



IP Media Server for Host Media Processing

Demo Guide

April 2005



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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
05-2389-002	April 2005	Globally changed file paths to use installation directory environment variable, and to reflect latest Windows directory hierarchy Globally removed Linux-specific information and references to pre-1.3 HMP releases Demo Description chapter: Added note about channel density and numbering restrictions Demo Voice Menu Flowchart figure: Multiple minor updates for clarity
05-2389-001	September 2004	Initial version under this title and part number as an HMP-specific document. Much of the information contained in this document was previously published in the <i>IP Media Server (Global Call) Demo Guide for Windows Operating Systems</i> , document number 05-2065-001. The following changes were made in preparing this document: Software Requirements section: Added HMP 1.2 Linux and HMP 1.1 Windows FP1 releases with description of differences Configuration File Location section: Added location info for Linux Editing the IPMediaServer.cfg Configuration File section: Updated descriptions of QoS attributes to match IPML API Reference. Updated sample configuration file listing. Compiling and Linking section: Added compile info for Linux Starting the Demo section: Added file location info for Linux Using the Media Server section: Added CSP Barge-in to Main Menu listing. Corrected description of CSP Prompt. Demo Voice Menu Flowchart figure: Corrected description of CSP Prompt. Clarified descriptions of fax prompts. Demo Source Code Files section: Added Linux directory info. Added Linux makefiles to file lists. PDL Files section: Added file location info for Linux. Added Linux makefile to file list. Application Classes table: Changed module order (now IP last) in description of init method Initialization section: Changed module initialization order (now IP last) System Initialization figure: Changed module initialization order (now IP last) Handling Application Exit Events section: Deleted Ctrl+C TSUsrEvent Structure section: Updated field descriptions



About This Publication

This section describes the purpose of the guide, the intended audience, and provides references to other documents that may be useful to the user.

- [Purpose](#)
- [Intended Audience](#)
- [How to Use This Publication](#)
- [Related Information](#)

Purpose

This guide provides information on the IP Media Server for HMP demo that is available with the Intel® NetStructure™ Host Media Processing Software product. The guide describes the demo, lists its requirements, and provides details on how it works.

This guide specifically documents the IP Media Server for HMP demo as it is supplied in the Host Media Processing Software 1.3 for Windows* release.

Note that the IP Media Server demo that is supplied with Intel® Dialogic® System Release 6.x software has significantly different functionality than the Host Media Processing implementation, and is therefore described in a separate Demo Guide document.

Intended Audience

This guide is intended for application developers who will be developing a media server application using the Global Call API. Developers should be familiar with the C++ programming language and the Windows programming environment.

This information is intended for:

- Distributors
- 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.

This publication assumes that you are familiar with the Windows operating system and the C++ programming language.

The information in this guide is organized as follows:

- [Chapter 1, “Demo Description”](#) introduces you to the demo and its features
- [Chapter 2, “System Requirements”](#) outlines the hardware and software required to run the demo
- [Chapter 3, “Preparing to Run the Demo”](#) describes the preparations required before running the demo
- [Chapter 4, “Running the Demo”](#) describes how to run the demo
- [Chapter 5, “Demo Details”](#) provides details on how the demo works

Related Information

See the following for more information:

- *Intel NetStructure Host Media Processing Software Release Guide*
- *Global Call IP for Host Media Processing Technology Guide*
- *Global Call API Library Reference*
- *Voice API Programming Guide*
- *Voice API Library Reference*
- *Standard Runtime Library API Programming Guide*
- *Standard Runtime Library API Library Reference*
- *Fax Software Reference*
- <http://developer.intel.com/design/telecom/support/> (for technical support)
- <http://www.intel.com/design/network/products/telecom> (for product information)

This chapter describes the basic features of the IP Media Server for HMP demo.

The IP Media Server for HMP demo is an object-oriented host-based application that demonstrates using the Global Call API to build an IP media server, providing voice and fax services via IP technology. The demo source code can be used as sample code for those who want to begin developing an application from a working application.

Note: The IP Media Server for HMP demo is limited to a maximum of four simultaneous channels. Additionally, the channel numbers used must be below 120; the demo will fail to run if you attempt to use a channel number higher than 120.

The IP Media Server for HMP demo supports the following features:

- Voice service
- Fax service
- CSP barge in
- Configuration file
- Command line options

Note: The IP Media Server for HMP demo does not function as a gateway. Therefore, it can only answer calls from the IP network. Gateway functionality can be added by writing additional software code within the IP module that will allow it to make outgoing calls to the IP network, and connecting a gateway to interface with the PSTN.

This chapter discusses the system requirements for running the IP Media Server for HMP demo. It contains the following topics:

- [Hardware Requirements](#) 13
- [Software Requirements](#) 14

2.1 Hardware Requirements

To run the IP Media Server for HMP demo, you need:

- Intel® Pentium® III processor (minimum requirement). For detailed processor clock speed and memory requirements, refer to the Release Guide (or Release Notes) for the HMP version you are using.
- CD-ROM drive
- VGA display
- Pointing device
- 100Base-T network interface card (NIC)

Note: A 1000Base-T NIC will yield better performance.

Memory Requirements

For production purposes, a minimum of 512 MB of memory is required. For development and demo purposes using a low-end configuration, 256 MB of memory may be sufficient.

IP Endpoints

The following H.323 IP devices were tested for interoperability with HMP:

- Microsoft* NetMeeting* (Version 3.0 or later)
- POLYCOM* SoundPoint IP 500
- Intel® NetStructure™ PBX-IP Media Gateway
- Intel Optimizers Internet Phone

The following SIP IP devices were tested for interoperability with HMP:

- POLYCOM SoundPoint IP 500
- Intel NetStructure PBX-IP Media Gateway

2.2 Software Requirements

To run the IP Media Server for HMP demo as documented in this guide, you need the following software release:

- Intel NetStructure Host Media Processing Software 1.3 for Windows

For operating system requirements, see the release documentation (Release Guide or Release Notes) that accompanies your specific HMP release.

This chapter discusses the preparations necessary to run the IP Media Server for HMP demo. It provides information about the following topics:

- [Editing Configuration Files](#) 15
- [Compiling and Linking](#) 18

3.1 Editing Configuration Files

This section discusses how to configure the demo for your system. It contains the following topics:

- [Configuration File Location](#)
- [Editing the IPMediaServer.cfg Configuration File](#)

3.1.1 Configuration File Location

Before running the IP Media Server for HMP demo, modify the *IPMediaServer.cfg* file to reflect your system environment. Use a text editor and open the file from the following location:

`$(INTEL_DIALOGIC_DIR)\Demos\IPMediaServer\Release`

3.1.2 Editing the IPMediaServer.cfg Configuration File

Below is an example of the *IPMediaServer.cfg* file. Update the following information:

ipProtocolName

The IP protocol for opening IP line devices. Possible values are:

- H323
- SIP
- both

DTMFmode

Specifies how DTMF tones are transmitted. Possible values are:

- OutofBand – usually used with low bandwidth coders, such as GSM
Note: OutofBand is used for H.323 only.
- InBand – usually used with G.711 coders
- RFC2833

Capability

Describes the transmit and receive coders. See the *Global Call IP Technology Guide* for specific information about coder support. The parameters are as follows:

- TxType – the transmit voice coder

Note: By default, the fax demo is turned off. This feature may be enabled when tested with T.38 capable IP endpoints. To do this, “uncomment” the line `TxType = t38UDPFax` in this section by removing the # from the start of the line, or add the line if not present.

- TxFramesPerPkt – the number of frames per packet for the selected Tx coder
- TxVAD – specifies if VAD is active for the selected Tx coder
- RxType – the receive voice coder
- RxFramesPerPkt – the number of frames per packet for the selected Rx coder

Note: The G.711 coder defines frames per packet using the packet size in milliseconds, i.e. 10, 20, or 30 milliseconds. Refer to the [Sample Configuration File](#), below, for the correct syntax for all the parameters.

- RxVAD – specifies if VAD is active for the selected Rx coder

Quality of Service

The application can set threshold values to monitor the quality of service during calls. A fault occurs when the result of a measurement of a QoS parameter crosses a predefined threshold. A success occurs when the result of a measurement of a QoS parameter does not cross a predefined threshold. The QoS parameters are measured during time intervals, starting when a call is established. The following parameters are supported:

- MediaAlarmLostPackets – monitors the number of lost IP packets during a call
- MediaAlarmJitter – monitors the jitter (as defined in RFC 1889) during IP transmission

QoS Attributes

The threshold for each QoS parameter is measured with the following six attributes:

- Threshold – defines when a QoS parameter is in a fault condition. A fault occurs when the result of a measurement of a QoS parameter crossed the Threshold value.
- DebounceOn – the time during which faults are measured (in msec., must be multiple of Interval)
- DebounceOff – the time during which successes are measured (in msec., must be multiple of Interval)
- Interval – the amount of time between two QoS parameter measurements (in multiples of 100 msec)
- Percent_Fail – used to detect failure condition, together with DebounceOn (expressed as a percentage of failures)
- Percent_Success – used to detect failure recovery, together with DebounceOff (expressed as a percentage of successes)

The default values are as follows:

QoS Type	Threshold	DebounceOn	DebounceOff	Interval	Percent_Fail	Percent_Success
Lost packets	20	10000	10000	1000	60	40
Jitter	60	20000	60000	5000	60	40

Sample Configuration File

```
#####
# IP Protocol :
#   The IP Protocol used for opening the IP Line devices, values: H323, SIP, both
#
# DTMFmode
#   possible options:
```



```
#          OutOfBand, inband, rfc2833
#
# Capability possibilities:
#   g711Alaw
#   g711Mulaw
#   gsm
#   gsmEFR
#   g723_5_3k
#   g723_6_3k
#   g729a
#   g729ab
#   t38UDPFax
#
# Note: if you want to run the demo with coder g729 use:
#   g729a for running with VAD disable
#   and 729ab for running with VAD enable
#
# Caution:
#   If capability is g711Alaw /Mulaw ==> FramesPerPkt = 10,20,30.
#                                           G711 frame per packet defines the packet size in
#                                           milliseconds
#   If capability is g723_5_3k / 6_3k ==> FramesPerPkt = 1, 2, 3 .
#                                           FrameSize isn't needed, default= 30ms.
#   If capability is gsm ==> FramesPerPkt = 1, 2, 3 .
#                                           FrameSize isn't needed, default= 20ms.
#   If capability is gsmEFR ==> FramesPerPkt = 1, 2, 3 .
#                                           FrameSize isn't needed, default= 20ms.
#   If capability is g729a ==> FramesPerPkt = 3, 4 .
#                                           FrameSize isn't needed, default= 10ms.
#                                           VAD disable, the VAD parameter is ignored
#   If capability is g729ab ==>FramesPerPkt = 3, 4 .
#                                           FrameSize isn't needed, default= 10ms.
#                                           VAD enable, the VAD parameter is ignored
#
#####

ipProtocolName = H323
DTMFmode = inBand
Channel = 1-120
{
  Capability
  {
    # TxType = g711Alaw
    # TxFramesPerPkt = 30
    # TxVAD = 0
    # RxType = g711Alaw
    # RxFramesPerPkt = 30
    # RxVAD = 0

    TxType = g711Mulaw
    TxFramesPerPkt = 20
    TxVAD = 0
    RxType = g711Mulaw
    RxFramesPerPkt = 20
    RxVAD = 0

    # TxType = t38UDPFax
  }
}
```

```
MediaAlarmLostPackets
{
    Threshold      = 20      # Threshold value
    DebounceOn     = 10000   # Threshold debounce ON
    DebounceOff    = 10000   # Threshold debounce OFF
    Interval       = 1000    # Threshold Time Interval (ms)
    PercentSuccess = 60      # Threshold Success Percent
    PercentFail    = 40      # Threshold Fail Percent
}

MediaAlarmJitter
{
    Threshold      = 60      # Threshold value
    DebounceOn     = 20000   # Threshold debounce ON
    DebounceOff    = 60000   # Threshold debounce OFF
    Interval       = 5000    # Threshold Time Interval (ms)
    PercentSuccess = 60      # Threshold Success Percent
    PercentFail    = 40      # Threshold Fail Percent
}

# MediaAlarmResetAlarmState = 0
}
```

3.2 Compiling and Linking

To compile the IP Media Server demo on a Windows system, use Microsoft* Visual Studio* 6.0 with Service Pack 5.

Set IPMediaServer as the active project and build.

This chapter discusses how to run the IP Media Server for HMP demo. It contains the following topics:

- Starting the Demo 19
- Demo Options 19
- Using the Demo 20
- Stopping the Demo 24

4.1 Starting the Demo

Browse to the executable at:

`$(INTEL_DIALOGIC_DIR)\Demos\IPMediaServer\Release\IPMediaServer.exe`

Select **Run** from the Start Menu. Click **OK** to run the IP Media Server for HMP demo using the default settings.

4.2 Demo Options

To specify certain options at run-time, launch the demo from a command line, using any of the switches listed in Table 1.

Table 1. Command Line Switches

Switch	Action	Default
-c<filename>	Configuration file name	-cIPMediaServer.cfg
-e<encoding type>	Sets the encoding type: <ul style="list-style-type: none"> • m – mu-law • a – A-law 	-em
-h or ?	Prints the command syntax to the screen	Off
-n<n>	Sets the number of channels	The lesser of Voice Devices or IP devices
-q	Activates Quality of Service	Disabled

Example

The following example shows how to launch the demo from a command line with options:

```
IPMediaServer -n64 -cmyconfig.cfg -ea
```

This command launches the demo with 64 channels, using the *myconfig.cfg* configuration file and A-law encoding.

4.3 Using the Demo

This section describes how to use the IP Media Server for HMP demo and contains the following topics:

- [Keyboard Commands](#)
- [Using the Media Server](#)

4.3.1 Keyboard Commands

The demo always waits for input from the keyboard. While the demo is running, you may enter any of the commands listed in Table 2.

Table 2. Runtime Keyboard Commands

Command	Function
q or Q or Ctrl+c	Terminates the application

4.3.2 Using the Media Server

The IP Media Server for HMP demo allows the caller to interact with a series of voice menus, using the telephone keypad to enter an option. Basic operations include playing a pre-recorded message, recording a new message, sending or receiving a fax, and barge-in for CSP. Each menu prompts the caller to select an action by pushing a key. The call state within which the menu is called is indicated by the square brackets. Figure 1 shows the voice prompt flow, grouping the prompts by feature (voice, fax, CSP).

Note: By default, the fax demo is turned off. This feature may be enabled when tested with T.38 capable IP endpoints. To do this, uncomment the line:

```
TxType = t38UDPFax
```

in the Capability section of the *IPMediaServer.cfg* file (or add the line if not present as a comment).

Main Menu [Main_Menu]

- 1 - Voice Mail
- 2 - Fax
- 3 - Conferencing (not supported in HMP 1.x)
- 4 - CSP Barge-in
- * - Quit

Voice Mail Menu [Voicemail_Menu]

- 1 - Record Message
- 2 - Listen to message from a mailbox
- * - Quit

Send Message Prompt [SendMsg_Menu]

Enter Mailbox Number - between 101 - 299

* - Quit

Start Record Prompt [Record_Menu]

2 - Start Record

Press 2 at end of message to stop recording (at end, Stop Record Prompt is played)

* - Quit

Stop Record Prompt [StopRec_Menu]

2 - Discard Message and re-record message to same mailbox

3 - Confirm Message [Save_Confirm]

4 - Listen to Message (and replay Stop Record Prompt)

* - Quit without saving

Confirm Message Saved [StopRec_Menu]

1 - Record a message

2 - Listen to a message from a mailbox

* - Quit

Listen to Message Prompt [ListenMsg_Menu]

Enter Mailbox Number - between 101 - 299 (Recorded message is played)

* - Quit

Stop Listen Prompt [Listening]

2 - Discard message and quit

* - Save message and quit

Fax Menu [Fax_Menu]

1 - Send fax (to the IP Media Server demo)

2 - Receive fax (sent from the IP Media Server demo)

* - Quit

Send Fax Prompt [Send_Fax_Menu]

Dial fax number - between 101 - 299

* - Quit

Fax Sent Prompt [Fax_Sent_Menu]

Announces that fax was sent and repeats Fax Menu:

- 1 - Send fax
- 2 - Receive fax
- * - Quit

Receive Fax Menu [Receive_Fax_Menu]

Dial fax number - between 101 - 299

- * - Quit

Fax Received Prompt [Fax_Received_Menu]

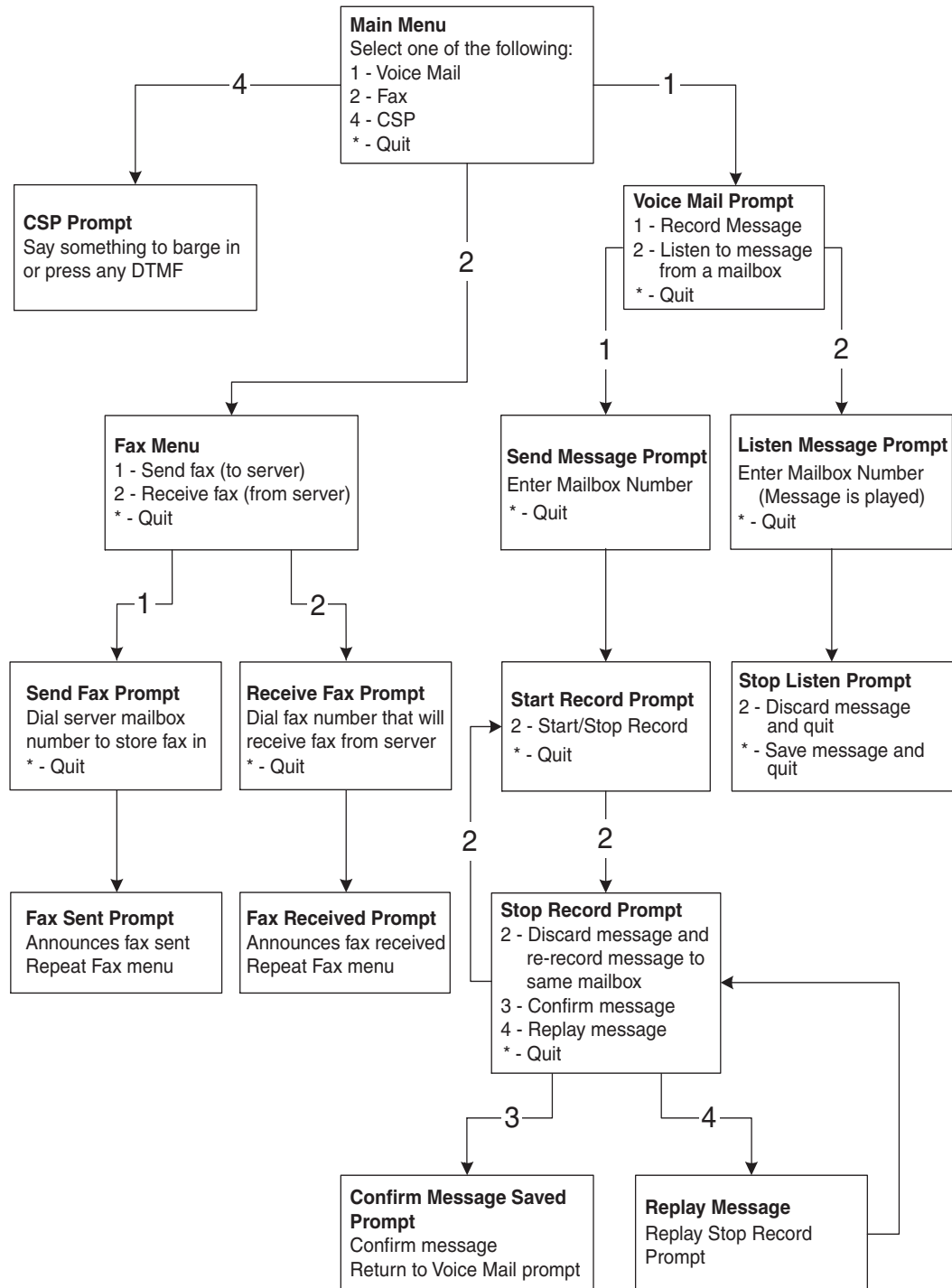
Announces that fax was received and repeats Fax Menu:

- 1 - Send fax
- 2 - Receive fax
- * - Quit

CSP Prompt [CSP_Menu]

Say something to barge in (new file will be created with barged-in message) or press any DTMF.

Figure 1. Demo Voice Menu Flowchart



4.4 Stopping the Demo

The IP Media Server demo runs until it is terminated. Press “q” or “Q” to terminate the demo application.

This chapter discusses the IP Media Server for HMP demo in more detail. It contains the following topics:

- [Files Used by the Demo](#) 25
- [Programming Model](#) 28
- [Threads](#) 40
- [Initialization](#) 40
- [Event Handling](#) 42
- [Typical Scenario](#) 43

5.1 Files Used by the Demo

This section lists the files used by the IP Media Server demo. It contains the following information

- [Demo Source Code Files](#)
- [PDL Files](#)

5.1.1 Demo Source Code Files

In Windows, the IP Media Server demo files listed in Table 3 are located within:
`$(INTEL_DIALOGIC_DIR)\Demos\IPMediaServer`

Table 3. Files in IPMediaServer Folder Used by the IP Media Server Demo

Sub-Directory (if any)	File Name	Purpose
	CConfig.cpp	Implements the operations of the Configuration class
	CConfig.h	Function prototype for config.cpp
	CEventRouter.cpp	Implements the operations of the EventRouter class
	CEventRouter.h	Function prototype for ceventrouter.cpp
	IPMediaServer.dsp	Visual C++ project file
	IPMediaServer.dsw	Visual C++ project workspace
	main.cpp	Contains the main function and the WaitForKey
	main.h	Function prototype for main.cpp
Release	200.tif	Sample fax file
Release	unavConf.vox	Voice file
Release	cspPrompt.vox	Voice file

Table 3. Files in IPMediaServer Folder Used by the IP Media Server Demo (Continued)

Sub-Directory (if any)	File Name	Purpose
Release	errorInput.vox	Voice file
Release	faxMenu.vox	Voice file
Release	faxReceived.vox	Voice file
Release	faxSent.vox	Voice file
Release	IPMediaServer.cfg	Demo configuration file
Release	IPMediaServer.exe	Demo executable
Release	listenMenu.vox	Voice file
Release	mainMenu.vox	Voice file
Release	receivefaxMenu.vox	Voice file
Release	saveCnfirm.vox	Voice file
Release	sendfaxMenu.vox	Voice file
Release	sendMsg.vox	Voice file
Release	startRec.vox	Voice file
Release	stopListen.vox	Voice file
Release	stopRec.vox	Voice file
Release	thankYou.vox	Voice file
Release	unavCsp.vox	Voice file
Release	unavFax.vox	Voice file
Release	unavMenu.vox	Voice file
Release	voicemailMenu.vox	Voice file

In Windows, the IP Media Server demo files listed in Table 4 are located within:
`$(INTEL_DIALOGIC_DIR)\Demos\IPMediaServer\Modules`

Table 4. Files in Modules Folder Used by the IP Media Server Demo

Sub-Directory	File Name	Purpose
common	Defines.h	Definitions and structures for the demo
common	Interfaces.h	Interfaces used in the demo
common	Parameters.h	Parameters used in the demo
FaxModule	CFaxDevice.cpp	Implements the operations of the CFaxDevice class
FaxModule	CFaxDevice.h	Function prototype for cfaxdevice.cpp
FaxModule	CFaxModule.cpp	Implements the operations of the CFaxModule class
FaxModule	CFaxModule.h	Function prototype for cfaxmodule.cpp
FaxModule	CFaxStateMachine.cpp	Implements the operations of the CFaxStateMachine class
FaxModule	CFaxStateMachine.h	Function prototype for cfaxstatemachine.cpp

Table 4. Files in Modules Folder Used by the IP Media Server Demo (Continued)

Sub-Directory	File Name	Purpose
FaxModule	FaxModule.dsp	Visual C++ project file
FaxModule\Release	FaxModule.lib	Compiled Fax Module library
IPModule	CIPDevice.cpp	Implements the operations of the CIPDevice class
IPModule	CIPDevice.h	Function prototype for cipdevice.cpp
IPModule	CIPMBoard.cpp	Implements the operations of the CIPMBoard class
IPModule	CIPMBoard.h	Function prototype for cipmboard.cpp
IPModule	CIPModule.cpp	Implements the operations of the CIPModule class
IPModule	CIPModule.h	Function prototype for cipmodule.cpp
IPModule	CIPStateMachine.cpp	Implements the operations of the CIPStateMachine class
IPModule	CIPStateMachine.h	Function prototype for cipstatemachine.cpp
IPModule	CIPTBoard.cpp	Implements the operations of the CIPTBoard class
IPModule	CIPTBoard.h	Function prototype for ciptboard.cpp
IPModule	CMediaAlarms.cpp	Implements the operations of the CMediaAlarms class
IPModule	CMediaAlarms.h	Function prototype for cmediaalarms.cpp
IPModule	IPModule.dsp	Visual C++ project file
IPModule\Release	IPModule.lib	Compiled IP Module library
VoiceModule	CCSPDevice.cpp	Implements the operations of the CCSPDevice class
VoiceModule	CCSPDevice.h	Function prototype for ccspdevice.cpp
VoiceModule	CMailBoxUtil.cpp	Implements the operations of the CMailBoxUtil class
VoiceModule	CMailBoxUtil.h	Function prototype for cmailboxutil.cpp
VoiceModule	CVoiceBoard.cpp	Implements the operations of the voiceBoard class
VoiceModule	CVoiceBoard.h	Function prototype for cvoiceboard.cpp
VoiceModule	CVoiceDevice.cpp	Implements the operations of the CVoiceDevice class
VoiceModule	CVoiceDevice.h	Function prototype for cvoicedevice.cpp
VoiceModule	CVoiceModule.cpp	Implements the operations of the CVoiceModule class
VoiceModule	CVoiceModule.h	Function prototype for cvoicemodule.cpp
VoiceModule	CVoiceStateMachine.cpp	Implements the operations of the CVoiceStateMachine class
VoiceModule	CVoiceStateMachine.h	Function prototype for cvoicestatemachine.cpp
VoiceModule	VoiceModule.dsp	Visual C++ project file
VoiceModule\Release	VoiceModule.lib	Compiled Voice Module library

5.1.2 PDL Files

In Windows, the PDL files listed in Table 5 are located within the directory:
`$(INTEL_DIALOGIC_DIR)\Demos\Shared\pdl_win`

Table 5. PDL Files Used by the IP Media Server Demo

Sub-Directory (if any)	File Name	Purpose
	iptransport.cpp	PDL IP transport functions
	iptransport.h	Function prototype for iptransport.cpp
	pdl.c	Platform dependency functions
	pdl.h	Function prototype for pdl.c
	pdl.ver	PDL version information
	pdl_win.dsp	PDL Visual C project file
	pdl_win.dsw	PDL Visual C project workspace
release	psl_win.lib	Compiled PDL library

5.2 Programming Model

This section describes the IP Media Server for HMP demo architecture in the following topics:

- [Module Structure](#)
- [EventRouter](#)
- [Interfaces](#)
- [Classes](#)

5.2.1 Module Structure

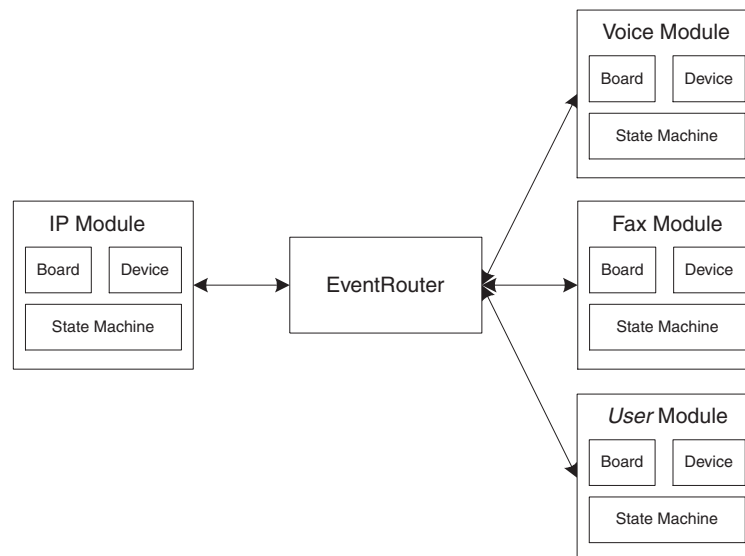
The IP Media Server for HMP demo uses a modular architecture, in which each technology (IP, voice, fax, CSP) is wrapped inside a module so that a particular technology can be easily added or removed.

The system contains three modules:

- IP module that serves as the front end to communicate with the IP network
- Voice module to provide voice service
- Fax module to provide fax service

The system also contains a software component, the EventRouter, to connect the modules. The basic architecture of the system is illustrated in Figure 2.

Figure 2. IP Media Server Demo Architecture



Each module is composed of four elements:

- Board
- Device
- State Machine (call control)
- Wrapper

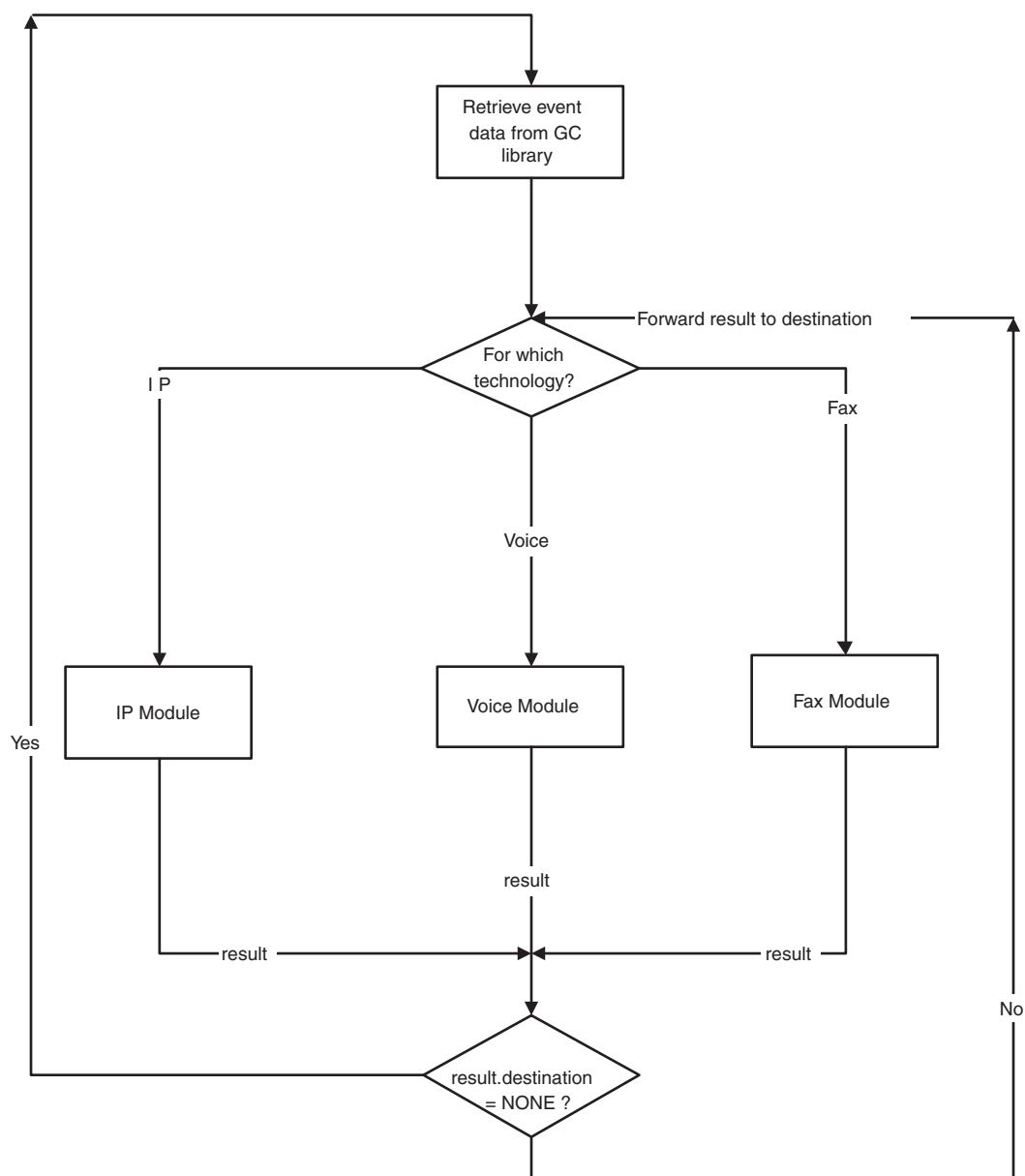
The Wrapper acts like a manager, receiving requests from the EventRouter and distributing the request to the boards or devices. A device can have one or multiple state machines attached to it. Each state machine represents one call.

5.2.2 EventRouter

The EventRouter is responsible for communicating with the modules. It does the following:

- Maintains routing tables
- Retrieves event data from the SRL and routes it to a module for processing
- Forwards event process result to another module if so requested.

Figure 3. EventRouter



5.2.3 Interfaces

The modular architecture implements a unified interface that allows replacement of modules by including new header files and adjusting routing statements.

A module is treated by the EventRouter as a block box. It has three types of APIs:

Initialization

- **Init()** – for initializing a module
- **GetNumOfDevices()** – returns the number of devices available to the application
- **GetDeviceHandle()** – returns a device handle
- **GetDeviceXmitSlot()** – returns a device transmit timeslot
- **SetDeviceReceiveSlot()** – sets a device receive timeslot

Runtime

- **ProcessEvent()** – processes event data

Termination

- **Exit()** – exits a module

5.2.4 Classes

This section describes the classes contained in the demo and within each module. Each module contains three classes: board, device, and state machine.

Table 6. Application Classes

Class Name	Interface
CConfig <ul style="list-style-type: none"> • Responsible for parsing configuration file and populating configuration variables in the program. 	ParseConfigFile() <ul style="list-style-type: none"> • Parses configuration file
	ChannelNumber() <ul style="list-style-type: none"> • Gets the number of channels that are the minimum of the number of voice lines and the number of IP lines
	IPParms() <ul style="list-style-type: none"> • Returns configured IP parameters
	VoiceParms() <ul style="list-style-type: none"> • Returns configured voice parameters
	FaxParms() <ul style="list-style-type: none"> • Returns configured fax parameters
CEventRouter <p>Responsible for connecting all the modules. It does the following:</p> <ul style="list-style-type: none"> • Maintains routing tables • Retrieves event data from the SRL and routes them to modules • Gets event process results from the modules and routes them to other modules if the destination is not NONE 	Init() <ul style="list-style-type: none"> • Initializes the fax module, voice module, and IP module • Builds event routing tables
	Exit() <ul style="list-style-type: none"> • Terminates the IP module, voice module, and fax module
	ProcessEvent() <ul style="list-style-type: none"> • Retrieves event data from Global Call and routes them to a module for processing • Routes processing result to other module(s) for further processing.

Table 7. IP Module Classes

Category	Class Name	Interface
Module	CIPModule <ul style="list-style-type: none"> Interacts with CIPBoard and CIPDevice. Exports IP module functions to CEventRouter. Note: The public functions in this class can be accessed by classes outside the IP module.	Init() <ul style="list-style-type: none"> Starts host based IP protocol Creates and initializes IPT (virtual) board objects Creates and initializes IPM (media) board objects Creates and initializes IP device objects
		Exit() <ul style="list-style-type: none"> Terminates and closes IPT boards Terminates and closes IPM boards Terminates and closes IP devices
		ProcessEvent() <ul style="list-style-type: none"> Receives event data from the event router and distributes them, based on handles, to IPT boards, IPM boards or IP devices
		GetNumOfDevices() <ul style="list-style-type: none"> Returns number of IP devices engaging in the communication
		GetDeviceHandle() <ul style="list-style-type: none"> Returns an IP device handle
		GetDeviceXmitSlot() <ul style="list-style-type: none"> Returns the transmit timeslot of an IP device
		SetDeviceReceiveSlot() <ul style="list-style-type: none"> Sets the receiving timeslot of an IP device

Table 7. IP Module Classes (Continued)

Category	Class Name	Interface
Board	CIPBoard <ul style="list-style-type: none"> Interacts with the Global Call library to handle IP virtual boards Note: The public function in this class should only be accessed by classes inside the IP module.	Init() <ul style="list-style-type: none"> Opens IPT (virtual) board and sets board parameters
		Exit() <ul style="list-style-type: none"> Closes IPT (virtual) board
		ProcessEvent() <ul style="list-style-type: none"> Processes IPT (virtual) board events
		GetNumOfDevicesOnBoard() <ul style="list-style-type: none"> Returns the number of IPT devices (signaling devices) on the board
	CIPMBoard <ul style="list-style-type: none"> Interacts with the Global Call library to handle IP media boards Note: The public functions in this class should only be accessed by classes inside the IP module.	Init() <ul style="list-style-type: none"> Opens IP media boards
		Exit() <ul style="list-style-type: none"> Closes IP media boards
		ProcessEvent() <ul style="list-style-type: none"> Processes IP media board events
		GetNumOfDevices() <ul style="list-style-type: none"> Returns number of IPM devices on the board

Table 7. IP Module Classes (Continued)

Category	Class Name	Interface
Device	CIPDevice <ul style="list-style-type: none"> Handles IP device operations, such as making/dropping calls, sending H.323 messages, making timeslot connections, etc. Holds CIPStateMachine (or call control) Note: The public functions in this class should only be accessed by classes inside the IP module.	Init() <ul style="list-style-type: none"> Opens an IP device. If successful, creates an IP state machine. If QoS is enabled, creates a media alarm object.
		Exit() <ul style="list-style-type: none"> Deletes IP state machine Deletes media alarm object Closes IP devices
		ProcessEvent() <ul style="list-style-type: none"> Processes IP device events
		Connect() <ul style="list-style-type: none"> Allows IP device to listen to its receiving timeslot
		Disconnect() <ul style="list-style-type: none"> Allows IP device to unlisten to its receiving timeslot
		GetDeviceHandle() <ul style="list-style-type: none"> Returns IP device handle
		GetXmitSlot() <ul style="list-style-type: none"> Returns IP device transmit timeslot
		SetDeviceReceiveSlot() <ul style="list-style-type: none"> Sets IP device receiving timeslot
		SetFaxHandle() <ul style="list-style-type: none"> Sets fax device handle associated with the device
		GetFaxHandle() <ul style="list-style-type: none"> Returns fax device handle associated with the device
State Machine	CIPStateMachine <ul style="list-style-type: none"> Handles IP events and maintains IP state machine(s) Note: The public functions in this class should only be accessed by the classes inside the IP module.	Init() <ul style="list-style-type: none"> Initializes the IP state machine
		Exit() <ul style="list-style-type: none"> Terminates the IP state machine
		ProcessEvent() <ul style="list-style-type: none"> Processes IP call events

Table 8. Voice Module Classes

Category	Class Name	Interface
Module	CVoiceModule <ul style="list-style-type: none"> Interacts with CVoiceBoard and CVoiceDevice. Exports Voice module functions to CEventRouter. Note: The public functions in this class can be accessed by classes outside the Voice module.	Init() <ul style="list-style-type: none"> Opens and initializes voice board objects Opens and initializes voice device objects
		Exit() <ul style="list-style-type: none"> Terminates and closes voice boards Terminates and closes voice devices
		ProcessEvent() <ul style="list-style-type: none"> Receives event data from the event router and distributes them, based on devicehandles, to voice boards or voice devices for processing
Board	CVoiceBoard <ul style="list-style-type: none"> Interacts with the voice library to handle voice boards Note: The public function in this class should only be accessed by classes inside the Voice module.	Init() <ul style="list-style-type: none"> Opens voice board
		Exit() <ul style="list-style-type: none"> Closes voice board
		ProcessEvent() <ul style="list-style-type: none"> Processes voice board events

Table 8. Voice Module Classes (Continued)

Category	Class Name	Interface
Device	CVoiceDevice <ul style="list-style-type: none"> Handles voice device operations, such as playing, recording, tone detection, and tone generation Holds CVoiceStateMachine Note: The public functions in this class should only be accessed by classes inside the Voice module.	Init() <ul style="list-style-type: none"> Opens the voice device. If successful, creates voice state machine.
		Exit() <ul style="list-style-type: none"> Deletes the voice state machine from the voice device Closes voice device
		ProcessEvent() <ul style="list-style-type: none"> Processes voice device events
		Connect() <ul style="list-style-type: none"> Allows IP device to listen to its receiving timeslot
		Play() <ul style="list-style-type: none"> Plays a vox file
		OnPlayComplete() <ul style="list-style-type: none"> Replays a vox file when it has finished playing
		Record() <ul style="list-style-type: none"> Records voice to a vox file
		GetDigits() <ul style="list-style-type: none"> Retrieves DTMF digits
		GetDigitCount() <ul style="list-style-type: none"> Returns the number of retrieved DTMF digits
		GetDigitString() <ul style="list-style-type: none"> Returns retrieved DTMF string
		Connect() <ul style="list-style-type: none"> Allows the voice device to listen to its receiving timeslot
		Disconnect() <ul style="list-style-type: none"> Allows voice device to unlisten to its receiving timeslot
		GetStoppedReason() <ul style="list-style-type: none"> Tells why a played voice file stops
		GetDeviceHandle() <ul style="list-style-type: none"> Returns voice device handle
		GetXmitSlot() <ul style="list-style-type: none"> Returns voice device transmit timeslot
		SetReceiveSlot() <ul style="list-style-type: none"> Sets voice device receiving timeslot

Table 8. Voice Module Classes (Continued)

Category	Class Name	Interface
State Machine	CVoiceStateMachine <ul style="list-style-type: none"> Handles voice events and maintains voice state machine(s) Note: The public functions in this class should only be accessed by the classes inside the voice module.	Init() <ul style="list-style-type: none"> Opens vox files Creates mailbox utility object that manages mailboxes
		Exit() <ul style="list-style-type: none"> Closes vox files Deletes mailbox utility object that manages mailboxes
		ProcessEvent() <ul style="list-style-type: none"> Processes voice events
Misc	CMailBoxUtil <ul style="list-style-type: none"> Provides utility function to manage mailboxes Note: The public functions in this class should only be accessed by the classes inside the voice module	InitMailBoxes() <ul style="list-style-type: none"> Initializes mailboxes
		CheckAndConvertDigits() <ul style="list-style-type: none"> Checks if the extension number is in allowed range. If it is, converts it into an integer.
		GetMailBox() <ul style="list-style-type: none"> Checks if the mailbox is ready to be used. If it is, gets the mailbox.
		CreateMailBoxFileName() <ul style="list-style-type: none"> Creates a filename for the mailbox
		FreeMailBox() <ul style="list-style-type: none"> Frees the mailbox for future use

Table 9. Fax Module Classes

Category	Class Name	Interface
Module	CFaxModule <ul style="list-style-type: none"> Interacts with CFaxDevice. Exports Fax module functions to CEventRouter. Note: The public functions in this class can be accessed by classes outside the Fax module.	Init() <ul style="list-style-type: none"> Creates fax device objects
		Exit() <ul style="list-style-type: none"> Deletes fax device objects
		GetNumOfDevices() <ul style="list-style-type: none"> Gets the number of fax resources
		GetDeviceHandle() <ul style="list-style-type: none"> Returns fax device handle
		TSUserEventProcessEvent() <ul style="list-style-type: none"> Processes fax events from the Global Call library
		ProcessEvent() <ul style="list-style-type: none"> Processes the events from the other modules

Table 9. Fax Module Classes (Continued)

Category	Class Name	Interface
Board	CFaxBoard <ul style="list-style-type: none">• Interacts with the fax library to handle fax boards• The public function in this class should only be accessed by classes inside the Fax module	Init() <ul style="list-style-type: none">• Open fax board.
		Exit() <ul style="list-style-type: none">• Close fax board.
		ProcessEvent() <ul style="list-style-type: none">• Processes fax board events.

Table 9. Fax Module Classes (Continued)

Category	Class Name	Interface
Device	CFaxDevice <ul style="list-style-type: none"> Handles fax device operations, such as sending fax, receiving fax, etc. Holds CFaxStateMachine Note: The public functions in this class should only be accessed by classes inside the Fax module.	Init() <ul style="list-style-type: none"> Opens the fax device. If successful, creates fax state machine.
		Exit() <ul style="list-style-type: none"> Deletes the fax state machine from the fax device Closes fax device
		SetIott() <ul style="list-style-type: none"> Sets up iott for the fax file
		SetFaxState() <ul style="list-style-type: none"> Sets initial fax state before fax transmission
		SendFax() <ul style="list-style-type: none"> Starts to send a fax file
		RecvFax() <ul style="list-style-type: none"> Starts to receive a fax file
		OpenFaxFile() <ul style="list-style-type: none"> Gets fax file handle
		CloseFaxFile() <ul style="list-style-type: none"> Closes fax file handle
		GetDeviceHandle() <ul style="list-style-type: none"> Returns fax device handle
		ToLower_String() <ul style="list-style-type: none"> Converts a string from uppercase to lowercase
		SetFaxFileName() <ul style="list-style-type: none"> Names the fax file to be sent or received
		GetFaxFileName() <ul style="list-style-type: none"> Returns the name of the fax file
		SetNeighborHandle() <ul style="list-style-type: none"> Sets IP device handle that is currently connected with the fax device
		GetNeighborHandle() <ul style="list-style-type: none"> Gets IP device handle that is currently connected with the fax device
		GetFaxStateMachineObject() <ul style="list-style-type: none"> Returns fax state machine object

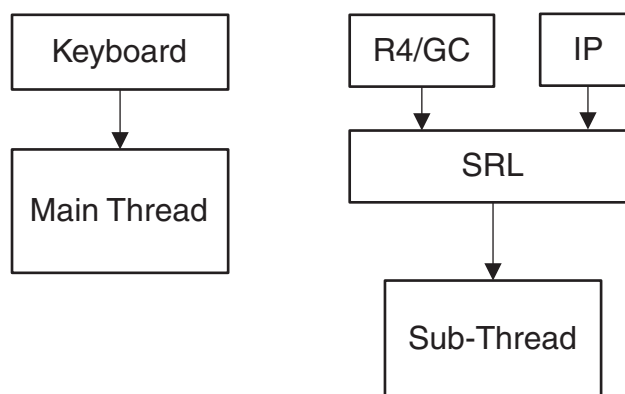
Table 9. Fax Module Classes (Continued)

Category	Class Name	Interface
State Machine	CFaxStateMachine <ul style="list-style-type: none"> Handles fax events and maintains fax state machine Note: The public functions in this class should only be accessed by the classes inside the fax module.	Init() <ul style="list-style-type: none"> Initializes fax state machine
		Exit() <ul style="list-style-type: none"> Terminates fax state machine
		ProcessEvent() <ul style="list-style-type: none"> Processes fax events

5.3 Threads

The IP Media Server for HMP demo operates with two threads, as shown in Figure 4.

Figure 4. IP Media Server Demo Threads



The threads are created as follows:

1. The first (main) thread is created by the demo application to get the keyboard input.
2. The second thread is an SRL thread, created as a result of the demo application calling **PDLsr_enblhdlr()**. All Global Call events are received through the SRL.

5.4 Initialization

This section describes the IP Media Server for HMPdemo initialization as shown in Figure 5.

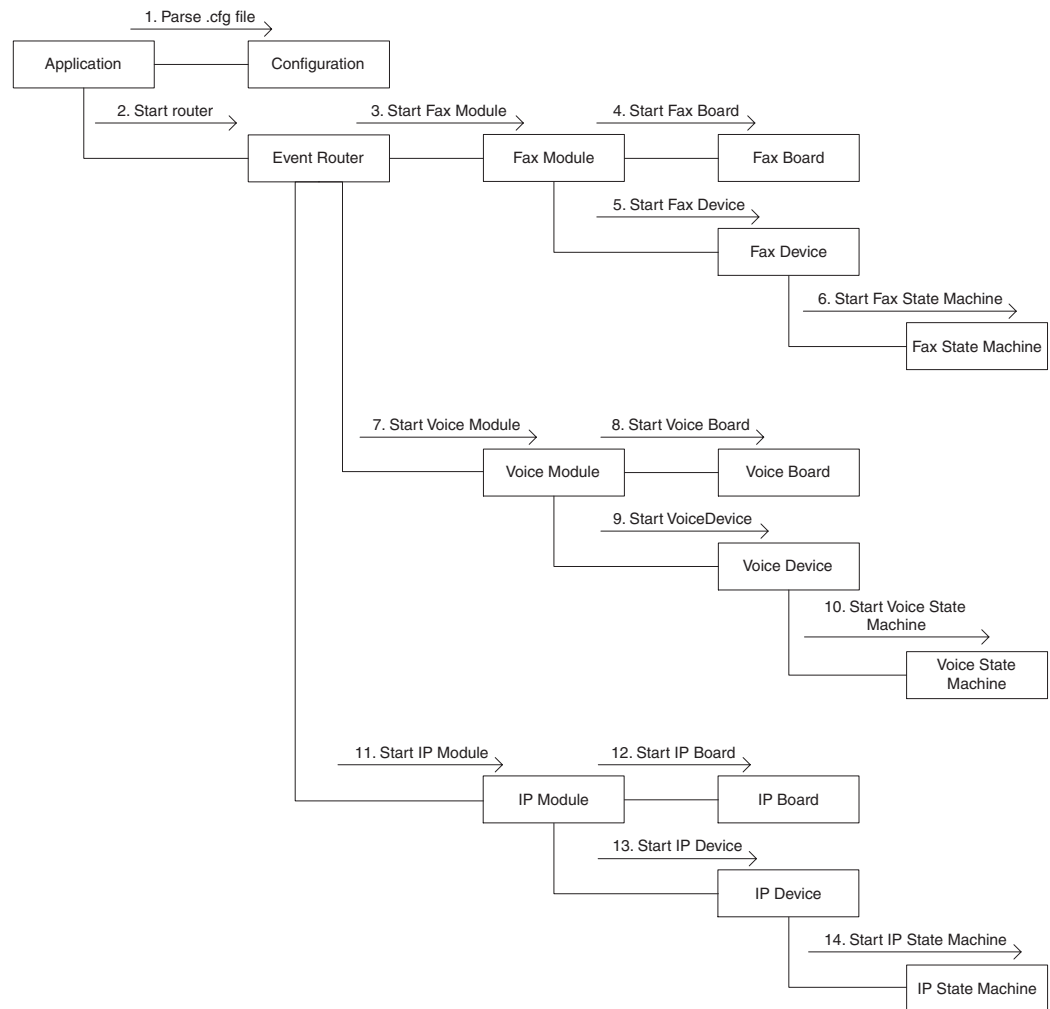
A system is started in the following sequence:

1. The application creates **CConfig()** to parse the configuration file.
2. The application creates **CEventRouter()** to start the Event Router, which, in turn, starts the Fax module, the Voice module, and the IP module. When a module is started, it initializes its boards, devices and state machines.

After all the modules are started, the EventRouter starts to build a static routing table that maps voice devices to IP devices. It is important that each IP device has a dedicated voice resource, so that when an IP channel is connected (an incoming call is answered) the user can get a voice prompt immediately.

If the initialization should fails, the application shuts down. The shutdown sequence is the reverse of the initialization sequence.

Figure 5. System Initialization



5.5 Event Handling

This section describes how the IP Media Server for HMP demo handles events. It contains the following topics:

- [Event Mechanism](#)
- [Handling Keyboard Input Events](#)
- [Handling SRL Events](#)
- [Handling Application Exit Events](#)
- [TSUsrEvent Structure](#)

5.5.1 Event Mechanism

The IP Media Server demo uses the SRL mechanism to retrieve events. When an event occurs, SRL calls event handlers automatically. All events are received by the SRL and then passed to the **CallbackHdlr()** function for handling.

In the initialization phase of the demo, the **main()** function sets up the call-back handler, by calling **PDLsr_enbhdlr()**.

5.5.2 Handling Keyboard Input Events

There is an endless loop **{while(0)}** in the **main()** function in the *Main.cpp* file. In that loop, the application waits forever for a keyboard event by calling the **waitForKey()** function. The event must be handled immediately and event-specific information should be retrieved before the next call to **waitForKey()**.

5.5.3 Handling SRL Events

When the R4/Global Call event is received, the application performs the following:

1. Get METAEVENT by calling **gc_GetMetaEvent()**.
2. Get channel ID through device handle to channel mapping.
3. Get device type through device handle to type mapping.
4. Route meta event to the module specified by device type.

5.5.4 Handling Application Exit Events

Normal application exit events, such as pressing either q or Q, don't enter the SRL. The **main()** function calls **PDLSetApplicationExitPath()** before initialization. In Windows, this function enables the detection of CTRL_CLOSE_EVENT (closing the window).

5.5.5 TSUsrEvent Structure

The TSUsrEvent structure is used by the demo modules to return event processing results to the event router.

The TSUserEvt structure is defined as follows:

```
typedef struct
{
    int          event;
    TDeviceType destination;
    int          lineDevice;
    long         xmitSlot;
    long         neighborDevice;
    char         dialString[MAX_STRING_LENGTH]
} TSUserEvent;
```

The fields of the TSUserEvt structure are described as follows:

event

the name of a user-defined event, such as `USR_CONNECTED`, `USR_SENDFAX`, etc.

destination

the name of the module that this event is destined for. Possible values are `IP`, `VOICE`, `FAX`, or `NONE`.

lineDevice

the device handle in this module. It will be later used by the Event Router as an index to find its counterpart in the destination module.

xmitSlot

an integer that normally indicates a time slot number

neighborDevice

the neighbor device handle

dialString

a char string that is normally filled with a DTMF dialing string

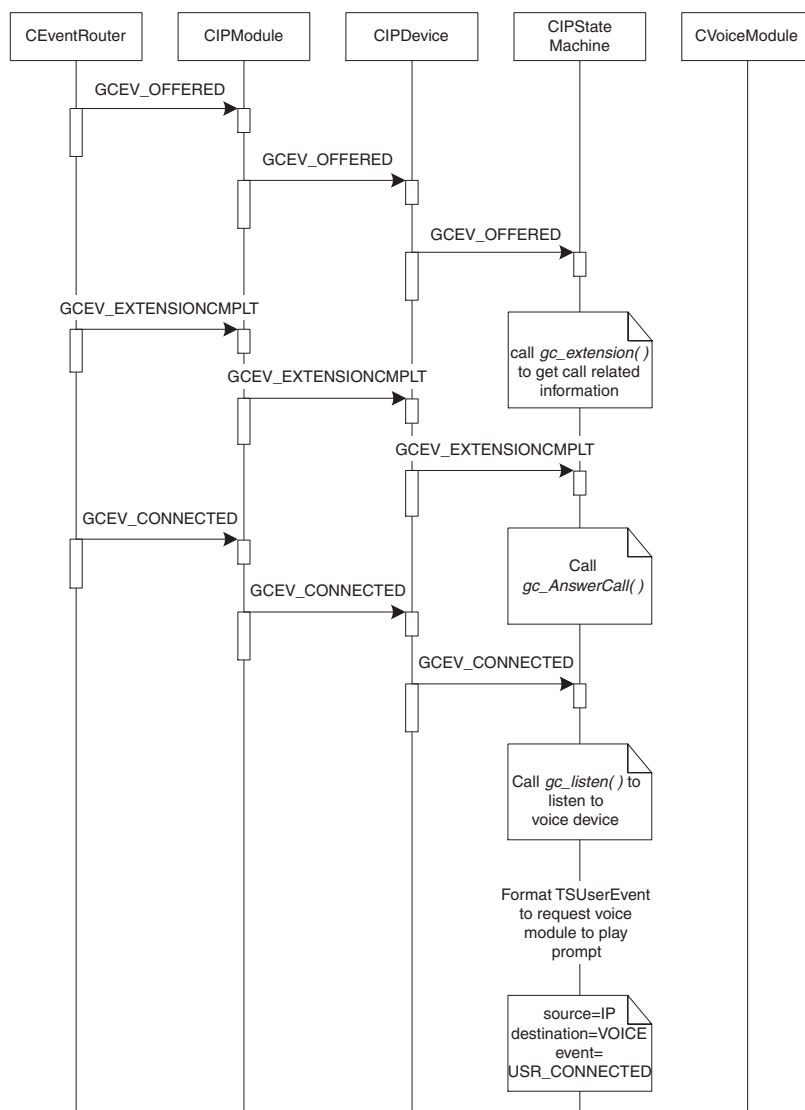
5.6 Typical Scenario

This section describes a typical scenario for sending a fax, which involves all the IP Media Server demo modules.

Call Offered

When an incoming call is received by the server, the IP module answers the call until the call is connected.

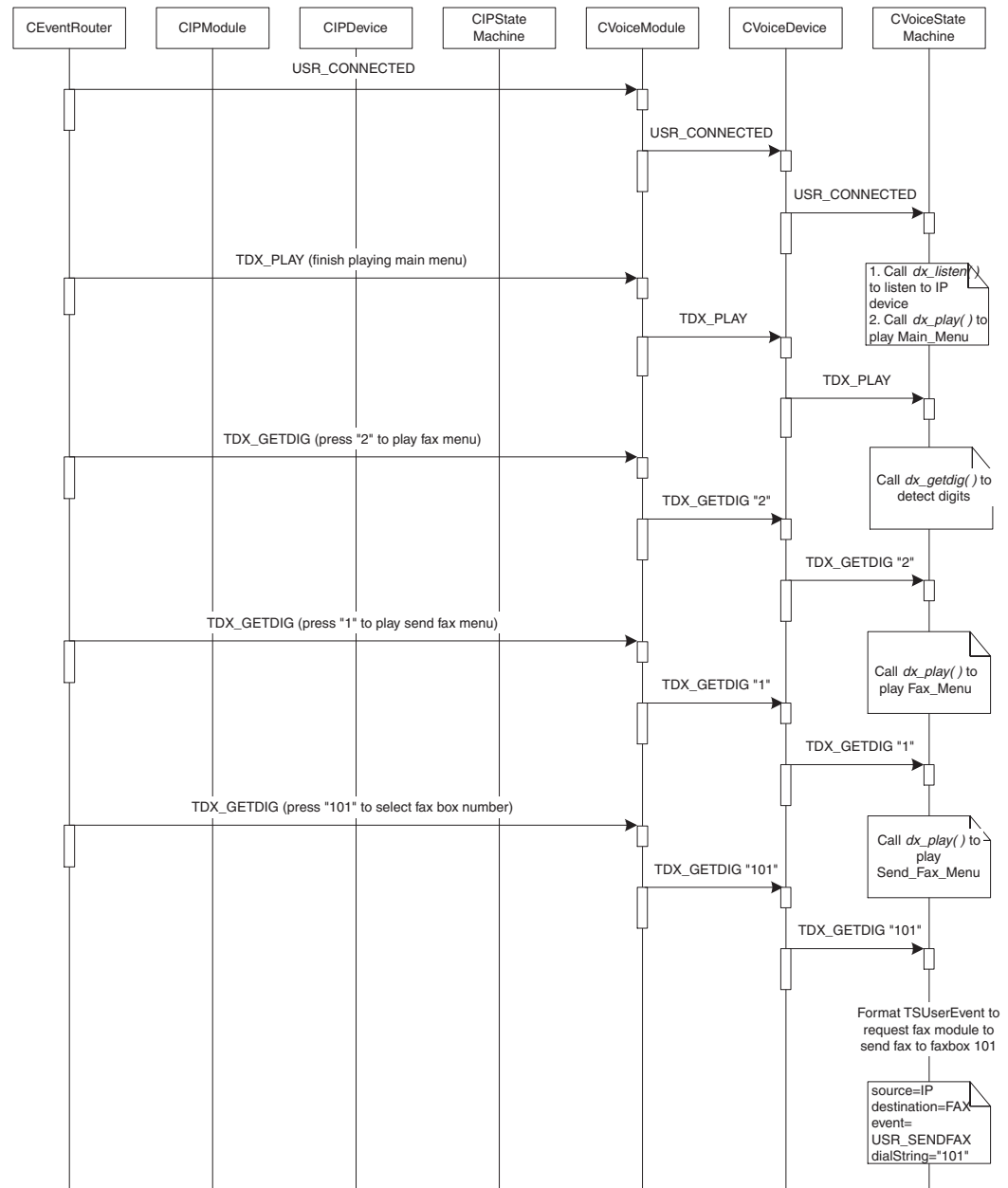
Figure 6. Typical Scenario: Call Offered



Play Prompts

After the call is connected, the Voice module is notified to play prompts and accept DTMF.

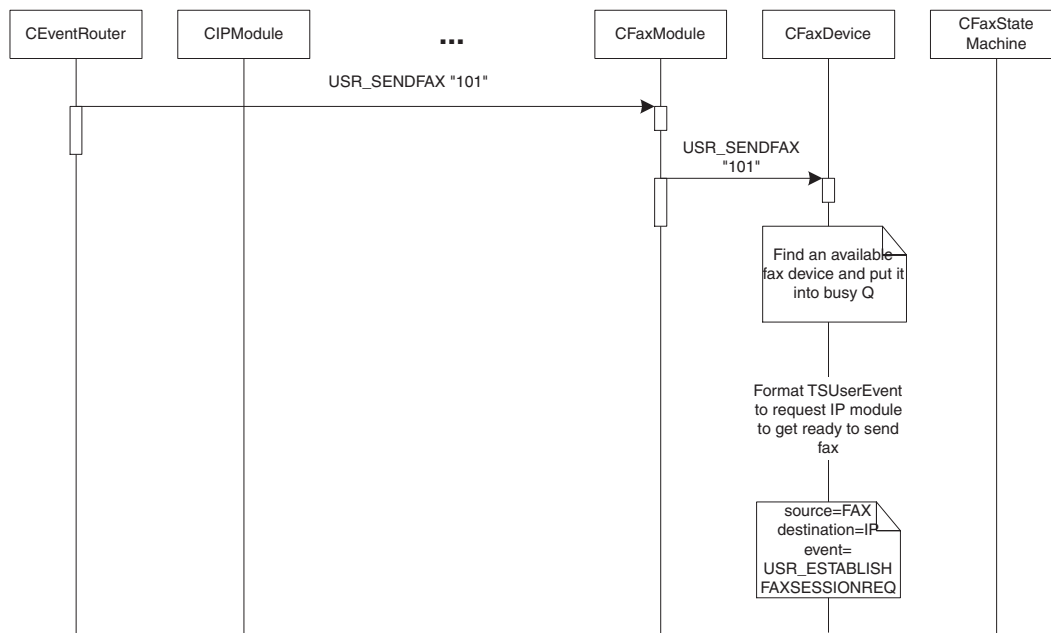
Figure 7. Typical Scenario: Play Prompts



Fax Mailbox

The user selects to send a fax to mailbox “101”. The Fax module is requested to send a fax.

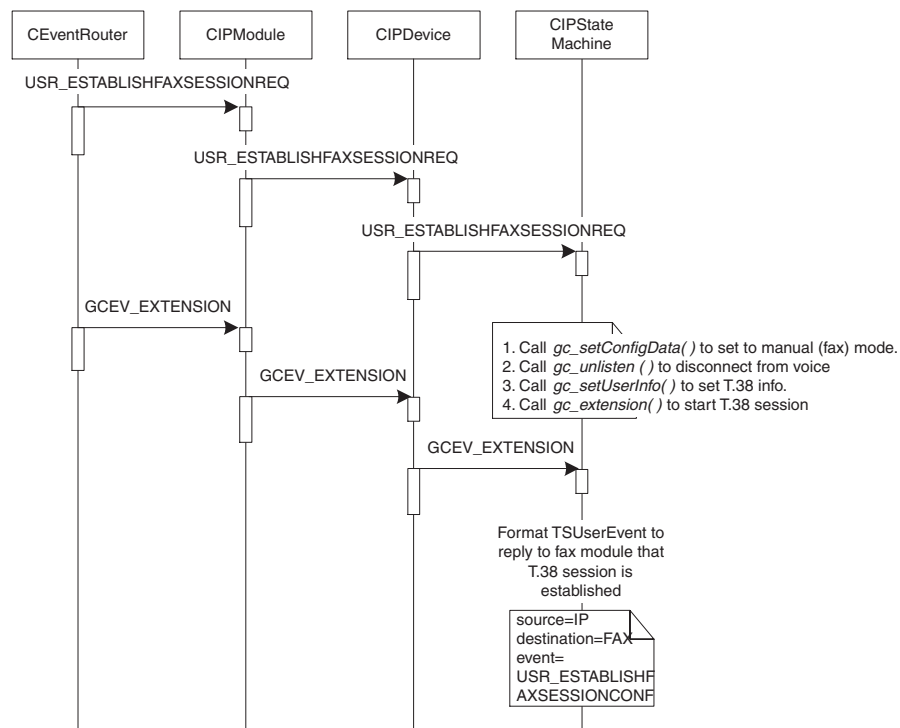
Figure 8. Typical Scenario: Fax Mailbox



Establish Fax Session

The Fax module requests the front end to get ready to send a fax. If the front end is IP, it should first move from an RTP port to a UDP port in order to send a fax.

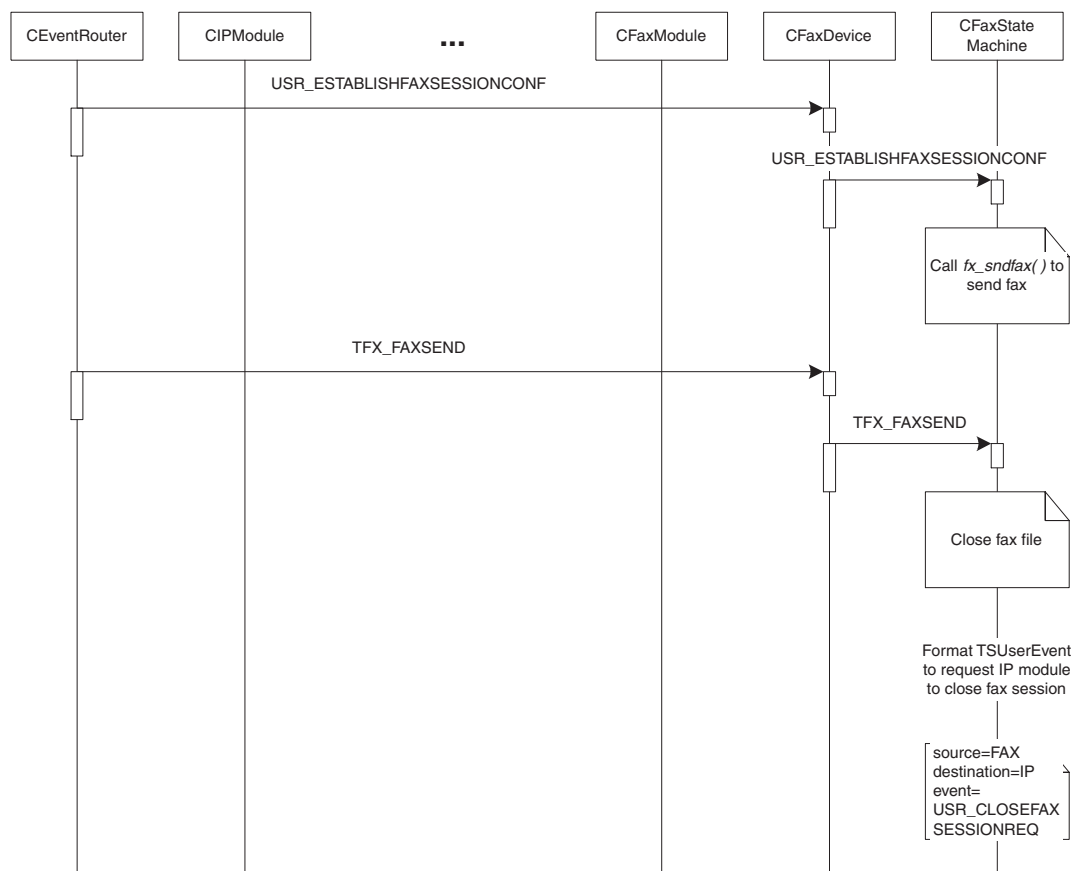
Figure 9. Typical Scenario: Establish Fax Session



Fax Session Established

The Fax module gets a reply from the front end that the fax session has been established.

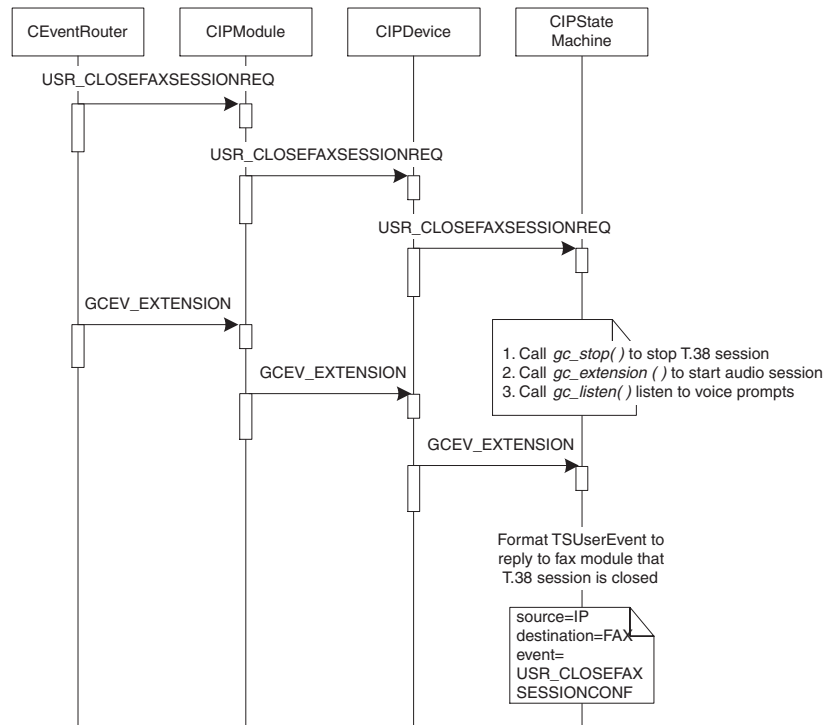
Figure 10. Typical Scenario: Fax Session Established



Fax Sent

The fax is sent. The front end is requested to close the fax session.

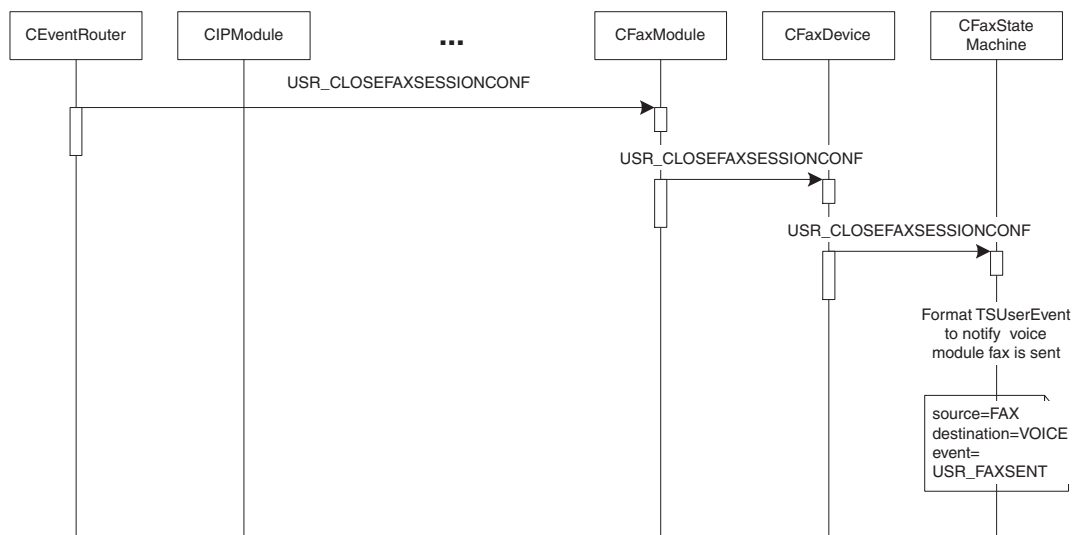
Figure 11. Typical Scenario: Fax Sent



Fax Session Closed

The Fax module gets a reply from the front end that the fax session has been closed.

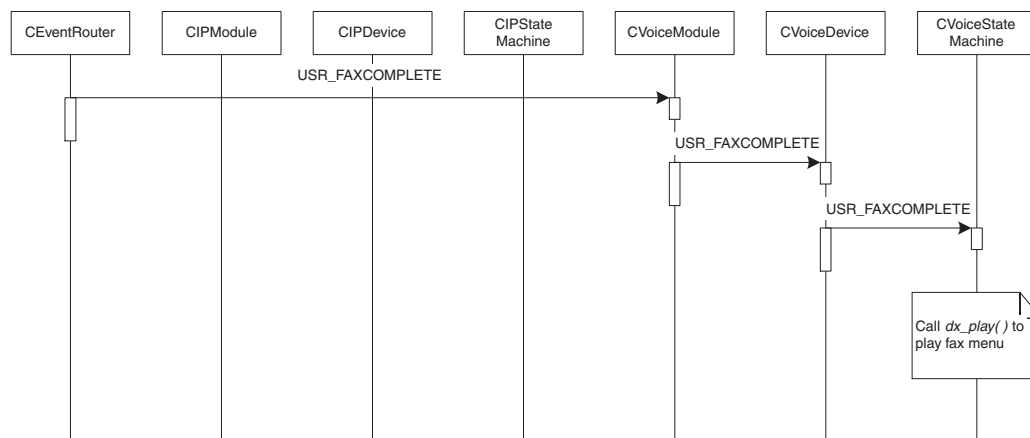
Figure 12. Typical Scenario: Fax Session Closed



Fax Complete

The Voice module gets a reply from the Fax module that a fax has been sent.

Figure 13. Typical Scenario: Fax Complete





Glossary

Codec: see COder/DECoder

COder/DECoder: A circuit used to convert analog voice data to digital and digital voice data to analog audio.

Computer Telephony (CT): Adding computer intelligence to the making, receiving, and managing of telephone calls.

DTMF: Dual-Tone Multi-Frequency

Dual-Tone Multi-Frequency: A way of signaling consisting of a push-button or touch-tone dial that sends out a sound consisting of two discrete tones that are picked up and interpreted by telephone switches (either PBXs or central offices).

Emitting Gateway: called by a G3FE. It initiates IFT service for the calling G3FE and connects to a Receiving Gateway.

E1: The 2.048 Mbps digital carrier system common in Europe.

FCD file: An ASCII file that lists any non-default parameter settings that are necessary to configure a DM3 hardware/firmware product for a particular feature set. The downloader utility reads this file, and for each parameter listed generates and sends the DM3 message necessary to set that parameter value.

Frame: A set of SCbus/CT Bus timeslots which are grouped together for synchronization purposes. The period of a frame is fixed (at 125 μ sec) so that the number of time slots per frame depends on the SCbus/CT Bus data rate.

G3FE: Group 3 Fax Equipment. A traditional fax machine with analog PSTN interface.

Gatekeeper: An H.323 entity on the Internet that provides address translation and control access to the network for H.323 Terminals and Gateways. The Gatekeeper may also provide other services to the H.323 terminals and Gateways, such as bandwidth management and locating Gateways.

Gateway: A device that converts data into the IP protocol. It often refers to a voice-to-IP device that converts an analog voice stream, or a digitized version of the voice, into IP packets.

H.323: A set of International Telecommunication Union (ITU) standards that define a framework for the transmission of real-time voice communications through Internet protocol (IP)-based packet-switched networks. The H.323 standards define a gateway and a gatekeeper for customers who need their existing IP networks to support voice communications.

IAF: Internet Aware Fax. The combination of a G3FE and a T.38 gateway.

IFP: Internet Facsimile Protocol

IFT: Internet Facsimile Transfer

International Telecommunications Union (ITU): An organization established by the United Nations to set telecommunications standards, allocate frequencies to various uses, and hold trade shows every four years.

Internet: An inter-network of networks interconnected by bridges or routers. LANs described in H.323 may be considered part of such inter-networks.

Internet Protocol (IP): The network layer protocol of the transmission control protocol/Internet protocol (TCP/IP) suite. Defined in STD 5, Request for Comments (RFC) 791. It is a connectionless, best-effort packet switching protocol.

Internet Service Provider (ISP): A vendor who provides direct access to the Internet.

Internet Telephony: The transmission of voice over an Internet Protocol (IP) network. Also called Voice over IP (VoIP), IP telephony enables users to make telephone calls over the Internet, intranets, or private Local Area Networks (LANs) and Wide Area Networks (WANs) that use the Transmission Control Protocol/Internet Protocol (TCP/IP).

ITU: See International Telecommunications Union.

Jitter: The deviation of a transmission signal in time or phase. It can introduce errors and loss of synchronization in high-speed synchronous communications.

NIC (Network Interface Card): Adapter card inserted into computer that contains necessary software and electronics to enable a station to communicate over network.

PCD file: An ASCII text file that contains product or platform configuration description information that is used by the DM3 downloader utility program. Each of these files identifies the hardware configuration and firmware modules that make up a specific hardware/firmware product. Each type of DM3-based product used in a system requires a product-specific PCD file.

PSTN: see Public Switched Telephone Network

Public Switched Telephone Network: The telecommunications network commonly accessed by standard telephones, key systems, Private Branch Exchange (PBX) trunks and data equipment.

Reliable Channel: A transport connection used for reliable transmission of an information stream from its source to one or more destinations.

Reliable Transmission: Transmission of messages from a sender to a receiver using connection-mode data transmission. The transmission service guarantees sequenced, error-free, flow-controlled transmission of messages to the receiver for the duration of the transport connection.

RTCP: Real Time Control Protocol

RTP: Real Time Protocol

SIP: Session Initiation Protocol: an Internet standard specified by the Internet Engineering Task Force (IETF) in RFC 3261. SIP is used to initiate, manage, and terminate interactive sessions between one or more users on the Internet.



T1: A digital transmission link with a capacity of 1.544 Mbps used in North America. Typically channeled into 24 digital subscriber level zeros (DS0s), each capable of carrying a single voice conversation or data stream. T1 uses two pairs of twisted pair wires.

TCP: see Transmission Control Protocol

Terminal: An H.323 Terminal is an endpoint on the local area network which provides for real-time, two-way communications with another H.323 terminal, Gateway, or Multipoint Control Unit. This communication consists of control, indications, audio, moving color video pictures, and/or data between the two terminals. A terminal may provide speech only, speech and data, speech and video, or speech, data, and video.

Transmission Control Protocol: The TCP/IP standard transport level protocol that provides the reliable, full duplex, stream service on which many application protocols depend. TCP allows a process on one machine to send a stream of data to a process on another. It is connection-oriented in the sense that before transmitting data, participants must establish a connection.

UDP: see User Datagram Protocol

UDPTL: Facsimile UDP Transport Layer protocol

User Datagram Protocol: The TCP/IP standard protocol that allows an application program on one machine to send a datagram to an application program on another machine. Conceptually, the important difference between UDP datagrams and IP datagrams is that UDP includes a protocol port number, allowing the sender to distinguish among multiple destinations on the remote machine.

VAD: Voice Activity Detection

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