Overview

The Cisco wireless mobile interface Card (WMIC) provides wireless connectivity for the Cisco 3200 Series wireless and mobile router. WMICs operate in the 2.4-GHz (license-free) or 4.9-GHz (public safety) bands and conform to the 802.11 standards.

For additional information, see the "Roles and the Associations of Wireless Devices" document at: http://www.cisco.com/en/US/products/hw/routers/ps272/prod_configuration_basics09186a008073f6b7.html

Understanding the Cisco Mobile Wireless Network

This section provides descriptions of basic wireless network configurations.

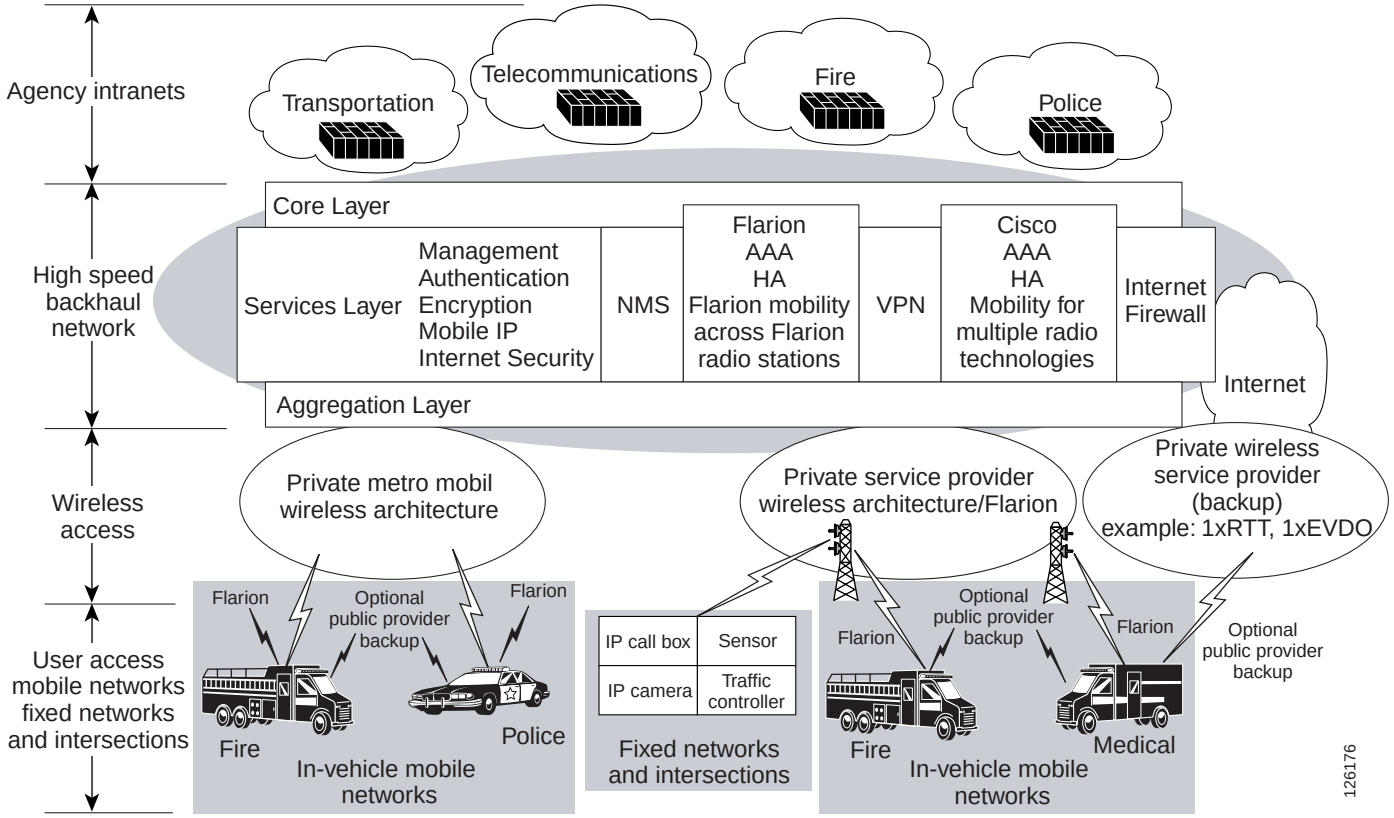
Public Safety Wireless Network Example

A Cisco Mobile Wireless Network provides wireless network services to multiple safety departments, such as police, fire, emergency medical services, and other public safety agencies.

The wireless technologies used in the Cisco Metropolitan Mobile Network include broadband wireless connectivity, providing high speed access for bandwidth-intensive applications, such as in-car video. To supplement the coverage areas where wireless network access is not provided, cellular service, such as code division multiple access (CDMA) 1xEVDO, can be used to fill gaps in connections and provide backup wireless connectivity.

The Cisco 3200 Series routers serve as aggregation devices in public safety vehicles and communicate with the broadband wireless infrastructure as well as aggregation devices at traffic intersections. This extends the existing agency IP network out to traffic intersections. A networked traffic intersection enables connections back to the agency network, providing central coordination of traffic signals and transferring streaming video to and from IP cameras.

Figure 1-1 Example of the Network Architecture for Emergency Services

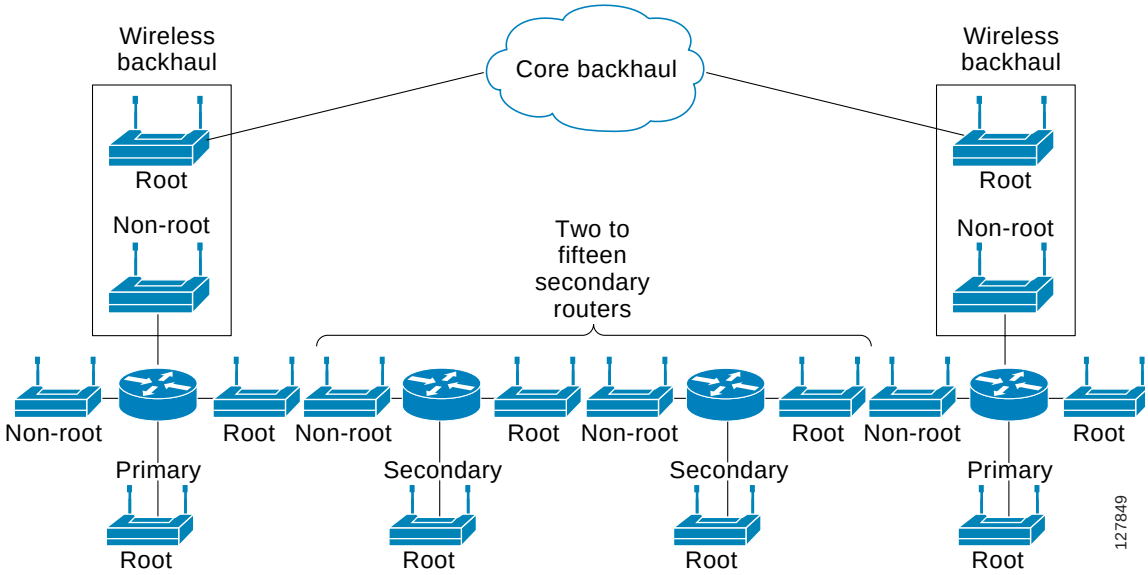


Intersection Example

In the Cisco Metro Mobile Architecture, each intersection is equipped with a Cisco 3200 Series router. An intersections is classified as either a *primary intersection* or a *secondary intersection*. A primary intersection funnels all traffic from surrounding secondary intersections through the backhaul to the core network. Within each cluster of primary and secondary intersections, typically there are two primary intersections for diversity.

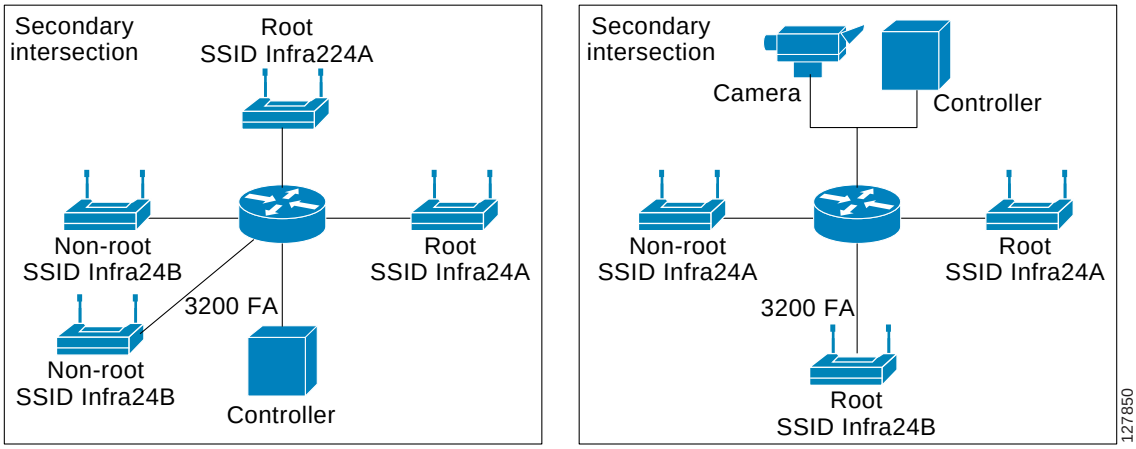
The Cisco 3200 Series routers at the secondary intersections are connected to all of the network devices at that intersection, such as a traffic controller and a video camera. In Figure 1-2, there are three bridges on the secondary intersections (integrated into the Cisco 3200 Series router). Two of the bridges are point-to-point links to other primary or secondary intersections in the local service area, and one is a root device serving mobile units in the area.

Figure 1-2 Intersection to Backhaul Example



The Cisco 3200 Series routers at the primary intersections connect to the wireless backhaul by using an integrated bridge. Figure 1-3 shows the intersection layout.

Figure 1-3 Primary Intersection and Secondary Intersection Layouts



This configuration supports a long chain of primary and secondary intersections. The number of secondary intersections allowed between two primary intersections depends on factors such as line-of-sight and bandwidth.

All secondary and primary intersections run an Interior Gateway Protocol (IGP), so the path to every primary and secondary intersection is advertised throughout the network. Applications, such as video and data communications, can be accessed from anywhere in the network. When a packet from a mobile unit arrives, the packet is forwarded to either end of the primary intersections in its cluster. The packet takes the shortest path based on routing metrics.

To extend IP networks to various parts of the community and achieve sufficient bandwidth for the required number of users and required applications, the Cisco Metro Mobile Network can use different methods of backhaul, including a fiber network, leased lines, or broadband wireless bridging. Each primary intersection has either a wireless or wired connection back to a nearby building.

Vehicle Network Example

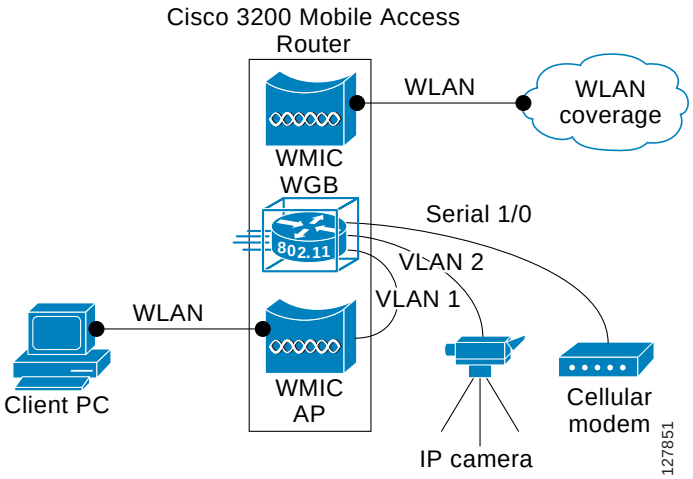
A Cisco 3200 Series router installed in a mobile unit allows the client devices in and around the vehicle to stay connected while roaming. WMICs in vehicle-mounted Cisco 3200 Series routers are configured as access points to provide connectivity for 802.11b/g and 4.9-GHz wireless clients. Ethernet interfaces are be used to connect any in-vehicle wired clients, such as a laptop or a camera, to the network.

Another WMIC is configured as workgroup bridge for connectivity to a root device at an intersection. This allows it to transparently associate and authenticate through each root device in the architecture as the vehicle moves about.

Serial interfaces provide connectivity to wireless WAN modems that connect to cellular networks that use either CDMA or general packet radio service (GPRS). Wireless 802.11 connections are the preferred service because they offer the most bandwidth; however, since a wireless connection is not always available, cellular technology provides a backup link.

Figure 1-4 shows an example of the devices that can connect to the Cisco 3200 Series router in each mobile unit.

Figure 1-4 Example Mobile Unit Configuration



Data Path Example

The wired and wireless devices in the mobile unit are not *aware* that they are mobile. When they must communicate with another node in the network, they send the request to their default gateway, the Cisco 3200 Series router. The Cisco 3200 Series router builds a modem over IP (MoIP) tunnel to its home agent, encapsulating the data packets.

When the Cisco 3200 Series router sends traffic over the wireless link, the MoIP tunnel goes from the local foreign agent to a local aggregation point and through the backhaul link to the home agent where the encapsulation is removed from the data packets.

If the mobile router is out of the wireless coverage area and a cellular technology is used to complete the connection to the home agent, the Mobile IP tunnel is built across the service provider network and into the home agent. The mobile router chooses a wireless link, depending on the following factors:

- Which link is up (and available for use)
- Priority set on each interface
- Bandwidth
- IP address

Regardless of which link is up, all traffic from the mobile devices travel through the MoIP tunnel to the home agent, where it is routed to its destination.

Call Setup Process

This section describes the processes of call setup and data flow as the Cisco 3200 Series router moves into the vicinity of the hot spot and exchanges data packets.

1. Association between the workgroup bridge in the vehicle and the root device at the intersection is initiated.
2. Once associated, the root device blocks all traffic from the associated workgroup bridge.
3. The root device forwards an authentication request and authentication credentials supplied by the workgroup bridge to an authentication, authorization, and accounting (AAA) server.

4. The AAA server authenticates the workgroup bridge. A Unicast Wired Equivalent Privacy (WEP) key is generated and sent back to the root device.
5. The root device sends out the Broadcast WEP key, encrypted with the Unicast WEP key, to the workgroup bridge.
6. The root device and the workgroup bridge activate WEP, using the Unicast and Broadcast WEP keys for transmission. Once there is a Layer 2 connection, the Layer 3 setup begins.
7. The WMIC sends a link-up notification to the Cisco 3200 Series router after it has associated successfully to a root device. In response to the link-up notification, the Cisco 3200 Series router sends four solicitations for a foreign agent.
8. A foreign agent responds to the Cisco 3200 Series router solicitation with an advertisement that includes its care-of-address (CoA).
9. The Cisco 3200 Series router sends a registration request to the home agent through this foreign agent.
10. The home agent checks authentication, adds the Cisco 3200 Series router to its binding and routing table, and sends a reply to the Cisco 3200 Series router that the registration is successful.

Data Flow to and from the Home Network

The Cisco 3200 Series router is registered to its home agent using the foreign agent CoA. If any devices attached to the Cisco 3200 Series router must communicate with nodes on the home network, they send the data to the Cisco 3200 Series router.

1. The Cisco 3200 Series router encrypts the data. The endpoint of the IPSec tunnel is the VPN gateway behind the home agent at the core network.
2. The data is encapsulated in the MoIP tunnel. The endpoint of the MoIP tunnel is the home agent at the core network.
3. The data is forwarded to the foreign agent, where a second encapsulation takes place. The endpoint is again the home agent at the core network.
4. The data is sent through the network to the home agent where the packet is deencapsulated and sent to the VPN gateway.
5. The data is decrypted at the VPN gateway and forwarded to the destination network of the corresponding node.

Data intended for the Cisco 3200 Series router mobile network from anywhere in the network must be sent through the VPN gateway for encryption, and then sent to the home agent for encapsulation.

1. Encapsulated data is sent to the foreign agent, where it is deencapsulated once and forwarded to the Cisco 3200 Series router.
2. The Cisco 3200 Series router does a final de-encapsulation at the end of the MoIP tunnel and decryption at the end of the IPSec tunnel, and forwards the data to the target node in its mobile network.

If the mobile vehicle is not in the vicinity of a wireless LAN hot spot, the vehicle uses a backup wireless service, such as cellular, to deliver the data. In this case, the Cisco 3200 Series router acquires a dynamic collocated care-of address (CCoA) address from the service provider network and the Cisco 3200 Series router registers with the home agent.

The registration process is similar to the process for CoA registration. The encapsulation and encryption process is also similar.

Features

The WMIC running Cisco IOS offers these software features:

- VLANs—Allow VLAN trunking on both wireless and Ethernet interfaces.
- QoS—Use this feature to support quality of service (QoS) for prioritizing traffic on the wireless interface. The WMIC supports required elements of Wi-Fi Multimedia (WMM) for QoS, which improves the user experience for audio, video, and voice applications over a Wi-Fi wireless connection and is a subset of the IEEE 802.11e QoS draft standard. WMM supports QoS prioritized media access through the Enhanced Distributed Channel Access (EDCA) method.
- Multiple Basic SSIDs—Support up to 8 basic service set identifiers (SSIDs) in access point mode.
- RADIUS Accounting—Enable accounting on the WMIC to send accounting data about wireless client devices to a RADIUS server on your network.
- TACACS+ administrator authentication—Enable TACACS+ for server-based, detailed accounting information and flexible administrative control over authentication and authorization processes. It provides secure, centralized validation of administrators attempting to gain access to your WMIC.
- Enhanced security—Enable three advanced security features to protect against sophisticated attacks on your wireless network's WEP keys: Message Integrity Check (MIC) and WEP key hashing. Enhanced security for Wi-Fi Protected Access (WPA) with AES and Temporal Key Integrity Protocol (TKIP) encryption is also available.
- Enhanced authentication services—Set up non-root bridges or workgroup bridges to authenticate to the network like other wireless client devices. After a network username and password for the non-root bridge or workgroup bridge are set, it authenticates to the network using Cisco Light Extensible Authentication Protocol (LEAP), and receives and uses dynamic WEP keys.
- 802.1x supplicant—Support 802.1x, the standardized framework defined by the IEEE to provide port-based network access using information unique to the client and with credentials known only to the client. The supplicant refers to the client software that supports the 802.1x and EAP protocols. The 802.1x supplicant provides a secure method for accomplishing this authentication. Transport Layer Security (TLS) is an enhancement to SSL and provides data encryption in conjunction with EAP.
- EAP-TLS and EAP-FAST—Support EAP-TLS and EAP-FAST in workgroup bridge and non-root device mode.
- Other EAP methods—Support WMIC.
- Advanced Encryption Standard (AES) (available on the 2.4-GHz and 4.9-GHz WMIC)—This feature supports Advanced Encryption Standard-Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). AES-CCMP is required for Wi-Fi Protected Access 2 (WPA2) and IEEE 802.11i wireless LAN security.
- Enhanced authentication for Cisco Centralized Key Management (CCKM).
- Roaming—Support fast, secure roaming of client devices, and radio management through wireless domain services (WDS) (See the "Configuring WDS, Fast Secure Roaming, and Radio Management" chapter for more information.
- Universal workgroup bridge—Support interoperability with non-Cisco devices.
- Multiple Client Profiles—Support provided on the 2.4-GHz WMIC.

Note The 4.9-GHz WMIC does not support Cisco Key Integrity Protocol (CKIP) and Cisco Message Integrity Check (CMIC) encryption.

The key differences between the 2.4-GHz WMIC and the 4.9-GHz WMIC are shown in Table 1-1.

Table 1-1 Differences Between the 2.4-GHz WMIC and the 4.9-GHz WMIC

Feature	2.4-GHz WMIC	4.9-GHz WMIC	Comment
Cisco IOS image release	12.3(8) JK	12.3.(2) JK	
Cookie and banner	C3201	C3202	
Frequency	2.4 GHz	4.9 GHz	
Data rates	802.11b data rates are 1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps. 802.11g data rates are 1 Mbps, 2 Mbps, 5.5 Mbps, 6 Mbps, 9 Mbps, 11 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, and 54 Mbps	20MHz baseband data rates are 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, and 54 Mbps 10MHz baseband data rates are 3 Mbps, 4.5 Mbps, 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, and 27 Mbps. 5MHz baseband data rates are 1.5 Mbps, 2.25 Mbps, 3 Mbps, 4.5 Mbps, 6 Mbps, 9 Mbps, 12 Mbps, and 13.5 Mbps	The **dot11 interface speed** command manages data rates and applies only to the 4.9-GHz WMIC. See "Configuring Radio Data Rates" in Chapter 3, "Configuring Radio Settings."
Power	Maximum orthogonal frequency-division multiplexing (OFDM) power level is 15 dBm (30 mW). This varies by country.	Maximum OFDM power level is 16 dBm (40 mW). U.S. only.	The **dot11 interface power** command is used to manage the power levels.
Concatenation	Supported	Not supported	
World mode	Supported	Not supported	World mode is supported for the U.S., European, and Japanese regulatory domains; however, the choice of radio limits the available channels and transmit power. To use the workgroup bridge and non-root bridge in the U.S.and Europe, select the European SKU; to use them in the U.S. and Japan, select the Japanese SKU; to use them in the Japan and Europe, select the Japanese SKU.
Universal workgroup bridge mode	Supported	Not supported	Enables operation with non-Cisco Aironet access points.
Multiple client profile	Supported	Not supported	Support is enabled only when universal workgroup bridge mode is enabled.
Multiple basic SSIDs	Supported	Not supported	

Table 1-1 Differences Between the 2.4-GHz WMIC and the 4.9-GHz WMIC

Feature	2.4-GHz WMIC	4.9-GHz WMIC	Comment
VLAN	16 unencrypted VLANs, 16 static key VLANs, or 16 dynamic key VLANs	16 unencrypted VLANs, 1 static key VLANs, or 4 dynamic key VLANs	
Wireless encryption/cipher suites	WEP-40, WEP-128, TKIP, CKIP, CMIC, and CKIP-CMIC, AES-CCM	WEP-40, WEP-128, TKIP, and AES-CCM	CKIP, CMIC and CKIP-CMIC are not part of 802.11 standard cipher suites.
Maximum number of stations with WEP	255	116	
Maximum number of stations with TKIP	256	26	
Maximum number of stations with AES-CCM	256	116	
Channelization	Statically declared as defined by IEEE 802.11b/g.	Channel spacing selected by using the CLI.	
Scanning enhancements for faster roaming	All Scanning Enhancements for Faster Roaming are available.	All Scanning Enhancements for Faster Roaming are available except “Use First Better Access Point.”	• Synthesizer tuning time • Start on Current Channel • Only Probe Current SSID • Shorten Wait time for Probe Response • Automatically Limiting Frequencies Scanned • Time out the Scan • Use First Better Access Point • Save Best Probe Response
CCXv4 features	Supported	Not supported	
802.11e MMN QoS	Supported	Not supported	
EAP-TLS, EAP-TTLS, EAP-FAST	EAP-TLS and EAP-FAST are supported on root and non-root devices. EAP-TTLS is supported on root devices only.	Not supported	

Table 1-1 Differences Between the 2.4-GHz WMIC and the 4.9-GHz WMIC

Feature	2.4-GHz WMIC	4.9-GHz WMIC	Comment
Simple Network Management Protocol (SNM)P MIB IDs	Supported	Supported for new values	The platform-dependent SNMP code was modified to return new values (entPhysicalVendorType, System OID, and Chassis ID).
Dot11 MIB parameters	Supported	The dot11 parameters are returned through the dot11 MIB interface.	

Management Options

You can use the WMIC management system through the following interfaces:

- The Cisco IOS command-line interface (CLI), which you use through a PC that is running terminal emulation software or a Telnet session. Appendix A, "Connecting to the Cisco 3200 Series Router and Using the Command-Line Interface," provides a detailed description of how to use the CLI to configure the router. The "Preface" describes the command formats.
- Simple Network Management Protocol (SNMP). Chapter 15, "Configuring SNMP," explains how to configure your bridge for SNMP management.