_WINK_Needed  = 0
All BOOLEAN_t CDP_OUT_DNIS_WINK_Needed = 0
```

Phase 3 – Connect

When the side being called is satisfied with the information presented, the next step is to connect the call.

The first value will match the idle pattern, and the second value matches the connect pattern. In this example, idle = 00xx, connect = 11xx:

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Application Note

```
/* Pattern to generate (inbound) or receive (outbound) to */
/* consider the call answered */
All CAS_SIGNAL_TRANS_t CAS_ANSWER = 00xx,11xx,50,50,0,80
```

When both sides issue this answer pattern, the call is connected. The audio path is now open to the users and the protocol is no longer involved in the call until disconnect (or call transfer, which is not covered in this application note).

Phase 4 – Disconnect

Disconnection can come from either side of the call.

If the remote side disconnects, the following pattern should be set to meet that pattern. The first value should equal the connected state (in the example, 11xx), and the second value will usually equal the idle state (in the example, 00xx):

```
/* Pattern to look for when the remote end disconnects a call */
All CAS_SIGNAL_TRANS_t CAS_REMOTE_DISCONNECT = 11xx,00xx,50,50,0,80
```

If the Dialogic board disconnects, the following pattern should be set to meet the appropriate pattern. The first value should equal the connected state (in the example, 11xx), and the second value will usually equal the idle state (in the example, 00xx):

```
/* Pattern to generate to hang up a call */
All CAS_SIGNAL_TRANS_t CAS_HANGUP = 11xx,00xx,50,50,0,80
```

After one side disconnects, the other side must also disconnect to fully release the call. This uses the same parameters set above. At this point, both sides are in the idle state awaiting the next call.

Troubleshooting in a T1 environment

After the T1 board is set, how does one determine if it is working? This section will discuss how to test the setup and troubleshoot some common issues.

Troubleshooting Dialogic® JCT Media Boards

After Dialogic services are started, the first thing to check is that the JCT Media Board is in sync with the switch. On the back bracket of the JCT Media Board, find four LEDs per trunk. A set of green, yellow, and red LEDs correspond to the alarm status. These are separated from another red LED by a loopback switch that is a loopback on/off indicator.

The three LEDs on the rear bracket of the firmware device indicate the alarm state of the signal being received. LED indicators will remain lit until the firmware is downloaded to the device. The colors indicate the following:

- × **Red LED** — The red LED lights up whenever the firmware device detects RLOS (Remote Loss Of Synchronization)
- ◇ **Yellow LED** — A yellow LED lights up whenever the firmware device receives an alarm indicating that a network span is receiving unsynchronized data from the firmware device.
- × **Green LED** — A green LED is lit whenever the firmware device is receiving a signal.

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Notes:

1. Red, yellow, and green LEDs will be lit when the system is powered up, regardless of whether or not a signal is being received.

2. No alarm handling is performed until boards are downloaded.

State	LEDs			
	Green	Red	Yellow	Loopback
F0	Off	Off	Off	Off
F1	On	Off	Off	Off
F2	On	Off	On	Off
F3	Off	On	Off	Off
F4	On	On	Off	Off
F5	On	On	On	Off
F6	On	On	On	On

State	Description
F0	Equipment powered off
F1	Board is operating correctly
F1	Receiving remote alarm
F3	Loss of signal or loss of sync
F4	Receiving all 1s (AIS)
F5	Combination of F2 + reception of many errors
F6	System is in the process of powering on

After starting Dialogic services, the JCT Media Board should have just a green light on the back of the board (state F1). If this is not the case, check the following:

1. Make sure the cable is installed correctly into the back of the JCT Media Board.

2. Make sure the framing and line coding are correct.

3. If it is not already set, set at least one trunk to be clockmaster and to derive clocking from the network (or LOOP).

4. Put the JCT Media Board into loopback mode and ask the Telco personnel to do a test. With the JCT Media Board in loopback mode and services started, the Telco personnel should see any signal they send out. If they do not see what they are sending, there is an issue between the Telco and the JCT Media Board that must be fixed.

If these tips do not isolate the issue, test the JCT Media Board next to make sure it can send and receive a signal. To do this, a loopback plug is needed, which allows a single span to see the signal that it is sending. To create a loopback plug (see Figure 5):

1. Using an RJ-48 connector, use one wire to connect the receive ring to the transmit ring (pin 1 to pin 4)

2. On the same RJ-48 connector, use another wire to connect the receive tip to the transmit tip (pin 2 to pin 5)

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Now, when the services are started, the JCT Media Board will see exactly what it is sending out. This should result in a green LED. If not, the board is may be in need of repair or replacement.
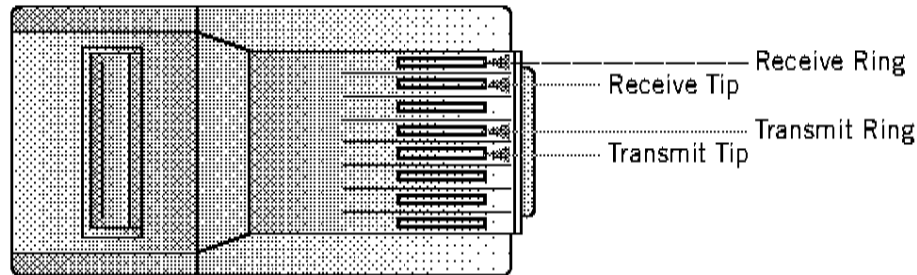

Receive Ring
Receive Tip
Transmit Ring
Transmit Tip

Figure 5. Loopback Plug

If the JCT Media Board is able to see its own signal and it emits just a green LED after the loopback plug test, then the JCT Media Board is most likely good and the issue is somewhere between the board and the Telco. Again, this may require more testing by the Telco to determine where the issue lies. At this point, it is useful to make sure that a CSU is in place in case the issue is with a weak signal causing the JCT Media Board not to see it.

If there is more than one span, it is possible to do a test using a loopback cable. To make a loopback cable, refer to Figure 5 and:

1. Using two RJ-48 connectors and an 8-wire T1 cable, connect the receive ring of each connector to the transmit ring of the other connector

2. Connect the receive tip of each connector to the transmit tip of the other connector

Note: Use the pins connections described in Figure 5 to determine the positions of the pins; in this case, connect pin 1 (Receive) to pin 4 (Transmit) and connect pin 2 (Receive) to pin 5 (Transmit) of the opposite connector.

With a crossover cable, two different trunks can be connected in back-to-back mode. Make sure that if testing in back-to-back mode with ISDN, one span is set to a user side protocol and the other is set to NT1. If all is set up correctly, a green LED should appear on both spans after services are started. If not, make sure that two trunks are set up for the same line coding and framing, as this is what can cause the board to lose synch.

At this point, the Dialogic services should be started and the back of the board should be showing a green light, which means that low level signaling is seen and is in sync. This does not necessarily mean that other issues cannot arise.

Testing with Demo Programs

One can verify that the T1 configuration is working correctly by using a demo program to make and take calls. The following are a few different programs that are available, depending on the technology.

Robbed-bit demos:

* **Bitset** — A utility that can both monitor and set the bit pattern for a particular channel. See the following website for more information — http://resource.dialogic.com/telecom/support/applets/winnt/bitset/index.htm
* **gc_basic_call_model** — Console-based Global Call application that can test multiple channels of inbound and/or outbound calls. It can test in back-to-back mode or just as one side of a test. This application is installed with the system release.

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The gc_basic_call_model is simple to use. To use this demo, you need to configure the .cfg file that goes with it, and then type gc_basic_call_model at a command prompt. The examples within the configuration file show how to set it up. Keep in mind that you can set up multiple channels for inbound and multiple channels for outbound. **If you're testing in back-to-back mode, make sure to select channels that match up to each other (for example, Outbound on dtiB1T1 and inbound on dtiB2T1).**

If calls cannot be made or answered successfully, it may be because the protocol is set up incorrectly. Use bitset, along with the gc_basic_call_model, to monitor the state of the bits at different stages of a call, and to set up the files accordingly. If bitset still does not fully help in understanding the bit patterns for all states, ask the Telco for a full specification of the protocol on the line, including:

1. Telco idle pattern

2. Telco seizure pattern

3. Telco wink pattern — Does it exist and if so, which bits wink?

4. Telco disconnect pattern

5. User idle pattern

6. User wink pattern — Does it have to wink, and if so what bits does it have to wink?

7. User seizure pattern

8. ANI / DNIS pattern — Use the guide above to ensure this is configured correctly. This may also correct calls that are slow to connect.

9. User disconnect pattern

10. Ask for the bit transitions for both a typical inbound and a typical outbound call, step–by-step (the above states will give a good guide as to what information is needed)

When troubleshooting, try to isolate the issue to a certain area or layer. For example:

- If the Global Call application is having troubles, first try fixing it with a Global Call demo. If that demo works, the issue is most likely with the application

- If the Global Call demo does not work, watch the output coming from the bitset while the calls are taking place. This may show a configuration issue.

- If calls are connecting, but seem to take too long, focus on the ANI/DNIS setup, as there may be a configuration issue that causes the protocol to wait for digits and only answers the call after that process times out.

ISDN demos:

* **Isdiag** — Installed with system release also; tests all basic ISDN functionality

* **gc_basic_call_model** — Works for ISDN as well

The first program to use to test an ISDN setup is isdiag. This console-based ISDN demo will show in detail whether a particular ISDN trunk is functioning correctly. To run isdiag on the first channel of the first trunk, type:

isdiag 1 1 t s

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In the upper right-hand corner of the isdiag window, is a display with several indicators. The most important is DCH (D-channel) – a 0 indicates the D-channel is up. All the other indicators should be 0 as well for a functioning ISDN line. If any of these are 1, contact the Telco and ask them to check the integrity of the line, to see if there is an issue, and to check if they have any way of restoring the line to full functionality.

By default, isdiag puts the requested channel into "waitcall" mode, meaning it is automatically waiting for a call and will answer as soon as a call is offered to that channel. To turn this feature off, use the "r" option when running isdiag – this puts isdiag into trace mode and then it works side-by-side with another application without interfering.

If Dialogic services are started and the lights on the back of the board are green, but a call cannot be received, the following can be tried:

1. Make sure the correct protocol is specified for the setup.

2. Especially if the line is a new installation, use isdiag to send an "in service" maintenance message (option 3). Sometimes the Telco will not put a line into service until specifically requested to do so, and sending this message gives them that request.

3. Use isdiag to capture a D-channel trace so the behavior can be analyzed and possibly spot why a call is failing (option 10).

4. Use isdiag and try to accept a call.

5. Use gc_basic_call_model and try to accept a call.

6. Use gc_basic_call_model or isdiag and try to make an outbound call.

7. If you have more than 1 ISDN span, set one span up as NT1 and the other as a user protocol and try to make calls in back-to-back mode, using a crossover cable. To do this, run two instances of isdiag or run gc_basic_call_model with both inbound and outbound channels set up. *If testing in back-to-back mode, make sure to select channels that match up to each other (for example, Outbound on dtiB1T1 and inbound on dtiB2T1).*

    isdiag 1 1 t s
    isdiag 2 1 t s

If an inbound call can be received but an outbound call cannot be made, an analysis of D-channel traces showing a successful inbound call and a failed outbound call can pinpoint differences that led to the failure.

If some inbound calls are failing, and review of D-channel traces show that the call is quickly rejected by the Dialogic side with cause code 34 (no circuit available) or 44 (requested channel not available), it may be due to slow call cleanup. By default, Dialogic® Springware firmware automatically sends the ISDN Release Complete message, thus freeing the channel. It is expected that the host will clean up the call quickly enough to be able to handle the next call. However, if that does not happen, a new call may be presented before the host library is ready to accept it. The result is a rejected call. Enabling host-controlled release prevents this situation by having the firmware only send the Release Complete message after gc_ReleaseCall is called. This ensures the host is ready to accept the next call. To enable the host controlled release, modify this parameter in the appropriate .prm file (that is, 4ess.prm) and restart Dialogic services:

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```
;--- ISDN feature list
;--- this parameter uses bit masks
; ;--- 01H = Layer 2 access active (default = inactive)
;--- 02H = Enable Double Call Feature
;--- 04H = not used
;--- 08H = Enable Overlap Sending Feature
;--- 10H = Enable Host Controlled Release
;--- 20H = Programable startup conditions for L2, start Layer 2 in DOWN state
; (default UP)
;--- 40H = Programmable startup conditions for L2, start Layer 2 in DISABLED state
; (default UP)
;--- 80H = FAXBU OPTION, control sending of CALL_DEALLOC_ACK to the host
; when gc_ReleaseCall is called, send CALL_DEALLOC_ACK when RELEASE_COMPLETE
; is received from network only
0024 10
```

Note: Host controlled release is enabled by default in DM3.

Summary of common T1 issues and suggestions for general troubleshooting:

Issues	Troubleshooting Suggestions

Global Call application not able to make or answer any calls	• Try gc_basic_call_model demo
	• If gc_basic_call_model demo does not work:
	  o Robbed-bit demo: watch output from bitset during calls to try to identify protocol configuration issue
	  o ISDN demo: Review/compare D-channel traces

Robbed-bit: Calls taking too long to connect	• Focus on ANI/DNIS setup: o Enable/disable, correct number of digits, etc.
Robbed-bit: Inbound calls fail sporadically	• If every second call fails, look at disconnect pattern o Likely something gets "reset" on the second call that should have happened during disconnect • If failure is more sporadic, use available logs to isolate timing issues
ISDN: Inbound calls rejected	• If call arrives shortly after previous call disconnected, enable host-controlled release

Troubleshooting Dialogic® DM3 Media Boards

Troubleshooting on DM3 Media Boards employs the same basic theories as troubleshooting JCT Meida Board issues, but aside from gc_basic_call_model it requires the use of different utilities. Some of these utilities and their functionality are discussed in this section. Refer to the Diagnostics Guide from your Dialogic release for details on the utilities available to help troubleshoot DM3 boards.

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gc_basic_call_model — Can be used the same way for DM3 Media Boards as for JCT Media Boards.

CASTrace — A utility that monitors bit states of channels. This is similar to bitset for JCT Media Boards. One limitation of CASTrace is that it will only log bit transitions if they are already defined in the .cdp file. Any unrecognized transitions will not be understood, and therefore not logged. This can hinder troubleshooting incorrect protocol configurations.

Example Trace: Slow answer

Channels idle

```
[03/31 10:11:04.234] B1 L1 T1 Rx=0000 Tx=0000 +22859
```

Inbound seizure (Rx 0000 -> 1111)

```
[03/31 10:11:15.906] B1 L1 T1 Rx=1111 Tx=0000 +10656
```

Outbound wink (Tx 0000 -> 1111 -> 0000)

```
[03/31 10:11:15.937] B1 L1 T1 Rx=1111 Tx=1111 +31
[03/31 10:11:15.953] B1 L1 T1 Rx=1111 Tx=0000 +16
```

ANI / DNIS transfer (not shown in CAS Trace):

Outbound connect — Indicates ANI/DNIS info transfer complete. Note that it takes 60 seconds to move to this state.

```
[03/31 10:12:16.000] B1 L1 T1 Rx=1111 Tx=1111 +60047
```

Call disconnected by remote side (this is normal)

```
[03/31 10:12:23.468] B1 L1 T1 Rx=0000 Tx=1111 +7468
```

Call released from Dialogic side

```
[03/31 10:12:23.562] B1 L1 T1 Rx=0000 Tx=0000 +94
```

This type of scenario usually indicates that the digit transfer is not configured properly. The bit transitions are set up properly because the call connects and everything works, but the fact that it takes 60 seconds to acknowledge receipt of ANI/DNIS information indicates that a timeout actually occurred and the call was allowed to proceed without the expected information. In this case, a reconfiguring of the ANI/DNIS resolved the issue and calls started connecting in 1 to 2 seconds.

ISDNTrace – Similar to using isdiag to create a D-channel trace.

PSTNDiag – This program provides the ability to step through attempts to make outbound or accept inbound calls. It also provides several pieces of information about the configuration in a single GUI. This is helpful in identifying any problem areas. It can also be used to launch the CASTrace or ISDNTrace utilities.

Summary

This application note presented introductory material about T1 telephony interfaces, provided information to enable the reader to plan for ordering a T1 line for a specific solution, and finally related information for configuring Dialogic® boards and troubleshooting the boards should issues arise during the process.

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Application Note

Acronyms

AMI	Alternate Mark Inversion
ANI	Automatic Number Identification
B8ZS	Binary Eight Zero Substitution
BER	Bit Error Rate
CRC	Cyclic Redundancy Check
CSU	Channel Service Unit
DCM	Dialogic® Configuration Manager
DNIS	Dialed Number Identification Service
DSP	Digital Signal Processing
DSU	Digital Service Unit
DTMF	Dual Tone Multi-Frequency
ESF	Extended Superframe
ISDN	Interface Integrated Services Digital Network
MF	Multi-Frequency
NFAS	Network Facility Associated Signaling
NETREF	Network Reference
PRI ISDN	Primary Rate Interface Integrated Services Digital Network
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
RLOS	Remote Loss Of Synchronization
RLT	Release-Link Trunking
SF	Superframe
SIT	Special Information Tones
TBCT	Two-B Channel Transfer

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For More Information

Global Call Country Dependent Parameters (CDP) for PDK Protocols Configuration Guide –
http://www.dialogic.com/manuals/docs/globalcall_cdp_config_v7.pdf

Dialogic® System Release PCI 6.0 for Windows® —
http://www.dialogic.com/manuals/sr60winpci/default.htm

Dialogic® System Release 6.1 for Linux —
http://www.dialogic.com/manuals/sr61lin/default.htm

Dialogic® Host Media Processing 3.0 for Windows® —
http://www.dialogic.com/products/ip_enabled/download/hmp30/default.htm

Dialogic® Host Media Processing 3.1 for Linux —
http://www.dialogic.com/manuals/hmp31lin/default.htm

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