

Planning Guide: Verizon LTE Split Data Routing, for Cisco ISR 4000, 8x9, 1900/2900/3900 Series

Overview

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

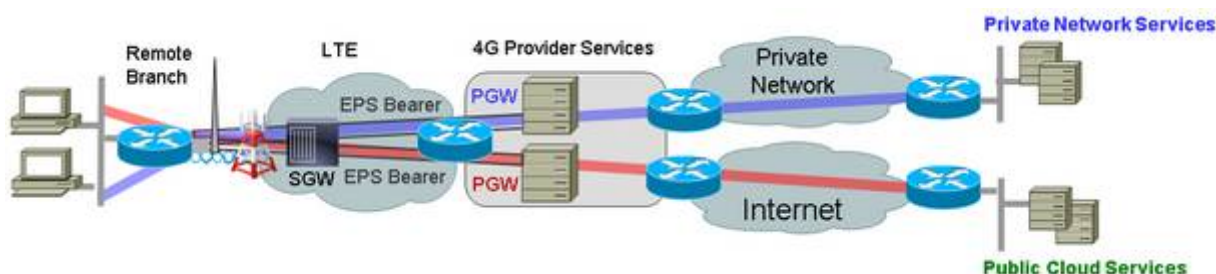
- Machine-to-Machine (M2M) with Internet access and dynamic IP: This service enables a router to connect devices to the Internet or an enterprise network (via a customer premises equipment (CPE)-based VPN).
- M2M plan with Internet access with static IP: This service offers the same services as the previous one, except the 3G or 4G interface of each router receives a consistent predetermined IP address.
- Mobile Private Network (MPN): This service enables a router to connect users to an organization's private network. Traffic does not traverse the Internet. It generally requires a customer premises-based VPN for the LTE router such as Cisco IWAN.
- MPN with Dynamic Mobile Network Routing (DMNR): This service enables a router to connect users to an organization's private network without the need for 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.

Verizon now offers a 5th LTE data service for enterprises that combines Internet access and private network access. The new offering, Verizon LTE Split Data Routing, allows a remote LTE-connected site to directly access the Internet while also directly accessing the organization's private network. Features include:

- A single SIM and rate plan. The service does not require multiple SIMs nor multiple LTE modems/modules.
- Direct Internet access without having to traverse the private network, providing a higher performing more efficient route (does not use private network links nor datacenter Internet gateway/security resources).

Combined with a Cisco ISR, the Verizon Split Data Routing Service:

- Allows for strong security via firewall, IPS, DNS and VRF options
- Can provide upstream quality of service (QoS) on both connections, and service level objectives on the private network connection via Verizon Private Network Traffic Management offering (PNTM)
- Combines the power of direct Internet access and Verizon's DMNR service for the highest flexibility and design, with dynamic routing whenever an organization makes changes



This planning guide outlines the process to plan for Verizon Split Data Routing LTE service. Relevant documents are also referenced.

1. No special service is needed outside of an approved plan and a provisioned SIM (Subscriber Identity Module). 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 a Verizon/Cisco demonstration loan program or by your organization. For the CGR-2010 the LTE GRWIC is required. For the ISR 4K the LTE NIM is required. For the 819, 829, 899, the LTE interface is integrated.
2. Ensure you have a subscriber identity module (SIM/USIM/Mini-SIM or Micro SIM that is appropriate for the ISR and module being used:
 - a. Verizon SKU "DIRECTSIM4G-D" for LTE NIM/eHWIC/GRWIC/CGM, 819, 899, 809, 829
 - b. Verizon SKU "DFILLSIM3FF-A" for NIM-LTEA-EA
3. Ensure the SIM is properly provisioned:
 - a. The SIM (its phone number, e.g. MDN/MSISDN) must be provisioned and associated with the international mobility equipment identity (IMEI) of the ISR LTE modem before activation on an approved plan.
 - i. The IMEI information is available via Cisco Commerce Workspace shipment details or via "sh cell x hardware" command on the ISR.
 - ii. 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. The APNs will need to be set manually. OTA-DM will not automatically set the APNs. Your Verizon Wireless representative can provide the APN information. No username or password is set for the APNs
4. 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
www.cisco.com/c/en/us/td/docs/routers/access/interfaces/NIM/hardware/installation/guide/4GLTENIM_HIG.html#pgfId-1201912.
The GRWIC on CGR is similar. The 819 has a small SIM panel underneath. The 809/829 have external slots.
5. Install the eHWIC/NIM/GRWIC/CMG module into the ISR/CGR (modular platforms only).
 - a. The instructions to physically install the LTE eHWIC or NIM into the ISR are at
www.cisco.com/en/US/docs/routers/access/interfaces/ic/hardware/installation/guide/inst_ic.html#wp1037332
www.cisco.com/c/en/us/td/docs/routers/access/interfaces/NIM/hardware/installation/guide/4GLTENIM_HIG.html#pgfId-1209630.
The CGR-2010 is similar. The 8x9 ISRs have the LTE already integrated.
 - b. Install the LTE eHWIC/NIM into the right-most eHWIC slot (looking at the rear of the ISR, slot 0/0).

Figure 1. LTE eHWIC



Figure 2: NIM for ISR4K and ENCS



6. Power up the ISR and ensure that the antennas are positioned appropriately.
 - a. With terminal or console access to the ISR (logging the terminal console is recommended):
 - di. Hit Enter, and log in if the ISR has already been configured. If the unit is new, no ID or password may be set. If a new unit prompts for userid/password, try cisco/cisco. If there is, follow the instructions to reset the password at:
www.cisco.com/en/US/products/ps5855/products_password_recovery09186a0080b3911d.shtml
 - ii. At the console prompt type “enable”. 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 “sh cell 0/x/0 hardware (cell 0 for 819) and “show version”, and ensure that the recommended Cisco IOS® Software version is running. The generally recommended Cisco IOS software release depends on the LTE modem firmware level (seen via “show cell 0/x/0|0 hardware” command). The SKUs below are approved or will be tested for operation with Verizon Split Data Routing.

ISR LTE SKU	LTE Modem	Recommended firmware	Recommended IOS Release
EHWIC-4G-LTE-VZ	MC7350	5.5.58.01	15.6.3.M2
C819G-4G-VZ-K9	MC7350	5.5.58.01	15.6.3.M2
C899G-LTE-VZ-K9	MC7350	5.5.58.01	15.6.3.M2
C819G-LTE-MNA-K9	MC7354	5.5.58.01	15.6.3.M2
C819GW-LTE-MNA-K9	MC7354	5.5.58.01	15.6.3.M2
NIM-LTEA-EA ISR4	EMM7455	02.20.03.22	16.3.3
NIM-4G-LTE-VZ ISR4K	MC7350	5.5.58.01	TBD
NIM-LTEA-EA on ENCS	EMM7455	02.20.03.22	NFVIS 3.6.1 IOS 16.3.3
IR809G-LTE-VZ-K9	MC7350	5.5.58.01	15.6.3.M2
IR829GW-LTE-VZ-AK9	MC7350	5.5.58.01	15.6.3.M2
IR829-2LTE-EA-BK9	MC7455	02.20.03.22	15.6(3)M2
C1111-8PLTEEA C1111-4PLTEEA	EMM7455	02.20.03.22	16.6.1A

- iv. Type “show run” to see if the configuration matches the configuration guide on the following pages.
- v. If the configuration does not match the provided configuration, add or change the appropriate lines through the command-line interface (CLI) **config t**, etc. **Note:** The cell interface’s IP address is always defined as “ip address negotiated” as the network always assigns it (even with persistent addressing).

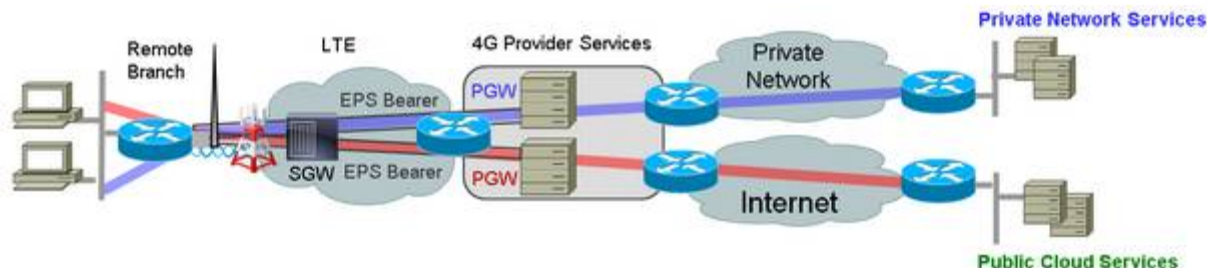
7. Set the APNs appropriately for both public and private networks
 - a. Verizon Split Data Routing allows for 2 active data connections, 1 public Internet, 1 private network, via connection to 2 separate Packet Data Networks (PDNs). These connections are defined by the appropriate LTE modem profiles. There is a separate ISR interface associated with each connection (cell 0 and 1 for 8xx, cell 0/x/0 and 0/x/1 for modular ISRs).
 - b. If a new deployment, the Internet APN (profile 3) will already be set. The private APN is defined via IOS enable-mode command. The profile number is different for ISR 4K vs ISR 8xx.
For 8xx: cell 0 lte profile create 6 <theapnvalue> <enter> <enter> <enter>
For 4K: cell 0/x/0 lte profile create 4 <theapnvalue> <enter> <enter> <enter>
 - c. If this ISR is an existing deployment, profile 3 is in use for the private network. Both the Internet profile and private network profile are defined via IOS enable-mode command.
For both: cell 0 lte profile create 3 VZWINTERNET none ipv4v6 <enter> <enter> <enter>
For 8xx: cell 0 lte profile create 6 <theapnvalue> <enter> <enter> <enter>
For 4K: cell 0/x/0 lte profile create 4 <theapnvalue> <enter> <enter> <enter>
 - d. The Cisco IOS Software command **show cellular 0/x/0 profile** displays the APN (**show cellular 0 profile** for the 8x9).
8. Connect both antennas (at least one with an antenna extension cable) to the LTE eHWIC/NIM/GRWIC/8x9. The antennas should be at least 2 feet apart. Instructions can be found in the section “Additional Information”.
9. **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 with a source address other than the LTE eHWIC IP address from leaking out.
10. See the configurations and display output in the sections below. Note that these configurations are for LTE only, and do not include security. **As the ISR is connected to both the Internet and private network, strong security should be enabled on the ISR.** The following page reviews available ISR security features (under “Branch Threat Defense”): www.cisco.com/c/en/us/products/security/router-security/index.html

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 NIM hardware overview, SIM install, antenna connection, and module install:
www.cisco.com/c/en/us/td/docs/routers/access/interfaces/NIM/hardware/installation/guide/4GLTENIM_HIG.html
- LTE eHWIC Cisco IOS Software configuration (use the Verizon planning/configuration documents):
www.cisco.com/en/US/docs/routers/access/interfaces/software/feature/guide/EHWIC-4G-LTESW.html
- LTE NIM Cisco IOS Software configuration (use the Verizon planning/configuration documents):
www.cisco.com/c/en/us/td/docs/routers/access/interfaces/NIM/software/configuration/guide/4GLTENIM_SW.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, and LTE eHWIC

High-Level Network Diagram



The traffic to/from the public network is logically separate from the traffic to/from the private network, between the ISR cellular interface and destination. Behind the ISR cellular interfaces, traffic can be logically separated using VRFs, policy-based routing, access control lists, and zone-based firewall SR functions.

Both LTE interfaces will send and receive traffic based on the ISR routing configuration. This is no different than wireline ISR interfaces. All ISR techniques are available to be used with cellular interfaces; however their use depends on configuration:

- Private Network APN:
 - o NeMo (Verizon DMNR service). Provides a default route, marked as an M (mobile) route. The organization's private LTE network peers with LTE ISRs and advertises the appropriate networks behind each LTE ISR to the organization's private wireline network. The configuration examples shown are for Verizon DMNR service with the private network APN.
 - o IGP (interior gateway routing protocols such as EIGRP and OSPF) can be used only if tunneled (i.e. DMVPN, FlexVPN, GRE) between each LTE ISR and the organization's VPN head end.
 - o Policy-Based Routing (PBR) in conjunction with one of the two methods above
- Public Internet APN:
 - o Static routes with NAT (Network Address Translation)
 - o Policy-Based Routing (PBR) with NAT

Recommendations for Split Data Routing with MPN and CPE-based VPN Tunnels (DMVPN, FlexVPN, etc.)

- Use an IGP (OSPF, EIGRP, etc.) within the Tunnel over the cellular interface to the LTE private network to receive specific route advertisements from the wireline VPN head end. This provides for routing to the private network without receiving a default route from the private network.
- Use a static default route pointing to the LTE interface to the public Internet. Thus any traffic not destined to the private network will be forwarded to the Internet via a single configuration line
 - o Example: "ip route 0.0.0.0 0.0.0.0 cell 0" for 8x9, "ip route 0.0.0.0 0.0.0.0 cell 0/x/0" for ISR 4K.

Recommendations for Split Data Routing with MPN and DMNR (NeMo)

- Verizon Dynamic Network Mobile Routing (DMNR) offers organizations LTE network routing/advertising that is simple, cost effective (no VPN tunnel head end equipment to acquire, maintain, manage), highly scalable (from ten to tens of thousands of LTE routers) and dynamic (add a subnet to the remote router, it is automatically advertised and reachable across the private wireline network).
- However, the LTE router receives a default route from the private network. There are 2 ways to direct traffic to public cloud services on the Internet
 1. Override the dynamically assigned default route to the private network with a static default route to the public network (cell 0 or cell 0/x/0); define static routes pointing to the private network (cell 0 or cell 0/x/1).
 - a. Example: "ip route 0.0.0.0 0.0.0.0 cell 0" for 8x9, "ip route 0.0.0.0 0.0.0.0 cell 0/0/0" for ISR 4K
 - b. Example: "ip route 10.0.0.0 255.0.0.0 cell 1" 8x9, "ip route 10.0.0.0 255.0.0.0 cell 0/0/1" ISR 4K
 2. Leave in place the static default route for interface cell 1 (8x9) or 0/x/1 (modular ISR) to the private network. Define static routes to cover the publicly routable IP space via cell 0 (8x9) or 0/x/0 (modular ISR).
 - a. A set of static routes accomplishing this is included in each configuration example and the display output in this guide.

NAT is always required for the Public Internet APN. Verizon provides one IP address (actually one IPv4 and one IPv6) to the ISR cell interface representing the public Internet connection. The NAT technique NPAT or PAT is used so that multiple users/devices can access the Internet via the single LTE IP address. This is also a common configuration for many broadband Internet connections.

The "show running-config" is provided for an ISR 4000 and 819. Other platforms will be similar (1900/2900/3900, 899). Only the configuration commands pertinent to LTE and IP routing are shown. Full configurations for various LTE scenarios can be found in the guides here:

www.cisco.com/en/US/products/ps5949/products_installation_and_configuration_guides_list.html

Display output (show command results) is subsequently provided for both platforms.

ISR 4000 Series NIM-LTEA-EA Split Data Routing/Dual APN Configuration

```
!### command allowing for "LTE test cellular" enable mode commands ###
service internal
!
hostname c4321-4G
!
!### load appropriate IOS image ###
boot system bootflash:isr4300-universalk9.16.03.03.SPA.bin
!
interface Loopback1234
  description ### NEMO Router Home Address
  ip address 1.2.3.4 255.255.255.255
!
!### The maximum TCP MSS is set to 1390 bytes to allow for GRE, IPsec and
other network overhead. The route-map clears DF bits in the IP headers. ###
!
interface GigabitEthernet0/0/0
  ip address 10.250.1.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1390
  ip policy route-map clear-df
  load-interval 30
  media-type rj45
  negotiation auto
!
interface GigabitEthernet0/0/1
  ip address 10.0.3.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1390
  ip policy route-map clear-df
  load-interval 30
  negotiation auto
!
!### Interface Cellular - 0/x/0 x depends on ISR slot. This interface is for
the Internet PDN. Connection is activated using dialer watch list 1. ###
!
interface Cellular0/1/0
  ip address negotiated
  no ip unreachable
  ip nat outside
  ip tcp adjust-mss 1390
  load-interval 30
  dialer in-band
  dialer idle-timeout 0
  dialer enable-timeout 2
  dialer watch-group 1
  pulse-time 1
!
!### Interface Cellular - 0/x/1 x depends on ISR slot. This interface is for
the private network PDN. Connection activated via dialer watch list 2. NAT
not needed as all traffic sent in the NeMo (IP Mobile Router) tunnel. ###
!
```

```

interface Cellular0/1/1
  ip address negotiated
  no ip unreachable
  ip mobile router-service roam
  ip mobile router-service collocated ccoa-only
  ip tcp adjust-mss 1390
  load-interval 30
  dialer in-band
  dialer idle-timeout 0
  dialer enable-timeout 2
  dialer watch-group 2
  pulse-time 1
!
!### This stanza enables NEMO Routing. Admin distance can be adjusted ###
!
router mobile
  distance 33
!
!### This NAT statement ensures all traffic leaving the ISR is sourced with
the IP address of the LTE cellular interface, to avoid auto-disconnection by
the network. All traffic appears to come from the LTE IP address. ###
!
ip nat inside source list 100 interface Cellular0/1/0 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 source address's 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
!
!### These static routes send all traffic destined to Internet routable
destinations via the LTE Internet connection/interface. This is the 2nd
option mentioned earlier, leaving the M/Mobile IP default route in place ###
ip route 0.0.0.0 248.0.0.0 Cellular0/1/0
ip route 8.0.0.0 254.0.0.0 Cellular0/1/0
ip route 11.0.0.0 255.0.0.0 Cellular0/1/0
ip route 12.0.0.0 254.0.0.0 Cellular0/1/0
ip route 14.0.0.0 254.0.0.0 Cellular0/1/0
ip route 16.0.0.0 240.0.0.0 Cellular0/1/0
ip route 32.0.0.0 224.0.0.0 Cellular0/1/0
ip route 64.0.0.0 192.0.0.0 Cellular0/1/0
ip route 128.0.0.0 224.0.0.0 Cellular0/1/0
ip route 160.0.0.0 240.0.0.0 Cellular0/1/0
ip route 168.0.0.0 248.0.0.0 Cellular0/1/0
ip route 172.0.0.0 255.240.0.0 Cellular0/1/0
ip route 172.33.0.0 255.255.0.0 Cellular0/1/0
ip route 172.34.0.0 255.254.0.0 Cellular0/1/0
ip route 172.36.0.0 255.254.0.0 Cellular0/1/0
ip route 172.38.0.0 255.254.0.0 Cellular0/1/0
ip route 172.40.0.0 255.248.0.0 Cellular0/1/0
ip route 172.56.0.0 255.248.0.0 Cellular0/1/0
ip route 172.64.0.0 255.192.0.0 Cellular0/1/0
ip route 172.128.0.0 255.128.0.0 Cellular0/1/0
ip route 173.0.0.0 255.0.0.0 Cellular0/1/0
ip route 174.0.0.0 254.0.0.0 Cellular0/1/0
ip route 176.0.0.0 255.240.0.0 Cellular0/1/0

```

```

ip route 192.0.0.0 255.128.0.0 Cellular0/1/0
ip route 192.128.0.0 255.224.0.0 Cellular0/1/0
ip route 192.160.0.0 255.248.0.0 Cellular0/1/0
ip route 192.169.0.0 255.255.0.0 Cellular0/1/0
ip route 192.170.0.0 255.254.0.0 Cellular0/1/0
ip route 192.172.0.0 255.252.0.0 Cellular0/1/0
ip route 192.176.0.0 255.248.0.0 Cellular0/1/0
ip route 192.192.0.0 255.192.0.0 Cellular0/1/0
ip route 192.224.0.0 255.224.0.0 Cellular0/1/0
ip route 193.0.0.0 255.0.0.0 Cellular0/1/0
ip route 194.0.0.0 254.0.0.0 Cellular0/1/0
ip route 196.0.0.0 252.0.0.0 Cellular0/1/0
ip route 200.0.0.0 248.0.0.0 Cellular0/1/0
ip route 208.0.0.0 248.0.0.0 Cellular0/1/0
ip route 216.0.0.0 248.0.0.0 Cellular0/1/0
!
!### This command configures NEMO Authentication with EXGW. Use the
appropriate EXGW IP address based on the geographic location (page 3). Note
that SPI and KEY must match to what is set on the EXGW under the NEMO
service. Note that the algorithm must be set to "hmac-md5". ###
ip mobile secure home-agent 66.174.XXX.XXX spi decimal 256 key ascii VzWNeMo
algorithm hmac-md5
!
!### This section configures the NEMO Mobile Router parameters and defines
what router interfaces and their subnets to be included into the NEMO
registration with EXGW. Use the appropriate EXGW IP address as above. ###
ip mobile router
  address 1.2.3.4 255.255.255.0
  collocated single-tunnel
  home-agent 66.174.XXX.XXX
  mobile-network GigabitEthernet0/0/1
  mobile-network GigabitEthernet0/0/0
  non-connected-network 192.168.222.0 255.255.255.0
  register extend expire 10 retry 3 interval 5
  reverse-tunnel
  tunnel mode gre
!
!### This route-map clears the DF-bit in IP packets that come into the ISR
from the Gigabit Ethernet interfaces. ###
route-map clear-df permit 10
  set ip df 0
!
!### This section defines the LTE call activation triggers and timers. ###
!### The LTE connection for cell 0/x/0 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
!### The ISR will wait 60 sec. before activating LTE after 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
!### These watch-list commands are for interface cell 0/x/1
dialer watch-list 2 ip 5.6.7.8 0.0.0.0
dialer watch-list 2 delay route-check initial 60
dialer watch-list 2 delay connect 1
!
end

```

ISR 819/899 Split Data Routing/Dual APN Configuration

```
!### command allowing for "LTE test cellular" enable mode commands ###
service internal
!
hostname 819-XL
!
!### load appropriate IOS image ###
boot system flash:c800-universalk9-mz.SPA.156-3.M2.bin
!
ip cef
!
!### CHAT Script to make a data call ###
chat-script lte "" "AT!CALL1" TIMEOUT 20 "OK"
!
!### This Loopback address used to source pings for testing purposes. ###
!
interface Loopback1
  description ### always-on interface ###
  ip address 1.2.3.22 255.255.255.255
  ip nat inside
!
!### The maximum TCP MSS is set to 1390 bytes to allow for GRE, IPsec and
other network overhead. The route-map clears DF bits in the IP headers. ###
!
interface VLAN1
  ip address 172.21.22.1 255.255.255.0
  ip nat inside
  ip tcp adjust-mss 1390
  ip policy route-map clear-df
!
!### Interface Cell 0 is the interface is for the Internet PDN. Connection
is activated using dialer watch list 1. ###
!
interface Cellular0
  ip address negotiated
  no ip unreachable
  ip nat outside
  encapsulation slip
  ip tcp adjust-mss 1390
  load-interval 30
  dialer in-band
  dialer idle-timeout 0
  dialer string lte
  dialer watch-group 1
  no peer default ip address
  async mode interactive
  pulse-time 0
  routing dynamic
!
!### Interface Cellular - 0/x/1 x depends on ISR slot. This interface is for
the private network PDN. Connection activated via dialer watch list 2. NAT
not needed as all traffic sent in the NeMo (IP Mobile Router) tunnel. ###
!
```

```

interface Cellular1
 ip address negotiated
 no ip unreachable
 ip mobile router-service roam
 ip mobile router-service collocated ccoa-only
 ip virtual-reassembly in
 encapsulation slip
 ip tcp adjust-mss 1390
 load-interval 30
 dialer in-band
 dialer idle-timeout 0
 dialer string lte
 dialer watch-group 2
 no peer default ip address
 async mode interactive
 pulse-time 0
 routing dynamic
!
!### This stanza enables NEMO Routing. Admin distance can be adjusted ###
!
!### This command configures NEMO Authentication with EXGW. Use the
appropriate EXGW IP address based on the geographic location (page 3). Note
that SPI and KEY must match to what is set on the EXGW under the NEMO
service. Note that the algorithm must be set to "hmac-md5". ###
!
router mobile
 distance 111
!
!### This NAT statement ensures all traffic leaving the ISR is sourced with
the IP address of the LTE cellular interface, to avoid auto-disconnection by
the network. All traffic appears to come from the LTE IP address. ###
!
ip nat inside source list 100 interface Cellular0 overload
!
!### This ACL enables NATing of traffic leaving the cell interface. "Permit
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the source address's 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
!
!### These static routes send all traffic destined to Internet routable
destinations via the LTE Internet connection/interface. This is the 2nd
option mentioned earlier, leaving the M/Mobile IP default route in place ###
!
ip route 0.0.0.0 248.0.0.0 Cellular0
ip route 8.0.0.0 254.0.0.0 Cellular0
ip route 11.0.0.0 255.0.0.0 Cellular0
ip route 12.0.0.0 254.0.0.0 Cellular0
ip route 14.0.0.0 254.0.0.0 Cellular0
ip route 16.0.0.0 240.0.0.0 Cellular0
ip route 32.0.0.0 224.0.0.0 Cellular0
ip route 64.0.0.0 192.0.0.0 Cellular0
ip route 128.0.0.0 224.0.0.0 Cellular0
ip route 160.0.0.0 240.0.0.0 Cellular0
ip route 168.0.0.0 248.0.0.0 Cellular0

```

```

ip route 172.0.0.0 255.240.0.0 Cellular0
ip route 172.33.0.0 255.255.0.0 Cellular0
ip route 172.34.0.0 255.254.0.0 Cellular0
ip route 172.36.0.0 255.254.0.0 Cellular0
ip route 172.38.0.0 255.254.0.0 Cellular0
ip route 172.40.0.0 255.248.0.0 Cellular0
ip route 172.56.0.0 255.248.0.0 Cellular0
ip route 172.64.0.0 255.192.0.0 Cellular0
ip route 172.128.0.0 255.128.0.0 Cellular0
ip route 173.0.0.0 255.0.0.0 Cellular0
ip route 174.0.0.0 254.0.0.0 Cellular0
ip route 176.0.0.0 255.240.0.0 Cellular0
ip route 192.0.0.0 255.128.0.0 Cellular0
ip route 192.128.0.0 255.224.0.0 Cellular0
ip route 192.160.0.0 255.248.0.0 Cellular0
ip route 192.169.0.0 255.255.0.0 Cellular0
ip route 192.170.0.0 255.254.0.0 Cellular0
ip route 192.172.0.0 255.252.0.0 Cellular0
ip route 192.176.0.0 255.248.0.0 Cellular0
ip route 192.192.0.0 255.192.0.0 Cellular0
ip route 192.224.0.0 255.224.0.0 Cellular0
ip route 193.0.0.0 255.0.0.0 Cellular0
ip route 194.0.0.0 254.0.0.0 Cellular0
ip route 196.0.0.0 252.0.0.0 Cellular0
ip route 200.0.0.0 248.0.0.0 Cellular0
ip route 208.0.0.0 248.0.0.0 Cellular0
ip route 216.0.0.0 248.0.0.0 Cellular0
!
!### This section configures the NEMO Mobile Router parameters and defines
what router interfaces and their subnets to be included into the NEMO
registration with EXGW. Use the appropriate EXGW IP address as above. ###
!
ip mobile secure home-agent 66.174.XXX.XXX spi decimal 256 key ascii VzWNeMo
algorithm hmac-md5
!
ip mobile router
address 1.2.3.22 255.255.255.255
collocated single-tunnel
home-agent 66.174.XXX.XXX
mobile-network Loopback100
mobile-network Vlan1
non-connected-network 172.30.30.0 255.255.255.0
register extend expire 10 retry 3 interval 5
reverse-tunnel
tunnel mode gre
!
!### Route-map clears DF-bit in packets to exit via the LTE interface. ###
!
route-map clear-df permit 10
set ip df 0
!
!### This section defines the LTE call activation triggers and timers. ###
!
!
!
!
!

```

```
!
!### The LTE connection for cell 0 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
!
!### These watch-list commands are for interface cell 1
dialer watch-list 2 ip 5.6.7.8 0.0.0.0
dialer watch-list 2 delay route-check initial 60
dialer watch-list 2 delay connect 1
!
!### chat script "lte" is also called by the line interface
!
line 3
  script dialer lte
  modem InOut
  no exec
  transport input ssh
!
end
```

Operation and Show Commands for ISR 4000 Series and LTE-A NIM

C4321-4G#### Some public addresses have been hidden via "XXXX"

C4321-4G#### Existing Deployment Example

C4321-4G#sh cell 0/1/0 profile

Profile 1 = INACTIVE **

PDP Type = IPv4v6

Access Point Name (APN) = vzwims

Authentication = None

Profile 2 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzwadmin

Authentication = None

Profile 3 = ACTIVE*

PDP Type = IPv4

PDP address = 10.1.1.18

Access Point Name (APN) = CISCO.GW4.VZWENTP

Authentication = None

Primary DNS address = 171.70.168.XXX

Secondary DNS address = 173.36.131.XXX

Primary DNS IPV6 address = 0

Secondary DNS IPV6 address = 0

Profile 4 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzwapp

Authentication = None

Profile 5 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzw800

Authentication = None

* - Default profile

** - LTE attach profile

C4321-4G#cell 0/1/0 lte profile create 3 VZWINTERNET ?

chap CHAP authentication only
none No authentication
pap PAP authentication only
pap_chap PAP or CHAP authentication
<cr>

C4321-4G#cell 0/1/0 lte profile create 3 VZWINTERNET none ?

ipv4 IPv4 type Bearer
ipv4v6 IPV4V6 type Bearer
ipv6 IPV6 type Bearer
<cr>

C4321-4G#cell 0/1/0 lte profile create 3 VZWINTERNET none ipv4v6 ?

<cr>

C4321-4G#cell 0/1/0 lte profile create 3 VZWINTERNET none ipv4v6

Warning: You are attempting to modify a currently ACTIVE data profile.
This is not recommended and may affect the connection state

PDP Type = IPv4

Access Point Name (APN) = CISCO.GW4.VZWENTP

Authentication = NONE

Profile 3 already exists with above parameters. Do you want to overwrite? [confirm]

Profile 3 will be overwritten with the following values:

PDP type = IPV4V6

APN = VZWINTERNET

Authentication = NONE

Are you sure? [confirm]

Profile 3 written to modem

C4321-4G#

C4321-4G#

C4321-4G#cell 0/1/0 lte profile create 4 cisco.gw4.vzwentp none ipv4

PDP Type = IPv4v6

Access Point Name (APN) = vzwapp

Authentication = NONE

Profile 4 already exists with above parameters. Do you want to overwrite? [confirm]

Profile 4 will be overwritten with the following values:

PDP type = IPv4

APN = cisco.gw4.vzwentp

Authentication = NONE

Are you sure? [confirm]n

Profile 4 written to modem

C4321-4G#

C4321-4G#sh cell 0/1/0 all

Hardware Information

=====

Modem Firmware Version = **SWI9X30C_02.20.03.22**

Modem Firmware built = 2016/10/11 16:03:14

Hardware Version = 1.0

Device Model ID: EM7455

International Mobile Subscriber Identity (IMSI) = 311480148781216

International Mobile Equipment Identity (IMEI) = 356129070053217

Integrated Circuit Card ID (ICCID) = 89148000001470156554

Mobile Subscriber Integrated Services

Digital Network-Number (MSISDN) = 408649XXXX

Modem Status = Modem Online

Current Modem Temperature = 36 deg C

PRI SKU ID = 1102526, PRI version = 002.026_000, Carrier = Verizon

OEM PRI version = 006

Profile Information

=====

Profile 1 = INACTIVE **

PDP Type = IPv4v6

Access Point Name (APN) = vzwims

Authentication = None

Profile 2 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzwadmin

Authentication = None

Profile 3 = ACTIVE*

PDP Type = IPv4v6

PDP address = 72.105.30.XXX

PDP IPV6 address = 2600:1002:B02D:XXXX:CC49:42FF:FE46:908/64 Scope: Global
PDP IPV6 address = FE80:0:0:0:CC49:42FF:FE46:908/64 Scope: Link
Access Point Name (APN) = VZWINTERNET
Authentication = None
 Primary DNS address = 198.224.188.XXX
 Secondary DNS address = 198.224.189.XXX
 Primary DNS IPV6 address = 2001:4888:15:XXXX:194:D:0:0
 Secondary DNS IPV6 address = 2001:4888:14:XXXX:196:D:0:0

Profile 4 = ACTIVE

PDP Type = IPv4
PDP address = 10.1.1.18
Access Point Name (APN) = cisco.gw4.vzwentp
Authentication = None
 Primary DNS address = 171.70.168.XXX
 Secondary DNS address = 173.36.131.XXX
 Primary DNS IPV6 address = 0
 Secondary DNS IPV6 address = 0

Profile 5 = INACTIVE

PDP Type = IPv4v6
Access Point Name (APN) = vzw800
Authentication = None

Configured default profile for active SIM 0 is profile 3.

Data Connection Information

=====

Profile 1, Packet Session Status = INACTIVE
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = ACTIVE
 Cellular0/1/0:
 Data Transmitted = 1440 bytes, Received = 1539 bytes
 IP address = 72.105.30.XXX
 IPV6 address = 2600:1002:B02D:XXXX:CC49:42FF:FE46:908/64 Scope: Global
 IPV6 address = FE80:0:0:0:CC49:42FF:FE46:908/64 Scope: Link
 Primary DNS address = 198.224.188.XXX
 Secondary DNS address = 198.224.189.XXX
 Primary DNS IPV6 address = 2001:4888:15:XXXX:194:D:0:0
 Secondary DNS IPV6 address = 2001:4888:14:XXXX:196:D:0:0
Profile 4, Packet Session Status = ACTIVE
 Cellular0/1/1:

Data Transmitted = 1496 bytes, Received = 264 bytes
IP address = 10.1.1.18
Primary DNS address = 171.70.168.XXX
Secondary DNS address = 173.36.131.XXX
Profile 5, Packet Session Status = INACTIVE
Profile 6, Packet Session Status = INACTIVE
Profile 7, Packet Session Status = INACTIVE
Profile 8, Packet Session Status = INACTIVE
Profile 9, Packet Session Status = INACTIVE
Profile 10, Packet Session Status = INACTIVE
Profile 11, Packet Session Status = INACTIVE
Profile 12, Packet Session Status = INACTIVE
Profile 13, Packet Session Status = INACTIVE
Profile 14, Packet Session Status = INACTIVE
Profile 15, Packet Session Status = INACTIVE
Profile 16, Packet Session Status = INACTIVE

Network Information

=====
Current System Time = Tue May 30 17:0:22 2017
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Home
Network Selection Mode = Automatic
Network = VzW
Mobile Country Code (MCC) = 311
Mobile Network Code (MNC) = 480
Packet switch domain(P.S) state = Attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 25856
Cell ID = 25932322

Radio Information

=====
Radio power mode = online
LTE Rx Channel Number = 1000
LTE Tx Channel Number = 19000
LTE Band = 2
LTE Bandwidth = 10 MHz
Current RSSI = -76 dBm
Current RSRP = -98 dBm
Current RSRQ = -11 dB
Current SNR = 14.4 dB

Physical Cell Id = 227

Number of nearby cells = 1

Idx PCI (Physical Cell Id)

1 227

Radio Access Technology(RAT) Preference = AUTO

Radio Access Technology(RAT) Selected = LTE

Modem Security Information

=====

Active SIM = 0

SIM switchover attempts = 0

Card Holder Verification (CHV1) = Disabled

SIM Status = OK

SIM User Operation Required = None

Number of CHV1 Retries remaining = 3

Cellular Firmware List

=====

Idx	Carrier	FwVersion	PriVersion	Status
1	ATT	02.20.03.00	002.019_000	Inactive
2	GENERIC	02.20.03.00	002.017_000	Inactive
3	SPRINT	02.20.03.22	002.020_000	Inactive
4	VERIZON	02.20.03.22	002.026_000	Active

Firmware Activation mode : AUTO

GPS Information

=====

GPS Info

GPS Feature: enabled

GPS Mode Configured: not configured

GPS Status: NMEA Disabled

SMS Information

=====

Incoming Message Information

SMS stored in modem = 0

SMS archived since booting up = 0

Total SMS deleted since booting up = 0

Storage records allocated = 25

Storage records used = 0

Number of callbacks triggered by SMS = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0

Outgoing Message Information

Total SMS sent successfully = 0
Total SMS send failure = 0
Number of outgoing SMS pending = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0
Last Outgoing SMS Status = SUCCESS
Copy-to-SIM Status = 0x0
Send-to-Network Status = 0x0
Report-Outgoing-Message-Number:
 Reference Number = 0
 Result Code = 0x0
 Diag Code = 0x0 0x0 0x0 0x0 0x0

SMS Archive URL =

Error Information

=====

This command is not supported on 4G modems.

Modem Crashdump Information

=====

Modem crashdump logging: off

=====

Dying Gasp Information

=====

Dying Gasp Detach: Enabled
SMS: Enabled

SMS Message = 4321LTEA in Horsham lab lost power
Destination Number = 215300XXXX
C4321-4G#ping 8.8.8.8
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 38/68/160 ms
C4321-4G#ping 10.1.1.18

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.1.1.18, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

sh ver | i IOS

Cisco IOS XE Software, Version 16.03.03

Cisco IOS Software [Denali], ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 16.3.3, RELEASE SOFTWARE (fc3)

Cisco IOS-XE software, Copyright (c) 2005-2017 by cisco Systems, Inc.

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ROM: IOS-XE ROMMON

C4321-4G#

C4321-4G#sh ip int brief | i Ce

Cellular0/1/0	72.105.31.XXX	YES	IPCP	up	up
---------------	---------------	-----	------	----	----

Cellular0/1/1	10.1.1.18	YES	IPCP	up	up
---------------	-----------	-----	------	----	----

C4321-4G#

C4321-4G#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

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

M* 0.0.0.0/0 is directly connected, Tunnel0

S 0.0.0.0/5 is directly connected, Cellular0/1/0

1.0.0.0/32 is subnetted, 1 subnets

C 1.2.3.4 is directly connected, Loopback1234

S 8.0.0.0/7 is directly connected, Cellular0/1/0

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

S 10.0.0.0/8 is directly connected, Cellular0/1/1

C 10.1.1.18/32 is directly connected, Cellular0/1/1

S 11.0.0.0/8 is directly connected, Cellular0/1/0

S 12.0.0.0/7 is directly connected, Cellular0/1/0

S 14.0.0.0/7 is directly connected, Cellular0/1/0

S 16.0.0.0/4 is directly connected, Cellular0/1/0

```
S    32.0.0.0/3 is directly connected, Cellular0/1/0
S    64.0.0.0/2 is directly connected, Cellular0/1/0
    66.0.0.0/32 is subnetted, 1 subnets
M    66.174.XXX.XXX [33/1], 01:05:09, Cellular0/1/1
    72.0.0.0/32 is subnetted, 1 subnets
C    72.105.31.45 is directly connected, Cellular0/1/0
S    128.0.0.0/3 is directly connected, Cellular0/1/0
S    160.0.0.0/4 is directly connected, Cellular0/1/0
S    168.0.0.0/5 is directly connected, Cellular0/1/0
S    172.0.0.0/12 is directly connected, Cellular0/1/0
S    172.33.0.0/16 is directly connected, Cellular0/1/0
S    172.34.0.0/15 is directly connected, Cellular0/1/0
S    172.36.0.0/15 is directly connected, Cellular0/1/0
S    172.38.0.0/15 is directly connected, Cellular0/1/0
S    172.40.0.0/13 is directly connected, Cellular0/1/0
S    172.56.0.0/13 is directly connected, Cellular0/1/0
S    172.64.0.0/10 is directly connected, Cellular0/1/0
S    172.128.0.0/9 is directly connected, Cellular0/1/0
S    173.0.0.0/8 is directly connected, Cellular0/1/0
S    174.0.0.0/7 is directly connected, Cellular0/1/0
S    176.0.0.0/12 is directly connected, Cellular0/1/0
S    192.0.0.0/9 is directly connected, Cellular0/1/0
S    192.128.0.0/11 is directly connected, Cellular0/1/0
S    192.160.0.0/13 is directly connected, Cellular0/1/0
S    192.169.0.0/16 is directly connected, Cellular0/1/0
S    192.170.0.0/15 is directly connected, Cellular0/1/0
S    192.172.0.0/14 is directly connected, Cellular0/1/0
S    192.176.0.0/13 is directly connected, Cellular0/1/0
S    192.192.0.0/10 is directly connected, Cellular0/1/0
S    192.224.0.0/11 is directly connected, Cellular0/1/0
S    193.0.0.0/8 is directly connected, Cellular0/1/0
S    194.0.0.0/7 is directly connected, Cellular0/1/0
S    196.0.0.0/6 is directly connected, Cellular0/1/0
S    200.0.0.0/5 is directly connected, Cellular0/1/0
S    208.0.0.0/5 is directly connected, Cellular0/1/0
S    216.0.0.0/5 is directly connected, Cellular0/1/0
C4321-4G#
C4321-4G#sh ip mob rou
```

Mobile Router

Enabled 06/01/17 13:21:41

Last redundancy state transition NEVER

Configuration:

Home Address 1.2.3.4 Mask 255.255.255.0

Home Agent 66.174.XXX.XXX Priority 100 (best) (current)
Registration lifetime 65534 sec
Retransmit Init 1000, Max 5000 msec, Limit 3
Extend Expire 10, Retry 3, Interval 5
Reverse tunnel required
Request GRE tunnel
Multi-path denied by HA, Requested metric: bandwidth
Mobile Networks: GigabitEthernet0/0/1 (Down)
 GigabitEthernet0/0/0 (Down)
 non connected subnet (192.168.222.0/255.255.255.0)

Monitor:

Status -Registered-
Using collocated care-of address 10.1.1.18
On interface Cellular0/1/1
Tunnel0 mode GRE/IP
C4321-4G#

819-XL#### Example of display output. This LTE SIM/subscription also has LTE QoS (PNTM)
 819-XL#### Some public addresses have been hidden via "XXXX"
 *May 31 23:45:06.451: %CELLWAN-2-BEARER_UP: Instance id=1, Default bearer (bearer_id=7) in Cellular1
 is now UP
 *May 31 23:45:06.551: %CELLWAN-2-BEARER_UP: Instance id=1, Dedicated bearer (bearer_id=8) QCI=7 in
 Cellular1 is now UP
 *May 31 23:45:08.555: %LINK-3-UPDOWN: Interface Cellular1, changed state to up
 *May 31 23:45:09.555: %LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular1, changed state to up
 819-XL#

819-XL#sh ip int brie

Interface	IP-Address	OK?	Method	Status	Protocol
Cellular0	72.105.X.X	YES	IPCP	up	up
Cellular1	10.1.1.18	YES	IPCP	up	up
CellNM5	unassigned	YES	unset	down	down
FastEthernet0	unassigned	YES	unset	down	down
FastEthernet1	unassigned	YES	unset	down	down
FastEthernet2	unassigned	YES	unset	down	down
FastEthernet3	unassigned	YES	unset	down	down
GigabitEthernet0	172.20.12.12	YES	NVRAM	down	down
Loopback99	unassigned	YES	unset	up	up
Loopback100	1.2.3.22	YES	NVRAM	up	up
Loopback1234	1.2.3.4	YES	NVRAM	up	up
Mobile0	unassigned	YES	unset	up	up
NV10	21.21.21.1	YES	unset	up	up
Serial0	unassigned	YES	unset	down	down
Tunnel0	10.1.1.18	YES	unset	up	up
Tunnel101	172.21.22.1	YES	TFTP	up	down
Vlan1	172.21.22.1	YES	NVRAM	down	down

819-XL#sh ip rou

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

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

M* 0.0.0.0/0 is directly connected, Tunnel0
S 0.0.0.0/5 is directly connected, Cellular0
1.0.0.0/32 is subnetted, 2 subnets
C 1.2.3.4 is directly connected, Loopback1234
C 1.2.3.22 is directly connected, Loopback100
S 8.0.0.0/7 is directly connected, Cellular0
10.0.0.0/32 is subnetted, 1 subnets
C 10.1.1.18 is directly connected, Cellular1
S 11.0.0.0/8 is directly connected, Cellular0
S 12.0.0.0/7 is directly connected, Cellular0
S 14.0.0.0/7 is directly connected, Cellular0
S 16.0.0.0/4 is directly connected, Cellular0
S 32.0.0.0/3 is directly connected, Cellular0
S 64.0.0.0/2 is directly connected, Cellular0
66.0.0.0/32 is subnetted, 1 subnets
M 66.174.XXX.XXX [111/1], 00:10:24, Cellular1
72.0.0.0/32 is subnetted, 1 subnets
C 72.105.31.99 is directly connected, Cellular0
108.0.0.0/32 is subnetted, 1 subnets
M 108.16.125.4 [111/1], 00:29:29, Cellular0
S 128.0.0.0/3 is directly connected, Cellular0
S 160.0.0.0/4 is directly connected, Cellular0
S 168.0.0.0/5 is directly connected, Cellular0
S 172.0.0.0/12 is directly connected, Cellular0
S 172.33.0.0/16 is directly connected, Cellular0
S 172.34.0.0/15 is directly connected, Cellular0
S 172.36.0.0/15 is directly connected, Cellular0
S 172.38.0.0/15 is directly connected, Cellular0
S 172.40.0.0/13 is directly connected, Cellular0
S 172.56.0.0/13 is directly connected, Cellular0
S 172.64.0.0/10 is directly connected, Cellular0
S 172.128.0.0/9 is directly connected, Cellular0
S 173.0.0.0/8 is directly connected, Cellular0
S 174.0.0.0/7 is directly connected, Cellular0
S 176.0.0.0/12 is directly connected, Cellular0
S 192.0.0.0/9 is directly connected, Cellular0
S 192.128.0.0/11 is directly connected, Cellular0
S 192.160.0.0/13 is directly connected, Cellular0
S 192.169.0.0/16 is directly connected, Cellular0
S 192.170.0.0/15 is directly connected, Cellular0
S 192.172.0.0/14 is directly connected, Cellular0

```
S    192.176.0.0/13 is directly connected, Cellular0
S    192.192.0.0/10 is directly connected, Cellular0
S    192.224.0.0/11 is directly connected, Cellular0
S    193.0.0.0/8 is directly connected, Cellular0
S    194.0.0.0/7 is directly connected, Cellular0
S    196.0.0.0/6 is directly connected, Cellular0
S    200.0.0.0/5 is directly connected, Cellular0
S    208.0.0.0/5 is directly connected, Cellular0
S    216.0.0.0/5 is directly connected, Cellular0
819-XL#sh ip mob rou
```

Mobile Router

```
Enabled 05/31/17 21:36:10
Last redundancy state transition NEVER
```

Configuration:

```
Home Address 1.2.3.22 Mask 255.255.255.255
Home Agent 66.174.XXX.XXX Priority 100 (best) (current)
Registration lifetime 65534 sec
Retransmit Init 1000, Max 5000 msec, Limit 3
Extend Expire 10, Retry 3, Interval 5
Reverse tunnel required
Request GRE tunnel
Multi-path denied by HA, Requested metric: bandwidth
Mobile Networks: Loopback100 (1.2.3.22/255.255.255.255)
                  Vlan1 (Down)
                  non connected subnet (172.30.30.0/255.255.255.0)
```

Monitor:

```
Status -Registered-
Using collocated care-of address 10.1.1.18
On interface Cellular1
Tunnel0 mode GRE/IP
```

```
819-XL#
```

819-XL#sh cell 0 all

Hardware Information

=====

Modem Firmware Version = SWI9X15C_05.05.58.01

Modem Firmware built = 2015/03/05 00:02:40

Hardware Version = 1.0

Device Model ID: MC7350

Package Identifier ID: 1102036_9903208_MC7350_05.05.58.01_00_Cisco_005.005_000

International Mobile Subscriber Identity (IMSI) = 311480148770693

International Mobile Equipment Identity (IMEI) = 356162050028156

Integrated Circuit Card ID (ICCID) = 89148000001470156414

Mobile Subscriber Integrated Services

Digital Network-Number (MSISDN) = 408649XXXX

Modem Status = Online

Current Modem Temperature = 37 deg C

PRI SKU ID = 1102036, PRI version = 005.029_000, Carrier = Verizon

OEM PRI version = 05.05

Profile Information

=====

Profile 1 = INACTIVE **

PDP Type = IPv4v6

Access Point Name (APN) = vzwims

Authentication = None

Profile 2 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzwadmin

Authentication = None

Profile 3 = ACTIVE*

PDP Type = IPv4

PDP address = 72.105.31.XXX

Access Point Name (APN) = VZWINTERNET

Authentication = None

Primary DNS address = 198.224.XXX.XXX

Secondary DNS address = 198.224.XXX.XXX

Profile 4 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzwapp

Authentication = None

Profile 5 = INACTIVE

PDP Type = IPv4v6

Access Point Name (APN) = vzw800

Authentication = None

Profile 6 = ACTIVE

PDP Type = IPv4

PDP address = 10.1.1.18

Access Point Name (APN) = cisco.gw4.vzwentp

Authentication = None

Primary DNS address = 171.70.XXX.XXX

Secondary DNS address = 173.36.XXX.XXX

* - Default profile

** - LTE attach profile

Data Connection Information

=====

Profile 1, Packet Session Status = INACTIVE

Profile 2, Packet Session Status = INACTIVE

Profile 3, Packet Session Status = ACTIVE

Cellular0:

Data Transmitted = 2759762 bytes, Received = 1656652 bytes

IP address = 72.105.31.XXX

Primary DNS address = 198.224.XXX.XXX

Secondary DNS address = 198.224.XXX.XXX

Profile 4, Packet Session Status = INACTIVE

Profile 5, Packet Session Status = INACTIVE

Profile 6, Packet Session Status = ACTIVE

Cellular1:

Data Transmitted = 952 bytes, Received = 616 bytes

IP address = 10.1.1.18
Primary DNS address = 171.70.XXX.XXX
Secondary DNS address = 173.36.XXX.XXX

Network Information

=====

Current System Time = Thu Jun 1 17:50:0 2017
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Home
Network Selection Mode = Automatic
Network = VzW
Mobile Country Code (MCC) = 311
Mobile Network Code (MNC) = 480
Packet switch domain(P.S) state = Attached
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 25856
Cell ID = 25932320
Negotiated network MTU is 1428

Radio Information

=====

Radio power mode = online
LTE Rx Channel Number = 2125
LTE Tx Channel Number = 20125
LTE Band = 4
LTE Bandwidth = 15 MHz
Current RSSI = -66 dBm
Current RSRP = -95 dBm
Current RSRQ = -10 dB
Current SNR = 19.0 dB
Physical Cell Id = 0xE3
Number of nearby cells = 3
Idx PCI (Physical Cell Id)

1 227
2 127
3 363

Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = LTE

Modem Security Information

=====

Card Holder Verification (CHV1) = Disabled

SIM Status = OK

SIM User Operation Required = None

Number of CHV1 Retries remaining = 3

GPS Information

=====

GPS Info

GPS Feature: enabled

GPS Port Selected: Dedicated GPS port

GPS Status: GPS acquiring

GPS auto tracking status: active

GPS auto tracking config: enabled

GPS Mode Configured: standalone

Last Location Fix Error: Not Available [0x0]

Latitude: 0 Deg 0 Min 0 Sec North

Longitude: 0 Deg 0 Min 0 Sec North

Timestamp (GMT): Sun Jan 6 00:00:00 1980

Fix type index: 0, Height: 0 m

HDOP: , GPS Mode Used: not configured/unknown

Satellite Info

Satellite #16, elevation 0, azimuth 0, SNR 25

SMS Information

=====

Incoming Message Information

SMS stored in modem = 0

SMS archived since booting up = 0

Total SMS deleted since booting up = 0

Storage records allocated = 25

Storage records used = 0

Number of callbacks triggered by SMS = 0

Number of successful archive since booting up = 0

Number of failed archive since booting up = 0

Outgoing Message Information

Total SMS sent successfully = 0

Total SMS send failure = 0

Number of outgoing SMS pending = 0

Number of successful archive since booting up = 0

Number of failed archive since booting up = 0

Last Outgoing SMS Status = SUCCESS

Copy-to-SIM Status = 0x0

Send-to-Network Status = 0x0

Report-Outgoing-Message-Number:

Reference Number = 0

Result Code = 0x0

Diag Code = 0x0 0x0 0x0 0x0 0x0

SMS Archive URL =

Error Information

=====

This command is not supported on this platform.

Modem Crashdump Information

=====

Chassis Model Name is C819G-4G-VZ-K9

Platform is MC73xx based

Modem crashdump logging: off

819-XL#sh ip mob rou

Mobile Router

Enabled 05/31/17 21:36:10

Last redundancy state transition NEVER

Configuration:

Home Address 1.2.3.22 Mask 255.255.255.255

Home Agent 66.174.XXX.XXX Priority 100 (best) (current)

Registration lifetime 65534 sec

```
Retransmit Init 1000, Max 5000 msec, Limit 3
Extend Expire 10, Retry 3, Interval 5
Reverse tunnel required
Request GRE tunnel
Multi-path denied by HA, Requested metric: bandwidth
Mobile Networks: Loopback100 (1.2.3.22/255.255.255.255)
Vlan1 (Down)
```

Monitor:

```
Status -Registered-
Using collocated care-of address 10.1.1.18
On interface Cellular1
Tunnel0 mode GRE/IP
819-XL#
```



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