

Planning Guide: Verizon Internet Access with VPN for Cisco LTE eHWIC/GRWIC/819

Overview

Verizon Wireless offers four 3G/4G data services for enterprises to connect remote sites through Verizon Wireless Long Term Evolution (LTE):

- Machine-to-Machine (M2M) price plan with Internet access and dynamic IP: This service enables a router to connect users or devices to the Internet or an enterprise network (through a customer premises equipment (CPE)-based VPN such as IP Security [IPsec], generic routing encapsulation [GRE], Dynamic Multipoint VPN [DMVPN], etc.).
- M2M price plan with Internet access and static IP: This service offers the same services as the previous one, except the 3G or 4G interface of each router receives a consistent predetermined 3G or 4G IP address.
- Mobile Private Network (MPN): This service enables a router to connect to an enterprise network. It requires a customer premises-based VPN or Network Address Translation (NAT) for users behind the remote router to access the network.
- Mobile Private Network (MPN) with Dynamic Mobile Network Routing (DMNR): This service enables a router to connect users to an enterprise private network without the need for a customer premises-based VPN. Traffic does not traverse the Internet. Dynamic routing allows changing of local and remote IP addresses without coordination with Verizon. It can be used with any Cisco VPN option, including Group Encrypted Transport VPN.

This planning guide outlines the process to plan for Verizon Internet LTE service with customer premises-based VPN (GRE, IPsec, IPsec with GRE, DMVPN, etc.). Relevant documents are also referenced.

1. No special service is needed outside of an approved pricing plan for Internet access. However, the LTE enhanced high-speed WAN interface card eHWIC must be used with a Cisco® Integrated Services Routers Generation 2 (ISR G2) router (Cisco 1900, 2900, or 3900 Series Integrated Services Router) whether provided by the Verizon demonstration loan program or by your organization. For the CGR-2010 the LTE GRWIC is required. For the C819G-4G-V, the LTE interface is integrated.
2. This deployment guide is also applicable to Verizon Mobile Private Network without Verizon DMNR service for private network access; however public Internet access would be dependent on the private network.
3. Ensure you have a subscriber identity module (SIM/USIM/Mini-SIM, Verizon SKU "DIRECTSIM4G-D") for the LTE eHWIC/GRWIC/819 with an approved pricing plan. Your Verizon account manager is the appropriate contact for obtaining a SIM.
 - a. The SIM must be provisioned and associated with international mobility equipment identity (IMEI) of the LTE eHWIC/GRWIC/819 modem before activation on an approved plan.
 - i. If this ISR is a demonstration unit provided by Verizon Wireless, an appropriately provisioned SIM should be included as part of the package sent to you.

- b. No username or password needs to be set or defined.
 - i. If the service is Internet with dynamic IP addressing, the Access Point Name (APN) should already be correct for the LTE eHWIC (VZWINTERNET). If so, skip to step 3.
 - ii. If the service is Internet with static IP addressing, the LTE network should set the APN without configuration. If this does not occur, you must know the APN for this service. Your Verizon Wireless representative can provide this information (ne01.vzwstatic, so01.vzwstatic, we01.vzwstatic, etc.).
4. Check the LTE eHWIC (in the separate box) to see if the SIM is inserted. If not, insert the SIM using the instructions found at: www.cisco.com/en/US/docs/routers/access/interfaces/ic/hardware/installation/guide/EHWIC-4G-LTEHW.html#wp1147248. The GRWIC on CGR is similar. The 819 has a small SIM panel underneath.
5. Install the LTE eHWIC into the ISR G2 (or GRWIC into the CGR-2010).
 - a. The instructions to physically install the LTE eHWIC into the ISR are available at: www.cisco.com/en/US/docs/routers/access/interfaces/ic/hardware/installation/guide/inst_ic.html#wp1037332. The CGR-2010 is similar. The C819G-4G-V has the LTE already integrated.
 - b. Install the LTE eHWIC into the right-most eHWIC slot (looking at the rear of the ISR, slot 0/0) (Figure 1).

Figure 1. LTE eHWIC



6. Install the antenna cables to the LTE eHWIC/GRWIC/819 and the antennas onto the extension cables.
 - a. Instructions are in the section “Additional Information”.
7. Power up the ISR, and ensure that the antennas are positioned appropriately.
 - a. With terminal or console access to the ISR G2 (logging the terminal console is recommended):
 - i. Power up the ISR. Hit Enter, and at the console prompt type “enable”. There should be no ID or password set. If there is, follow the instructions to reset the password at: www.cisco.com/en/US/products/ps5855/products_password_recovery09186a0080b3911d.shtml
 - ii. Position antennas for the best RSSI signal > -80 dBm and RSRP signal > - 105 dBm, with the **show cell 0/0/0 radio** command (**show cell 0 radio** for 819).
 - iii. Type “show run” to see if the configuration matches the key values shown in the appropriate configuration example as provided later in this document.
 - iv. If the configuration does not match the appropriate configuration example, add or change the appropriate lines through the command-line interface (CLI) **config term**, etc. **Note:** Even with the Internet with static IP service, the cell interface remains “IP address negotiated”.
 - b. If the service is Internet with dynamic IP addressing, skip the next step.
 - c. If the service is Internet with static IP addressing, it may take up to 10 minutes after ISR power-up before the LTE interface becomes active because the SIM must connect to the network and start a process to configure the LTE modem appropriately. The ISR should not be powered down for at least 10 minutes after initial power-up (with antennas attached). This process provisions the appropriate APN. If the network-based process (SIM-Over-the-Air/Over-the-Air-Device Management [SIM-OTA/OTA-DM]) does not change the APN, either the SIM is not properly activated or provisioned (Call Verizon Wireless Customer Care) or

the SIM was installed in the LTE eHWIC without this network process completed and the ISR powered down. If the latter, there are two ways to address the problem: 1) Power down the ISR, remove the SIM, and then put the SIM into another LTE device (Novatel Mifi hotspot, LTE eHWIC, etc.). When that device connects, reinsert the SIM into the LTE eHWIC, connect the antennas, power up, and wait 10 minutes. 2) Use the local APN change command in step 9. The Cisco IOS Software command **show cellular 0/x/0 profile** displays the APN (**show cellular 0 profile** for the 819).

8. **If the LTE connection becomes active but then begins to flap (repeats going down and up periodically, usually every 5 to 60 seconds), a configuration problem must be resolved.**
 - a. This behavior can be caused by a network disconnect due to IP source address violations. It is resolved by reconfiguring the traffic to be tunneled, NAT, or access control lists (ACLs) so that no traffic is routed without being tunneled or subjected to NAT. If you cannot determine which IP address is causing the IP source violation, contact the Verizon Wireless Enterprise Help Desk (800 922-0204) and ask them to trace the call and report the IP address that is causing the problem. Then correct or add NAT, ACL, or VPN to stop any packets without the LTE eHWIC IP address from leaking out.
9. The data APN for Verizon Internet with Static IP LTE service is different than for Internet/Dynamic. The APN depends on the U.S. region, and should be provided by your Verizon representative. If the value is incorrect (IOS command **show cellular 0/x/0 profile** displays the APN, **show cellular 0 profile** for the 819), OTA-DM has not changed it automatically. Change the value manually via the appropriate 1-line IOS command:
 - a. For 15.2(4)M3 or M4 (ISR) or 15.3(1)T1 (CGR), below is an enable-mode command example:
`cellular 0/0/0 lte profile create 1 ne01.VZWSTATIC` (Note that the Data APN is profile 1)
 - b. For IOS 15.3(3)M2 and later, additional APNs have been exposed (IMS, admin), so the profile number has been changed from 1 to 3. Below is an example:
`cellular 0/0/0 lte profile create 3 ne01.VZWSTATIC` (Note that the Data APN is profile 3)
 - c. The preceding methods also are applicable for Verizon MPN without DMNR service

Additional Information

- Cisco LTE Portal: www.cisco.com/go/4g
- Verizon planning/configuration documents:
www.cisco.com/en/US/products/ps5949/products_installation_and_configuration_guides_list.html
- LTE eHWIC hardware overview, SIM install, antenna connection, and module install:
www.cisco.com/en/US/docs/routers/access/interfaces/ic/hardware/installation/guide/EHWIC-4G-LTEHW.html
- LTE eHWIC Cisco IOS Software configuration (use the Verizon planning/configuration documents), monitoring, and troubleshooting:
www.cisco.com/en/US/docs/routers/access/interfaces/software/feature/guide/EHWIC-4G-LTESW.html
- LTE eHWIC antenna, cabling, and lightning arrestor instructions:
 - www.cisco.com/en/US/docs/routers/access/wireless/hardware/notes/4G3G_ant.html
 - www.cisco.com/en/US/docs/routers/access/wireless/hardware/notes/4Gantex15-10r.html
 - www.cisco.com/en/US/docs/routers/access/wireless/hardware/notes/4Glar.html

Configuration Guide: Verizon Internet Access, Static IP, LTE eHWIC

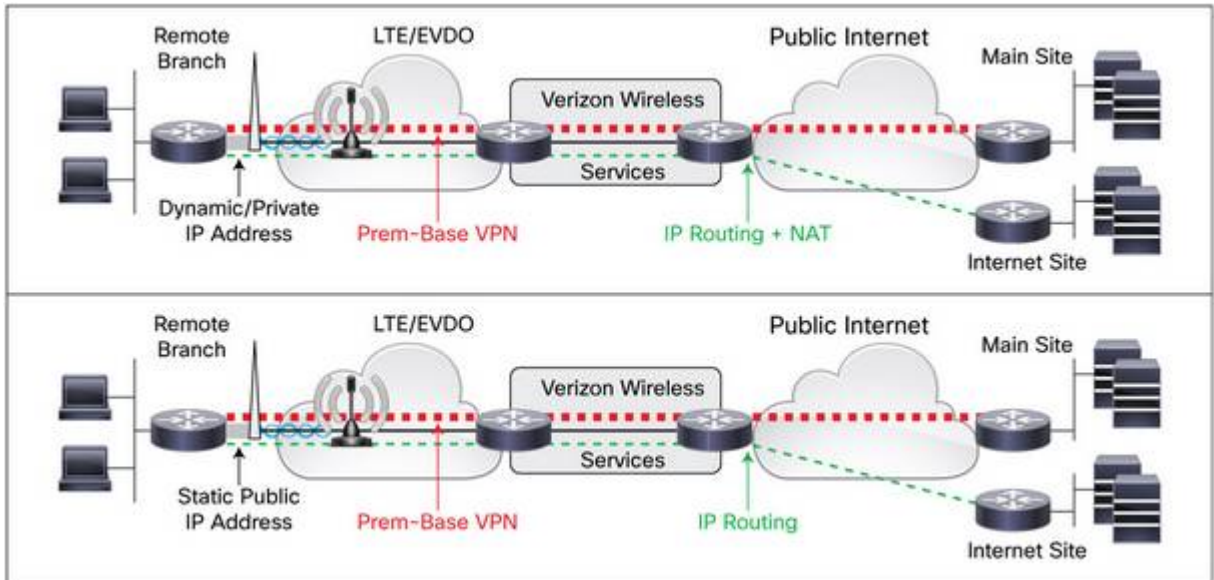
1. For general recommendations regarding IOS and LTE firmware releases please see the table below.

ISR LTE SKU	LTE Modem	Recommended firmware	Recommended IOS Release
EHWIC-4G-LTE-V	MC7750	3.5.10.6	15.5.3M4
EHWIC-4G-LTE-VZ	MC7350	5.5.58.01	15.5.3M4
C819G-4G-V-K9	MC7750	3.5.10.6	15.5.3M4
C819HG-4G-V-K9	MC7750	3.5.10.6	15.5.3M4
C819G-4G-VZ-K9	MC7350	5.5.58.01	15.5.3M4
C899G-LTE-VZ-K9	MC7350	5.5.58.01	15.5.3M4
NIM-4G-LTE-VZ	MC7350	5.5.58.01	XE 3.16.4
C819G-LTE-MNA-K9	MC7354	5.5.58.01	15.6.1T
C819GW-LTE-MNA-K9	MC7354	5.5.58.01	15.5.3M4

2.
 - a. LTE modem firmware level can be checked with the Cisco IOS enable mode command **"show cellular 0/x/0 hardware"** (for modular ISRs, **"show cell x hardware for fixed port ISRs"** (where "x" is the cell interface number from **"show ip interface brief"** Cisco IOS command).
3. If an LTE connection cannot be made, the Access Point Name (APN) should be checked (**show cellular 0/x/0 profile**, for 819 **show cellular 0 profile**). If it is not the correct APN ("VZWINTERNET" for Verizon Internet Dynamic service, "xx01.VZWSTATIC" for Internet/Static service, where xx can be ne, so, we or mw), refer to step 9 in the above planning section.
4. This guide is for the Internet with VPN use case, with either Verizon Internet dynamic IP address service or Verizon Internet static IP address service. Some VPN examples follow; other VPN methods can be used.
5. All packets through the LTE interface **must be sent** via Port Address Translation (PAT) or VPN. If packets are sent over LTE with the source IP address other than the LTE interface IP address, the LTE connection will be disconnected (IP address violation). The ISR will attempt to reconnect, and a flapping condition will occur.

High-Level Network Diagram

Figure 2. Customer Design Scenarios



Because the configurations vary greatly depending on VPN type, listed will be the basic Internet configuration, followed by Easy VPN, followed by DMVPN. These configurations are only examples; actual configuration should match enterprise policies and best practices. However, routing protocol timers should be within Verizon Wireless guidelines.

ISR LTE eHWIC Internet Configuration for Primary Access

```
!### command allowing for "LTE test cellular" enable mode commands ###
service internal
!
hostname c1921-Internet
!
!### load appropriate IOS image ###
boot system flash:c1900-universalk9-mz.SPA.155-3.M4.bin
!
ip cef
!
!### CHAT Script to make a data call ###
chat-script ltescript "" "AT!CALL1" TIMEOUT 20 "OK"
!
!### This Loopback address used to source pings for testing purposes. ###
!
interface Loopback1
  description ### always-on interface ###
  ip address 1.2.3.9 255.255.255.255
  ip nat inside
!
!### The maximum TCP MSS is set to 1300 bytes to allow for GRE, IPsec and
other network overhead. The route-map clears DF bits in the IP headers. ###
!
interface GigabitEthernet0/0
  ip address 10.20.30.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1300
  ip policy route-map clear-df
!
interface GigabitEthernet0/1
  ip address 10.20.40.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1300
  ip policy route-map clear-df
!
!### Interface Cellular -Receives Pool/WAN IP (dynamic or static) from P-GW.
The call will be activated using the Dialer Watch group. For static IP
address services, still use "ip address negotiated". ###
!
interface Cellular0/0/0
  ip address negotiated
  ip nat outside
  no ip unreachable
  encapsulation slip
  load-interval 30
  dialer in-band
  dialer idle-timeout 0
  dialer enable-timeout 1
  dialer string ltescript
  dialer watch-group 1
  async mode interactive
  pulse-time 0
!
```

```

##### This NAT statement ensures non-VPN traffic leaving the ISR is sourced
with cellular interface's IP address to avoid network auto-disconnect. All
traffic appears to come from the LTE IP address. ###
ip nat inside source list 100 interface Cellular0/0/0 overload
!
##### This ACL enables NATing of traffic leaving the cell interface. "Permit
ip any any" is no longer supported. This example will NAT any packet with
the 1st octet having an even number (including 10.x.x.x 172.x.x.x and
192.x.x.x, a superset of RFC1918 addresses). ###
access-list 100 permit ip 0.0.0.0 254.255.255.255 any
!
##### This static route sends all traffic destined for other than the ISR LAN
and loopback subnets out the LTE connection. ###
ip route 0.0.0.0 0.0.0.0 Cellular0/0/0
!
##### Route-map clears the DF-bit in packets the LTE interface. ###
!
route-map clear-df permit 10
    set ip df 0
!
##### This section defines the LTE call activation triggers and timers. ###
!
##### The call will be triggered by this statement. The address "5.6.7.8" is
a "dummy" route. Any "dummy" value can be used. ###
dialer watch-list 1 ip 5.6.7.8 0.0.0.0
##### Wait for 60 sec. before activating the call after the initial boot. ###
dialer watch-list 1 delay route-check initial 60
##### The ISR will wait 1 sec. before activating the call. ###
dialer watch-list 1 delay connect 1
!
line 0/0/0
    script dialer ltescript
    modem InOut
    no exec
    transport input telnet
!
end

```

CGR-2010 with LTE GRWIC is configured similarly to the ISR with LTE eHWIC.

809, 819 and 829 are configured similarly to modular ISRs with these caveats:

- The cell interface is "cellular 0"
- The line interface representing LTE is "line 3"

ISR LTE eHWIC Internet Configuration for Primary Access with DMVPN, No NAT, and No Split Tunnel

```
!### addresses with values above 254 shown in the configuration are to
highlight those that must be changed.  If accidentally used in a
configuration, they will result in error messages as they are disallowed
!### command allowing for "LTE test cellular" enable mode commands ###
service internal
!
hostname c1921-Internet
!
!### load the appropriate IOS image ###
boot system flash:c1900-universalk9-mz.SPA.155-3.M4.bin
!
ip cef
!
!### CHAT Script to make a data call ###
chat-script ltescript "" "AT!CALL1" TIMEOUT 20 "OK"
!
!### IKE/IPsec Definition to DMVPN Hub - IP addresses must be replaced ###
crypto isakmp policy 1
  encr 3des
  authentication pre-share
  group 2
crypto isakmp key IkEkEy address 4.300.400.500
!
crypto ipsec transform-set SDM_TRANSFORMSET_1 esp-3des esp-sha-hmac
!
crypto ipsec profile SDM_Profile1
  set transform-set SDM_TRANSFORMSET_1!
!
!### Tunnel interface for DMVPN - Change Tunnel Destination IP Address ###
!### EIGRP hello interval must be changed, conform to Verizon Contract ###
!### Head end DMVPN, EIGRP peer timer values should match what's below ###
interface Tunnel0
  description $FW_INSIDE$
  bandwidth 1000
  ip address 10.10.1.8 255.255.255.0
  no ip redirects
  no ip unreachable
  no ip proxy-arp
  ip hello-interval eigrp 1 300
  ip hold-time eigrp 1 600
  ip policy route-map clear-df
  ip nhrp authentication NhRpKeY
  ip nhrp map 10.10.1.1 4.300.400.500
  ip nhrp network-id 123451
  ip nhrp holdtime 3600
  ip nhrp nhs 10.300.400.500
  ip nhrp registration no-unique
  ip route-cache flow
  delay 1000
  qos pre-classify
  tunnel source Cellular0/0/0
  tunnel destination 4.300.400.500
  tunnel key 100000
```



```

    tunnel protection ipsec profile SDM_Profile1
!
!### This Loopback address used to source pings for testing purposes. ###
!
interface Loopback1
    description ### always-on interface ###
    ip address 1.2.3.9 255.255.255.255
!
!### The maximum TCP MSS is set to 1300 bytes to allow for GRE, IPsec and
other network overhead. The route-map clears DF bits in the IP headers. ###
!
interface GigabitEthernet0/0
    ip address 10.20.30.1 255.255.255.0
    ip tcp adjust-mss 1300
    ip policy route-map clear-df
!
interface GigabitEthernet0/1
    ip address 10.20.40.1 255.255.255.0
    ip tcp adjust-mss 1300
    ip policy route-map clear-df
!
!### Interface Cellular -Receives Pool/WAN IP (dynamic or static) from P-GW.
The call will be activated using the Dialer Watch group. For static IP
address services, still use "ip address negotiated". ###
!
interface Cellular0/0/0
    ip address negotiated
    no ip unreachable
    encapsulation slip
    load-interval 30
    dialer in-band
    dialer idle-timeout 0
    dialer enable-timeout 1
    dialer string ltescript
    dialer watch-group 1
    async mode interactive
    pulse-time 0
!
!### This stanza represents the IP routing protocol of choice and
definitions ###
router eigrp 1
    network 10.0.0.0
    no auto-summary
!
!### This static route only allows traffic destined for the DMVPN head end
out the LTE connection. No other traffic is permitted to exit the LTE
interface ###
ip route 4.300.400.500 255.255.255.255 Cellular0/0/0
!
!### Route-map clears the DF-bit in packets exiting the LTE interfaces. ###
!
route-map clear-df permit 10
    set ip df 0
!
!### This section defines the LTE call activation triggers and timers. ###
!

```

```
##### The call will be triggered by this statement. The address "5.6.7.8" is
a "dummy" route. Any "dummy" value can be used. ###
dialer watch-list 1 ip 5.6.7.8 0.0.0.0
##### Wait for 60 sec. before activating the call after the initial boot. ###
dialer watch-list 1 delay route-check initial 60
##### The ISR will wait 1 sec. before activating the call. ###
dialer watch-list 1 delay connect 1
!
line 0/0/0
  script dialer ltescript
  modem InOut
  no exec
  transport input telnet
!
end
```

CGR-2010 with LTE GRWIC is configured similarly to the ISR with LTE eHWIC.

809, 819 and 829 are configured similarly to the ISR with LTE eHWIC with these caveats:

- The cell interface is "cellular 0"
- The line interface representing LTE is "line 3"

ISR LTE eHWIC Internet Configuration for Primary Access: Easy VPN, Split Tunnel + NAT

```
!### addresses with values above 254 shown in the configuration are to
highlight those that must be changed.  If accidentally used in a
configuration, they will result in error messages as they are disallowed
!### command allowing for "LTE test cellular" enable mode commands ###
service internal
!
hostname c1921-Internet
!
!### load the appropriate IOS image ###
boot system flash:c1900-universalk9-mz.SPA.155-3.M4.bin
!
ip cef
!
!### CHAT Script to make a data call ###
chat-script ltescript "" "AT!CALL1" TIMEOUT 20 "OK"
!
!### IKE/IPsec Definition to DMVPN Head end - IP addresses must be
replaced:-)
crypto isakmp policy 1
  encr 3des
  authentication pre-share
  group 2
crypto isakmp key IkeKey address 0.0.0.0 0.0.0.0
crypto isakmp keepalive 60
!
crypto ipsec client ezvpn ez
  connect auto
  group ezdemo key ezdemo
  mode network-extension
  peer 4.300.400.500
  virtual-interface 2
  username ezclient password ezclientpw
  xauth userid mode local
!
!### This Loopback address used to source pings for testing purposes. ###
interface Loopback1
  description ### always-on interface ###
  ip address 1.2.3.9 255.255.255.255
  ip nat inside
!
!### The maximum TCP MSS is set to 1300 bytes to allow for GRE, IPsec and
other network overhead. The route-map clears DF bits in the IP headers. ###
!
interface GigabitEthernet0/0
  ip address 10.20.30.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1300
  ip policy route-map clear-df
  crypto ipsec client ezvpn ez inside
!
interface GigabitEthernet0/1
  ip address 10.20.40.1 255.255.255.0
  ip nat inside
```

```

ip tcp adjust-mss 1300
ip policy route-map clear-df
crypto ipsec client ezvpn ez inside
!
!### Interface Cellular -Receives Pool/WAN IP (dynamic or static) from P-GW.
The call will be activated using the Dialer Watch group. For static IP
address services, still use "ip address negotiated". ###
!
interface Cellular0/0/0
 ip address negotiated
 ip nat outside
 no ip unreachable
 encapsulation slip
 load-interval 30
 dialer in-band
 dialer idle-timeout 0
 dialer enable-timeout 1
 dialer string ltescript
 dialer watch-group 1
 async mode interactive
 crypto ipsec client ezvpn ez
 pulse-time 0
!
!### This NAT statement ensures non-VPN traffic leaving the ISR is sourced
with cellular interface's IP address to avoid network auto-disconnect. All
traffic appears to come from the LTE IP address. ###
ip nat inside source list 100 interface Cellular0/0/0 overload
!
!### This ACL enables NATing of traffic leaving the cell interface. "Permit
ip any any" is no longer supported. This example will NAT any packet with
the 1st octet having an even number (including 10.x.x.x 172.x.x.x and
192.x.x.x, a superset of RFC1918 addresses). ###
access-list 100 permit ip 0.0.0.0 254.255.255.255 any
!
!### This static route sends all traffic destined for other than the ISR LAN
and loopback subnets out the LTE connection. ###
ip route 0.0.0.0 0.0.0.0 Cellular0/0/0
!
!### Route-map clears the DF-bit in packets exiting the LTE interface. ###
!
route-map clear-df permit 10
 set ip df 0
!
!### This section defines the LTE call activation triggers and timers. ###
!
!### The call will be triggered by this statement. The address "5.6.7.8" is
a "dummy" route. Any "dummy" value can be used. ###
dialer watch-list 1 ip 5.6.7.8 0.0.0.0
!### Wait for 60 sec. before activating the call after the initial boot. ###
dialer watch-list 1 delay route-check initial 60
!### The ISR will wait 1 sec. before activating the call. ###
dialer watch-list 1 delay connect 1
!
line 0/0/0
 script dialer ltescript
 modem InOut

```

```
no exec
transport input telnet
!
end
```

CGR-2010 with LTE GRWIC is configured similarly to the ISR with LTE eHWIC.

809, 819 and 829 are configured similarly to the ISR with LTE eHWIC with these caveats:

- The cell interface is “cellular 0”
- The line interface representing LTE is “line 3”

Sample Operation and Show Commands

LTE Call Comes Up

```
C1921-Internet#test cellul 0/0/0 modem-power
Modem Power cycled successfully
C1921-Internet#
.Mar 12 21:54:23.334: %CELLWAN-2-MODEM_UP: Modem in HWIC slot 0/0 is now UP
.Mar 12 21:54:51.514: %LINK-3-UPDOWN: Interface Cellular0/0/0, changed state to
up
.Mar 12 21:54:52.514: %LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular0/
0/0, changed state to up
```

```
c1921-Internet#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
```

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

```
S* 0.0.0.0/0 is directly connected, Cellular0/0/0
    1.0.0.0/32 is subnetted, 1 subnets
C    1.2.3.9 is directly connected, Loopback1
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C    10.20.30.0/24 is directly connected, GigabitEthernet0/0
L    10.20.30.1/32 is directly connected, GigabitEthernet0/0
C    166.158.61.41/32 is directly connected, Cellular0/0/0
```

```
C1921-Internet#sh ip int brie
```

Interface	IP-Address	OK?	Method	Status	Prot ocol
Embedded-Service-Engine0/0	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0/0	10.20.30.1	YES	NVRAM	up	up
GigabitEthernet0/1	10.20.40.1	YES	NVRAM	down	down
GigabitEthernet0/1/0	unassigned	YES	unset	down	down

GigabitEthernet0/1/1	unassigned	YES	unset	down	down
GigabitEthernet0/1/2	unassigned	YES	unset	down	down
GigabitEthernet0/1/3	unassigned	YES	unset	down	down
Cellular0/0/0	166.158.61.41	YES	IPCP	up	up
Cellular0/0/1	unassigned	YES	unset	down	down
Cellular0/0/2	unassigned	YES	unset	down	down
Cellular0/0/3	unassigned	YES	unset	down	down
Loopback1	1.2.3.9	YES	NVRAM	up	up
NVI0	10.20.30.1	YES	unset	up	up
Vlan1	unassigned	YES	unset	down	down

C1921-Internet#sh dialer

Ce0/0/0 - dialer type = IN-BAND ASYNC NO-PARITY
Idle timer (never), Fast idle timer (20 secs)
Wait for carrier (30 secs), Re-enable (10 secs)
Dialer state is data link layer up
Dial reason: Dialing on watched route loss
Time until disconnect never
Current call connected 00:01:24
Connected to newchat

Dial String	Successes	Failures	Last DNIS	Last status	Default
ltechat	1	1	00:01:24	successful	Default

C1921-Internet#ping 4.2.2.2 source lol

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 1.2.3.9
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/69/76 ms

C1921-Internet#ping 4.2.2.2 source gi0/0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 10.20.30.1
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms

C1921-Internet#sh ip nat trans

Pro	Inside global	Inside local	Outside local	Outside global
icmp	166.158.61.41:9309	1.2.3.9:9309	4.2.2.2:9309	4.2.2.2:9309
icmp	166.158.61.41:9310	1.2.3.9:9310	4.2.2.2:9310	4.2.2.2:9310
icmp	166.158.61.41:9311	10.20.30.1:9311	4.2.2.2:9311	4.2.2.2:9311
udp	166.158.61.41:123	10.20.30.3:123	173.244.211.10:123	173.244.211.10:123
tcp	166.158.61.41:44096	10.20.30.3:44096	65.210.41.142:5061	65.210.41.142:5061
tcp	166.158.61.41:44736	10.20.30.3:44736	65.210.41.142:5061	65.210.41.142:5061

C1921-Internet#

```

C1921-Internet#sh cell 0/0/0 all
Hardware Information
=====
Modem Firmware Version = SWI9600M_01.00.09.03
Modem Firmware built = 2011/07/01 19:31:09
Hardware Version = 20460000
International Mobile Subscriber Identity (IMSI) = 311480003046872
International Mobile Equipment Identity (IMEI) = 990000820020925
Electronic Serial Number (ESN) = 0x8002A36C [12800172908]
Integrated Circuit Card ID (ICCID) = 8914800000030771738
Mobile Subscriber International Subscriber
IDentity Number (MSISDN) = +12675657329

Profile Information
=====
Profile 1 = ACTIVE*
-----
PDP Type = IPv4
PDP address = 166.158.61.41
Access Point Name (APN) = ne01.VZWSTATIC
Authentication = None
Username:
Password:
    Primary DNS address = 198.224.188.236
    Secondary DNS address = 198.224.189.236

* - Default profile

Data Connection Information
=====
Data Transmitted = 0 bytes, Received = 0 bytes
Profile 1, Packet Session Status = ACTIVE
IP address = 166.158.61.41

```



```
Primary DNS address = 198.224.188.236
Secondary DNS address = 198.224.189.236
Profile 2, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 3, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 4, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 5, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 6, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 7, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 8, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 9, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 10, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 11, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 12, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 13, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 14, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 15, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
Profile 16, Packet Session Status = INACTIVE
Inactivity Reason = Unknown
```

Network Information

```
=====
Current Service Status = No service, Service Error = None
Current Service = Packet switched
Current Roaming Status = Home
Network Selection Mode = Automatic
Mobile Country Code (MCC) = 27296
Mobile Network Code (MNC) = 0
```

Radio Information

```
=====
```

```
Radio power mode = ON
Current RSSI = -60 dBm
LTE Technology Preference = AUTO
LTE Technology Selected = LTE

Modem Security Information
=====
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
C1921-Internet#
C1921-Internet# sh ver
Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.1(4)M4,
MAINTENANCE INTERIM SOFTWARE
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Sun 04-Mar-12 01:07 by prod_rel_team

ROM: System Bootstrap, Version 15.0(1r)M12, RELEASE SOFTWARE (fc1)

C1921-Internet uptime is 6 days, 5 hours, 4 minutes
System returned to ROM by power-on
System restarted at 17:56:21 UTC Tue Mar 6 2012
System image file is "flash:c1900-universalk9-mz.SPA.151-4.M4"
Last reload type: Normal Reload

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco CISCO1921/K9 (revision 1.0) with 487424K/36864K bytes of memory.
Processor board ID FTX155180ES
```

```
6 Gigabit Ethernet interfaces
2 terminal lines
1 Virtual Private Network (VPN) Module
4 Cellular interfaces
DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
250864K bytes of USB Flash usbflash0 (Read/Write)
```

License Info:

License UDI:

```
-----
Device#   PID                SN
-----
*0        CISCO1921/K9       FTX155180ES
```

Technology Package License Information for Module:'c1900'

```
-----
Technology  Technology-package  Technology-package
             Current    Type                Next reboot
-----
ipbase      ipbasek9           Permanent          ipbasek9
security    securityk9         Permanent          securityk9
data        datak9             Permanent          datak9
```

Configuration register is 0x2102

DMVPN Show Commands with LTE (From show debug)

Addresses with values above 254 shown in the output below have been manually changed, to highlight those that must be changed. If accidentally used in a configuration, they will result in error messages as they are disallowed.

```
----- show dmvpn detail -----  
  
Legend: Attrb --> S - Static, D - Dynamic, I - Incomplete  
        N - NATed, L - Local, X - No Socket  
        # Ent --> Number of NHRP entries with same NBMA peer  
        NHS Status: E --> Expecting Replies, R --> Responding, W --> Waiting  
        UpDn Time --> Up or Down Time for a Tunnel  
=====
```

Interface: Tunnel0, IPv4 NHRP Details
IPv4 Registration Timer: 30 seconds

```

IPv4 NHS:
10.249.248.1  E priority = 0 cluster = 0
Type:Spoke, Total NBMA Peers (v4/v6): 1

# Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb  Target Network
-----
1  4.300.400.500  10.249.248.1  IKE 00:05:54  S  10.249.248.1/32 <<IP@
changed>>

Interface: Tunnell, IPv4 NHRP Details
IPv4 Registration Timer: 30 seconds

IPv4 NHS:
10.249.244.2  RE priority = 0 cluster = 0
Type:Spoke, Total NBMA Peers (v4/v6): 1

# Ent  Peer NBMA Addr Peer Tunnel Add State  UpDn Tm Attrb  Target Network
-----
1  4.300.207.59  10.249.244.2  UP 00:03:01  S  10.249.244.2/32 <<IP@
changed>>

Crypto Session Details:
-----
----- show crypto map -----

Crypto Map: "HSC_DMVPN-head-1" idb: Cellular0/0/0 local address: 166.142.300.400

Crypto Map IPv4 "HSC_DMVPN-head-1" 65536 ipsec-isakmp
  Profile name: HSC_DMVPN
  Security association lifetime: 4608000 kilobytes/3600 seconds
  Responder-Only (Y/N): N
  PFS (Y/N): N
  Transform sets={
    HSC_DMVPN: { esp-256-aes esp-md5-hmac } , { comp-lzs } ,
  }

Crypto Map IPv4 "HSC_DMVPN-head-1" 65537 ipsec-isakmp
  Map is a PROFILE INSTANCE.
  Peer = 4.300.207.59
  Extended IP access list

```

```
access-list permit gre host 166.142.300.400 host 300.400.207.59
Current peer: 72.20.207.59
Security association lifetime: 4608000 kilobytes/3600 seconds
Responder-Only (Y/N): N
PFS (Y/N): N
Transform sets={
    HSC_DMVPN: { esp-256-aes esp-md5-hmac }, { comp-lzs },
}

Crypto Map IPv4 "HSC_DMVPN-head-1" 65538 ipsec-isakmp
Map is a PROFILE INSTANCE.
Peer = 4.300.400.500
Extended IP access list
    access-list permit gre host 166.142.156.185 host 62.189.229.67
Current peer: 4.300.400.500
Security association lifetime: 4608000 kilobytes/3600 seconds
Responder-Only (Y/N): N
PFS (Y/N): N
Transform sets={
    HSC_DMVPN: { esp-256-aes esp-md5-hmac }, { comp-lzs },
}

Interfaces using crypto map HSC_DMVPN-head-1:
    Tunnel1

    Tunnel0

----- show crypto isakmp policy -----

Global IKE policy
Protection suite of priority 10
    encryption algorithm:    AES - Advanced Encryption Standard (256 bit keys).
    hash algorithm:          Message Digest 5
    authentication method:   Pre-Shared Key
    Diffie-Hellman group:    #2 (1024 bit)
    lifetime:                86400 seconds, no volume limit

----- show crypto ipsec transform -----

Transform set HSC_DMVPN: { esp-256-aes esp-md5-hmac }
will negotiate = { Tunnel, },
```

```

{ comp-lzs }
will negotiate = { Tunnel, },

Transform set #${default_transform_set_1}: { esp-aes esp-sha-hmac }
will negotiate = { Transport, },

Transform set #${default_transform_set_0}: { esp-3des esp-sha-hmac }
will negotiate = { Transport, },

----- show crypto isakmp sa -----

IPv4 Crypto ISAKMP SA
dst          src          state          conn-id status
4.300.400.500 166.142.300.400 MM_NO_STATE      0 ACTIVE (deleted)
72.300.400.59  166.142.300.400 QM_IDLE          1001 ACTIVE

IPv6 Crypto ISAKMP SA

----- show crypto engine connection active -----
Crypto Engine Connections

  ID  Type    Algorithm          Encrypt  Decrypt  LastSeqN  IP-Address
1001  IKE     MD5+AES256         0        0         0 166.142.156.185
2001  IPsec   AES256+MD5         0       1458      1458 166.142.156.185
2002  IPsec   AES256+MD5        2325        0         0 166.142.156.185

```

Easy VPN Show Commands with LTE

Addresses with values above 254 shown in the output below have been manually changed, to highlight those that must be changed. If accidentally used in a configuration, they will result in error messages as they are disallowed.

```
ISR_LTE# sh cry isa peer
Peer: 4.300.400.500 Port: 4500 Local: 10.170.93.251
Phase1 id: 4.300.400.500
ISR_LTE#
ISR_LTE#sh cry isa sa
IPv4 Crypto ISAKMP SA
dst          src          state          conn-id status
4.300.400.500 10.170.93.251 QM_IDLE        1009 ACTIVE   <<dst ip@ changed
to match

IPv6 Crypto ISAKMP SA

ISR_LTE# sh cry ips client ez
Easy VPN Remote Phase: 8
```



```
Tunnel name : ez
Inside interface list: GigabitEthernet0/1, Vlan1
Outside interface: Virtual-Access2 (bound to Cellular0/0/0)
Current State: IPSEC_ACTIVE
Last Event: MTU_CHANGED
Save Password: Allowed
Split Tunnel List: 1
    Address   : 192.168.0.0
    Mask      : 255.255.0.0
    Protocol  : 0x0
    Source Port: 0
    Dest Port  : 0
Split Tunnel List: 2
    Address   : 10.0.0.0
    Mask      : 255.0.0.0
    Protocol  : 0x0
    Source Port: 0
    Dest Port  : 0
Split Tunnel List: 3
    Address   : 11.0.0.0
    Mask      : 255.0.0.0
    Protocol  : 0x0
    Source Port: 0
    Dest Port  : 0
Current EzVPN Peer: 4.300.400.500 <<address is not valid, changed to match config
example>>
```

```
ISR_LTE# sh ip route
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override
```

```
Gateway of last resort is 0.0.0.0 to network 0.0.0.0
```

```
S*   0.0.0.0/0 is directly connected, Cellular0/0/0
     1.0.0.0/32 is subnetted, 1 subnets
C     1.2.3.16 is directly connected, Loopback1
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
```

```
S      10.0.0.0/8 [1/0] via 0.0.0.0, Virtual-Access2
C      10.170.93.251/32 is directly connected, Cellular0/0/0
S      4.0.0.0/8 [1/0] via 0.0.0.0, Virtual-Access2
      4.300.0.0/32 is subnetted, 1 subnets                    <<dst ip@ changed
to match
S      4.300.400.500 [1/0] via 0.0.0.0, Cellular0/0/0       <<dst ip@ changed
to match
S      192.168.0.0/16 [1/0] via 0.0.0.0, Virtual-Access2
      192.168.9.0/32 is subnetted, 1 subnets
C      192.168.9.9 is directly connected, Loopback0
      192.168.178.0/24 is variably subnetted, 2 subnets, 2 masks
C      192.168.178.0/24 is directly connected, Vlan1
L      192.168.178.1/32 is directly connected, Vlan1
ISR_LTE#
```




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