IP Media Library API for Linux and Windows Operating Systems

Programming Guide

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About This Publication

The following topics provide information about this publication:

Purpose

This guide provides programming guidelines for the IP media software, which is typically used with the Global Call call control application programming interface (API). This is a companion guide to the *IP Media Library API Library Reference*, which provides details on functions and parameters in the IP media software.

Intended Audience

This guide is intended for software developers who will access the IP media 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 IP media software. This publication assumes that you are familiar with the Linux or Windows operating system and the C programming language. It is helpful to keep the *Voice Software Reference* handy as you develop your application.

The information in this guide is organized as follows:

- Chapter 1, "Product Description" introduces the IP media software and its key features.
- Chapter 2, "Programming Models" describes methods of developing IP media-based applications.

- Chapter 3, "State Models" describes a simple state-based IP media application.
- Chapter 4, "Event Handling" defines an event and describes how to handle an event.
- Chapter 5, "Error Handling" presents information on how to obtain error codes and handle errors.
- Chapter 6, "Application Development Guidelines" provides information on developing IP media-based applications.
- Chapter 7, "Quality of Service (QoS)" details how QoS may be used in an application.
- Chapter 8, "Building Applications" describes how to compile and link IP media-based applications.

Related Information

The following guides may also be used to develop IP technology-based applications:

- *IP Media Library API Library Reference*
- *Global Call IP Technology User's Guide*
- *Global Call API Programming Guide*
- *Global Call API Library Reference*
- *Standard Runtime Library API Library Reference*
- *http://developer.intel.com/design/telecom/support/* (for technical support)
- *http://www.intel.com/network/csp/* (for product information)

Product Description 1

This chapter provides an overview of the IP media software. It contains the following sections:

1.1 Features

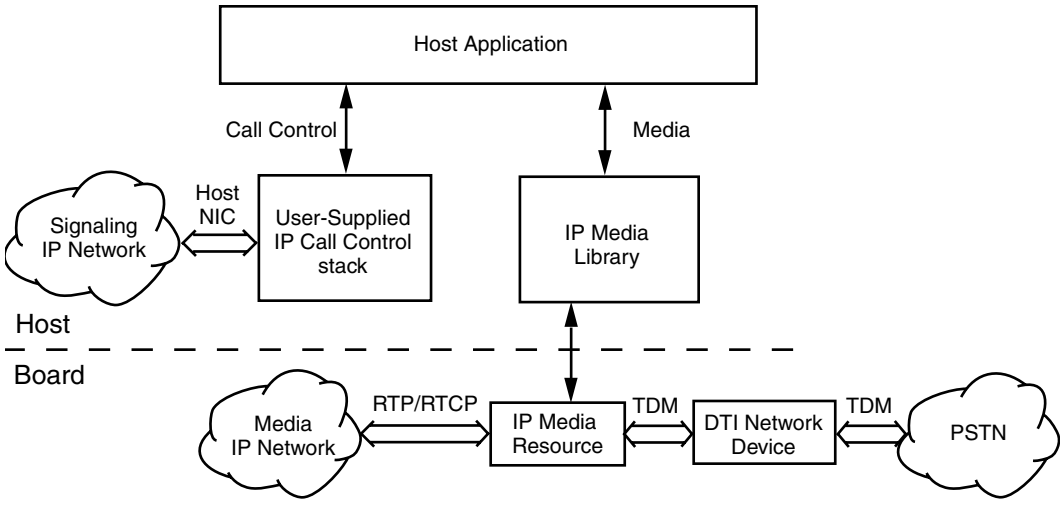
Some of the features of the IP media software include:

- media resource management, such as open, close, and configure tasks
- media resource operations, such as start, stop, and detect digits
- Quality of Service (QoS) threshold alarm configuration and status reporting
- support of standard runtime library event management routines for error retrieval
- compatibility with Global Call or another call control stack to provide IP call control functionality

1.2 Architecture

Figure 1 shows the IP media library architecture when using an Intel® NetStructure DM/IP board or an Intel® NetStructure IPT board and a user-supplied call control stack.

Figure 1. IP Media Architecture



1.3 Introduction to the IP Media Library

The IP media library (IPML) provides an application programming interface to control the starting and stopping of RTP sessions, transmit and receive DTMF or signals, QoS alarms and their thresholds, and general-purpose device control functions. The library is only used to control media functions. It is not used to control the signaling stack. The application developer may choose to integrate any third party IP signaling stack (H.323, SIP, MGCP, etc), or implement a proprietary signaling stack solution. The application developer uses the IP signaling stack to initiate or answer calls, and negotiate media characteristics such as coder, frames per packet, destination IP address, etc. Once media characteristics have been negotiated, the application uses IPML functions to start RTP streaming using the desired media characteristics.

1.4 Relationship with Global Call Library

The Global Call library provides a common call control interface that is independent of the underlying network interface technology. While the Global Call library is primarily used for call establishment and teardown, it also provides capabilities to support applications that use IP technology, such as:

- call control capabilities for establishing calls over an IP network, via the RADVISION H.323 and SIP signaling stacks
- support for IP media control by providing the ability to open and close IP media channels for streaming, using the IP media software internally (under the hood)

Note: Applications should not mix Global Call and IP media library usage of the same ipm_ devices.

Refer to the following Global Call manuals for more details:

- *Global Call IP Technology User's Guide*
- *Global Call API Programming Guide*
- *Global Call API Library Reference*

1.5 Standard Runtime Library Support

The IP media library performs event management using the Standard Run-time Library (SRL), which provides a set of common system functions that are applicable to all devices. SRL functions, parameters, and data structures are described in the *Standard Runtime Library API Library Reference*. Use the SRL functions to simplify application development by writing common event handlers to be used by all devices.

1.6 Media Channel Device Naming

To determine available resources, call **ipm_Open( )** on a board device, then call ATDV_SUBDEVS to get the available resources. (SRL operations are described in the *Standard Runtime Library API Library Reference*.)

To determine available resources in the Windows environment, use the **sr_getboardcnt( )** function, which returns the number of boards of a particular type. (SRL operations are described in the *Standard Runtime Library API Library Reference*.)

Each IP media channel device follows the naming convention ipmBxCy; where:

- B is followed by the unique logical board number
- C is followed by the number of the media device channel

You may also use the **ipm_Open( )** function to open a board device, ipmBx, where B is followed by the unique logical board number.

Before you can use any of the other IP media library functions on a device, that device must be opened. When the device is opened using **ipm_Open( )**, the function returns a unique device handle. The handle is the only way the device can be identified once it has been opened. The **ipm_Close( )** function closes a device.

Programming Models 2

This chapter describes the programming models supported by the IP media software.

The *Standard Runtime Library API Programming Guide* describes different programming models which can be used by applications. The IP media library supports all the programming models described therein.

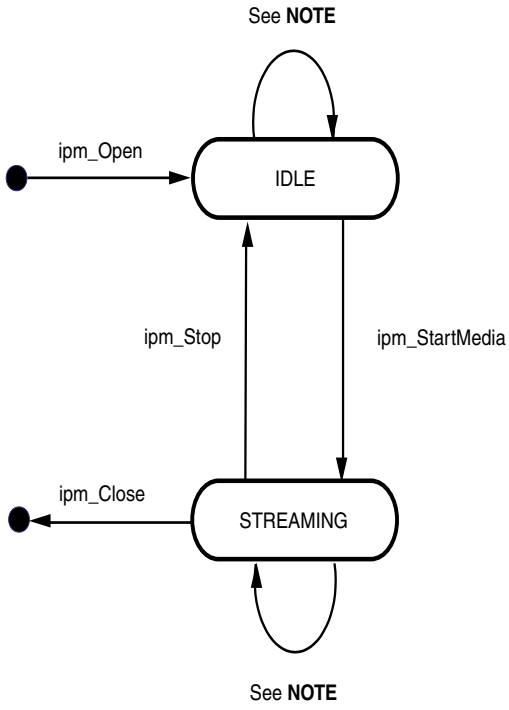
Note: The synchronous programming model is recommended for low density systems only. For high density systems, asynchronous programming models provide increased throughput for the application.

State Models 3

This chapter describes a very simple IP media state-based application.

Figure 2 shows a simple IP media application using two channel device states, IDLE and STREAMING.

Figure 2. IP Media Channel State Diagram



NOTE: The other functions in the IP Media library can be called from any state. They do not cause a state change.

Event Handling 4

All IP media events are retrieved using standard runtime library (SRL) event retrieval mechanisms, including event handlers. The SRL is a device-independent library containing Event Management functions and Standard Attribute functions. This chapter lists SRL functions that are typically used by IP media-based applications.

4.1 SRL Event Management Functions

SRL Event Management functions retrieve and handle device termination events for certain library functions. Applications typically use the following functions:

sr_enbhdlr( )
enables event handler

sr_dishdlr( )
disables event handler

sr_getevtdev( )
gets device handle

sr_getevttype( )
gets event type

sr_waitevt( )
wait for next event

sr_waitevtEx( )
wait for events on certain devices

Note: See the *Standard Runtime Library API Library Reference* for function details.

4.2 SRL Standard Attribute Functions

SRL Standard Attribute functions return general device information, such as the device name or the last error that occurred on the device. Applications typically use the following functions:

ATDV_ERRMSGP( )
pointer to string describing the error that occurred during the last function call on the specified device

ATDV_LASTERR( )
error that occurred during the last function call on a specified device. See the function description for possible errors for the function.

ATDV_NAMEP( )
pointer to device name, for example, ipmBxCy

ATDV_SUBDEVS( )
number of subdevices

Note: See the *Standard Runtime Library API Library Reference* for function details.

Error Handling 5

This chapter describes error handling for the IP media software.

All IP media library functions return a value that indicates the success or failure of the function call. Success is indicated by a return value of zero or a non-negative number. Failure is indicated by a value of -1.

If a function fails, call the Standard Attribute functions **ATDV_LASTERR( )** and **ATDV_ERRMSGP( )** for the reason for failure. These functions are described in the *Standard Runtime Library API Library Reference*.

If an error occurs during execution of an asynchronous function, the IPMEV_ERROR event is sent to the application. No change of state is triggered by this event. Upon receiving the IPMEV_ERROR event, the application can retrieve the reason for the failure using the standard runtime library functions **ATDV_LASTERR( )** and **ATDV_ERRMSGP( )**.

Application Development Guidelines 6

This chapter contains guidelines for developing applications which use the IP media library. The following topics are discussed:

6.1 Introduction to DTMF Handling

When a session is started on an IPM device, the IPM device receives data from its IP interface and transmits data towards the TDM bus. A DTI device receives data from its PSTN interface and transmits towards the TDM bus as well. In a gateway configuration, the DTI and IPM devices will be configured, via **gc_Listen( )** and **ipm_Listen( )** respectively, to listen to each other and thus create a full duplex communication path. The IPM device will forward DTMF that it receives on one interface to the other interface. Figure 1, “IP Media Architecture”, on page 10 shows the data flow between the IP media library, the IP network, and the PSTN network.

When an IPM device receives DTMF from the TDM bus, there are several ways to forward it towards the IP interface. These include: forwarding it in the RTP stream (also called in-band), sending via RFC 2833, and using an application-controlled/defined method (also called out-of-band).

The IPM device can automatically forward the DTMF when either the in-band or RFC 2833 DTMF transfer mode has been selected. DTMF is **not** automatically forwarded when the application controlled/defined method, also known as out-of-band mode, has been selected. In the out-of-band case, the application must call **ipm_ReceiveDigits( )** and have an IPM_DIGITS_RECEIVED event handler in place. Upon receiving the IPM_DIGITS_RECEIVED event, the DTMF information is contained in the IPM_DIGIT_INFO structure delivered with the event. The application has the responsibility to forward the DTMF via whatever mechanism, open or proprietary, it desires.

When using RFC 2833 mode, the DTMF could optionally be sent in both RFC 2833 packets and in-band. The default is that the DTMF is only sent in the RFC 2833 packet and the audio is muted. Setting the mute audio parameter (IPM_RFC2833MUTE_AUDIO) to RFC2833MUTE_AUDIO_OFF will cause the DTMF to be sent in-band as well as via RFC 2833.

Note: Use caution when using both RFC 2833 and in-band DTMF, because an endpoint device may recognize two separate digits instead of one.

When using out-of-band mode, the DTMF is never transmitted in-band. As mentioned earlier, the application has the responsibility to forward the digits.

The setting for DTMF transfer mode also affects the handling of DTMF that is received from the IP interface. When the mode is set to in-band, the DTMF is automatically forwarded to the TDM bus.

If out-of-band mode has been selected, then the application will use its own mechanism to be notified that a DTMF digit has been received. Then, **ipm_SendDigits( )** is used when necessary to transmit a DTMF digit towards the TDM bus.

When the mode is set to RFC 2833, DTMF is automatically forwarded to the TDM bus as PCM data.

Note: For Intel® NetStructure™ DM/IP Series boards only: if you wish to be notified of RFC 2833 packets as they arrive at the IP port, the application must enable the EVT_RFC2833 event via a call to **ipm_EnableEvents( )**. Upon receiving the IPMEV_RFC2833SIGNALRECEIVED event, the DTMF information is contained in the IPM_RFC2833_SIGNALID_INFO structure. The application must use **ipm_SendDigits( )** to forward the digit towards the DTMF bus.

6.2 Setting DTMF Parameters

This section contains the following topics:

6.2.1 DTMF Modes

The IP media library can be used to configure which DTMF mode (in-band, RFC 2833, or out-of-band) is used by the application. The DTMF mode is set on a per-channel basis using **ipm_SetParm( )** and the IPM_PARM_INFO data structure.

The eIPM_DTMFXFERMODE enumeration identifies which DTMF mode to use. The following values are supported:

- DTMFXFERMODE_INBAND - DTMF digits are sent and received in-band via standard RTP transcoding. This is the default mode when a channel is opened.
- DTMFXFERMODE_RFC2833 - DTMF digits are sent and received in the RTP stream as defined in RFC 2833.
- DTMFXFERMODE_OUTOFBAND - DTMF digits are sent and received outside the RTP stream.

Depending on the mode being used, the digit information transferred in the RTP stream.

When using RFC2833, the payload type is specified by using the following parameter/value setting in a call to **ipm_SetParm( )**:

- PARMCH_RFC2833_EVT_TX_PLT - Identifies the transmit payload type. The only value for this field is 101
- PARMCH_RFC2833_EVT_RX_PLT - Identifies the receive payload type. The only value for this field is 101

6.2.2 Setting In-Band Mode

In in-band mode, the DTMF audio is not clamped (not muted) and DTMF digits are sent in the RTP packets.

Note: When a channel is opened, the DTMF transfer mode is in-band by default.

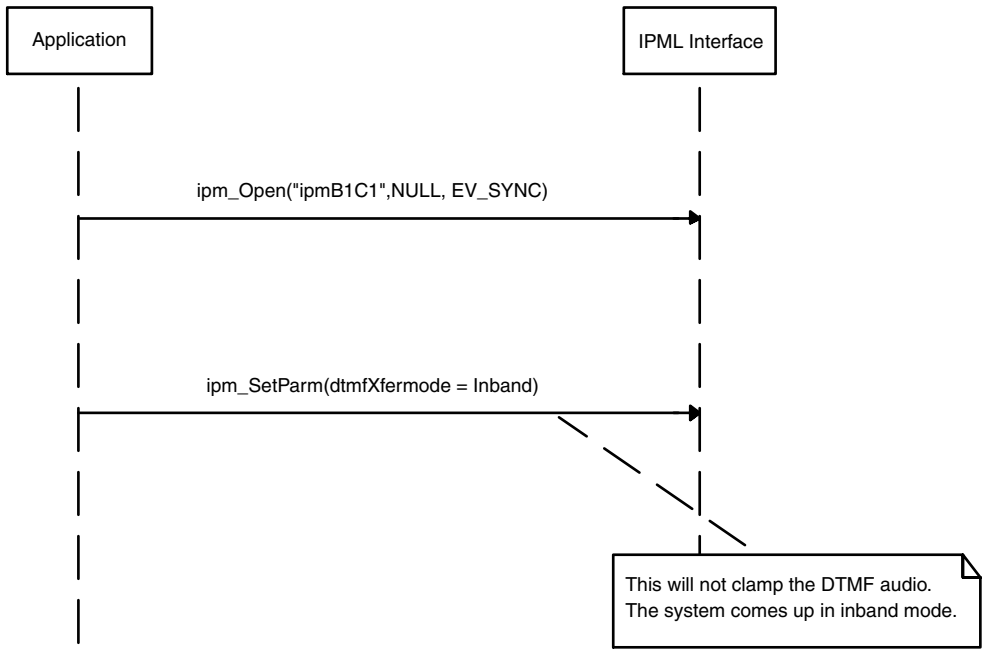
To set up a channel for in-band mode:

1. Open a channel using **ipm_Open**("ipmB1C1",NULL,EV_SYNC)
2. Set up the IPM_PARM_INFO structure and call **ipm_SetParm( )** as shown below:

```
IPM_PARM_INFO parmInfo;
unsigned long ulParmValue = DTMFXFERMODE_INBAND;
parmInfo.eParm = PARMCH_DTMFXFERMODE;
parmInfo.pvParmValue = &ulParmValue
ipm_SetParm(chdev, &parmInfo, EV_ASYNC)
```

Figure 3 shows a scenario diagram for setting in-band mode.

Figure 3. In-Band Mode Scenario Diagram



6.2.3 Setting RFC 2833 Mode

To set up a channel for RFC 2833 mode, do the following:

1. Open a channel using **ipm_Open**("ipmB1C1",NULL,EV_SYNC)
2. Set the mode via the IPM_PARM_INFO structure and **ipm_SetParm( )** as shown below:

```
IPM_PARM_INFO parmInfo;
unsigned long ulParmValue = DTMFXFERMODE_RFC2833;
parmInfo.eParm = PARMCH_DTMFXFERMODE;
parmInfo.pvParmValue = &ulParmValue
ipm_SetParm(chdev, &parmInfo, EV_ASYNC)
```

3. Set up the RFC 2833 event payload on the transmit side as shown below:

```
IPM_PARM_INFO parmInfo;
unsigned long ulParmValue = 101;
parmInfo.eParm = PARMCH_RFC2833EVT_TX_PLT;
parmInfo.pvParmValue = &ulParmValue
ipm_SetParm(chdev, &parmInfo, EV_ASYNC)
```

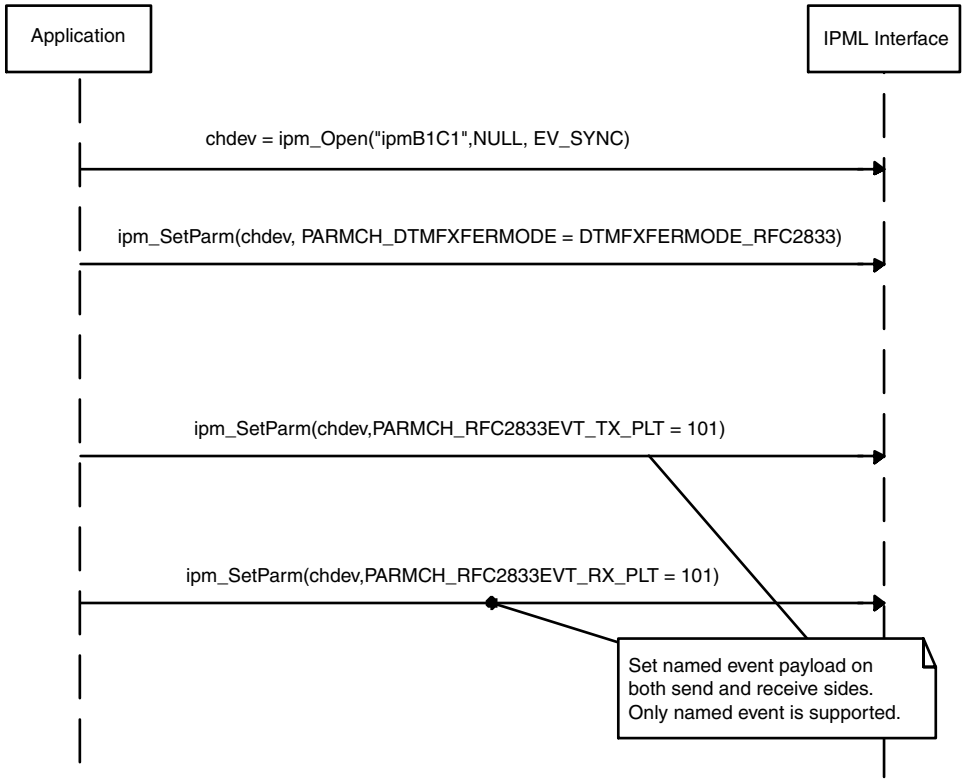
4. Set up the RFC 2833 event payload on the receive side as shown below:

```
IPM_PARM_INFO parmInfo;
unsigned long ulParmValue = 101;
parmInfo.eParm = PARMCH_RFC2833EVT_RX_PLT;
parmInfo.pvParmValue = &ulParmValue
ipm_SetParm(chdev, &parmInfo, EV_ASYNC)
```

5. Optionally, you can mute or un-mute the audio data in the RTP stream using the eIPM_RFC2833MUTE_AUDIO enumeration. The default state is for muting to be ON.

Figure 4 shows a scenario diagram for setting RFC 2833 mode.

Figure 4. RFC 2833 Scenario Diagram



6.2.4 Setting Out-of-Band Mode

In out-of-band mode, the DTMF audio is automatically clamped (muted) and DTMF digits are not sent in the RTP packets. To set up a channel for out-of-band mode, do the following:

1. Open a channel using **ipm_Open**("ipmB1C1",NULL,EV_SYNC)
2. Set the mode via the IPM_PARM_INFO structure and **ipm_SetParm**( ) as shown below:

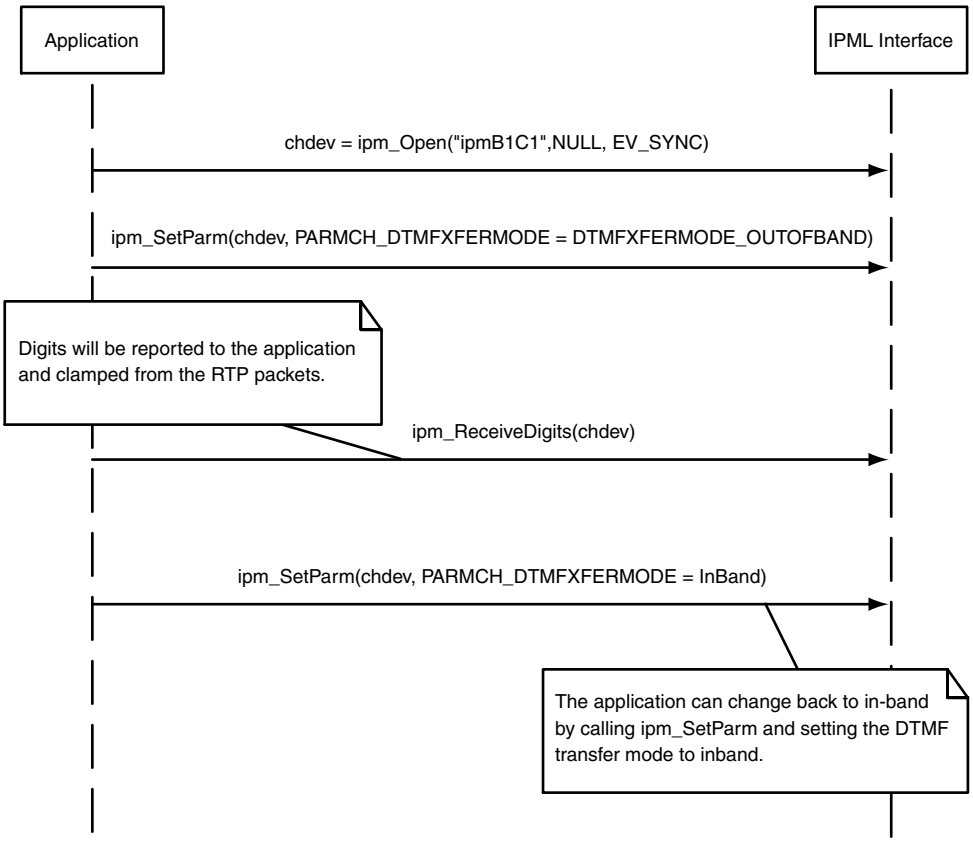
```
IPM_PARM_INFO parmInfo;
unsigned long ulParmValue = DTMFXFERMODE_OUTOFBAND;
parmInfo.eParm = PARMCH_DTMFXFERMODE;
parmInfo.pvParmValue = &ulParmValue
ipm_SetParm(chdev, &parmInfo, EV_ASYNC)
```

3. Call **ipm_ReceiveDigits**(chdev) to have digits reported to the application and clamped from the RTP packets.

To change back to in-band mode, set the PARMCH_DTMFXFERMODE parameter to DTMFXFERMODE_INBAND.

Figure 5 shows a scenario diagram for setting out-of-band mode.

Figure 5. Out-of-Band Mode Scenario Diagram



6.3 Notification of DTMF Detection

Notification of DTMF detection depends on the DTMF mode being used. For out-of-band mode, when an incoming DTMF digit is detected (received from the TDM bus), the application receives an unsolicited IPMEV_DIGITS_RECEIVED event. The event data is contained in IPM_DIGIT_INFO. One event is returned for each digit that is received.

For applications using Intel® NetStructure™ DM/IP Series boards and RFC 2833 mode, the application can request notification when DTMF digits are detected by using **ipm_EnableEvents( )** with the EVT_RFC2833 parameter. Once the events are enabled, when an incoming DTMF digit is detected, the application receives an unsolicited IPMEV_RFC2833SIGNALRECEIVED event. The event data is contained in IPM_RFC2833_SIGNALID_INFO.

6.4 Generating DTMF

Once DTMF mode has been configured, the application can generate DTMF digits using the **ipm_SendDigits( )** function.

Note: The only supported direction for DTMF digit generation is towards the TDM bus.

Alternatively, the **ipm_SendRFC2833SignalIDToIP( )** function can be used to send RFC 2833 data to the IP network.

Note: The **ipm_SendRFC2833SignalIDToIP( )** function is not supported on Intel® NetStructure™ IPT Series boards. In this case, once you set the mode to RFC 2833, the only way to send an RFC 2833 digit is to have the ipmBxCy device listening to a TDM time slot. If the ipmBxCy device detects a digit from the TDM time slot, it will convert it to RFC 2833 and transmit the digit over RTP.

A typical use of the **ipm_SendRFC2833SignalIDToIP( )** function is to:

- fill in the IPM_RFC2833_SIGNALID_INFO structure with the signal (tone) to send and the signal state set to SIGNAL_STATE_ON to start generating DTMF.
- call **ipm_SendRFC2833SignalIDToIP( )** to indicate the start of the data
- wait an appropriate amount of time (for example, 50 msec)
- fill in the IPM_RFC2833_SIGNALID_INFO structure with the signal (tone) to stop and the signal state set to SIGNAL_STATE_OFF to stop generating DTMF.
- call **ipm_SendRFC2833SignalIDToIP( )** to indicate the end of the data

This scenario is useful in situations when the application receives ringback from the PSTN and needs to send the tone data to the IP network. The application uses voice library functions to detect ringback. (See the Voice API Library Reference for more details.) Then the application sets the RFC2833 signal on and leave it on until the ringback stops.

6.5 Using T.38 Fax

The IP media software supports sending fax information during a session using the T.38 protocol, as shown in Figure 6.

Note: Another method of transferring fax information is to use the G.711 protocol. In this case, the fax data is sent from a fax-capable board in the system across the TDM bus. The IP media software can then send the data outside the system using IP. However, this method uses more bandwidth than the T.38 method.

To set up a channel to handle T.38 fax, do the following:

1. Open a channel using **ipm_Open**("ipmB1C1",NULL,EV_SYNC)
2. Enable event reporting using ipm_EnableEvents(chDev, *pEvents) and the IPMEV_T38CALLSTATE and IPMEV_FAXTONE events.
3. Get local RTP information using ipm_GetLocalMediaInfo(chDev,&MediaInfo) and setting the eMediaType field to MEDIATYPE_LOCAL_RTP_INFO
4. Start an RTP call using ipm_StartMedia(chDev)

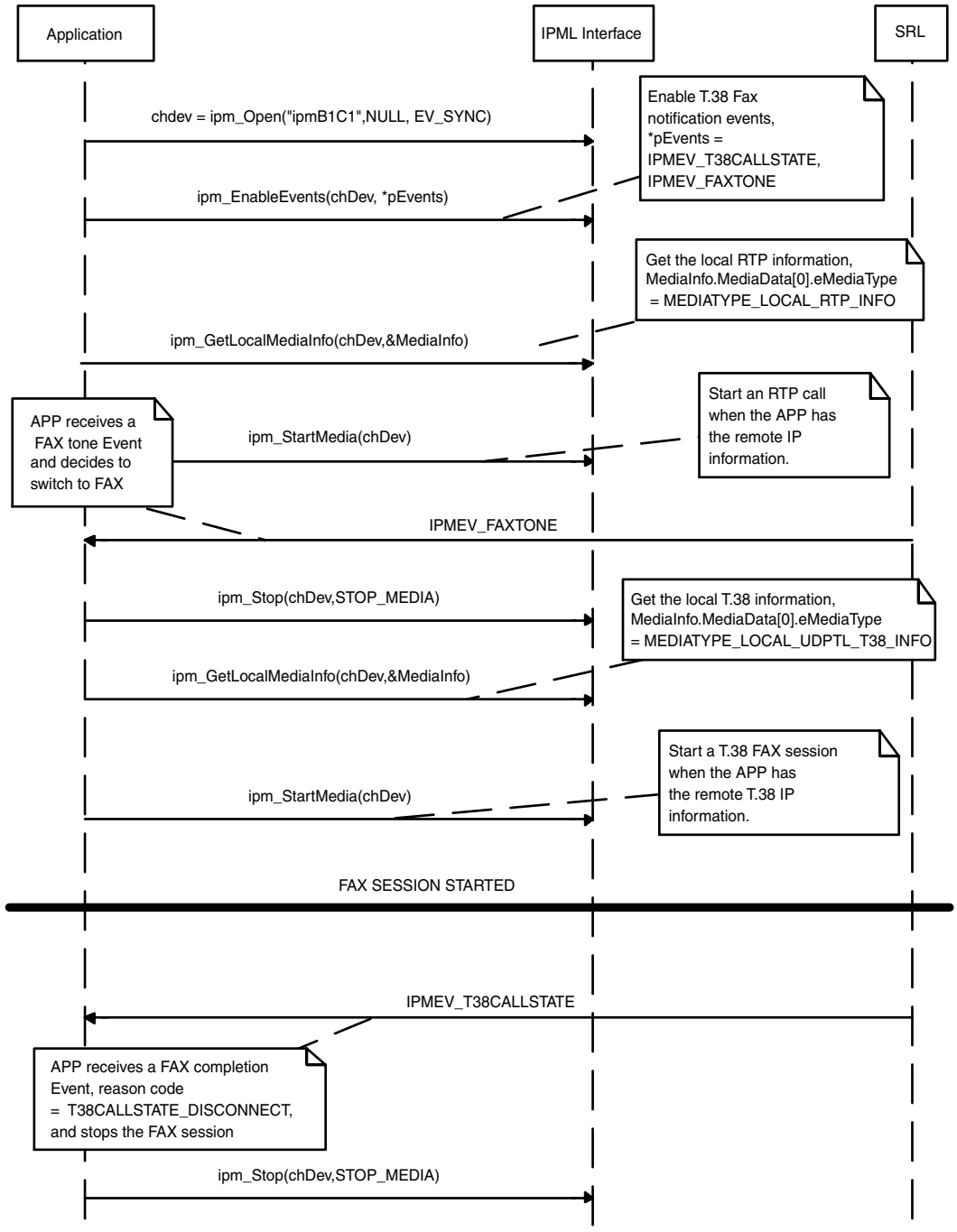
5. When the fax event IPMEV_FAXTONE is received, the application should first stop the call in progress using ipm_Stop(chDev,STOP_MEDIA), then retrieve the local T.38 fax information using ipm_GetLocalMediaInfo(chDev,&MediaInfo) and the eMediaType field MEDIATYPE_LOCAL_UDPTL_T38_INFO

   Note: It is the responsibility of the application to respond promptly when the fax event is received or latency errors may occur. Refer to the T.38 Fax specification and ITU-T T.30 specification for latency guidelines. (Details on fax timing are in the T.30 specification.)

   Note: CED and CNG tones must be exchanged before switching to T.38 mode. Also, CED and CNG tones will not transmit reliably over coders other than G.711 and G.726.

6. Once the remote fax information is available, the application then starts a fax session by calling ipm_StartMedia(chDev)
7. When the fax event IPMEV_T38CALLSTATE is received, with the reason code T38CALLSTATE_DISCONNECT, the application can stop the fax session using ipm_Stop(chDev,STOP_MEDIA)

Figure 6. Using T.38 Fax Scenario Diagram



Quality of Service (QoS) 7

This chapter describes the QoS alarms that are supported by the IP media software, including the following sections:

7.1 QoS Overview

The public switched telephone network (PSTN) defines quality of service as a particular level of service, for example “toll-like” service. However, quality of service for voice or other media over the Internet Protocol is defined as a continuum of levels, which are affected by packet delay or loss, line congestion, and hardware quality such as microphone quality. The IP media software is designed to operate along the entire range of quality of service, enabling the application to retrieve information necessary for correct billing.

All QoS parameters supported by the IP media software are disabled by default. That is, QoS monitoring must be enabled by the application. If desired, the application can set threshold values to monitor the quality of service during sessions. The QoS parameters are measured during time intervals, starting when a session is established. A fault occurs when the measurement of a QoS parameter crosses a predefined threshold. A success occurs when the measurement of a QoS parameter does not exceed a predefined threshold value.

7.2 QoS Alarm Types and Thresholds

All QoS alarms operate on a per-channel basis. That is, a QoS alarm indicates the status of particular channel during a particular session, not the status of an entire IP media resource board. The QoS alarms and thresholds described in this section are defined in the IPM_QOS_THRESHOLD_DATA data structure.

The following QoS alarms are identified by the enumeration eIPM_QOS_TYPE:

EVT_DTMFDISCARDED
: number of lost DTMF digits since the beginning of the call; indicates the system could not process the digits that were sent (Intel® NetStructure™ DM/IP Series boards only)

EVT_LOSTPACKETS
: percent of lost packets per second since the beginning of the call

EVT_JITTER
average jitter since the beginning of the call (in msec)

EVT_ROUNDTRIPLATENCY
RTP packet latency (Intel® NetStructure™ IPT Series boards only)

Each QoS alarm has the following threshold attributes:

Note: Only the **unFaultThreshold** field is supported on Intel® NetStructure™ IPT Series boards.

unTime_Interval
amount of time between two QoS parameter measurements (in multiples of 100 msec)

unDebounceOn
time interval for measuring potential alarm set condition (in msec., must be multiple of **unTime_Interval**).

unDebounceOff
time interval for measuring potential alarm clear condition (in msec., must be multiple of **unTime_Interval**)

unFaultThreshold
alarm threshold value. When this value is exceeded, the **unDebounceOn** timer is triggered. The units for **unFaultThreshold** are dependent on what alarm is being measured. In the case of the Lost Packets alarm, **unFaultThreshold** is measured in lost packets per second.

unPercentSuccessThreshold
number of poll instances that the error threshold must be exceeded in a **unDebounce_On** time interval before declaring alarm (expressed as a percentage of successes)

unPercentFailThreshold
number of poll instances that the error threshold was not exceeded in **unDebounce_Off** time interval before clearing alarm (expressed as a percentage of failures)

7.3 Alarm and Recovery Mechanisms

Figure 7 shows how a QoS alarm is triggered and an event is sent to an application. The time line shows that QoS parameters are measured every **unTime_Interval**. The QoS parameter in this example transitions from Success to Failure which starts the **unDebounceOn** timer. The QoS parameter transitions to Success and the **unDebounceOn** timer stops timing and is reset. At this time, the percentage failure rate is less than **unPercentFailThreshold** so no alarm event is sent. Later, the QoS parameter transitions from Success to Failure and the **unDebounceOn** timer begins timing again. In this scenario, the **unDebounceOn** timer expires while the QoS parameter is in Failure period and the percentage failure rate is equal to or greater than **unPercentFailThreshold**. Both of these situations cause an alarm event to be sent and the unDebounceOn timer to be reset.

Figure 7. Alarm Mechanism

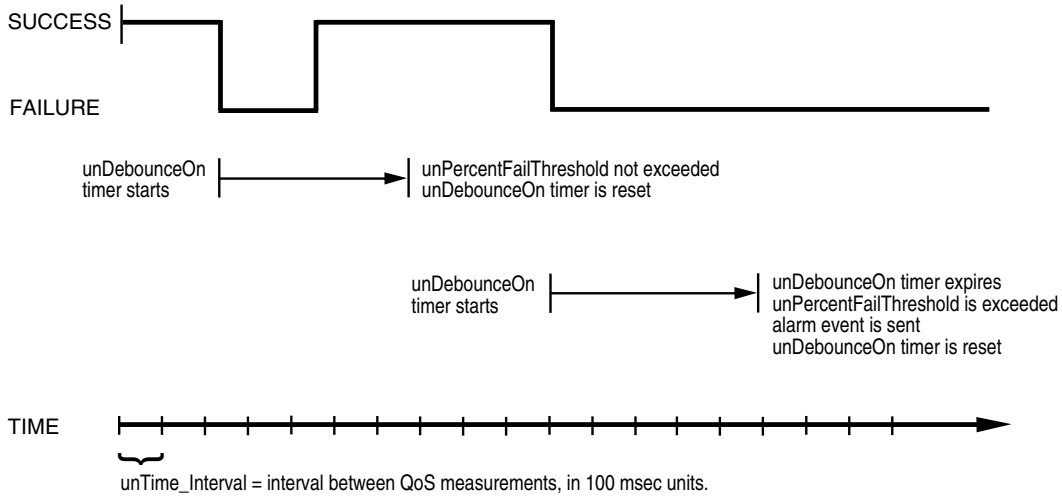
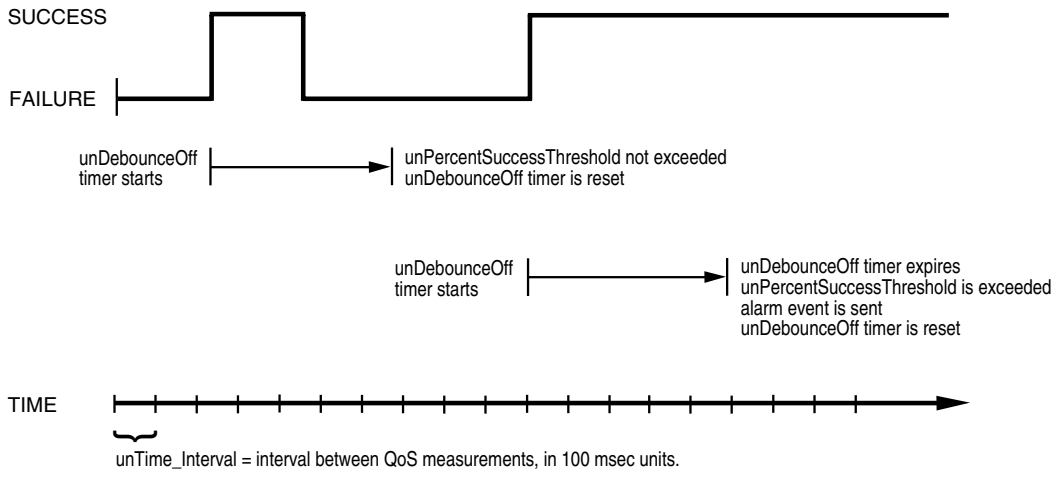


Figure 8 shows how an application recovers from a QoS alarm. The time line shows that QoS parameters are measured every **unTime_Interval**. The QoS parameter in this example transitions from Failure to Success which starts the **unDebounceOff** timer. The QoS parameter transitions to Failure and the **unDebounceOff** timer stops timing and is reset. At this time, the percentage success rate is less than **unPercentSuccessThreshold** so no alarm recovery event is sent. Later, the QoS parameter transitions from Failure to Success and the **unDebounceOff** timer begins timing again. In this scenario, the **unDebounceOff** timer expires while the QoS parameter is in Success period and the percentage success rate is equal to or greater than **unPercentSuccessThreshold**. Both of these situations cause an alarm recovery event to be sent and the **unDebounceOff** timer to be reset.

Figure 8. Recovery Mechanism



7.4 Using QoS Alarms

The following steps are an overview of how to use QoS alarms in your application. For details, refer to the specific API and data structure descriptions:

1. Call **ipm_GetQoSThreshold( )** to retrieve the current settings of QoS parameters.
2. Set up the IPM_QOS_THRESHOLD_INFO structure with desired values for QoS parameter settings.
3. Call **ipm_SetQoSThreshold( )** to set the desired QoS parameters. This function may be called at any time by an application, including while a session is in progress.
4. Call **ipm_EnableEvents( )** to start QoS parameter monitoring.
5. When a QoS alarm has been triggered, an IPMEV_QOS_ALARM event is sent by the system.
6. Use standard runtime library API functions to query the IPMEV_QOS_ALARM_DATA structure to retrieve more details about the alarms which have been triggered.
7. Call **ipm_DisableEvents( )** to stop QoS parameter monitoring.

The following pseudocode illustrates how you might use QoS alarms in an application.

```
#include <stdio.h>
#include <srllib.h>
#include <ipmlib.h>
typedef long int(*HDLR)(unsigned long);
void CheckEvent();

/* % Packet Loss */
Time_Interval = 1000;           /* 1 second                          */
Debounce_On = 20000;            /* 20 seconds                        */
Debounce_Off = 45000;           /* 45 seconds                        */
Fault_Threshold = 6;            /* 2 lost 30 msec packets per second. */
Percent_Success_Threshold = 10; /* 10 seconds (in 20 seconds)        */
Percent_Fail_Threshold = 30;    /* 30 seconds (in 45 seconds)        */

/* Jitter */
Time_Interval = 100;             /* 100 msec                         */
Debounce_On = 20000;             /* 20 seconds                       */
Debounce_Off = 45000;            /* 45 seconds                       */
Fault_Threshold = 360;           /* 1.5 30 msec G711 packet jitter per second. (unscaled) */
Percent_Success_Threshold = 100; /* 10 seconds (in 20 seconds)       */
Percent_Fail_Threshold = 300;    /* 30 seconds (in 45 seconds)       */

void main()
{
    int nDeviceHandle;
    eIPM_EVENT myEvents[3] ={EVT_ROUNDTRIPLATENCY, EVT_LOSTPACKETS, EVT_JITTER};
    // Register event handler function with srl
    sr_enbhdlr( EV_ANYDEV ,EV_ANYEVT ,(HDLR)CheckEvent);
    /*
    .
    Main Processing
    .
    */

    /*
    Need to enable three events for IP device handle, nDeviceHandle.
    ASSUMPTION: A valid nDeviceHandle was obtained from prior call to ipm_Open().
    */
    if(ipm_EnableEvents(nDeviceHandle, myEvents, 3, EV_SYNC) == -1)
    {
```

```
            printf("ipm_EnableEvents failed for device name %s with error = %d\n",
                ATDV_NAMEP(nDeviceHandle), ATDV_LASTERR(nDeviceHandle));
                /*
                .
                Perform Error Processing
                .
                */
        }
        /*
        .
        Continue Processing
        .
        */
}

void CheckEvent()
{
    int nEventType = sr_getevttype();
    int nDeviceID = sr_getevtdev();
    switch(nEventType)
    {
    /*
    .
    . List of expected events
    .
    */
        /* When alarm occurs you get this event. */

    case IPMEV_QOS_ALARM:
        {
            printf("Received IPMEV_QOS_ALARM for device = %s\n",
                ATDV_NAMEP(nDeviceID));
            IPM_QOS_ALARM_DATA * l_pAlarm = (IPM_QOS_ALARM_DATA*)l_pVoid;
            switch(l_pAlarm->eQoSType)
            {
            case QOSTYPE_ROUNDTRIPLATENCY:
                printf("QOSTYPE_ROUNDTRIPLATENCY=%d\n", l_pAlarm->eAlarmState);
                break;
            case QOSTYPE_JITTER:
                printf("QOSTYPE_JITTER=%d\n", l_pAlarm->eAlarmState);
                break;
            case QOSTYPE_LOSTPACKETS:
                printf("QOSTYPE_LOSTPACKETS=%d\n", l_pAlarm->eAlarmState);
                break;
            }
            break;
        }

    default:
        printf("Received unknown event = %d for device = %s\n",
            nEventType, ATDV_NAMEP(nDeviceID));
        break;

    }
}
```

7.5 Hints for QoS Alarm Handling

The following hints may be useful in designing your application to handle QoS alarms:

If a QoS alarm occurs in the middle of a call and you wish to change coders, you must stop the particular media stream before you can change to a different coder. Note that stopping and restarting the media stream tears down the call, therefore, a brief interruption in the audio stream will likely be experienced.

For Intel® NetStructure™ IPT Series boards, the system software sends a QoS alarm event when a threshold is exceeded (ALARM_STATE_ON).

For Intel® NetStructure™ DM/IP Series boards and for HMP software, the system software sends a QoS alarm event when a threshold is exceeded (ALARM_STATE_ON) and when the threshold returns to the programmed level (ALARM_STATE_OFF).

Building Applications 8

This chapter contains the following sections:

8.1 Compiling and Linking under Linux

The following topics discuss compiling and linking requirements:

- Include Files
- Required Libraries

8.1.1 Include Files

To use IP media API functions in your Linux application, certain include files (also known as header files) and library files are required. You must add statements for these include files in your application. The following header files contain equates that are required for each Linux application that uses the IP media library:

ipmerror.h
IP media library error header file

ipmlib.h
IP media library header file

8.1.2 Required Libraries

The following library files must be linked to the application **in the following order**:

libipm.so
Linking this file is mandatory. Specify `-lipm` in makefile.

libgc.so
Required only if the application uses R4 Global Call library functions directly, for example, **gc_OpenEx( )**. Specify `-lgc` in makefile.

libdxxx.so
Required only if the application uses R4 voice library functions directly, for example, **dx_play( )**. Specify `-ldxxx` in makefile.

libsrl.so
Standard Runtime Library (SRL) is mandatory. Specify `-lsrl` in makefile.

libpthread.so
POSIX threads system library. Specify `-lpthread` in makefile.

libdl.so
Dynamic Loader system library. Specify `-ldl` in makefile.

8.2 Compiling and Linking under Windows

The following topics discuss compiling and linking requirements:

- Include Files
- Required Libraries

8.2.1 Include Files

To use IP media library API functions in your Windows application, certain include files (also known as header files) and library files are required. You must add statements for these include files in your application. The following header files contain equates that are required for each Windows application that uses the IP media library:

ipmerror.h
IP media library error header file

ipmlib.h
IP media library header file

8.2.2 Required Libraries

The following library files must be linked to the application:

libipm.lib
Linking this file is mandatory.

libgc.lib
Required only if the application uses R4 Global Call library functions directly, for example, **gc_OpenEx( )**. Use the `-lgc` argument to the system linker.

libdxxxmt.lib
Required only if the application uses R4 voice library functions directly, for example, **dx_play( )**.

libsrlmt.lib
Standard Runtime Library (SRL) is mandatory.

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