

# Cisco AS5350 Universal Gateway

The Cisco AS5350 Universal Gateway is the only one-rack-unit gateway supporting two-, four-, or eight-T1/E1 configurations that provides universal port data, voice, wireless, and fax services on any port at any time. The Cisco AS5350 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

Cisco Any Service, Any Port (ASAP) implemented on the Cisco AS5350 enables the universal gateway to operate simultaneously as a network access server and a voice gateway, delivering universal services on any port at any time. Cisco ASAP services on the Cisco AS5350 include dial access, real-time voice and fax, wireless data access, and unified communications on a call-by-call basis. The Cisco AS5350 Universal Gateway achieves cost savings through optimized utilization 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.

## Your Complete Point of Presence Solution

The Cisco AS5350 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/CE1s.

Figure 1 Cisco AS5350 Universal Gateway



The two 10/100 autosensing Ethernet ports are perfect for redundancy and firewalled applications. 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 Routing Protocol (HSRP), and all cards and the fan tray are hot-swappable for carrier-class resiliency. The Cisco AS5350 is the only access server 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 (that is, 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 “POP-in-a-box” universal port solution.

#### Cisco AS5350 Enables New Cisco ASAP Services

Its rich set of Cisco IOS® Software features enable ISPs and enterprise network managers to meet traditional dial-in needs, including Internetwork Packet Exchange (IPX) and AppleTalk, while supporting the migration to New World universal port services (See Figure 1).

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 virtual private networks (VPNs), mobile wireless solutions, long distance for ISPs, international wholesale long distance, distributed prepaid calling, Signaling System 7 (SS7) interconnect, wholesale dial and voice, and enhanced voice services. The Cisco AS5350 provides the perfect solution for telephony application service providers (ASPs) who would like to deploy PC-to-phone, unified communications, IP conferencing, 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 enables customers to pick the right starting point for a “pay as you grow” rollout 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.

## Key Features

### Modular Architecture

All feature cards are field upgradable 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.

### Remote Access Capabilities

The Cisco AS5350 takes advantage of the full-feature richness and strong routing capabilities of Cisco IOS Software. The Cisco AS5350 can be deployed in a variety of architectures, from multiprotocol (IP, IPX, AppleTalk, and NetBEUI) corporate networks 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 (TCP) Clear connections.

The Cisco AS5350 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 to be 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 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 “broadband lite” experience at dialup prices.

### Packet Telephony

The framework for voice-over-IP services (VoIP) 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 Universal Gateway because H.323, Session Initiation Protocol (SIP), and Media Gateway Control Protocol (MGCP) support are all built in. This allows service providers to enable the call control protocol that is the best fit for their networks 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.

- 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.

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

### Session Initiation Protocol

SIP is the Internet Engineering Task Force’s (IETF’s) standard for multimedia conferencing over IP. SIP is an ASCII-based, application-layer control protocol (defined in RFC 2543) that can be used to establish, maintain, and terminate calls between two or more end points. The SIP implementation on the Cisco AS5350 Universal Gateway includes support for key features like third-party call control and RFC 2833 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.



## Media Gateway Control Protocol and Trunking Gateway Control Protocol

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. It 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 Universal Gateway 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. PacketCable developed the TGCP protocol, which contains extensions and modifications to MGCP while preserving the basic MGCP architecture and constructs.

## Cisco Voice Extensible Markup Language (XML) Solution Infrastructure

The Cisco AS5350 Universal Gateway has the ability to interpret 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 universal accessibility of the telephone and its ease of use make VoiceXML applications a powerful alternative to HTML for accessing the information and services of the Internet. 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.

## Programmable IVR Tool Command Language (TCL) 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 TCL IVR 2.0 application programming interface (API) to create customized TCL scripts that control calls coming into or going out of the gateway. The term IVR describes systems that 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 the flow of the call is controlled by a finite state machine, defined by the TCL script. All verbs are nonblocking, meaning 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.

## Voice Quality

Use the extensive voice and fax capabilities of the Cisco AS5350 Universal Gateway to 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 Public Switched Telephone Network (PSTN). Comprehensive voice-quality testing is a critical component in the Cisco AS5350 Universal Gateway development 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/Masurement System.



The high-performance design of the Cisco AS5350 Universal Gateway minimizes delay and packet loss during the voice encoding and packetization processes. The Cisco AS5350 introduces only 20 to 30 milliseconds (ms) of delay as voice data is received from the PSTN and transmitted to the IP network for G.711 calls, with receive delay ranging from 35 to 45 ms. 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 Universal Gateway 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 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.729a, and G.729ab. 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 Cisco ASAP Services

For VoIP to be a realistic replacement for standard PSTN telephony services, customers need to receive the same quality of voice transmission they receive with basic telephone services: consistently high-quality voice transmissions. 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.

A variety of 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, fragmentation and interleaving.

Call Admission Control (CAC) extends the QoS tool suite to protect voice traffic from being negatively affected by other voice traffic by keeping excess voice traffic off 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.

- 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 or 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.



## 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, and fax handling capability of the platform. TDM switching (drop and insert) plus network-side Integrated Services Digital Network (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 dial 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 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 Universal Gateways. Cisco UGM supports all Cisco AS5000 Universal Gateways for voice, dial, and Cisco ASAP applications.

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) 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 via syslog or RADIUS as an alternative to polling via 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

### Sparing

The Cisco AS5350 is designed to meet 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 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. 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. These ports support all the Cisco serial routing protocols for flexibility in connecting to remote networks. The third method uses Dial Feature Card (DFC) trunk 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.

AC power supply is provided with a mean time between failure (MTBF) of more than 200,000 hours. The power supply has dual fans as well as 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 complies with 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 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 is homologated worldwide with all major T1 and E1 switch types.

### Cisco IOS Software Enables Rich Services

#### Cisco Any Service, Any Port

The experience gained by Cisco in both data and voice worlds is unique. Known industry-wide for its strength in data products, which is reflected in its majority market share in all segments of the remote-access marketplace, Cisco has also taken a leadership role in the VoIP gateway market since analysts first started tracking that product category. The company's experience in building voice networks extends beyond millions of VoIP operating hours and Cisco boasts the world's largest deployment.

Cisco takes advantage of this experience by providing the next generation in technology: Cisco ASAP, a unified network architecture that delivers integrated voice, data, and fax services at a profit. Cisco ASAP benefits three key constituencies:

- End users who want to get their Internet services and applications anywhere, at any time and on any device
- Service providers that need to offer unified services at a profit
- Application developers who are bringing innovative Internet applications to market but who currently lack the ability to deliver multimedia applications with carrier-class resiliency



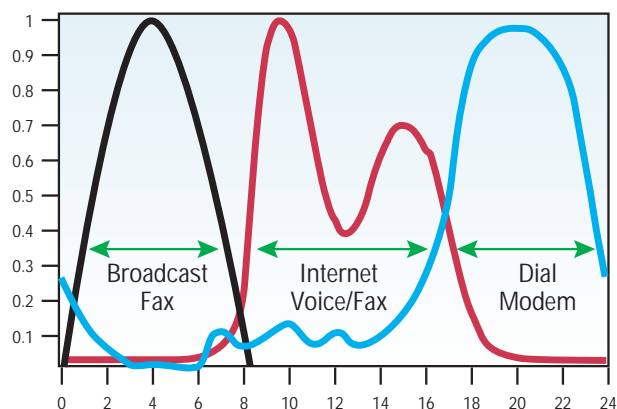
## Flexibility in Deploying New Services

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, or any other application. The capability to use the Cisco AS5350 in multiple service environments provides unprecedented capital investment protection. It also ensures that the access gear 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.

## Optimized Use of Access Infrastructure

Access gear that is capable of handling voice-only or data-only services remains underused during off-peak hours. The Cisco AS5350 alleviates this limitation by supporting more services that can be offered during off-peak hours, thus optimizing the use of the existing access infrastructure. This support of any service on any port at any time also enables service providers to generate more revenue streams from a single access infrastructure (See Figure 2).

Figure 2 Universal Service Traffic Distribution



## 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, 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 these calls are billed at the lower voice rate. Cisco Resource Pool Manager (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.

### 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, and 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 holding down operations costs. The network infrastructure deployed for wholesale dial can also be used to offer standard retail dial-up 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 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 is ideally suited to providing wholesale dial services to both large corporations and ISPs who do not want to support their own dial pools. With support for VPNs in Cisco IOS Software, 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. The Cisco Virtual Private Dialup Network (VPDN) session-counting software can keep track of the number of connections from the Cisco AS5350 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 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 AOL 6.0 clients and later.

### Packet Telephony Services

#### Global Long-Distance Service over IP Networks

Service providers can carry voice traffic over packet networks, opening the door to a variety of new services. Service providers can offer domestic and international long-distance voice calls and real-time fax transmissions to subscribers using packet telephony technology. The Cisco AS5350 Universal Gateway makes IP access to the local PSTN possible. Users can make calls from home or office using regular phone and fax machines, or from other locations by dialing a password. ISPs can continue to differentiate themselves by creating strong linkages across their range of data and voice services, building customer loyalty through enhanced service offerings.

#### 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 card 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 for Cisco ASAP Services

Using the Cisco SC 2200 Signaling Controller (or a third-party SS7 gateway), service providers can interconnect their data and VoIP networks with the PSTN via SS7 links. In many countries carriers must interconnect via SS7 to qualify for reciprocal compensation. The Cisco SC 2200 and Cisco AS5350 provide the interface needed to interconnect using Q.931 over IP, allowing service providers to enter markets they otherwise would not be able to access 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.

#### Telephony Application Hosting

Telephony application service providers (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 PC-to-phone services, unified communications, IP teleconferencing, voice-enabled Web commerce, and content delivery. This creates new business partnering opportunities for VoIP service providers. The standards-based Cisco AS5350 Universal Gateway 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 AS5350 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 churn:

- 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 supports RADIUS-based CiscoRPM. This enables service providers to offer guaranteed port availability across a shared infrastructure, which translates to guaranteed service levels for 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 AS5350 universal gateways 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 Pool Manager Server (RPMS) software running on a Sun Solaris server holds the customer profiles and keeps track of port utilization across multiple Cisco AS5000 gateways or other vendors’ RADIUS-compliant gateways. The Cisco AS5350 Universal Gateway queries the Cisco RPMS when a new call is presented, and the Cisco RPMS determines whether the call should be accepted based on network utilization and customer profiles.

#### Cisco AS5350 Architecture

The Cisco AS5350 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 Network Processing Engine 300. The Cisco AS5350 has three slots for DFCs; DFCs contain DSP or trunk cards. The Cisco AS5350 architecture uses distributed processing between the DFCs and the motherboard to optimize the processing path for unparalleled performance (See Figure 3).



Figure 3 Cisco AS5350 Chassis View



### Egress Interfaces

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

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

### Ingress Interfaces

The Cisco AS5350 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 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

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 4).

Figure 4 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 60- and 108-universal port cards are full-featured DSP-based cards that support 60 (former) or 108 (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 5).



Figure 5 Cisco AS5350 60- and 108-Universal Port Feature Card



## Summary

The Cisco AS5350 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 1-RU universal gateway that delivers high reliability and performance in a compact 8-T1/E1 density.

The Cisco AS5350 universal DSPs provide voice, data, fax, and wireless services on any port at any time. The benefits to the service providers are flexibility in deploying services and optimized utilization of their 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 Universal Gateway.

Table 1 Hardware Features and Benefits of the Cisco AS5350

Feature	Benefit
Up to 8T1/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 “POP-in-a-box”</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>• 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 input/output (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-MB 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.
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)	2 max (rated), 1A (typical)
Input Frequency (AC unit)	50 to 60 Hertz
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	
LAN Protocols	<ul style="list-style-type: none"> <li>• IP, IPX, AppleTalk, DECnet, ARA, NetBEUI, bridging, HSRP, 802.1Q</li> </ul>
WAN Protocols	<ul style="list-style-type: none"> <li>• Frame Relay, PPP, HDLC (leased line)</li> </ul>
Routing Protocols	<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>
QoS Protocols	<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>
Access Protocols	<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>
Bandwidth Optimization	<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>
Voice Compression	<ul style="list-style-type: none"> <li>• G.711, G.723.1 (5.3K and 6.3K), G.729a, G.729ab</li> </ul>
DSP Voice Features	<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 (MF), Continuity Testing (COT)</li> </ul>
Voice and Fax Signaling Protocols	<ul style="list-style-type: none"> <li>• H.323v2, H.323v3, SIP, MGCP 1.0, TGCP 1.0</li> <li>• T.38 Real-Time Fax Relay</li> <li>• T.37 fax store and forward</li> <li>• Fax detection</li> </ul>
Network Security	<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> </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>• Firewall security and intrusion detection</li> <li>• QoS features (committed access rate, Random Early Detection, IP Precedence, policy-based routing)</li> </ul>
Channelized T1	<ul style="list-style-type: none"> <li>• Robbed-bit signaling; Loop Start, Immediate Start, and Wink Start protocols</li> </ul>
Channelized E1	<ul style="list-style-type: none"> <li>• CAS, E1 R1, E1 R2, leased line, Frame Relay</li> </ul>



Table 5 Overview of Cisco AS5350 Protocols (Continued)

Protocols	
ISDN Protocols Supported	<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>
Modem Protocols Supported	<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</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>
Wireless Protocols	<ul style="list-style-type: none"> <li>• V.110 and V.120</li> </ul>
Full Cisco IOS Software Support	<ul style="list-style-type: none"> <li>• IP Plus and Enterprise Plus feature sets</li> </ul>
Console and Auxiliary Ports	<ul style="list-style-type: none"> <li>• Asynchronous serial (RJ-45)</li> </ul>

Table 6 Cisco AS5350 Compliance Data

Certification	Requirements
NEBS Certification	<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>
Safety Certifications	<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>
Electromagnetic Emissions and Immunity Compliance	<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	
Heat Dissipation	478 Btu/hr (maximum), 389 Bt/hr (typical)
AC Power Cable Supplied with AC Systems	18 American wire gauge (AWG), 15-amp IEC 320 standard cable
DC Power Cable Required for DC Systems	12-14 AWG stranded copper wire
Storage Temperature	25.8° to 185°F (-40° to 85°C)
Acoustics	55 dBA max.; sound pressure level at 1m
Humidity	5 to 95 percent, noncondensing
Altitude	-200 to 10,000 ft
Reliability (at 40°C, 120 VAC and -48VDC, 140W)	7500 FITS per TR-332, (FIT = 1/MTBF) 1.5 x 10 <sup>5</sup> hours MTBF per RIN



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