

## Cisco AS5400XM Universal Gateway

The Cisco® AS5400XM Universal Gateway offers unparalleled capacity in only two rack units (2RUs) and provides best-of-class voice, fax, and remote-access services. High density (1 Channelized T3 [CT3] interface for voice over IP [VoIP] and 2 CT3 interfaces for time-division multiplexing [TDM] switching), low power consumption (as low as 2.4A at 48 VDC per G.711 CT3), high-density packet voice digital-signal-processor (DSP) modules, universal port DSPs, and session-border-control (SBC) features make the Cisco AS5400XM Universal Gateway ideal for many network deployment architectures, especially co-location environments and mega points of presence (POPs).

The Cisco AS5400XM Universal Gateway (Figure 1) doubles the performance of the Cisco AS5400 and delivers significant memory enhancements to offer high performance and high reliability in a compact, modular design. The Cisco AS5400XM High-Density Packet Voice/Fax Feature Card (AS5X-FC) and DSP Module (AS5X-PVDM2-64) available for the Cisco AS5400XM Universal Gateway enable higher-density configurations and world-class performance for intelligent packet voice services. The Cisco AS5400XM Universal Gateway (Figure 1) also supports existing Cisco AS5400 and AS5400HPX features, trunk termination, and universal port DSP feature cards in a more powerful chassis to help ensure continuing network investment protection. This cost-effective platform is ideally suited for service provider and enterprise environments that require innovative voice, fax, and data services.

**Figure 1.** Cisco AS5400XM Universal Gateway



### Flexibility To Deploy New Services

Demand for new services can be easily accommodated with the Cisco AS5400XM Universal Gateway, whether the initial business opportunity is voice services over broadband, wholesale voice transport, unified communications, call-center services, IP-enabled interactive voice response (IVR), hosted IP telephony, prepaid calling card, SBC, Common Channel Signaling System 7 (SS7/C7) interconnect, high-volume Internet access, regional or branch-office connectivity, corporate VPNs, or wholesale dial. The flexibility to use the Cisco AS5400XM Universal Gateway in multiple service environments provides unprecedented capital investment protection. It helps ensure that the network can promptly adapt to changes in the business environment and meet the demands of the marketplace for new services.

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## Cisco AS5400XM Universal Gateway Helps Enable New Cisco Services

The Cisco AS5400XM Universal Gateway supports a wide range of IP-based, value-added voice, fax, and data services. It helps service providers with existing data networks quickly and easily add voice services to their portfolios, and carriers that offer voice services over existing time-division multiplexing (TDM) networks can expand their coverage more cost-effectively. The Cisco AS5400XM provides the perfect solution for telephony application service providers (ASPs) that want to deploy PC-to-phone, voice portals, voice-enabled Web commerce, and content delivery services. The combination of Session Initiation Protocol (SIP) voice gateway, services platform, and SBC interconnectivity make the Cisco AS5400XM perfect for both IP Multimedia Subsystem (IMS) and non-IMS deployments. SBC functions provide a network-to-network interface point for billing, security, Call Admission Control (CAC), quality of service (QoS), and signaling interworking. SBC functions operate concurrently with the public switched telephone network (PSTN)-to-IP gateway functions.

The rich set of Cisco IOS® Software features available in the Cisco AS5400XM Universal Gateway helps Internet service providers (ISPs) and enterprise network managers meet traditional dial-in access needs, including Internetwork Packet Exchange (IPX) and AppleTalk, while supporting the migration to new universal port services.

Cisco Systems® customers worldwide have proven that Cisco AS5000 Universal Gateways provide the flexibility, scale, reliability, and suite of services required to meet market demands.

By providing the industry's broadest product line of intelligent voice gateway and access server products, Cisco makes it easy for customers to select the right starting point for a phased rollout based on revenue generation, without compromising future capabilities. Complemented by the industry's highest-rated service and support, Cisco also can provide assistance with startup, maintenance, and marketing tasks, as well as advanced and custom solutions.

## Your Complete POP Solution

The Cisco AS5400XM Universal Gateway eliminates the need for switches and routers to create a POP or "POP-in-a-box" solution. The gateway has eight primary packet voice and universal gateway configurations: 4 CT1/CE1 interfaces, 8 CT1/CE1 interfaces, 16 CT1/CE1 interfaces, and 1 CT3 (up to 550 channels) interface. It also can accommodate 2 CT3 cards for TDM switching and includes an integrated signaling link terminator (SLT) for direct connection to an SS7/C7 signaling gateway.

The Cisco AS5400XM Universal Gateway comes with two 10/100/1000BASE-T autosensing Gigabit Ethernet ports, which are perfect for redundancy and firewall applications. Additionally, two high-speed serial ports are provided to support Frame Relay, Point-to-Point Protocol (PPP), and High-Level Data Link Control (HDLC) backhaul. All Ethernet interfaces support Hot Standby Router Protocol (HSRP), and all cards are hot-swappable for carrier-class resiliency. Availability is further enhanced with the standard AC redundant or optional DC redundant power supplies. The Cisco AS5400XM is the only gateway in this form factor that offers voice, fax, SBC, and remote-access capabilities with these high-availability features.

The Cisco AS5400XM Universal Gateway also supports widely deployed routing protocols, including those generally found in high-end access servers and routers (for example, Border Gateway Protocol Version 4 [BGPv4], Open Shortest Path First [OSPF], Enhanced Interior Gateway Routing Protocol [EIGRP], and Intermediate System-to-Intermediate System [IS-IS]). This capability allows service providers and enterprises to deploy the Cisco AS5400XM Universal Gateway as a standalone universal gateway solution.

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## Features and Solutions

### Packet Telephony

With more than 24 million voice gateway ports shipped, Cisco is a proven leader in product innovation for packet telephony services. Cisco AS5000 Universal Gateways are a primary component in many Cisco end-to-end voice solutions:

- Cisco Voice Infrastructure and Applications (VIA)
- Business voice services
- Residential voice over broadband (VoBB) PSTN termination services
- Contact center in combination with Cisco Unified Customer Voice Portal (CVP)

The framework for VoIP services on the Cisco AS5400XM Universal Gateway is based on open interfaces and industry standards, and it allows an ecosystem of partners to work together to develop innovative network services. Service providers are not locked into a single VoIP signaling technology when they choose the Cisco AS5400XM—SIP, H.323, Media Gateway Control Protocol (MGCP), and Trunking Gateway Control Protocol (TGCP) support are all built in, allowing service providers to enable the call-control protocol that is the best fit for their network today, with the assurance that they can respond to evolving market requirements whenever necessary.

### SIP

SIP is a peer-to-peer, multimedia signaling protocol that integrates with other Internet services, such as e-mail, voicemail, instant messaging, multiparty conferencing, and multimedia collaboration. When used with an IP infrastructure, SIP helps enable rich communications with numerous multivendor devices and media. SIP is the IETF standard for multimedia conferencing over IP. Defined originally in RFC 2543 and updated with RFC 3261, SIP is an ASCII-based, application layer control protocol that can be used to establish, maintain, and terminate calls between two or more endpoints.

Cisco has been instrumental in defining SIP standards. The company has been at the forefront of SIP technology since the first SIP IETF RFC was published in 1999. As the IETF co-chair for multiple SIP working groups, Cisco actively contributes to SIP standards.

The SIP implementation on the Cisco AS5400XM Universal Gateway includes support for RFC 3261 as well as critical features such as third-party call control, secure signaling using Transport Layer Security (TLS), and RFC 2833: RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals. The Cisco AS5400XM also supports many important SIP extensions, including RFC 3262: Standard for Reliability of Provisional Responses in SIP (PRACK), and RFC 3264: Standard for Offer/Answer Model with Session Description Protocol (SDP).

### H.323

Leading the industry through the adoption of new standards-based H.323 technology, the Cisco AS5400XM Universal Gateway supports the feature and scalability enhancements introduced in H.323v2 and H.323v4. For example:

- Media authentication and encryption using Secure Real-Time Transport Protocol (SRTP) are supported.
- Multiple concurrent calls can be supported over a single H.225 call-signaling channel to reduce call-setup and call-clearing times and increase network call capacity.

- H.225 messages can be transported over TCP or User Datagram Protocol (UDP) as described in H.323 Annex E. Using UDP for call-signaling transport effectively enables media cut-through in a single round trip.
- H.225 offers the ability to report capacity statistics to the gatekeeper on a per-call basis for each DS-0, trunk group, or carrier associated with the PSTN-side interfaces to assist in routing decisions.

H.323 operates in most VoIP backbone networks today, carrying billions of call minutes in many of the world's largest VoIP networks. H.323-based services continue to grow in service provider usage and profit.

### Similarities Between SIP and H.323

Although SIP messages are not directly compatible with H.323, both protocols can coexist in the same packet telephony network because the Cisco AS5400XM Universal Gateway can process individual SIP and H.323 calls simultaneously, allowing service providers to integrate complementary H.323 and SIP services in the same network.

- Both H.323 and SIP were designed to address session control and signaling functions in a distributed call-control architecture.
- Both are especially well-suited for communication with intelligent network endpoints.

Both protocols are essential for solutions where an intelligent media gateway is used for PSTN termination.

### MGCP

MGCP 1.0 is a protocol for centralized control of VoIP calls by external call-control elements known as media gateway controllers (MGCs) or call agents. MGCP is described in RFC 3435: Media Gateway Control Protocol (MGCP) Version 1.0, published by the IETF.

### Package Types

An MGCP call connection involves a series of events and signals—such as off-hook status, a ringing signal, or a signal to play an announcement—that are specific to the type of endpoint involved in the call. MGCP groups these events and signals into packages. A trunk package, for example, is a group of events and signals relevant to a trunking gateway; an announcement package is a group of events and signals relevant to an announcement server.

The Cisco AS5400XM Universal Gateway supports the following MGCP package types:

- Trunk package
- Generic media package
- Dual tone multifrequency (DTMF) package
- DTMF trunk package (for channel-associated-signaling [CAS] endpoints)
- Multifrequency operator services package (for CAS endpoints)
- Multifrequency Wink Start and Immediate Start package (for CAS endpoints)
- Real-Time Transport Protocol (RTP)
- FXR package for fax transmissions
- Announcement server package
- Script package
- Resource Reservation Protocol (RSVP) package (QoS)

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Standards-based T.38 Fax Relay and RFC 2833 DTMF Relay are available with MGCP as well as improved voice-quality metrics.

### Voice Quality

The extensive voice and fax capabilities of the Cisco AS5400XM Universal Gateway can help build a reliable, high-quality VoIP network. Voice-quality tests confirm that the Cisco AS5400XM Universal Gateway delivers end-to-end voice-quality performance that meets the high standards established for toll-quality voice services in the PSTN. Comprehensive voice-quality testing is a critical component in the Cisco AS5400XM Universal Gateway development process. Cisco conducts subjective voice-quality tests to determine mean opinion scores using a methodology derived from ITU-T Recommendations P.830 and P.831. Objective voice-quality tests are also conducted using the Perceptual Evaluation of Speech Quality (PESQ) algorithm (P.862), an enhanced perceptual measurement for voice quality in telecommunications specifically developed for end-to-end voice-quality testing under real network conditions.

The high-performance design of the Cisco AS5400XM Universal Gateway minimizes delay and packet loss during voice encoding and packetization processes. The Cisco AS5400XM High-Density Packet Voice/Fax Feature Card (AS5X-FC) and DSP Module (AS5X-PVDM2-64) optimize packetization performance and reduce delay up to 20 percent compared with earlier-generation DSP feature cards. Cisco QoS features, including IP Precedence, RSVP, Weighted Fair Queuing (WFQ), Weighted Random Early Detection (WRED), and Multichassis Multilink PPP (MMP) fragmentation and interleaving, implemented on both the universal gateway and backbone routing infrastructure, can provide a low-latency, high-reliability path for sensitive voice traffic through today's networks.

Echo control is essential for packet-switched networks to carry voice traffic successfully. The Cisco AS5400XM Universal Gateway conforms to the voice tests of ITU-T Recommendation G.168 2002 for echo cancellation with a tail length up to 64 ms. Fixed and adaptive jitter buffering and comfort-noise generation further enhance voice quality. The Cisco AS5400XM also supports the enhanced measurements and call-specific debug features in Cisco IOS Software. In addition, the user can set items such as IP-side attenuation down to the individual T1 or E1 voice port.

### Voice Codecs

The Cisco AS5400XM Universal Gateway offers multiple codecs to meet interoperability, compression, and latency requirements for a variety of voice applications. The Cisco AS5400XM High-Density Packet Voice/Fax Feature Card (AS5X-FC) provides complete flexibility in channel allocation to achieve highest densities. Each voice/fax feature card supports from one to six high-density DSP modules (AS5X-PVDM2-64) providing scalability from 64 to 384 channels. Enabling voice activity detection (VAD) reduces packet traffic through the network. With VAD enabled, the Cisco AS5400XM detects silence and stops transmitting packets when callers stop speaking. Variable frame sizing provides further control over speech packetization.

The Cisco AS5400XM Universal Gateway supports the voice codecs listed in Tables 1 and 2.

**Table 1.** Codec Support: Cisco AS5400XM High-Density Packet Voice/Fax Feature Card

DSP Feature Card	Low-Complexity Codecs	Medium-Complexity Codecs	High-Complexity Codecs
<b>Cisco AS5400XM High-Density Packet Voice/Fax Feature Card (AS5X-FC) with 6 DSP module (AS5X-PVDM2-64) slots</b>	<ul style="list-style-type: none"> <li>• G.711 mu-law</li> <li>• G.711 a-law</li> <li>• Fax pass-through</li> <li>• Modem pass-through</li> <li>• Clear channel codec</li> </ul>	<ul style="list-style-type: none"> <li>• G.729 a</li> <li>• G.729 ab</li> <li>• G.726 16K, 24K, 32K</li> <li>• T.38 Fax Relay</li> <li>• Cisco Fax Relay</li> </ul>	<ul style="list-style-type: none"> <li>• Adaptive multirate-narrow Band (AMR-NB) 4.75K, 5.15K, 5.9K, 6.7K, 7.4K, 7.95K, 10.2K, 12.2K, silence indicator (SID)</li> <li>• G.723.1 5.3K, 6.3K</li> <li>• G.723.1A 5.3K, 6.3K</li> <li>• G.728</li> <li>• Modem relay</li> <li>• Internet Low-Bitrate Codec (iLBC)</li> </ul>
<b>Maximum channel capacity per feature card (AS5X-FC)</b>	384	192	144

**Table 2.** Codec Support: Cisco AS5400XM Universal Gateway with the Universal Port Feature Card

DSP Feature Card	Codecs
<b>Cisco AS5400XM Voice/Universal Port Feature Card (AS5XM-VUFC-108NP and AS5XM-VUFC-60NP)</b>	<ul style="list-style-type: none"> <li>• G.711 mu-law</li> <li>• G.711 a-law</li> <li>• Fax pass-through</li> <li>• Modem pass-through</li> <li>• Clear channel codec</li> <li>• G.723.1 5.3K, 6.3K</li> <li>• G.726 16K, 24K, 32K</li> <li>• G.729ab, G729a</li> <li>• Global System for Mobile Communications - Full-Rate (GSM-FR)</li> <li>• T.38 Fax Relay</li> </ul>
<b>Maximum channel capacity per universal port feature card for all codec types</b>	<ul style="list-style-type: none"> <li>• 60 per AS5XM-VUFC-60NP</li> <li>• 108 per AS5XM-VUFC-108NP</li> </ul>

## Session Border Control

SBC functions interconnect independent VoIP networks for data and voice transport (Table 3). SBCs are critical components for scaling networks from islands within a single customer network to an end-to-end IP community. The Cisco AS5400XM Universal Gateway is a simple and cost-effective solution that provides a network-to-network demarcation interface for signaling interworking, media interworking, address and port translations, billing, security, and QoS and bandwidth management. SBC functions operate concurrently with the voice gateway functions. The Cisco AS5400XM Universal Gateway supports SBC for H.323 and SIP.

**Table 3.** SBC Features

Features	Support Details
<b>Voice</b>	
Protocols	<ul style="list-style-type: none"> <li>• H.323 and SIP</li> </ul>
Protocol and signal interworking	<ul style="list-style-type: none"> <li>• H.323 to H.323 (including Cisco Unified CallManager)</li> <li>• H.323 to SIP (including Cisco Unified CallManager)</li> <li>• SIP to SIP (including Cisco Unified CallManager)</li> </ul>
Media support	<ul style="list-style-type: none"> <li>• RTP and Real-Time Control Protocol (RTCP)</li> </ul>
Media modes	<ul style="list-style-type: none"> <li>• Media flow-through</li> <li>• Media flow-around</li> </ul>
Transport mode	<ul style="list-style-type: none"> <li>• TCP</li> <li>• UDP</li> <li>• TCP-to-UDP interworking</li> </ul>

Features	Support Details
Fax support	<ul style="list-style-type: none"> <li>• T.38 Fax Relay</li> <li>• T.38 Digit Relay</li> <li>• Modem pass-through</li> <li>• Fax pass-through</li> <li>• Cisco Fax Relay</li> </ul>
DTMF	<ul style="list-style-type: none"> <li>• H.245 Alphanumeric</li> <li>• H.245 Signal</li> <li>• RFC 2833</li> <li>• SIP Notify</li> <li>• Interworking capabilities: <ul style="list-style-type: none"> <li>◦ H.323 to SIP</li> </ul> </li> </ul>
Supplementary services <sup>1</sup>	<ul style="list-style-type: none"> <li>• Call hold, call transfer, and call forward for H.323 networks using H.450 and transparent passing of Empty Capability Set (ECS) capabilities</li> </ul>
CAC	<ul style="list-style-type: none"> <li>• RSVP</li> <li>• Maximum number of calls per trunk</li> <li>• CAC based on IP circuits</li> </ul>
QoS	<ul style="list-style-type: none"> <li>• IP Precedence and differentiated-services-code-point (DSCP) marking</li> </ul>
Network hiding	<ul style="list-style-type: none"> <li>• IP network privacy and topology hiding</li> <li>• IP network security boundary</li> <li>• Intelligent IP address translation for call media and signaling</li> </ul>
Number translation	<ul style="list-style-type: none"> <li>• Number translation rules for VoIP numbers</li> <li>• ENUM support for E.164 number mapping into Domain Name System (DNS)</li> </ul>
Security	<ul style="list-style-type: none"> <li>• IP Security (IPsec)</li> <li>• SRTP</li> <li>• TLS</li> </ul>
Authentication, authorization, and accounting (AAA)	<ul style="list-style-type: none"> <li>• AAA with RADIUS</li> </ul>
Voice media applications	<ul style="list-style-type: none"> <li>• Tool Command Language (TCL) scripts support for application customization</li> <li>• Voice Extensible Markup Language (VoiceXML) script support for application customization</li> </ul>
Billing	<ul style="list-style-type: none"> <li>• Standard call detail records (CDRs) for accurate billing</li> </ul>
Lawful Intercept	<ul style="list-style-type: none"> <li>• Provide replicated packets to third-party mediation device</li> </ul>
Session performance	<ul style="list-style-type: none"> <li>• 1000 concurrent calls with 2000 sessions in flow-through mode</li> </ul>

## Call Admission Control

For VoIP to be a practical replacement for standard PSTN telephony services, customers need to receive the same consistent, high quality of voice transmission they receive with basic telephone services. For real-time, delay-sensitive traffic such as voice, it is better to deny network access under congestion conditions than to allow traffic onto the network to be dropped and delayed, causing intermittent impaired QoS and resulting in customer dissatisfaction.

Numerous QoS mechanisms exist in Cisco IOS Software to allow service providers to design and configure packet networks that provide the necessary low latency and guaranteed delivery required for voice traffic. These mechanisms include tools such as queuing, policing, traffic shaping, packet marking, and fragmentation and interleaving.

CAC extends the QoS tool suite to protect voice traffic from being negatively affected by other voice traffic, keeping excess voice traffic off the network. CAC allows the Cisco AS5400XM Universal Gateway to make

<sup>1</sup> Supplementary services supported only for H.323-to-H.323 networks at this time

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deterministic and informed decisions before a voice call is established based on whether the required network resources are available to provide suitable QoS for the new call. CAC provides:

- Voice call admission decisions based on overall CPU use and call arrival rate at the individual gateway
- The ability to monitor the status of an Ethernet interface and use that information to take a TDM interface out of service
- Voice call admission based on the prevailing conditions in the packet network such as end-to-end latency, jitter, or the ability to reserve the resources required to handle the call and assure quality
- Reporting information about only the available circuits to H.323 gatekeepers, accounting for the circuits in use for data, voice, or fax services to achieve higher call success rates

### VoiceXML Solution Infrastructure

The Cisco AS5400XM Universal Gateway can interpret VoiceXML documents. VoiceXML is an open-standard markup language used to create voice-enabled Web browsers and IVR applications. Just as HTML enables users to retrieve data with a PC, VoiceXML enables subscribers to retrieve data with a telephone. The accessibility of the telephone and its ease of use make VoiceXML applications a powerful alternative to HTML for accessing the information and services that the Internet provides. The Cisco VoiceXML Solution Infrastructure takes advantage of Cisco AS5400XM Universal Gateway DSP resources, signaling, and media-conversion capabilities to execute VoiceXML application logic at the edge of the network, offloading servers and the network to support unified communications services. Cisco VoiceXML gateways support two standard audio formats for recording and playback: .au (audio/basic) and .wav (audio/wav). The VoiceXML Store and Forward feature allows streaming-based voice recording and playback features for various media, including local memory, HTTP, Extended Simple Mail Transfer Protocol (ESMTP), and Real-Time Streaming Protocol (RTSP) for 14 different Cisco codecs and the two standard audio file formats.

The Cisco AS5400XM Universal Gateway running a VoiceXML or TCL application can use Media Resource Control Protocol (MRCP) to control media resources on external media servers, such as speech synthesizers for text-to-speech (TTS) and speech recognizers for automatic speech recognition (ASR). MRCP is an application-level protocol developed by Cisco and its ASR and TTS media server partners, Nuance Communications and SpeechWorks International. The ability of this gateway to interact with ASR and TTS servers provides the capabilities required to satisfy the most demanding and advanced IVR solutions.

### Programmable Tool Command Language 2.0

Integrated, programmable IVR extends the ability of the Cisco AS5400XM Universal Gateway to support unique and differentiated voice services. Voice application software developers can use the TCL IVR 2.0 application programming interface (API) to create customized TCL scripts that control calls coming into or going out of the gateway. IVR systems collect user input in response to recorded messages. The prompts used in a TCL IVR 2.0 script can be either static or dynamic. The scripts are event-directed, and call flow is controlled by a finite-state machine that is defined by the TCL script. All verbs are nonblocking—they can execute without causing the script to wait. Prompts can be played and digits can be collected over telephony or VoIP call legs. RTSP-based prompts are supported. TCL IVR 2.0 offers enhanced multilanguage support by providing the capability to add new languages and TTS notations to the core IVR infrastructure. The Cisco Developer Support program assists companies developing or modifying TCL IVR 2.0 scripts.

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## Unified Communications

Voicemail solutions are rapidly moving away from traditional TDM-based messaging solutions to a unified messaging architecture where subscribers can access messages from a variety of devices.

Unified communications uses the IP infrastructure to unify the communications methods that were previously disjointed—e-mail applications, fax machines, voicemail systems, cellular phones, and Web communications. This scenario gives users a common method to both access messages and initiate real-time communications—all using familiar devices.

Service providers can implement unified communications solutions by deploying Cisco AS5400XM Universal Gateways between traditional PSTN or wireless networks and their packet-based telephony network and adding application servers that support unified communications services. Cisco has partnered with several industry-leading developers to provide unified communications solutions. Following are some of the cost-effective services that carriers can offer to build brand identity and increase customer loyalty while reducing turnover:

- Unified voicemail, fax, and e-mail
- Voice, fax, and e-mail retrieval by phone
- Integration of electronic documents with faxes
- Personal message agents
- Caller access to Web-based content through VoiceXML-enabled applications
- Never-busy fax lines
- Broadcast fax

## Fax Features

Fax transmission over an IP infrastructure is an important and growing service opportunity, especially in international markets where fax represents a large percentage of network traffic. The Cisco AS5400XM Universal Gateway supports standards-based T.38 Real-Time Fax Relay and T.37 Fax Store and Forward, allowing greater interoperability between networks. The fax detection capabilities of the Cisco AS5400XM Universal Gateway allow service providers to offer a single E.164 number for subscriber voice and fax services. Half as many subscriber phone numbers are needed, resulting in significant cost savings. The Cisco AS5400XM also supports fax pass-through and Cisco Real-Time Fax Relay for VoIP environments that cannot support T.38 Real-Time Fax Relay end to end. Enhanced T.38 Fax Relay statistics in the gateway RADIUS call accounting record provide detailed information about each fax call, including modulation rate, number of pages, packets transmitted and received, and a fax success indication.

## Softswitch Interoperability

Softswitch products that support SIP, H.323, or MGCP can be used with the Cisco AS5400XM Universal Gateway to support advanced applications for broadband services. The Cisco BTS 10200 Softswitch and the Cisco PGW 2200 Softswitch are two of the many softswitch products that interoperate with the Cisco AS5400XM Universal Gateway.

## SS7 Interconnect

Using the Cisco PGW 2200 PSTN Signaling Gateway (or a third-party SS7 gateway) and the Cisco AS5400XM Universal Gateway with integrated SLT functions, service providers can interconnect their data and VoIP networks with the PSTN through SS7 links. In many countries carriers must interconnect through SS7 to qualify for reciprocal compensation.

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The Cisco PGW 2200 PSTN Signaling Gateway and Cisco AS5400XM Universal Gateway provide the interface needed for SS7 interconnect using ISDN User Adaptation Layer (IUA) with Stream Control Transmission Protocol (SCTP) as the call signaling IP transport mechanism, allowing service providers to enter markets previously unavailable to them because of signaling requirements. SS7 trunks are more efficient than CAS trunks, and they typically cost less than Primary Rate Interface (PRI) trunks. With SS7, call setup time decreases, increasing the amount of billable traffic carried by the network.

### Integrated SLT

The Cisco AS5400XM Universal Gateway trunk cards also have serial interfaces for integrated SLT functions. With integrated SLT, the Cisco AS5400XM Universal Gateway provides distributed Message Transfer Part (MTP) SS7 signaling functions directly on the gateway. The integrated SLT backhauls upper-layer SS7 protocols across an IP network using Cisco Reliable UDP (RUDP) or SCTP, terminating the MTP1 and MTP2 layers of the SS7 protocol stack. Integrated SLT support is available through a software upgrade—no new hardware is required. MTP3 with ISUP backhaul is included. Pricing is on a per-platform basis.

### TDM Switching

TDM switching is the ability to take an incoming call on a given DS-0 and send it out on a different DS-0 before the call is answered by the gateway. This feature is used in applications such as:

- SS7-to-PRI grooming
- Local-number-portability (LNP) support in Europe
- Automatic number identification (ANI) or Digital Number Identification Service (DNIS) manipulation
- Meeting special provisional requirements for test calls (for example, 911 call handling)

This feature typically does not require any DSP resource and hence has no effect on the voice, fax, or data-handling capability of the platform. TDM switching plus network-side ISDN functions provide a means of grooming incoming traffic and passing selected calls to external devices, such as private branch exchanges (PBXs), test sets, VoIP gateways, or access servers. The Cisco AS5400XM Universal Gateway can switch calls between SS7, PRI, and CAS trunks. TDM switching of CAS calls requires DSP resources.

The Cisco AS5400XM Universal Gateway TDM backplane supports CT3-to-CT3 TDM switching.

### Remote-Access Capabilities

While still maintaining its capabilities as a best-of-class voice gateway, the Cisco AS5400XM Universal Gateway takes advantage of the full-feature richness and strong routing capabilities of Cisco IOS Software. It can be deployed in various architectures, from multiprotocol corporate networks (IP, IPX, AppleTalk, and NetBEUI, for example) to service provider IP networks. In addition, the Cisco AS5400XM fully supports the specialized needs of AOL, MSN, and other content-oriented dialup services through PPP, Layer 2 Tunneling Protocol (L2TP), or TCP Clear connections.

The Cisco AS5400XM Universal Gateway also supports the most complete set of access protocols of any access server in the industry, including PPP, IPX Control Protocol (IPXCP), AppleTalk Control Protocol (ATCP), AppleTalk Remote Access (ARA), NetBIOS Frame Control Protocol (NBFCP), NetBIOS over TCP/IP, NetBEUI over PPP, and protocol translation.

### V.92 and V.44 Support

V.92 and V.44 are the latest modem standards adopted by the industry. The standards specify a set of features that allow modems to mimic many of the benefits of broadband:

- V.44 increases throughput by more than 100 percent when surfing the Internet.
- V.92 Modem on Hold suspends an Internet session to place or receive a phone call.
- V.92 Quick Connect provides a faster connect time to the Internet.

Service providers can offer revenue-generating services and increase subscriber retention with V.92 and V.44 standards. Cisco RADIUS support for Modem on Hold allows premium subscribers to suspend their Internet sessions for longer periods of time to place or receive phone calls. Quick Connect saves the line conditions of the last number dialed, encouraging subscribers to dial into the same ISP to reduce connection time. Combined with greater compression and connection speeds, V.92 and V.44 allow service providers to offer their subscribers a “broadband-lite” experience, enabling Internet users to experience the qualities usually associated with broadband for the price of dialup or modem access.

### Security Management

Cisco IOS Software security features allow authorized users dialup access while preventing access to intruders. These features include: multilevel password protection; user authentication such as Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP); access control lists (ACLs); IP address spoofing prevention and logging; support of the industry-standard AAA protocols; RADIUS; and TACACS+.

### Internet Connectivity

Enterprises and service providers need to extend network access to a broad range of remote users, including employees, customers, and partners. Successful remote access means being able to connect these users from practically any location, almost transparently. The Cisco AS5400XM Universal Gateway, combined with Cisco IOS Software, meets these needs by extending the core infrastructure through secure, reliable dial-in connections.

Data over Voice Bearer Service (DoVBS) is used in areas where ISDN data calls are charged at a higher rate (or tariff) than ISDN voice calls. The ISDN customer-premises-equipment (CPE) device (terminal adapter or router) must support DoVBS operation—most popular ISDN devices available today support DoVBS. The ISDN CPE device is programmed to signal all ISDN data calls as voice calls to ensure that these calls are billed at the lower voice rate. Cisco Resource Pool Management (RPM) on the Cisco AS5400XM Universal Gateway is used to configure a customer profile for DoVBS calls based on DNIS. This profile configures the Cisco AS5400XM to treat all calls received on that number as ISDN data calls, even if they are signaled as voice calls by the PSTN network.

### Wholesale Dial

Many ISPs and content providers (or “portals”) must provide dialup Internet access as part of their service packages, and enterprise companies want to offer “private-label” Internet access to promote their brands. However, they do not have the experience, personnel, time, or money to build out a dialup access infrastructure, or they cannot build it fast enough—particularly when expanding into new regions. Service providers can now take advantage of this opportunity through the Cisco Wholesale Dial solution.

The Cisco Wholesale Dial outsourcing solution delivers “virtual port” capability across any number of Cisco remote-access servers. Coupled with third-party port policy management that guarantees port availability to wholesale customers, Cisco helps carriers and ISPs offer unique service offerings that increase incremental revenue while keeping operations costs low. The network infrastructure deployed for wholesale dialup also can be used to offer standard retail dialup services, plus other value-added services such as corporate dial outsourcing, Internet gaming, unified communications, VoIP, and VPNs.

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## Regional and Branch-Office Connectivity

The Cisco AS5400XM Universal Gateway is ideally suited for deployment in branch offices for providing remote access for telecommuters and mobile users. The CT1, CE1, and PRI interfaces can be used for remote access; the Ethernet ports can be used for LAN connectivity; and the serial ports can be used for access to the corporate site or to the Internet. Using the Enterprise Plus features of Cisco IOS Software, desktop protocols can be enabled.

## Access VPNs

The Cisco AS5400XM Universal Gateway is ideally suited to providing wholesale dial services to both large corporations and ISPs that do not want to support their own dial pools. With Cisco IOS Software support for VPNs, service providers can take advantage of their existing infrastructures to deliver local dialup access for users of enterprise networks. By providing virtual dialup solutions, service providers can offer a full range of services closer to the remote user. Local calls can now be placed to gain access to the core infrastructures. Virtual dialup services attract more users of this service, and because calls are terminated locally, long-distance charges are eliminated and infrastructure costs are reduced.

## VPN Provisioning and Accounting

Of importance to service providers in the VPN environment is the need to both provision and account for the number of connections that are allowed by VPN customers. Cisco Virtual Private Dialup Network (VPDN) session-counting software can keep track of the number of connections from the Cisco AS5400XM Universal Gateway to the user's home gateway. This software is provided in Cisco IOS Software running on the Cisco AS5400XM and in the Cisco Access Control Server to provide comprehensive accounting and billing information to ISPs about the virtual connections that their customers make.

## AOL Support

The Cisco AS5400XM Universal Gateway offers 100-percent coverage for dedicated AOL dial installations, as well as other services that use the TCP Clear or autocommand Telnet method of carrying dialup data. DNS round robin also is supported to allow load balancing of connections across multiple AOL hosts. The Cisco AS5400XM also includes all the L2TP features necessary to support clients with AOL 7.0 and later versions.

## Manageability

The Cisco AS5400XM offers a wide range of open protocols to support management. The Simple Network Management Protocol (SNMP) Versions 2 and 3 management capability includes a rich call-tracking SNMP MIB that provides highly detailed records for active and historical calls, with a configurable call-history buffer. Call records also can be obtained through syslog or RADIUS as an alternative to polling through SNMP. Call records include connect rate, connect duration, disconnect codes, end-to-end delay, and line statistics. Voice and dial service providers can use this performance-management data to establish service-level agreements with their customers.

The console-management features include a comprehensive set of debugging commands that can be enabled on a specific calling line ID (CLID) or ANI, called number (DNIS), user, or interface to immediately isolate only the relevant debugging output.

CiscoWorks includes a plug-in to manage the Cisco AS5400XM Universal Gateway.

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Cisco AS5400XM High-Density Packet Voice/Fax Feature Card with DSP Modules or Universal DSPs  
The Cisco AS5400XM High-Density Packet Voice/Fax Feature Card (AS5X-FC) and DSP Module (AS5X-PVDM2-64) bring greater price/performance, higher density, and expanded codec and feature support to the Cisco AS5400XM Universal Gateway.

A universal DSP feature card is also available to support remote-access services in combination with voice and fax applications. The universal DSP can execute multiple codec and modem algorithms on any DSP at any time. When the type of codec or modem required for a specific call is determined, the DSP activates the appropriate service type in real time.

## Reliability

### DSP Sparing and Pooling

The Cisco AS5400XM Universal Gateway is designed to meet high-availability requirements. The DSPs are pooled and can be configured as hot spares. Because DSPs are allocated on a call-by-call basis, a DSP failure does not cause a DS-0 or B channel to be left without a DSP to terminate the call, preventing occurrence of “holes” (unused channels) within a hunt group. Having spare DSPs in the pool also allows DSP code to be updated without affecting active calls. DSP resources are tested at power-up and after disconnect to check for defects. Any defective DSPs found are moved to the resource recovery pool. An automatic DSP recovery process can be activated to recover DSPs in the recovery pool and add them back into the resource pool if possible.

### Hot-Swappable Cards and Redundant Fans

Hot-swap capability on all cards allows hardware maintenance to be performed on an active Cisco AS5400XM Universal Gateway with little or no service interruption. During a hot-swap, any card can be removed, inserted, or replaced, and only the calls on the card being removed are affected. The Cisco AS5400XM chassis provides four high-capacity fans with front-to-back airflow for cooling.

### Redundant Backhaul Methods

Three redundant methods that can be used to backhaul traffic from the server to the network are included by default on the Cisco AS5400XM. The first method uses the two Gigabit Ethernet ports, which can be configured to run different types of traffic on each link for increased reliability. The second method uses the two high-speed, 12-in-1, 8-Mbps serial ports. These ports support all the Cisco serial routing protocols for flexibility in connecting to remote networks. The third method uses trunk feature cards as possible backhaul interfaces.

### Environmental Monitoring

Thermal sensors monitor the inlet and outlet temperatures and temperature rise across each card. If the operating temperature of the system exceeds its maximum, the thermal sensors initiate a shutdown of the feature cards, starting with the DSP cards and finishing with the trunk cards. The trunk cards are shut down last so the system has a chance to recover before putting the trunks into alarm status at the central office. If the system continues to exceed its maximum operating temperature, the thermal sensors initiate a shutdown, preventing damage to the unit or its surrounding environment from excess heat.

The Cisco AS5400XM Universal Gateway offers the option of a redundant AC or DC power supply. The redundant power system comprises a fully redundant switching power supply with two AC (or two DC) inputs to the main power modules. Each input and output is 100-percent fully redundant, with dual fans for added reliability and mean time between failure (MTBF) of more than 200,000 hours. Both the AC redundant and DC redundant power

supplies have internal protection features: overcurrent, overvoltage, and thermal shutdown. Internal sensors to the power supplies monitor all operational parameters, and alarm status is provided to the system.

## Regulatory Compliance

The Cisco AS5400XM Universal Gateway complies with Network Equipment Building Standards (NEBS) Level 3 requirements, as defined by Telcordia SR-3580, and also complies with European requirements as defined by the ETSI.

## Multivendor Back-Office Integration

The Cisco AS5400XM Universal Gateway supports RADIUS and TACACS+ protocols for back-office integration, control, and security. In addition to supporting the IETF-defined RADIUS attributes, Cisco IOS Software supports many vendor-specific RADIUS attributes for preauthentication, user authentication, and call accounting, meaning that the Cisco AS5400XM can be integrated into any multivendor remote-access and voice network with no changes to the back-office systems.

## Worldwide Certification

The Cisco AS5400XM Universal Gateway is homologated worldwide with all major T1 and E1 switch types

## Cisco AS5400XM Universal Gateway Architecture

The Cisco AS5400XM Universal Gateway provides all the system components that service providers have come to expect from carrier-class products as well as all the routing, WAN, and QoS features that are the hallmark of Cisco routing products. The Cisco AS5400XM uses a 750-MHz Reduced Instruction Set Computer (RISC) microprocessor with a 256-KB secondary cache and 512 MB of main memory. It offers the option of a redundant AC or DC power supply and has seven slots that can contain trunk and high-density packet voice/fax or universal port DSP feature cards. The Cisco AS5400XM architecture uses multiple data and control paths between feature cards and the motherboard to optimize media and signaling traffic for unparalleled performance (Figure 2).

**Figure 2.** Cisco AS5400XM Universal Gateway Chassis View



## Egress Interfaces

The Cisco AS5400XM Universal Gateway provides three redundant WAN backhaul methods for moving packets out to the network:

- Two 10/100/1000BASE-T autosensing Gigabit Ethernet ports
- Two 8-Mbps serial ports
- Any T1 or E1 port on a trunk feature card

## Ingress Interfaces

The Cisco AS5400XM Universal Gateway accepts and consolidates all types of traffic, including voice, fax, dial-in analog, digital ISDN, and GSM V.110 calls. It currently supports the following trunk feature cards as ingress interfaces:

- Two-port CT1/CE1/PRI termination
- Four-port CT1/CE1/PRI termination
- Eight-port CT1/CE1/PRI termination
- CT3 termination

Additionally, the two serial ports on the motherboard and trunk feature cards can be used for leased-line termination and aggregation using Frame Relay, HDLC, or PPP.

#### Cisco AS5400XM Universal Gateway 2-, 4-, and 8-Port CE1/CT1/PRI Termination Feature Cards

When provisioned for CE1 trunks, these cards provide physical termination for E1 R1, E1 R2, E1 PRI, or Inter Machine Trunks (IMTs). When provisioned as a CT1 trunk, they provide physical termination for CAS, PRI, or IMT trunks, and include channel service units (CSUs) that connect directly to the telco network. Nonintrusive monitoring of individual T1/E1 signals is available at the front of the T1/E1 termination card through standard 100-ohm bantam jacks (Figure 3).

**Figure 3.** Cisco AS5400XM Universal Gateway 8-Port Termination Feature Card

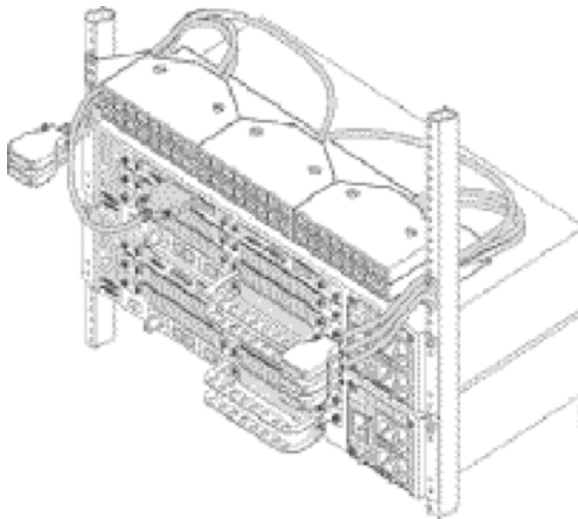


The following is a brief description of the trunk types supported:

- North American robbed-bit signaling (RBS) is supported on T1 trunks, including a variety of North American RBS protocol, framing, and encoding types on these trunks.
- CAS is supported for E1 trunks, with R2 signaling.
- IMT is supported when used with an SS7 signaling controller.
- Many countries require an E1 R2 variant; per-country defaults are provided for supervisory and inter-register signaling.
- Universal access (analog modem or digital calls) is supported when an interface is configured for ISDN PRI signaling; PRI signaling is available for both T1 and E1 trunks.

An optional 19-inch 1RU rack-mount is available to hold up to six 8-port breakout cables (DFC-8CT1/CE1)—anywhere in the rack (Figure 4).

**Figure 4.** Optional Rack-Mount Feature



#### Cisco AS5400XM Universal Gateway CT3 Trunk Feature Cards

When provisioned as a CT3 trunk, the CT3 interface cards provide physical termination for CAS, PRI, or IMT trunks, and include CSUs that connect directly to the telco network (Figure 5). The CT3 interface card provides physical-line termination for a CT3 ingress trunk line. It uses an onboard multiplexer to multiplex 28 CT1 lines into a single CT3 line. Nonintrusive monitoring of individual T1/E1 signals is available at the front of the T1/E1 termination card with standard 100-ohm bantam jacks.

**Figure 5.** Cisco AS5400XM CT3A Termination Feature Card



#### Cisco AS5400XM Universal Gateway High-Density Packet Voice/Fax Feature Card and DSP Module

The Cisco High-Density Packet Voice/Fax Feature Card (AS5X-FC) supports one to six high-density packet voice/fax DSP modules (AS5X-PVDM2-64), increasing the density of the feature card to 384 low-complexity, 192 medium-complexity, or 144 high-complexity VoIP calls. The Cisco AS5400XM Universal Gateway manages DSP resources on a call-by-call basis to service all codec types (low, medium, and high complexity). Support for multiple codec complexities makes it easy to customize the voice gateway DSP configuration to match individual network requirements. The unique codec mix operating in the network determines the number of DSP modules

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required. The DSP module is a field replaceable unit (FRU), making additions and servicing much easier while reducing downtime (Figure 6).

It is easy to integrate the high-density packet voice/fax feature card and DSP module into existing Cisco AS5400XM Universal Gateway networks. The new feature card and DSP module operate on the gateway without any changes to the Cisco IOS Software configuration file in use for existing universal port DSP feature cards, making network upgrades simple. Current configurations are automatically updated.

**Figure 6.** Cisco AS5400XM Universal Gateway High-Density Packet Voice/Fax Feature Card and DSP Module



#### Cisco AS5400XM Universal Gateway 60- and 108-Universal Port Feature Cards

The Cisco AS5400XM Universal Gateway 60- and 108-Universal Port Feature Cards are full-featured DSP-based cards that support 60 (on the former) or 108 (on the latter) voice, fax, and data calls. DSP-management features are available for troubleshooting, including DSP status, real-time call-in-progress statistics, DSP activity log, hard and soft busy out, and DSP firmware upgrade. Additional information can be obtained through the console, SNMP, or RADIUS accounting with the call-tracker feature (Figure 7).

**Figure 7.** Cisco AS5400XM Universal Gateway 60- and 108-Universal Port Feature Card



## Summary

The Cisco AS5400XM Universal Gateway is a cost-effective platform that combines the functions of a voice gateway, session border controller, remote-access server, VPN terminator, and router to create a complete “POP-in-a-box” solution. It is the only 2RU universal gateway that delivers high reliability and performance for up to 550 simultaneous calls on a CT3 interface. The Cisco AS5400XM can be deployed in both IMS and non-IMS architectures.

Demand for new services can be easily accommodated with the Cisco AS5400XM Universal Gateway whether the initial business opportunity is voice services over broadband, wholesale voice transport, unified communications, call-center services, IP-enabled IVR, hosted IP telephony, prepaid calling card, SBC interconnectivity, SS7/C7 interconnect, high-volume Internet access, regional or branch-office connectivity, corporate VPNs, or wholesale dial.

Tables 4 through 10 provide detailed specifications for the Cisco AS5400XM Universal Gateway.

**Table 4.** Hardware Features and Benefits of Cisco AS5400XM Universal Gateway

Feature	Benefit
Up to 22 T1, 18 E1, or CT3 (550) Voice or Fax Sessions Up to 16 T1/E1 or CT3 (550) Remote-Access Sessions	<ul style="list-style-type: none"> <li>Offers superior density in a compact form factor that is easy to deploy</li> </ul>
Multiple egress interface types	<ul style="list-style-type: none"> <li>Provides two 10/100/1000BASE-T Ethernet LAN connections</li> <li>Provides two 8-MB serial connections</li> <li>Provides trunk feature cards</li> <li>Offers stackable design-low initial cost</li> <li>Offers a universal port solution in one product</li> </ul>
High-density packet voice/fax feature card and DSP module	<ul style="list-style-type: none"> <li>Offers expanded codec and feature support for new, innovative services</li> <li>Helps enable higher-density configurations</li> <li>Improves price and performance for intelligent packet voice services</li> </ul>
Universal port DSPs	<ul style="list-style-type: none"> <li>Provides flexibility in deploying services—voice, fax, dialup, and ISDN termination</li> <li>Allows service providers to deliver universal services on any port at any time</li> </ul>
Built-in resiliency	<ul style="list-style-type: none"> <li>Provides hot-swappable cards and spare DSPs</li> <li>Offers redundant power supply option</li> <li>Offers three redundant backhaul methods</li> <li>Provides thermal management and environmental monitoring</li> <li>Provides fourfield-replaceable fan assembly with N+1 redundant fans in a tray</li> <li>Improves network and service availability, reducing time and money lost because of outages</li> </ul>

**Table 5.** Cisco AS5400XM Universal Gateway System Data

Feature	Description
Processor	<ul style="list-style-type: none"> <li>750-MHz RISC processor</li> </ul>
Memory	<ul style="list-style-type: none"> <li>512-MB synchronous dynamic RAM (SDRAM) (default), up to 1024 MB</li> <li>128-MB Compact Flash memory (system and boot flash memory)</li> <li>256-KB secondary cache</li> </ul>
Feature card slots	<ul style="list-style-type: none"> <li>Seven slots</li> <li>PCI slot for future expansion</li> </ul>
Egress ports	<ul style="list-style-type: none"> <li>Two 10/100/1000BASE-T Gigabit Ethernet ports</li> <li>Two 8-Mbps serial ports</li> <li>T1/E1 DS-1 trunk feature cards</li> <li>CT3 trunk feature cards</li> </ul>

**Table 6.** Cisco AS5400XM Universal Gateway Chassis Data

Feature	Description
Dimensions (H x W x D)	<ul style="list-style-type: none"> <li>3.5 x 17.5 x 18.25 in. (2RU) (8.89 x 44.45 x 46.36 cm)</li> </ul>
Weight	<ul style="list-style-type: none"> <li>35 lb (fully loaded CT3 configuration) (15.8 kg)</li> </ul>
Normal operating conditions	<ul style="list-style-type: none"> <li>32 to 104°F (0 to 40°C)</li> <li>–200 to 10,000 ft elevation (–61 to 3048m)</li> <li>5 to 95 percent humidity, noncondensing</li> </ul>

**Table 7.** Cisco AS5400XM Universal Gateway Power Supply Data

Input Description	Input Specifications
Input power	<ul style="list-style-type: none"><li>• 150W to 350W (maximum)</li></ul>
Input voltage (AC unit)	<ul style="list-style-type: none"><li>• 95 to 260 VAC</li></ul>
Input current (AC unit)	<ul style="list-style-type: none"><li>• 3A (maximum @ 120VAC), &lt;2A (typical)</li></ul>
Input frequency (AC unit)	<ul style="list-style-type: none"><li>• 47 to 63 Hz</li></ul>
Input voltage (DC unit)	<ul style="list-style-type: none"><li>• 40 to 70 VDC telco standards, positive ground</li></ul>
Input current (DC unit)	<ul style="list-style-type: none"><li>• 7.2A (maximum with NP108 based voice)</li><li>• 3.75A (maximum with AS5x-FC based voice)</li></ul>

**Table 8.** Overview of Protocols and Features of Cisco AS5400XM Universal Gateway

Feature	Description
<b>Protocols</b>	
LAN protocols	<ul style="list-style-type: none"><li>• IP</li><li>• IPX</li><li>• AppleTalk</li><li>• DECnet</li><li>• ARA</li><li>• NetBEUI</li><li>• Bridging</li><li>• HSRP</li><li>• 802.1Q</li></ul>
WAN protocols	<ul style="list-style-type: none"><li>• Frame Relay</li><li>• PPP</li><li>• HDLC (leased line)</li></ul>
Routing protocols	<ul style="list-style-type: none"><li>• Routing Information Protocol (RIP) and RIPv2</li><li>• OSPF</li><li>• IGRP</li><li>• EIGRP</li><li>• BGPv4</li><li>• IS-IS</li><li>• AppleTalk EIGRP</li><li>• IPX-EIGRP</li><li>• Next Hop Resolution Protocol (NHRP)</li><li>• AppleTalk Update-Based Routing Protocol (AURP)</li></ul>
QoS protocols	<ul style="list-style-type: none"><li>• IP Precedence</li><li>• RSVP</li><li>• WFQ</li><li>• WRED</li><li>• MMP fragmentation and interleaving</li><li>• 802.1P</li></ul>

Feature	Description
Access protocols	<ul style="list-style-type: none"> <li>• PPP</li> <li>• Serial Line Internet Protocol (SLIP)</li> <li>• TCP Clear</li> <li>• IPXCP</li> <li>• ATCP</li> <li>• ARA</li> <li>• NBFCP</li> <li>• NetBIOS over TCP/IP</li> <li>• NetBEUI over PPP</li> <li>• Protocol translation (PPP, SLIP, ARA, X.25, TCP, local-area transport [LAT], and Telnet)</li> <li>• XRemote</li> </ul>
Bandwidth optimization	<ul style="list-style-type: none"> <li>• Multilink PPP (MLPPP)</li> <li>• TCP/IP header compression</li> <li>• Bandwidth Allocation Control Protocol (BACP)</li> </ul>
Voice codecs and fax protocols	<ul style="list-style-type: none"> <li>• G.711 mu-law, G.711 a-law, G.729 a, G.729 ab, G.726 16K, 24K, 32K, G.728, G-Clear</li> <li>• Adaptive Multirate: AMR-NB 4.75K, 5.15K, 5.9K, 6.7K, 7.4K, 7.95K, 10.2K, 12.2K, SID</li> </ul>
Voice codecs and fax protocols High-density packet voice/fax DSPs	<ul style="list-style-type: none"> <li>• G.711 mu-law, G.711 a-law, G.729 a, G.729 ab, G.726 16K, 24K, 32K, G.728, G-Clear</li> <li>• Adaptive Multirate: AMR-NB 4.75K, 5.15K, 5.9K, 6.7K, 7.4K, 7.95K, 10.2K, 12.2K, SID</li> <li>• G.723.1 5.3K, 6.3K, G.723.1A 5.3K, 6.3K, iLBC</li> <li>• T.38 Real-Time Fax Relay</li> <li>• Super Group 3 fax interoperability</li> <li>• Cisco Real-Time Fax Relay</li> <li>• Fax detection</li> <li>• Fax pass-through</li> <li>• T.37 Store and Forward Fax</li> <li>• Modem Relay, modem pass-through</li> <li>• RFC 2833, H245 and Inband DTMF Relay and SIP NOTIFY and SUBSCRIBE</li> <li>• Media Authentication and Encryption using Secure RTP (H.323)</li> </ul>
Voice compression and fax protocols Universal DSPs	<ul style="list-style-type: none"> <li>• G.711, G.723.1 (5.3 and 6.3 KB), G.726, G.729ab, G729a, G-Clear, and GSM-FR</li> <li>• T.38 Real-Time Fax Relay</li> <li>• T.37 Fax Store and Forward</li> <li>• Fax pass-through</li> <li>• Modem pass-through</li> <li>• Fax detection</li> <li>• RFC 2833, H245 and Inband DTMF Relay and SIP NOTIFY and SUBSCRIBE</li> </ul>
DSP voice features	<ul style="list-style-type: none"> <li>• G.711, G.723.1 (5.3-KB and 6.3-KB), G.726, G.729ab, G729a, G-Clear, and GSM-FREcho cancellation, programmable up to 64 ms</li> <li>• Transparent transcoding between a-law and mu-law encoding</li> <li>• VAD, silence suppression, and comfort-noise generation</li> <li>• Fixed and adaptive jitter buffering</li> <li>• Call progress tone detection and generation—Dial tone, busy, ring-back, congestion, and reorder tones with local country variants</li> <li>• DTMF, multifrequency, and Continuity Testing (COT)</li> <li>• Per DS-1 modification of IP-side attenuation</li> </ul>
Voice signaling protocols	<ul style="list-style-type: none"> <li>• H.323v4, SIP, MGCP 1.0, TGCP 1.0, VoiceXML, RTSP, and ESMTTP</li> <li>• Fax out (transmission) Group 3, standards EIA 2388 Class 2 and EIA 592 Class 2.0, at modulations V.33, V.17, V.29, V.27ter, and V.21Open Settlements Protocol (OSP)</li> <li>• Media Recording Control Protocol (MRCP)</li> <li>• TTS servers</li> <li>• ASR servers</li> </ul>
SS7	<ul style="list-style-type: none"> <li>• Integrated SLT functions for MTP1 and MTP2 layer termination</li> <li>• IUA and RUDP backhaul of SS7 messages</li> </ul>

Feature	Description
Network security	<ul style="list-style-type: none"> <li>• RADIUS or TACACS+, PAP or CHAP authentication, and local user and password database</li> <li>• DNIS, CLID, and call-type preauthentication</li> <li>• Inbound and outbound traffic filtering (including IP, IPX, AppleTalk, and bridged traffic)</li> <li>• Network Address Translation (NAT) and dynamic access lists</li> <li>• SNMPv2 and SNMPv3</li> <li>• Secure Shell (SSH) Protocol Version 2</li> <li>• H.235</li> <li>• Media Authentication and Encryption using SRTP</li> <li>• Secure SIP signaling using TLS</li> </ul>
Virtual private networking	<ul style="list-style-type: none"> <li>• IP Security (IPsec) and policy enforcement (RADIUS or TACACS+)</li> <li>• L2TP, Layer 2 Forwarding (L2F), and generic-routing-encapsulation (GRE) tunnels</li> <li>• ACL-based security and intrusion detection</li> <li>• QoS features (committed access rate, Random Early Detection, IP Precedence, and policy-based routing)</li> </ul>
CT1	<ul style="list-style-type: none"> <li>• RBS; Loop Start, Immediate Start, and Wink Start protocols</li> <li>• Feature Group B and Feature Group D with operator services</li> </ul>
CEI	<ul style="list-style-type: none"> <li>• CAS, E1 R1, E1 R2, leased line, Frame Relay, G.703, and G.704</li> </ul>
ISDN protocols supported	<ul style="list-style-type: none"> <li>• Synchronous-mode PPP, V.120, and V.110 at rates up to 38,400 bps</li> <li>• User-side PRI switch types: NTT, NI, 4ESS, 5ESS, DMS100, NET5, and TS014</li> <li>• Non-Facility Associated Signaling (NFAS) with backup D channel</li> <li>• User-side NFAS switch types: NTT, NI, 4ESS, and DMS100</li> <li>• Network-side PRI switch types: NTT, NI, and NET5</li> <li>• Network-side NFAS not supported</li> <li>• DoVBS</li> <li>• Partial Q.SIG support</li> </ul>
Modem protocols supported	<ul style="list-style-type: none"> <li>• V.90 or V.92 standard supporting rates of 56,000 to 28,000 in 1,333-bps increments</li> <li>• V.92 Modem on Hold and Quick Connect</li> <li>• V.44 compression supporting increased throughput by more than 100 percent for Internet browsing</li> <li>• K56Flex at 56,000 to 32,000 in 2000-bps increments</li> <li>• ITU-T V.34 Annex 12 at 33,600 and 31,200 bps</li> <li>• ITU-T V.34 at 28,800, 26,400, 24,000, 21,600, 19,200, 16,800, 14,400, 12,000, 9,600, 7,200, 4,800, or 2,400 bps</li> <li>• V.32bis 14,400, 12,000, 9,600, 7,200, and 4,800; V.32 9,600 and 4,800; V.22bis 2,400 and 1,200; V.21 300; Bell 103, 300; V.22 1,200; and V.23 1,200/75</li> <li>• ITU-T V.42 (including Microcom Networking Protocol [MNP] 2-4 and Link Access Procedure for Modems [LAPM]) error correction</li> <li>• ITU-T V.42bis (1,000 nodes) and MNP 5 data compression</li> <li>• Asynchronous-mode PPP</li> </ul>
Wireless protocols	<ul style="list-style-type: none"> <li>• V.110 and V.120</li> </ul>
TDM clocking	<ul style="list-style-type: none"> <li>• Ability to synchronize clock with any T1 or E1 channel</li> <li>• Ability to synchronize clock with external Building Integrated Timing Supply (BITS) clock (Stratum 4E-compliant)</li> </ul>
Full Cisco IOS Software support	<ul style="list-style-type: none"> <li>• IP Plus and Enterprise Plus feature sets, including Triple Data Encryption Standard (3DES) and Lawful Intercept images</li> </ul>
Console and auxiliary ports	<ul style="list-style-type: none"> <li>• Asynchronous serial (RJ-45)</li> </ul>

**Table 9.** Cisco AS5400XM Universal Gateway Call-Capacity Table

Feature	Description
<b>Voice Call Capacities</b>	
Direct inward dialing (DID)	<ul style="list-style-type: none"> <li>• 550</li> </ul>
Calls using TCL IVR	<ul style="list-style-type: none"> <li>• 550</li> </ul>
Voicemail	<ul style="list-style-type: none"> <li>• 480</li> </ul>

Feature	Description
VoiceXML	<ul style="list-style-type: none"> <li>• 192 with DSPs and trunk interfaces</li> <li>• 200 with DTMF interaction only; no ASR/TTS, no trunk cards, and no DSPs</li> </ul>
TDM switching	<ul style="list-style-type: none"> <li>• 1344 (2 CT3s) without DSP (PRI or SS7)</li> <li>• 648 with DSP (CAS or E1 R2)</li> </ul>
<b>Dial Call Capacity</b>	
Asynchronous-mode PPP, synchronous-mode PPP, MLPPP, and TCP Clear	<ul style="list-style-type: none"> <li>• 550 DS-0s in use</li> </ul>
Microsoft Point-to-Point Compression (MPPC)	<ul style="list-style-type: none"> <li>• 460 asynchronous and 360 synchronous</li> </ul>

**Table 10.** Cisco AS5400XM Universal Gateway Compliance Data

Certification	Requirements
<b>NEBS certification</b>	<ul style="list-style-type: none"> <li>• Telcordia SR-3580</li> <li>• GR-1089-CORE, Issue 2</li> <li>• GR-63-CORE, Issue 1</li> <li>• Level 3 certification based on usage and critical nature of equipment</li> <li>• All equipment Common Language Equipment Identifier (CLEI) coded</li> <li>• Available in TIRKS database</li> </ul>
<b>Safety certifications</b>	<ul style="list-style-type: none"> <li>• UL 1950, third edition</li> <li>• CSA 950, third edition</li> <li>• EN 60950, with Amendments 1, 2, 3, and 4</li> <li>• IEC 60950</li> <li>• AS/NZS 3260</li> <li>• TS 001</li> </ul>
<b>Electromagnetic Emissions and Immunity Compliance</b>	<ul style="list-style-type: none"> <li>• EN 55022B (CISPR22)</li> <li>• EN 300386</li> <li>• NZS/AS3548 Class A</li> <li>• VCCI B</li> <li>• FCC 47CR15 Class A</li> </ul>
<b>BITS Clock</b>	<ul style="list-style-type: none"> <li>• Stratum Layer 4E-compliant</li> </ul>

**Table 11.** Cisco AS5400XM Universal Gateway Environmental Specifications

Feature	Description
<b>Heat Dissipation</b>	<ul style="list-style-type: none"> <li>• 1190 Btu/hr (maximum); 525 Btu/hr (typical)</li> </ul>
<b>AC Power Cable Supplied with AC Systems</b>	<ul style="list-style-type: none"> <li>• Redundant power supply: 18 AWG, 15-amp IEC 320 Type C5 standard cable</li> </ul>
<b>DC Power Cable Required for DC Systems</b>	<ul style="list-style-type: none"> <li>• 12-14 AWG stranded copper wire</li> </ul>
<b>Storage Temperature</b>	<ul style="list-style-type: none"> <li>• -40 to 185°F (-40 to 85°C)</li> </ul>
<b>Acoustics</b>	<ul style="list-style-type: none"> <li>• 55 dBA maximum; sound pressure level at 1m</li> </ul>
<b>Humidity</b>	<ul style="list-style-type: none"> <li>• 5 to 95 percent, noncondensing</li> </ul>
<b>Altitude</b>	<ul style="list-style-type: none"> <li>• -200 to 10,000 ft (-60 to 3,050m)</li> </ul>
<b>Reliability (at 104°F [40°C], 120 VAC and -48 VDC, 140W)</b>	<ul style="list-style-type: none"> <li>• 165,000 hours MTBF per chassis</li> </ul>



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