



Overview of ISDN Voice Interfaces

This chapter provides an overview of ISDN Basic Rate Interface (BRI) and Primary Rate Interface (PRI) for support of voice traffic. With those ports so configured, you can do the following:

- Bypass PSTN tariffed services such as trunking and administration.
- Connect your PBXs directly to a Cisco router and route PBX station calls automatically to the WAN.
- Configure a voice interface on a Cisco router to emulate either a terminal-equipment (TE) or network-termination (NT) interface. All types of PBXs can send calls through a router and deliver those calls across the customer network.
- Configure Layer 2 operation as point-to-point (static terminal endpoint identifier [TEI]) or point-to-multipoint (automatic TEI).

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Prerequisites for Configuring ISDN Voice Interfaces

- Obtain PRI or BRI service and T1 or E1 service from your service provider, as required. Ensure that the BRI lines are provisioned at the switch to support voice calls.
- Establish a working IP, Frame Relay, or ATM network. Ensure that at least one network module or WAN interface card is installed in the router to provide connection to the LAN or WAN.
- Complete your company's dial plan.
- Establish a working telephony network based on your company's dial plan and configure the network for real-time voice traffic. This chapter describes only a portion of the process; for further information, see the chapter "Cisco Voice Telephony."
- Cisco 2600 series and Cisco 3600 series routers—Install digital T1 or E1 packet-voice trunk network modules, BRI voice interface cards, and other voice interface cards as required on your network.
- Cisco 7200 series routers—Install a single-port 30-channel T1/E1 high-density voice port adapter.

- Cisco MC3810 multiservice concentrators—Install the required digital voice modules (DVMs), BRI voice module (BVM), and multiflex trunk modules.
- Configure, for all platforms (as required), the following:
 - Voice card and controller settings
 - Serial and LAN interfaces
 - Voice ports
 - Voice dial peers

Restrictions for Configuring ISDN Voice Interfaces

ISDN Voice Interface Limitations

- Basic-net3 and basic-qsig are the only ISDN switch types currently supported for an NT interface.
- When the ISDN BRI port on the router is configured as an NT port, you must use a “rolled” cable (one with the transmit and receive leads swapped) to connect to a TE interface.
- Layer 1 can be configured only as point-to-point (that is, with one TE connected to each NT). Automatic TEI support issues only one TEI.

QSIG Support Limitations

- Cisco 2600 series routers do not support VoATM.
- The following restrictions apply to the Cisco MC3810 multiservice concentrator:
 - QSIG data calls are not supported. All calls with bearer capability indicating a nonvoice type (such as for video telephony) are rejected.
 - Cisco MC3810 supports only one T1/E1 interface with direct connectivity to a private integrated services network exchange (PINX).
 - Cisco MC3810 supports a maximum of 24 B channels.
 - When QSIG is configured, serial port 1 does not support speeds higher than 192 kbps. This restriction assumes that the MFT is installed in slot 3 on the Cisco MC3810. If the MFT is not installed, then serial port 1 does not operate.
- The following restrictions apply to Cisco 7200 series routers:
 - VoATM is not supported.
 - BRI is not supported.

Information About ISDN Voice Interfaces

To configure ISDN voice interfaces, you should understand the following concepts:

- [ISDN Media Types, page 5](#)
- [Interface Cards and Network Modules, page 5](#)
- [Typical ISDN Application, page 6](#)
- [QSIG Protocol, page 6](#)
- [Traceability of Diverted Calls, page 10](#)

ISDN Media Types

Cisco routing devices support ISDN BRI and ISDN PRI. Both media types use bearer (B) channels and data (D) channels as follows:

- ISDN BRI (referred to as “2 B + D”) uses the following:
 - Two 64-kbps B channels that carry voice or data for a maximum transmission speed of 128 kbps
 - One 16-kbps D channel that carries signaling traffic—that is, instructions about how to handle each of the B channels.
- ISDN PRI (referred to as “23 B + D” or “30 B + D”) uses the following:
 - 23 B channels (in North America and Japan) or 30 B channels (in the rest of the world) that carry voice or data
 - One 64-kbps D channel that carries signaling traffic

The D channel, in its role as signal carrier for the B channels, directs the central-office switch to send incoming calls to particular timeslots on the Cisco access server or router. It also identifies the call as a circuit-switched digital call or an analog modem call. Circuit-switched digital calls are relayed directly to the ISDN processor in the router; analog modem calls are decoded and then sent to the onboard modems.

Interface Cards and Network Modules

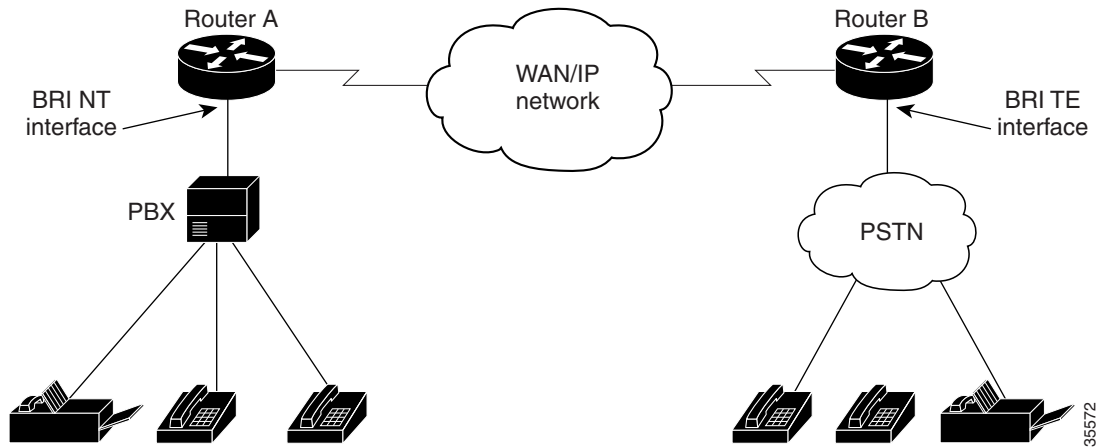
The VIC-2BRI-NT/TE voice interface card for the Cisco 2600 series and Cisco 3600 series routers and the BVM4-NT/TE voice module for the Cisco MC3810 multiservice concentrator enable Cisco IOS software to replicate the PSTN interface to a PBX that is compatible with European Telecommunications Standards Institute (ETSI) NET3 and QSIG switch types.

Before these cards and modules became available, if your PBXs implemented only a BRI TE interface, you had to make substantial hardware and software changes on the PBX to provide an NT interface to the router. provide an NT interface to the router. VIC-2BRI-NT/NE and BVN4-NT/NE allow you to connect ISDN PBXs and key systems to a multiservice network with minimal configuration changes on the PBX.

Typical ISDN Application

A typical application (see [Figure 1](#)) allows an enterprise customer with a large installed base of legacy telephony equipment to bypass the PSTN.

Figure 1 Typical Application Using BRI-NT/TE Voice Interface Cards or BVM4-NT/TE Voice Modules



QSIG Protocol

This section contains the following information:

- [QSIG Basics, page 6](#)
- [ISDN Switch Types for Use with QSIG, page 9](#)

QSIG Basics

QSIG is a variant of ISDN Q.921 and Q.931 ISDN D-channel signaling, for use in private integrated-services network-exchange (PINX) devices such as PBXs or key systems. Using QSIG signaling, a router can route incoming voice calls from a PINX across a WAN to a peer router, which can then transport the signaling and voice packets to another PINX.

The QSIG protocol was originally specified by European Computer Manufacturers Association (ECMA), and then adopted by European Telecommunications Standards Institute (ETSI) and the International Organization for Standardization (ISO). It is becoming the standard for PBX interoperability in Europe and North America.

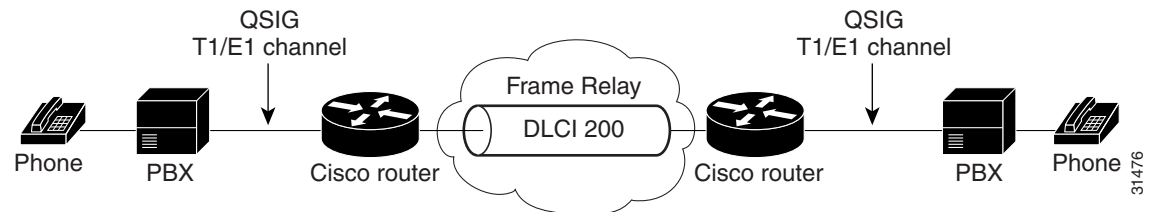
Table 1 identifies the ECMA standards and the OSI layer of the QSIG protocol stack to which they relate.

Table 1 QSIG Protocol Stack

OSI Layer	Standard	Description
7 to 4	Application mechanisms	End-to-end protocols; network transparent
3	Multiple ECMA standards	Standards for supplementary services and advanced network features
	ECMA-165	QSIG generic functional procedures
	ECMA-142/143	QSIG basic call
2	ECMA-141	Interface-dependent protocols
1	I.430 / I.431	PRI and BRI

QSIG enables Cisco networks to emulate the functionality of the PSTN. A Cisco device routes incoming voice calls from a PINX across a WAN to a peer device, which then transports the signaling and voice packets to a second PINX (see Figure 2).

Figure 2 QSIG Signaling



The Cisco voice-packet network appears to the QSIG PBXs as a distributed transit PBX that can establish calls to any PBX, non-QSIG PBX, or other telephony endpoint served by a Cisco gateway, including non-QSIG endpoints.

QSIG messages that originate and terminate on QSIG endpoints pass transparently across the network; the PBXs process and provision any supplementary services. When endpoints are a mix of QSIG and non-QSIG, only basic calls that do not require supplementary services are supported.

QSIG signaling provides the following benefits:

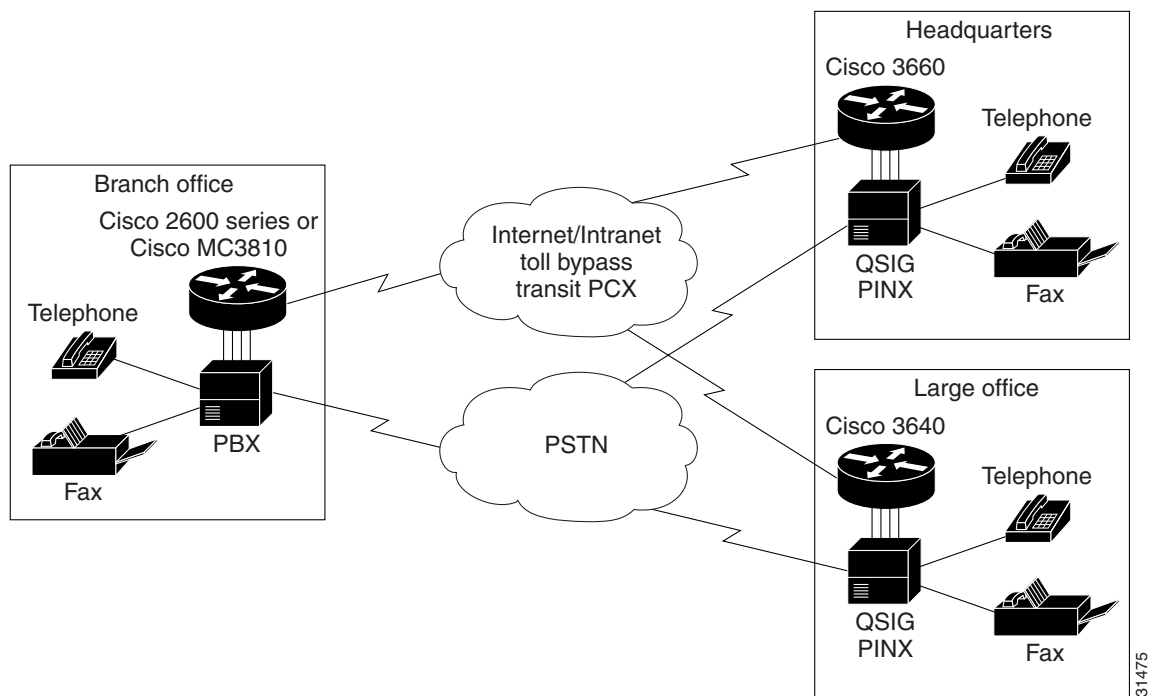
- It provides efficient and cost-effective telephony services on permanent (virtual) circuits or leased lines.
- It allows enterprise networks that include PBX networks to replace leased voice lines with a Cisco WAN.
- It eliminates the need to route connections through multiple tandem PBX hops to reach the desired destination, thereby saving bandwidth, PBX hardware, and switching power.
- It improves voice quality through the single-hop routing provided by voice switching while allowing voice to be compressed more aggressively, resulting in additional bandwidth savings.
- It supports PBX feature transparency across a WAN, permitting PBX networks to provide advanced features such as calling name and number display, camp-on/callback, network call forwarding, centralized attendant, and centralized message waiting. Usually these capabilities are available on only a single site where users are connected to the same PBX.

QSIG support enables the following:

- Digit forwarding on POTS dial peers
- On Cisco 2600 series, QSIG-switched calls over VoFR and VoIP for T1/E1 and BRI voice interface cards
- On Cisco 3600 series, QSIG-switched calls over VoFR, VoIP, and VoATM for T1/E1 and BRI voice interface cards
- On Cisco 7200 series, QSIG-switched calls over VoFR and VoIP on T1/E1 voice interface cards
- On Cisco MC3810, T1 or E1 PRI and BRI QSIG-switched calls over VoFR, VoIP, and VoATM for Cisco MC3810 digital voice modules and BRI voice module.

Figure 3 shows an example of how QSIG support can enable toll bypass.

Figure 3 QSIG Toll-Bypass Application



ISDN Switch Types for Use with QSIG

You can configure QSIG at either the global configuration level or the interface configuration level. To do so requires that you know your switch type. Available types are shown in [Table 2](#).

Table 2 ISDN Central-Office Switch Types

Country	ISDN Switch Type	Description
Australia	basic-ts013	Australian TS013 switches
Europe	basic-1tr6	German 1TR6 ISDN switches
	basic-nwnet3	Norwegian NET3 ISDN switches (phase 1)
	basic-net3	NET3 ISDN switches (United Kingdom and others)
	vn2	French VN2 ISDN switches
	vn3	French VN3 ISDN switches
Japan	ntt	Japanese NTT ISDN switches
New Zealand	basic-nznet3	New Zealand NET3 switches
North America	basic-5ess	Lucent Technologies basic rate switches
	basic-dms100	NT DMS-100 basic rate switches
	basic-ni1	National ISDN-1 switches

[Table 3](#) lists the ISDN service-provider BRI switch types.

Table 3 ISDN Service-Provider BRI Switch Types

ISDN Switch Type	Description
basic-1tr6	German 1TR6 ISDN switches
basic-5ess	Lucent Technologies basic rate switches
basic-dms100	NT DMS-100 basic rate switches
basic-net3	NET3 (TBR3) ISDN, Norway NET3, and New Zealand NET3 switches. (This switch type covers the Euro-ISDN E-DSS1 signaling system and is ETSI-compliant.)
basic-ni1	National ISDN-1 switches
basic-nwnet3	Norwegian NET3 ISDN switches (phase 1)
basic-nznet3	New Zealand NET3 switches
basic-qsig	PINX (PBX) switches with QSIG signaling in compliance with Q.931
basic-ts013	Australian TS013 switches
ntt	Japanese NTT ISDN switches
vn2	French VN2 ISDN switches
vn3	French VN3 ISDN switches

Cisco platforms that support Q.931 offer both user-side and network-side switch types for ISDN call processing, providing the following benefits:

- User-side PRI enables the Cisco device to provide a standard ISDN PRI user-side interface to the PSTN.
- Network-side PRI enables the Cisco device to provide a standard ISDN PRI network-side interface via digital T1/E1 packet voice trunk network modules on Cisco 2600 series and Cisco 3600 series routers.

Traceability of Diverted Calls

European Telecommunication Standard ETSI 300 207-1 specifies that calls must be traceable if diverted. This requires that a VoIP call, when diverted, must translate into divertingLegInformation2 instead of Redirection IE. Cisco's ISDN implementation satisfies this requirement.

Additional References

The following sections provide references related to ISDN.



Note

- In addition to the references listed below, each chapter provides additional references related to ISDN.
- Some of the products and services mentioned in this guide may have reached end of life, end of sale, or both. Details are available at http://www.cisco.com/en/US/products/prod_end_of_life.html.

Related Documents

Related Topic	Document Title
AIM, ATM, and IMA	<ul style="list-style-type: none"> • <i>AIM-ATM, AIM-VOICE-30, and AIM-ATM-VOICE-30 on the Cisco 2600 Series and Cisco 3660</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122t/122t8/ft_04gin.htm • <i>ATM Software Segmentation and Reassembly (SAR)</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122limit/122x/122xb/122xb_2/ft_t1atm.htm • <i>Cisco IOS Wide-Area Networking Configuration Guide</i>, chapter on configuring ATM at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fwan_c/wcfatm.htm • <i>Installing the High Performance ATM Advanced Integration Module in Cisco 2600 Series Routers</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/hw_inst/aim_inst/aim_inst.htm

Related Topic	Document Title
Basic router configuration	<ul style="list-style-type: none"> • Cisco 2600 series documentation at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/index.htm • Cisco 3600 series documentation at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis3600/index.htm • Cisco 3700 series documentation at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis3700/index.htm • Cisco AS5300 documentation at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/5300/index.htm
Cisco IOS command references	<ul style="list-style-type: none"> • <i>Cisco IOS Debug Command Reference, Release 12.3T</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123tcr/123dbr/index.htm • <i>Cisco IOS Voice Command Reference, Release 12.3T</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123tcr/123tvr/index.htm
Cisco IOS configuration fundamentals and examples	<ul style="list-style-type: none"> • <i>Cisco IOS Configuration Fundamentals Configuration Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/ffun_c/ • <i>Cisco IOS Interface Command Reference</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/finter_r/index.htm • <i>Cisco IOS Interface Configuration Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/finter_c/ • Cisco Systems Technologies website at http://cisco.com/en/US/tech/index.html From the website, select a technology category and subsequent hierarchy of subcategories, then click Technical Documentation > Configuration Examples.
Cisco IOS Voice Configuration Library, including library preface and glossary	<ul style="list-style-type: none"> • Cisco IOS Voice Configuration Library at http://www.cisco.com/en/US/products/ps6441/prod_configuration_guide09186a0080565f8a.html
Clock sources	<ul style="list-style-type: none"> • <i>Cisco IOS Voice, Video, and Fax Configuration Guide</i> chapter on configuring voice ports at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fvfax_c/vvfport.htm#18533
ISDN basics	<ul style="list-style-type: none"> • Cisco IOS Release 12.2 Configuration Guides and Command References library at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/ • Cisco IOS Release 12.3 Configuration Guides and Command References library at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/index.htm
ISDN cause codes	<ul style="list-style-type: none"> • <i>ISDN Switch Types, Codes, and Values</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/dbook/disdn.htm

Related Topic	Document Title
ISDN configuration	<ul style="list-style-type: none"> • <i>Cisco IOS Voice, Video, and Fax Configuration Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fvfax_c/vvfidn.htm • <i>ISDN Basic Rate Service Setup Commands</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/dial_r/drprt1/drbr1.htm
ISDN interfaces for voice	<ul style="list-style-type: none"> • <i>Cisco 7200 Series Port Adapter Hardware Configuration Guidelines</i> at http://www.cisco.com/univercd/cc/td/doc/product/core/7206/port_adp/config/ • <i>Cisco MC3810 Multiservice Concentrator Hardware Installation</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/multicon/3810hwig/ • <i>Quick Start Guide: Cisco MC3810 Installation and Startup</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/multicon/3810qsg.htm • <i>Voice over IP for the Cisco 3600 and Cisco 2600 Series</i> at http://cco-rtp-1.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip3600/index.htm
ISDN network modules and interface cards	<ul style="list-style-type: none"> • <i>Cisco Network Modules Hardware Installation Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/hw_inst/nm_inst/nm-doc/ • <i>Cisco WAN Interface Cards Hardware Installation Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis3600/wan_mod/ • <i>Installing and Configuring 1-Port J1 Voice Interface Cards</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis3600/hw_inst/hw_notes/j1vwic.htm • <i>Update to Cisco WAN Interface Cards Hardware Installation Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/hw_inst/wic_inst/wan_updt.htm • <i>Voice Network Module and Voice Interface Card Configuration Note</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis3600/voice/4712voic.htm
MIX module	<ul style="list-style-type: none"> • <i>Multiservice Interchange (MIX) for Cisco 2600 and 3600 Series Multiservice Platforms</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122t/122t4/ft_24mix.htm
RADIUS VSA configuration	<ul style="list-style-type: none"> • <i>RADIUS VSA Voice Implementation Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/vapp_dev/vsaig3.htm
SCTP	<ul style="list-style-type: none"> • <i>Stream Control Transfer Protocol (SCTP)</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122t/122t8/ft_sctp2.htm
Security	<ul style="list-style-type: none"> • <i>Cisco IOS Security Configuration Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fsecur_c/index.htm

Related Topic	Document Title
SS7 for voice gateways	<ul style="list-style-type: none"> • <i>Configuring Media Gateways for the SS7 Interconnect for Voice Gateways Solution</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/sc/re17/soln/das22/gateway/dascfg5.htm
Tcl IVR programming	<ul style="list-style-type: none"> • <i>Tcl IVR API Version 2.0 Programmer's Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/vapp_dev/tclivr2/index.htm
Troubleshooting	<ul style="list-style-type: none"> • <i>Cisco IOS Debug Command Reference, Release 12.3T</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123tcr/123dbr/index.htm • <i>Cisco IOS Voice Troubleshooting and Monitoring Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/vvfax_c/voipt_c/index.htm • <i>Internetwork Troubleshooting Guide</i> at http://www.cisco.com/univercd/cc/td/doc/cisintwk/itg_v1/index.htm • <i>Voice over IP Troubleshooting and Monitoring</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/vvfax_c/voipt_c/index.htm
VoATM configuration	<ul style="list-style-type: none"> • <i>Configuring AAL2 and AAL5 for the High-Performance Advanced Integration Module on the Cisco 2600 Series</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122limit/122x/122xa/122xa_2/ft_ataim.htm
VoIP configuration	<ul style="list-style-type: none"> • <i>Voice over IP for the Cisco 2600/3600 Series</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip3600/index.htm • <i>Voice over IP for the Cisco AS5300</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip5300/index.htm • <i>Voice over IP for the Cisco AS5800</i> at http://www.cisco.com/univercd/cc/td/doc/product/access/nubuvoip/voip5800/index.htm
WAN configuration	<ul style="list-style-type: none"> • <i>Cisco IOS Wide-Area Networking Command Reference</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fwan_r/index.htm • <i>Cisco IOS Wide-Area Networking Configuration Guide</i> at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fwan_c/wcfatm.htm

Standards

Standards	Title
014-0018-04.3D-ER	<i>CPE Requirements for MCI ISDN Primary Rate Interface</i> , revision 4.3D, February 10, 1998
ETSI 300 207-1	<i>Integrated Services Digital Network (ISDN): Diversion supplementary services; Digital Subscriber Signalling System No. one (DSS1) protocol; Part 1: Protocol specification</i> , December 1994

Additional References

Standards	Title
TR-41459	<i>AT&T Network ISDN Primary Rate Interface and Special Applications Specifications, User-Network Interface, 1999</i>
TTC JJ-20.10 to JJ-20.12	<i>PBX</i>

MIBs

MIBs	MIBs Link
<ul style="list-style-type: none"> CISCO-CAS-IF-MIB.my CISCO-ICSUDSU-MIB RFC 1407 MIB 	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
SCTP	<i>Stream Control Transmission Protocol (SCTP), Release 2</i>

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport