



AudioCodes

» BLADES BUSINESS LINE



SmartWORKS Users Guide v. 5.2.0

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Front Matter

Approvals and Compliance Notices

FCC Compliance

AudioCodes' SmartWORKS hardware complies with Part 68 of the FCC rules and the requirements adopted by ACTA. On the non-component side of each individual product board is a label that contains, among other information, a product identifier in the format US:AAAEQ##TXXXX. If requested, this number must be provided to the telephone company.

Company: Ai-Logix, Inc. Model: SmartWORKS PT1600 Registration Number: US:AAAEQ##TXXXX Complies With 47 CFR Part 68 This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation Made in the USA 

Agency Approvals and Homologations

A complete list of all agency approvals is available on the SmartWORKS CD-ROM.

Ringer Equivalence Numbers

The ringer equivalence number (REN) is used to determine the number of devices that may be connected to a telephone line. Excessive RENs on a telephone line may result in the devices not ringing in response to an incoming call. In most but not all areas, the sum of RENs should not exceed five (5). To be certain of the number of devices that may be connected to a line, as determined by the total RENs, contact the local telephone company.

On AudioCodes SmartWORKS hardware, the REN is part of the product identifier and has the format "US:AAAEQ##TXXXX." The digits represented by ## are the REN without a decimal point (e.g., if ## was 03 it would be a REN of 0.3).

Individual SmartWORKS product RENs are as follows:

SmartWORKS LD409	US:5SERC13BNPT00 AC – REN =<0.5
SmartWORKS LD409H	US:5SERC13BNPT00 AC – REN = <0.5
SmartWORKS LD809	US:5SERC13BNPT00 AC – REN = <0.5
SmartWORKS LD1609	US:5SERC13BNPT00 AC – REN = <0.5
SmartWORKS LD2409	US:5SERC13BNPT00 AC – REN = <0.5

Telephone Company Notices

The following notices relate to network damage, change notices, damaged hardware, and product repair.

NETWORK DAMAGE

In the event that any AudioCodes SmartWORKS hardware causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

CHANGE NOTICES

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of AudioCodes SmartWORKS hardware. If this happens the telephone company will provide advance notice in order for you to make necessary modifications to maintain uninterrupted service.

DAMAGED HARDWARE NOTICE

For repair or warranty information, call technical support at 732.469.0880 or call toll free in the USA at 800.648.3647. If the AudioCodes SmartWORKS hardware is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

PRODUCT REPAIR

No AudioCodes SmartWORKS hardware or component thereof is intended for user repair. Do not attempt to perform any product repairs.

Chapter 1

Using this Guide

Introduction

This user's guide covers both hardware and software installation of all SmartWORKS products as well as customer premises equipment (CPE) connectivity. Chapters are written in one of two formats: *common* or *product specific*. Chapters 4–9 are product specific and contain information that pertains to individual SmartWORKS products. The remaining chapters apply to the entire family of products.

Chapter Descriptions

The purpose of each chapter is described below:

- ["Introduction" on page 2](#) explains how to use this document and provides AudioCodes' contact information.
- ["Product Installation" on page 5](#) details the hardware and software installation process, including system requirements.
- ["Product Overviews" on page 15](#) provides product descriptions and outlines the common architecture of SmartWORKS products.
- ["SmartWORKS VR" on page 27](#), ["SmartWORKS DP and DP-eh" on page 27](#), ["SmartWORKS PT" on page 53](#), ["SmartWORKS NGX, NGXeh" on page 47](#), ["SmartWORKS AT" on page 119](#), ["SmartWORKS DT and DT-eh" on page 81](#), ["Chapter 8" on page 65](#), and ["SmartWORKS PCM and PCM-eh" on page 95](#) are product-specific sections that cover architectural variations, unique features, connection details, and hardware specifications.

Related Documents

For additional information, refer to the following documents:

- The *SmartWORKS Developer's Guide* located on the product CD-ROM.
 - The *SmartWORKS Function Reference Library* located on the product CD-ROM.
 - The *SmartWORKS Release Notes* located on the product CD-ROM.
 - The *SmartWORKS Utilities Guide* located on the product CD-ROM.
 - The *NGX Integration Guide* located on the product CD-ROM.
 - The *IPX Integration Guide* located on the product CD-ROM.
 - H.100 Hardware Compatibility Specification: CT Bus revision 1.0, ECTF
-

Document Version Control

The following has been added to this document since the last release:

TABLE 1: VERSION CONTROL

Page	Description
REV A	
48	corrected channel to timeslot mapping diagrams for E1 (CAS).

Contacting AudioCodes USA

Your feedback is important to maintain and improve the quality of our products. Use the information below to request technical assistance, make general inquiries, or to provide comments.

TECHNICAL SUPPORT

For programming, installation, or configuration assistance, use the following contact methods:

- Call technical support at 732.469.0880 or call toll free in the USA at 800.648.3647.
- Contact technical support via our online help system. Be sure to include a detailed description of the problem along with PC configuration, AudioCodes hardware, driver versions, firmware versions, a sample program that demonstrates the issue, and any other pertinent information.

To obtain an account for the online help system please contact technical support at blade-support@audiocodes.com.

SALES AND GENERAL INFORMATION

For sales and general information, use the following contact methods:

- Call us at 732.469.0880 or toll free from the USA at 800.648.3647.
- Fax us at 732.469.2298.
- E-mail us at bladesinfo@audiocodes.com
- Visit our web site at www.audiocodes.com/blades.

MAILING ADDRESS - USA

Ship packages or send certified mail to us at the following address:

AudioCodes USA, Inc.
27 World's Fair Drive
Somerset, NJ 08873 U.S.A.

Chapter 2

Product Installation

Overview

The following section details the hardware and software installation process for the entire SmartWORKS family of products.

Installation Requirements

Prior to installing any of the SmartWORKS products, ensure the requirements are met.

NOTE: These units are for use only with compatible UL listed PCs or servers.

HARDWARE

The hardware requirements are as follows:

Host computer processor

300 MHz Intel® Pentium® II or better.
Multiprocessor systems are supported.

RAM

Minimum of 1 MB of RAM per SmartWORKS board

Power Requirements

The computer must supply 3.3V to the PCI slots.

NOTE: A 3.3V power supply to a computer's PCI slots is standard for ATX motherboards. A system built with a passive backplane and single board computer should have an ATX power supply connected to the backplane. SmartWORKS boards require 2.5Amp @ 3.3V per board.

Media drives

CD-ROM drive.

Hard Drive space

1 Gigabyte of free hard drive space.

PCI SPECIFICATION

PCI local bus specification Revision 2.2 or later.

PLATFORMS

SmartWORKS release for Windows supports the following platforms:

Microsoft® Windows® 2000, (Service Pack 3 is required)
Microsoft® Windows® XP, (Service Pack 1 is required)

Microsoft® Windows® 2003 Server 32 -Bit
Microsoft® Windows® 2008 Server 32 -Bit

SmartWORKS release for Linux supports the following platforms:

Special Linux releases are available for the following:
RedHat Enterprise Server 4.0 AS
RedHat Enterprise Server 4.0 ES

RedHat Enterprise Server 4.0 WS
Suse Enterprise Server 10 - x86
Suse Enterprise Desktop 10 -x86

DEVELOPER ENVIRONMENTS

Windows Developers

In addition to the platform requirements above, the Microsoft Visual C++® 6.0 service pack 5 should be installed for application development.

Installing a SmartWORKS Board

This information pertains to the entire SmartWORKS family of boards.

ELECTROSTATIC DISCHARGE PRECAUTIONS

SmartWORKS boards are electrostatic sensitive, and can be damaged by static electricity. To prevent possible damage, be sure to wear an electrostatic discharge (ESD) grounded wrist-strap whenever handling boards. Also, SmartWORKS boards should be installed in a static-safe work area (which includes a static-safe surface).

INSTALLING A BOARD

Assuming the hardware and platform requirements are met, SmartWORKS boards are installed in a standard PCI or PCI express slot. For systems containing multiple boards, use a TDM bus cable (MVIP or H.100) to establish connections between each board.

NOTE: If you are installing an NGX MX80 expansion card, refer to “Installing an MX80 Expansion Card” on page 62.

To install a SmartWORKS board, perform the following steps:

1. Turn off and unplug the host computer, including any additional peripherals that may be connected; then, remove the PC cover.
2. Before installing a board, write down the serial number(s). Insert the board into an available PCI slot. You may need to remove a cover bracket. When the board is in the PCI slot screw the board into the chassis.

Note: If you're using multiple boards which must communicate with one another, install a bus cable. Jumper J8 must be closed to enable clock termination of the TDM Bus. For the location of jumper J8, see your product's corresponding section of this manual.

3. Restart your computer and verify that the green LED indicator CR-17 is ON. For the location of CR-17, see your product's specific chapter. Upon power-up the CR17 is ON indicating presence of 3.3V. This also holds true for all SmartWORKS products with the exception of SmartWORKS NGX. For SmartWORKS NGX LED functionality see [Chapter 7, “Board Status LEDs,” on page 56](#).

NOTE: Windows 2000 automatically detects that new hardware has been installed and prompts you with an Add New Hardware Wizard. For instructions, see “Windows 2000, 2008 and XP” on page 8 of the software installation procedures.

Installing the SmartWORKS Software

If you are using Windows 2000 or XP, follow the instructions detailed below. For Linux instructions, see ["Linux" on page 9](#). Note that you must complete the hardware installation process prior to installing the software.

The SmartWORKS system allows for a silent install option. For details refer to the section that describes silent installation.

NOTE: NtiServices (NtiSrv.exe) is automatically installed and enabled when SmartWORKS is installed. More information is available in the SmartWORKS Developer's Guide

WINDOWS 2000, 2008 AND XP

Before running SmartWORKS applications, Windows 2000 Service Pack 3 must first be installed.

To install the SmartWORKS software on Windows 2000 or XP, perform the following steps:

1. Insert the SmartWORKS CD-ROM.
An auto-installer displays the Main Menu.
2. Click **Products>SmartWORKS Series>Install Software**.
3. Click the *Install Software* option that appears on the right hand side. Proceed as prompted by the Install Shield Wizard. All files are copied into Program Files/Ai-Logix/SmartWORKS unless you specify another folder. The install shield copies the following:
 - Documentation - all product documentation in .pdf format.
 - Firmware - firmware files for all AudioCodes' products
 - Inc - software header files
 - Lib - board driver
 - Samples - files of sample applications used for development purposes
4. Upon completion, the SmartControl panel is displayed. You can close this window and return to the Main Menu.

NOTE: AudioCodes' documentation is delivered in Portable Document Format (PDF). If your PC does not have Adobe Acrobat Reader®, which is required to view a PDF, then install it from the Install Products menu of this CD-ROM before rebooting your PC.

To view the files that were installed with the SDK, see ["SDK Contents" on page 12](#). Note that the Main Menu of the installer application provides access to AudioCodes' Internet resources such as the company web site and valuable e-mail addresses.

5. The next step is to upgrade the board's firmware. For instructions to upgrade firmware, proceed to ["Upgrading a Board's Firmware" on page 10](#).

LINUX

If you are using Linux, follow the instructions detailed below. Note that you must complete the hardware installation process prior to installing the software.

To install the SmartWORKS software on Linux, perform the following steps:

1. Log on as **root**.
2. Download the software from the customer support website:
 - Mount your CD ROM device (if you haven't already) with the command:

```
# mount /media/cdrom
```
 - Change to the directory you want the software to be installed. The `/usr/src` directory is recommended.

```
# cd /usr/src
```
 - Enter the command:

```
# tar -zxvf /dev/cdrom/linux/SmartWORKS-version-os.tar.gz
```

(This will make a directory structure containing all required SmartWORKS components.)
3. Install the SmartWORKS driver. Once you have the AudioCodes board(s) installed in the system, install the AudioCodes SmartWORKS driver and device nodes as follows:
 - Change to the following directory:

```
# cd /usr/src/SmartWORKS-version-os
```
 - Enter the following command to load the driver and install the device nodes:

```
# ./SmartWORKS install
```

The system will display the following:

```
Linux Version = kernel version
Installing NtiDrv.....
Creating /dev/mtbrd0
Creating /dev/mtbrd1
Creating /dev/mtbrd2
Creating /dev/mtbrd15
#
```

The driver is then up and running.

REMOVE SMARTWORKS

To install any future releases, the previous release must first be removed with the following command:

```
# ./SmartWORKS remove
```

Upgrading a Board's Firmware

To enhance product performance, the SmartWORKS series of firmware is constantly being improved. New firmware may have been developed since your board was packaged. To ensure your board has the most current functionality, perform the firmware upgrade procedure detailed below.

For the latest firmware, contact customer service for information on our latest version and access to our ftp site. With each software install, the latest firmware versions are loaded onto your computer. Do the following to install the correct firmware to your board. The SmartWORKS utility used to upgrade the firmware is compatible with Windows and Linux operating systems.

To upgrade a board's firmware, perform the following steps:

1. Click **Start>Programs>Ai-Logix>SmartWORKS>SmartWF**.
Windows opens the SmartWF utility.
2. Click **File>Write Flash Image**.
A dialog box allows you to select and download a new firmware image to the SmartWORKS board.
3. Select the products corresponding firmware file.

NOTE: Firmware files are located where SmartWORKS was installed. The default directory is: C:\Program Files\Ai-Logix\Firmware.

SmartWF will not allow improper firmware to be loaded. For example, VR firmware can not be loaded on a PT board..

COMMAND LINE UTILITY

A command line version of the flash upgrade is available for Linux. Two options are available:

-u = unattended mode. Firmware will automatically be updated in needed.

-i = Interactive mode. User controls upgrade process.

After the command line argument you need to add smartwf.ini. Make sure smartwf.ini is located in the same directory as the firmware.

For example: smartwf -u smartwf.ini

NOTE: All command line prompts use lower case letters only.

SILENT INSTALLATION

As of the SmartWORKS 5.2 release, a silent installation option is available. There will be no windows displayed except for those coming from the Windows operating system.

The silent installation is available by executing the msiexec program using the /qn option. Users also have the ability to omit specified firmware and / or documentation during the install process.

SYNTAX

The syntax for installing a package with Msiexec is as follows:

Msiexec /i {package name}

To initiate silent install, put a 'qn':

```
Msiexec /i package /qn
```

To add features to the installation you must add ADDLOCAL="{some feature}, {another feature}" to the command line.

Silent no documentation, no SDK, dynamic config install

```
Msiexec /i package ADDLOCAL="Cpl,Minimum,DynamicConfig" /qn
```

EXAMPLES

Install package foo

```
Msiexec /i foo
```

Install package foo silently

```
Msiexec /i foo /qn
```

Install package foo silently with a feature called 'featureone'

```
Msiexec /i foo ADDLOCAL="featureone" /qn
```

Install package foo silently with features called 'featureone' and 'featuretwo'

```
Msiexec /i foo ADDLOCAL="featureone,featuretwo" /qn
```

No HPX Install

The HPX feature must not be on the command line to omit this feature from the install.

No Documentation Install

The Documentation feature must not be on the command line to omit this feature.

COMMAND LINE OPTIONS

Minimum – The driver, utilities, dlls and readme and license

Cpl – the control panel

DP – the firmware for the DP boards

DT - the firmware for the DT boards

LD - the firmware for the LD boards

NGX- the firmware for the NGX boards

PCM – the firmware for the PCM boards

IPX – the firmware for the IPX boards

HPX – the HPX service and WinPCap

DynamicConfig – the registry key for the dynamic configuration feature

Documentation - the SmartWORKS documentation

SDK - includes the following

- Apps – the SmartView application

- Inc – the header files for development

- Lib – the library files for development

SDK Contents

The files detailed below are copied to your PC during the SDK installation process. To locate these files, view the Readme file by clicking Start>Programs>Ai-Logix>SmartWORKS.

Release Notes

General notes about the release installed.

SmartWORKS User's Guide

The universal user's guide for the SmartWORKS family of products.

SmartWORKS Developer's Guide

The developer's guide for the SmartWORKS SDK. This manual details all of the custom API functions included in the SmartWORKS SDK, theories of operation for the SmartWORKS product family, and implementation instructions for SmartWORKS features.

SmartWORKS Utilities Guide

A user guide explaining each of the SmartWORKS utilities: SmartWF, SmartView, SmartProfiler and the SmartControl panel.

NGX Integration Guide

Designed to aid developers working behind proprietary PBXs using the SmartWORKS NGX. Provides D-channel information, example call scenarios and observed behavior per PBX model.

IPX Integration Guide

Designed to aid developers working behind proprietary IPPBXs using the IPX. Provides a detailed look at VoIP call recording, D-channel information, example call scenarios and observed behavior per PBX model.

Product Quick Installs

Each product in the SmartWORKS family has its own Quick Install guide in PDF format that walks you through the basic installation of the product.

NOTE: Linux users must be aware that all command line prompts require lower case letters.

SmartView

SmartView is a sample application provided by AudioCodes that demonstrates and the functionality of SmartWORKS products.

SmartWF

The SmartWF application is used to upgrade firmware images on the SmartWORKS product family.

SmartControl

SmartControl is a control panel applet that allows you to configure products and observe various board conditions.

SmartProfiler

The SmartProfiler is used to profile common signals used by a telephone network, ie busy, dial tone. This application is used on conjunction with the Call Progress Monitoring (CPM) feature.

SAMPLE APPLICATION CODE

To better understand how to call and analyze API functions, three application code samples are provided on the SmartWORKS CD. Each sample application code has a Windows Project Workspace file that you can compile to use as a demonstration application.

The files and directories are detailed below:

NOTE: Visual Studio (C++) is required to open and compile these files.

A GUI application that illustrates a sample recording process when using the SmartWORKS DP boards.

CD: \SmartWORKS\Sample\DPApp

Record and Play when using the buffer

CD: \SmartWORKS\Sample\NtiBuffer

Record data and save directly to a file:

CD: \SmartWORKS\Sample\NtiFile

Record data when using the streaming method:

CD: \SmartWORKS\Sample\NtiStream

Record data when using the streaming method, with Watermark thresholds:

CD: \SmartWORKS\Sample\NtiWatermark

Moving Ahead

Once the board and its software is installed, for architectural details and common features proceed to [“Product Overviews” on page 15](#). For individual product configuration and connectivity information, refer to your product’s corresponding chapter. The product specific chapters are as follows:

- [Chapter 4, “SmartWORKS VR,” on page 27.](#)
- [Chapter 5, “SmartWORKS DP and DP-eh,” on page 27.](#)

- Chapter 6, "SmartWORKS PT," on page 53.
- Chapter 7, "SmartWORKS NGX, NGXeh," on page 47.
- Chapter 8, "Introduction - SmartWORKS LD," on page 66
- Chapter 10, "SmartWORKS AT," on page 119.
- Chapter 9, "SmartWORKS DT and DT-eh," on page 81.
- Chapter 12, "SmartWORKS PCM and PCM-eh" on page 95

Chapter 3

Product Overviews

Product Descriptions

For an overview of each product that is contained in the SmartWORKS family, refer to the sections below.

SMARTWORKS VR

The SmartWORKS VR (Voice Resource) board is designed specifically for DSP-intensive applications in the CTI market. The SmartWORKS VR (formerly called SmartDSP VR) hosts Multiple Texas Instruments TMS320C5402 DSP chips for intense raw processing power. The SmartWORKS VR can be combined with an AudioCodes or third party network interface board to dramatically increase an application's ability to process data.

The SmartWORKS VR has the flexibility to trigger call recording, write to multiple CODECs (including G.729A if using the SmartWORKS VR6409), mix (or sum) voice data, perform voice processing, and much more. The SmartWORKS VR is often used in applications such as Call Logging, Interactive Voice Response (IVR), Voice Messaging, and Speech Recording.

SMARTWORKS DP

Our T1/E1 board, formerly named SmartTAP DT, is available in two versions: 3209 and 6409. The 3209 supports one T1 or E1 trunk and up to 30 channels(E1), and the 6409 supports two T1 or E1 trunks and up to 60 channels(E1). Both versions have a high impedance (Z) interface and passively tap a T1 or E1 trunk in parallel, providing audio data without interrupting service.

Inbound and outbound traffic is monitored while dedicated on-board DSPs provide simultaneous recordings of up to 60 channels per board or 512 channels per system. The SmartWORKS DP is typically used in Audio Recording, Call Monitoring, and Call Logging. Other intended applications include the following capabilities:

- Signaling protocol analyzer for DASS2, CAS, and ISDN
- Performance monitoring of T1 or E1 trunks
- Billing information generation (CDR) for billing systems

SMARTWORKS NGX

Our scalable board that contains on-board DSP resources is an alternative to the DAC ISA. The SmartWORKS NGX is designed for call centers that require voice data management and PBX integration allowing call recorders to track multiple agents throughout a call center.

When an agent logs into the call center, the SmartWORKS NGX can decode the Agent ID and pass the information back to the call recording application. Thereafter, every feature key, each call taken, and all telephone actions performed by the agent are automatically decoded and passed to the call recording application. These features provide your call recording application a competitive advantage not found in other systems.

SMARTWORKS LD

The SmartWORKS LD combines the functionality of both active and passive analog support. This board is used to passively tap an analog loop or ground start 2-wire trunk. AudioCodes' Voltage-Sense technology is also programmable using SmartWORKS APIs. A change in line voltage produces an event for either starting (receiver taken off-hook) or stopping (receiver placed on-hook) recording.

Each voice resource has a full set of detectors, encoders, and decoders along with numerous voice processing functions such as automatic gain control (AGC), automatic volume control (AVC) and adaptive echo cancellation.

Each line interface has a forward and reverse loop current detector, ring detector and a hook switch. In the ON-HOOK mode the line interface has the following capabilities: recording, Caller ID detection, alert tone generation, and ring detection.

SMARTWORKS DT

Our digital terminating single slot board that is equipped with two T1 or E1 interfaces and a full set of voice resources. The DT terminates two T1 or E1 trunks, which are selectable through the SmartControl applet. Each board has two framers that are connected with voice resource channels through the programmable TDM switch. Intended applications include the following capabilities:

- Interactive Voice Response (IVR)
- Voice Messaging
- Speech Recognition
- Call Logging
- ACD Routing

SMARTWORKS PCM

PCM32 is the common name for the proprietary BT Syntegra ITS switch using PCM32 Megalink protocol. AudioCodes' SmartWORKS PCM3209 and PCM6409 boards include PCM32 trunk interface(s) with Voice Resources.

The SmartWORKS PCM series cards have been designed to combine the same features and capabilities of SmartWORKS cards with a PCM32 front end.

The front end of the cards have been designed with a standard RS485 electrical interface that is optically isolated from the board. RJ45 connectors are used to connect the cards to the network. The PCM3209 has one trunk while the PCM6409 is built with two. Each trunk supports up to 32 channels.

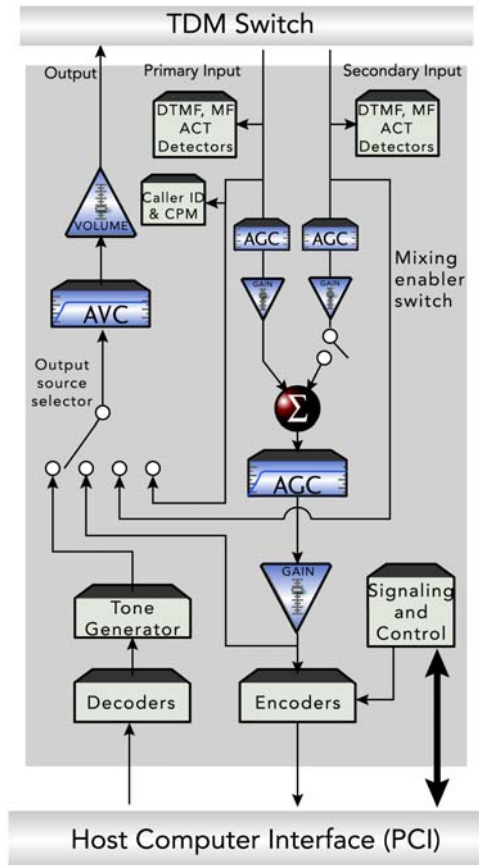
NOTE: New SmartWORKS products are in development. For information about our latest products, visit our web site at <http://www.audiocodes.com/blades>.

Common Architecture

A core set of powerful DSP algorithms are the foundation of all SmartWORKS boards. These algorithms enable industry standard codecs, echo cancellation, automatic gain control, DTMF, MF, CallerID and activity detectors.

The SmartWORKS DSP channel architecture illustrated below is a logical representation of the voice resource channel that is common to all SmartWORKS products. The diagram shows major functional blocks and how they are interconnected.

Figure 3-1: SmartWORKS Logical Card Model



BOARD CHARACTERISTICS

The following are characteristics common to all SmartWORKS boards.

INPUTS

Each channel has two inputs: a primary input and a secondary input which facilitates recording. Each input has its own set of DTMF, MF, and activity detectors (Both MF R1 and R2 tones are detected). The primary input also has Caller ID detection and a Call Progress Monitoring capabilities. All detectors can be enabled or disabled via the SmartWORKS API.

On analog systems, the primary input is the main source of voice data. The secondary input is used when recording both sides of a trunk conversation (T1 or E1).

INPUT MIXER

Each logical channel has a two-way mixer that can be used to combine the primary and secondary voice data inputs. The mixer is enabled or disabled through software control on a per channel basis. These inputs are very useful when recording digital trunks (T1 or E1) in which case the voice logger has to add (mix) both sides of the conversation.

HOST INTERFACE

The host interface is used to move voice data to and from the logical channel. It is also used to control how event data is communicated. The host interface is a 33 MHz, PCI2.2 compliant bus.

TDM Bus

Logical channels connect to and communicate with other devices in the system through a TDM switch. By default, each channel is connected to the local TDM switch via two inputs and one output. Along with the local bus, the TDM switch connects to other boards in a system via an MVIP or H.100 interface (global bus). The user can connect any logical channel to a desired MVIP or H.100 timeslot using API function calls.

TDM ENCODING

When boards are connected using a bus cable, TDM switch timeslots must be configured for either A-law or μ -law. All boards in a system must use the same TDM encoding type. TDM bus encoding is configured using the SmartControl Panel applet or a SmartWORKS API.

NOTE: TDM Encoding must be set on all SmartWORKS NGX cards. This is required even when boards are not connected with a Bus cable.

OUTPUTS

All SmartWORKS boards are equipped with a 3-pin audio jack that can be used to listen to audio in real-time. The audio jack is designed for use with an AudioCodes 3.5mm to 3-pin connector audio cable, which facilitates a microphone/headset.

NOTE: The output section of the logical channel can be configured for either live monitor or playback, but not both at the same time.

FEATURE SET

All SmartWORKS boards have been designed to provide a complete call recording solution. The following section outlines the features common to all SmartWORKS products.

CALL PROGRESS MONITORING

SmartWORKS' Call Progress Monitoring (CPM) tracks the progress of outbound calls by identifying possible call results (or call states). SmartWORKS CPM was designed around a signal processing service able to detect and recognize of a wide range of Call Progress Tones (CPT) - such as dial tone, busy signal, or ringback. CPM has pre-programmed profiles for typical call progress tones used in North America. These profiles can be replaced at any time to better suit the needs of a particular application. For more information refer to the application note: *Call Progress Monitoring*.

CALLER ID

All SmartWORKS boards support Bell 202 and V.23 standards. These standards are used on analog systems where caller ID is passed over the voice channel (SmartWORKS LD).

Boards which support ISDN rely on call control structures to obtain this information (PRI - SmartWORKS DT or SmartWORKS DP; BRI - SmartWORKS NGX).

Some PBX models also pass this information into the phone LCD display. When this option is present, the Caller ID can be obtained from D-channel (SmartWORKS NGX).

ACTIVITY DETECTION

The Activity Detector is capable of monitoring the line for activity and silence. It features programmable parameters such as activity threshold, silence threshold, minimum silence, and minimum activity duration. The events generated by this feature are enabled by default and can be disabled using the **MTSetEventFilters()** API.

AUTOMATIC GAIN CONTROL

Each board features an optional automatic gain control (AGC) followed by a gain stage. AGC handles a wide, dynamic range that is typically encountered when a voice logger is connected close to a PBX. By default this feature is disabled, but can be enabled using the **MTAGCControl()** API.

A fixed gain stage is provided to adjust the overall amplitude of the received voice data. This gain stage can be set to a value from -50 dB to +24dB.

AUTOMATIC VOLUME CONTROL

Each board has the capability to take the output of a channel mixer, apply automatic volume control (AVC) to it, and adjust the output by programming volume control. The resulted voice stream must be connected to a selected timeslot on the globalTDM bus.

A fixed gain stage (referred to as "volume") is provided to adjust the overall amplitude of the transmit voice data. This gain stage can be set to a value from -50 dB to +24dB.

DTMF/MF TONE DETECTION

Each input has its own set of DTMF, MF, and activity detectors (Both MF R1 and R2 tones are detected). The following DTMF digits can be detected: 0 - 9, *, #, A, B, C, D. When a DTMF/MF tone is detected, the events EVT_DIGIT or EVT_MFTONE are generated with the digit passed into the subreason field.

ECHO CANCELLATION

Each board is capable of providing adaptive echo cancellation, however it is reserved for terminate products (SmartWORKS DT or AT). Echo cancellation is located between the primary and secondary inputs on all SmartWORKS boards.

TONE GENERATOR

Each logical channel has a programmable tone generator that can be used to play tones to the TDM switch. User applications can generate standard DTMF tones of programmable amplitude and duration. The **MTPlayTone()** function allows generation of single and dual frequency tones with frequency components from 300 - 3400 Hz, programmable amplitude, duration and cadence (e.g. SIT tones, MF tones, dial tone etc.).

DTMF tone duration and tone pause have a fixed minimum of 75 ms. Additionally, the DTMF low gain and high gain are respectively fixed at 9500 and 12000 (which meets FCC requirements).

ALERT TONE

Alert tone generation is supported for call logging applications. The generated alert tone is also mixed with recorded data to minimize distortion to the recording.

NOTE: Though passive tap cards support this feature, they are unable to play the sound out onto the line. Tones can be played out a timeslot on the global bus or passed into the recording.

ENCODERS / DECODERS

SmartWORKS offers a wide range of voice encoders and decoders. Digitalization methods are programmable on a per channel basis. You may select a GSM 6.10 decoder and a 32 kbp/s G.726 encoder to be used at the same time on any given channel. Table 3-2 lists the currently supported vocoders (voice codec).

TABLE 3-2: CURRENTLY SUPPORTED VOCODERS

SmartWORKS Compatible CODECs
μ-law 8-bit PCM 64 k bps
A-law 8-bit PCM 64 k bps
μ-law PCM ⁺ (recording only)
A-law PCM ⁺ (recording only)
Linear signed 8-bit PCM 64 k bps
Linear unsigned 8-bit PCM 64 k bps*
Linear signed 16-bit PCM 128 k bps *
Linear unsigned 16-bit PCM 128 k bps
Linear signed 6 Khz, 16-bit PCM, 96 k bps

TABLE 3-2: CURRENTLY SUPPORTED VOCODERS (CONTINUED)

SmartWORKS Compatible CODECs
GSM 6.10 13 k bps
Microsoft GSM 13 k bps *
Dialogic (Oki) ADPCM 24 k bps
Dialogic (Oki) ADPCM 32 k bps
G.723.1 5.3 k bps
G.723.1 6.3 k bps**
G.729A 8 k bps
G.726 ADPCM 16, 24, 32, 40 kbps
G.726 ADPCM 16, 24, 32, 40 kbps MSB first
μ-law 8-bit PCM 64 k bps, with energy tagging#
A-law 8-bit PCM 64 k bps, with energy tagging#
G.723.1 5.3 k bps, with energy tagging#

* Supports WAV headers

**Not supported on the NGX

+ Users must disable mixing of the channel inputs

Digital tapping only

Live Monitoring

All AudioCodes boards support live monitoring. This feature enables the user to route incoming voice data to the global TDM switch via the output side of the logical channel. Here Automatic Volume Control (AVC) and gain can be applied without effecting the recorded signal.

To listen to audio that is being played onto a timeslot use the API *MTAJListen()*. The following section explains the APIs which control output to the CTBus.

CT Bus Switching Control

TDM CONNECTIONS

All SmartWORKS boards can be configured to connect channel input or DSP output to the global CT bus, MVIP or H.100.

Before connecting output to the CT Bus, the parameter *TDM Encoding* must be set. The board design requires all channels on the TDM bus to use the same encoding: either μ-law or A-law. Generally speaking, the following holds true: μ-Law is used in North America and Japan, A-Law is used in Europe and in areas outside of North American influence.

Using the Control Panel select the **Board** tab and set TDM Encoding.

The TDM switch is a central component of the SmartWORKS family of products. The following CT Bus switching control information applies to all SmartWORKS boards.

On the global side the TDM switch is connected to the MVIP and H.100 bus. On the local side the switch is connected to DSP resources (channels, summation resources, audio codec) and telephone network interfaces when applicable.

Only one bus can be used at a time; either MVIP or H.100. When using the MVIP bus, boards can be set to one of two modes: *Master* or *Slave*. When using the H.100 Bus, boards can be set to one of three modes: *MasterA*, *MasterB*, or *Slave*. Additionally, when using the H.100 bus you can designate the bus speed for the first 16 streams.

NOTE: In some applications it is advantageous to set all boards to the Master setting and not connect them with a bus cable.

MAKING A CONNECTION TO THE CT BUS

The API offers various functions to connect the channel output/input to the CT bus. The API used depends on the type of board used in the field and the implementation. Refer to the *SmartWORKS Developer's Guide* for more information. Generally speaking, the following holds true:

MTSetOutput()/MTSetInputs() - supported by all SmartWORKS boards, but recommended with SmartWORKS NGX and DP. When used, the channel source must be defined by using ***MTSetOutputSource()***. The incoming data is passed from the DSP output into the CT Bus plus processed on the board for recording. The following can still be applied to incoming data: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain.

MTSetCTRoute() - recommended for use with SmartWORKS DT and SmartWORKS LD boards. It is important to note, the audio passed onto the CTBus cannot be controlled with any gain/volume control.

MTSetFramerOutput() - used by the SmartWORKS NGX, DP and SmartWORKS DT boards. When is API is used, framer output is passed directly to the CT Bus and into the board's DSP for processing. The data passed onto the CT Bus by-passes the boards DSPs therefore the following in not applied: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain.

MTSetInputs() - routes data from the CT Bus via the boards primary and secondary inputs. Supported by all SmartWORKS boards.

H.100 OVERVIEW

The main features of H.100 are:

- 32 data streams and up to 4,096 timeslots.
- Programmable data rate from 2.048 to 8.192 Mbps for the first 16 streams.
- Fixed rate of 8.192 Mbps for the second group of 16 streams.
- Two sets of timing signals that allow for implementation of the clock fallback mechanism: CT_C8_A/B and CT_FRAME_A/B.

NOTE: For a full description of the H.100 bus, visit [ECTF online](#).

MVIP OVERVIEW

The MVIP bus has 16 streams, each stream has 32 timeslots. Only one board can be a bus master.

In MVIP-90 nomenclature, MVIP streams are categorized as follows:

- Streams 0-7 are called forward streams
- Streams 8-15 are called reverse streams

Timeslots on MVIP bus are numbered from 0 to 255, and according to MVIP conventions network boards *TALK* on forward streams and *LISTEN* on reverse streams. Additionally, resource boards *TALK* on reverse streams and *LISTEN* on forward streams.

Board Control

Use the information contained below for identification and status purposes.

BOARD IDENTIFICATION

SmartWORKS boards are identified by the following series of numbers:

AudioCodes Vendor ID

0x1523

Device ID

0x1016

BOARD STATUS

The status of a SmartWORKS board is determined through LEDs. Each product specific section lists, identifies, and defines the LEDs for a particular board.

LED CR17 is the primary LED for all SmartWORKS boards. To learn more about board-specific LEDs, see the "Board Status LEDs" section of the following chapters:

- [Chapter 4, "SmartWORKS VR," on page 27.](#)
- [Chapter 5, "SmartWORKS DP and DP-eh," on page 27.](#)
- [Chapter 6, "SmartWORKS PT," on page 53.](#)
- [Chapter 7, "SmartWORKS NGX, NGXeh," on page 47.](#)
- [Chapter 8, "Chapter 8," on page 65](#)
- [Chapter 10, "SmartWORKS AT," on page 119.](#)
- [Chapter 9, "SmartWORKS DT and DT-eh," on page 81.](#)
- [Chapter 11, "SmartWORKS PCM and PCM-eh," on page 95](#)

BOARD NUMBERING

When the SmartWORKS driver loads, it scans all PCI slots of the system to locate AudioCodes boards. As the boards are located, the driver assigns Physical Board Numbers to each. These board numbers are assigned sequentially from zero and are linked to the address (or slot number) of the physical PCI slot the card is located in.

An AudioCodes SmartWORKS board with the lowest address becomes Physical Board 0. The board located in the PCI slot with the next higher address will become Physical Board 1. This process is repeated until all PCI slots are scanned.

This PCI slot may or may not be the absolute lowest numbered PCI slot in the system; it is simply the lowest in relation to the other PCI slots with boards inserted into them. The PCI address or slot number is generally noted on the system motherboard or passive back plane.

NOTE - If an additional board is inserted into a PCI slot that has a lower address than the previously installed boards, the additional board will become board 0, affecting all channel numbers on the system.

Chapter 5

SmartWORKS DP and DP-eh

NOTE: PCI express boards are available. Contact your sales representative for information on hardware availability.

Introduction

This section explains the SmartWORKS DP and DPeh products. The DP-eh is a full-sized PCI express product with an H.100 bus. For sake of documentation, both products are referred to as the SmartWORKS DP.

The SmartWORKS DP is a dual passive board designed to tap digital T1/E1 networks. The board taps the line before its destination (either the Central Office-CO or the Customer Premises Equipment-CPE) is reached. The tap itself is undetected by both the CO and the CPE (which consists of a PBX and individual phones or other communication equipment).

The following section outlines important information relative to features, installation, configuration and specifications of the SmartWORKS DP card.

UNIQUE FEATURES

The SmartWORKS DP has been designed to provide a complete call recording solution. The following section outlines board capabilities.

INPUTS

Each channel has two inputs: a primary input and a secondary input which facilitates digital trunk (T1 or E1) recording. As a result, a two-way mixer is available for each channel on the SmartWORKS DP board. By default, the mixer is enabled upon a successful load of the application.

NOTE: Both primary and secondary inputs are mapped respectively to the inbound and outbound traffic on the trunk(s). It is crucial to follow the proper wiring diagram.

Each input has its own set of DTMF, MF, and activity detectors (Both MF R1 and R2 tones are detected). The primary input also has Caller ID detection and a Call Progress Monitoring capabilities. All detectors can be enabled or disabled via the SmartWORKS API.

CALL PROGRESS MONITORING

SmartWORKS' Call Progress Monitoring (CPM) tracks the progress of outbound calls by identifying possible call results (or call states). The SmartWORKS CPM was designed around a signal processing service able to detect and recognize of a wide range of Call Progress Tones (CPT) - such as dial tone, busy signal, or ringback. CPM has pre-programmed profiles for typical call progress tones used in North America. These profiles can be replaced at any time to better suit the needs of a particular application. For more information refer to the application note: *Call Progress Monitoring*.

CALLER ID

All SmartWORKS boards detect Caller ID when it is passed over voice channels (supports Bell 202, V.23 standards). However, Caller ID is not passed over voice channels on digital networks. When using the SmartWORKS DP to tap T1/E1 lines, Caller ID is passed to the user application via a call control structure (MT_CC_CALL_INFO).

ACTIVITY DETECTION

The Activity Detector is capable of monitoring line activity / silence and features programmable parameters such as activity threshold, silence threshold, minimum silence, and minimum activity duration. The events generated by this feature can be disabled using the **MTSetEventFilters()** API.

AUTOMATIC GAIN CONTROL

The SmartWORKS DP offers optional automatic gain control (AGC) followed by a gain stage. The DP's AGC handles a wide, dynamic range that is typically encountered when a voice logger is connected close to a PBX. By default this feature is disabled, but can be enabled using the **MTAGCControl()** API.

AUTOMATIC VOLUME CONTROL

The SmartWORKS DP has the capability to take the output of a channel mixer, apply automatic volume control (AVC) to it, and adjust the output by programming volume control. The resulted voice stream must be connected to a selected timeslot on the global TDM bus.

tone GENERATION

All SmartWORKS boards are capable of tone generation. The SmartWORKS DP is a passive card, therefore tones are not played out onto the line.

ENCODERS / DECODERS

The SmartWORKS DP offers a wide range of voice encoders and decoders. Digitalization methods are programmable on a per channel basis. You may select a GSM 6.10 decoder and a 32 kbp/s G.726 encoder to be used at the same time on any given channel. All codecs are listed in this *SmartWORKS User Guide* (Chapter 3, "Encoders / Decoders," on page 21).

TDM CONNECTIONS

The SmartWORKS DP can be configured to connect to the global CT bus, MVIP or H.100. Initially, all channels are configured with both the primary and secondary inputs connected to the DSPs.

Before connecting any channel output to the CT Bus, a parameter *TDM Encoding* must be set. The board design requires all channels on the TDM bus to use the same encoding: either μ -law or A-law. Generally speaking, the following holds true: μ -Law is used in North America and Japan, A-Law is used in Europe and in areas outside of North American influence.

Using the Control Panel select the **Board** tab and set TDM Encoding.

MAKING A CONNECTION TO THE CT BUS

The API offers many functions to connect the channel output/input to the CT bus. The following functions are recommended for use with the SmartWORKS DP:

MTSetOutput() - The incoming data is passed from the DSP output into the CT Bus, plus processed on the board for recording. The following is still be applied to data passed onto the CT Bus: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain. **MTSetOutputSource()** must be used to select the data source.

MTSetFramerOutput() - framer output is routed directly to the CT Bus, and to the board's DSP for processing. The signal that passes directly from the Network Interface onto the CT Bus by-passes the boards DSPs therefore the following is not

applied: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain. A diagram is available in the *SmartWORKS Developer's Guide* where this API is explained.

MTSetInputs() - routes data from the CT Bus to the channel's primary and secondary inputs.

NOTE: Although MTSetCTRoute() is part of the SmartWORKS API, please note that it is not supported by the SmartWORKS DP.

ARCHITECTURE

DSP

At the center of the SmartWORKS DP are advanced DSPs (16 on the SmartWORKS 6409, and 8 on the SmartWORKS 3209).

CHANNEL COUNT

The maximum number of channels supported per board is line dependant:

TABLE 1: TOTAL CHANNEL NUMBERS PER BOARD

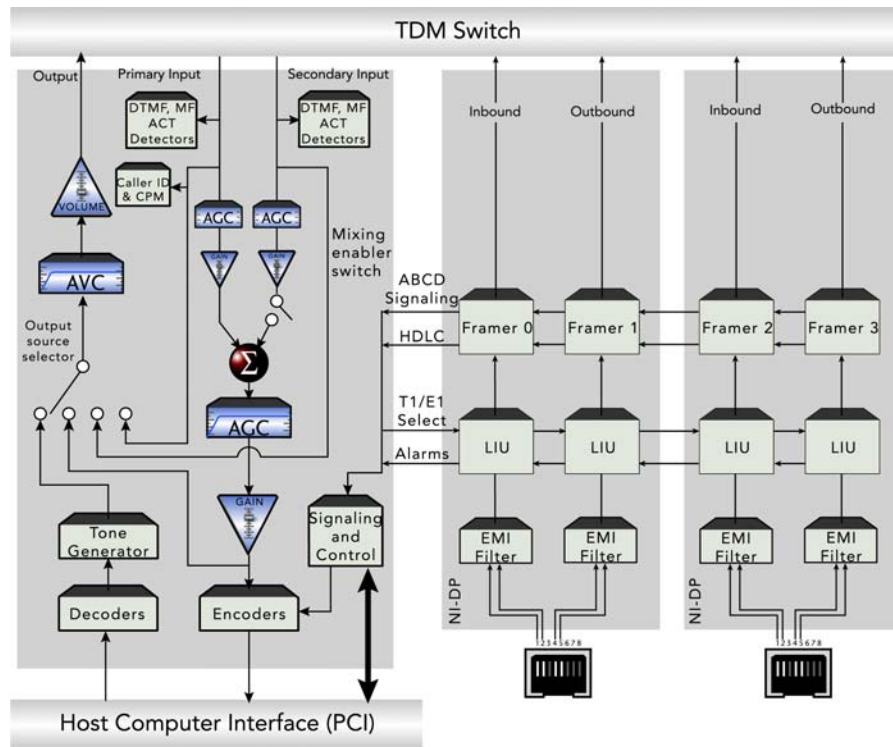
	DP 3209	DP 6409
T1	24 channels	48 channels
E1	30 channels	60 channels

NOTE: The number of channels supported varies on the protocol used on the line. Refer to the section that defines "[Channel Numbering](#)" on page 41.

The DP 6409 has four framers arranged in pairs (one pair for each trunk). The 3209 has two framers. Each pair monitors inbound and outbound traffic on one T1 or E1 trunk. The framers are connected to voice resource channels through the local TDM switch. Each voice resource has a full set of signal detectors, encoders, decoders and other voice processing functions such as automatic gain control (AGC), and automatic volume control (AVC).

The following diagram shows a visual representation of the architecture.

Figure 5-1: SmartWORKS DP Logical Card Model



PROTOCOL SUPPORT

Any Q.931 based ISDN variant is supported on the SmartWORKS DP card. The SmartWORKS can also be configured to support Channel Associated Signaling (CAS), Non-Facility Associated Signaling (NFAS) and DASS2.

The following table shows the framing, line coding, and signaling protocol options available when configuring the SmartWORKS DP for either a T1 or E1. The boards must be configured to match the specifications of your local carrier.

TABLE 6: FRAMING AND LINE CODING OPTIONS

	Framing	Line Coding	Signaling Protocol
T1	SF (D4) ESF	AMI B8ZS	ISDN NFAS None (used for CAS)
E1	Basic G CRC-4	AMI HDB3	ISDN DASS2 None (used for CAS) DPNSS MFR2 (China, Brazil)

ISDN EVENTS

When configured for ISDN PRI, NFAS or MFR2 the following call control events are generated:

- EVT_CALL_ABANDONED

- EVT_CALL_IN_PROGRESS
- EVT_CALL_CONNECTED
- EVT_CALL_HELD
- EVT_CALL_REJECTED
- EVT_CALL_RELEASED
- EVT_CALL_RESUMED
- EVT_CALL_RETRIEVED
- EVT_CALL_SUSPENDED

When configured for ISDN DASS2 or DPNSS the following call control events are generated:

- EVT_CALL_ABANDONED
- EVT_CALL_CONNECTED
- EVT_CALL_REJECTED
- EVT_CALL_RELEASED

These events are generated with the MT_CALL_INFO data structure. When available, information is presented in this data structure:

- Called Party number
- Called Party sub-address
- Caller Party number
- Caller Party sub-address
- Redirecting Number
- Connected Number
- Call Origin (CO or CPE)
- Call Source (incoming, outgoing)

CHANNEL ASSOCIATED SIGNALING EVENTS

The SmartWORKS DP is capable of extracting signaling bits. Configure the boards signaling protocol to "None" on either a T1 or E1 line. The SmartWORKS DP can extract the ABCD signaling bits and present them for use upon a state change- (CO to CPE) or outgoing (CPE to CO) direction. Signaling bits extraction is disabled by default. To enable ABCD signaling extraction, use the **MTEnableFramerABCDSignalingEvent()** API. Once enabled, the following events are generated:

- EVT_INCOMING_SIGCHANGE
- EVT_OUTGOING_SIGCHANGE

NOTE: When configured for CAS, ISDN events (EVT_CALL_) are not generated.

PRE-INSTALLATION

Before installing the SmartWORKS DP, it is important review the following pre-installation information.

UNDERSTAND NETWORK PROTOCOLS

Before using the SmartWORKS DP as a tapping device, it must be configured properly. The following table shows the configuration options. The board must be configured to the specifications of the local network:

	Framing	Line Coding	Signaling Protocol
T1	SF (D4) ESF	AMI B8ZS	ISDN NFAS None (use for CAS)
E1	Basic G CRC-4	AMI HDB3	ISDN DASS2 None (use for CAS) DPNSS MFR2 (China, Brazil)

CLOCK TERMINATION

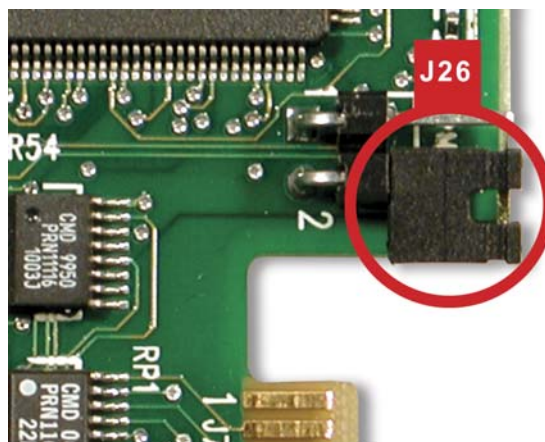
Some applications require multiple boards connected via a CT Bus cable (MVIP or H.100). For synchronization purposes the last board in the chain must terminate the TDM clocks. If the last board in your system is the SmartWORKS DP close Jumper J8 to enable clock termination (see [Figure 5-2](#)).

Refer to the *SmartWORKS Developer's Guide* for guidelines on setting Master/Slave mode and clock termination.

JUMPER J8

Jumper J8 is located on the outside of the board (see [Figure 5-2](#)). To activate clock termination, close the jumper by placing it over both pins (to establish a connection). By default, this jumper is open.

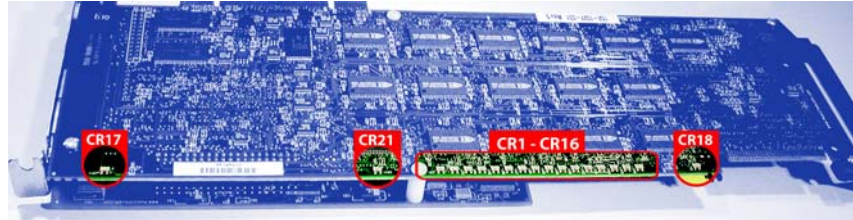
Figure 5-2: Jumper J8 Installed



BOARD STATUS LEDs

In board status LEDs are located on the SmartWORKS DP. The location of each LED is shown in Figure 5-3.

Figure 5-3: SmartWORKS DP LEDs



CR1 - CR16 (DP 6409)

When on, these LEDs indicate that the DSP has started. Each DSP turns its LED ON to indicate a successful initialization. The DP 3209 has CR1-8.

CR17

A three stage power and board initialization monitoring LED with the following occurrences:

- ON, indicating 3.3V power is supplied and the board is ready for the driver to be loaded.
- OFF, indicating the driver has successfully loaded and the board has initialized.
- BLINKING, indicating the board initialization process has failed.

Note: Invoking the *MTBlinkBoard()* API function causes the LED to blink. The total number of times it blinks equals the board number + 1. Use this function to match board location in a chassis with its board number.

CR18

This LED indicates that clock termination is enabled. "ON" indicates TDM clocks are being terminated. Note, to terminate clocks jumper J8 must be closed.

CR21

This LED indicates the state of the CPU. This LED is turned ON by the local CPU upon successful initialization.

TRUNK STATUS LEDs





Two Trunk Status LEDs per trunk are included to help troubleshoot installation problems. As shown below, they are located next to the cable connections.

Figure 5-4: Trunk Status LED Locations



The following table shows possible states of LEDs and describes the state of trunk interface.

TABLE 5-5: SMARTWORKS DP TRUNK STATUS LED MEANINGS

Lights	Red	Green	Status
	OFF	OFF	FramerReset
	OFF	ON	Normal Operation
	ON	ON	Signal Present & Alarm
	ON	OFF	No Signal, Framer Started

INSTALLATION AND WIRING

The following section explains how to install the SmartWORKS DP. Wiring diagrams for T1 and E1 systems are also provided.

NOTE: When installing on a network without homologations approval, a CSU/DSU is required between the PBX and the DP card.

ESD PRECAUTIONS

Switch off the power and remove power cords before opening the computer case. Do not re-attach power cords or switch on power to the computer while the computer case is removed.



Exercise ESD Precautions: Wear an ESD wrist strap.

Secure the card in a PCI slot with a chassis screw. **NOTE:** Cancel out of the Windows "Found New Hardware" screen. Place the SmartWORKS CD into the CD ROM and allow the board installation to finish.

NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

CABLE LENGTHS

The maximum allowable cable lengths from the tap to the SmartWORKS DP card:

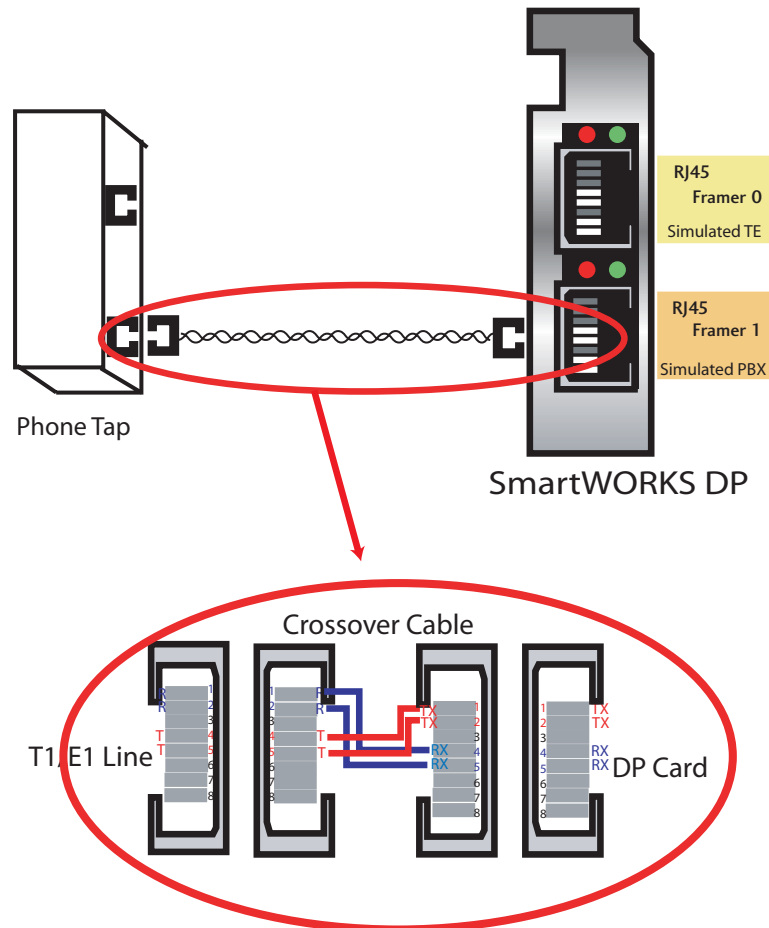
Trunk Type	Maximum Length
E1	16 meters
T1	30 meters

WIRING REQUIREMENTS

A cross-over cable is typically required when installing a SmartWORKS DP. If a cross over cable is not used, the Receive and Transmit wires do not line up properly.

NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

Use the following diagram as a reference:

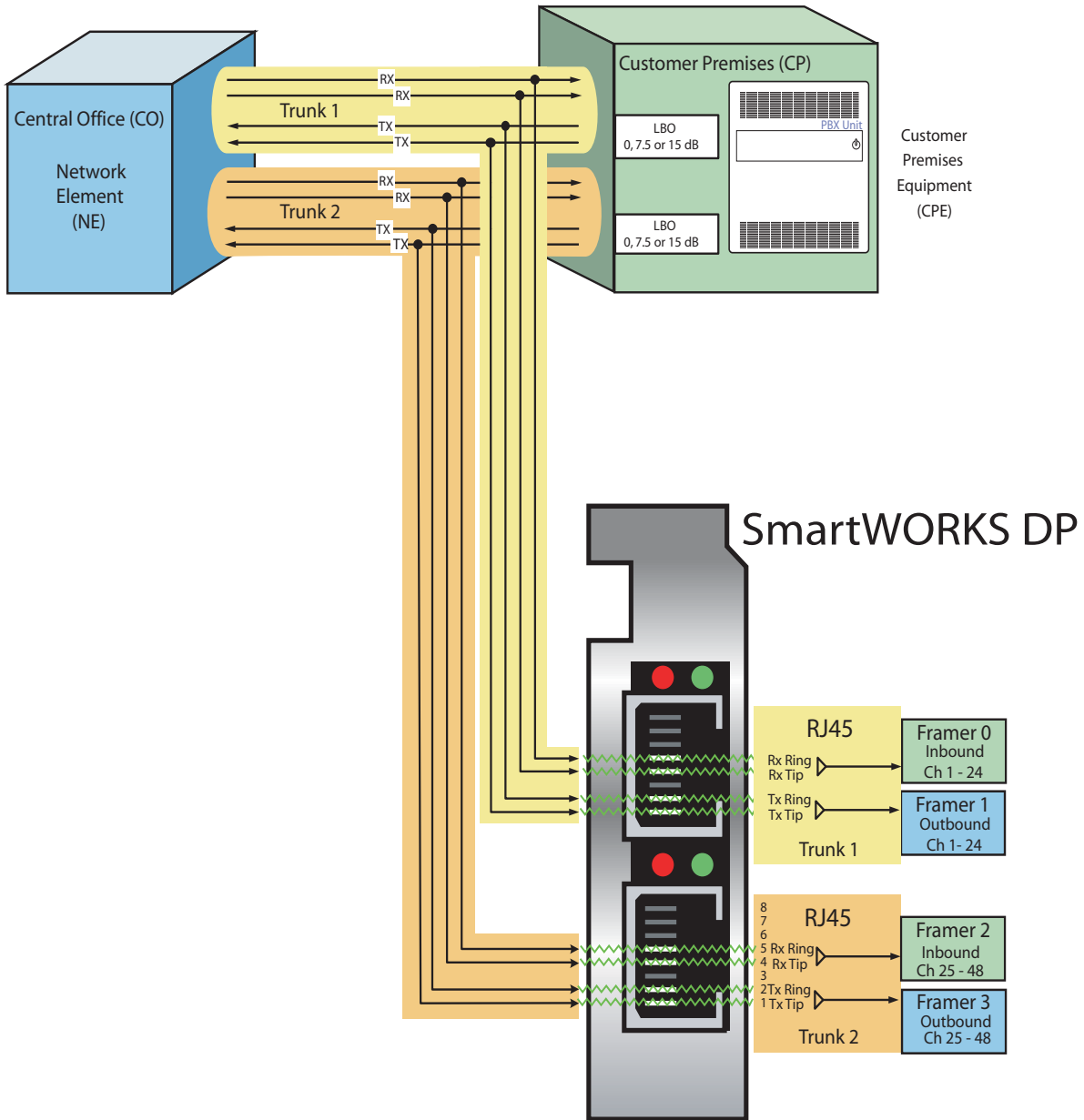


WIRING ON T1 INTERFACE

The SmartWORKS DP has two RJ-45 ports on its front bracket. In a typical configuration, standard Category 5 (Cat 5) network cables connect the DP to a pair of T1 trunks via a punch-down block. Connecting to the punch-down block may

require cable modification. For more information on connecting Cat 5 cables to a punch-down block, refer to the documentation that accompanies your punch-down block.

SmartWORKS DP Wiring Diagram for T1 Trunks



Due to the non-symmetrical aspect of the ISDN protocol, it's vital to follow the wiring scheme above when passive ISDN support is used.

WIRING ON E1 INTERFACE

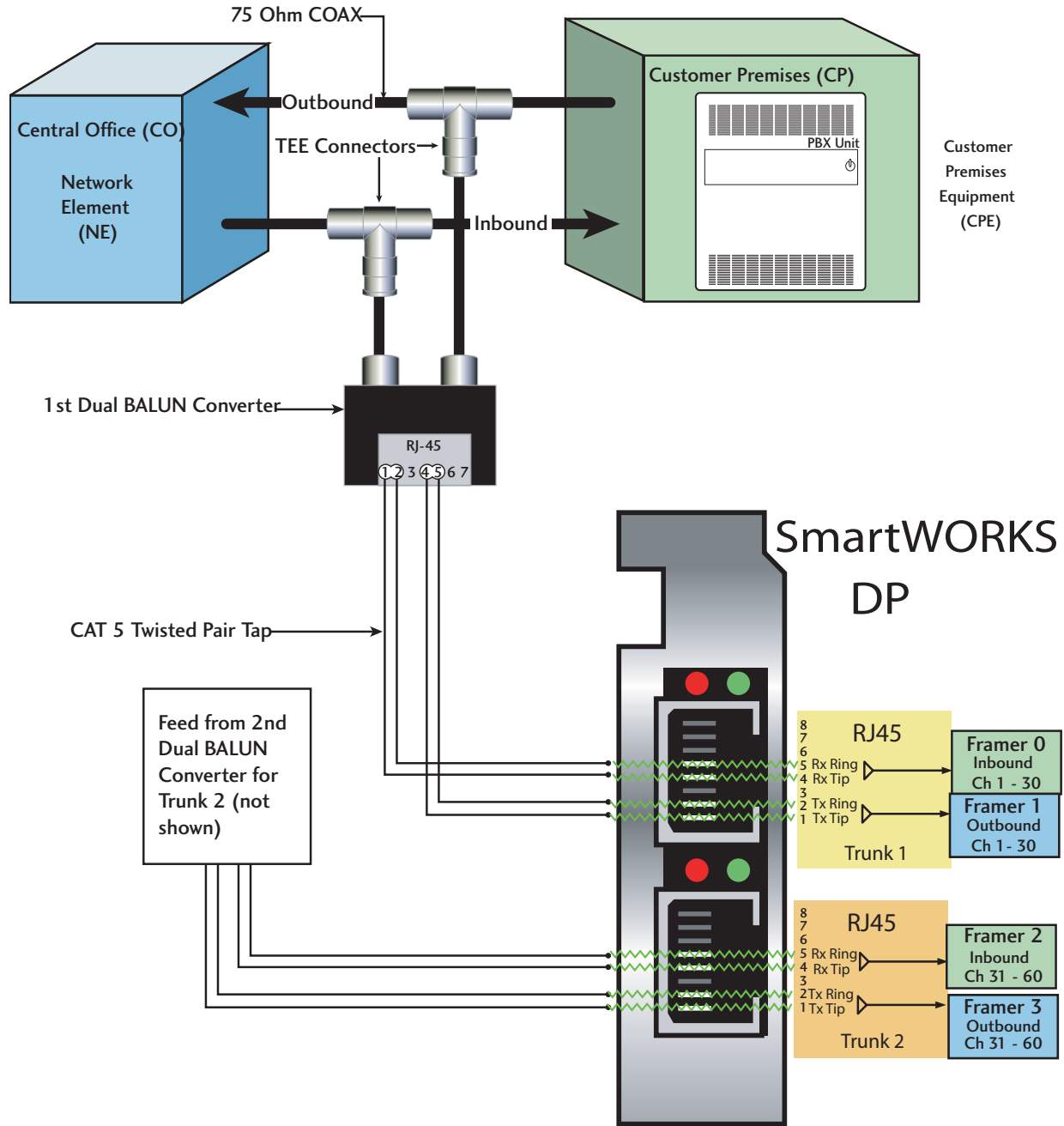
The process of passively tapping E1 trunks is no different than tapping T1 trunks. However, with European telephony there are a few differences in channel numbers and possibly hardware.

Instead of Cat 5 cable, some European networking and telephony lines run over standard Coaxial cable. So, a Dual BALUN converter may be necessary to make the switch from Coaxial to RJ-45 (see [Figure 5-6 on page 39](#)).

Also, if Coaxial is the type of networking cable being used tapping can be done through Coaxial TEE connectors.

Figure 5-6: DP E1 Wiring Diagram

SmartWORKS DP Wiring Diagram for E1 Dual Trunk (For Twisted pair TAP under 30 meters)



BOARD CONFIGURATION

Boards can be configured using the SmartControl Panel Applet (located on your PC's Control Panel) or using the SmartWORKS API. **NOTE:** Board drivers must be restarted after making changes with the Control Panel.

MASTER / SLAVE

If multiple boards are connected with a MVIP or H.100 cable, they must be configured as Master or Slave. Refer to the *SmartWORKS Developer's Guide* for guidelines on setting Master/Slave mode and clock termination.

CONFIGURING TO THE SYSTEM PROTOCOL

Trunk type and signaling protocol selection must be made before starting the driver. Trunk type selection is done per board, meaning one board can operate in T1 mode while another in E1 mode. Trunk coding and framing is selected on a per framer basis. This allows a single board to monitor two trunks that each have different settings (for example: a T1 voice trunk with AMI line coding/D4 framing, and a T1 trunk with ISDN signaling, B8ZS line coding/ESF framing).

Boards can be configured using the SmartControl or the SmartWORKS API. Using SmartControl select the **Digital Network** tab.

The following table shows the framing, line coding, and signaling protocol options available when configuring the SmartWORKS DP for either a T1 or E1. The boards must be configured to match the specifications of your local carrier.

TABLE 6: FRAMING AND LINE CODING OPTIONS

	Framing	Line Coding	Signaling Protocol
T1	SF (D4) ESF	AMI B8ZS	ISDN NFAS None (use for CAS)
E1	Basic G CRC-4	AMI HDB3	ISDN DASS2 None (use for CAS) DPNSS MFR2 (China, Brazil)

CONFIGURING THE BOARD FOR NFAS

When NFAS is used, further configuration is required. The trunk index, and NFAS index must also be set for all trunks on the system. These can be set by using SmartControl (**Digital Network** tab).

BOARD NUMBERING

When the SmartWORKS driver loads, it scans all PCI slots of the system to locate AudioCodes boards. As the boards are located, the driver assigns Physical Board Numbers to each. These board numbers are assigned sequentially from zero and are linked to the address (or slot number) of the physical PCI slot the card is located in.

If an additional board is inserted into a PCI slot with a lower address, the board numbers are reassigned affecting all channel numbers on the system.

CHANNEL NUMBERING

All channels on the SmartWORKS DP cards are full-duplex, meaning they can record and playback at the same time. Each channel's output is disconnected by default. When desired, any channel's output can be connected to the global TDM using the SmartWORKS API **MTSetOutput()**.

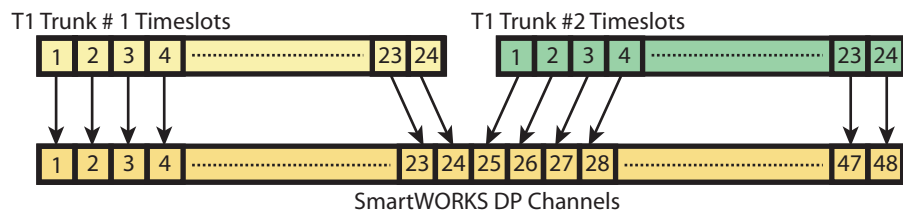
The number of channels available on a SmartWORKS DP depends on trunk type and the signaling protocol used. The following set of diagrams shows the number of channels reported per signaling protocol.

T1 TRUNKS CONFIGURED FOR CHANNEL ASSOCIATED SIGNALING (CAS)

When a SmartWORKS DP is programmed to monitor T1 trunks with no signaling protocol selected, the board reports having 24 channels per trunk (a total of 24 on the DP 3209 and 48 channels on the DP 6409). The first 24 channels are connected to 24 timeslots on the first trunk. Channels 25–48 on the DP 6409 boards are connected to timeslots of the second T1 trunk as depicted below.

Figure 5-1: T1 Trunk (no signaling protocol) To SmartWORKS DP Channel

T1 Trunk to SmartWORKS DP Channel Map

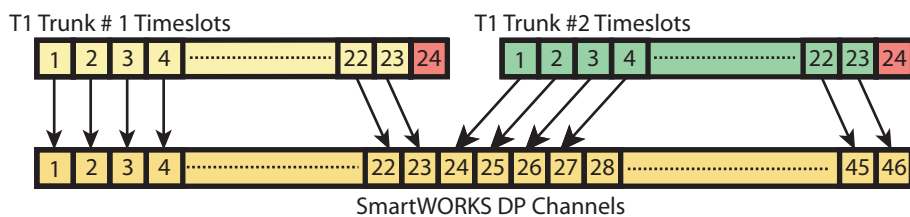


T1 TRUNKS CONFIGURED FOR ISDN PRI

For the DP models with ISDN protocol stack support the board reports the presence of 23 or 46 channels of which channels 1–23 are connected to 23 timeslots on the first T1 trunk; while channels 24–46 (DP 6409) are connected to 23 timeslots on the second T1 trunk. Timeslot 24 on both trunks carries D-channel information which is processed by the on-board ISDN protocol stack. Call events produced by the ISDN-DP protocol stack are reported as channel events.

Figure 5-2: T1 PRI Trunk to SmartWORKS DP Channel Map

T1 PRI Trunk to SmartWORKS DP Channel Map



NOTE: 24 = D Channel

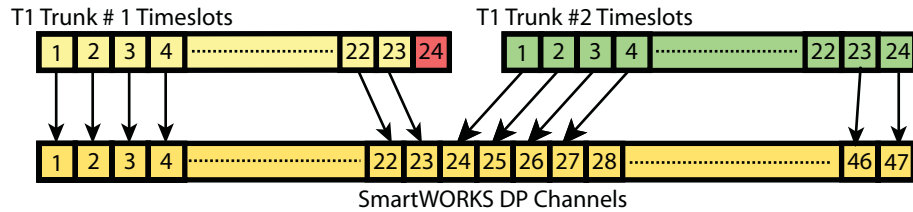
T1 TRUNKS CONFIGURED FOR NFAS

Each T1 trunk provides 24 timeslots (0 through 23). When configured for NFAS, only one D-channel is required per system. The D-channel on the first trunk (timeslot 24), on the first board is used to for all trunks on the system. The first trunk of the first board reports 23 channels while all other trunks on the system use 24 channels.

NOTE: Up to 15 NFAS trunks can be monitored in a single NFAS group.

Figure 5-3: T1 NFAS Trunk to SmartWORKS DP Channel Map

T1 NFAS Trunk to SmartWORKS DP Channel Map



NOTE: 24 = D Channel

E1 TRUNKS CONFIGURED FOR ISDN PRI, DASS2, DPNSS, MFR2 OR CAS (CHANNEL ASSOCIATED SIGNALING)

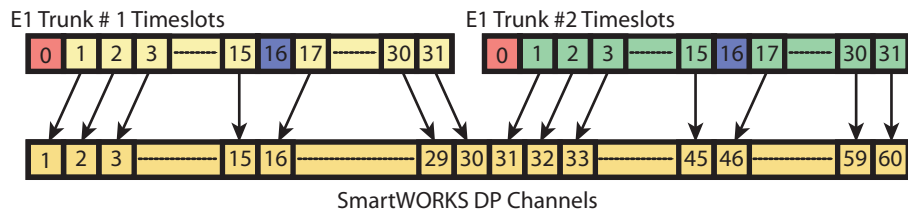
Each E1 trunk provides 32 timeslots (0 through 31). When configured for ISDN, the board reports having 30 channels per trunk (a total of 30 on the DP 3209 and 60 channels on the DP 6409). Framing and synchronization is carried out on timeslot 0, D-channel information (signaling data) is carried on timeslot 16, and B-Channel information (voice) is carried on timeslots 1-15 and 17-31.

Channels 1–30 are connected to 30 timeslots on the first E1 trunk; while channels 31–60 (DP DP 6409) are mapped to the second E1 trunk.

NOTE: With DPNSS, channels that are flagged as “virtual” are treated the same as “real” or “non-virtual” channels.

Figure 5-4: E1 PRI/DASS/CAS/DPNSS/MFR2 Trunk to SmartWORKS DP Channel Map

E1 Trunk to SmartWORKS DP Channel Map



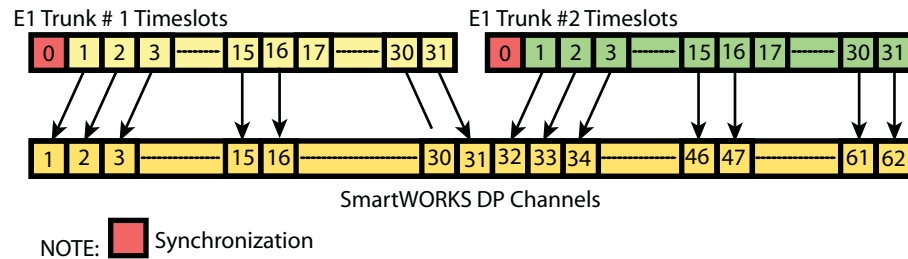
NOTE: 0 16 = Reserved slots

E1 TRUNKS CONFIGURED FOR NO PROTOCOL

Each E1 trunk provides 32 timeslots (0 through 31). When configured for the board reports having 31 channels per trunk (a total of 31 on the DP 3209 and 62 channels on the DP 6409). Framing and synchronization is carried out on timeslot 0. D-channel is not used. B-Channel information (voice) is carried on timeslots 1-31.

Figure 5-5: Trunk to SmartWORKS DP Channel Map - No Protocol

E1 Trunk to SmartWORKS DP Channel Map



HOW DO CHANNELS MAP TO FRAMERS?

The DP 6409 has four framers arranged in pairs (one pair for each trunk). The DP 3209 has two framers. Each pair monitors inbound and outbound traffic on one T1 or E1 trunk. The total number of active framers is available from the API function **MTGetAdapterInfo()**.

Inbound and outbound calls are handled by different framers on the DP (Refer to the framers portion of the wiring diagrams). This means that on a T1 line, timeslots 1–24 inbound are handled by Framer 0, and timeslots 1–24 outbound are handled by Framer 1. On the DP 6409, the same logic applies to Trunk 2 and its respective timeslots.

On an E1 line timeslots 1–31 inbound are handled by Framer 0, and timeslots 1–31 outbound are handled by Framer 1. On the DP 6409, the same logic applies to Trunk 2 and its respective timeslots.

Using AudioCodes Utilities to Test Installation

AudioCodes ships utilities with each CD-ROM. SmartControl is a control panel used for board configuration. SmartView is an application provided by AudioCodes used to test the functionality of SmartWORKS products. Developers or System Administrators, by using the commands accessible via the SmartView interface, can test whether the board is installed and configured properly for the network, as well as view events generated as the board is used.

This section demonstrates how to use SmartControl and SmartView to test basic board functionality after installation. For complete information about using these and other utilities, refer to the *SmartWORKS Utilities Guide*.

VERIFY SETUP:

1. Run the SmartWORKS Control Panel.
2. Click on the **Board** tab. Select the board number that represents the DP board. Verify that the board information is displayed correctly.
3. Click on the **System** tab. Verify that the settings are correct.

VERIFY EVENTS:

Run SmartView: From the Start Menu select Programs > Ai-Logix > SmartWORKS > SmartView.exe.

Open Channels: From the Tool Bar, select **System** > **MTSysStartup**. This opens the board and all channels.

1. At this point, the system is set up to operate and capture events. Verify that the first trunk is connected to a simulator or a network connection so that a call can be monitored with the DP:
2. Highlight the first channel on the first trunk using the SmartView Interface.
3. From the Toolbar, select **Settings** then select **(Set/Get)EventFilters...**
Enable Activity and Silence by placing a check in each box.
4. Place a call on the simulator or digital line. Look for the following events in the Event Viewer:
EVT_ACTIVITY
EVT_SILENCE
EVT_CC_ (call control events)
-OR-
EVT_INCOMING_SIGCHANGE (If ABCD was enabled, **FramerStatistics** > **ABCD-Signaling...**)
5. If no events are generated - verify the following:
 - a) Use SmartView to look for errors on the line indicating a connectivity issue:
FramerStatistics > **MTGetT1/E1FramerStatistic...**
 - b) Check your tap and verify that the wiring matches the tip and ring schematic provided.
 - c) Monitor another channel to verify the channel is not bad.

CHECK RECORDING:

1. Using SmartView, highlight a monitored channel.
2. Initiate a phone call and keep the line open.
3. From the Tool Bar select **Media** > **RecFile...**
Set the following:
 - File Name: [Filename].wav - the .wav extension must be appended
 - Data Format: This must be set as MSGSM
 - Click the Advanced button:
Under the MS Wave Option, select RIFF Format Data..
4. Stop recording: from the toolbar select **Channel Functions** then **MTStopChannel**.
5. You can play this back using any standard Media Player.
6. If the recording contains static or noise:
 - a) View the tap connection and verify that there are no loose lines.
 - b) Check whether the actual phone line contains static, it may just be a bad line.
 - c) Send the recording to AudioCodes USA for evaluation.

ALARM MANAGEMENT

The SmartWORKS DP can report alarms indicating problems with network conditions or frame synchronization. Framer statistics are also available. This information is available via the SmartWORKS API and the SmartView interface.

ALARMS

The SmartWORKS DP is capable of reporting common signal alarms. To avoid flooding the user application with redundant events, all alarms must be armed. Once an alarm event is reported, the alarm must be rearmed.

Use the API function **MTArmFramerAlarm()** or SmartView **Settings>MTArm/Disarm(CT/Framer/Master)Alarm...** to arm the alarm. To retrieve alarm events, the user can invoke API **MTGetFramerAlarmStatus()** or use SmartView **FramerStatistics> MTGet FramerAlarmStatus...**

NOTE: All alarms are defined in the SmartWORKS Developer's Guide where the API MTGetFramerAlarmStatus() is explained.

Supported framer alarms for the SmartWORKS DP (T1) boards are:

Event	Alarm
EVT_LOS_ALARM	Loss of signal
EVT_LOF_ALARM	Loss of frame
EVT_AIS_ALARM	Alarm indication signal
EVT_YELLOW_ALARM	YELLOW (Remote Alarm Indication - RAI)

Supported framer alarms for the SmartWORKS DP (in an E1 environment) board are:

Event	Alarm
EVT_LOS_ALARM	Loss of signal
EVT_YELLOW_ALARM	YELLOW (Remote Alarm Indication - RAI)
EVT_LOSMF_ALARM	Loss of Signaling multi-frame alignment. This alarm is not used when configured for Basic E1.
EVT_LOCRCMF_ALARM	Loss of CRC multi-frame alignment. This alarm is not used when configured for Basic E1.
EVT_TS16RAI_ALARM	Time slot 16 remote alarm indication signal. This alarm is not used when configured for ISDN or DASS2.

SMARTWORKS DP ALARM RECOVERY PROCEDURE

When a loss of signal situation arises on the network, PBXs and a Central Office follow the same standard:

- If a call is not active (connected state) then the call is released.
- If a call is in an active state (connected) then a timer is started. If the alarm persists for 90 seconds then the call is released.

The SmartWORKS DP is designed to follow this same standard. If a loss of signal occurs on the tapped network (between the local and far side), then the SmartWORKS DP is able to decode these alarms and detect the loss of signal. Standard operations are followed.

In the event that the alarm occurs between the tap and the SmartWORKS DP, the same loss of signal alarms occur. In this scenario, the same standard operation is followed. The SmartWORKS DP is unable to determine whether the loss of signal has occurred on the tapped network or on the tapping line itself.

ERRORS AND STATISTICS

Framer errors are available for the user application to retrieve when desired. The total count equals the number accumulated on the specified framer either since the system was started or since the last call of **MTClearFramerStatistic()**.

The API functions for retrieving/clearing error counters are:

- ***MTGetT1FramerStatistic()***
- ***MTGetE1FramerStatistic()***
- ***MTClearFramerStatistic()***

NOTE: All framer statistics are defined in the SmartWORKS Developer's Guide where each API has been defined.

Maximum Number of SmartWORKS Boards per System

SmartWORKS is designed to support up to 512 channel or 16 boards (any combination) per system, whichever limit is reached first.

Application developers should note that their system may not reach these limits due to external factors such as processor speed, number of processors, and CODEC compression rate.

- Please contact AudioCodes Technical Support for more Information.

Chapter 7

SmartWORKS NGX, NGXeh

Introduction

This section describes the SmartWORKS NGX, NGXe and NGXeh series of boards. It explains the board's unique features and defines the SmartWORKS NGX architecture. Also included is an overview of hardware and detailed technical specifications.

SYSTEM COMPATIBILITY

The SmartWORKS NGX is a full sized PCI. The SmartWORKS NGXe and NGXeh are designed for the PCI express chassis. The NGXeh has the H.100 bus enabled, while the NGXe does not. Product functionality across the NGX series of boards is the same. All documentation in this section pertains to all boards in the NGX series. Any functional differences that do apply are specifically documented in this section.

PBX COMPATIBILITY

A complete listing of each PBX the NGX supports along with the phone models and Dchannel events reported is available on the online support system in the NGX/IPX Support Matrix.

UNIQUE FEATURES

SCALABILITY

The SmartWORKS NGX, is an 8 channel board that is field upgradeable to a maximum of 24 channels via two 8 channel MX80 expansion cards. Adding an MX80 expansion card to the NGX provides a cost-effective solution for all system sizes.

To perform an upgrade, refer to ["Installing an MX80 Expansion Card"](#) on page 62.

SWITCHABLE LINE IMPEDANCE

The switchable line impedance allows you to select the line impedance to be Hi-Z or a 120 Ohm nominal input impedance.

BOARD IDENTIFICATION SWITCH

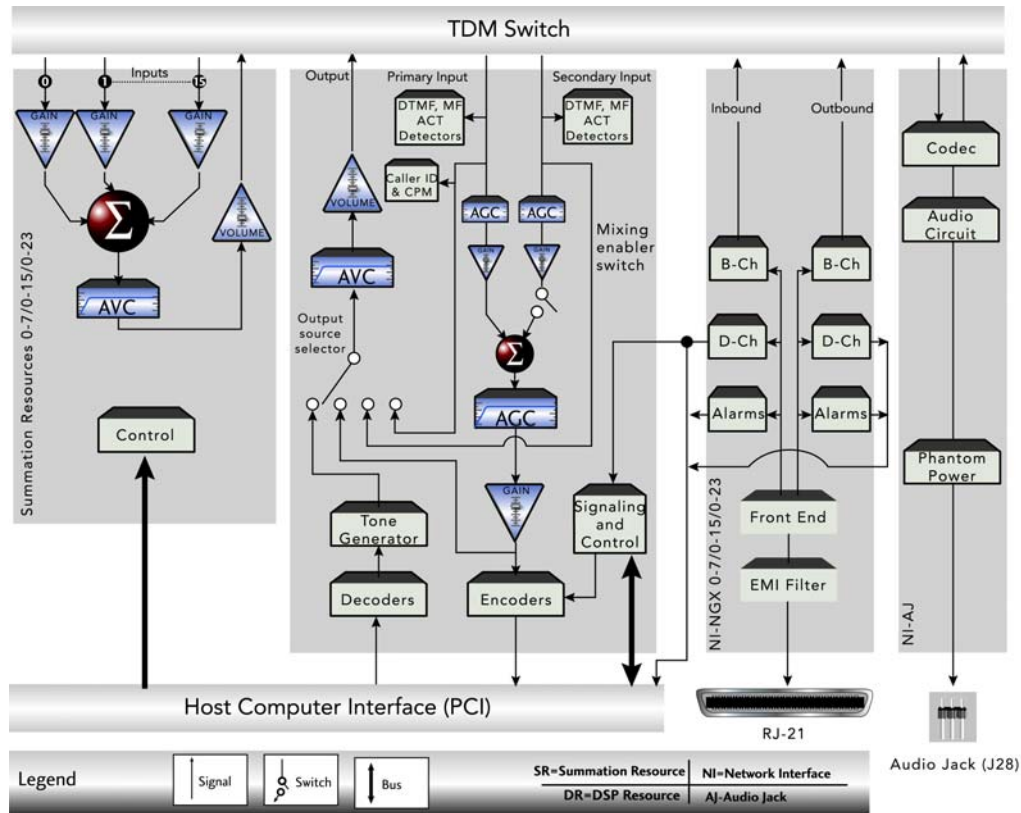
The board identification switch, located adjacent to the LEDs, allows you to assign a value ranging from 0-F that displays in the SmartControl Panel applet.

DSP

At the center of the SmartWORKS NGX are its DSPs, also called *voice resources*. One voice resource provides enough power to process 8 isochronous channels. Each voice resource has a full set of detectors, encoders, and decoders along with numerous voice processing functions such as automatic gain control (AGC), automatic volume control (AVC), and adaptive echo cancellation. In addition to traditional voice resources, the NGX contains a summation resource. This summation resource has 16 inputs with independent gain control per input, and a 16 channel mixer followed by AVC. AVC may be enabled or disabled using API functions.

The SmartWORKS NGX hosts 8 high/low impedance digital interfaces, a voice processing subsystem for each interface, an audio jack, and a PCI (NGX) or PCIexpress (NGXe or NGXeh) host interface. For a visual representation of the SmartWORKS NGX architecture, see Figure 7-1.

Figure 7-1: NGX Logical Card Model



INTERFACES

The SmartWORKS NGX has the following interfaces:

1. A high/low selectable impedance digital tap (RJ-21X line interface).
2. An isochronous TDM interface (both MVIP and higher capacity H.100)
NOTE: The H.100 bus is not enabled in the NGXe board.
3. An audio jack.
4. A PCI host interface (NGX) or PCI express (NGXe or NGXeh).

The SmartWORKS NGX's on-board voice resources bypass the need for TDM bus connections. If desired, voice resources can be connected to the TDM bus through a programmable TDM bus controller (see Figure 7-1 on page 49). Any channel can be connected to a desired MVIP or H.100 timeslot using the SmartWORKS API. All channels on the TDM bus must use the same encoding: either μ -law or A-law. TDM bus encoding is configured using the SmartControl Panel applet.

Each input has its own set of DTMF, MF, and activity detectors. The primary input has an additional Caller ID detector and Call Progress Monitor (CPM). The detectors can be enabled or disabled under software control. The Activity Detector features programmable thresholds, minimum silence, and minimum activity timing parameters.

The CPM has pre-programmed profiles for typical call progress tones used in North America. These default values with another set better suited for a given application at any time.

CALLER ID

All SmartWORKS boards detect Caller ID when it is passed over voice channels (supports Bell 202 and V.23 standards). However, Caller ID is not passed over voice channels on digital networks. When using the NGX to tap ISDN BRI systems Caller ID is passed to the user application via a call control structure (MT_CC_CALL_INFO). On some PBX systems Caller ID is passed over the D-channel and displayed on the phone's LCD. The NGX decodes this as the event EVT_MESSAGE_CHANGE and the Caller ID is passed into a buffer. **NOTE:** The NGX must support D-channel for this PBX model. This feature is also PBX and phone model dependant.

AUTOMATIC GAIN CONTROL

The SmartWORKS NGX offers automatic gain control (AGC) followed by a gain stage. If necessary, AGC can be disabled. AGC has been optimized to handle a wide, dynamic range. For the best performance, set AGC's target amplitude to - 6 dBm, the maximum amplification to 30 dB, and the gain to - 10 dBm.

AGC can not be used in some applications, yet there is still a need to monitor the recording in real time. The SmartWORKS NGX has the capability to take the output of a channel mixer, apply AVC to it, and adjust the output by programming volume control. The resultant voice stream is then connected to a selected timeslot on the TDM Bus.

ENCODERS AND DECODERS

The SmartWORKS NGX offers a wide range of voice encoders and decoders. Digitization methods are programmable on a per channel basis. For example, you may select a GSM 6.10 decoder and a 32 kbp/s G.726 encoder to be used at the same time on a given channel.

ERROR MONITORING

The SmartVIEW application provides error monitoring capabilities that are tailored to meet various levels of details. You can perform a high level system functionality test to retrieve a general system status or you can drill down to obtain information on a specific line.

Planning Your System

Before you set-up your NGX system, a few questions need to be answered. These questions will narrow the field of variables that exist in planning and configuring an NGX.

NOTES:

When planning a system that is tapping an Avaya / SDX INDEX, Siemens IBM Rolm 9751 CBX or a Mitel Sx2000 PBX an AudioCodes RTS is required. Refer to the wiring diagram at the end of this section.

Multi-Point monitoring is supported with the Panasonic TDA 50 using KX-T7600 series phones. Refer to the NGX Integration Guide for specific wiring instructions.

Answer the following questions:

1. What type of system are you looking to set up?
(There are three basic possibilities.)
 - a) **Vox Only:** the NGX is used for voice recording only, using activity detection to trigger recording. (Simplest configuration, quickest time to market, least control.)
 - b) **D-Channel:** the user application collects raw D-channel information to determine call states and control the NGX.
(Greatest amount of control, requires the most programming.)

NOTE: These configurations can be combined as well. For example, an application can be designed to record voice data, and report raw D-channel information.

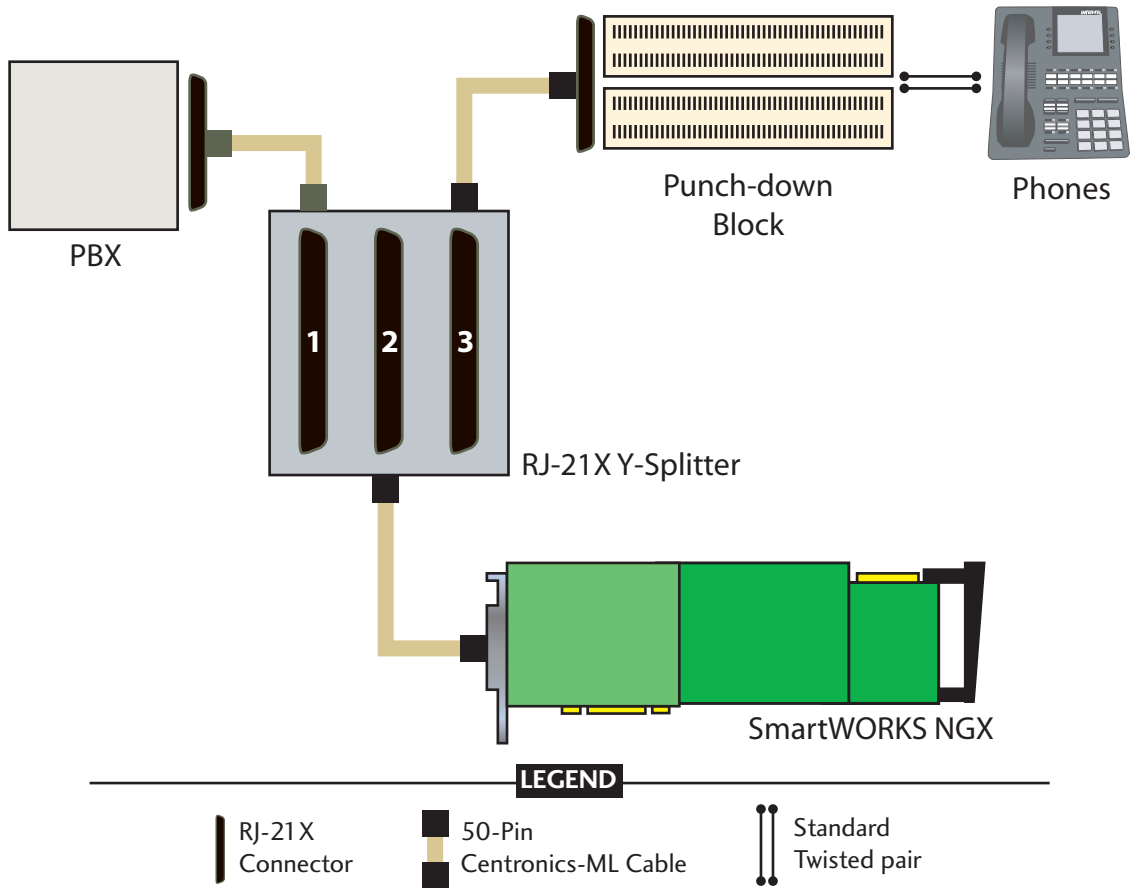
2. How will you connect the NGX between your PBX and phones?
(Again, there are three basic possibilities, as well as some variables to consider.)
 - a) **Using a Y-Splitter:** Where a Y-splitter is inserted between the PBX and the punch-down block that breaks out to phones (see [Figure 7-2 on page 52](#)).

In this optimal solution, an RJ-21X Y-splitter is inserted between the punch-down block and the PBX, preferably as close to the PBX as possible. The PBX plugs into the first RJ-21X connector on the Y-splitter, after which the NGX and punch-down block can connect to either of the remaining connectors on the Y-splitter. This configuration offers the most flexibility. It allows the NGX to passively tap the PBX without having to interface to the punch-down block. The signal quality is optimized because it's routed to the NGX before reaching the punch-down block.

This is the recommended method of passively tapping with the NGX. If this solution is not possible for your particular system, see the other two solutions following this one.

Figure 7-2: NGX Wiring Solution #1

SmartWORKS NGX Wiring Solution # 1: RJ-21X Y-Splitter

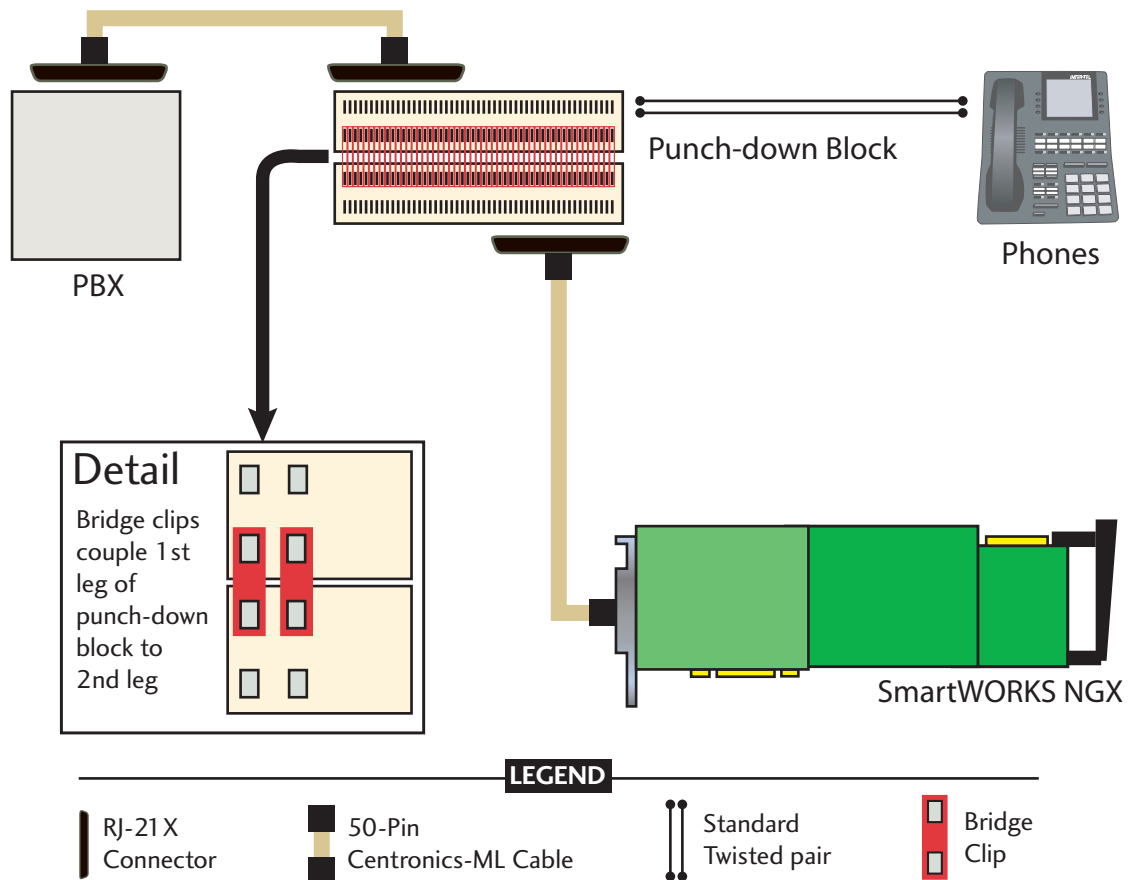


- b) **Using Bridge Clips:** Where the second leg of the punch-down block receives a duplicate PBX signal from the first leg through bridge clips, after which the NGX is connected to the second leg of the punch-down block (see [Figure 7-3 on page 53](#)). Depending on the quality of the components, this method may cause a mild signal degradation.

Although it is not as flexible as the first solution, this method is a viable means of passively tapping a PBX at the punch-down block with the NGX. Bridge clips are applied between the first leg of the punch-down block to the second leg to duplicate the PBX signal between the legs. This method limits the user to wiring only one leg of the punch-down block to the phones while the second leg must be dedicated entirely to the NGX.

Figure 7-3: NGX Wiring Solution #2

SmartWORKS NGX Wiring Solution # 2: Bridging Clips



- c) **Using Dual Punch Down Blocks:** the PBX signal is duplicated by wiring each channel on the main punch-down block to a second punch-down block that connects to the NGX (see [Figure 7-4 on page 54](#)). This solution is the least desirable method. Use this method when the alternatives are not possible.

Use this configuration if you meet the following criteria:

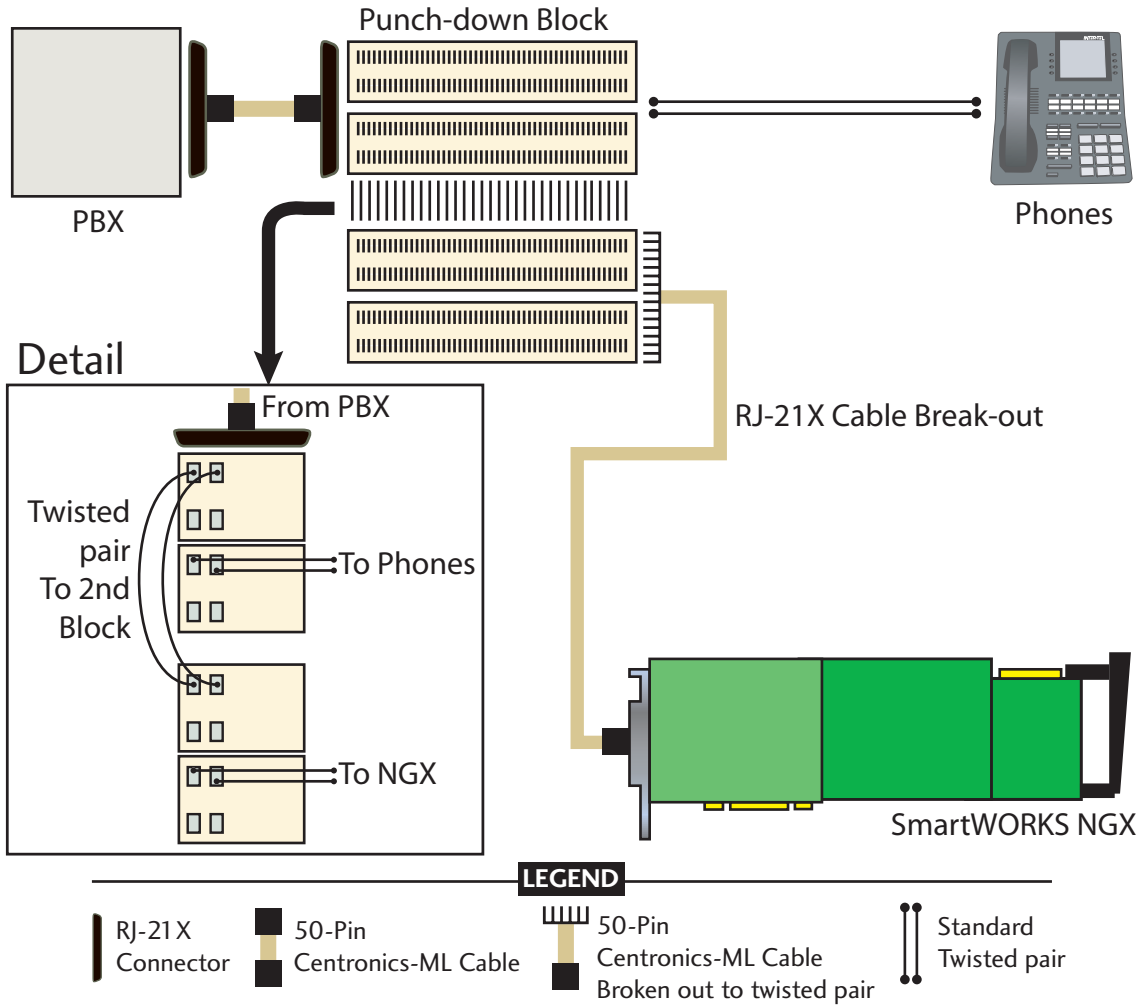
- You have no access to alter the PBX signal path, which eliminates solution 1
- You are not able to reconfigure the punch-down block that routes the PBX to the phones, which eliminates solution #2.

Using standard twisted pair wire, each channel is connected to an additional punch-down block that the NGX can connect through either an RJ-21X connection, or if necessary, by manually breaking out the HD68 cable that normally connects to the RK-21X connector into its individual lines and connecting them each to a channel.

NOTE: Each additional connection made on the punch-down block reduces signal energy and therefore may degrade signal quality. As each PBX vendor's signal varies, AudioCodes highly recommends testing recording quality once installation has been completed.

Figure 7-4: NGX Wiring Solution #3

SmartWORKS NGX Wiring Solution # 3: Dual Punch Blocks



USING THE AUDIOCODES RTS

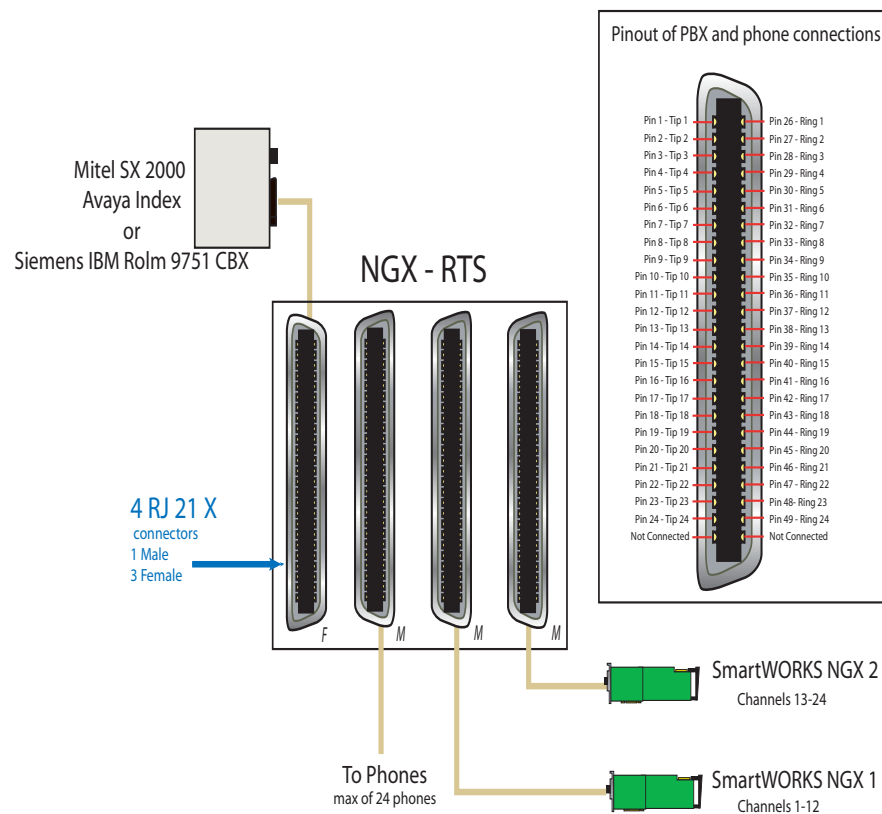
An AudioCodes RTS is required when tapping an Avaya SDX INDEX, a Siemens IBM Rolm 9751 CBX, or a Mitel Sx2000 PBX.

Inrush current can damage the RTS box when power is first applied to the phone. To prevent this, users must follow the correct installation process which is presented in the Application Note, *Proper Installation of the RTS*.

Protection diodes have been added to RTS boxes REV E or greater. This protects the box from damage resulting from inrush current. AudioCodes still recommends proper installation procedures as outlined in the *Proper Installation of the RTS* application note.

NOTE: AudioCodes does not support the use of the RTS box when integrating with a Siemens system using an older SLMR line card. Refer to the Technical Bulletin: Known Issue RTS Box.

The following diagram shows a very simple installation:



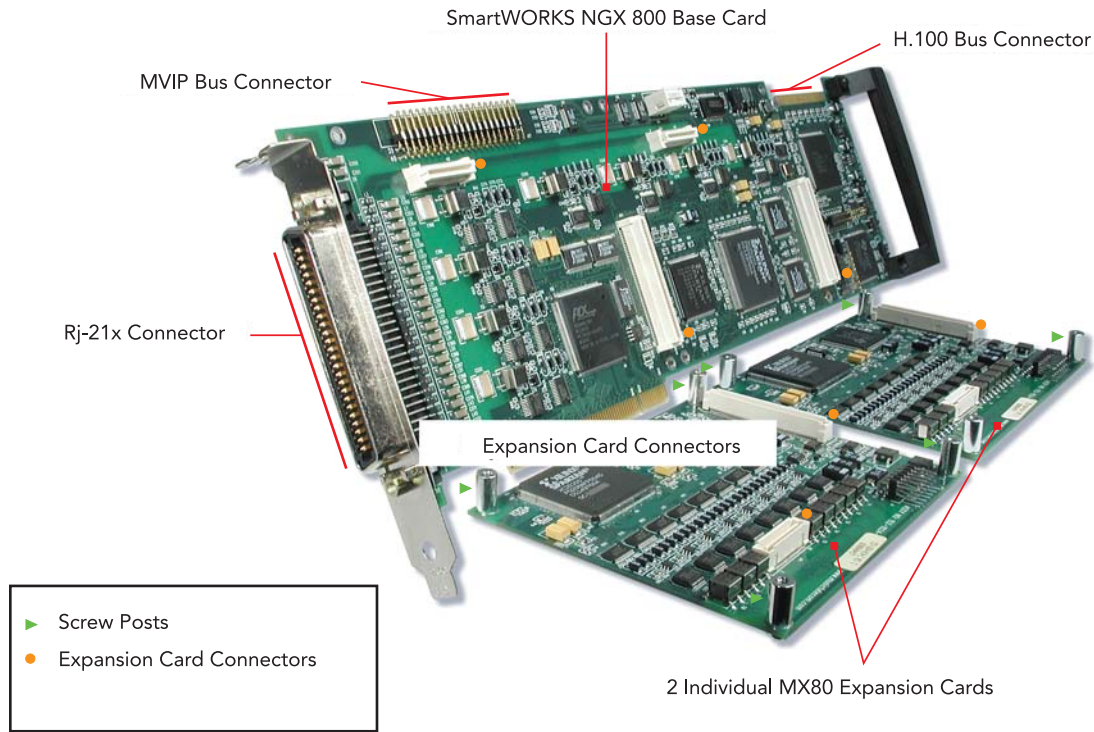
EVENT REPORTING

When using the RTS box, two of the NGX channels are used per each channel that is tapped on the live network. One NGX channel is used to receive D-Channel information while the other is receiving the voice data. All events are passed to a single event queue for both channels. If your GCI index is set to 0, then channels 0 and 1 receive data for the first line on the network. All events are reported in channel 0's queue while event reporting continues on channel 2, 4, 6... for all subsequent channels.

SmartWORKS NGX Hardware

The following section details the SmartWORKS NGX hardware, including LED locations and meanings. Figure 7-5, located below, identifies the components of the NGX.

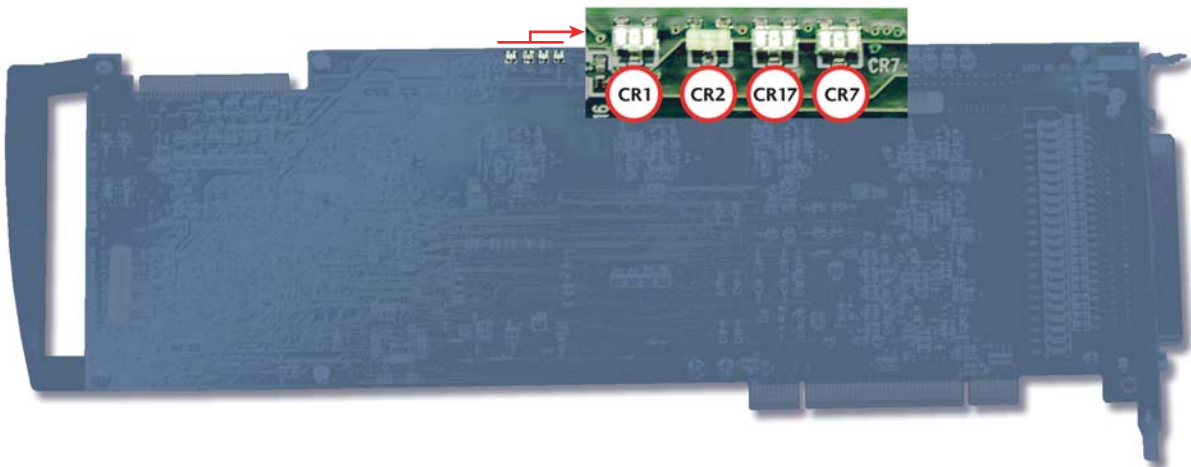
Figure 7-5: The SmartWORKS NGX and Components



BOARD STATUS LEDs

Four board status LEDs are located on the SmartWORKS NGX. The location of each LED is shown in Figure 7-6.

Figure 7-6: SmartWORKS NGX LEDs



CR1

When "ON" this LED indicates that the DSP has been started. If the LED is ON, the board downloaded successfully. This doesn't occur until the first time an application starts.

CR2

Three stage channel monitoring LED with the following occurrences:

- "GREEN," indicating all channels are connected, synchronized, and functioning properly.
- "AMBER," indicating one or more channels is not synchronized.
- "RED," indicating no channels are synchronized.

CR7

This LED indicates that the TDM clock has been terminated. "ON" indicates the boards TDM clocks are being terminated. The TDM clocks can be terminated via the control panel. **NOTE:** The NGXe does not support the H.100.

CR17

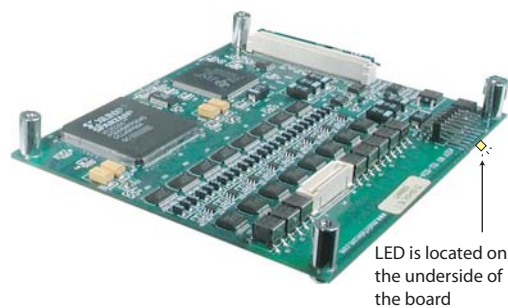
Three stage power and board initialization monitoring LED with the following occurrences:

- "ON," indicates that the board has successfully loaded.
- "OFF," no communication to the board.
- "BLINKING," board ready to be downloaded and the driver is properly communicating with the board. After the DLL is loaded this light will stop blinking. If light continues blinking the download failed or board panic has occurred.

MX-80 EXPANSION LEDs

Figure 7-7 displays the SmartWORKS MX-80 expansion card LED. The LED is DSP started. If the LED is "ON," the board downloaded successfully. This doesn't occur until the first time an application starts.

Figure 7-7: MX-80 Expansion



Making Connections

The following sections cover audio jack, audio cable, Telco, and MVIP connections.

NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

AUDIO JACK

The SmartWORKS NGX is equipped with a 3-pin audio jack that can be used to listen to audio in real-time. The audio jack is located adjacent to the board's MVIP connector as shown below. The audio jack is designed for use with an AudioCodes 3.5mm to 3-pin connector audio cable, which facilitates a microphone/headset.

AUDIO CABLE

The SmartWORKS NGX series can be used with an optional 3-pin to 3.5mm adapter (part number: 129-0004-001) that connects to the board's audio jack header.

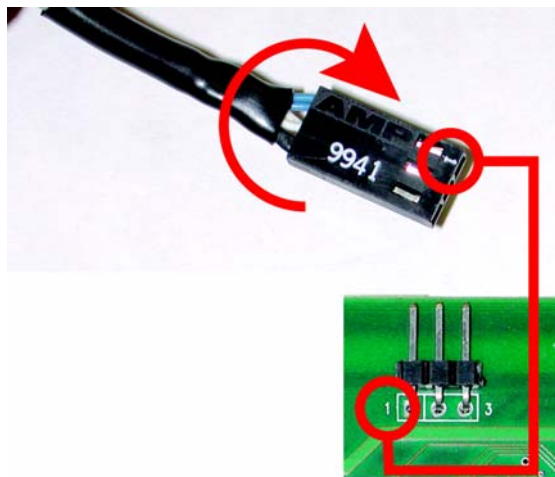
Figure 7-8: 5mm to 3-pin Connector Audio Cable



CONNECTING THE ADAPTER TO THE AUDIO JACK HEADER

When connecting the adapter, ensure it is properly aligned with the pins on the audio jack header. As shown in Figure 7-9, rotate the adapter's connector until the "1" identifying mark aligns with pin 1 of the audio jack header.

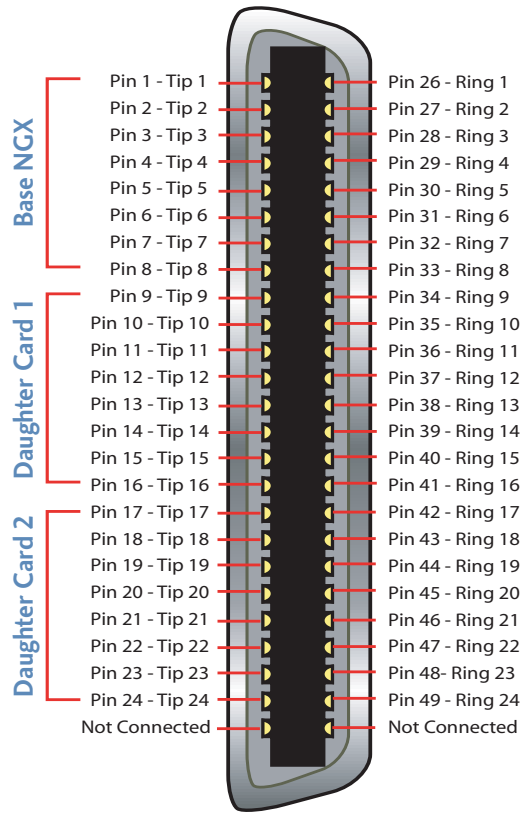
Figure 7-9: Connecting Adapter to the Audio Jack



CONNECTIONS

Figure 7-10 shows the 50-pin high impedance digital tap RJ-21 connector on the SmartWORKS NGX, which is used to interface the NGX to a standard Telco punch-down block or break-out box. As shown in Figure 7-10, pins 1–16 of the connector connect to Rings 1–16 on the punch-down block while pins 26–41 connect to Tips 1–16. For an NGX base board, only pins 1-8 and 26-33 need to be connected.

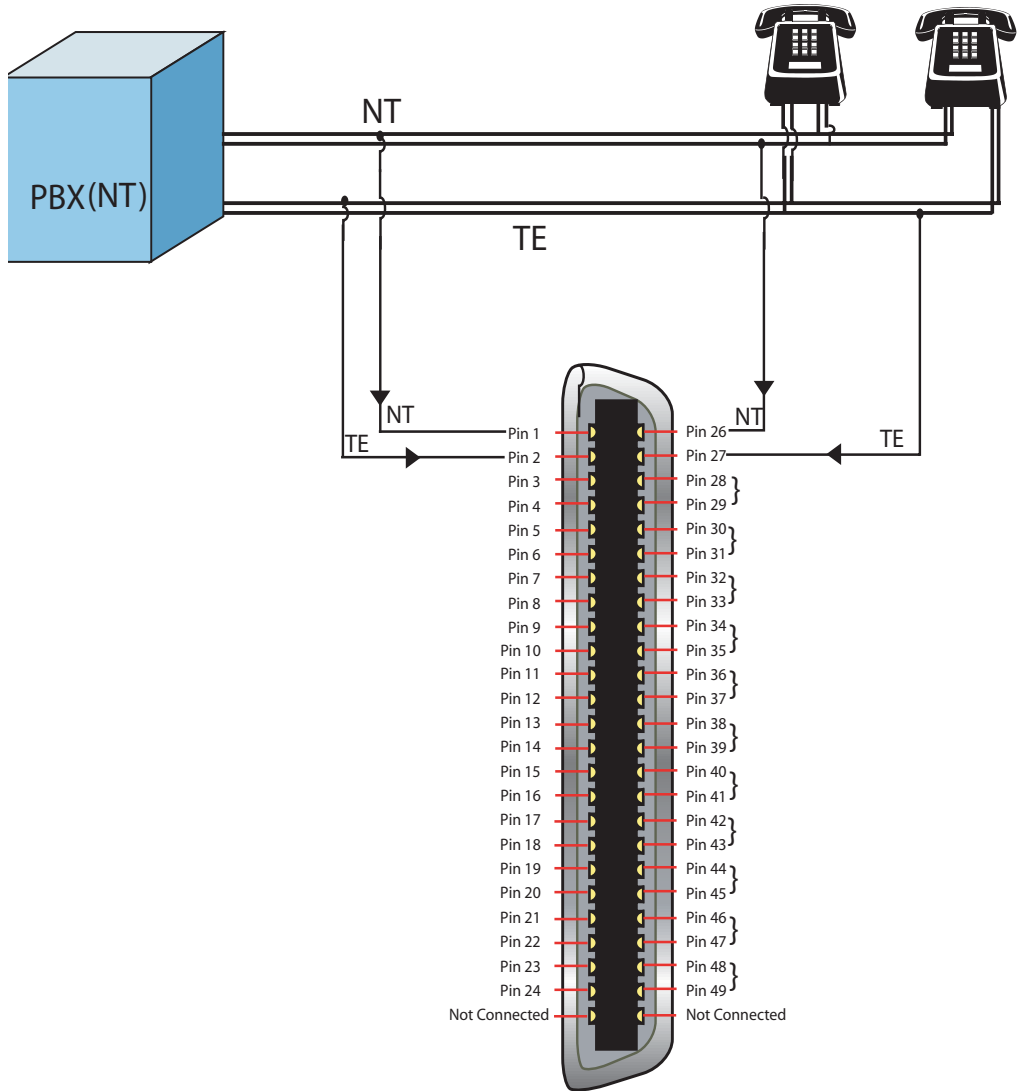
Figure 7-10: Telco Connector Pinout



BRI AND 4-WIRE CONNECTIONS

The following is an illustration of the RJ-21 pin connectivity in this 4-wire scenario. Two phone channels share B-channel resources in a BRI application.

Frame and timeslot numbering is explained in detail in the Developer's Guide, where the API *MTSetFramerOutput()* is explained. .



SmartWORKS NGX

SmartWORKS NGX Software

For application development information, see the *SmartWORKS Developer's Guide*. The SmartWORKS Developer's Guide defines the purpose of all API functions and lists their parameters.

MAKING A CONNECTION TO THE CT BUS

Four functions are provided by the API to connect the channel output to the MVIP or H.100 bus: (**NOTE:** The NGXe does not support the H.100 bus)

MTSetOutput()

MTResetOutput()

MTSetInputs()

MTResetInputs()

For more information on using these API functions, refer to the SmartWORKS Developer's Guide.

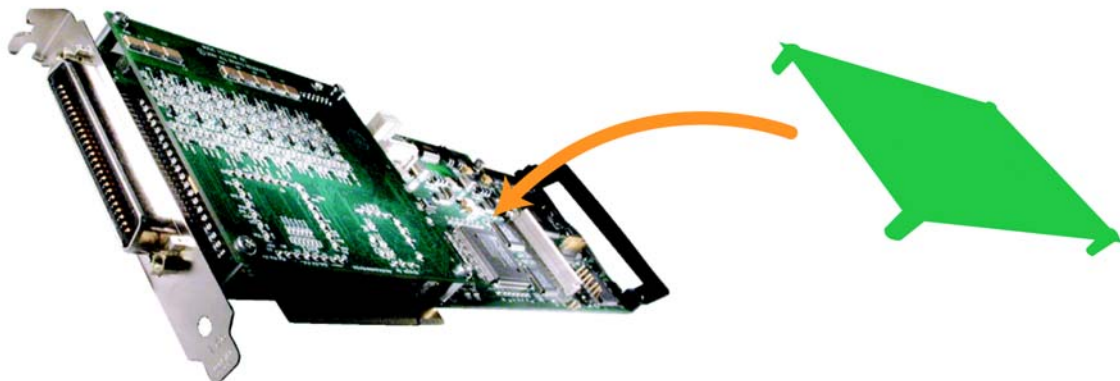
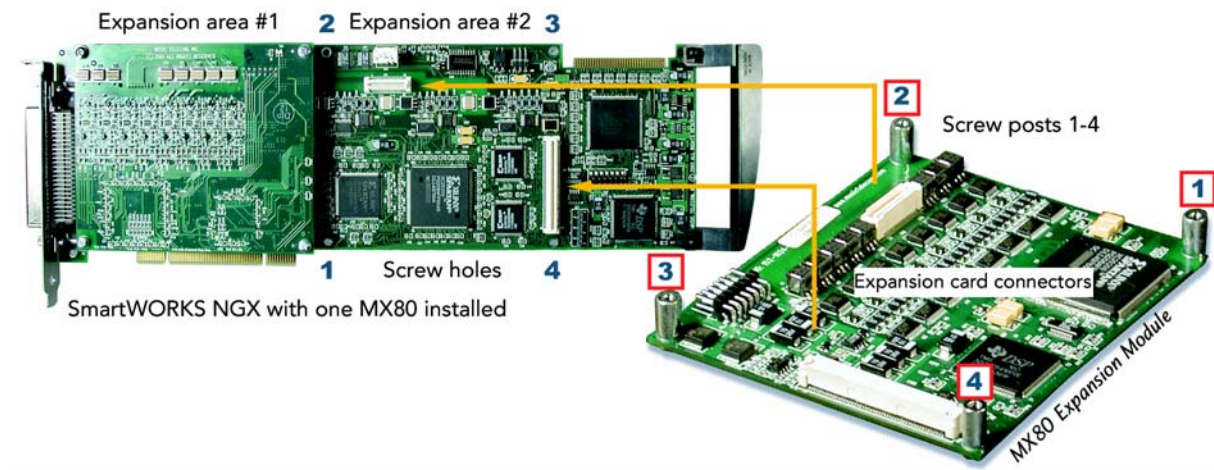
Installing an MX80 Expansion Card

The SmartWORKS NGX is field upgradable and can expand its channel capacity with the addition of MX80 8-channel expansion cards. Up to two MX80s can be installed onto a SmartWORKS NGX for a total of 24 channels (8 channels on the NGX base board, 8 channels per MX80 expansion card).

To install the MX80 expansion card(s), perform the following steps:

1. Remove the SmartWORKS NGX from its PC. Be sure to wear an ESD wrist strap and unplug the PC before removing the NGX.
2. Identify the two expansion areas on the SmartWORKS NGX base board (see Figure 7-11). If you are only installing one MX80 expansion card, you must use expansion area #1. If you are installing two cards, the installation order does not matter.
3. Properly align the MX80 and secure it to the NGX using the screw posts that were provided.
4. Re-install the NGX and restart the PC.

Figure 7-11: Installing an MX80 Expansion Card



Using AudioCodes Utilities to Test Installation

AudioCodes ships utilities with each CD-ROM. SmartControl is a control panel used for board configuration. SmartView is an application provided by AudioCodes used to test the functionality of SmartWORKS products. Developers or System Administrators, by using the commands accessible via the SmartView interface, can test whether the board is installed and configured properly for the network, as well as view events generated as the board is used.

This section demonstrates how to use SmartControl and SmartView to test basic board functionality after installation. For complete information about using these and other utilities, refer to the *SmartWORKS Utilities Guide*.

VERIFY SETUP

1. Run the SmartWORKS Control Panel.
2. Click on the Board tab. Select the board number that represents the NGX board. Verify that the board information is displayed correctly.
3. Click on the System tab. Verify that the settings are correct.

VERIFY EVENTS

NOTE: Check that the board is configured to generate D-channel events. Go to Control Panel and look under the **Board** tab. DChannel must be enabled.

Verify that the system is set up to monitor a call on the first channel.

Run SmartView: From the Start Menu select Programs > Ai-Logix > SmartWORKS > SmartView.exe.

Open Channels: From the Tool Bar, select **System > MTSysStartup**. This opens the board and all channels.

At this point, the system is set up to operate and capture events. Do the following:

1. Highlight the first channel using the SmartView Interface.
2. From the Toolbar, select **Settings** then select **T(Get/Set)EventFilters...** Enable all options by placing a check in each box.
3. Pick up a phone connected to this channel and place a call.
4. Look for events in the Event Viewer:

If no events are generated - verify the following:

- a) Use SmartView to look for errors on the line indicating a connectivity issue:
FramerStatistics > MTGetNGXFramerStatistic...
- b) Check the tap and verify that the wiring matches the pin-out schematic provided.
- c) Monitor another channel to verify that the channel is not bad.

CHECK RECORDING

1. Using SmartView, highlight the tapped channel.
2. Initiate a phone call and keep the line open.
3. From the Tool Bar select, **Media > TRecFile...**
Set the following:
 - File Name: [Filename].wav - the .wav extension must be appended

- Data Format: This must be set as MSGSM.
 - Click the Advanced button: Under the MS Wave Option, select RIFF Format Data..
4. Stop recording: from the toolbar select **Channel Functions > MTStopChannel()**.
 5. You can play this back using any standard Media Player.

If the recording contains static or noise:

- a) View the tap connection and verify that there are no loose lines.
- b) Check whether the actual phone line contains static, it may just be a bad line.
- c) Send the recording to AudioCodes for evaluation.

Maximum Number of SmartWORKS Boards per System

SmartWORKS is designed to support up to 512 channel or 16 boards (any combination) per system, whichever limit is reached first.

Application developers should note that their system may not reach these limits due to external factors such as processor speed, number of processors, and CODEC compression rate.

Please contact AudioCodes Technical Support for more information.

Chapter 8

SmartWORKS LD and LD-eh

NOTE: PCI express boards are available. Contact your sales representative for information on hardware availability.

Introduction - SmartWORKS LD

This section explains the SmartWORKS LD and LD-eh products. The LD-eh is a full-sized PCI express product with an H.100 bus. For sake of documentation, both products are referred to as the SmartWORKS LD. The pci Express board is only available in the LD 2409, 1609, and 809 products.

UNIQUE FEATURES

The SmartWORKS LD family is a low or high density product that can passively and actively interface with analog phone lines. This card was designed to blend the passive functionality and terminate features. The SmartWORKS LD delivers a rich feature set that includes advance voltage detection, line voltage reporting, and polarity reversal detections. Enhancements, such as low-bit rate coders (G.723.1 and G.729A), add to the value of this product.

DSP

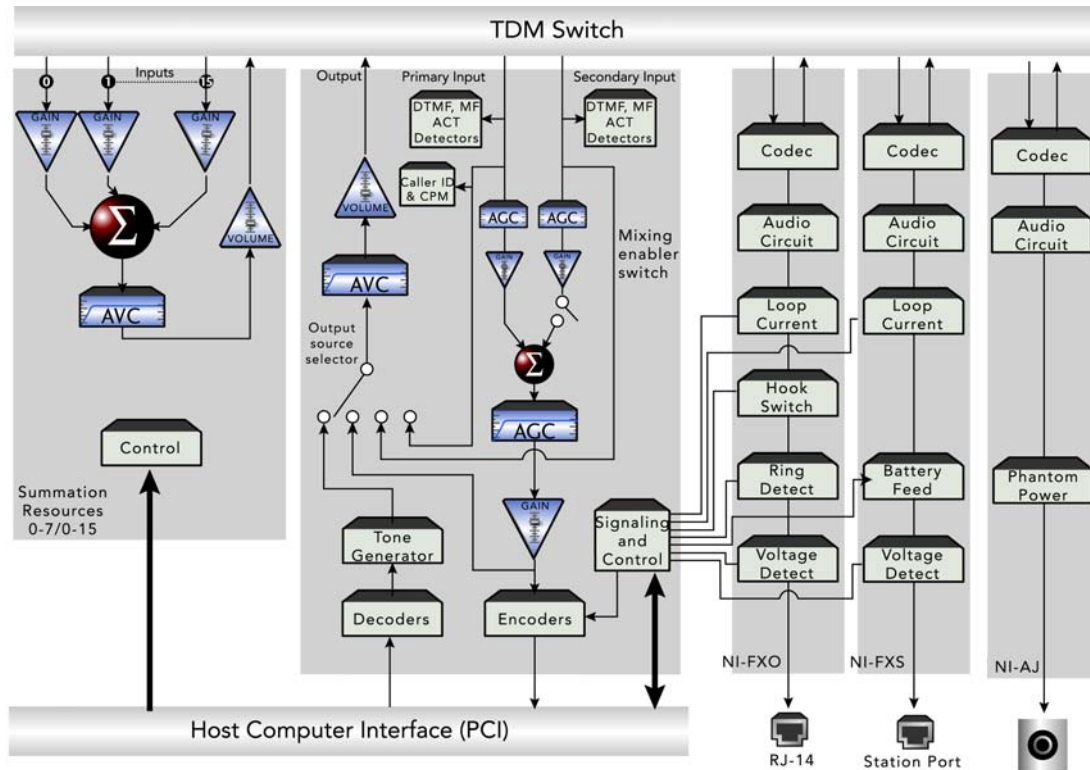
At the center of the SmartWORKS LD are modern DSPs that provide enough power to process up to 4 full-duplex channels per DSP. Each voice resource has a full set of detectors, encoders, and decoders along with numerous voice processing functions such as automatic gain control (AGC), automatic volume control (AVC), call progress detection, and adaptive echo cancellation. In addition to traditional voice resources, it also has summation resources. Each summation resource has 8 inputs with independent gain control per input. The high impedance analog interface has been designed to support line voltage detection and alert tone insertion.

The SmartWORKS LD hosts 8 line interface modules. Each line interface has a forward and reverse loop current detector, ring detector, and a hook switch. Programable forward and reverse voltatage detection is available in passive mode. In the ON-HOOK mode the line interface has the following capabilities: recording, Caller ID detection, alert tone generation, and ring detection.

A visual representation of the SmartWORKS LD architecture is provided on the next page.

NOTE: Each board in the LD series is unique. For example, the some LD boards have a RJ-14 connector, while others use an RJ-21. The number of DSPs is also board dependant. The logical card model remains the same.

Figure 8-1: LD Logical Card Model



INTERFACES

The SmartWORKS LD has the following interfaces:

1. Eight (LD809) or four (LD409) analog line interface modules terminated on an RJ-14 connector.
2. One RJ-21 Telco connector (LD809X, LD1609, LD2409, LD809eh, LD1609eh, LD2409eh)
3. A bi-directional TDM interface (H.100) configured to operate at 2.048 Mbps (LD409H, LD809, LD809X, LD1609, LD2409, LD809eh, LD1609eh, and LD2409eh)
4. An audio jack: standard stereo plug (LD409, LD409H, LD809) or three-pin (LD809X, LD1609, LD2409, LD809eh, LD1609eh, LD2409eh)
5. A PCI host interface.

The SmartWORKS LD board has an analog interface that is configurable for both passive and terminate mode operation. (The LD 101 also contains a station port which is described below).

In the terminate mode, the termination impedance is programmable by software setting. It supports four different standards: North America, South America, European Union and Australia.

NOTE: Under power failure conditions, this equipment may not operate. Please ensure that a separate telephone, not dependent on local power, is available for emergency use.

In the passive mode, the internal circuit snoops the voice signal on the Tip and Ring lines with alert tone generation support. (The impedance of the snooping circuit should be more than 15 Kohms). Each port has a DC voltage detection circuit to monitor DC voltage level between Tip and Ring and its polarity.

Voice resources are connected to the line interfaces through the TDM bus. The SmartWORKS LD design requires all channels on the TDM bus to use the same encoding: either μ -law or A-law. TDM bus encoding is configured through the SmartControl Panel applet. Any channel can be connected to a H.100 timeslot using the SmartWORKS API (This is only available on the LD 809, LD809X, LD409H, LD1609, and LD2409).

The audio jack and the line interface module that are provided by AudioCodes are equipped for either μ -law or A-law encoding. Once the TDM bus encoding is specified, the audio jack and line interface module is automatically configured for the designated encoding type.

Basic channel structure and capability are consistent throughout the SmartWORKS family of products. Variations in structure occur to provide different capabilities. For example, the SmartWORKS LD structure also has an echo cancellation unit (not shown on the diagram) that resides between the primary and secondary input. Each channel has two inputs. The primary input is connected to the line interface module and the secondary input is available for individual use.

Each input has its own set of DTMF, MF, FSK and activity detectors. The primary input has an additional caller ID detector and call progress monitor (CPM). The detectors can be enabled or disabled under software control. The activity detector features programmable thresholds, minimum silence, and minimum activity timing parameters.

When used in passive mode, the SmartWORKS LD is capable of voltage detection. The detectors can be enabled or disabled under software control and features programmable thresholds.

The CPM has pre-programmed profiles for typical call progress tones used in North America. These profiles can be replaced at any time to better suit the needs of a given application. The system supports up to 20 programmable tones.

CALLER ID

Caller ID supports Bell 202 and V.23 standards.

VOLTAGE DETECTION

The SmartWORKS LD delivers a rich feature set that includes advanced voltage detection, line voltage reporting, and polarity reversal detections. The LD constantly samples current line voltage. Normal ring to tip values on telephone networks in the United States is +48V coming from the CO (Sprint phone lines are typically reversed) and +24V coming from the PBX. The SmartWORKS LD has the ability to measure and report voltage within the following range: +61V to -61V. Users can control Threshold High and Threshold Low ranges through API parameters, with recommended settings of: Threshold High = +16V and Threshold Low = 4 V.

Below is a test setup in SmartView to describe LD operation:

1. Under SmartView, select **Settings** then select **MT(Get/Set)LV(Params/Detect)()**.
 2. Check current voltage, if positive, go to step 7, if negative continue with step 3.
 3. Close the Loop Voltage screen.
 4. Choose **Settings** then select **MT(Get/Set)ReverseLoopPolarity()**.
 5. Change to Reverse and select the **OK** button. Close the Loop Polarity screen.
 6. Choose **Settings** then select **MT(Get/Set)LV(Params/Detect)()**.
 7. Set *Threshold low* to 4 and *Threshold high* to 16. (This is a recommended setup for 24V systems, ensure your onhook state is above threshold high and your offhook is between 4-16.)
 8. These settings will give you:
-

- a. EVT_LVOLTAGE_ABOVE for an Onhook state (Generated when line voltage is measured ABOVE the Threshold High value).
- b. EVT_LVOLTAGE_OFFHOOK for an offhook state (Generated when line voltage is measured in between the Threshold High and Threshold Low values).
- c. EVT_LVOLTAGE_BELOW for a line that is not connected (Generated when line voltage is measured BELOW the Threshold Low value).

About Deglitch Time

When using the **MTSetLVParams()** API, one parameter Deglitch Time is used to control De-bouncing time in unit of 10ms. When the line voltage crosses over one threshold it must remain above or below the threshold level for the time period set with this parameter. To set this parameter with SmartView select **Settings** then select **MT(Get/Set)LV(Params/Detect)()**.

RING DETECTION

Signal on each channel is sent to two comparators for window voltage detection. Two offset voltages shared by all channels for the comparators are provided to decide the detection threshold on both high and low rails. The SmartWORKS LD can detect a ringing signal of 16.5Hz to 70Hz. .

AUTOMATIC GAIN CONTROL

The SmartWORKS LD offers an optional automatic gain control (AGC) followed by a gain stage. AGC handles a wide, dynamic range that is typically encountered when a voice logger is connected close to an analog phone. The recommended AGC's settings are: target amplitude to - 6 dBm, the maximum amplification to 30 dB, and the gain to - 10 dBm.

In some applications, AGC can not be used, yet there is still a need to monitor the recording in real time. The SmartWORKS LD provides programming volume control to optimize a recording's playback. This is accomplished by applying automatic volume control (AVC) to the output of a channel mixer. The resulted voice stream is then connected to a selected timeslot on TDM bus.

ENCODERS AND DECODERS

The SmartWORKS LD offers a wide range of voice encoders and decoders. Low bit rate standards such as GSM and G.729A are supported. Digitization methods are programmable on a per channel basis. A GSM 6.10 decoder and a 32 kbp/s G.726 encoder can be used at the same time on any given channel.

In addition to decoders, the SmartWORKS LD is capable of tone generation. The MTPlayTone() function provides single and dual frequency tone generation with frequency components from 300 - 3400 Hz, programmable amplitude, duration, and cadence (e.g. SIT tones, MF tones, dial tone etc.).

SmartWORKS LD Hardware

The following section details the SmartWORKS LD hardware, including jumper and LED locations as well as meanings.

H.100 JUMPER TERMINATION

Each board that supports a H.100 bus (LD409H, LD809, LD809X, LD1609, and LD2409) must use a jumper to terminate the bus' clock. Jumper J7 is located just below the H.100 bus on each board.

The CR37 LED will be ON if clocks are terminated on the LD409H and LD809.

The CR9 will be ON if clocks are terminated on the LD809X, LD1609 and LD2409.

For more information on clock termination, see ["Board-to-Board Connections and TDM Clock Termination"](#) on page 76.

AUDIO JACK JUMPERS

Two jumpers control the audio jack. One two pin jumper controls the power to the microphone while the other, three pin, jumper controls the use of a microphone or headset.

All audio jack jumpers are located directly behind audio jack on each board.

POWER JUMPER

If the microphone on the headset is not dynamic (i.e. power must be supplied to it), close this jumper. The following table lists the jumper number per board type:

LD 101	LD409	LD409H	LD809	LD809X	LD1609	LD2409
J9	J9	J11	J11	J8	J8	J8

HEADSET/SPEAKER JUMPER

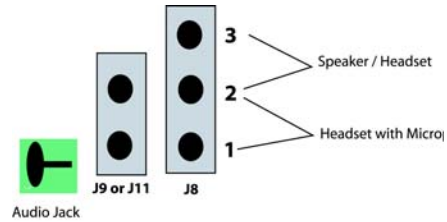
This is a three pin jumper that must be set properly to configure for use with a headset or a headset/microphone combination. The following table lists the jumper number per board type:

LD 101	LD409	LD409H	LD809	LD809X	LD1609	LD2409
J8	J8	J8	J8	J9	J9	J9

When using a headset or speakers, close pins 2 & 3. When using a headset with a microphone, close pins 1 & 2. The following diagram represents both jumpers on the SmartWORKS LD boards which are situated behind the Audio Jack.

The illustration on the following page shows the pin locations:

Figure 8-2: Headset/Speaker Jumper with pin locations.



3.3 V TO 5 V JUMPER (LD 101 ONLY)

The LD 101 is designed to work with hosts that have 3.3V or 5V power supply. Jumper J10 must be closed to support the 5V environment.

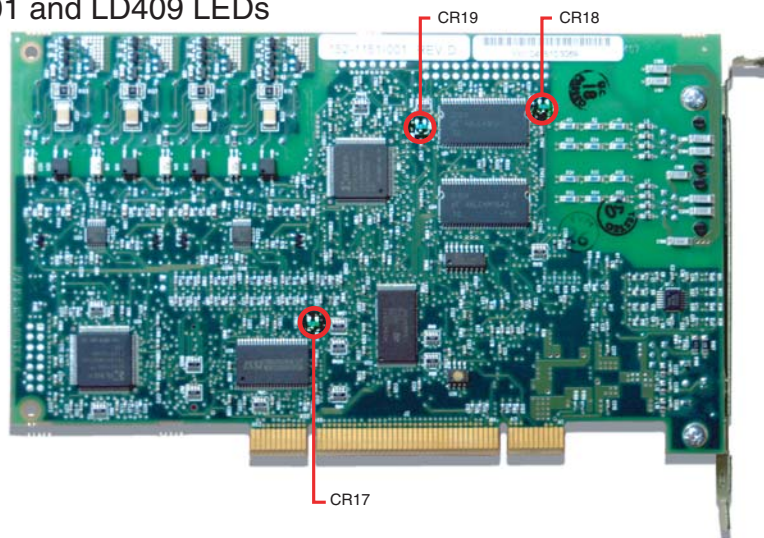
BOARD STATUS LEDs

The following illustrations show the location of board LEDs.

LD409 LEDs

Three board status LEDs are located on the SmartWORKS LD409. The location of each LD is shown in the illustration below using the LD409 board:

LD101 and LD409 LEDs



CR17

When "ON" this LED indicates the DSP has been started. The light is on when the processor is running.

CR18

This LED is used to monitor the state of the PCI connection. This LED blinks while the board is initializing and then will turn off. If the board is reset, the light is on.

CR19

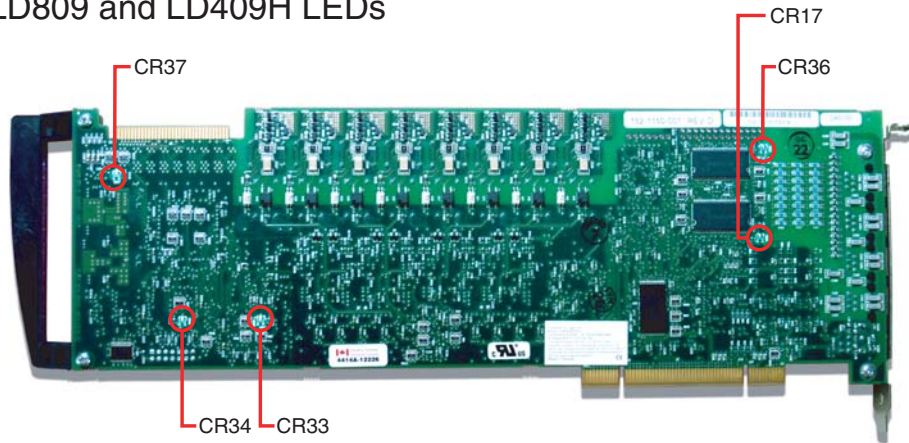
This LED indicates the state of the Coldfire Processor. This LED is on when the processor is running.

LD809 AND 409H LEDs

Five board status LEDs are located on the SmartWORKS LD809 and LD409H. The location of each LD is shown below with an explanation following the picture:

NOTE: The LD409H does not have CR34 as it only has one DSP.

LD809 and LD409H LEDs



CR33 AND CR34

When "ON" these LEDs indicate the DSP has been started. The lights are on when the processors are running. CR33 matches DSP 0, and CR34 matches up with DSP 1. **NOTE:** LD409H does not have CR34

CR37

This LED indicates that the TDM clock is terminated. This LED is turned ON by the local TDM switch. This light will be ON if H.100 clocks are terminated.

CR17

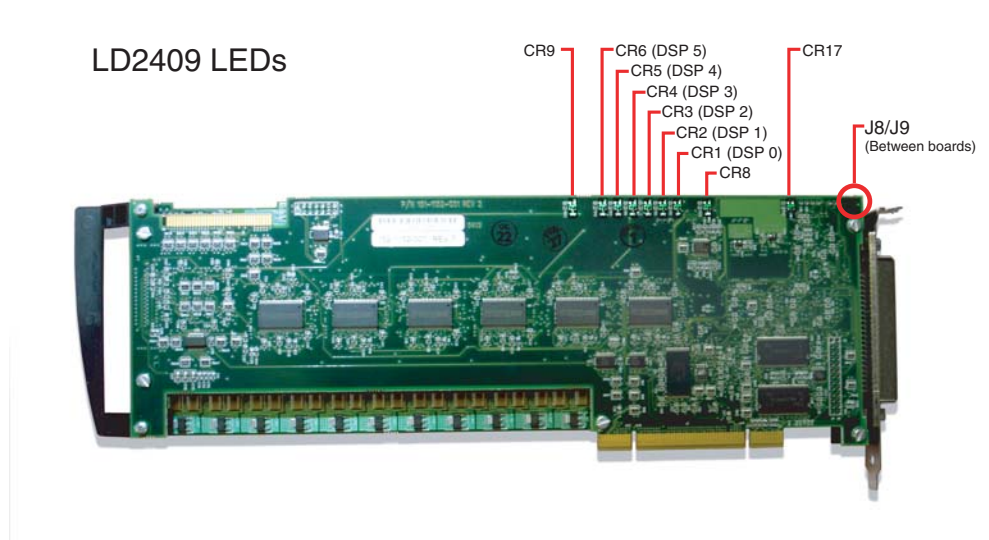
This LED is used to monitor the state of the PCI connection. This LED blinks while the board is initializing and then will turn off. If the board is reset, the light is on.

CR36

This LED indicates the state of the Coldfire Processor.. This LED is "ON" when the processor is running.

LD1609 AND LD2409 LEDs

Five board status LEDs are located on the SmartWORKS LD2409. The location of each LD is shown below with an explanation following the picture:



CR1-6 (CR1-3 ON LD1609 AND CR1-2 ON LD809X)

When "ON" these LEDs indicate the DSP has been started. The lights are on when the processors are running.

CR9

This LED indicates that the TDM clock is terminated. This LED is turned ON by the local TDM switch. This light will be ON if H.100 clocks are terminated.

CR17

This LED is used to watch the state of the PCI connection. This LED blinks while the board is initializing and then will turn off. If the board is reset, the light is on.

CR8

This LED indicates the state of the Coldfire Processor.. This LED is "ON" when the processor is running.

Making Connections

The following sections cover audio jack, audio cable, Telco, and other connections.

NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

AUDIO JACK

The SmartWORKS LD is equipped with an audio jack that can be used to listen to audio in real-time. All boards have two jumpers that control the use of the audio jack. For more information refer to the section that explains "Audio Jack Jumpers" on page 70.

On the LD409, LD409H, and the LD809 the audio jack is located adjacent to the board's RJ14 connectors. The Audio jack is designed for use with a 3.5mm Male Stereo Plug.

The audio jack on the LD809X, LD1609 and the LD2409 is a three pin connector. Users can buy an optional 3.5mm to 3-pin connector audio cable (part number: 129-0004-001) that connects to the board's audio jack.

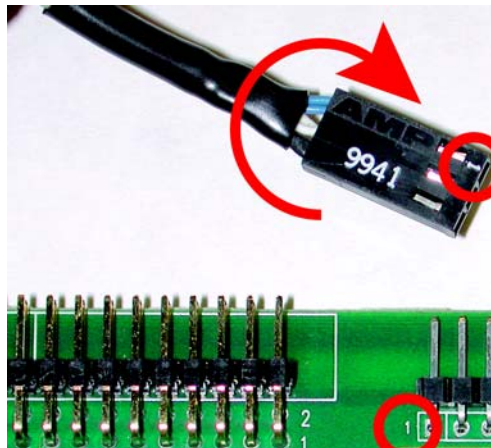
Figure 8-3: 5mm to 3-pin Connector Audio Cable



CONNECTING THE AUDIO CABLE TO THE AUDIO JACK

When connecting the audio cable, ensure it is properly aligned with the audio jack pins. As shown below, rotate the audio cable's connector until the "1" identifying mark aligns with pin 1 of the audio jack.

Figure 8-4: Connecting the Audio Cable to the Audio Jack



TELCO CONNECTIONS

The LD409, LD409H and the LD809 use RJ-14 connectors while the LD 809X, LD1609 and the LD2409 has an RJ-21 standard Telco connector.

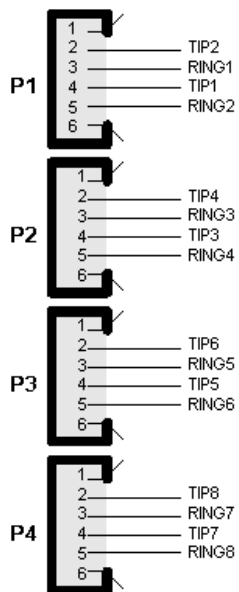
NOTE: AudioCodes recommends that the cable from the tap point to the LD cards should not exceed 500 feet.

Figure 8-5 shows the SmartWORKS LD's trunk RJ-14 connector, which allows the LD to interface with standard Telco analog lines. Only pins 2-5 are connected.

NOTE: To prevent cross-talk, channels that are not physically connected to a line should remain closed within your application.

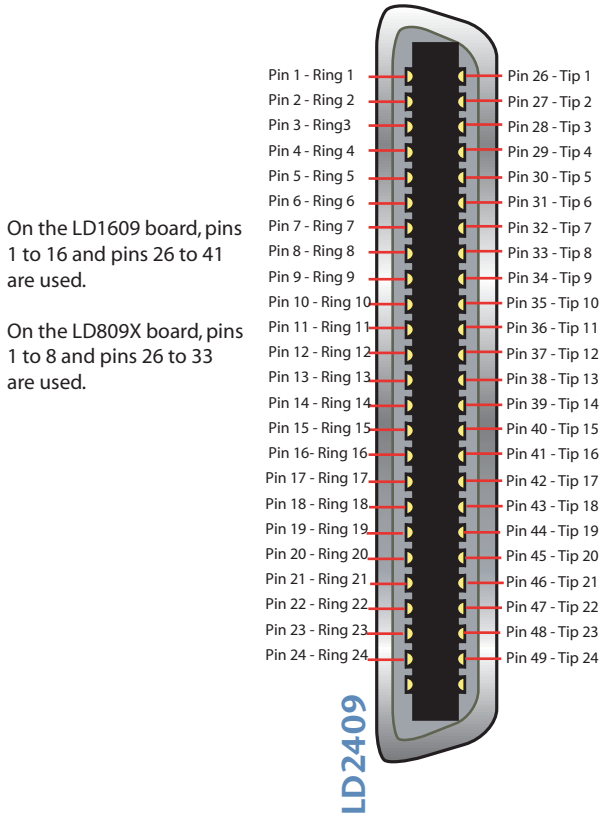
Figure 8-6 shows the SmartWORKS LD's RJ-21 connector with pinout descriptions.

Figure 8-5: Telco Connector Pinout (RJ14x4)



NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

Figure 8-6: Telco Connector Pinout (RJ-21)



On the LD1609 board, pins 1 to 16 and pins 26 to 41 are used.

On the LD809X board, pins 1 to 8 and pins 26 to 33 are used.

BOARD-TO-BOARD CONNECTIONS AND TDM CLOCK TERMINATION

The SmartWORKS LD was designed to meet the standards outlined by the Enterprise Computer Telephony Forum (ECTF). Specifications for clock termination when using a H.100 cable can be found at www.ectf.org. If you have multiple boards in one system, for synchronization purposes the boards must comply with these standards. To enable clock termination on the SmartWORKS LD, close jumper J7. The SmartWORKS LD cannot be used as the final board for clock termination as it does not have the H.100 interface.

SmartWORKS LD Software

Default TDM connections for the SmartWORKS LD are contained below.

NOTE: After installing SmartWORKS and the SmartWORKS LD board, you must also configure impedance. Open the SmartControl Panel, select the Parameters tab, then set the OffHookImpedance to match your network environment: FCC, ETSI, Australia, or China.

Upon startup of the driver and DLL, the initial configuration for all channels is as follows:

- The primary input of each channel is connected to the output of the telephone line interface and the secondary input of each channel is not connected.
- The channel output is connected to the input of a the telephone line interface.
- Mixing is disabled.
- Output source is set to "decoder."
- The initial state of the line interface is ON-HOOK for all the channels.
- Audio jack is not connected to the TDM bus.

Telephone Line Interface

Each SmartWORKS LD channel has its own analog line interface module that is capable of incoming ring signal detection, forward and reverse loop current detection, alert tone generation, and voice band signal monitoring. This line interface operates in both ON-HOOK and OFF-HOOK mode.

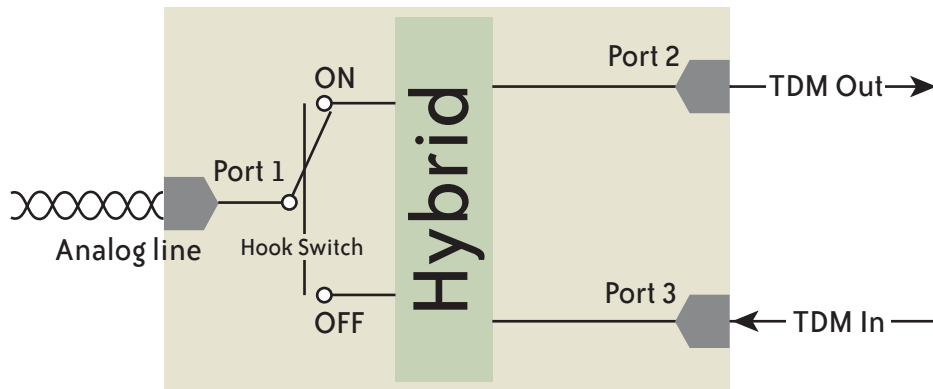
In ON-HOOK mode, voice band signal monitoring, alert tone generation, and caller ID detection is enabled.

In OFF-HOOK mode, forward and reverse loop current detection and voice band signal communication is enabled.

NOTE: Under power failure conditions, this equipment may not operate. Please ensure that a separate telephone, not dependent on local power, is available for emergency use.

Figure 8-7 shows the Telephone Line Interface model.

Figure 8-7: Telephone Line Interface



It is important to understand the basic characteristics of the line interface incorporated in the board design.

Port 1 consists of two wires (Tip and Ring) and is connected to the loop start analog line.

Port 2 is a PCM output from the telephone line interface. This output is connected to the primary input of the DSP resource (DR). It may also be connected to the TDM Bus through a standard API function.

Port 3 is a PCM input to the telephone line interface. This input is connected to the output of the DSP resource (DR). It may also be connected to the TDM Bus through a standard API function.

The loss plan for the line interface is shown below:

TABLE 8-1: SMARTWORKS LD LINE INTERFACE LOSS PLAN

Port Path	Description	Loss (Gain)
From 1 to 2	Receive loss incurred while recording. The channel state is OFF-HOOK.	0.3 dB @ 1000 Hz
From 1 to 2	Receive loss incurred while recording. The channel state is ON-HOOK.	5.5 dB @ 1000 Hz
From 3 to 1	Transmit loss from DR to analog line. Both PBX and channel interface have 600 Ohm impedance. The channel state is OFF-HOOK.	3.3 dB @ 1000 Hz
From 3 to 1	Transmit loss from DR to analog line. The PBX has a 600 Ohm impedance. The channel state is ON-HOOK.	22.4 dB @ 1300 Hz
From 3 to 2	Loss associated with echo path. Port 1 is connected to telephone line. Both PBX and phone have 600 Ohm impedance. Phone is in OFF-HOOK state.	32 dB @ 1000 Hz
From 3 to 2	Loss associated with echo path. Port 1 is connected to telephone line. The PBX has a 600 Ohm impedance. The channel state is ON-HOOK.	.5 @ 1000 Hz

Due to receive loss (from Port 1 to Port 2) activity detection settings have to be adjusted by the amount of loss to reflect signal energy on the monitored analog line.

Recordings without AGC are also impacted unless gain is applied. To achieve 0 dB overall gain (from the line to the recorded file), the amount of gain should be equal to the receive loss.

DTMF GENERATION

DTMF tone duration and tone pause have a fixed minimum of 75 mS. Additionally, the DTMF low gain and high gain are respectively fixed at 9500 and 12000 (which meets FCC requirements).

ALERT TONE

In ON-HOOK mode, SmartWORKS LD offers voice band signal monitoring and alert tone generation to be used in call logging applications. Due to the substantial loss from Port 3 to Port 1 (20 dB), alert tone amplitude must be set to -4 dBm resulting in a -24 dBm output to the line (which meets FCC requirements).

AUDIO JACK

SmartWORKS LD's on-board audio jack can monitor any time slot on the TDM bus. The audio jack communicates via input and output pins.

Use the output to play files by connecting the output of the DR to the TDM time slot. The audio jack can also be used to monitor previously recorded files.

Use the input to route audio by connecting the microphone (or radio) to the TDM bus.

Channel resources (DR) can be connected to the same time slot and recorded. If a microphone requires phantom power, close the proper jumper.

Using AudioCodes Utilities to Test Installation

AudioCodes ships utilities with each CD-ROM. SmartControl is a control panel used for board configuration. SmartView is an application provided by AudioCodes used to test the functionality of SmartWORKS products. Developers or System Administrators, by using the commands accessible via the SmartView interface, can test whether the board is installed and configured properly for the network, as well as view events generated as the board is used.

This section demonstrates how to use SmartControl and SmartView to test basic board functionality after installation. For complete information about using these and other utilities, refer to the *SmartWORKS Utilities Guide*.

SET IMPEDANCE

1. Open the SmartControl Panel Applet (located on your PC's Control Panel).
2. Select the Parameters tab, then set the *OffHookImpedance* to match your network: FCC, ETSI, Australia, or China.
3. Board drivers must be restarted after making changes in the Control Panel.

VERIFY SETUP

1. Run the SmartWORKS Control Panel.
2. Click on the **Board** tab. Select the board number that represents the LD board. Verify that the board information is displayed correctly.
3. Click on the **System** tab. Verify that the settings are correct.

SET LINE VOLTAGE PARAMETERS

1. Run the SmartView (Start menu, Programs>Ai-Logix>SmartWORKS>SmartView.exe).
 2. From the toolbar, select **Settings** then select **MT(Get/Set)LV(Params/Detect)...**
 3. View current voltage, if positive, go to step 8, if negative continue with step 4.
 4. Close the Loop Voltage screen.
 5. Choose **Settings** then select **MT(Get/Set)ReverseLoopPolarity...**
 6. Change to *Reverse* and select the OK button. Close the Loop Polarity screen.
 7. Choose **Settings** then select **MT(Get/Set)LV(Params/Detect)...**
 8. Set *Threshold low* to 4 and *Threshold high* to 16. (This is a recommended setup for 24V systems, ensure your onhook state is above threshold high and your offhook is between 4-16.)
-

VERIFY EVENTS

Run SmartView: From the Start Menu select Programs > Ai-Logix > SmartWORKS > SmartView.exe.

Open Channels: From the Tool Bar, select **System > MTSysStartup**. This will open the board and all channels. Verify that an analog phone line (terminate configuration) or analog phone (passive configuration) is connected to the first channel.

At this point, the system is set up to operate and capture events. Do the following:

1. Highlight the first channel using the SmartView Interface.
2. From the Tool Bar select **Settings > MT(Get/Set)EventFilters...** Using the check boxes, enable all the events.
3. Terminate: Using an external phone, place a call into the phone line connected to the first channel.
Passive: Place a call on the analog phone connected to the monitored channel.
4. Verify events are present in the Event Viewer.

If no events are generated - verify the following:

- a) Check your connections and verify that the wiring matches the Tip& Ring schematic provided.
- b) Use another channel to verify that it is not a bad channel.

CHECK RECORDING

1. Using SmartView, highlight the first channel.
2. Place a call (passive) or call into the first channel (terminate) and keep the line open.
3. From the Tool Bar select, **Media > MTRecFile...**
Set the following:
 - File Name: [Filename].wav - the .wav extension must be appended
 - Data Format: This must be set as MSGSM.
 - Click the Advanced button: Under the MS Wave Option, select RIFF Format Data.
4. Stop recording: from the toolbar select **Channel Functions > MTStopChannel**.
5. You can play this back using any standard Media Player.

If the recording contains static or noise:

- a) View the tap connection and verify that there are no loose lines.
- b) Check whether the actual phone line contains static, it may just be a bad line.
- c) Send the recording to AudioCodes for evaluation.

Maximum Number of SmartWORKS Boards per System

SmartWORKS is designed to support up to 512 channel or 16 boards (any combination) per system, whichever limit is reached first.

Application developers should note that their system may not reach these limits due to external factors such as processor speed, number of processors, and CODEC compression rate.

Please contact AudioCodes Technical Support for more Information.

Chapter 9

SmartWORKS DT and DT-eh

Introduction

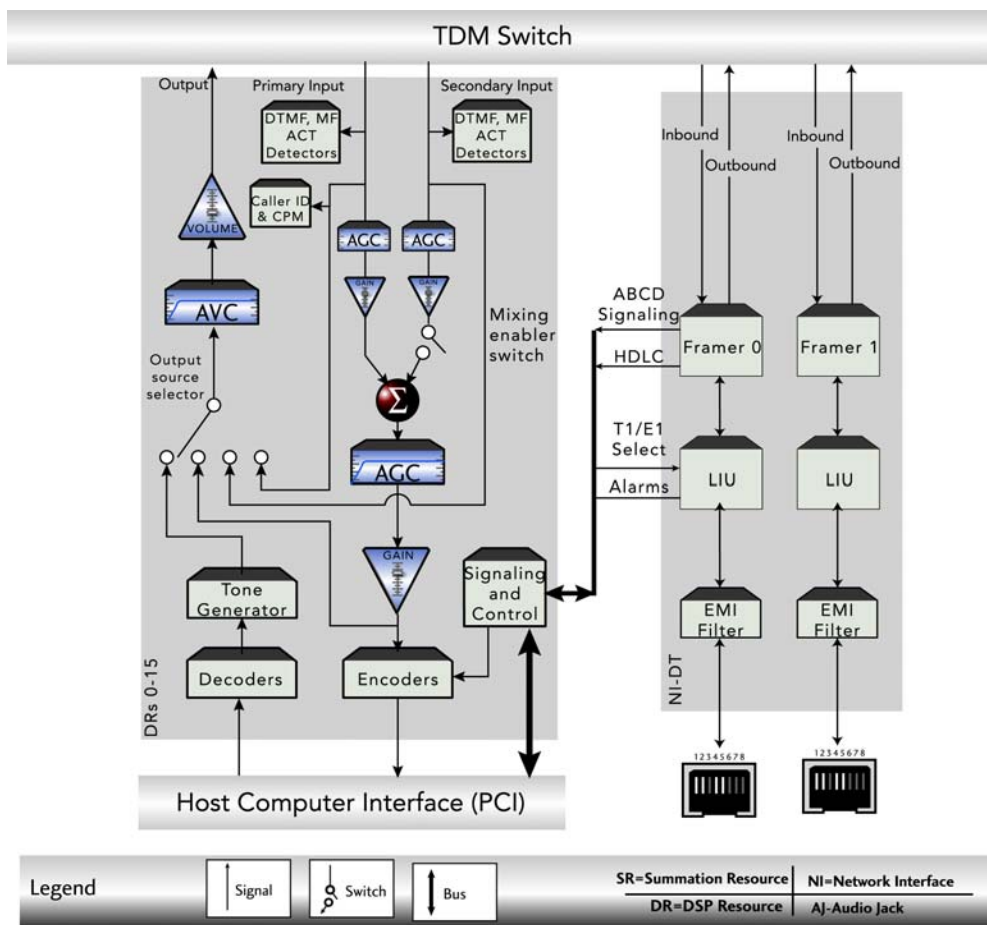
This section explains the SmartWORKS DT and DT-eh products. The DT-eh is a full-sized PCI express product with an H.100 bus. For sake of documentation, both products are referred to as the SmartWORKS DT.

UNIQUE FEATURES

DSP

At the center of the SmartWORKS DT are 16 advanced DSPs providing enough horsepower to process up to 60 full-duplex channels. Each voice resource has a full set of signal detectors, encoders, decoders and other voice processing functions such as automatic gain control (AGC) and automatic volume control (AVC). For a visual representation of the SmartWORKS DT architecture, see [Figure 9-1](#).

Figure 9-1: DT Logical Card Model



CHANNELS

Voice resource (channel) inputs are connected to the framers through the TDM switch during system startup.

NOTE: Channels on the DT6409, DT6409TE, DT3209, and DT3209TE have been verified to limit at -10dBm.

All channels in the SmartWORKS family are *full-duplex*, meaning they can record and play at the same time. The SmartWORKS API allows the user application to disconnect any channel's (DRs) input or output from the framers and connect them to the TDM (MVIP or H.100) bus.

The number of channels available on a SmartWORKS DT depends on trunk type and the signaling protocol used. Trunk type and signaling protocol selection must be made before starting the driver. Trunk type selection is done per board, meaning one board can operate in T1 mode while another is in E1 mode. Trunk coding and framing is selected on a per framer basis. This allows a single board to terminate two trunks that each have different settings (e.g. a T1 voice trunk with AMI line coding/ D4 framing, and a T1 trunk with ISDN signaling, B8ZS line coding/ESF framing).

Configure the board and framers through the SmartControl applet configuration tool that is provided on the SmartWORKS CD-ROM.

CHANNEL MAPPING

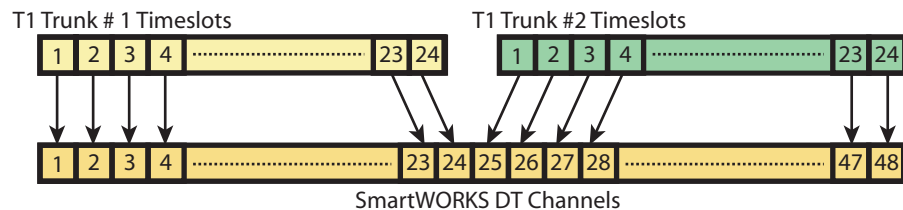
The following information details how timeslots on the trunk are mapped to DT channels for various trunk types and protocols.

T1 trunks with Robbed Bit Signaling:

When a SmartWORKS DT is programmed to terminate T1 trunks with Robbed Bit Signaling, the board reports having 48 channels. The first 24 channels are connected to 24 timeslots on the first trunk, and channels 25–48 are connected to timeslots of the second T1 trunk as depicted below.

Figure 9-2: T1 Trunk to SmartWORKS DT Channel Map

T1 Trunk to SmartWORKS DT Channel Map



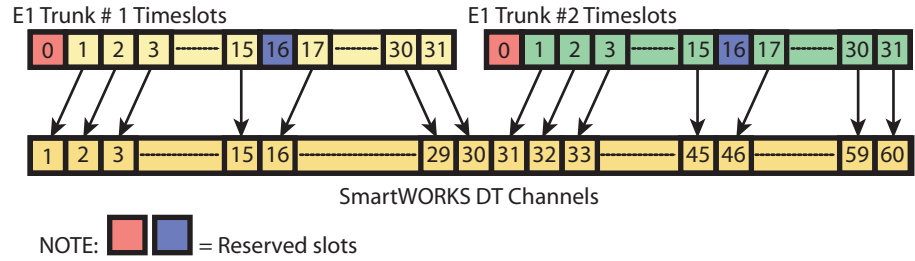
E1 TRUNKS

E1 lines provide 32 timeslots (0 through 31). Framing and synchronization is carried out on timeslot 0, D-channel information (signaling data) is carried on timeslot 16, and B-channel information (voice) is carried on timeslots 1-15 and 17-31.

Switching trunk type from T1 to E1, changes the number of available channels on the SmartWORKS DT from 48 to 60. Channels 1–30 are connected to 30 timeslots on the first E1 trunk; while channels 31–60 are mapped to the second E1 trunk. Regardless of what signaling protocol is used (CAS or ISDN), the number of channels on an E1 trunk remains the same.

Figure 9-3: E1 Trunk to SmartWORKS DT Channel Map

E1 Trunk to SmartWORKS DT Channel Map



TDM BUS ENCODING

The SmartWORKS DT design requires all channels on the TDM bus to use the same encoding: either μ -law or A-law. The TDM bus encoding is configured through the SmartControl applet.

SmartWORKS DT Hardware

Below is a view of the SmartWORKS DT and its user configured components.

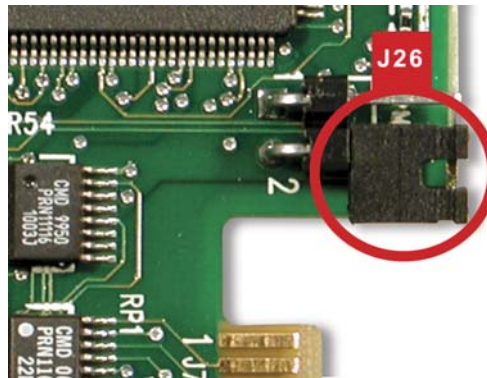
NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

JUMPER J8

Jumper J8 terminates the clock and control signals on the MVIP or H100 Bus. When jumper J8 is closed, a connection is established that enables termination and activates LED CR18. For a functional description of LED CR18, see “CR18” on page 86.

Jumper J8 is located on the outside of the board (see Figure 9-4). To activate clock termination, close the jumper by placing it over both pins (to establish a connection). By default, this jumper is open. Termination is only required when multiple boards are installed and connected by a H.100 or MVIP cable.

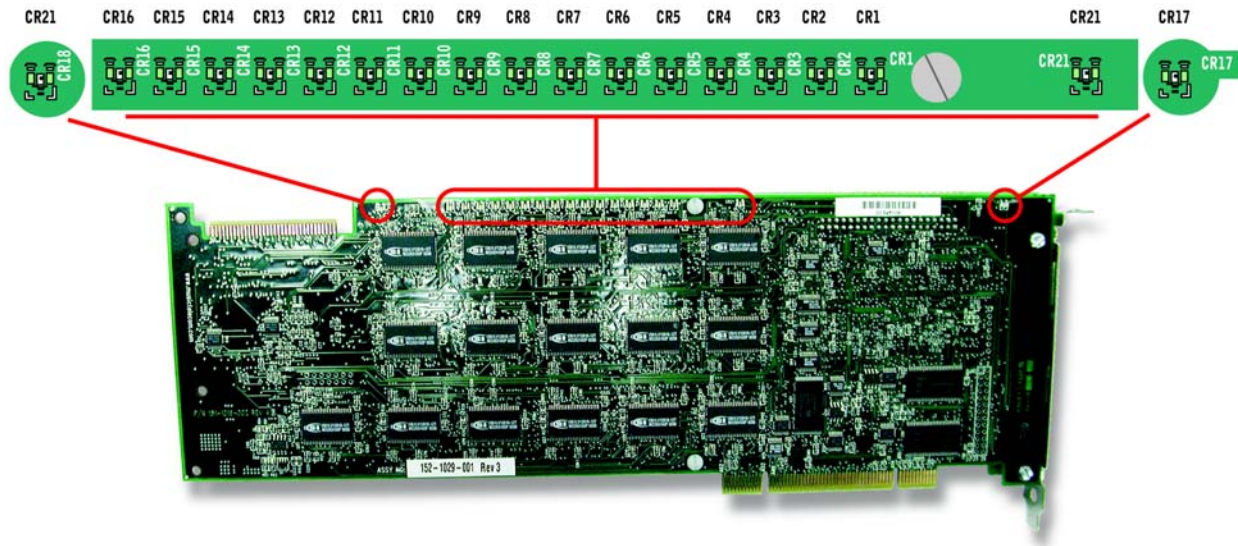
Figure 9-4: Jumper J8 Installed



BOARD STATUS LEDs

Nineteen board status LEDs are the SmartWORKS DT. The location of each LED is shown in Figure 9-5.

Figure 9-5: SmartWORKS DT LEDs



CR1 - CR16

These LEDs indicated that the DSPs have started. Each DSP turns its LED "ON" to indicate a successful initialization.

CR17

Three stage power and board initialization monitoring LED with the following occurrences:

- "ON," indicating 3.3V power is supplied and the board is ready for the driver to be loaded.
- "OFF," indicating the driver has successfully loaded and the board has initialized.
- "BLINKING," indicating the board initialization process has failed or board panic has occurred. **Note:** Invoking the MTBlinkBoard() API function causes the LED to blink. The total number of times it blinks equals the board number + 1. Use this function to match board location in a chassis with its board number.

CR18

This LED indicates that the TDM clock has been terminated. "ON" indicates TDM clocks are being terminated. **Note:** to terminate clocks jumper J8 must be closed.

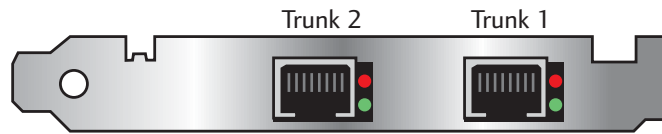
CR21

This LED indicates the state of the CPU. This LED is turned ON when the local CPU is started by the driver.

TRUNK STATUS LEDs

Two Trunk Status LEDs per trunk are included to help troubleshoot installation problems. As shown below, they are located next to the cable connections.

Figure 9-6: Trunk Status LED Locations



The following table shows possible states of LEDs and describes the state of trunk interface.

TABLE 9-7: SMARTWORKS DT TRUNK STATUS LED MEANINGS

Lights	Red	Green	Status
○ ○	OFF	OFF	Framer Reset
○ ●	OFF	ON	Normal Operation
● ●	ON	ON	Signal Present & Alarm(s) Present
● ○	ON	OFF	No Signal, Framer Started

Making Connections

The following sections cover connecting the DT to T1 and E1 trunks, as well as, voice recording applications.

NOTE: This unit is for use only with compatible UL listed PCs or servers.

CONNECTING THE DT TO T1 AND E1 TRUNKS

SYSTEM CONFIGURATION

The SmartWORKS DT is a dual Digital Terminate board, which means the board terminates the trunk. The trunk typically connects to the Central Office (CO). However, for service observance applications the trunk is connected to the Customer Premises Equipment (CPE) i.e. PBX.

NOTE: When installing on an external network without homo approval, a CSU/DSU is required between the CO and the DT card.

LINE INTERFACE CHARACTERISTICS

The SmartWORKS DT has two trunk interfaces. The list below details the characteristics of each trunk interface.

- Connectors: two RJ-45 (located on its front bracket)
- Interface type: balanced
- Characteristic Impedance for Input and Output in T1 or E1 mode: 110 Ω

The characteristic impedance is 110 Ω , which meets T1 and E1 requirements. In T1 mode, the interface supports line AMI and B8ZS coding as well as SF and ESF framing. In E1 mode, the interface supports line AMI and HDB3 coding as well as basic G704 and CRC4 framing.

Instead of balanced lines, some European networking and telephony trunks use unbalanced lines (Coaxial cable). In this case, to convert from Coax to twisted pair (RJ-45) a Dual BALUN converter is required.

For more information, see [Figure 9-8 on page 89](#).

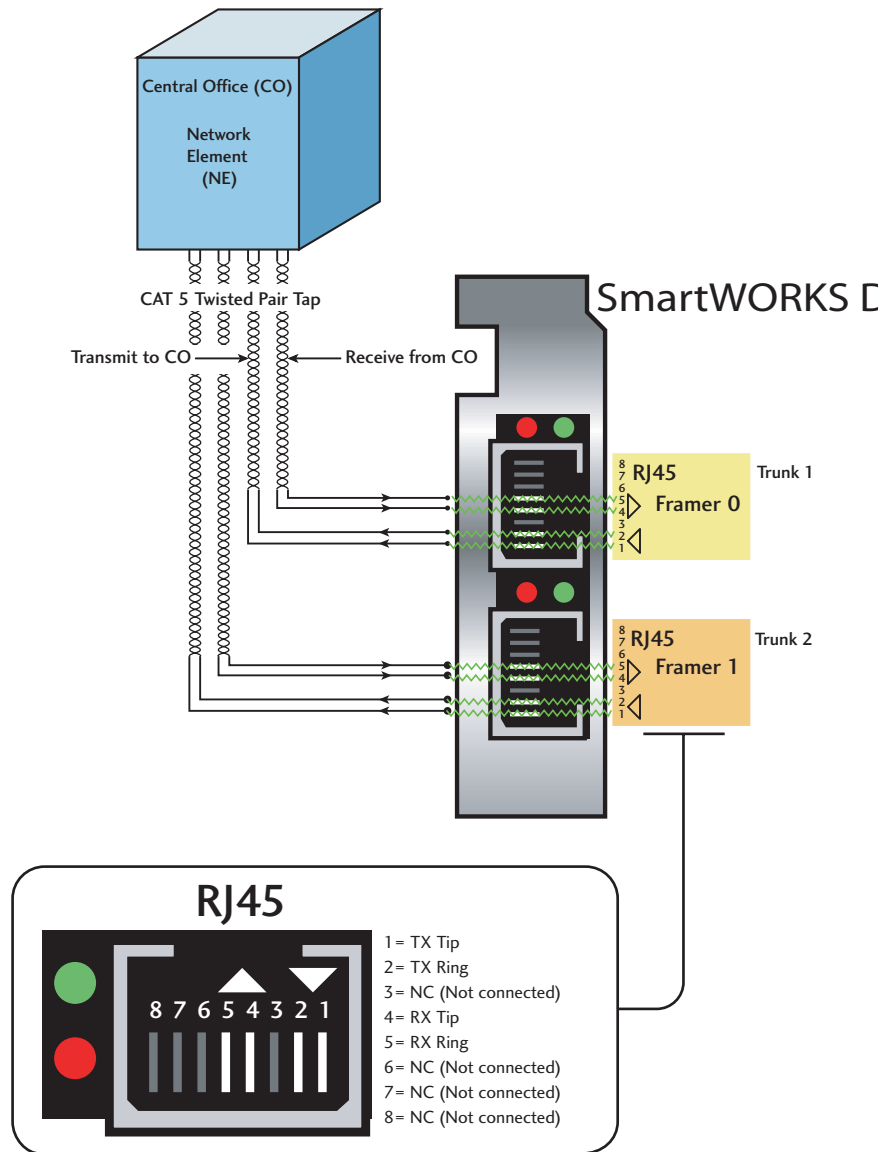
T1 AND E1 TRUNKS

When the DT board was originally introduced, a crossover cable was required. This is illustrated in the wiring diagram on the following page. Later versions of the DT board (DT6409TE and DT3209TE) do not require a crossover cable, as the Transmission and Receive lines have been re-positioned. A diagram of the newer RJ45 connector is provided following the wiring diagram shown below.

NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

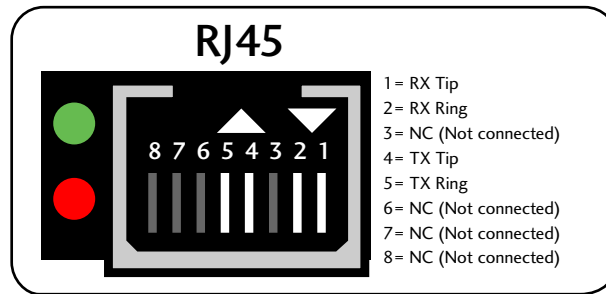
Figure 9-8: DT T1/E1 Wiring Diagram

SmartWORKS DT Wiring Diagram for T1/E1 Trunk



The following diagram shows the RJ45 connector that is implemented on newer versions of the DT card (DT6409TE, and the DT3209TE). A crossover cable is not required when installing these boards.

Figure 9-9: RJ45 Connector - DT6409TE and DT3209TE



SIGNALING BITS EXTRACTION AND INSERTION

To allow custom interfacing with foreign protocols, the SmartWORKS DT provides signaling bits extraction and insertion. When this feature is enabled, the user application reads the current state of ABCD signaling bits' and ABCD signaling bits are extracted and presented for use upon a state change.

Signaling bits extraction is disabled by default. Hence, user applications must enable ABCD signaling when it is to be used. To enable ABCD signaling extraction, invoke `MTEnableFramerABCDSignalingEvent()` event.

VOICE RECORDING APPLICATIONS

INPUTS

Each channel has two inputs: primary and secondary. The primary input and the output is connected to the framer. Each input has its own set of DTMF, MF, and activity detectors. Both MF R1 and R2 tones are supported. The Activity Detector features programmable parameters such as activity threshold, silence threshold, minimum silence, and minimum activity duration. The primary input also has a Caller ID detector and a Call Progress Monitor. All detectors can be enabled or disabled via the SmartControl applet.

NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

ECHO CANCELLATION

Echo cancellation resources are available for each channel. The canceler is connected between the output and primary input. Enable or disable this feature from the user application.

CALL PROGRESS MONITORING

The call progress monitor (CPM) has pre-programmed profiles for typical call progress tones used in North America. These profiles can be replaced at any time to better suit the needs of a particular application.

CALLER ID

Caller ID supports Bell 202 and V.23 standards.

AUTOMATIC GAIN CONTROL

The SmartWORKS DT offers optional automatic gain control (AGC) followed by a gain stage. The DT's AGC handles a wide, dynamic range which is typically encountered when a voice logger is connected close to a PBX or analog phone. For the best performance set the AGC's target amplitude to -6 dBm and the gain to -10 dBm.

ISDN TERMINATE

The DT card fully supports ISDN terminate capabilities with supplementary services support. The DT supports the following ISDN PRI standards:

ISDN PRI **T1** variants:

- NI-2 (North America)
- AT&T 5ESS (North America)
- Nortel DMS100 (North America)
- Euro-ISDN (Europe & Rest of the World)
- NTT Japan

ISDN PRI **E1** variants:

- Austel 1 (Australia)
- ETS 300
- QSIG (North America)

T1 RBS variants:

- E&M immediate
- E&M Wink
- Loop Start FXS
- Loop Start FXO

SUPPLEMENTARY SERVICES

Information elements are collected to provide the following supplementary services:

Call Hold /Call Retrieve	Call transfer
Call Forward on Busy	Charging
Call Forward unconditional	Recall
Call Forward on No Reply	Three party Conference
Suspend/Resume	Malicious Call ID

The supplementary services are provided through the following API structures:

- CC_FACILITY_REQ
- CC_FACILITY_CONF

- CC_FACILITY_IND
- CC_CONNECT_REQ

NOTE: The support of Supplementary services depends on ISDN variants

- Call Hold / Call Retrieve (valid for US variants only)
- Recall (valid for ETSI variant only)

API SUPPORT

The following APIs are used to support ISDN terminate on the DT card. More information can be found in the API library which provides a thorough explanation of ISDN terminate.

- CC_CONNECT_REQ
- CC_DISC_REQ
- CC_USER_INFO_REQ
- CC_FACILITY_REQ
- CC_SUSPEND_REQ
- CC_RESUME_REQ
- CC_CONNECT_RESP

SMARTWORKS DT SOFTWARE

For default configurations and switching control information for the SmartWORKS DT, refer to the sections below.

DEFAULT TDM CONNECTIONS

Upon startup of the driver and DLL, the initial configuration for all channels is as follows:

- The primary input of each channel is connected to the output of the framer and the secondary input of each channel is not connected.
- The channel output is connected to the input of a framer.
- Mixing is disabled.
- The master clock source is set to "crystal oscillator."
- The output source is set to "decoder."

For more information, see [Figure 9-1 on page 82](#).

MAKING A CONNECTION TO THE CT BUS

Four functions are provided by the API to connect the channel output to the MVIP or H.100 bus:

MTSetOutput()

MTResetOutput()

MTSetInputs()

MTResetInputs()

Three functions are provided by the API to connect the framer to the MVIP or H.100 bus:

MTSetPoint()

MTJoin()

For more information on using these API functions, refer to the SmartWORKS Developer's Guide.

BOARD-TO-BOARD CONNECTIONS AND TDM CLOCK TERMINATION

If you have multiple boards in one system, for synchronization purposes the last board in the chain must terminate the TDM clocks. Connect multiple boards with a standard drop cable. If the last board in your system is the SmartWORKS DT close jumper J8 to enable clock termination (see [Figure 9-4](#)).

Using AudioCodes Utilities to Test Installation

AudioCodes ships utilities with each CD-ROM. SmartControl is a control panel used for board configuration. SmartView is an application provided by AudioCodes used to test the functionality of SmartWORKS products. Developers or System Administrators, by using the commands accessible via the SmartView interface, can test whether the board is installed and configured properly for the network, as well as view events generated as the board is used.

This section demonstrates how to use SmartControl and SmartView to test basic board functionality after installation. For complete information about using these and other utilities, refer to the *SmartWORKS Utilities Guide*.

BOARD CONFIGURATION

1. Open the SmartControl Panel Applet (located on your PC's Control Panel).
NOTE: Board drivers must be restarted after making changes in the Control Panel.
2. Select the **Digital Network** tab and set the following (this information must be obtained from the local carrier):
3. Select either the *T1/E1* option. Then configure the following to match the local network:
Trunk Framing, Line Coding, Signaling Protocol, and Variant.
4. Board drivers must be restarted after making changes in the Control Panel.

VERIFY SETUP

1. Run the SmartWORKS Control Panel.
2. Click on the **Board** tab. Select the board number that represents the DT board. Verify that the board information is displayed correctly.
3. Click on the **System** tab. Verify that the settings are correct.

VERIFY EVENTS

Run SmartView: From the Start Menu select Programs > Ai-Logix > SmartWORKS > SmartView.exe.

Open Channels: From the Tool Bar, select **System** > **MTSysStartup**. This opens the board and all channels.

At this point, the system is set up to operate and capture events. Verify that a call simulator has been configured to place a call on the first channel. Do the following:

1. Highlight the first channel using the SmartView Interface.
2. From the Toolbar, select **Settings** then select **T(Get/Set)EventFilters...**
Enable Activity and Silence by placing a check in each box.
3. Place or receive a call on the first channel.
4. Look for the following events in the Event Viewer:
EVT_CC_ (call control events)
EVT_ACTIVITY
EVT_SILENCE

If no events are generated - verify the following:

- a) Use SmartView to look for errors on the line indicating a connectivity issue:
FramerStatistics > **MTGetT1/E1FramerStatistic...**
- b) Check your tap and verify that the wiring matches the tip and ring schematic provided.
- c) Monitor another channel to verify the channel is not bad.

CHECK RECORDING

1. Using SmartView, highlight a monitored channel.
2. Initiate a phone call and keep the line open.
3. From the Tool Bar select **Media** > **TRecFile...**
Set the following:
 - File Name: [Filename].wav - the .wav extension must be appended
 - Data Format: This must be set as MSGSM.
 - Click the Advanced button: Under the MS Wave Option, select RIFF Format Data...
4. Stop recording: from the toolbar select **Channel Functions** > **MTStopChannel**.
5. You can play this back using any standard Media Player.

If the recording contains static or noise:

- a) View the tap connection and verify that there are no loose lines.
- b) Check whether the actual phone line contains static, it may just be a bad line.
- c) Send the recording to AudioCodes for evaluation.

Maximum Number of SmartWORKS Boards per System

SmartWORKS is designed to support up to 512 channel or 16 boards (any combination) per system, whichever limit is reached first.

Application developers should note that their system may not reach these limits due to external factors such as processor speed, number of processors, and CODEC compression rate.

Please contact AudioCodes Technical Support for more information.

Chapter 11

SmartWORKS PCM and PCM-eh

Introduction

PCM32 is the common name for the proprietary BT Syntegra ITS switch using PCM32 Megalink protocol. AudioCodes' SmartWORKS PCM3209 and PCM6409 boards include PCM32 trunk interface(s) with Voice Resources.

The SmartWORKS PCM series cards have been designed to combine the same features and capabilities of SmartWORKS cards with a PCM32 front end.

This section explains the SmartWORKS PCM and PCM-eh products. The PCM-eh is a full-sized PCI express product with an H.100 bus. For sake of documentation, both products are referred to as the SmartWORKS PCM.

The front end of the cards have been designed with a standard RS485 electrical interface that is optically isolated from the board. RJ45 connectors are used to connect the cards to the network. The PCM3209 has one trunk while the PCM6409 is built with two. Each trunk supports up to 32 channels.

TRUNKS

Each trunk supports three types of signals:

- frame sync
- data in
- data out

NOTE: All signals are optically isolated from the board.

FRAME SYNCHRONIZATION

The frame sync is a 8khz clock. The positive transition defines the start of a frame. Frame sync can be set on a per trunk basis to be either input or output. When set to input the trunk may be set to HiZ or 120 Ohm impedance via a SmartWORKS API. When set to output, it complies with the RS485 driver specifications.

DATA IN

The serial data stream is carried at the rate of 2.048Mbps. Input impedance is programmable to HiZ or 120 Ohm.

DATA OUT

The serial data stream is carried at the rate of 2.048Mbps. Output impedance complies with the RS485 driver specifications.

FRAMER

Each trunk is connected to one framer which performs the following functions:

- Synchronization of the local clock to the frame sync.
- Loss of synchronization alarm - when synchronization is lost, the framer reports an alarm via the EVT_LOSYNC_ALARM. **NOTE:** This alarm must be armed using the **MTArmFramerAlarm()** API.

- Idle packet - when synchronization is lost, the framer replaces the data stream normally sent to the TDM with idle packets. The idle packet format is programmable via a SmartWORKS API and can be sent in either A-Law or μ -Law format (μ -Law by default).

BOARD FEATURES

This section outlines the various features associated with the SmartWORKS PCM cards.

CALL PROGRESS MONITORING

The SmartWORKS Call Progress Monitoring (CPM) tracks the progress of outbound calls by identifying possible call results (or call states). The SmartWORKS CPM was designed around a signal processing service able to detect and recognize of a wide range of Call Progress Tones (CPT) - such as dial tone, busy signal, or ringback. CPM has pre-programmed profiles for typical call progress tones used in North America. These profiles can be replaced at any time to better suit the needs of a particular application. For more information refer to the application note: *Call Progress Monitoring*.

CALLER ID

All SmartWORKS boards detect Caller ID when it is passed over voice channels (supports Bell 202, V.23 and Japanese NTT standards). If CallerID is present on the voice channels, CallerID will be detected and reported to the user application as an event.

ACTIVITY DETECTION

The Activity Detector is capable of monitoring line activity/silence and features programmable parameters such as activity threshold, silence threshold, minimum silence, and minimum activity duration. The events generated by this feature can be disabled using the ***MTSetEventFilters()*** API.

AUTOMATIC GAIN CONTROL

The SmartWORKS PCM cards offer optional automatic gain control (AGC) followed by a gain stage. AGC handles a wide, dynamic range that is typically encountered when a voice logger is connected close to a PBX. By default this feature is disabled, but can be enabled using the ***MTAGCControl()*** API.

AUTOMATIC VOLUME CONTROL

The SmartWORKS PCM cards have the capability to take the output of a channel mixer, apply automatic volume control (AVC) to it, and adjust the output by programming volume control. The resulting voice stream must be connected to a selected timeslot on the TDM bus.

TONE GENERATION

All SmartWORKS boards are capable of tone generation. This feature is only available when the board is operating in a terminate scenario.

ENCODERS / DECODERS

All SmartWORKS boards offer a wide range of voice encoders and decoders. Digitalization methods are programmable on a per channel basis. You may select a GSM 6.10 decoder and a 32 kbp/s G.726 encoder to be used at the same time on any given channel. All codecs are listed in this *SmartWORKS User Guide*.

TDM CONNECTIONS

The SmartWORKS PCM cards can be configured to connect to the global CT bus, H.100 or MVIP. Initially, all channels are configured with both the primary and secondary inputs connected to the DSPs.

Before connecting any channel output to the CT Bus, a parameter *TDM Encoding* must be set. The board design requires all channels on the TDM bus to use the same encoding: either μ -law or A-law. Generally speaking, the following holds true: μ -Law is used in North America and Japan, A-Law is used in Europe and in areas outside of North American influence.

Using the Control Panel select the **Board** tab and set TDM Encoding.

MAKING A CONNECTION TO THE CT BUS

The API offers many functions to connect the channel output/input to the CT bus. The following functions are recommended for use with the SmartWORKS PCM cards:

MTSetOutput() - The incoming data is passed from the DSP output into the CT Bus, plus processed on the board for recording. The following is still be applied to data passed onto the CT Bus: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain. ***MTSetOutputSource()*** must be used to select the data source.

MTSetFramerOutput() - framer output is routed directly to the CT Bus, and to the board's DSP for processing. The signal that is passed directly onto the CT Bus bypasses the boards DSPs therefore the following is not applied: DTMF/MF, Caller ID, Activity detection, Automatic Gain Control and Gain. Refer to a diagram in the SmartWORKS Developer's Guide where the API ***MTSetFramerOutput()*** is explained.

MTSetInputs() - routes data from the CT Bus to the channel's primary and secondary inputs. **NOTE:** Although *MTSetCTRoute()* is part of the SmartWORKS API, please note that it is not supported by the SmartWORKS PCM cards.

Board Architecture

The architecture of the SmartWORKS PCM cards is modeled after all SmartWORKS products.

DSP

At the center of the SmartWORKS PCM cards are advanced DSPs (16 on the PCM6409, and 8 on the PCM3209).

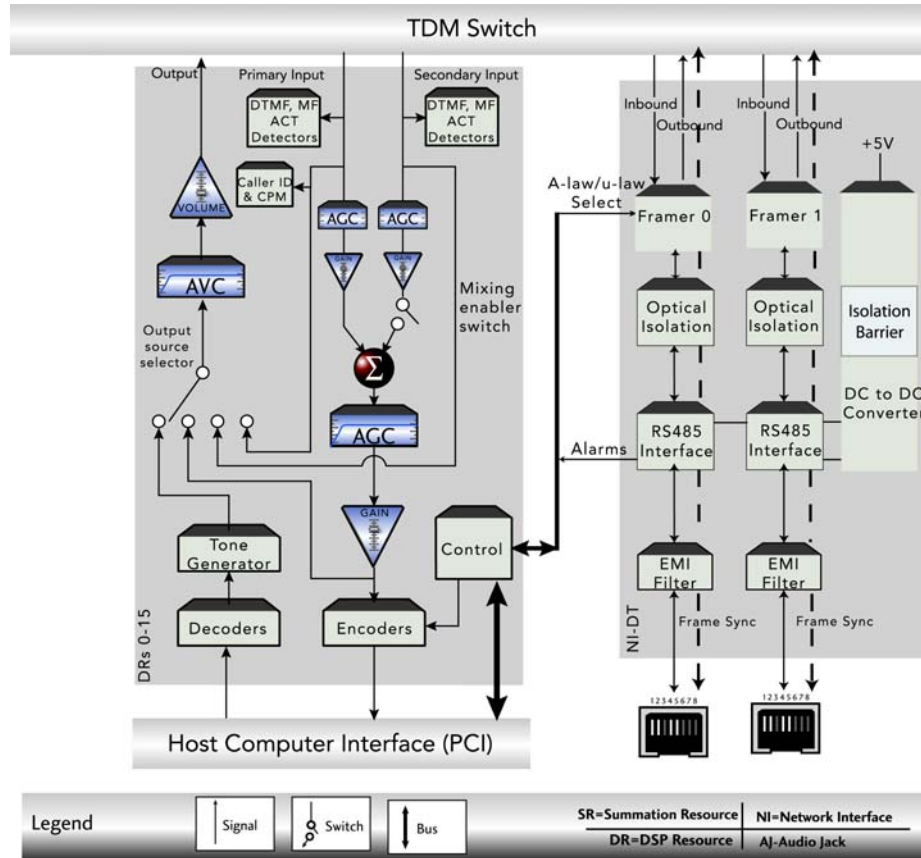
CHANNEL COUNT

The PCM6409 has two framers, one for each trunk. The PCM3209 has one framer. Each trunk can support up to 32 channels. Each framer monitors inbound and outbound traffic on one PCM32 trunk. The framers are connected to voice resource channels through the local TDM switch. Each voice resource has a full set of signal

detectors, encoders, decoders and other voice processing functions such as automatic gain control (AGC), and automatic volume control (AVC). Only the primary input of the voice resources are used on the SmartWORKS PCM cards.

The diagram on the following page provides a visual representation of the SmartWORKS PCM architecture.

Figure 11-1: PCM Logical Card Model



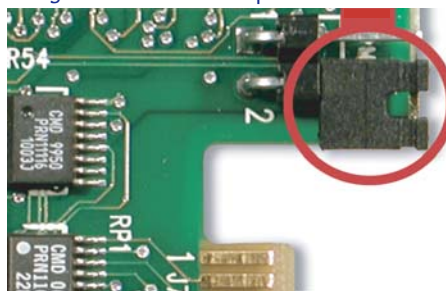
Hardware Overview

The SmartWORKS PCM cards are comprised of a single basecard containing Voice Resources and a daughter card for the PCM32 front end. This section illustrates the location of jumpers, board LEDs, and trunk LEDs.

JUMPER J8

Jumper J8 on the basecard is used to terminate the clock and control signals on the MVIP or H100 Bus. When jumper J8 is closed, a connection is established that enables clock termination and activates LED CR18. Jumper J8 is located on the outside of the board (see figure below). To activate clock termination, close the jumper by placing it over both pins (to establish a connection). By default, this jumper is open. If only one SmartWORKS card is installed per system or if the CT bus is not connected, clock termination is not required.

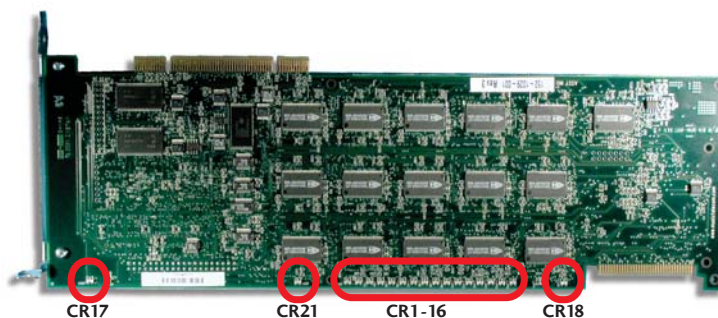
Figure 11-2: Jumper J8 Installed



BOARD LEDs

Nineteen board status LEDs are located on the basecard of the SmartWORKS PCM 6409. The location of each LED is shown in the figure below.

Figure 11-3: LED Locations



CR1 - CR16 (CR1-8 ON THE 3209)

These LED indicates that the DSP has started. Each DSP turns its LED ON to indicate a successful initialization.

CR17

A three stage power and board initialization monitoring LED with the following occurrences:

- "ON," indicating 3.3V power is supplied and the board is ready for the driver to be loaded.
- "OFF," indicating the driver has successfully loaded and the board has initialized.
- "BLINKING," indicating the board initialization process has failed or a board panic has occurred. **NOTE:** Invoking the *MTBlinkBoard()* API causes the LED to blink. The total number of times it blinks equals the board number + 1. Use this function to match board location in a chassis with its board number.

CR18

This LED is used to indicate that TDM clock termination is enabled. "ON" indicates the TDM clocks are being terminated. **NOTE:** to terminate clocks jumper J8 must be closed.

CR21

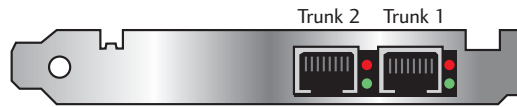
This LED indicates the state of the CPU. This LED is turned ON by the local CPU upon successful initialization.

TRUNK STATUS LEDs

Two Trunk Status LEDs per trunk are included to help troubleshoot installation problems. As shown below, they are located next to the cable connections.

NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

Figure 11-4: Trunk Status LED Locations



The following table shows possible states of the trunk LEDs:

TABLE 11-5: SMARTWORKS PCM TRUNK STATUS LEDs

Lights	Red	Green	Status
○ ○	OFF	OFF	Trunk is disabled
○ ●	OFF	ON	Normal Operation, trunk is enabled and in sync
● ●	ON	ON	Trunk is enabled, but not in sync
● ○	ON	OFF	Trunk is enabled, but no signal

Installation and Wiring

The following section reviews the installation of the SmartWORKS PCM cards.

NOTE: The maximum allowable cable length from the PBX to the SmartWORKS PCM cards is 30 meters (100 feet).

PRE-INSTALLATION

Some applications require multiple boards connected via a CT Bus cable (MVIP or H.100). For synchronization purposes the last board in the chain must terminate the TDM clocks. If the last board in your system is a SmartWORKS PCM card close Jumper J8 to enable clock termination.

Refer to the *SmartWORKS Developer's Guide* for guidelines on setting Master/Slave mode and TDM clock termination.

INSTALLATION AND WIRING

The following section explains how to install the SmartWORKS PCM cards. Wiring diagrams are also provided.

NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

ESD Precautions

Switch off the power and remove power cords before opening the computer case. Do not re-attach power cords or switch on power to the computer while the computer case is removed.



Exercise ESD Precautions: Wear an ESD wrist strap.

Secure the card in a PCI slot with a chassis screw. **NOTE:** Cancel out of the Windows "Found New Hardware" screen. Place the SmartWORKS CD into the CD ROM and allow the board installation to finish. The SmartWORKS PCM card requires the same installation procedure as other SmartWORKS cards. Follow the installation instructions available on any quick install for more information.

CABLE LENGTHS

The front end of the SmartWORKS PCM cards is designed to comply with a standard RS485 interface. The maximum allowable cable length from the PBX to the card is 30 meters (100 feet).

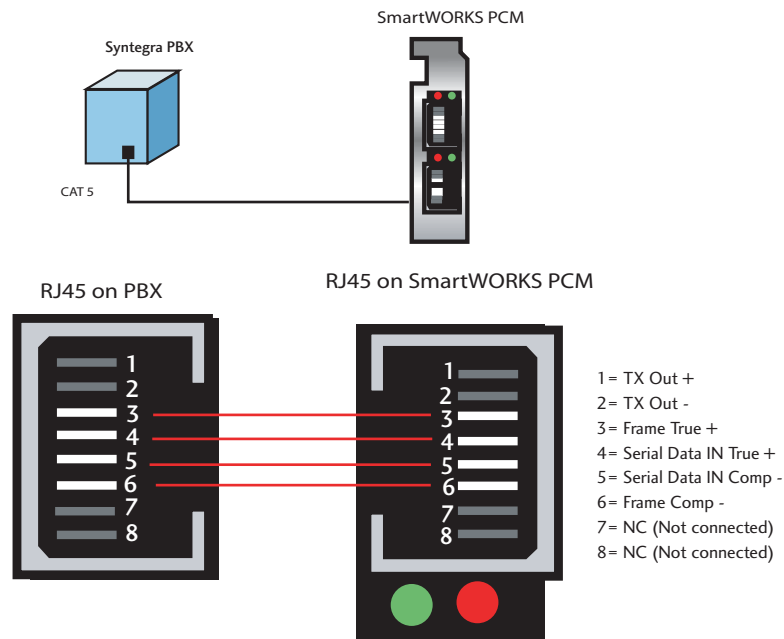
WIRING REQUIREMENTS

For correct functionality, the SmartWORKS PCM cards must be wired properly. Refer to the wiring diagram below.

NOTE: Port numbering begins with port 0. The top port, or the port nearest the bracket screw, is port 0.

Figure 11-6: SmartWORKS PCM Wiring Diagram

SmartWORKS PCM Wiring Diagram



Board Configuration

Boards can be configured using the SmartControl Panel Applet (located on your PC's Control Panel) or using the SmartWORKS API. **NOTE:** Board drivers must be restarted after making changes with the Control Panel.

TDM CLOCK TERMINATION

If multiple boards are connected with a MVIP or H.100 cable, they must be configured as Master or Slave. Refer to the *SmartWORKS Developer's Guide* for guidelines on setting Master/Slave mode and TDM clock termination.

CLOCK SETTINGS

Clock settings are controlled with existing SmartWORKS API MTSet/GetNET(nBoard, nNET, nFramer). Only NET1 is available for this adapter.

BOARD NUMBERING

When the SmartWORKS driver loads, it scans all PCI slots of the system to locate AudioCodes boards. As the boards are located, the driver assigns Physical Board Numbers to each. These board numbers are assigned sequentially from zero and are linked to the address (or slot number) of the physical PCI slot the card is located in.

NOTE: If an additional board is inserted into a PCI slot with a lower address, the board numbers are reassigned affecting all channel numbers on the system.

CHANNEL NUMBERING

All channels are full-duplex, meaning they can record and playback at the same time. Each channel's output is disconnected by default. When desired, any channel's output can be connected to the TDM using the SmartWORKS API ***MTSetOutput()***.

A total of 32 channels per trunk is supported by the SmartWORKS PCM cards.

How do Channels map to Framers?

The SmartWORKS PCM 6409 has two framers (one for each trunk). The SmartWORKS 3209 has one framer. Each framer monitors inbound and outbound traffic on one PCM32 trunk. The total number of active framers is available from the API function ***MTGetAdapterInfo()***.

The first channel on a PCM6409 board is connected the first slot on the first trunk; the 33rd channel on a PCM6409 board is connected to the first slot on the second trunk.

PCM32 Interface Configuration

FRAME SYNC CONFIGURATION

By default, TDM reference is received on trunk 0 (framer 0). The SmartWORKS PCM cards are also capable of transmitting the frame sync from either trunk. To switch the frame sync reference between trunks or to enable frame sync transmission use the API ***MTBoardPCMTrunkFrameSyncControl()***. Another API, ***MTBoardPCMTrunkFrameSyncStatus()*** gets the current frame sync status for the specified trunk.

TRUNK IMPEDANCE

The SmartWORKS PCM trunks can be configured for passive or terminate use. An API has been included in the SmartWORKS API to control trunk impedance which is configured on a per trunk basis. By default, all trunks are set to high impedance (passive mode). Use the APIs ***MTBoardSet/GetTerminationImpedance()***.

CODING FORMAT

Idle packets are transmitted when there is no sync to the trunk (port). Users must set the coding format to match the local network. This feature is enabled by default, and the coding format is set to μ -Law. The APIs ***MTBoardGet/SetIdleCoding()*** are used to control this feature. These APIs are defined in the last section of this document.

SIGNAL CONFIGURATION

When wired correctly, most installations do not require further signal configuration. Ai-Logic recommends to check wiring configuration before using this API. This function inverts the signal. This can be used when the paired wires have been reversed on installation. Use the API ***MTBoardSetSignalConfig()*** to configure each trunk on the board. This API has been defined in the last section of this document.

DISABLE MIXING

Normal operation of the SmartWORKS PCM card requires the user to disable mixing. Each channel on a SmartWORKS board has two inputs: a primary and a secondary input. Typically, a SmartWORKS board mixes the signal on both inputs so that the Rx and Tx sides of a conversation can be recorded as a single file.

When using the SmartWORKS PCM card, the Rx and Tx sides of a conversation are summed on the network and then routed onto the PCM card. As a result, both sides of the conversation enter the board via the primary input and mixing is not required.

When the SmartWORKS DLL is loaded, mixing is enabled by default. The user application must disable mixing when connecting to a PCM32 system. The API **MTDisableMixing()** is defined in the *SmartWORKS Developer's Guide*.

Framer Alarms and Statistics

The SmartWORKS PCM card can report a loss of sync. This information is available via the SmartWORKS API and the SmartView interface.

ALARMS

The SmartWORKS PCM is capable of reporting a loss of synchronization alarm. To avoid flooding the user application with redundant events, all alarms must be armed. Once an alarm event is reported, the alarm must be rearmed. When loss of sync is reported the event EVT_LOSYNC_ALARM is generated.

Use the API function **MTArmFramerAlarm()** or SmartView **Settings>MTArm/Disarm(CT/Framer/Master)Alarm...** to arm the alarm. To retrieve alarm events, the user can invoke the API **MTGetFramerAlarmStatus()** or use SmartView **FramerStatistics> MTGet FramerAlarmStatus...**

These APIs are supported by other SmartWORKS boards and are documented in the *SmartWORKS Developer's Guide*.

Maximum Number of SmartWORKS Boards per System

SmartWORKS is designed to support up to 512 channel or 16 boards (any combination) per system, whichever limit is reached first.

Application developers should note that their system may not reach these limits due to external factors such as processor speed, number of processors, and CODEC compression rate.

Please contact AudioCodes Technical Support for more Information.

Chapter 12

SmartWORKS IPX

Overview

The AudioCodes' VoIP product line offers passive, near real-time IP call recording. These products serve the same purpose as AudioCodes' traditional PSTN based call recording products but for the VoIP environment. The patent pending IPX provides the following capabilities:

- decode signaling information
- filter non-VoIP related packets
- report media connections
- transmit RTP voice packets to a media processing component

The IPX has two Ethernet ports for monitoring upstream (Tx) and downstream (Rx) VoIP traffic on the network. Call control information is decoded and passed to the user application. The IPX also has an active Ethernet port for routing media (RTP) packets to another destination for remote media processing.

NOTE: Once an IPX or IPX-C board is upgraded to the SmartWORKS 3.9 software, this board cannot be rolled back to SmartWORKS 3.8.

Board Features

The following section provides a brief overview of the features and capabilities of the IPX:

PORT INTERFACES

The IPX is designed with three 10/100 Ethernet ports. A typical application relies on two of the ports for receiving upstream (Tx) and downstream(Rx) packets. The third port is an active port and used for transmitting media (RTP) packets to a network device for recording purposes.

Protocol Settings

This board is capable of decoding multiple VoIP protocols at a single time. Users are required to enable all protocols used per logging system. Protocol settings are maintained as board settings and are not configured on a per port basis.

The APIs used for board and port configuration are explained in the *Developer's Reference* section of the *IPX Integration Guide*.

PACKET FILTERING

On a conventional circuit-based telephone network, the line is used to transmit voice related data (voice and signaling). On an IP network many types of packets - data, voice and media - are present on the same ethernet cable. Packet filtering is the selective passing or blocking of packets as they pass through a network interface. Packet filtering is used by VoIP recording systems to isolate voice related packets from data and media packets.

The IPX filters all VoIP related packets and forwards them to the appropriate on-board resource. Signaling packets are directed to the appropriate protocol stack for decoding. All RTP packets are passed over to the Session Manager. All other packets, such as data packets, are ignored by the IPX. When using the IPX the host PC does not need to provide packet filtering services.

NOTES:

- IP/TCP/UDP checksum is supported. Packets which are not valid are thrown out.
- The IPX can be configured to process packets from a specific VLAN. Use the SmartWORKS Control Panel to enable this feature.

MEDIA (RTP) FORWARDING

The IPX is designed with media forwarding services which allows users to direct all or individual media sessions (RTP packets) to a recording device. Currently, the IPX only forwards media packets to a network device.

Media forwarding by the IPX is limited by a license key. By default, the IPX is capable of forwarding a maximum of 8 concurrent media sessions to a recording apparatus. A license key may be purchased, to support additional media forwarding capabilities. Directions on how to upload the license key to the IPX board are available in the *IPX Integration Guide*.

SESSION MANAGER

Legacy SmartWORKS boards are designed for traditional PSTN systems where a channel is a physical element or a fixed timeslot on each network. During initialization, as the Physical Boards are numbered, the SmartWORKS software builds a list of the logical channels available in the system. VoIP networks do not rely on physical channels - therefore the SmartWORKS software on the VoIP boards does not build a list of logical channels.

Our VoIP boards are designed with a Session Manager for tracking media sessions on the network. When a media session is established this board treats this as a unique call and assigns a Session ID to this connection. The primary and secondary IP addresses and port numbers associated with this media session are also reported to the user application. The user application is able to manage the forwarding of media packets using the Session ID. Once the media session is disconnected, this call is considered terminated and the Session ID is returned for re-use by the Session Manager.

A detailed explanation of this feature is provided in the *IPX Integration Guide*.

STATION MANAGER

The IPX identifies all VoIP endpoints on the network and assigns each with a unique Station ID. When phone events are passed to the user application, the Station ID associated with each message is presented with each event.

The IPX supports the ability to dynamically identify VoIP endpoints when they are added or removed from the network. When a station is removed the Station ID is no longer associated with an endpoint and the number is returned for re-use by the Station Manager.

The application developer must understand that a Station ID is a dynamic number and can change while the application is running. It is highly recommended that the user application incorporate a station management system into their application.

Two events are reported by the IPX so that Station IDs can be managed by the user application: EVT_STATION_ADDED and EVT_STATION_REMOVED.

A detailed explanation of this feature is provided in the *IPX Integration Guide*.

DECODING CAPABILITIES

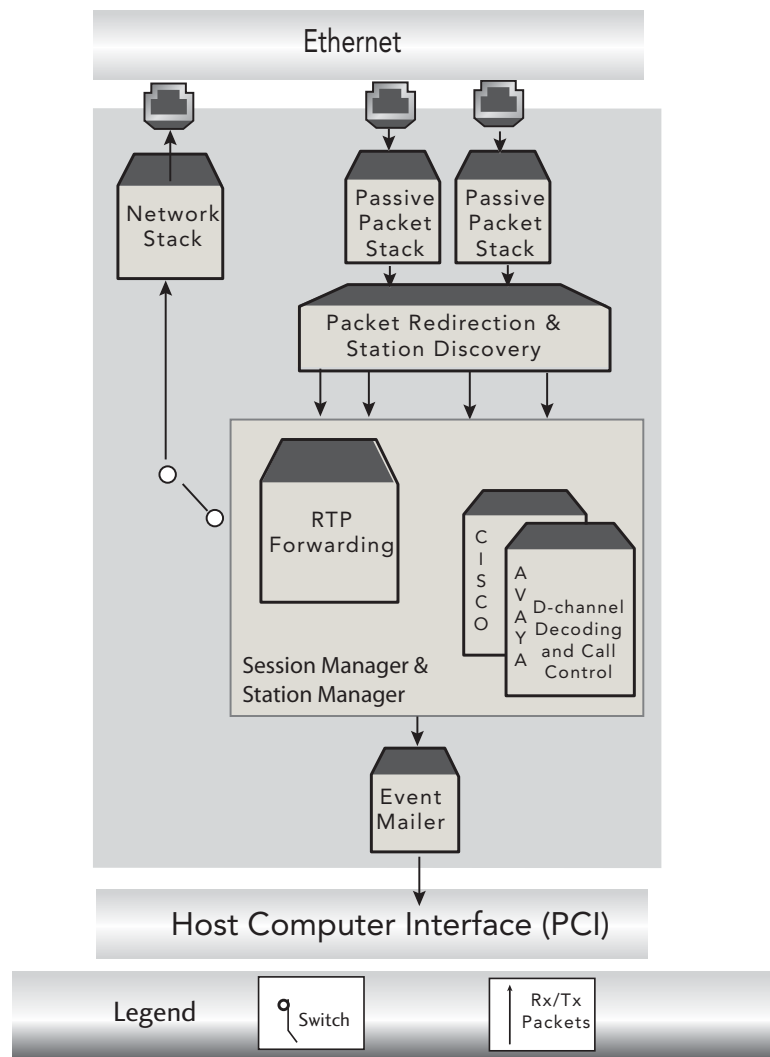
The IPX provides D-Channel decoding similar to the D-Channel decoding on the NGX. The D-Channel decoder provides a message-to-event translation for the station control messages. One benefit of the IPX is that it abstracts the various VoIP protocols and provides a consistent interface to the user application - for any protocol used on the tapped network. A Call State Machine abstracts the underlying protocol and tracks the state of a call. As the call state changes, Call Control events are passed to the user application.

Users can enable/disable D-channel and Call State reporting independently of one another. The Session Manager and Station Manager is always enabled.

A detailed explanation of these features is provided in the *IPX Integration Guide*.

LOGICAL MODEL

The following diagram shows a logical representation of the IPX:



Pre-Installation

Before installing the IPX, it is important review the following pre-installation information.

UNDERSTAND NETWORK PROTOCOLS

By design the IPX is capable of decoding more than one VoIP protocol at the same time. Users must enable the protocol decoding stacks running on each board. To do this users can enable protocol stack decoding using ***MTIpEnableSignalingProtocol()*** API.

CLOCK TERMINATION

Though the IPX does have an H.100 bus, the functionality is not enabled at this time. Clock termination is not required.

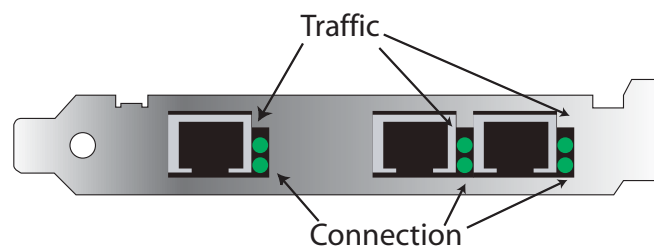
PORT LEDs

Two LEDs are available per ethernet port.

- Port Connection - the bottom LED indicates the state of the connection - 'OFF' when disconnected
'ON' when the ethernet cable is plugged in

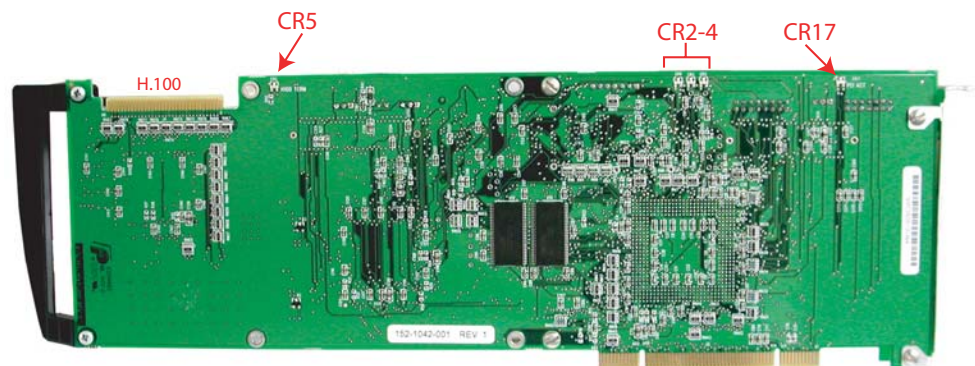
Traffic - the upper LED blinks when traffic is passing on the line

Figure 12-1: IPX LEDs



BOARD LEDs

The IPX has four LEDs used to report board state. The following image shows the location of each LED on the back side of the board:



CR 17 - PCI ACTIVATION

Three stage power and board initialization monitoring LED with the following occurrences:

- "ON," indicates that the board has successfully loaded.
- "OFF," no communication to the board.
- "BLINKING," board ready to be downloaded and the driver is properly communicating with the board. After the DLL is loaded this light will stop blinking. If light continues blinking the download failed or board panic has occurred.

CR5 - H100 TERM

TDM clock termination LED. "ON" indicates TDM clocks are being terminated.

NOTE: the H.100 bus is not enabled on the IPX.

CR2-4

CPU LED. This LED is turned ON by the local CPU upon successful initialization. These LEDs are also used throughout the boot up process. The meaning of these LEDs are represented in the table below:

The following table shows the order of illumination during boot up:

TABLE 12-2: LEDs DURING BOOT UP

Stage	CR4	CR3	CR2
Boot Rom Initialize	○	○	○
Relocating Code	○	○	●
Post Test Running*	○	●	○
Initialize Devices	○	●	●
Initialize Ethernet	●	○	○
Waiting for Host	●	○	●
Firmware Booting	●	●	○
Firmware Running	●	●	●

* If Post Test fails the LEDs indicate the point of failure.

POST TEST LED STATES

If any one of the post tests fail, blinking LEDs can be used to determine the exact point of failure. The following table shows the LEDs that blink in the event of post test failure:

TABLE 12-3: LED STATES INDICATING POST TEST FAILURE

Post Test Failed	CR4	CR3	CR2
CPU	○	○	○
SRAM	○	○	●
Interrupt	○	●	○
Flash	○	●	●
CPLD	●	○	○
EEPROM	●	○	●
FCC	●	●	○
Ambassador	●	●	●

Installation and Wiring

The following section explains how to install the IPX.

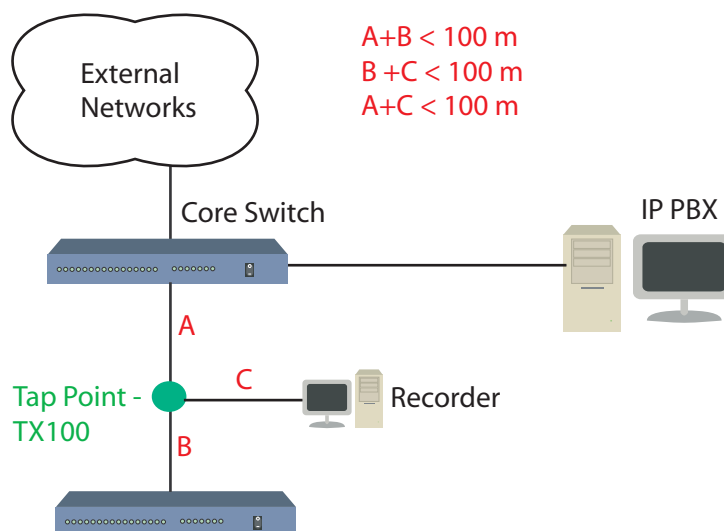
NOTE: This unit is for use only with compatible UL Listed PC, server etc. that have installation instructions detailing user installation of card cage accessories.

IMPORTANT INSTALLATION NOTE

While installing the IPX for development purposes or testing, users may not install the tap point (the TX100) between two switches. While using this product in a lab, developers may choose to connect a phone directly to the TX100. AudioCodes has observed that some IP phones do not terminate the signal, and rely on terminating network devices, such as a switch. When a non-terminating phone is connected directly to the TX100, the signaling information passing from the TX100 to the IPX is not correct. The AudioCodes lab has noticed, that the Dchannel path from the PBX to the phone is broken, and these type of events are not reported by the IPX. Should users experience this type of problem while tapping with the IPX, they should change their network configuration and position the TX100 between two terminating devices - such as two switches.

CABLE LENGTHS

When planning a tapping system, it is important to understand cable length restrictions. The following is recommended by AudioCodes:



TOPOLOGY OF THE TAPPING SYSTEM

On traditional telephone networks, all voice and call control information passes through a central location - the PBX. Each channel on the network is tapped individually, and a logger is capable of obtaining all voice and call control information from a single point on the network. VoIP transmits voice and signaling information along two different paths. The challenge of VoIP recording is learning how to design a recording system so that all call data can be tapped per the needs of your application.

The first chapter of this book provides diagrams of tapping architectures used for trunk recording, applications that monitor agent behavior, or capturing peer-to-peer voice. The following section provides a detailed view of a tapping system using the AudioCodes tap box (TX100).

THE TX100

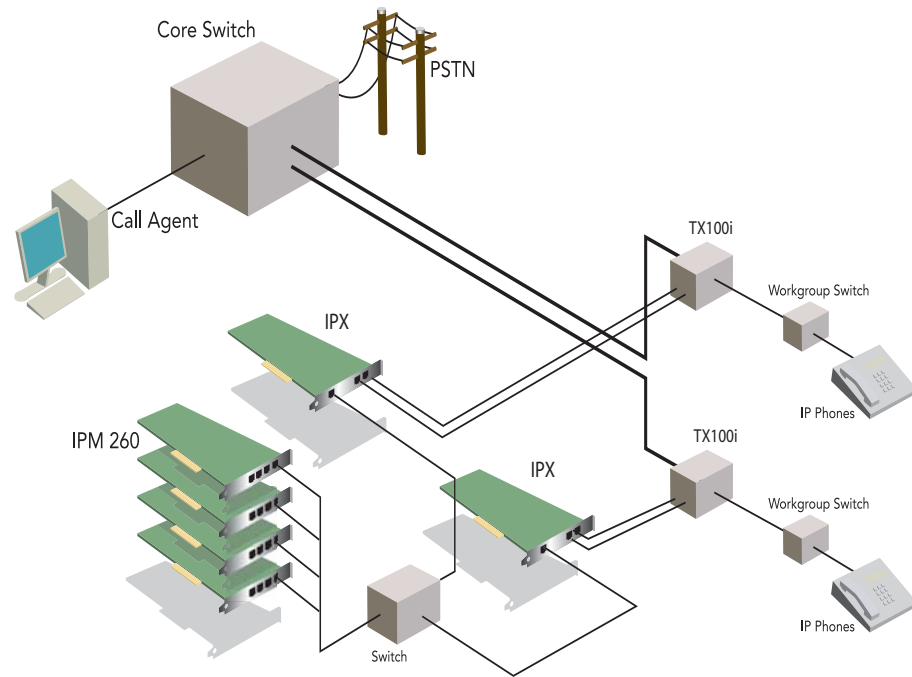
Tap boxes allow loggers to tap into an Ethernet line without adding a point of failure to the system. It also does not require a MAC or IP Address, therefore remains transparent to the network. AudioCodes' VoIP product family includes tap boxes - TX100i (which is installed in a pci slot) and the TX100 which comes with a North American or a Universal power supply. All TX100 components separate upstream (Tx) and downstream (Rx) traffic.

The tap box is placed anywhere between two network devices. It separates traffic on the Ethernet cable into two streams - data from pins 3&6 are passed out via the port labeled 'A' while traffic from pins 1&2 leaves the tap box via the port labeled 'B'. Typically - the master Switch transmits onto pair 3&6 while uplink port on the slave Switch transmits onto pair 1&2. Refer to the wiring illustration on the casing of the tap box.

These two lines then pass into the two receiving Ethernet devices on the IPX.

NOTE: If using a TX100i, both the IPX and the TX100i can be installed into the same server.

The following diagram shows one example of a tapping scenario:



ESD PRECAUTIONS

Switch off the power and remove power cords before opening the computer case. Do not re-attach power cords or switch on power to the computer while the computer case is removed.



Exercise ESD Precautions: Wear an ESD wrist strap.

Secure the card in a PCI slot with a chassis screw. Boot up the computer. The when board start - up is complete, LEDs CR2-4 will be a solid green.

NOTE: Cancel out of the Windows "Found New Hardware" screen. Place the SmartWORKS CD into the CD ROM and allow the board installation to finish. When software installation is complete, the computer is operational and does *not* have to be rebooted.

BOARD CONFIGURATION

After the board and software is installed, the following configuration is required. After these changes are made, the board drivers must be restarted.

ETHERNET PORT CONFIGURATION

The IPX has three ethernet interfaces numbered 0-2. Ports 1 and 2 are configured in promiscuous mode and receive all packets from the tapped line. A typical application relies on one port to receive upstream packets while the other receives downstream packets (direction of traffic is relative to local endpoints). The third port is used to transmit media (RTP) media packets to a recording device. Only the third port must be configured on the IPX as it is an active port. Users must supply the IP address, subnet mask, for this port.

When the board's default gateway is configured, it must be a gateway that is available to the port used for media forwarding. The IPX also supports DHCP. This feature can be enabled on a port by port basis.

All of the above configuration can be accomplished with the API.

NOTE: The board's driver must be restarted after modifying these values.

LICENSE KEY

Media forwarding by the IPX is limited by a license key. By default, the IPX is capable of forwarding a maximum of 8 concurrent media sessions to a recording apparatus. A license key may be purchased, to support additional media forwarding capabilities.

Instructions on how to add and verify the license key are available in the *IPX Integration Guide*.

CONFIGURING THE SYSTEM PROTOCOL

By design the IPX is capable of decoding more than one VoIP protocol at the same time. Users must enable the protocol decoding stacks running on each board. To do this users can enable protocol stack decoding using the **MTIpEnableSignalingProtocol()** API. The parameters associated with this function are PBX specific. Refer to the *SmartWORKS IPX Integration Guide* for PBX specific instructions.

BOARD NUMBERING

When the SmartWORKS driver loads, it scans all PCI slots of the system to locate AudioCodes boards. As the boards are located, the driver assigns Physical Board Numbers to each. These board numbers are assigned sequentially from zero and are linked to the address (or slot number) of the physical PCI slot the card is located in.

If an additional board is inserted into a PCI slot with a lower address, the board numbers are reassigned.

CHANNEL NUMBERING

The IPX is not a channel based card. The RTP protocol, which carries voice traffic on a VoIP network, is virtually connectionless. To track individual calls on each IPX board, a unique Session ID is assigned to each connected call. For more information refer to *IPX Integration Guide* for a detailed explanation.

USING UTILITIES TO TEST INSTALLATION

AudioCodes ships utilities with each CD-ROM. SmartControl is a control panel used for board configuration. SmartView is an application provided by AudioCodes used to test board functionality after installation. Developers or System Administrators, by using the commands accessible via the SmartView interface, can test whether the board is installed and configured properly for the network.

This section demonstrates how to use SmartControl and SmartView to test basic board functionality after installation. For complete information about using SmartView with the IPX, refer to the last chapter in this book.

VERIFY SETUP:

1. Run the SmartWORKS Control Panel.
2. Click on the **Board** tab. Select the board number that represents the IPX board. Verify that the board information, port IP Addresses, and SubNet Address are configured correctly.

TEST BOARD FUNCTIONALITY:

1. **Run SmartView:** From the Start Menu select Programs > Ai-Logix > SmartWORKS > SmartView.exe.
2. **Open Board:** From the Tool Bar, select **System > MTSysStartup**. This opens the board.
3. From the Tool Bar, select **System > MTRsyncTime**. If the board is operating correctly then two events are visible in the Event Viewer of the SmartVIEW application: EVT_SYS_SYNCTIME_OLD and EVT_SYS_SYNCTIME_NEW.

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