

# Cisco AS5350 Universal Gateway

The Cisco® AS5350 Universal Gateway is the only one-rack-unit (1RU) gateway supporting 2-, 4-, or 8-port T1/7-port E1 configurations that provides universal port data, voice, and fax services on any port at any time (Figure 1). The Cisco AS5350 Universal Gateway offers high performance and high reliability in a compact, modular design. This cost-effective platform is ideally suited for Internet service providers (ISPs) and enterprise companies that require innovative universal services.

### Cisco Any Service, Any Port

The economic environment is prompting service providers to generate revenues quickly, improve returns from capital investments, and adapt to changing demands for various services in the market place. Cisco Any Service, Any Port (ASAP)—the architecture for rapid deployment of concurrent services on Cisco AS5000 universal gateways—allows service providers to meet these challenges. Cisco ASAP enables faster service introduction using a common platform for quick return on investment (ROI). Service providers can generate new revenue streams from multiple voice and data services such as long-distance voice over IP (VoIP), managed IP telephony, VPNs, and dial-up Internet.

### Your Complete Point-of-Presence Solution

The Cisco AS5350 Universal Gateway eliminates the need for switches and routers to create a point of presence (POP) or “POP-in-a-box” solution. The Cisco AS5350 has three primary universal gateway configurations: two Channelized T1(CT1)/Channelized E1(CE1)s, four CT1/CE1s, and eight CT1/seven CE1s. It also includes integrated signaling link termination (SLT) functions for direct connection to a Common Channel Signaling System 7 (SS7/C7) signaling gateway.

The Cisco AS5350 comes with two 10/100 autosensing Ethernet ports, which are ideal 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 backhaul interfaces support Hot Standby Router Protocol (HSRP), and all cards and the fan tray are hot-swappable

Figure 1 Cisco AS5350 Universal Gateway



for carrier-class resiliency. The Cisco AS5350 is the only gateway in this form factor that offers universal port capability with these high-availability features.

The Cisco AS5350 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] Protocol). This capability allows service providers and enterprises to deploy the Cisco AS5350 as a standalone universal port solution.

### **Cisco AS5350 Universal Gateway Enables New Cisco Services**

The rich set of Cisco IOS® Software features available in the Cisco AS5350 Universal Gateway enables ISP and enterprise network managers to meet traditional dial-in access needs, including Internetwork Packet Exchange (IPX) and AppleTalk, while supporting the migration to new universal port services.

The Cisco AS5350 supports a wide range of IP-based, value-added services such as high-volume Internet access, regional- or branch-office connectivity, corporate VPNs, long distance for ISPs, international wholesale long distance, distributed prepaid calling, SS7 interconnect, wholesale dial and voice, and enhanced voice services. The Cisco AS5350 provides an ideal solution for telephony application service providers (ASPs) that would like to deploy PC-to-phone, voice portals, unified communications, IP teleconferencing, voice-enabled Web commerce, and content delivery services.

Cisco 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 family of access server products with universal port digital signal processors (DSPs), Cisco Systems® 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 can also provide assistance with startup, maintenance, and marketing tasks, as well as advanced and custom solutions.

## Primary Features

### **Cisco ASAP**

The Cisco ASAP architecture enables the Cisco AS5350 Universal Gateway to operate simultaneously as a network access server (NAS) and a voice gateway, delivering universal services on any port at any time. The Cisco ASAP services on the Cisco AS5350 include dial access, real-time voice and fax for local or long-distance transport, managed services (hosted IP telephony, for example), and unified communications on a call-by-call basis. Cisco AS5350 achieves cost savings through optimized use of the universal port access infrastructure. Service providers can now quickly capitalize on new opportunities and realize multiple revenue streams from a single access infrastructure.

### **Modular Architecture**

All feature cards can be upgraded in the field to accommodate future technologies while providing a solution to meet today's needs. The removable system fan tray maximizes uptime.

### **Universal DSPs**

The Cisco ASAP architecture is based on universal DSP technology. The universal DSP can execute multiple coder/decoder (codec) and modem algorithms on any DSP at any time. When the type of codec or modem required for a specific call has been determined, the DSP activates the appropriate service type in real time. When the call is determined, different signaling schemes and modem negotiations are used to determine the actual firmware code to be downloaded onto the DSP for that particular call.

### **Remote Access Capabilities**

The Cisco AS5350 Universal Gateway takes advantage of the full-feature richness and strong routing capabilities of Cisco IOS Software. The Cisco AS5350 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 AS5350 fully supports the specialized needs of AOL, MSN, and other content-oriented dialup services through PPP, Layer 2 Tunneling Protocol (L2TP), or Transmission Control Protocol Clear (TCP Clear) connections.

The Cisco AS5350 also supports the most complete set of access protocols of any access server, 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, including:

- 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 Remote Authentication Dial-In User Service (RADIUS) support for Modem on Hold will allow 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, which enables Internet users to experience the qualities usually associated with broadband for the price of dialup or modem access.

## Packet Telephony

The framework for VoIP services on the Cisco AS5350 Universal Gateway is based on open interfaces and 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 AS5350—H.323, Session Initiation Protocol (SIP), Media Gateway Control Protocol (MGCP), and Trunking Gateway Control Protocol (TGCP) support are all built in. This allows 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.

## H.323

Leading the industry through the adoption of new standards-based H.323 technology, the Cisco AS5350 Universal Gateway supports the scalability enhancements introduced in H.323v3 and H.323v4. For example:

- 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.
- Ability to report capacity statistics to the gatekeeper on a per-call basis for each DS0, trunk group, or carrier associated with the public switched telephone network (PSTN)-side interfaces to assist in routing decisions.

The Cisco AS5350 Universal Gateway supports a broad array of proven, interoperable H.323-based solutions for service provider networks including global long distance, distributed prepaid calling, SS7 interconnect, telephony application hosting, and unified communications.

## SIP

SIP is the Internet Engineering Task Force (IETF) standard for multimedia conferencing over IP. Defined in RFC 2543, SIP is an ASCII-based, application-layer control protocol that can be used to establish, maintain, and terminate calls between two or more endpoints. The SIP implementation on the Cisco AS5350 Universal Gateway includes support for key features such as third-party call control and RFC 2833 dual-tone multifrequency (DTMF) relay for interconnection with ASP networks.

## Similarities Between H.323 and SIP

- Both 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 end points

Although SIP messages are not directly compatible with H.323, both protocols can coexist in the same packet telephony network because the Cisco AS5350 Universal Gateway has the ability to process individual SIP and H.323 calls simultaneously. This allows service providers to integrate complementary H.323 and SIP services in the same network.

## MGCP and TGCP

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 the informational RFC 2705, published by the IETF.

The Cisco AS5350 Universal Gateway includes support for the MGCP network access server (NAS) package. This allows the platform to operate simultaneously as a network access server and a voice gateway to deliver universal port services in an MGCP network. Standards-based T.38 Fax Relay and RFC 2833 DTMF Relay are available with MGCP.

The Cisco AS5350 also supports the PacketCable Trunking Gateway Control Protocol (TGCP) 1.0. PacketCable is an industry-wide initiative to develop interoperability standards for multimedia services over cable facilities using packet technology. CableLabs developed the TGCP protocol, which contains extensions and modifications to MGCP while preserving the basic MGCP architecture and constructs.

## Voice Extensible Markup Language Solution Infrastructure

The Cisco AS5350 Universal Gateway has the ability to interpret Voice Extensible Markup Language (VoiceXML) documents. VoiceXML is an open-standard markup language used to create voice-enabled Web browsers and interactive voice response (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 AS5350 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.

## Programmable Tool Command Language IVR 2.0

Integrated, programmable IVR extends the ability of the Cisco AS5350 Universal Gateway to support unique and differentiated voice services. Voice application software developers can use the Tool Command Language (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-driven, 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. Real-Time Streaming Protocol (RTSP)-based prompts are supported. TCL IVR 2.0 offers enhanced multi-language support by providing the capability to add new languages and text-to-speech notations to the core IVR infrastructure. The Cisco Developer Support Program supports companies developing or modifying TCL IVR 2.0 scripts.

## Integrated SLT

The trunk cards also have a serial and RJ45 interfaces for integrated SLT functionality. With integrated SLT, the Cisco AS5350 Universal Gateway provides distributed Message Transfer Part (MTP) SS7 signaling functionality directly on the gateway. Like the Cisco 2600 Series-based SLT, the integrated SLT backhauls upper-layer SS7 protocols across an IP network using Cisco Reliable UDP (RUDP), 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/ISUP backhaul is included. Pricing is on a per-platform basis.

## Voice Quality

The extensive voice and fax capabilities of the Cisco AS5350 Universal Gateway can help build a reliable, high-quality VoIP network. Voice-quality tests confirm that the Cisco AS5350 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 AS5350 hidevelopment process. Cisco conducts subjective voice-quality tests to determine mean opinion scores using a methodology derived from International Telecommunication Union Telecommunication Standardized Sector (ITU-T) Recommendations P.830 and P.831. Objective voice-quality tests are also conducted using the Perceptual Analysis Measurement System.

The high-performance design of the Cisco AS5350 Universal Gateway minimizes delay and packet loss during voice encoding and packetization processes. The Cisco AS5350 introduces minimal

delay as voice data is received from the PSTN and transmitted to the IP network for G.711 calls. Cisco quality-of-service (QoS) features, including IP Precedence, Resource Reservation Protocol (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 AS5350 supports ITU-T Recommendation G.168 for echo cancellation with a tail length up to 128 ms. Fixed and adaptive jitter buffering and comfort-noise generation further enhance voice quality.

### **Voice Codecs**

The Cisco AS5350 Universal Gateway offers multiple codecs to meet interoperability, compression, and latency requirements for a variety of phone-to-phone and PC-to-phone applications—G.711, G.723.1 (5.3K and 6.3K), G.726, G.729ab, G-Clear and GSM-FR. The same number of calls is supported across all codec types to simplify network engineering. Enabling voice activity detection (VAD) reduces packet traffic through the network. With VAD enabled, the Cisco AS5350 detects silence and stops transmitting packets when callers stop speaking. Variable frame sizing provides further control over speech packetization.

### **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.

Call admission control (CAC) extends the QoS tool suite to protect voice traffic from being negatively affected by other voice traffic, keeping excess voice traffic off of the network. CAC allows the Cisco AS5350 Universal Gateway to make 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 utilization and call arrival rate at the individual gateway
- 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, taking into account the circuits in use for data, voice, or fax services to achieve higher call-success rates

### **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 AS5350 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 AS5350 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 AS5350 also supports fax passthrough upspeed for VoIP environments that cannot support T.38 Real-Time Fax Relay end to end.

### **Time-Division Multiplexing Switching**

Time-division multiplexing (TDM) switching is the ability to take an incoming call on a given DS0 and send it out on a different DS0 before the call is answered by the gateway. This feature is used in applications such as:

- SS7 to Primary Rate Interface (PRI) grooming
- Local number portability (LNP) support in Europe
- Meeting special provisional requirements for test calls (for example, 911 call handling)

This feature does not require any DSP resource and hence has no impact on the dial, voice, or fax handling capability of the platform. TDM switching plus network-side ISDN functionality provides 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 AS5350 is capable of switching calls between SS7, PRI, and channel-associated signaling (CAS) trunks.

## 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; and support of the industry-standard authentication, authorization, and accounting (AAA) protocols; RADIUS; and Terminal Access Controller Access Control System (TACACS+).

## Manageability

The Cisco AS5350 Universal Gateway has a wide range of management tools designed to reduce operations costs. The Cisco Universal Gateway Manager (UGM) is an element management system that supports the configuration, management, and troubleshooting of Cisco AS5000 universal gateways.

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

The Simple Network Management Protocol (SNMP) v2 and v3 management capability includes a rich call-tracking SNMP Management Information Base (MIB) that provides highly detailed records for active and historical calls, with a configurable call-history buffer. Call records can also 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. This information allows service providers to debug problems for individual users. Wholesale dial and voice service providers can use this performance-management data to establish service-level agreements with their retail ISP customers.

The Cisco UGM is a next-generation element management system offering robust, scalable, carrier-class capabilities for Cisco AS5000 universal gateways. Providing comprehensive fault, configuration, accounting/inventory, performance, security (FCAPS) capabilities, the Cisco UGM enables operators to effectively configure, manage, and maintain dial-access networks. The Cisco UGM facilitates the rapid deployment of new services and provides quick and effective network diagnostics to meet the rigorous demands of today's fast-moving marketplace.

## Reliability

### DSP Sparing and Pooling

The Cisco AS5350 Universal Gateway meets high-availability requirements. Modem and voice DSPs are pooled and can be configured as hot spares. Because DSPs are allocated on a call-by-call basis, a DSP failure will not cause a DS0 or B channel to be left without a DSP to terminate the call. This prevents 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 Fan Tray

Hot-swap capability on all cards allows hardware maintenance to be performed on an active access server with little or no service interruption. During a hot-swap, any card may be removed, inserted, or replaced, and only the calls on the card being removed are affected. The Cisco AS5350 Universal Gateway chassis provides five high-capacity fans with front-to-back airflow to cool the chassis. The fan tray can be replaced while the unit is in operation.

### Redundant Backhaul Methods

Three redundant methods, which can be used to backhaul traffic from the server to the network, are included by default on the Cisco AS5350 Universal Gateway. The first method uses the two Fast Ethernet ports. These can be configured to run different types of traffic on each link or use the HSRP in a redundant mode for increased reliability. The second method uses the two high-speed, 12-in-1, 8-Mbps serial ports on the rear of the chassis. 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 modem 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 AS5350 Universal Gateway offers the option of a redundant power supply or single power supply. The redundant power supply 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 1,000,000 hours in redundant mode. The single AC or DC power supply also has dual fans for added reliability and a MTBF of more than 200,000 hours. Both the redundant and single 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 AS5350 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 European Telecommunication Standards Institute (ETSI).

### **Multivendor Back-Office Integration**

The Cisco AS5350 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 both preauthentication and user authentication. This means that the Cisco AS5350 can be integrated into any multivendor remote access and voice network with no changes to the back-office systems.

### **Worldwide Certification**

The Cisco AS5350 Universal Gateway is homologated worldwide with all major T1 and E1 switch types.

### **Cisco IOS Software Enables Rich Services**

#### **Flexibility in Deploying New Services**

Demand for new services can be easily accommodated with the Cisco AS5350 Universal Gateway, whether the initial business opportunity is wholesale dial, prepaid calling card, unified communications, hosted IP telephony, or any other application. The flexibility to use the Cisco AS5350 in multiple service environments provides unprecedented capital investment protection. It also ensures that remote access equipment can promptly adapt itself to any change in business environment or demand for new services. The ability for service providers to offer innovative new services allows differentiation from competition.

## **Remote Access Services**

### **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 AS5350 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 AS5350 is used to configure a customer profile for DoVBS calls based on DNIS. This profile configures the Cisco AS5350 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 sophisticated port policy management that guarantees port availability to wholesale customers, Cisco enables carriers and ISPs to offer unique service offerings that drive incremental revenue while keeping operations costs low. The network infrastructure deployed for wholesale dialup can also 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.

### **Regional- and Branch-Office Connectivity**

The Cisco AS5350 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 IP Plus features of Cisco IOS Software, firewall functions can be enabled to protect internal servers. Using the Enterprise Plus features of Cisco IOS Software, desktop protocols can be enabled.

### Access VPNs

The Cisco AS5350 Universal Gateway is ideally suited for providing wholesale dial services to both large corporations and ISPs who 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 not only attract more users of this service, but 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 AS5350 Universal Gateway to the user's home gateway. This software is provided in Cisco IOS Software running on the Cisco AS5350 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 AS5350 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. Domain Name System (DNS) round robin is also supported to allow load balancing of connections across multiple AOL hosts. The Cisco AS5350 also includes all the L2TP features necessary to support clients with AOL 7.0 and later versions.

### Packet Telephony Services

#### Cisco Voice Infrastructure and Applications

The Cisco AS5350 Universal Gateway supports Cisco Voice Infrastructure and Applications (VIA), an ideal solution for service providers building next-generation networks. Cisco VIA is a VoIP solution designed to lower network costs and rapidly deliver a multitude of revenue-generating carrier-class voice transport services. These include: national and international transport,

prepaid and postpaid calling card services, application service provider (ASP) termination, dial access, and voicemail/unified communications.

The Cisco VIA solution scales easily for small and large voice networks. Using the Cisco AS5350 and Cisco VIA, service providers with existing data networks can quickly and easily add voice services to their portfolios, while carriers who offer voice services over existing TDM networks can expand their coverage more cost-effectively. Cisco VIA extends network reach through worldwide compatibility and operability, and is a field-proven solution that has been deployed in more than 80 countries worldwide.

#### Distributed Prepaid Calling

The Cisco Prepaid Calling Card solution gives Internet telephony service providers a competitive advantage in the prepaid calling market. By tapping the intelligence embedded in IP network components, the solution allows service providers to centralize the service application in a single location at a low cost while bandwidth-intensive call connections are handled at the network edge in Cisco gatekeepers and gateways. The benefit: lower costs than traditional debit card applications, which are based on service points in large POPs in circuit-switched networks. The prepaid calling card solution supports IVR in different languages, so carriers can target specific markets.

#### SS7 Interconnect

Using the Cisco PGW 2200 Softswitch (or a third-party SS7 gateway) and the Cisco AS5350 Universal Gateway with integrated SLT functionality, service providers can interconnect their data and VoIP networks with the PSTN via SS7 links. In many countries carriers must interconnect using SS7 to qualify for reciprocal compensation. The Cisco PGW 2200 and Cisco AS5350 provide the interface needed to interconnect using Q.931 over IP, 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 PRI trunks. With SS7, call setup time decreases, increasing the amount of billable traffic carried by the network.

#### Managed Voice Services

Telephony ASPs are emerging as an important market force, offering new, hosted, enhanced IP communications services that provide additional functionality beyond the services offered by the PSTN. Example applications hosted by telephony ASPs include hosted IP telephony, managed IP PBX, PC-to-phone services, unified communications, multiservice VPN, IP contact center, IP

teleconferencing, voice-enabled Web commerce, and content delivery. This creates new business partnering opportunities for VoIP service providers. The standards-based Cisco AS5350 enables interconnection between telephony ASPs and VoIP network infrastructure providers to bring complete solutions to end users.

## Unified Communications

Unified communications uses the IP infrastructure to unify the communications methods that were previously disjointed—e-mail applications, fax machines, voice-mail systems, cellular phones, and Web communications. This 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 AS5350s 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 voice mail, 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

## Service-Level Management

The Cisco AS5350 Universal Gateway supports RADIUS-based Cisco RPM. This enables service providers to offer guaranteed port availability across a shared infrastructure, which translates to guaranteed service levels for their customers. In addition, Cisco RPM offers the ability to ensure “fairness” across multiple customers for the same shared ports when there is no service-level guarantee.

Resource pooling can be configured on a per-gateway or per-network basis. In the former case, customer profiles stored on Cisco AS5350s determine how resources are allocated to each of the wholesale service provider’s customers. Each customer is identified based on a list of dialed numbers from DNIS. When network-wide service levels are required, external Cisco Resource Policy Management System (RPMS) software running on a Sun Solaris server holds the customer profiles and keeps track of port utilization across multiple Cisco AS5000 universal gateways and/or other vendors’ RADIUS-compliant gateways. When the Cisco AS5350

receives an incoming call, the Cisco RPMS determines whether the call should be accepted based on information in the customer profile.

## Cisco AS5350 Architecture

The Cisco AS5350 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 AS5350 uses a 250-MHz RISC microprocessor with 256K secondary and 2-MB tertiary caching. The main CPU in the Cisco AS5350 is also used in the Cisco 7200 Series Network Processing Engine 300. The Cisco AS5350 offers the option of a redundant power supply or single power supply. The Cisco AS5350 has three slots that can contain trunk and universal port feature cards. The Cisco AS5350 architecture uses distributed processing between the feature cards and the motherboard to optimize the processing path for unparalleled performance (See Figure 2).

Figure 2 Cisco AS5350 Chassis View



## Egress Interfaces

The Cisco AS5350 Universal Gateway provides three redundant WAN backhaul methods for moving packets out to the network:

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

## Ingress Interfaces

The Cisco AS5350 Universal Gateway accepts and consolidates all types of traffic, including dial-in analog, digital ISDN, wireless, voice, Global System for Mobile Communications (GSM) V.110 calls, and fax calls. The Cisco AS5350 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

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 AS5350 Two-, Four-, and Eight-Port CE1/CT1/PRI Termination Feature Cards

When provisioned for CE1 trunks, these cards provide for physical termination for E1 R1, E1 R2, E1 PRI, or intermachine trunks (IMTs). When provisioned as a CT1 trunk, it provides physical termination for CAS, PRI, or IMT trunks, and includes 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 via standard 100-ohm bantam jacks (See Figure 3).

Figure 3 Cisco AS5350 Two-, Four-, or Eight-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

### Cisco AS5350 60- and 108-Universal Port Feature Cards

The Cisco AS5350 Universal Gateway 60- and 108-universal port cards are full-featured DSP-based cards that support 60 (on the former) or 108 (on the latter) modem, wireless, voice, and fax calls. Modem-management features are available for troubleshooting, including modem status, real-time call-in-progress statistics, modem activity log, hard/soft busy out, and modem firmware upgrade. Additional information can be obtained through the console, SNMP, or RADIUS accounting via the call-tracker feature (See Figure 4).

Figure 4 Cisco AS5350 60- and 108-Universal Port Feature Card



### Summary

The Cisco AS5350 Universal Gateway is a cost-effective platform that combines the functions of a VPN terminator, firewall, router, access server, and voice gateway to create a complete “POP-in-a-box” solution. The Cisco AS5350 is the only 1RU universal gateway that delivers high reliability and performance in a compact 8-T1/7-E1 density.

The Cisco AS5350 universal DSPs provide voice, data, and fax services. The benefits to the service providers are flexibility in deploying services and optimized utilization of their universal port access infrastructure. The Cisco AS5350 provides a space-saving solution for Tier 2 and 3 ISPs, small Tier 1 POPs, and telephony ASPs.

Tables 1 through 7 provide detailed specifications for the Cisco AS5350.



Table 1 Cisco AS5350 Hardware Features and Benefits

Feature	Benefit
Up to 8-T1/7-E1 data, voice, or fax 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>• Two 10/100 Ethernet LAN connections</li><li>• Two 8-MB serial connections</li><li>• Trunk feature cards</li><li>• Offers stackable design—low initial cost</li><li>• Offers a universal port solution in one product</li></ul>
Universal port DSPs	<ul style="list-style-type: none"><li>• Provides flexibility in deploying services—voice, dialup, fax, ISDN termination</li><li>• Service providers can deliver universal services on any port at any time</li></ul>
Built-in resiliency	<ul style="list-style-type: none"><li>• Hot-swappable cards and spare modems</li><li>• Redundant power supply option</li><li>• Three redundant backhaul methods</li><li>• Thermal management and environmental monitoring</li><li>• Fan tray hot-swappable while in rack</li><li>• Improves network and service availability, reducing time and money lost because of outages</li></ul>

Table 2 Cisco AS5350 System Data

System Data	
Processor	<ul style="list-style-type: none"><li>• 250-MHz RISC processor</li></ul>
Memory	<ul style="list-style-type: none"><li>• 128- (default) to 512-MB SDRAM (maximum)</li><li>• 64- (default) to 128-MB shared I/O (maximum)</li><li>• 8- (default) to 16-MB boot Flash (maximum)</li><li>• 32- (default) to 64-MB system Flash (maximum)</li><li>• 2-MB Layer 3 cache</li></ul>
Feature card slots	<ul style="list-style-type: none"><li>• Three slots</li></ul>
Egress ports	<ul style="list-style-type: none"><li>• Two 10/100-MB Ethernet ports</li><li>• Two 8-Mbps serial ports</li><li>• T1/E1 DS1 trunk feature cards</li></ul>

Table 3 Cisco AS5350 Chassis Data

Chassis Data	
Dimensions (H x W x D)	1.75 x 17.5 x 20.5 in. (1RU)
Weight	22 lb (fully-loaded two-PRI configuration)
Normal operating conditions	0 to 40 C -200 to 10,000 ft elevation



Table 4 Cisco AS5350 Power Supply Data

Input Description	Input Specifications
Input power (AC unit)	114 to 140W (maximum)
Input voltage (AC unit)	100 to 240 VAC
Input current (AC unit)	2A (maximum), 1A (typical)
Input frequency (AC unit)	50 to 60 Hz
Input power (DC unit)	114 to 140W (maximum)
Input voltage (DC unit)	-48 to -60 VDC
Input current (DC unit)	3.0A (maximum), 2.0A (typical)

Table 5 Overview of Cisco AS5350 Protocols

Protocols	
<b>LAN protocols</b>	<ul style="list-style-type: none"> <li>• IP, IPX, AppleTalk, DECnet, ARA, NetBEUI, bridging, HSRP, 802.1Q</li> </ul>
<b>WAN protocols</b>	<ul style="list-style-type: none"> <li>• Frame Relay, PPP, HDLC (leased line)</li> </ul>
<b>Routing protocols</b>	<ul style="list-style-type: none"> <li>• Routing Information Protocol (RIP), RIPv2, OSPF, IGRP, EIGRP, BGPv4, IS-IS, AT-EIGRP, IPX-EIGRP, Next Hop Resolution Protocol (NHRP), AppleTalk Update-Based Routing Protocol (AURP)</li> </ul>
<b>QoS protocols</b>	<ul style="list-style-type: none"> <li>• IP Precedence</li> <li>• Resource Reservation Protocol (RSVP)</li> <li>• Weighted Fair Queuing (WFQ)</li> <li>• Weighted Random Early Detection (WRED)</li> <li>• Multichassis Multilink PPP (MMP) fragmentation and interleaving</li> <li>• 802.1P</li> </ul>
<b>Access protocols</b>	<ul style="list-style-type: none"> <li>• PPP, Serial Line Internet Protocol (SLIP), TCP Clear, IPXCP, ATCP, ARA, NBFCP, NetBIOS over TCP/IP, NetBEUI over PPP, protocol translation (PPP, SLIP, ARA, X.25, TCP, local-area transport [LAT], Telnet), and XRemote</li> </ul>
<b>Bandwidth optimization</b>	<ul style="list-style-type: none"> <li>• Multilink PPP (MLP), TCP/IP header compression, Bandwidth Allocation Control Protocol (BACP), bandwidth on demand, traffic shaping</li> </ul>
<b>Voice compression</b>	<ul style="list-style-type: none"> <li>• G.711, G.723.1 (5.3K and 6.3K), G.726, G.729ab, G-Clear, GSM-FR</li> </ul>
<b>DSP voice features</b>	<ul style="list-style-type: none"> <li>• Echo cancellation, programmable up to 128 ms</li> <li>• Transparent transcoding between A-law and mu-law encoding</li> <li>• Voice activity detection, silence suppression, 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>• Dual Tone Multifrequency (DTMF), Multifrequency, continuity testing</li> </ul>



Table 5 Overview of Cisco AS5350 Protocols (Continued)

Protocols	
<b>Voice and fax signaling protocols</b>	<ul style="list-style-type: none"> <li>• H.323v2, H.323v3, H.323v4, SIP, MGCP 1.0, TGCP 1.0, VoiceXML, RTSP, ESMTTP</li> <li>• T.38 Real-Time Fax Relay</li> <li>• T.37 fax store and forward</li> <li>• Fax passthrough</li> <li>• Modem passthrough</li> <li>• Fax detection</li> <li>• Open Settlements Protocol (OSP)</li> <li>• Media Resource Control Protocol (MRCP)</li> <li>• Text to Speech (TTS) servers</li> <li>• Automatic Speech Recognition (ASR) servers</li> </ul>
<b>SS7</b>	<ul style="list-style-type: none"> <li>• Integrated SLT functionality</li> </ul>
<b>Network security</b>	<ul style="list-style-type: none"> <li>• RADIUS or TACACS+, PAP or CHAP authentication, local user/password database</li> <li>• DNIS, CLID, call-type preauthentication</li> <li>• Inbound/outbound traffic filtering (including IP, IPX, AppleTalk, bridged traffic)</li> <li>• Network Address Translation (NAT) and dynamic access lists</li> <li>• SNMPv2, SNMPv3</li> </ul>
<b>VPN</b>	<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>• Firewall security and intrusion detection</li> <li>• QoS features (committed access rate, Random Early Detection, IP Precedence, policy-based routing)</li> </ul>
<b>Channelized T1</b>	<ul style="list-style-type: none"> <li>• Robbed-bit signaling: Loop Start, Immediate Start, and Wink Start protocols</li> </ul>
<b>Channelized E1</b>	<ul style="list-style-type: none"> <li>• CAS, E1 R1, E1 R2, leased line, Frame Relay, G.703, G.704</li> </ul>
<b>ISDN protocols supported</b>	<ul style="list-style-type: none"> <li>• Sync-mode PPP, V.120, V.110 at rates up to 38400 bps</li> <li>• Network- and user-side ISDN</li> <li>• DoVBS</li> <li>• NFAS with backup D-channel</li> <li>• QSIG, Feature Group B, Feature Group D</li> </ul>



Table 5 Overview of Cisco AS5350 Protocols (Continued)

Protocols	
<b>Modem protocols supported</b>	<ul style="list-style-type: none"><li>• V.90 or V.92 standard supporting rates of 56000 to 28000 in 1333-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>• 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.21</li><li>• K56Flex at 56000 to 32000 in 2000-bps increments</li><li>• ITU-T V.34 Annex 12 at 33600 and 31200-bps</li><li>• ITU-T V.34 at 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400-bps</li><li>• V.32bis 14400, 12000, 9600, 7200, 4800; V.32 9600, 4800; V.22bis 2400, 1200; V.21 300; Bell 103, 300; V.22 1200; V.23 1200/75</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 (1000 nodes) and MNP 5 data compression</li><li>• Async-mode PPP</li></ul>
<b>Wireless protocols</b>	<ul style="list-style-type: none"><li>• V.110 and V.120</li></ul>
<b>Full Cisco IOS Software support</b>	<ul style="list-style-type: none"><li>• IP Plus and Enterprise Plus feature sets</li></ul>
<b>Console and auxiliary ports</b>	<ul style="list-style-type: none"><li>• Asynchronous serial (RJ-45)</li></ul>



Table 6 Cisco AS5350 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 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 B</li> <li>• VCCI B</li> <li>• FCC 47CR15 Class B</li> </ul>

Table 7 Cisco AS5350 Environmental Data

Environmental Specifications	
<b>Heat dissipation</b>	478 Btu/hr (maximum), 389 Bt/hr (typical)
<b>AC power cable supplied with AC systems</b>	Single power supply: 18 American wire gauge (AWG), 15-amp IEC 320 Type C13 standard cable Redundant power supply: 18 American wire gauge (AWG), 15-amp IEC 320 Type C5 standard cable
<b>DC power cable required for DC systems</b>	12-14 AWG stranded copper wire
<b>Storage temperature</b>	25.8 to 185°F (-40 to 85°C)
<b>Acoustics</b>	55 dBA max.; sound pressure level at 1m
<b>Humidity</b>	5 to 95 percent, noncondensing
<b>Altitude</b>	-200 to 10,000 ft
<b>Reliability (at 40°C, 120 VAC and -48VDC, 140W)</b>	7500 FITS per TR-332, (FIT = 1/MTBF) 1.5 x 10 <sup>5</sup> hours MTBF per RIN

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