Modular Station Interface API for Linux and Windows Operating Systems

Programming Guide

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Revision History

This revision history summarizes the changes made in each published version of this document.

Document No.	Publication Date	Description of Revisions
05-1907-003	February 2005	This document version was released in conjunction with SR 6.1 Windows for CompactPCI*. Modular Station Interface API Features section: Added brief feature description and hardware support for station interface alarms. Event Handling chapter: Added MSEV_CHANSTATE for handling station interface alarms. Station Interface Alarms chapter: Added this new chapter on how to use station interface alarms. Performance Considerations section: Added requirement for HDSI boards to follow performance considerations in *SRL API Programming Guide* (PTR 35656).
05-1907-002	October 2004	Error Handling chapter: Updated system error handling, removed errno, and errno.h (PTR 28013). Include Files section: Removed errno.h from list of files (PTR 28013). Including Header Files section: Removed errno.h from list of files (PTR 28013).
05-1907-001	January 2003	Initial version of document. Much of the information contained in this document was previously published in the *MSI/SC Software Reference for Linux and Windows*, document number 05-1218-004.

About This Publication

The following topics provide information about this publication:

Purpose

This publication provides programming guidelines for the Modular Station Interface (MSI) API library. It is a companion document to the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference*, which provides details on functions and parameters of the MSI software.

Intended Audience

This guide is intended for software developers who will access the modular station interface software. This may include any of the following:

- Distributors
- System Integrators
- Toolkit Developers
- Independent Software Vendors (ISVs)
- Value Added Resellers (VARs)
- Original Equipment Manufacturers (OEMs)

How to Use This Publication

Refer to this publication after you have installed the hardware and the system software which includes the modular station interface software. This publication assumes that you are familiar with the Linux* or Windows* operating system and the C programming language.

The information in this guide is organized as follows:

Chapter 1, “Modular Station Interface API Description”, introduces the modular station interface software and its key features.

Chapter 2, “Event Handling”, defines events returned by the modular station interface library and discusses different ways of handling events.

Chapter 3, “Error Handling”, presents information on how to obtain error codes and handle errors.

Chapter 4, “Application Development Guidelines”, discusses methods of developing MSI-based applications.

Chapter 5, “Station Interface Alarms”, provides information about how to use the station interface alarms.

Chapter 6, “Building Applications”, contains library header file information and guidelines for compiling and linking your code.

Chapter 7, “MSI/SC Platform Description”, describes the Intel® Dialogic® MSI/SC-Global Series boards, including a hardware overview and function block diagram.

The Glossary provides definitions of key terms used in this document.

Related Information

For more information, refer to the following:

- *Modular Station Interface API Library Reference*
- *Voice API Library Reference*
- *Voice API Programming Guide*
- *Standard Runtime Library API Library Reference*
- *Standard Runtime Library API Programming Guide*
- *http://developer.intel.com/design/telecom/support/* (for technical support)
- *http://www.intel.com/design/network/products/telecom/* (for product information)

Modular Station Interface API Description 1

This chapter contains the following topics:

1.1 MSI-Supported Boards

The modular station interface (MSI) software is supported on more than one type of hardware platform. The following boards use the MSI software:

- Intel NetStructure® High Density Station Interface (HDSI) boards
- Intel® Dialogic® Integrated (DI) Station Interface boards
- Intel® Dialogic® MSI/SC-Global Series boards (supported on Intel® Dialogic System Release 5.x only)

DM3 boards is a collective name used in this document to refer to products that are based on the Intel Dialogic DM3 mediastream architecture. The Intel NetStructure High Density Station Interface (HDSI) boards and Intel® Dialogic Integrated (DI) Station Interface boards are DM3 boards.

Springware boards refer to boards based on earlier-generation architecture, such as the Intel® Dialogic MSI/SC-Global Series boards.

Although an MSI feature may be supported on both DM3 and Springware boards, there may be some restrictions on its use. For example, some library functions or parameter values may not be supported. For details, see the function reference descriptions in the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference*.

1.2 Modular Station Interface API Features

The following features of the modular station interface software are discussed in this section:

- Station Connectivity
- Conferencing
- Extended Connection
- Resource Allocation
- TDM Bus Routing
- Station Interface Alarms

1.2.1 Station Connectivity

The key functionality of the modular station interface (MSI) software is station connectivity, which includes the following features:

- detecting when a station goes on-hook, off-hook, or hookflash
- ringing phones with standard or distinctive rings
- ringing phones and sending frequency shift keyed (FSK) data (DM3 boards only)
- providing zip tone (MSI boards only)

Note: The MSI software is not capable of taking a station on-hook or off-hook. Instead, the MSI software reports what has happened on the channel or rings the phone.

1.2.2 Conferencing

Note: Conferencing is supported on Intel® Dialogic® Integrated (DI) Station Interface boards and MSI/SC-Global Series boards only.

The MSI software provides the following conferencing features:

Monitor
: This feature allows a conference to be monitored by several people without interrupting the conference.

Coach
: Typically a supervisor. The supervisor, or coach, while monitoring a conversation between a pupil and a client, can talk to the pupil in confidence. The pupil, however, cannot reply in confidence to the coach.

Pupil
: Typically, the agent who is heard by all parties in the conference. The pupil is the only conference participant who hears the coach.

  Note: A conference may include only one coach and one pupil at any given time. There may be more than one client, but conference size is limited to the maximum number of participants permitted in the conference.

1.2.3 Extended Connection

Note: Extended connection is supported on Intel® Dialogic® MSI/SC-Global Series boards only.

A connection is defined as a full-duplex, TDM bus routing between two parties. One of the parties in the connection must be a station on an MSI-supported board. An extended connection allows a coach to join a connection at anytime without interrupting the conversation between the pupil and the client.

An extended connection is a connection where there is a third party, herein referred to as the *connection extender*, that can always hear what the other two parties are saying. The connection extender's input in the connection is application defined. If the connection extender has no input, it is in monitor mode. If the connection extender can talk to only one party, designated as the pupil, it

is in coach mode. If the connection extender can talk to both members of the connection, it is in participant mode.

Notes: ***1.*** A connection may be set up using the TDM bus routing convenience function, **nr_scroute( )**. For details on this function, refer to the *Voice API Library Reference*.

2. The application is responsible for seting up a connection prior to extending it. The MSI software does not check for the presence of a connection between parties in order to extend it.

1.2.4 Resource Allocation

Each MSI-supported board has 32 resources managed by the application.

Notes: ***1.*** For details on the functions below, see the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference*.

2. The channel selector of the party does not affect the resource usage.

3. Conferencing is supported on Intel® Dialogic® Integrated (DI) Station Interface boards and MSI/SC-Global Series boards only. Each of these hardware platforms has different conference size limits.
For DI boards: refer to the Release Notes for applicable conference size limits.
For MSI/SC boards: a conference is limited to eight parties. A monitor is counted as one of the eight parties.

4. For MSI/SC boards: when zip tone support is enabled, 31 conferencing resources are available.

Calling any of the following functions will cause the available resource count to change:

ms_setbrdparm( )
When **parm_id** = MSG_ZIPENA and **value** = MS_ZIPENABLE, one resource will be used
When **parm_id** = MSG_ZIPENA and **value** = MS_ZIPDISABLE, one resource will be freed

ms_estconf( )
Uses the total number of parties in the conference

ms_addtoconf( )
Uses one resource every time a party is added to a conference

ms_remfromconf( )
Frees one resource

ms_delconf( )
Frees all resources in use by the conference

ms_monconf( )
Uses one resource

ms_unmonconf( )
Frees one resource

ms_estxtdcon( )
Uses three resources

ms_delxtdcon( )
Frees three resources

1.2.5 TDM Bus Routing

TDM routing functions are used in time division multiplexing (TDM) bus configurations, which include the CT Bus and SCbus. A TDM bus is resource sharing bus that allows information to be transmitted and received among resources over multiple time slots.

TDM routing functions enable the application to make or break a connection between voice, telephone network interface, and other resource channels connected via TDM bus time slots. Each device connected to the bus has a transmit component that can transmit on a time slot and a receive component that can listen to a time slot.

The transmit component of each channel of a device is assigned to a time slot at system initialization and download. To listen to other devices on the bus, the receive component of the device channel is connected to any one time slot. Any number of device channels can listen to a time slot.

Note: When you see references to the SCbus or SCbus routing, this information also applies to the CT Bus. That is, the physical interboard connection can be either SCbus or CT Bus. The SCbus protocol is used and the SCbus routing API applies to all the boards regardless of whether they use an SCbus or CT Bus physical interboard connection.

1.2.6 Station Interface Alarms

Note: Station interface alarms are supported on Intel® Dialogic® DI boards and Intel NetStructure® HDSI boards and only.

Station interface alarms provide notification of problems with the communication link between a board and its associated Station Interface Box (SIB). The alarm notification is provided using asynchronous events that can be enabled or disabled by the **ms_setevtmsk( )** function on a per station basis. See Chapter 5, “Station Interface Alarms” for more information.

Event Handling 2

The Event Management functions in the Standard Runtime Library (SRL) retrieve and handle MSI termination events for the **ms_setevtmsk( )**, **ms_tstcom( )**, and **ms_tstdat( )** functions. For a description of MSI events and event types, see the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference*.

The following tables list Event Management functions and their relevance to MSI-based applications. For function details, refer to the *Standard Runtime Library API Library Reference*.

Table 1. MSI Inputs for Event Management Functions

SRL Function	Input	MSI Specific Input Values
sr_enbhdlr( ) Enable event handler	event type	MSEV_CHANSTATE MSEV_NORING MSEV_RING MSEV_SIGEVT DTEV_COMRSP DTEV_DATRSP
sr_dishdlr( ) Disable event handler	event type	Same as above
sr_waitevt( ) Wait for next event	N/A	N/A
sr_waitevtEx( ) Extended wait event	list of device handles	N/A

Table 2. MSI Returns from Event Management Functions

SRL Function	Return	MSI Specific Return Values
sr_getevtdev( ) Get Dialogic device handle	device	MSI device handle
sr_getevttype( ) Get event type	event type	MSEV_CHANSTATE MSEV_NORING MSEV_RING MSEV_SIGEVT DTEV_COMRSP DTEV_DATRSP
sr_getevtlen( ) Get event length	event length	Number of bytes in the data returned
sr_getevtdatap( ) Get pointer to event data	event data	Pointer to variable containing the value of a selected bitmask

Error Handling 3

This chapter describes error handling for the modular station interface (MSI) software.

All the MSI library functions return a value that indicates the success or failure of the function call. MSI library functions can return one of the following values:

0
: function success

-1
: function error

If a function fails, the error can be retrieved using the Standard Runtime Library (SRL) **ATDV_LASTERR( )** function.

Notes: ***1.*** The **ms_open( )** function is the exception to the above error-handling rules. An **ms_open( )** function call returns a device handle if the function call is successful. A device handle is a non-zero value. If **ms_open( )** fails, the return code is -1, and it indicates a system error.

2. The Standard Attribute functions **ATDV_LASTERR( )** and **ATDV_ERRMSGP( )** can be used to obtain the last error that occurred on a device. Refer to the *Standard Runtime Library API Library Reference* for more information on these functions.

3. If the error returned by **ATDV_LASTERR( )** is E_MSSYSTEM, an operating system error has occurred.

For a complete list of MSI errors, see the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference*.

Error Handling Example

```
/* error handling routine */
void do_error( devh, funcname )

int devh;
    char *funcname;
{
   int errorval = ATDV_LASTERR( devh );
   printf( "Error while calling function %s on device %s.  \n", funcname,
                    ATDV_NAMEP( devh ) );
   if ( errorval == E_MSSYSTEM ) {
       printf( "system error\n" );
       perror("");
   } else {
       printf( "Error value = %d\n Error message = %s\n",
                    errorval,ATDV_ERRMSGP( devh ) );
   }
   return;
}
```

```
main( )
{
         .
         .
         .
   /* call to Dialogic MSI/SC library function */
   if (ms_setevtmsk( devh, MSEV_SIGMSK, 0, DTA_SETMSK ) ) != 0) {
      do_error( devh, "ms_setevtmsk()" );
   }
   /* successful function call -
      continue processing ...  */
            .
            .
            .
}
```

Notes: ***1.*** Calls to **ms_open( )** return either a -1 or a nonzero device handle. Therefore, when issuing the **ms_open( )** function, check for a return of a -1, which indicates a system error.

2. Calls to **ATMS_TSSGBIT( )** return the pointer AT_FAILUREP when the function fails.

Application Development Guidelines 4

This chapter contains suggestions for programmers who are designing and coding an application which uses the modular station interface (MSI) software. This chapter includes the following MSI general guidelines and task-specific programming guidelines:

4.1 General Guidelines

The following general guidelines for writing MSI-based applications are explained in this section:

- Using Symbolic Defines
- Including Header Files
- Checking Return Codes

Note: These guidelines are not a comprehensive guide to developing or debugging MSI applications.

4.1.1 Using Symbolic Defines

We do not guarantee the numerical values of defines will remain the same as new versions of a software package are released. In general, do not use a numerical value in your application when an equivalent symbolic define is available. Symbolic defines are found in the *dtilib.h* and *msilib.h* files.

4.1.2 Including Header Files

Various header files must be included in your application to test for error conditions, to use library functions from other Intel® Dialogic® products, or to perform event-management and standard-attribute functions. An example is shown below. See Chapter 6, "Building Applications" for details.

```
#include <windows.h>    /* For Windows applications only */
#include "srllib.h"
#include "dtilib.h"
#include "msilib.h"
```

Note: To avoid redundancy in the remaining programming examples in this chapter, #include statements will not be shown.

4.1.3 Checking Return Codes

Most Intel® Dialogic® library functions return a value of -1 if they fail (extended attribute functions return -1 or AT_FAILUREP). Therefore, any call to a library function should check for a return value indicating an error. This can be done by using a format similar to the following:

```
/* call to MSI/SC library function */

if (ms_xxx(arguments) == -1) {
    /* error handling routine */
}
/* successful function call -
    continue processing ...  */
```

Using this technique ensures that all errors resulting from a library call will be trapped and handled properly by the application. In many cases, you can check for a return value of other than zero (0), however, this should only be used where a nonzero value is returned when the function fails. For details, see Chapter 3, “Error Handling”.

4.2 Initialization

Before an MSI-based application can perform any processing or access devices, it should initialize the appropriate hardware to correspond with the physical configuration of your system and set other parameters needed to support the application. Tasks that are performed as a part of initialization generally include:

- Configuring DM3 Boards
- Configuring MSI/SC Boards
- Setting Event Mask on MSI Stations
- Initializing MSI Stations
- Terminating

4.2.1 Configuring DM3 Boards

Intel NetStructure® High Density Station Interface (HDSI) boards and Intel® Dialogic® Integrated (DI) Station Interface boards are collectively called DM3 boards. Refer to the *DM3 Configuration File Reference* for more information on configuring HDSI and DI boards, including FCD file descriptions and configuration parameter listings.

4.2.2 Configuring MSI/SC Boards

4.2.2.1 Setting Hardware Configuration on MSI/SC Boards

Use **ms_setbrdparm( )** to set hardware configuration, debounce times, minimum and maximum hook flash times, ring cadence patterns, and ziptone. See the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference* for a description of the parameters.

MSI/SC board parameters which may be modified include:

MSG_DBONTM
Debounce on time

MSG_DBOFFTM
Debounce off time

MSG_MINFLASH
Minimum hook flash time

MSG_MAXFLASH
Maximum hook flash time

MSG_PDRNGCAD
Select the predefined ring cadence pattern

MSG_RING
Ringing capability support information

MSG_RNGCAD
Ring cadence pattern

MSG_UDRNGCAD
Set user-defined ring cadence pattern

MSG_ZIPENA
Ziptone enable

MSCB_ND
Notify on add

MSCB_ZIP
Zip tone notification

4.2.2.2 Changing Default Ring on MSI Boards

To change ring options on MSI boards, you must download a parameter file using the Intel® Dialogic Configuration Manager (DCM). To change the default active ring cycle, you must modify the *RING.PRM* parameter file. To set the frequency at which the individual stations ring, you must modify the *RINGFREQ.PRM* file. For more details, see the Intel DCM on-line help.

4.2.2.3 Country-Specific Parameter Files for MSI Boards

A country-specific parameter file contains a unique set of coefficients so that specific gain and impedance values are met. When a country specific parameter file is not used, the firmware

automatically defaults to U.S. specifications. Each parameter file contains the calculated data for the transmit/receive gain settings, impedance scaling settings, ring frequency settings and the programmable filters of a SLAC (Subscriber Line Audio Circuit) device.

4.2.3 Setting Event Mask on MSI Stations

Use the **ms_setevtmsk( )** function for setting and clearing the mask for on-hook transitions, off-hook transitions, and hook flash detection. The MS_OFFHOOK, MS_ONHOOK, and MS_HOOKFLASH equates are used for setting and clearing respective bits in the message mask.

4.2.4 Initializing MSI Stations

To set channel level parameters, the functions **ms_setbrdparm( )** is used. See the *Modular Station Interface API for Linux and Windows Operating Systems Library Reference* for a description of the parameters.

4.2.5 Terminating

When your process completes, devices should be shut down in an orderly fashion. Tasks that are performed to terminate an application generally include:

- Disabling events
- Resetting time slots
- Closing devices

The **ms_setevtmsk( )** function can disable all currently enabled event notification masks.

Note: SRL Event Management functions such as **sr_dishdlr( )**, (which disables an event handler), must be called before closing the device that is sending the handler event notifications.

4.3 Aborting

If you abort an MSI-based application by pressing the interrupt key, the system will terminate the current process but may leave devices in an unknown state. The next time you run your application, therefore, you may encounter errors.

To avoid errors of this type, your application should include an event handler that traps the interrupt key and performs the actions listed in Section 4.2.5, “Terminating”, on page 22.

4.4 Standard Attribute Functions

The Standard Attribute functions in the Standard Runtime Library (SRL) return general device information such as the device name, or the last error that occurred on the device. The Standard Attribute functions and the MSI-specific information returned are listed below.

Table 3. Standard Attribute Functions

Standard Attribute Function	Information Returned for MSI
ATDV_ERRMSGP( )	Pointer to string describing the error that occurred during the last function call on a device
ATDV_IRQNUM( )	Interrupt number for a specified device
ATDV_LASTERR( )	The error that occurred during the last function call on a specified device
ATDV_NAMEP( )	Pointer to device name (MSIBb)
ATDV_SUBDEVS( )	Number of MSI subdevices. Note that the number of devices returned by this API is different for DI boards, HDSI boards, and MSI/SC boards.

See the *Standard Runtime Library API Library Reference* for details on these functions.

4.5 Performance Considerations

When using HDSI boards, application developers **must** follow the recommendation outlined in Section 2.6 “Performance Considerations” of the *Standard Runtime Library API Programming Guide*.

Station Interface Alarms 5

This chapter provides information about how to use the station interface alarms.

Note: Station interface alarms are supported on Intel® Dialogic® DI boards and Intel NetStructure® HDSI boards and only.

Feature Description

Station interface alarms provide notification of problems with the communication link between a board and its associated Station Interface Box (SIB). For example, if power to the SIB is lost or if any communication links between the board and the SIB are accidentally disconnected (e.g., cable is disconnected), the MSI API can notify the application by sending it an alarm event.

The MSI API sends a station interface alarm to the application when a station interface goes offline, so that the application can stop sending calls to the station interfaces that are no longer in service. The MSI API can also notify the application when the problem is corrected; that is, when the station interface goes on-line.

The alarm notification is provided using asynchronous events that can be enabled or disabled by the **ms_setevtmsk( )** function on a per station basis.

Enabling and Disabling Station Interface Alarms

Use the **ms_setevtmsk( )** function to enable or disable station interface alarms through the MSEV_CHANSTATE event. (The MSEV_CHANSTATE event is disabled by default.) The following alarms can be specified in the bitmask:

MSMM_CS_ALARM
: Station interface failure, e.g., communication link disconnected.

MSMM_CS_IDLE
: Station interface online; sent when cable is reconnected, alarm is cleared, or station is powered up.

MSMM_CS_OUT_OF_SERVICE
: Loop current to station interface disabled, e.g., for maintenance purposes.

For example, the following function call enables the station interface alarm, out-of-service, and idle events on channel B1C1:

```
ms_setevtmsk(msiB1C1, MSEV_CHANSTATE, MSMM_CS_ALARM |
             MSMM_CS_OUT_OF_SERVICE | MSMM_CS_IDLE, DTA_SETMSK)
```

Alarms are provided on a per station basis as opposed to a per link basis. This means that if a communication link is disconnected on an HDSI board, for example, 30 alarms corresponding to the 30 stations on that link would be sent to the application. It is up to the application to enable or mask the appropriate alarms to arrive at the desired number of alarms per link. The number of

stations per link depends on the board you are using; for example, on the HDSI/960 Station Interface Board, link 1 = stations 1-30, link 2 = stations 31-60, link 3 = stations 61-90, and link 4 = stations 91-96.

Note: The enabling/disabling of the event is local to a process. If multiple processes are running on the same board, the event has to be enabled for each process.

Code Example for Enabling and Processing SI Alarm Events

The following code example shows how to use the **ms_setevtmsk( )** function to enable a station to receive three types of channel state events.

```
#include <msilib.h>

/* Enable channel state event */
void EnableCSEvents(int a_DevHdl)
{
     unsigned short t_SetBitMsk = MSMM_CS_ALARM | MSMM_CS_IDLE | MSMM_CS_OUT_OF_SERVICE;
     int t_Action = DTA_ADDMSK;
     unsigned short t_GetBitMsk = 0;
     if ( ms_setevtmsk(a_DevHdl, MSEV_CHANSTATE, t_SetBitMsk, t_Action) == -1 )
     {
          printf("ms_setevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X, action:%d) failed \n",
a_DevHdl, t_SetBitMsk, t_Action);
          printf("Error Message = %s\n",ATDV_ERRMSGP(a_DevHdl) );
     }
     else
     {
          printf("ms_setevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X, action:%d) success \n",
a_DevHdl, t_SetBitMsk, t_Action);
     }
     /* Verify the setting */
     if ( ms_getevtmsk(a_DevHdl, MSEV_CHANSTATE, &t_GetBitMsk) == -1 )
     {
          printf("ms_getevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X) failed \n", a_DevHdl,
t_GetBitMsk);
          printf("Error Message = %s\n",ATDV_ERRMSGP(a_DevHdl) );
     }
     else
     {
          if ( (t_GetBitMsk & MSMM_CS_ALARM) == MSMM_CS_ALARM )
               printf("ms_getevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X) - MSMM_CS_ALARM is
set\n", a_DevHdl, t_GetBitMsk);
          if( (t_GetBitMsk & MSMM_CS_IDLE) == MSMM_CS_IDLE )
               printf("ms_getevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X) - MSMM_CS_IDLE is
set\n", a_DevHdl, t_GetBitMsk);
          if ( (t_GetBitMsk & MSMM_CS_OUT_OF_SERVICE) == MSMM_CS_OUT_OF_SERVICE )
              printf("ms_getevtmsk(dvh:%d, MSEV_CHANSTATE, bitmsk:0x%X) - MSMM_CS_OUT_OFSERVICE
is set\n", a_DevHdl, t_GetBitMsk);
     }
}

/* Process the SRL event */
long EventHandler (unsigned long temp)
{
     int devh = sr_getevtdev();
     long event = sr_getevttype();
     unsigned short * evtdata = (unsigned short*) sr_getevtdatap();
     switch(event)
     {

/*… */
```

```
          case MSEV_CHANSTATE :
               switch(*evtdata)
               {
                    case MSMM_CS_ALARM :
                         printf("MSEV_CHANSTATE(MSMM_CS_ALARM) is detected on devh:%d \n",
devh);
                         break;
                    case MSMM_CS_IDLE :
                         printf("MSEV_CHANSTATE(MSMM_CS_IDLE) is detected on devh:%d\n", devh);
                         break;
                    case MSMM_CS_OUT_OF_SERVICE :
                         printf("MSEV_CHANSTATE(MSMM_CS_OUT_OF_SERVICE) is detected on
devh:%d\n", devh);
                         break;
                    default:
                        printf("**Unknown EventData received...MSEV_CHANSTATE(Eventdata = 0x%x)
on %d**\n", *evtdata, devh);
                         break;
               }     /* switch event data ends */
          break;
     }
     return 0;
}
```

Building Applications 6

This chapter contains the following sections:

6.1 Include Files

Function prototypes and equates are defined in *dtilib.h* and *msilib.h*. Applications that use the MSI library functions for MSI support must include the following statements:

```
#include <windows.h>    /* For Windows applications only */
#include "srllib.h"
#include "dtilib.h"
#include "msilib.h"
```

Code that uses voice boards with the current version of the voice driver must include the following statements in the order shown:

```
#include <windows.h>    /* For Windows applications only */
#include "srllib.h"
#include "dxxxlib.h"
#include "dtilib.h"
#include "msilib.h"
```

The current version of the voice driver requires that *srllib.h* precedes any other Intel® Dialogic® header file include statements.

6.2 Compiling and Linking

To compile and link your application, follow the syntax instructions for your version of the C Development Package.

Make sure when compiling or linking, the SRL library name is specified last. If your application includes MSI and Voice library functions, for instance, use either of the following two library orders on the command line for Linux:

```
-l dti -l dxxx -l srl
```

or

```
-l dxxx -l dti -1 srl
```

Include the following libraries when using the MSI software on the Windows operating system:

```
libsrlmt.lib
libdtimt.lib
```

Depending on your application, you may need to link with other libraries. Refer to the appropriate documentation for other Intel® Dialogic® products.

MSI/SC Platform Description 7

The modular station interface (MSI) software is supported on more than one type of hardware platform. This chapter describes the Intel® Dialogic® MSI/SC-Global Series boards, including the following topics:

7.1 MSI Hardware Overview

MSI/SC, MSI/SC-Global, and MSI/PCI-Global Series boards make up this hardware family.

- The MSI/SC product series consists of an ISA form factor baseboard that includes eight integrated station interfaces and allows up to two additional daughterboard modules, each with an additional eight station interfaces. The baseboard-only product is referred to as an MSI/80SC. A baseboard with one daughterboard module is referred to as an MSI/160SC (16 station interfaces), and a baseboard with two daughterboard modules is the MSI/240SC (24 station interfaces). The MSI/SC feature set is based on the Intel® Dialogic® MSI-C board; however, its hardware architecture is based on the D/41ESC board. This allows the MSI/SC to take advantage of the D/41ESC BLT (board locator technology) circuit, programmable interrupts, and shared RAM interface. In addition, the MSI/SC board provides a ringing option, making it capable of generating AC voltage sufficient to ring standard 2500 type telephones.
- The MSI/SC-Global boards support a ringer for each station attached to the board with two RENs (Ringer Equivalency Numbers) per station. MSI/SC-Global also features an international approvability.
- The MSI/PCI-Global product is a modular station interface board containing a digital signal processor (DSP) and the H.100 (CT Bus) connector for operation in SCbus mode. The MSI/PCI is also completely API- and feature-compatible with the MSI/SC ISA products. The MSI/80PCI-GBL consists of a baseboard and one SI/80PCI-GBL daughterboard module supporting eight station interface circuits and the MSI/160PCI-GBL is a baseboard product with two SI/80PCI-GBL daughterboard modules providing 16 station interface circuits.

7.2 Typical Applications

The MSI/SC boards and software allow an application program operating in the host PC to communicate between SCbus-compatible devices and analog station devices. Applications for the MSI/SC boards include:

- Inbound/outbound telemarketing

- Operator services such as billing automation, directory assistance, and intercept treatments
- Customer service
- Automatic call distribution (ACD)
- Dictation/transcription
- Local information services

Conferencing resources serve the SCbus with advanced features such as:

- Two-party to eight-party conferencing
- Up to 32 resources of total conferencing (four to 16 conferences)
- Conferences of any combination of stations and network channels
- Hidden training for smooth entry of new participants without disruptive training noise
- Monitoring an agent without disrupting the conversation
- Coaching feature to allow a supervisor to speak to an agent without the client hearing the supervisor; client can hear the agent at all times (no switching)
- Tone generation:
  - Zip tone indicates incoming call to agents using headsets
  - Notification tones when a party is added to or removed from a conference (as required by the law in many states)
- User programmable periodic notification tones to indicate units of time that expired during a call
- Programmable volume control for station devices
- Programmable ring cadences

7.3 Compatibility with other MSI boards

The MSI board feature set is based on the Intel® Dialogic® MSI-C board and its hardware design enables the MSI to take advantage of the Board Locator Technology (BLT) circuit, programmable interrupts, and shared RAM interface.

Using the MSI, developers can build large call center configurations without the need for DMX boards or crossover cables. Other significant differences between the MSI and the MSI-C board include:

- Relay interlock for loop and ring voltages (only on the MSI/SC-R boards)
- Ability to ring 2500-type telephones
- On-board ring voltage generator (only on the MSI/SC-R boards)
- Ringing SLICs (Subscriber Line Interface Circuits) (MSI/SC-Global and MSI/PCI-Global boards)
- Use of the 1024 time slots available on the SCbus

Conference-specific differences between the MSI boards and the MSI-C board include:

- Pupil/coach feature

- Hidden training
- Extended connections

7.4 MSI Board Functional Description

The MSI baseboard and each daughterboard contain eight line interfaces and eight COder/DECoders (CODECs). Each line interface provides loop-start current to one 2500 series equivalent station device.

The line interface also separates the inbound signal into an audio signal which is sent to the CODEC, and an on-hook/off-hook signal which is forwarded by the control processor to the application program.

The CODEC converts inbound audio to 8-bit PCM data and outbound PCM data to analog audio. The gain may be individually set for each station device.

A cross-point switch on the MSI board routes PCM data between the station devices, the DSP, and the SCbus.

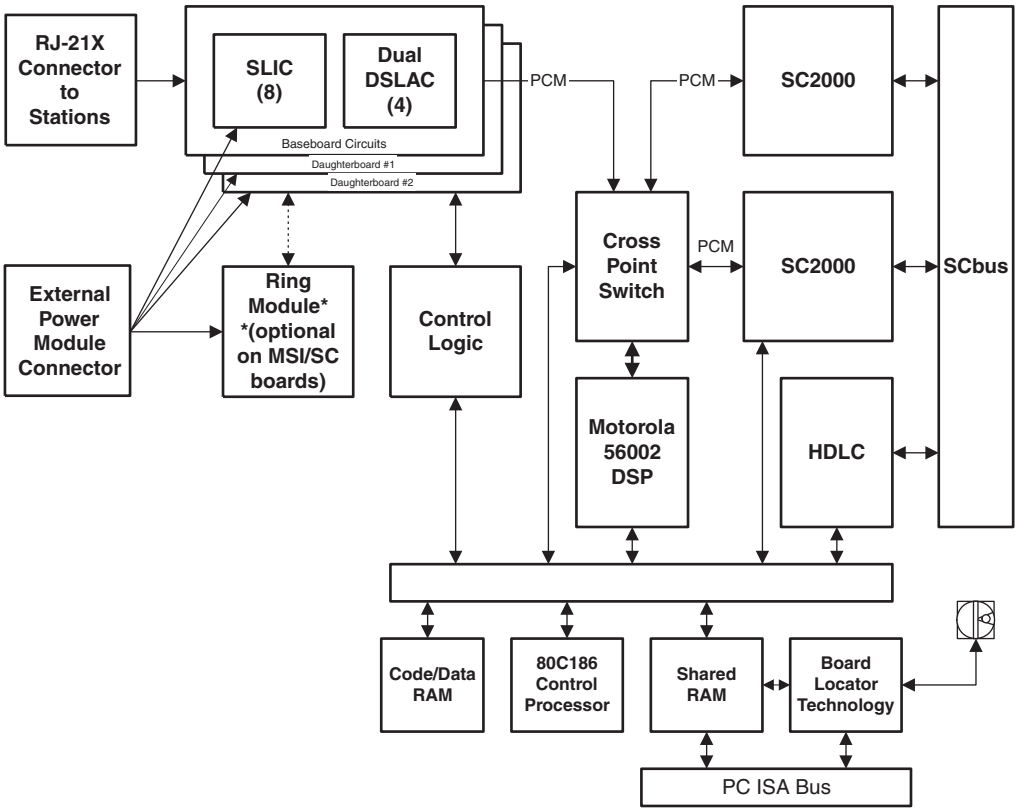
The MSI board conferencing feature allows conferences to be established between SCbus time slots and/or station interfaces.

The control microprocessor executes commands received from the host PC, and controls all operations of the MSI board. Communications between the control microprocessor and the host PC is accomplished via a shared RAM interface mechanism.

Operations demanding real time responses are interrupt driven. All MSI boards installed in the PC share the same interrupt line. When the system is initialized, the firmware needed to control all board operations is downloaded from the host PC to the on-board RAM. The downloadable firmware enables easy feature enhancements in the future.

The Board Locator Technology (BLT) circuit operates in conjunction with a rotary switch to determine and set non-conflicting slot and IRQ interrupt-level parameters. This feature eliminates the need to set jumpers or DIP switches.

Figure 1. MSI Board Block Diagram



Note: The optional ring module is only applicable to the MSI/SC-R boards. Ringing SLICs (Subscriber Line Interface Circuits) provide the ringing function for the MSI/SC-Global and MSI/PCI-Global boards.

Glossary

ACD: Automatic call distributor. An automated (usually software-driven) system that connects incoming calls to agents based on a distribution algorithm. The system also gathers traffic analysis statistics, such as number of calls per hour, average time holding, and call length.

agent: An operator, transcriber, telemarketing or sales representative, or other employee. In this guide, agent refers to any person using an analog station device who can be connected to a caller or recorded message through the MSI board.

A-Law: A pulse code modulation (PCM) algorithm used in digitizing telephone audio signals in E1 areas.

analog: In this guide, analog refers to agent communications between a headset and the MSI or to the loop-start type of network interface.

asynchronous function: Allows program execution to continue without waiting for a task to complete. Contrast with *synchronous function*.

automatic call distributor: See *ACD*.

baseboard: A term used in voice processing to mean a printed circuit board without any daughterboards attached.

blocking mode: When a telephone call cannot be completed, it is said that the call is "blocked". In blocking mode, it is said that the caller is "receiving a busy".

channel: 1. When used in reference to an Intel® Dialogic® digital expansion board, a data path, or the activity happening on that data path. 2. When used in reference to the CEPT telephony standard, one of 32 digital data streams (30 voice, 1 framing, 1 signaling) carried on the 2.048 MHz/sec E1 frame. (See *time slot*.) 3. When used in reference to a bus, an electrical circuit carrying control information and data.

CT Bus: Computer Telephony bus. A time division multiplexing communications bus that provides 4096 time slots for transmission of digital information between CT Bus products. See *TDM bus*.

data structure: C programming term for a data element consisting of fields, where each field may have a different type definition and length. The elements of a data structure usually share a common purpose or functionality, rather than being similar in size, type, etc.

daughterboard: In the context of this guide, the MSI daughterboard assembly. The daughterboard enables the MSI hardware to interface to analog station devices.

device: Any computer peripheral or component that is controlled through a software device driver.

digital: Information represented as binary code.

DIP switch: A switch usually attached to a printed circuit board with two settings: on or off. DIP switches are used to configure the board in a semi-permanent way.

DM3: Refers to Intel® Dialogic® mediastream processing architecture, which is open, layered, and flexible, encompassing hardware as well as software components. A whole set of products from Intel are built on DM3 architecture. Contrast with *Springware,* which is earlier-generation architecture.

driver: A software module that provides a defined interface between a program and the hardware.

DTMF: Dual Tone Multi-Frequency. DTMF refers to the combination of two tones which represents a number on a telephone key pad. Each push button has its own unique combination of tones.

E1: Another name given to the CEPT digital telephony format devised by the CCITT that carries data at the rate of 2.048 Mbps (DS-1 level). This service is available in Europe and some parts of Asia.

event: An unsolicited communication from a hardware device to an operating system, application, or driver. Events are generally attention-getting messages, allowing a process to know when a task is complete or when an external event occurs.

Extended Attribute functions: Class of functions that take one input parameter (a valid device handle) and return device-specific information.

flash: A signal generated by a momentary on-hook condition. This signal is used by the voice hardware to alert a telephone switch that special instructions will follow. It usually initiates a call transfer. See also *hook state*.

frequency shift keying (FSK): A frequency modulation technique used to send digital data over voice band telephone lines.

full-duplex: Transmission in two directions simultaneously, or more technically, bi-directional, simultaneous two-way communications.

hook flash: See *flash*.

hook state: A general term for the current line status of the channel: either on-hook or off-hook. A telephone station is said to be on-hook when the conductor loop between the station and the switch is open and no current is flowing. When the loop is closed and current is flowing, the station is off-hook. These terms are derived from the position of the old fashioned telephone set receiver in relation to the mounting hook provided for it.

host PC: The system PC in which Intel® Dialogic® hardware and software are installed and applications are run and/or developed.

IRQ: Interrupt request. A signal sent to the central processing unit (CPU) to temporarily suspend normal processing and transfer control to an interrupt handling routine. Interrupts may be generated by conditions such as completion of an I/O process, detection of hardware failure, power failures, etc.

loop start interfaces: Devices, such as an analog telephones, that receive an analog electric current. For example, taking the receiver off hook closes the current loop and initiates the calling process.

Mu-Law: The PCM coding and companding standard used in Japan and North America (T1 areas).

MSI/SC: Modular Station Interface. An SCbus-based expansion board that interfaces SCbus time slots to analog station devices.

off-hook: The state of a telephone station when the conductor loop between the station and the switch is closed and current is flowing. When a telephone handset is lifted from its cradle (or an equivalent condition occurs), the telephone line state is said to be off-hook. See also *hook state*.

on-hook: Condition or state of a telephone line when a handset on the line is returned to its cradle (or an equivalent condition occurs). See also *hook state*.

PCM: Pulse Code Modulation. The most common method of encoding an analog voice signal into a digital bit stream. PCM refers to one technique of digitization. It does not refer to a universally accepted standard of digitizing voice.

rfu: Reserved for future use.

SCbus (Signal Computing Bus): A hard-wired connection between switch handlers on SCbus-based products. SCbus is a third generation TDM (time division multiplexed) resource sharing bus that allows information to be transmitted and received among resources over 1024 time slots. See *TDM Bus*.

SCSA: Signal Computing System Architecture. A generalized open-standard architecture describing the components and specifying the interfaces for a signal processing system for the PC-based voice processing, call processing, and telecom switching industry.

Signal Computing System Architecture: See *SCSA*.

Springware: Software algorithms built into the downloadable firmware that provides the voice processing features available on all Intel® Dialogic® voice boards. The term "Springware" is also used to refer to a whole set of boards from Intel built using this architecture. Contrast with *DM3,* which is newer-generation architecture.

SRL: Standard Runtime Library containing Event Management functions, Standard Attribute functions, and data structures that are used by all Intel NetStructure® and Intel® Dialogic® devices.

Standard Attribute functions: Class of functions that take one input parameter (a valid device handle) and return generic information about the device. The SRL contains Standard Attribute functions for all Intel NetStructure and Intel Dialogic devices. Standard Attribute function names are case-sensitive and must be in capital letters. See *Extended Attribute functions*.

synchronous function: Blocks program execution until a value is returned by the device. Also called a blocking function. Contrast with *asynchronous function*.

T1: The digital telephony format used in North America and Japan that carries data at the rate of 1.544 Mbps (DS-1 level).

TDM bus: Time division multiplexing bus. A resource sharing bus such as the SCbus or CT Bus that allows information to be transmitted and received among resources over multiple data lines.

TDM bus routing functions: Used to set up communications between devices connected to the TDM bus. These functions enable an application to connect or disconnect (make or break) the receive (listen) channel of a device to or from a TDM bus time slot.

time slot: In a digital telephony environment, a normally continuous and individual communication (for example, someone speaking on a telephone) is (1) digitized, (2) broken up into pieces consisting of a fixed number of bits, (3)

combined with pieces of other individual communications in a regularly repeating, timed sequence (multiplexed), and (4) transmitted serially over a single telephone line. The process happens at such a fast rate that, once the pieces are sorted out and put back together again at the receiving end, the speech is normal and continuous. Each individual pieced-together communication is called a time slot.

zip tone: Short burst of a specified tone to an ACD agent headset usually indicating a call is being connected to the agent console.

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