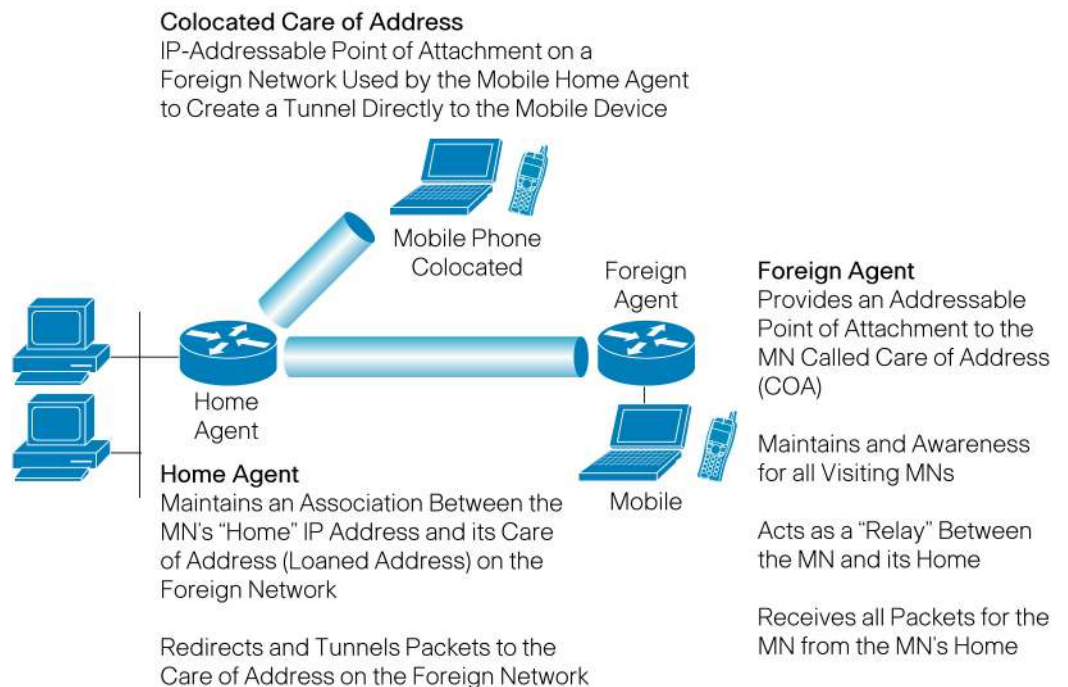


Cisco Mobile Wireless Home Agent Release 4

Product Overview

Today's networking environment offers a multitude of wireless and wired access technologies. For wireless technologies, the well-established list includes Wi-Fi, 2.5G GPRS, 3G CDMA2000, and UMTS. Looking forward, the list will include the emerging 4G technologies, such as WiMAX. Mobile IP technologies can be leveraged alongside the established access technologies to provide ubiquitous service and enable service providers and Mobile Virtual Network Operators (MVNO) to deliver a persistent connection for users, independent of their location. The Cisco Mobile Wireless Home Agent serves as an anchor point for IP services, and provides easy, secure, seamless roaming with integrated quality-of-service (QoS) capabilities to optimize the mobile user experience. The Cisco Mobile Wireless Home Agent works in conjunction with a foreign agent and Mobile IP client to provide an efficient Mobile IP solution. Figure 1 shows a basic topology.

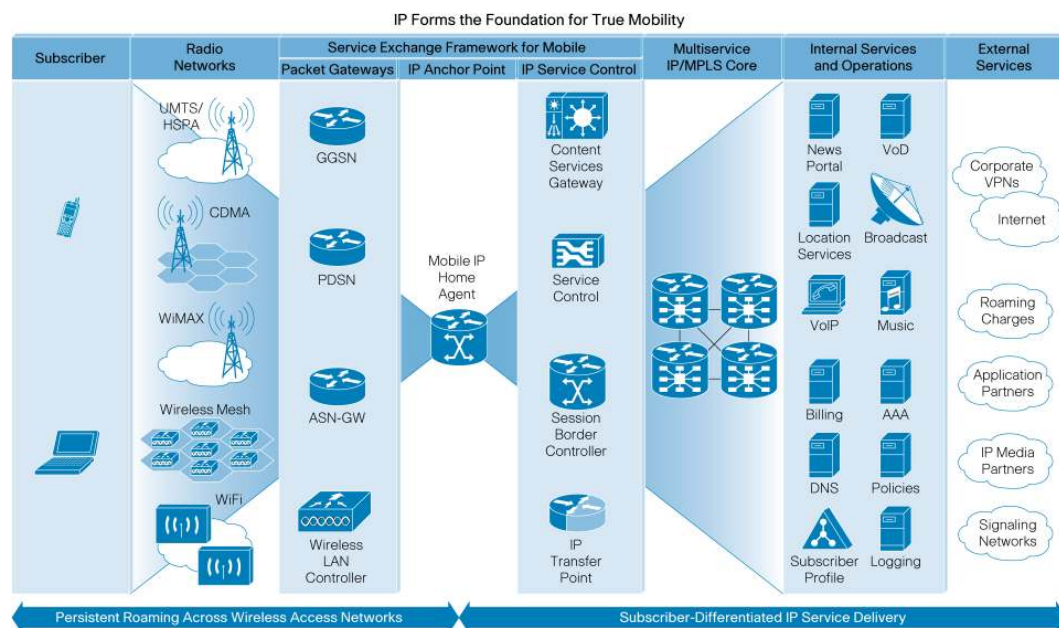
Figure 1. Topology for Mobile IP



The Cisco Mobile Wireless Home Agent maintains mobile user registrations – through a foreign agent, or directly with mobile devices when they are using Colocated Care-of Addresses (CCoA) – and tunnels packets destined for the mobile device to the foreign agent. It supports reverse tunneling, and can securely tunnel packets to the foreign agent using IP Security (IPsec). Additionally, the Cisco Mobile Wireless Home Agent supports dynamic and static home address assignment, for both public and private addresses, for the mobile device. Home address assignment can be from address pools configured either locally, or remotely using Dynamic Host Configuration Protocol (DHCP) server access, from the authentication, authorization, and accounting (AAA) server, or using an On-Demand Address Pool (ODAP).

The Cisco Mobile Wireless Home Agent is as a natural aggregation point for mobile terminals for which mobile or proxy mobile services are provided. Cisco Mobile Wireless home agent acts as an anchor point under the Service Exchange Framework for Mobile (SEF for mobile). Figure 2 shows the SEF architecture. Traffic sent to the terminal is routed using the Home Agent. With reverse tunneling, traffic from the terminal is also routed through the Cisco Mobile Wireless Home Agent. Unique features such as home agent redundancy and load balancing provide a high level of availability and reliability, and allow geographical dispersion while maintaining accounting integrity. Another unique feature, Network Address Translation (NAT) traversal, allows the Cisco Mobile Wireless Home Agent to be used as an anchor point across many access technologies.

Figure 2. SEF for Mobile



This Cisco Mobile Wireless Home Agent enables users to transparently roam across different access networks while retaining a constant connection, addressability, and a per subscriber-differentiated IP service delivery.

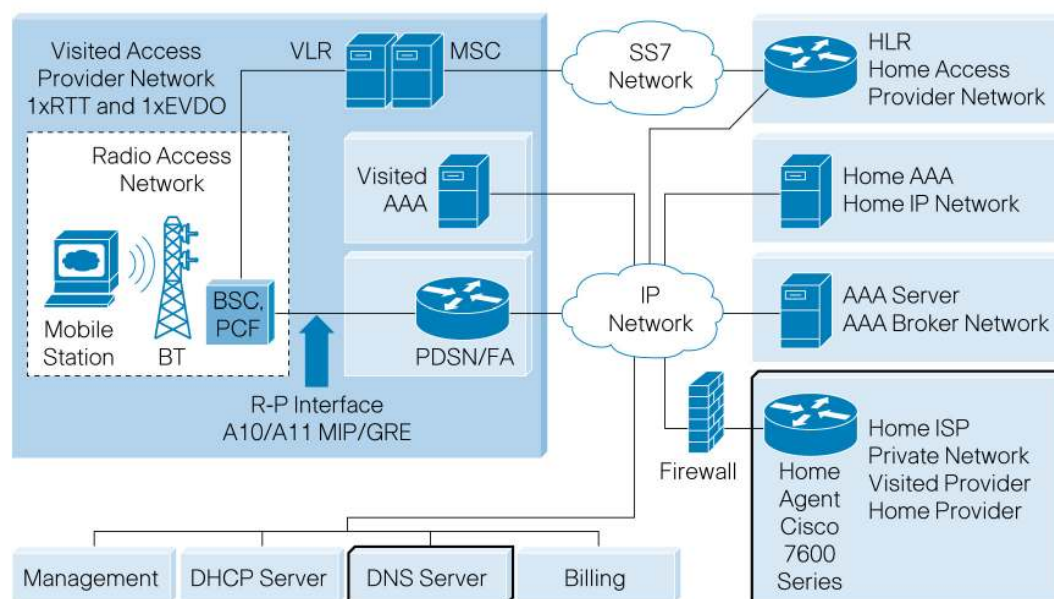
Cisco Mobile Wireless Home Agent in a CDMA Environment

CDMA2000 is a third-generation (3G) wireless solution that allows the mobile wireless operator already using CDMA technology to offer packet data services. The Cisco CDMA2000 Packet Data Services solution is designed to meet the needs of the mobile wireless industry as it transitions toward 3G cellular data services. The Cisco Mobile Wireless Home Agent is an important component of this solution. The Cisco CDMA2000 Packet Data Services solution includes the Cisco Packet Data Serving Node (PDSN) with the foreign agent function, the CDMA2000-based Cisco Mobile Wireless Home Agent, the Cisco Network Registrar®, Cisco Access Registrar® server, and several other security products and features. Figure 3 illustrates the functional elements in a typical Cisco CDMA2000 Packet Data Services system.

The Cisco Mobile Wireless Home Agent is part of a Cisco solution that complies with international wireless standards, enables expanded mobility, and is always addressable and reachable through the use of Mobile IP and proxy Mobile IP. The Cisco Mobile Wireless Home Agent, in conjunction with the Cisco Packet Data Serving Node (PDSN) Foreign Agent, allows a mobile station with Mobile IP client functions to access the Internet or a corporate intranet using Mobile IP-based

service access. Mobile IP extends user mobility beyond the coverage area and provides roaming capabilities. In a CDMA2000 environment when another Cisco PDSN is allocated to the call (following a handoff), the new Cisco PDSN performs a Mobile IP registration with the Cisco Mobile Wireless Home Agent. This helps to ensure that the same home address assigned when the initial session is established is allocated to the mobile client. Traffic is routed through the Cisco Mobile Wireless Home Agent, and the home agent also provides proxy Address Resolution Protocol (ARP) services. When reverse tunneling is used, traffic from the terminal also is routed through the home agent. Clients without a Mobile IP client can take advantage of these services by using the proxy Mobile IP or client Mobile IP capabilities. Figure 3 shows a CDMA2000 network with a Cisco Mobile Wireless Home Agent and other required components for packet data services.

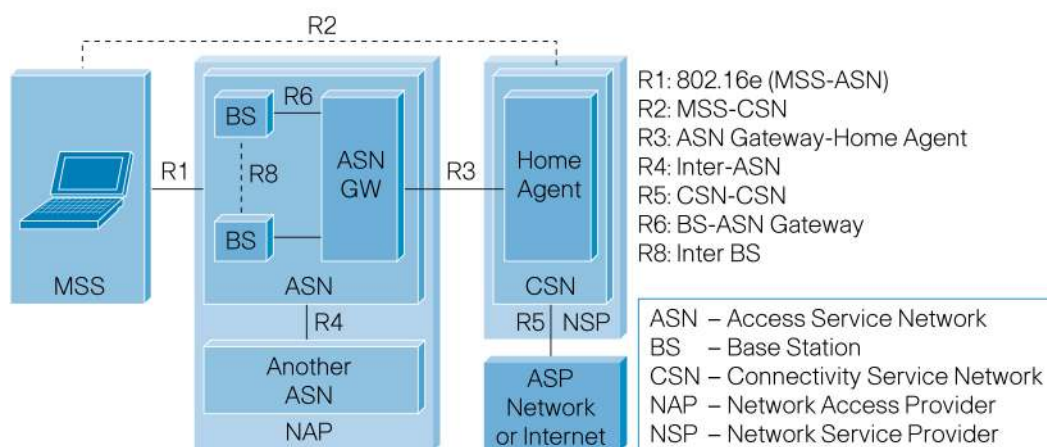
Figure 3. CDMA2000 Network



The Cisco Mobile Wireless Home Agent supports all required standards, including the Third-Generation Partnership Project 2 (3GPP2) Technical Specification Group P and X (TSG-P, TSG-X) Standard, and the Wireless IP Network Standard (also known as TIA/EIA/IS-835-D), which defines the overall structure of a CDMA2000 network. It includes features such as enhanced Mobile IP, security, and authentication.

Cisco Mobile Wireless Home Agent in a WiMAX Environment

WiMAX is a fourth-generation (4G) wireless solution based on the IEEE 802.16e standard for delivering advanced broadband wireless services in emerging, high-growth, and developed markets. WiMAX offers significant benefits, including lower deployment costs through the use of an all-data, all-IP architecture, lower spectrum acquisition costs, and a wide range of IP-enabled applications, many of which come from the IP broadband domain. The Cisco Mobile Wireless Home Agent is part of the Core Service Node in the WiMAX End-to-End Reference Model. The WiMAX End-to-End Reference Model consists of the following logical entities: Mobile Subscriber Station (MSS), Access Service Network (ASN), and Connectivity Services Network (CSN). Further ASN decomposition is shown in Figure 4. The Network Reference Model (NRM) is a logical representation of the network architecture. The NRM identifies functional entities, and reference points over which interoperability may be achieved between functional entities.

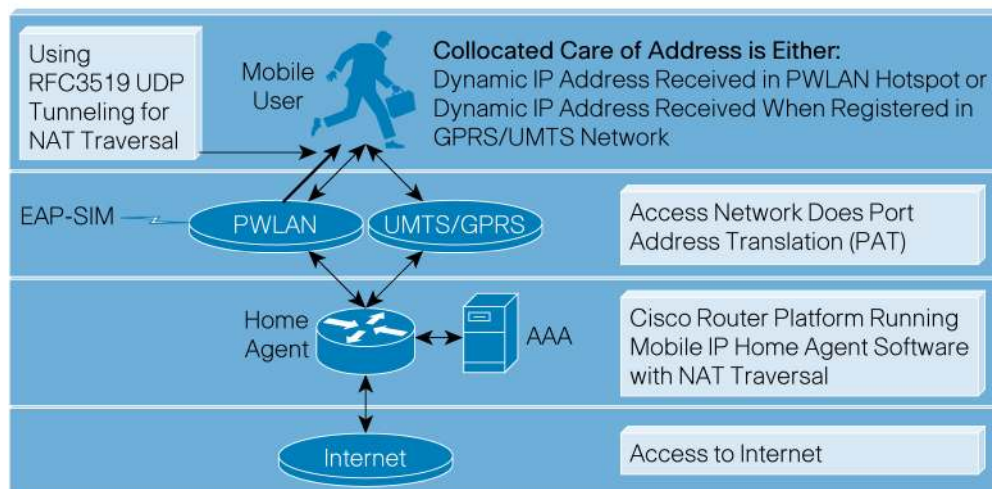
Figure 4. WiMAX Reference Model

The Access Services Network (ASN): The ASN is defined as a set of network functions that provide radio access to a WiMAX subscriber. ASN comprises network elements such as base station(s) (in one or more base station clusters), and ASN gateway(s). An ASN may be shared by more than one Connectivity Service Network (CSN).

Connectivity Services Network: The Connectivity Services Network is a set of network elements that provides the IP connectivity to the service layer. Provisioning elements such as the AAA and DHCP servers are residing in the CSN as well as the macro mobility anchor point, a function enabled by the home agent. The service layer provides the foundation for enabling the delivery of rich services, subscriber identification, and policy enforcement. Cisco is helping service providers evolve toward network convergence through its comprehensive IP Next-Generation Network (NGN) vision, architecture, and networking solutions. The WiMAX Forum Network Reference Model (as defined by the organization's Network Working Group) hints at the use of network, service control, and application layer convergence.

Cisco Mobile Wireless Home Agent Supporting Roaming Between Radio Access Technologies

The Cisco Mobile Wireless Home Agent, in conjunction with a Mobile IP Client at the mobile node, is capable of providing seamless roaming between access technologies. For example, several mobile service providers today offer the ability to roam between Wi-Fi and GPRS networks as per Figure 5 here after. This capability provides seamless mobility without service disruption when moving between access technologies.

Figure 5. Wi-Fi, GPRS/UMTS Seamless Roaming

The home agents are the anchor points for MIP and are running in active/standby mode, whereby they exchange their MIP binding tables using an extension of the HSRP. This capability allows for a stateful redundancy.

No Mobile IP foreign agents are used in the solution today. This implies that the MIP client stack running on the subscriber's laptop uses the CCoA, and that the client gets an IP address from the access network to which it is attached. For example, one IP address might be from a PWLAN service and another one might be acquired through the GPRS/UMTS access network (neither of which uses foreign agents). The client, depending on the priority of the access network, could use either address as its MIP tunnel source IP address.

To fulfill the requirement to go through the NAT/PAT aggregation point in the access network, the system must comply with IETF RFC 3519 for NAT traversal.

The home address that the client uses to address its traffic is assigned during the MIP control phase through the AAA server assignment. Because a private address is used, the home agent performs NAT-PAT to route the traffic to the Internet. At the same time, through Cisco IOS[®] Software features such as NAT Services and per-user access lists, the home agent allows certain applications that would otherwise fail to work properly and provides access filtering with the well-known access control lists (ACLs).

Hardware Platform Support

The Cisco Mobile Wireless Home Agent runs on the Cisco Service Application Module for IP (SAMI) for the Cisco 7600 Series Routers. The physical interfaces supported on the Cisco 7600 Series platforms are mainly Fast Ethernet and Gigabit Ethernet, FlexWAN (ATM, Frame Relay), and the new line of Cisco Shared Port Adaptor (SPA) and SPA Interface Processor (SIP) line cards, and are independent of physical media.

Platform Benefits

- The Cisco SAMI runs on the carrier-class Cisco 7600 Series Router, which offers a variety of chassis configurations providing flexible deployment options.

- Highly scalable platform allows the home agent solution to scale by adding more service modules to the Cisco 7600 Series chassis.
- The very robust and proven technology has been used to support a variety of different applications in the mobile space

Features and Specifications

The Cisco Mobile Wireless Home Agent solution provides all standard interfaces and includes value-added features that enhance the customer experience and improve availability, scalability, and security. Specific IETF Requests for Comments (RFCs) and features are outlined in this document. Table 1 defines Cisco Mobile Wireless Home Agent features and benefits.

Table 1. Cisco Mobile Wireless Home Agent Features and Benefits

Description	Benefit	
Standards compliance	<ul style="list-style-type: none"> • Complies with 3GPP2 TSG-P TSG-X (TIA/EIA/IS-835) • Complies with IETF RFCs • Complies with WiMAX Network Working Group NWG 1.1 RFCs 	<ul style="list-style-type: none"> • Provides interoperability with other standards-compliant components
WiMAX support	<ul style="list-style-type: none"> • PMIP/CMIP extensions for WiMAX • WiMAX AAA RADIUS Attribute support 	<ul style="list-style-type: none"> • Provides mobility services for WiMAX deployments • Supports PMIP/CMIP ASN-GW deployments
Mobile IP-to-L2TP support	<ul style="list-style-type: none"> • Allows a Mobile IP session to negotiate an L2TP to LNS 	<ul style="list-style-type: none"> • Support advanced enterprise deployments
Home agent address assignment	<ul style="list-style-type: none"> • Supports dynamic home agent address • Supports static home agent address 	<ul style="list-style-type: none"> • Offers load balancing by distributing mobile clients among pool of home agents • Provides deployment flexibility • Facilitates scaling • Eases provisioning • Minimizes the impact of network changes
Virtualized home agent (VHA)	<ul style="list-style-type: none"> • Ability to virtualize home agent for full VPN service type • VPN transport as VLAN, tunneling (IP-in-IP, GRE, IPsec), • MPLS/VPN, Frame Relay (DLCI), ATM • Applicable per domain and/or per user • Offers support per AAA 	<ul style="list-style-type: none"> • Reduces amount of equipment needed • Simplifies administration • Supports multiple VPNs on same home agent • Allows address overlapping • Supports separate routing tables • Helps with IPv4 address scarcity
Home agent redundancy	<ul style="list-style-type: none"> • Provides local and geographical redundancy • Provides stateful redundancy intra and inter chassis • Active/standby mode • Active/active mode 	<ul style="list-style-type: none"> • Avoids service disruption if active home agent fails; the standby home agent takes over with no noticeable impact to user • Scales without disrupting service • Enhances availability and reliability • Maintains accounting integrity during failover • Facilitates software and hardware upgrades
Mobile IPsec	<ul style="list-style-type: none"> • Protects data flow between home agent and foreign agent 	<ul style="list-style-type: none"> • Offers security services at IP level • Provides secure tunnel between home agent and PDSN or foreign agent • Protects data confidentiality, integrity, and authentication
Resource management	<ul style="list-style-type: none"> • Supports MIP resource revocation (IS.835 C) • Supports Packet of Disconnect (IS.835 C) 	<ul style="list-style-type: none"> • Frees resources as quickly as possible • Enables provider to have greater control and to take action toward a specific user
Standard Cisco hardware platforms	<ul style="list-style-type: none"> • Cisco hardware platforms are proven in some of the largest networks in the world 	<ul style="list-style-type: none"> • Minimizes risk; speeds rollout of network
Cisco IOS® Software Feature Set	<ul style="list-style-type: none"> • Cisco Home Agent runs with the standard Cisco IOS Software Feature Set, which includes rich IP, security, Mobile IP, and voice and data integration capability 	<ul style="list-style-type: none"> • Helps accelerate time to market with advanced features • Provides a more competitive solution

Description	Benefit	
Network Address Translation (NAT) traversal	<ul style="list-style-type: none"> • Supports an intermediate device performing NAT 	<ul style="list-style-type: none"> • Offers increased flexibility of network design and address allocation • Allows the mobile node to be behind a NAT entity address
Hot-lining	<ul style="list-style-type: none"> • Offers redirection IP and HTTP traffic, profile- or rule-based • Supports the IS835D hot-lining standard • New session and active session support 	<ul style="list-style-type: none"> • Dynamically redirects users during a session • Can be used for monitoring or security purposes
Mobile network support	<ul style="list-style-type: none"> • Provides ability to configure and utilize the Cisco 3200 Series Mobile Access Router to enable mobile subnets 	<ul style="list-style-type: none"> • Supports mobility with mobile subnets • Offers ability to extend services to vertical markets such as public safety
Call Admission Control	<ul style="list-style-type: none"> • Monitor load information and manage system availability, for example through dynamic feedback protocol (DFP) to the Home Agent server load balancing function • Ability to configure maximum bindings per Home Agent 	<ul style="list-style-type: none"> • Enhanced availability and scalability
Simple IP roaming	<ul style="list-style-type: none"> • Support for the LNS capability to enable simple IP roaming scenarios 	<ul style="list-style-type: none"> • Allows the home agent to support access via an L2TP tunnel, enhancing roaming scenarios
Mobile-node address management	<ul style="list-style-type: none"> • Offers local pool, with priority metrics, thresholds and traps • Offers Dynamic Host Configuration Protocol (DHCP) with AAA • Offers on-demand address pools (ODAPs) • Offers alarms thresholds • Supports public and private addresses • Supports NAT/PAT 	<ul style="list-style-type: none"> • Enhances mobile-node address management efficiency and minimizes provisioning
Access control list (ACL) per user	<ul style="list-style-type: none"> • Enables per-user ACLs 	<ul style="list-style-type: none"> • Per-user access list information can be retrieved from AAA server to customize access to network resources and services
QoS per user	<ul style="list-style-type: none"> • Supports use of Cisco IOS MQC • Reflects inner to outer ToS/DSCP marking • Provides ability to police traffic 	<ul style="list-style-type: none"> • Can be used to identify, classify, and mark traffic • Provides ability to retrieve per-user policing and shaping information (from AAA server) • Helps to enhance user experience for services such as voice over IP (VoIP) and push-to-talk (PTT)
Increased AAA functionality fine-tuning	<ul style="list-style-type: none"> • Offers AAA group, retry, timer • Delivers broadcasting capability • Offers enhanced authentication granularity based on Electronic Serial Number (ESN), Mobile Station Identifier (MSID), and service option • Offers customization of Mobile IP re-authentication and handoff • Offers per-domain AAA • Provides AAA accounting synchronization for session redundancy 	<ul style="list-style-type: none"> • Improves AAA availability (groups and broadcast) • Minimizes RADIUS messages toward AAA servers • Helps operator to further authenticate mobile user accounting • Helps ensure accounting integrity for session redundancy
Policy-based routing (PBR)	<ul style="list-style-type: none"> • Delivers Cisco IOS Software routing capability plus PBR 	<ul style="list-style-type: none"> • Provides further granularity and control to steer mobile network traffic
Transparent roaming and easy mobility across access technologies	<ul style="list-style-type: none"> • Mobile IP delivers ubiquitous access • Supports CCOA and non-CCOA modes • Supports NAT traversal • Supports mobile network and multicast services 	<ul style="list-style-type: none"> • Home agent can be used as an anchor point for CDMA2000, HC-SDMA, GPRS, UMTS, WLAN, WiMAX, and upcoming 4G technologies to help enable transparent mobility services and is a key component in fixed mobile convergence and mobile networks
Advanced billing and service-selection capability	<ul style="list-style-type: none"> • Offers advanced billing feature • Offers advanced service-selection feature 	<ul style="list-style-type: none"> • Provides advanced billing capability by looking at transaction and content all the way to Layer 7 • Provides per-user "walled" and "open garden" service selection

Description	Benefit	
Advanced and user-friendly debugging	<ul style="list-style-type: none"> • Provides conditional debugging based on username and mobile station ID • Allows multiple simultaneous conditions • Provides trace functionality • Delivers GUI-based full packet decoding capability 	<ul style="list-style-type: none"> • Enhances and eases troubleshooting
Domain Name System (DNS)	<ul style="list-style-type: none"> • Provides IP Reachability (IS-835 C) • Provides IP DNS server address (IS.835 D) 	<ul style="list-style-type: none"> • Enhances user experience and services by facilitating user-to-user communication
Home agent server load balancing (HA-SLB)	<ul style="list-style-type: none"> • Provides load balancing to home agent • Supports static and dynamic home agent address scenario 	<ul style="list-style-type: none"> • Provides scaling in a non-disruptive manner • Minimizes provisioning • Permits geographical dispersion availability with local redundancy

Capabilities of Cisco Mobile Wireless Home Agent

- Supports both Mobile IP and proxy Mobile IP service for mobile terminals
- Receives and processes registration requests from a mobile station using the foreign agent containing a new care-of address (CoA) for that mobile station (Mobile IP service); the home agent may use a home AAA for authentication and IP address assignment purposes or it may perform these functions itself
- Supports static and dynamic home address allocation
- Attracts, intercepts, and tunnels datagrams for delivery to the mobile station
- Receives tunneled datagrams from the mobile station (through the foreign agent), de-encapsulates them, and delivers them to the content node (Mobile IP service)
- Supports both generic routing encapsulation (GRE) and IP-in-IP tunneling for foreign agent-home agent tunnel
- Presents a unique, routable address to the network
- Supports packet filtering using ACLs; this is available per user
- Maintains binding information for each registered mobile station containing an association of CoA with home address, NAI, and security key(s) together with the lifetime of that association
- Receives and processes registration renewal requests within the bounds of the Mobile IP registration lifetime timer, either from the mobile station (through the foreign agent in the Mobile IP case) or from the foreign agent (in the proxy Mobile IP case)
- Receives and processes requests to remove registration, either from the mobile station (through the foreign agent in the Mobile IP case), or from the foreign agent (in the proxy Mobile IP case)
- Maintains a subscriber database either stored locally or retrieved from an external source
- Mobile IP Resource Revocation allows the home agent to quickly free and recover resources no longer needed, as in the case of a handoff; alternatively, when configured, the home agent also supports the sending of a binding update to the source Cisco PDSN under handoff conditions
- Supports dynamic and static home agent assignment
- Supports home agent local and geographical redundancy built on Hot Standby Router Protocol (HSRP) with support for using local address pools and proxy DHCP
- Supports RADIUS servers for authentication and authorization of subscriber information

- With home agent server load balancing (HA-SLB) feature, allows a set of home agents, each running on the Cisco Service Application Module for IP (SAMI), to be identified by a single virtual server IP address
- With the On-Demand Address Pools (ODAPs) feature, simplifies address pool management and allocation by using a central source to allocate address pools based on dynamic demand
- Supports IPsec protocols including Internet Key Exchange (IKE), Authentication Header (AH), and Encapsulating Security Payload (ESP) as required in IS-835-B
- With conditional debugging, allows the home agent to debug the activity of all users or a particular user identified by NAI
- With Virtual Route Forwarding (VRF) support on the home agent, supports overlapping of IP addresses for mobile nodes and Mobile IP flows that are opened for different realms; also allows for specification of different authentication and accounting server groups for different realms
- Allows configuration of one virtual Cisco Mobile Wireless Home Agent per realm to support authentication and accounting server groups per realm
- With hot-lining feature, allows the upstream traffic from individual users or domains to be monitored or redirected to a specified server
- With RADIUS Disconnect or Packet of Disconnect (PoD) feature, allows a RADIUS server to instruct the home agent to release resources

Standards Compliance

- IP Version 4 (IPv4) Mobility, RFC 2002, RFC 3344
- IP Encapsulation Within IP, RFC 2003
- Applicability Statement for IP Mobility Support, RFC 2005
- The Definitions of Managed Objects for IP Mobility Support Using SMIv2, RFC 2006
- Reverse Tunneling for Mobile IP, RFC 3024
- Mobile IPv4 Challenge-and-Response Extensions, RFC 3012 –bis 03
- Mobile Ip Vendor/Organization Specific Extensions, RFC 3115
- Mobile NAI Extension, RFC 2794
- Generic Routing Encapsulation, RFC 1701
- GRE Key and Sequence Number Extensions, RFC 2890
- IP Mobility Support for IPv4, RFC 3220, Section 3.2 Authentication
- The Network Access Identifier, RFC 2486
- An Ethernet Address Resolution Protocol, RFC 826
- The Internet Key Exchange (IKE), RFC 2409
- Cisco Hot Standby Router Protocol (HSRP), RFC 2281
- Mobile IPv4 host configuration extensions, RFC 4332
- Mobile IP Traversal of Network Address Translation (NAT) Devices, RFC 3519

Network Management

Cisco Mobile Wireless Home Agent Release 4.0 is supported by Cisco Mobile Wireless Transport Manager Service Manager. For more information on the current MWTM product support and features, please visit: www.cisco.com/go/mwtm.

The Cisco Mobile Wireless Home Agent supports the Cisco platform MIBs, in addition to the Mobile IP MIB, RFC 2006, and the CISCO-MOBILE-IP-MIB.

Ordering Information

Table 2 lists the product numbers for the Cisco Home Agent for 7600 software licenses, subscriber license, and SAMI hardware. The software license provides for unlimited use of features in the release with a defined number of connected subscribers, which may be limited by hardware resource capacity and traffic mix. The Cisco Home Agent for 7600 subscriber license allows for increasing the number of connected subscribers in increments of 10,000 and 100,000 connected subscribers.

Table 2. Cisco Home Agent Ordering Information for Cisco 7600 Series Routers

Product Number	Description
SAMI Module	
WS-SVC-SAMI-BB-K9	Service Application Module for IP 6 x PPCs w/ 1GB (Crypto)
WS-SVC-SAMI-BB-K9=	Service Application Module for IP 6 x PPCs w/ 1GB Spare (Crypto)
Software RTU Licenses, one RTU license is required per software module	
SSAH40K9-12415XM	Cisco Home Agent R4.0 RTU SAMI
SSAH40K9-12415XM=	Cisco Home Agent R4.0 RTU SAMI (Spare)
Connected Subscriber Licenses, per chassis	
FL-SH-10K-SUB	Cisco Home Agent 10K Connected Subs SAMI
FL-SH-10K-SUB=	Cisco Home Agent 10K Connected Subs SAMI (Spare)
FL-SH-100K-SUB	Cisco Home Agent 100K Connected Subs SAMI
FL-SH-100K-SUB=	Cisco Home Agent 100K Connected Subs SAMI (Spare)

Service and Support

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For More Information

For more information about Cisco mobile wireless products and solutions, go to www.cisco.com/go/mobile.



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