Cisco 819 Integrated Services Routers

Cisco Machine-to-Machine IOS Gateway

3G Wireless WAN Technology

Q. What is 3G? What are the 3G standards groups?

A. Third-generation (3G) is the term for the latest generation of mobile services, which provide advanced voice communications and high-speed data connectivity, including access to the Internet, mobile data applications, and multimedia content. The ITU, working with industry-standards groups from around the world, has defined the technical requirements and standards as well as the spectrum for 3G systems under the International Mobile Telecommunications-2000 (IMT-2000) program. The ITU requires that IMT-2000 (3G) networks deliver (among other capabilities) improved system capacity and spectrum efficiency over 2G systems and that they support data services at minimum transmission rates of 144 kbps in mobile (outdoor) and 2 Mbps in fixed (indoor) environments.

Q. What is the difference between EVDO and HSPA?

A. EVDO and HSPA are parallel 3G data standards in the Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM) environments. EVDO evolved from the Code Division Multiple Access 2000 (CDMA2000) standards, whereas high-speed packet access (HSPA) evolved from the Universal Mobile Telecommunication System (UMTS) standard that was developed for the countries using GSM technology.

Q. In general, what is the level of adherence to the 3G Partnership Project 2 (3GPP2)? For example, does the Cisco® 3G PCI Express Minicard Standard Form Factor F2 support EVDO Rev A quality of service (QoS)?

A. Adherence to the EIA/TIA and CDMA Development Group (CDG) standards depends on the carrier implementation and a combination of modem hardware and firmware and software. All Cisco 3G PCI Express Minicard Standard Form Factor F2 modems comply with the standards, but the specifics of carrier implementations vary by carrier.

Q. Who are the carriers' examples for CDMA and GSM 3G standards?

A. 1xRTT, EVDO Rev0, and RevA CDMA technologies used in the United States do not require SIM cards. The examples of such carriers are Verizon and Sprint. GSM-based technologies require SIM cards to be installed in the device; such carriers include AT&T, T-Mobile, Vodafone, etc. Please refer to the [Cisco 819 Data Sheet](#) for more information.

Q. Does the Cisco 3G PCI Express Minicard Standard Form Factor F2 support Mobile IP or Simple IP only?

A. The CDMA 3G PCI Express Minicards Standard Form Factor F2 support Mobile IP (MIP) on the modem. Depending on the configuration on the carrier network, it could be set to either MIP only or MIP preferred mode. In the MIP preferred mode, when MIP fails, the modem falls back to Simple IP. The GSM 3G wireless WAN (WWAN) does not have a Mobile IP stack.

Q. How does the modem select the service to which to attach? Does it switch to a better service when one is available?

A. Yes. For GSM networks, the modem always looks for HSPA/HSPA+ as the first choice. If HSPA/HSPA+ is not available, the modem downshifts to the next best available radio network; that is, UMTS to EDGE and finally to General Packet Radio Service (GPRS). If you have only EDGE service, the modem continues to scan in the background for UMTS or HSPA service. If the UMTS or HSPA service becomes available, the modem automatically switches to that service. For CDMA networks, the modem always looks for EVDO Rev A first, then Rev 0, and then 1xRTT.

Q. What factors affect throughput on the 3G WWAN?

A. Several factors can affect throughput and performance:

- Congestion: 3G WWAN data services use a shared wireless medium; therefore, the number of active users in a cell site affects throughput.

- Coverage: The distance from the cell tower affects throughput. The further you are located from the cell tower, the lower the achievable throughput. A site survey is recommended as part of the installation process to help ensure adequate network coverage.

- Interference: RF noise from nearby devices can inhibit performance.

Q. Are the Cisco 3G WWAN interfaces suitable for use as primary links?

A. The 3G wireless standards for data rate and latency performance have continuously improved. Today both Evolution-Data Optimized or Evolution-Data only EVDO and HSPA services offer fractional T1 data rates and latency below 100 milliseconds (ms). For sites and applications that have low and intermittent data usage (such as bank ATMs, kiosks, and gas stations), the Cisco 3G WWAN interface may be suitable.

Q. Can I run voice-over-IP (VoIP) traffic over Cisco 3G WWAN Express Cards?

A. Yes. It is recommended to use the latest 3G technology—EVDO Rev A and HSPA+/HSPA—to run VoIP over a 3G link.

Q. Is latency a problem with the Cisco 3G solution?

A. Latencies vary by technology. Depending on the service available in your area and the applications you are running over your link, latency may be a concern. The most advanced technologies support latencies of less than 100 ms.

Product Overview

Q. What are the available models for the Cisco 819 Integrated Services Routers (ISRs)?

A. Tables 1 and 2 list the models available for these fixed routers.

Table 1. Ordering Information for Supported 3G SKUs of Cisco 819HG and Cisco 819G ISRs

Part Number	Description
Cisco 819H Hardened Integrated Services Router Generation 2	
C819HG-U-K9	Compact Hardened 3G IOS Router with GLOBAL HSPA 3GPP Release 6
C819HG-S-K9	Compact Hardened 3G IOS Router with SPRINT EVDO Rev A
C819HG-V-K9	Compact Hardened 3G IOS Router with VERIZON EVDO Rev A
C819HG-B-K9	Compact Hardened 3G IOS Router with BSNL EVDO Rev A
C819HG+7-K9	Compact Hardened 3G IOS Router with GLOBAL HSPA+ 3GPP Release 7
Cisco 819 Non-Hardened Integrated Services Router Generation 2	
C819G-U-K9	Compact 3G IOS Router with GLOBAL HSPA 3GPP Release 6
C819G-S-K9	Compact 3G IOS Router with SPRINT EVDO Rev A
C819G-V-K9	Compact 3G IOS Router with VERIZON EVDO Rev A
C819G-B-K9	Compact 3G IOS Router with BSNL EVDO Rev A
C819G+7-K9	Compact 3G IOS Router with GLOBAL HSPA+ 3GPP Release 7
Power Supplies and Mounting Brackets	
PWR1-20W-AC	AC Power Adapter for the Cisco 810 Series ISR
PWR1-20W-12VDC	DC Power Adapter for the Cisco 810 Series ISR
ACS-810-DM	Din-Rail Mounting Kit for the Cisco 810 Series ISR
ACS-810-FWM	Floor Mount and Wall Mount Kit for the Cisco 810 Series IS
IOS SW and Licenses	
S81UK9-15104M	Cisco 810 Series IOS Universal Data (Default)
S81NPEK9-15104M	Cisco 810 Series IOS Universal Data with No Payload Encryption
SL-810-AIS	Cisco 810 Advanced IP Services License (Default)
SL-810-ADVSEC	Cisco 810 Advanced Security Software License (Default)
FL-C810-WAASX[*]	810 Series WAAS Express

* Available by default in Cisco harden 819HG ISRs, and option for Cisco non harden 819G ISRs. Feature will be supported in later release of IOS.

Table 2. Ordering Information for Cisco 819HGW, Cisco 819H, and Cisco 819HWD ISRs

Part Number	WLAN ID	Description
C819HGW+7-E-K9	AP802H-AGN-E-K9	Cisco 819 Secure Hardened M2M GW (non-US) 3.7G HSPA + Release 7 with SMS/GPS and Dual WiFi Radio with ETSI
C819HGW+7-N-K9	AP802H-AGN-N-K9	Cisco 819 Secure Hardened M2M GW (non-US) 3.7G HSPA + Release 7 with SMS/GPS and Dual WiFi Radio with HongKong and Mexico
C819HGW+7-A-A-K9	AP802H-AGN-A-K9	Cisco 819 Secure Hardened M2M GW (North America) 3.7G HSPA + Release 7 with SMS/GPS and Dual WiFi Radio with FCC for ATT
C819HGW-V-A-K9	AP802H-AGN-A-K9	Cisco 819 Secure Hardened Router for Verizon EV-DO Rev A with SMS/GPS and Dual WiFi Radio with FCC
C819HGW-S-A-K9	AP802H-AGN-A-K9	Cisco 819 Secure Hardened Router for Sprint EV-DO Rev A with SMS/GPS and Dual WiFi Radio with FCC
C819H-K9	N/A	Cisco 819 Secure Hardened Router with Serial WLAN and 3G are not supported
C819HWD-E-K9	AP802H-AGN-E-K9	Cisco 819 Secure Hardened Router and Dual WiFi Radio with ETSI 3G is not supported

Part Number	WLAN ID	Description
C819HWD-A-K9	AP802H-AGN-A-K9	Cisco 819 Secure Hardened Router and Dual WiFi Radio with FCC 3G is not supported
Power Supplies and Mounting Brackets		
PWR2-20W-AC	AC Power Adapter for the Cisco 810 Series ISR	
PWR2-20W-12VDC	DC Power Adapter for the Cisco 810 Series ISR	
ACS-810-DM*	Din-Rail Mounting Kit for the Cisco 810 Series ISR	
ACS-810-FWM	Floor Mount and Wall Mount Kit for the Cisco 810 Series IS	
IOS SW and Licenses		
S81UK9-15204M	Cisco 810 Series IOS Universal Data (Default)	
S81DNPK9-15204M	Cisco 810 Series IOS Universal Data with No Payload Encryption	
SL-810-AIS	Cisco 810 Advanced IP Services License (Default)	
SL-810-ADVSEC	Cisco 810 Advanced Security Software License (Default)	
FL-C810-WAASX**	810 Series WAAS Express	
S802W7K9-12425JAX	Cisco 802 Series IOS WIRELESS LAN Autonomous	
S802RK9W8-12425JA	Cisco 802 Series IOS WIRELESS LAN LWAPP RECOVERY	

* ACS-810-DM is not supported on C819HGW and C819HWD ISRs.
** WAASX will be supported in later release of IOS.

Q. Do the Cisco 819G and 819HG routers have AT&T SKUs?

A. No. Only the Cisco 819HGW has AT&T SKU C819HGW+7-A-A-K9.

Q. What kind of 3G modem is integrated with the Cisco 819G ISRs?

A. Cisco 819 routers are available with embedded 3G PCI Express Minicards Standard Form Factor F2 listed in Table 3 for the 3GPP standard based on Wideband Code Division Multiple Access (WCDMA) and the 3GPP2 standard based on CDMA2000 carriers. These 3G modems are backward compatible to 2G technologies, namely EDGE/GPRS based on GSM technology and 1xRTT based on narrowband CDMA technology. In addition, Cisco 819G ISRs support "HSPA Evolved" (or HSPA+) embedded modems based on 3GPP Release 7.

Table 3. Cisco 819G Supported PCI Express Minicard Standard Form Factor F2 Modems for HSPA+/HSPA and CDMA2000 Carriers

Part Number	Description	Supported Platform SKUs
MC5728V	3G Wireless WAN PCI Express Minicard Standard Form Factor F2 supporting CDMA Rev A/Rev 0/1xRTT (Sprint, Verizon, and BSNL SKU)	C819G-S-K9, C819G-V-K9, C819G-B-K9 C819HG-S-K9, C819HG-V-K9, C819HG-B-K9 C819HGW-S-A-K9, C819HGW-V-A-K9
MC8795V	3G Wireless WAN PCI Express Minicard Standard Form Factor F2 supporting HSPA/UMTS/EDGE/GPRS (Global SKU)	C819G-U-K9, C819HG-U-K9
MC8705	3G Wireless WAN PCI Express Minicard Standard Form Factor F2 supporting HSPA+/HSPA/UMTS/EDGE/GPRS (Global SKU and North American SKU)	C819G+7-K9, C819HG+7-K9 C819HGW+7-E-K9, C819HGW+7-A-A-K9, C819HGW+7-N-K9

Q. What chat scripts should be used for each type of modem?

A. For MC5728V modem:

chat-script <chatscript_name> "" "ATDT#777" TIMEOUT 60 "CONNECT"

For MC8795V modem:

chat-script <chatscript_name> "" "atdt*98*current_profile#" TIMEOUT 180 "CONNECT"

chat-script <chatscript_name> "" "atdt*99#" TIMEOUT 180 "CONNECT"

For MC8705 modem:

chat-script <chatscript_name> "" "AT!SCACT=1,1" TIMEOUT 60 "OK"

Q. What technology is the Cisco modem based on?

A. The Sierra Wireless MC5728V modem is based on the Qualcomm QSC6085 chipset, which supports CDMA Rev A/Rev 0/1xRTT. It can support speeds up to 3.1 Mbps downlink and 1.8 Mbps uplink. The Sierra Wireless MC8795V modem is based on the Qualcomm MSM6290 chipset, which supports Quad-Band HSPA (850/900/1900/2100 MHz). It supports speeds up to 7.2 Mbps downlink and 2.0 Mbps uplink. It is also backward compatible with GPRS/EDGE (850/900/1800/1900 MHz). The Sierra Wireless MC8705 modem is based on the Qualcomm MDM8200A chipset, which supports Quad-Band HSPA+ (850/900/1900/2100 MHz). It supports speeds up to 21.1 Mbps downlink and 5.76-Mbps uplink. It is also backward compatible with GPRS/EDGE (850/900/1800/1900 MHz).

Q. Is the account information stored on Cisco IOS® Software?

A. No. The account information is stored on the nonvolatile RAM (NVRAM) for the Cisco 3G CDMA modems and on the subscriber-identity-module (SIM) card for the Cisco 3G HSPA+/HSPA modems, not on Cisco IOS Software.

Each CDMA modem is uniquely provisioned using the electronic serial number (ESN). You need to activate the new card with your service provider, and your service provider needs to move your account information to the new ESN.

Q. What are the available antenna solutions with the embedded 3G modem for the Cisco 819 ISRs?

A. For all Cisco 819(H)G ISRs, two multiband swivel-mount dipole antennas are included. For customers whose deployment requires extended cable and high-gain indoor/outdoor antennas, we now offer a cable adapter as an accessory that allows you connect high-gain indoor/outdoor antennas to 819(H)G. Please refer to Table 4 for antenna order information; for technical specifications, please refer to the [Cisco Machine-to-Machine IOS Gateway (Cisco 819 ISRs)](#) data sheet.

Table 4.   Ordering Information for Cisco 819 ISRs with 3G Modems

Description	Part Number
Multi-Band Swivel Mount Dipole Antenna-Faceplate Mount	3G-ANTM1919D 3G-ANTM1919D= (Spare)
Multi-Band Omnidirectional Antenna-Ceiling Mount	3G-ANTM1916-CM 3G-ANTM1916-CM= (Spare)
Single Unit Antenna Extension Base (10-ft cable included)	3G-AE010-R 3G-AE010-R= (Spare)
Single Unit Antenna Extension Base (15-ft cable included)	3G-AE015-R 3G-AE015-R= (Spare)
50-ft (15m) Ultra Low Loss LMR 400 Cable with TNC Connector	3G-CAB-ULL-50 3G-CAB-ULL-50= (Spare)
20-ft (6m) Ultra Low Loss LMR 400 Cable with TNC Connector	3G-CAB-ULL-20 3G-CAB-ULL-20= (Spare)
3G Outdoor Antenna Lightning Arrestor	3G-ACC-OUT-LA 3G-ACC-OUT-LA= (Spare)

Description	Part Number
Multi-Band Outdoor Low Profile Antenna with 15ft cable	3G-ANT-OUT-LP 3G-ANT-OUT-LP= (Spare)
Multi-Band Outdoor Omnidirectional Antenna Mast/Wall Mount & 3G Outdoor Antenna Lightning Arrestor (3G-ACC-OUT-LA)	3G-ANT-OUT-COMBO 3G-ANT-OUT-COMBO= (Spare)
25-ft (7.5 m) Low Loss LMR 240 Cable with TNC Connector	3G-CAB-LMR240-25 3G-CAB-LMR240-25= (Spare)
50-ft (15 m) Low Loss LMR 240 Cable with TNC Connector	3G-CAB-LMR240-50 3G-CAB-LMR240-50= (Spare)
75-ft (23 m) Low Loss LMR 240 Cable with TNC Connector	3G-CAB-LMR240-75 3G-CAB-LMR240-75= (Spare)
3G Omnidirectional Outdoor Antenna	3G-ANTM-OUT-OM 3G-ANTM-OUT-OM=Spare)

Q. What wireless standards are supported with the 3G modem for the Cisco 819?

A. The following 2G and 3G wireless technologies are supported on the 3G modems. Note that performance numbers listed here are theoretical limits and may not be seen in production networks; contact your preferred wireless carrier for expected performance rates:

EVDO (CDMA2000):

- CDMA 1xEV-DO Rev A (forward link up to 3.1 Mbps; reverse link up to 1.8 Mbps)
- CDMA 1xEV-DO Rev 0 (forward link up to 2.4 Mbps; reverse link up to 153.6 kbps)
- CDMA 1xRTT (forward link up to 153.6 kbps; reverse link up to 153.6 kbps)

HSPA+/HSPA/UMTS/EDGE/GPRS:

- HSPA+: 850, 900, 1900, and 2100 MHz (downlink up to 21.1 Mbps; uplink up to 5.76 Mbps)
- HSPA: 850, 900, 1900, and 2100 MHz (downlink up to 7.2 Mbps; uplink up to 5.76 Mbps)
- UMTS: 850, 1900, and 2100 MHz (forward link up to 2.0 Mbps; reverse link up to 384 kbps)
- Enhanced Data Rates for GSM Evolution (EDGE): 850, 900, 1800, and 1900 MHz (forward link up to 384 kbps; reverse link up to 115 kbps)

Q. What Cisco IOS Software release and feature set are required to support the Cisco 819 with the 3G integrated modems?

A. Cisco 819(H)G is supported with Cisco IOS Software Release 15.1(4)M and 15.2(1)T or later. Cisco 819 HGW, Cisco 819HWD, Cisco 819H are supported with Cisco IOS Software Release 15.2(4)M1 or later.

Q. What is the difference between the Sprint and the Verizon PCI Express Minicard Standard Form Factor F2 cards?

A. Essentially, these cards are carrier-specific for Sprint and Verizon. Their hardware is the same. The differences are in the following:

- Modem firmware
- Modem Preferred Roaming List (PRL)

The modem activation processes supported on these two carrier-specific products are different. Verizon supports automatic activation based on over-the-air service provisioning (OTASP), whereas Sprint supports the OMA-DM modem activation process.

For more information about the modem activation and provisioning process, please visit: http://www.cisco.com/en/US/docs/routers/access/1800/1861/software/feature/guide/mrwlcdma.html.

Q. For 3GPP HSPA+/HSPA/UMTS/EDGE/GPRS carriers, how many kinds of modems are there now?

A. Two. MC8795V supports the Global (non-U.S.) HSPA/UMTS/EDGE/GPRS networks. MC8705 supports both the Global (non-U.S.) and the North American HSPA+/HSPA/UMTS/EDGE/GPRS networks. Some carriers may require unique modem settings or modem firmware, but most of the carrier and account information resides in the SIM.

Q. Are different firmware versions available for the Cisco 3G PCI Express Minicard Standard Form Factor F2 modems?

A. Yes. Different firmware versions may be introduced to address feature enhancements or carrier-specific functions. Current firmware versions and supported carriers are listed at: http://www.cisco.com/go/m2m. MC5728V has firmware Version 1.33.0.1; MC8795V has firmware Version K2.0.7.44; and MC8705 has firmware Version T1.0.3.2.

Q. Is the firmware bundled with the Cisco IOS Software image?

A. The firmware comes preloaded with the PCI Express Minicard Standard Form Factor F2; it is not bundled with the Cisco IOS Software image. When a new firmware version is released, it is made available at: http://www.cisco.com/go/m2m.

To upgrade the firmware of your modem, please check configuration guide at: http://www.cisco.com/en/US/docs/routers/access/1800/1861/software/feature/guide/mrwls_hspa.html.

Q. How many SIM slots are supported on the Cisco 819 ISRs?

A. Two SIM card sockets are located under the back of the HSPA+/HSPA/UMTS/EDGE/GPRS based routers, with a cover for protection. Dual SIM card slots allow customers to subscribe cellular services from two different carriers, and they use one cellular link to back up the other one for mission-critical applications. When the cover is open, the router stays functional and powered up, except that the 3G modem needs to be powered off.

Q. Do the Cisco 819 3G PCI Express Minicards Standard Form Factor F2 cards ship preloaded with SIM cards?

A. No. You must obtain the SIM cards from a supported wireless carrier; the cards must be associated with an appropriate rate plan. A complete list of carriers is available at: http://www.cisco.com/go/m2m.

Q. Can I use the SIM card from my personal digital assistant (PDA) in the express card?

A. No. Rate plans for PDAs and laptop computers typically do not cover multiple users, and they have data-usage restrictions. We highly recommended that you purchase a data plan designed for wireless router or machine-to-machine applications.

Q. Can I use micro SIM with Cisco 819?

A. Cisco 819 is equipped with a mini SIM (2FF) slot. Micro SIM (3FF) is not supported by default, but you may be able to use it along with an adapter to convert the micro SIM to mini SIM.

Q. What wireless LAN (WLAN) radio is used in Cisco 819HGW and Cisco 819HWD ISRs?

A. The Cisco 819HGW and 819HWD support Cisco Access Point 802 (AP802 Dual Radio contains two different types of wireless radio that can support connections on 2.4 GHz used by 802.11b, 802.11g, and 802.11n; and 5 GHz used by 802.11a and 802.11n. AP802 has feature parity (Mesh AP function is still under validation) with Cisco Aironet 3500, please refer to AP3500 data sheet for detailed information.

Q. Can AP802 radio of Cisco 819HGW and 819HWD operate at unified mode?

A. AP802 of Cisco 819HGW and 819HWD can operate at both autonomous mode and unified mode.

Q. What is required to operate AP802 of Cisco 819HGW and 819HWD under unified mode?

A. Cisco 819HGW and 819HWD must have the Advanced IP Services feature set in order to enable unified mode for the embedded access point. The boot image type of the access point must be configured on the host router to enable unified mode. After this enable command-line interface (CLI) is invoked, the access point must be rebooted in order to go to unified mode. Make sure that the wireless LAN controller is running the Release 7.3 (7.3.101.0) WLC image.

Q. What images are supported by AP802 of Cisco 819HGW and 819HWD?

A. AP802 of Cisco 819HGW and 819HWD is supported in KMR1(Unified) and 12.4(25d)JAX1(Autonomous) releases. Recovery image 15.2(2)JA release is required to upgrade AP802 to unified mode. Autonomous (ap802-k9w7) and recovery image (ap802-rcvk9w8) will be installed on the system by default.

Q. What Multiple-input and Multiple-output (MIMO) technology is supported by AP802 of Cisco 819HGW and 819HWD?

A. AP802 of Cisco 819HGW and 819HWD supports 2X3 MIMO technology with two spatial streams that provide increased throughput, reliability, and predictability.

Q. What connectors are supported by AP802 of Cisco 819HGW and 819HWD?

A. Three RP-TNC connectors are supported by AP802 of Cisco 819HGW and 819HWD. The left (A) and right (B) antenna support both 2.4Ghz/5.0Ghz at transmit and receive. The middle antenna (C) supports only receive.

Q. What Wi-Fi antenna options are available for AP802 of Cisco 819HGW and 819HWD?

A. AP802 of Cisco 819HGW and 819HWD support various external Wi-Fi antennas that cover different deployment scenarios, including the multiband swivel-mount dipole antenna, Cisco Aironet® 3- and 4-dBi omnidirectional antennas, and 2.4- and 5.0-GHz MIMO wall-mount omnidirectional antennas. Please refer to Table 5 and the Cisco 819 Integrated Service Router Hardware Installation Guide for more information.

Table 5.　　AP802 External Wi-Fi Antennas

Antenna Part Number	Frequency Band(s)	Mounting Mechanical	IP Rating	Description
AIR-ANTM2050D-R	2.4-2.5 GHz 4.9-5.9 GHz	Faceplate Dipole	IP 41	This is the default antenna. For more information, see Cisco Multiband Swivel-Mount Dipole Antenna (AIR-ANTM2050D-R).
AIR-ANT2430V-R	2.4 GHz	Ceiling	IP 41	For more information, see Cisco Aironet 3-dBi Omnidirectional Antenna (AIR-ANT2430V-R).
AIR-ANT5140V-R	5 GHz	Ceiling	IP 41	For more information, see Cisco Aironet 4-dBi Omnidirectional Antenna (AIR-ANT5140V-R).
AIR-ANT2440NV-R	2.4 GHz	Multi-mount (Wall/Ceiling/Mast)	IP 54	For more information, see Cisco Aironet 2.4-GHz MIMO Wall-Mounted Omnidirectional Antenna (AIR-ANT2440NV-R).

Antenna Part Number	Frequency Band(s)	Mounting Mechanical	IP Rating	Description
AIR-ANT5140NV-R	5 GHz	Multi-mount (Wall/Ceiling/Mast)	IP 54	For more information, see Cisco Aironet 5-GHz MIMO Wall Mount Omnidirectional Antenna (AIR-ANT5140NV-R).

Q. What extension cables are available for antennas of AP802 of Cisco 819HGW and 819HWD?

A. Please refer to Table 6 and Cisco 819 Integrated Service Router Hardware Installation Guide for more information.

Table 6.   Wi-Fi Extension Cables

Cisco Product Number	Cable Length	Insertion Loss	Frequency (MHz)
AIR-CAB005LL-R	5 ft	0.5 dB 0.8 dB	2400 5800
AIR-CAB020LL-R	20 ft	1.3 dB 2.5 dB	2400 5800
AIR-CAB050LL-R	50 ft	3.4 dB 5.75 dB	2400 5800

Q. How is AP802 of Cisco 819HGW and 819HWD managed?

A. When AP802 of Cisco 819HGW and 819HWD is running under unified mode, it can managed by wireless LAN controllers and Prime Infrastructure/NCS/WCS. (Version 1.2.0.103).

Q. What is the difference between AP802 and AP801?

A. AP802 is running on the second core of the same CPU chipset used by the host router. AP801 is running on a separate CPU that is different from the host router. AP802 shares the boot flash, Compact Flash, and DRAM with the first core, whereas AP801 has its own dedicated resource. Bootloader upgrade in AP802 is possible only from the host router because of security reasons, whereas AP801 bootloader upgrade is possible from the bootloader itself. AP802 supports Cisco CleanAir® technology but AP801 does not.

Q. What mounting options do the Cisco 819 ISRs support?

A. The Cisco 819H(G) supports a variety of mounting options, including 35-mm din-rail per EN60715, floor mount, and wall mount, allowing for flexibility in deployments. DIN rail mounting is not supported on Cisco 819HGW and 819HWD ISRs.

Q. What power connectors do Cisco 819 AC and DC adapters use?

A. Cisco 819 AC and DC power adapters have two type of connectors. Please refer to Table 7 for more details.

Table 7.   Power Adapter Connectors for Cisco 819

Power Adapters	C819G+7-K9 C819G-B-K9 C819G-S-K9 C819G-U-K9 C819G-V-K9	C819HG+7-K9 C819HG-B-K9 C819HG-S-K9 C819HG-U-K9 C819HG-V-K9	C819HGW+7-E-K9 C819HGW+7-A-A -K9 C819HGW-S-A-K9 C819HGW-V-A-K9 C819HGW+7-N-K9	C819HWD-E-K9 C819HWD-A-K9	C819H-K9
Molex	Yes	Yes	—	—	—
Barrel-type	—	—	Yes	Yes	Yes

Q. What power supply options do the Cisco 819 ISRs support?

A. The Cisco 819H(G) ISR supports both AC and DC power adapters. The DC power adapters include 12 and 24 VDC nominal vehicle power and 24, 52, and 72 VDC DC power adapters that meet railway standards. Railway DC power adapters are referenced from Martek. They will maintain Cisco warranty and router support. The power adapter itself is covered by Martek warranty. Please refer to Table 8 and Cisco 819 Integrated Service Router Hardware Installation Guide for more details.

Table 8.   Ordering Information for Cisco 819 ISRs with 3G Modems

Power Adapters	Nominal Input Range	C819G+7-K9 C819G-B-K9 C819G-S-K9 C819G-U-K9 C819G-V-K9	C819HG+7-K9 C819HG-B-K9 C819HG-S-K9 C819HG-U-K9 C819HG-V-K9	C819HGW+7-E-K9 C819HGW+7-A-A -K9 C819HGW-S-A-K9 C819HGW-V-A-K9 C819HGW+7-N-K9	C819HWD-E-K9 C819HWD-A-K9	C819H-K9
PWR1-20W-AC	100-240 VAC	Yes	Yes	—	—	—
PWR2-20W-AC	100-240 VAC	—	—	Yes	Yes	Yes
PWR1-20W-12VDC	12 VDC	Yes	Yes	—	—	—
PWR2-20W-12VDC	12 VDC	—	—	Yes	Yes	Yes
PWR1-20W-24VDC	24 VDC	Q1CY13	Q1CY13	—	—	—
PWR2-20W-24VDC	24 VDC	—	—	Q1CY13	Q1CY13	Q1CY13
Martek MBRH 0500-B/V1	24 VDC	Q1CY13	Q1CY13	—	—	—
Martek MBRH 0500-C/V1	52 VDC	Q1CY13	Q1CY13	—	—	—
Martek MBRH 0500-D/V1	72 VDC	Q1CY13	Q1CY13	—	—	—
Martek MBRH 0500-B/V2	24 VDC	—	—	Q1CY13	Q1CY13	Q1CY13
Martek MBRH 0500-C/V2	52 VDC	—	—	Q1CY13	Q1CY13	Q1CY13
Martek MBRH 0500-D/V2	72 VDC	—	—	Q1CY13	Q1CY13	Q1CY13

Q. What is the 12 VDC vehicle power adapter operating range?

A. The 12 VDC vehicle power adapter has a 10 to 36 VDC operating range.

Q. What is the 24 VDC vehicle power adapter operating range?

A. The 24 VDC vehicle power adapter has an 18 to 75 VDC operating range.

Q. Can the 12 VDC vehicle power adapters be used in a 24 VDC environment?

A. Yes, you can use the 12V Nominal power supply with 24V, but only if the operating range of the 24V source is within the 10V to 36V limits. The 12V adapter is intended to work with automotive applications that can have a wide range of voltage under fault conditions. If your 24V source is regulated or even semi regulated, it should have no problem powering the 12V Nominal adapter. One caution: the 12 VDC adapter does not have electrical isolation from input to output; the input negative is connected to output negative, so the input negative will be connected to the 819 router chassis ground.

Q. What is the IP41 rating?

A. The protection of enclosures against ingress of dirt or against the ingress of water is defined in IEC529. The degrees of protection are most commonly expressed as "IP" followed by two numbers; for example, IP41, where the numbers define the degree of protection. The first digit, foreign bodies protection, shows the extent to which the equipment is protected against particles, and the second digit, water protection, indicates the extent of protection against water. Number 4 in the first digit represents the protection against the foreign body

that has a diameter longer than 1 mm, and number 1 in the second digit represents the protection against water dripping or falling vertically.

Q. Is the AC power adapter IP41 rated?

A. The Cisco 819 ISR AC power adapter is not IP41 rated. Installation must include protection from the power adapter and power plug from water.

Q. What is DC power adapter IP rating?

A. The DC power adapter for the Cisco 819HG and 819G is not IP41 rated. It is IP41 rated for Cisco 819HGW ISRs. Martek railway DC power adapter is IP65 rated.

Q. What are the DC power adapter mounting options?

A. The DC power supply may be mounted to a wall using four #6 pan or round-head wood screws for the mounting holes on the supply. Each mounting screw must go into a wall stud (wood) or a wall anchor of the appropriate type for the wall. Screws into the drywall are not sufficient to support the DC power supply. Please refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for installation instructions.

Q. What is the power cord retention lock?

A. The Cisco 819 ISRs have a power cord retention mechanism as an accessory. It locks the power cord to the router so when a user accidentally pulls out the power cord, the power cord will not come out from the router. For the complete list of Cisco 819 ISRs that support power cord retention lock, it is available in Cisco 819HGW, 819HWD, and 819H routers. Refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for installation of retention lock.

Q. What is the power switch lock?

A. The Cisco 819 ISRs have a power switch lock as an accessory. The power switch lock prevents unauthorized access to a tampered router (for example, router in a bus). It is available in Cisco 819HGW, 819HWD, and Cisco 819H routers. Please refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for installation of the power switch lock.

Q. What is the power consumption for Cisco 819 ISRs?

A. Cisco 819 Wi-Fi ISRs have maximum power consumption of 20W, other non Wi-Fi Cisco 819 ISRs have a maximum power consumption of 11W.

Q. What LEDs are available on Cisco 819 ISRs?

A. The LEDs are located at the front panel of the Cisco 819, which include SYS, ACT, WWAN, GPS, RSSI, SIM, 3G, and WLAN. Please refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for detailed LED behavior.

Q. What are the memory options of Cisco 819 ISRs?

A. The Cisco 819G and 819HG support fixed 512-MB DRAM 256-MB Compact Flash. The Cisco 819HGW, 819HWD, and 819H support fixed 1-GB DRAM and 1-GB Compact Flash in IDE mode.

Q. What is the mean time between failure (MTBF) of Cisco 819 ISRs?

A. Cisco 819 MTBF is calculated based on ground benign condition. Please refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for the MTBF value of each SKU.

Q. What serial port does the Cisco 819 support?

A. Cisco 819 ISRs support a 12-in-1 serial port, which you can attach to sync, async, and bisync interfaces. Please refer to the Cisco Machine-to-Machine IOS Gateway (Cisco 819 ISRs) data sheet: http://www.cisco.com/en/US/docs/routers/access/interfaces/ic/hardware/installation/guide/ser_hwic.html.

Q. Does the Cisco 819 ISR 12-in-1 serial port support the RS-485 protocol?

A. No. It requires interface converters to support the RS-485 protocol. Some examples of those converters follow:

Schweitzer Engineering Labs:
http://www.selinc.com/sel-2886.htm

ICP-DAS USA:
http://www.l-com.com/item.aspx?id=9165&cmp=Similar

Megatel Industries Corp:
http://www.l-com.com/productFamily.aspx?id=2036&cmp=MI

Q. What are the environmental operating temperature and altitude for the Cisco 819?

A. Nonhardened Cisco 819G routers operate at 32 to 104°F (0 to 40°C), and can operate at 104°F (40°C) up to 5000 feet. Hardened Cisco 819HG ISRs operate at –13 to 140°F (–25 to 60°C), and can operate at 140°F (60°C) up to 5000 feet. The derate maximum operating temperature is 1.5°C per 1000 feet above 5000 ft.

Q. What is the cold start temperature of Cisco 819 hardened ISRs?

A. The Cisco 819 hardened router has clod start temperature at –15°C. With 5°C tolerance, if the Cisco 819 hardened router started at temperature below –10°C, the radio will be off and will be turned on automatically if the modem temperature is at –10°C or if you reset the modem when the modem temperature is at –20°C.

Q. What are the operating conditions for the Cisco 819 Hardened ISRs?

A. Hardened Cisco 819HG ISRs operate at the following conditions:

- Noncondensing humidity: 95%
- IP41 per IEC 60529 for Vertical Falling Water
- Pollution 3 for Dust
- Please refer to the Cisco Machine-to-Machine IOS Gateway (Cisco 819) data sheet for vibration and shock information.

Q. What compliance standards are supported by Cisco 819 ISRs?

A. Cisco 819 ISRs meet the following compliance standards: Safety, Telecom, Electromagnetic Compatibility, and Radio. Please refer to the Cisco Machine-to-Machine IOS Gateway (Cisco 819 ISRs) data sheet for more details.

Q. What railway related standards are supported by Cisco 819 Hardened ISRs?

A. Cisco 819 Hardened ISRs meet EN50155, EN50121-3-2, and EN50121-4.

Features and Applications

Q. What are the industrial markets for the Cisco 819?

A. Following are the industrial markets for the Cisco 819(H)G:

- Financial
- Transportation
- Fleet management
- Security
- Telecommunications
- Telemetry
- Government
- Micro branch office
- Construction
- Manufacturing
- Healthcare
- Education
- Retail
- Telematics
- Public safety
- Utility
- Smart connected community or city
- Insurance
- Professional services

Q. How are the Cisco 3G routers integrated with Cisco IOS Software?

A. An Interface Cellular based on an asynchronous serial interface has been created in Cisco IOS Software to support these cards. This interface is a dial-on-demand routing (DDR) interface, so a data call is initiated when there is traffic to be routed over the 3G networks. Refer to the software configuration guide for more information about how to use the Cisco 3G.

Q. What management capabilities are available for the Cisco 3G PCI Express Minicard Standard Form Factor F2 card for the Cisco 819 ISRs?

A. You can configure and monitor the Cisco 3G Express Card from the router CLI using Cisco IOS Software commands that allow you to:

- Activate the 3G modem (only for CDMA)
- Configure the data profile (only for HSPA)
- Upgrade 3G modem firmware either locally or remotely
- Dial in and bring up the 3G link remotely through Short Message Service (SMS) and voice
- Monitor the signal strength, available network and service, and data-connection statistic
- Use SIM locking/unlocking; it adds SIM security by verifying the SIM PIN at modem power-up

- Use mobile equipment personalization (MEP) unlocking, which allows locking the modem or high-speed WAN interface card (HWIC) to a particular cellular carrier, thus allowing the carrier to subsidize the equipment. This feature allows end users to use the modem with other carriers after the locking period is over, as required in some geographical regions and countries
- Use Open Mobile Alliance Diagnostic & Monitoring (OMA-DM) activation, which allows CDMA modems to be activated and provisioned using the OMA-DM protocol

For remote-management capabilities, the Cisco 3G PCI Express Minicard Standard Form Factor F2 card supports the Simple Network Management Protocol (SNMP) interface 3G MIB, allowing access to the standard interface counters. The interface MIB also provides traps for interface up, interface down, and modem presence events. (Note that a cellular MIB that allows polling of signal and network statistics is under development.)

It supports collecting modem logs through remote Diagnostic & Monitoring capability.

The Cisco 819 supports configuration through a Cisco web-based application, Cisco Configuration Professional.

Q. What new 3G MIB features are supported on the Cisco 819 ISRs?

A. In addition to traditional 3G WWAN, ENTITY, and IF MIB support, the Cisco 819 ISRs support 3G WWAN MIB persistence, which allows SET objects to survive from router reloads and modem power cycle. New MIB objects will be implemented for SMS statistics and Global Positioning System (GPS) data: ftp://ftp.cisco.com/pub/mibs/v2/CISCO-WAN-3G-MIB.my.

Q. What protocol is used by MC8705 modem?

A. The Sierra Wireless MC8705 modem uses direct IP protocol to transmit packets between Cisco IOS Software and the modem. The cellular interface created for the HSPA+ modem is hardcoded with "slip" encapsulation to differentiate from the existing GSM/HSPA modems, which have a Point-to-Point Protocol (PPP) link to Cisco IOS Software. The migration to direct IP is mainly directed by the increase in data throughputs. The 4G/LTE modems are also direct IP-based protocol. Please refer to the Configuring Cisco EHWIC and 880G for 3.7G/3.5 configuration guide for more information about how to configure MC8705-based Cisco 819 ISRs.

Q. How can I debug direct IP sessions in the Cisco 819HG+7 and 819HGW+7 ISRs?

A. Execute the **debug cellular 0 message callcontrol** command to debug direct IP call setup and termination.

Q. Does the Cisco 819 support SIM online insertion and removal (OIR)?

A. No. The SIM slots are located under the chassis and protected by the SIM access panel. Please refer to the Cisco 819 Integrated Service Router Hardware Installation Guide for installation of retention lock.

Q. When does SIM switchover happen?

A. The Dual SIM feature implements auto-switch and failover between two cellular networks. The switch is controlled by a failover timer. The failover timer starts when the modem powers up or changes service status from normal to others. When the failover timer expires, the modem switches from the primary slot (default is slot 0) to the secondary (failover) slot (default is 1). When switchover happens, the modem is power cycled to activate the new SIM. The default failover time is 2 minutes. The maximum number of retries is 10. Please refer to the configuration guide for more details: http://www.cisco.com/en/US/docs/routers/access/1800/1861/software/feature/guide/mrwls_hspa.html.

Q. Do the 3G Cisco 819 ISRs support SMS?

A. Yes. SMS service, which allows event notification through SMS and SMS-initiated data callback, is supported. Refer to Configuring Cisco EHWIC and 880G for 3.7G (HSPA+)/3.5G (HSPA) and Configuring Cisco EHWIC and 880G for 3G (EV-DO Rev A) for SMS and SMS initiated data callback related configuration.

Q. What is SMS-initiated data callback?

A. Voice-initiated data callback (also called dial-in), which is implemented in previous Cisco 3G products, requires customers to subscribe to a voice plan. However, not all service providers offer voice service for data-only modems. SMS initiated data callback addresses this limitation. It allows customers to set up a data connection by sending a text message to the modem. This feature includes message screening using the originating number. This feature improves the feature security and eliminates unauthorized callback requests.

Q. Do the 3G Cisco 819 ISRs support GPS?

A. The Cisco 819 ISRs support standalone GPS. Refer to Configuring Cisco EHWIC and 880G for 3.7G (HSPA+)/3.5G (HSPA) and Configuring Cisco EHWIC and 880G for 3G (EV-DO Rev A) for GPS related configuration.

Q. How do I display GPS data information?

A. The Cisco IOS EXEC command **show cellular** <slot> **gps** displays GPS state, mode, latitude, and longitude information.

Q. Do the 3G Cisco 819 ISRs support the National Marine Electronics Association (NMEA)?

A. NMEA is a combined electrical and data specification for communication between marine electronic devices such as echo sounders, sonar devices, anemometers, gyrocompasses, autopilots, GPS receivers, and many other types of instruments. It has been defined by—and is controlled by—the U.S.-based National Marine Electronics Association. For the Cisco 819, a virtual serial port will be implemented to export NMEA-formatted GPS data. Through COM port emulation software on a PC, location-based applications running on the PC can retrieve real-time GPS data from the modem.

Q. Do the 3G Cisco 819 ISRs support the NMEA streaming over the onboard serial interface?

A. The NMEA streaming feature delivers GPS data from the modem through a virtual COM port. This delivery requires the device running the GPS-based application to set up a reverse Telnet session to the cellular NMEA TTY line using TCP/IP. For devices that are not capable of establishing a Telnet session, such as ticket machines, the Cisco 819 ISR can deliver NMEA data through an onboard serial interface. The feature provides a Cisco IOS Software interface that allows you to configure NMEA 0183 standard (4800 bps, 8-1-N), NMEA 0183HS (38400 bps, 8-1-N), and any standard RS-232 configuration for future needs.

Q. Do the embedded 3G modems on the fixed Cisco 819 ISRs support the diagnostic monitor port on the chassis?

A. Yes. Cisco 819 ISRs support 1 mini Type B USB port for 3G modem diagnostics and provisioning. Users can also collect logs remotely with remote Diagnostic & Monitoring capabilities. Only 3G SKUs have this mini Type B USB port; Wi-Fi–only, non–Wi-Fi, and non-3G SKUs do not have this port.

Q. How do I upgrade the CDMA modem Preferred Roaming List (PRL)?

A. Please refer to 3G CDMA Rev A Software Configuration Guide for instructions about how to upgrade the CDMA modem PRL.

Q. What is Cisco CleanAir technology?

A. The AP802 supports Cisco CleanAir technology. This technology is a systemwide feature of the Cisco Unified Wireless Network that improves air quality by:

- Detecting RF interference that other systems cannot see
- Identifying the source and locating it on a floor plan
- Providing automatic adjustments to optimize wireless coverage around the interference

This innovative technology provides the following benefits:

- Self-healing and self-optimizing wireless networks
- Faster troubleshooting for less downtime
- Effective policy enforcement
- Layer 1 security

Please refer to the Cisco CleanAir Technology Q&A for detailed information.

Q. What other advanced Wi-Fi radio technologies are supported by AP802?

A. AP802 delivers industry-leading performance for secure and reliable wireless connections. Enterprise-class silicon and optimized radios deliver a robust mobility experience using Cisco M-Drive technology, which includes:

- ClientLink improves reliability and coverage for older clients.
- BandSelect improves 5-GHz client connections in mixed client environments.
- VideoStream uses multicast to improve rich-media applications.

Please refer to the AP3500 data sheet for more information.

Q. Is Dynamic Frequency Selection (DFS) supported on AP802?

A. DFS is currently not supported for FCC SKUs pending FCC certification.

Q. How many radios are available on AP802?

A. AP802 has 802.11a/b/g/n dual radios: 2.4Ghz and 5.0Ghz.

Q. Can the AP802 802.11 radio and Cisco 819 cellular radio operate at the same time?

A. Yes. Both AP802 Wi-Fi radios and the Cisco 819 cellular radio can operate at the same time. The AP802 2.4-GHz radio can serve as an access point, and the 5.0-GHz radio can act as a client in work-group bridge (WGB) mode to provide the backhaul function to the existing Wi-Fi network.

Q. What is the router behavior when the reset button is pressed in Cisco 819 ISRs?

A. When the reset button is pressed while the device is powering up, the router will go through configuration and image recovery processes: a) Rommon will set the console baud rate to 9600 and RM1 (read only) Rommon will be executed; that is, if RM2 (upgrade) Rommon is programmed; b) No backup of the original startup config will be performed; c) If there is a Cisco IOS Software image with *.default name, that image will be loaded by Rommon; d) If no *.cfg config file is available on flash or NVRAM, the original startup config will be erased and the router will boot up with empty configuration.

Q. What is the AP802 behavior when the reset button is pressed in Cisco 819 ISRs?

A. When the reset button is pressed while the device is powering up, the access point will go through configuration and image recovery processes: a) if a cpconfig-ap802.cfg config file exists in flash memory, then config.txt will be overwritten with contents of the cpconfig-ap802.cfg file; b) if the cpconfig-ap802.cfg config file does not exist in flash memory, the config.txt file will be deleted. The access point will boot up with empty configuration in this case; this phase is the configuration recovery phase; c) the access point on the second core will boot with the first image on the flash memory. This phase is the image recovery phase.

Q. What is the environmental high temperature logging feature?

A. Cisco 819 ISRs support six temperature sensors in the system: System Ambient, Sensor 1, Sensor 2, Sensor 3, and Sensor 4 (all temperatures read from MCU), and 3G (temperature read from the 3G modem). When the temperature threshold is crossed, action is taken based on the information in Table 9. **Crossed** means that the measured temperature is "less than" the low threshold; **or** that the measured temperature is "more than" the high threshold. Temperature is sensed or read every **30 seconds**, and action taken is based on information in Table 9.

Table 9.   Temperature Thresholds and Associated Actions

	Low Temp. Threshold (in C) [No Traps (T)]			High Temp. Threshold (in C)		
	System	**3G**	**S1, S2, S3, S4**	**System**	**3G**	**S1, S2, S3, S4**
C819	0 (S,C,L)	0 (S,C,L)	0 (S,C)	60 (S,C,L,T)	85 (S,C,L,T)	60 (S,C,T)
C819H	-25 (S,C,L)	-25 (S,C,L)	-25 (S,C)	75 (S,C,L,T)	90 (S,C,L,T)	75 (S,C,T)

When temperature on a sensor crosses the threshold, action as indicated by the letters is taken.

S = Syslog generated
C = Call home
L = Logging in NVRAM
T = Generate Trap

Q. Can I use IP Security (IPsec) with the Cisco 3G PCI Express Minicard Standard Form Factor F2 card?

A. Yes. All Cisco ISR security features are supported on the Cisco 3G PCI Express Minicard Standard Form Factor F2 interface. IPsec has been tested in both site-to-site and Dynamic Multipoint VPN (DMVPN) configurations with the new Cisco 3G WWAN Express Cards.

Q. How many VLANs are supported in Cisco 819 ISRs?

A. The Cisco ISR 819 supports 8 VLANs by default, but will support 16 VLANs in Q1CY13.

Service Plans and Carriers

Q. How do I get a service plan for the Cisco 819 ISRs?

A. You must obtain a service plan from a supported wireless carrier. For a complete list of supported wireless carriers, please visit http://www.cisco.com/en/US/products/ps11615/index.html.

For the GSM express card, the service plan information is included in the SIM card. You must purchase the SIM card from your local wireless carrier. In general, service plans should be metered plans. Several of the unlimited data plans are designed for laptop computers and PDAs and not for routers, where a customer can have multiple data devices.

For the CDMA express card, the carrier must activate the modem. Typically this activation involves providing account information as well as the ESN of the modem.

Q. How do I activate my Cisco 3G?

A. The service activation procedure varies by wireless carrier. Activation can be performed through a phone call or by logging into a specific website so that the carrier can perform the activation. To activate a modem, typically you need to have a reseller agreement with the carrier. The typical scenarios follow:

- Managed services or wireless carrier: If you purchased the modem through a wireless carrier or affiliate, that carrier or affiliate should activate the modem.
- Reseller: If your reseller has an agreement with a wireless carrier, the reseller may perform service activation. If the reseller does not have a relationship with a wireless carrier, the reseller may partner with a wireless agent to activate the modem.

Q. Is over-the-air (OTA) provisioning supported, or is provisioning performed by a technician during installation over the connection to the console port?

A. OTA provisioning is supported; however, the OTA protocols of different wireless network operators vary. Sprint supports OMA-DM provisioning and Verizon supports OTASP provisioning.