ISR LTE With Non-Connected Subnets and Secondary Addressing

For Verizon Wireless Mobile Private Network DMNR (Dynamic Mobile Network Routing) Service

Revision 4.4

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Overview

Introduction

Verizon Wireless Dynamic Mobile Network Routing (DMNR) is a network-based, application-agnostic, mobile technology capable of providing dynamic routing and support for mobile or stationary enterprise routers in primary wireless access or automatic wireless backup configurations. DMNR enables integration between wireless and wireline enterprise services (4G Wireless WAN) by making use of the Mobile IPv4 NEtwork MObility (NEMO) protocol and without the need for end to end overlay tunneling.

Dynamic Mobile Network Routing (DMNR) is part of the Verizon Wireless Mobile Private Network (MPN). DMNR is compatible with the Cisco IOS Mobile IP Mobile Networks feature (it is based on the NEMO protocol).

This guide describes how to configure an ISR with LTE on a Verizon MPN with DMNR to support non-connected subnets and secondary IP addressing. Normally, a mobile router supports networks directly connected to its interfaces. In some remote sites, another layer 3 (IP routing) device may be between the mobile router and the networks (such as a layer 3 Ethernet switch). The method used varies depending on IOS release.

This guide also describes how to configure an ISR with LTE on a Verizon MPN with DMNR to support multiple subnets on a single physical LAN interface. There may be remote sites in the process of IP address migration or with devices that are limited in their IP address/mask configuration. An ISR can support secondary IP addressing on an interface to support multiple subnets on a single Ethernet network.

This document is an addendum to the detailed DMNR primary and backup access configuration guides available at www.cisco.com/c/en/us/support/interfaces-modules/high-speed-wan-interface-cards/products-installation-and-configuration-guides-list.html under "Verizon LTE Deployment Guides for Cisco…"

The subsequent configurations will be based on the diagram below:

VzW Dynamic Mobile Network Routing
With Non-Connected Subnets and Secondary IP Addresses
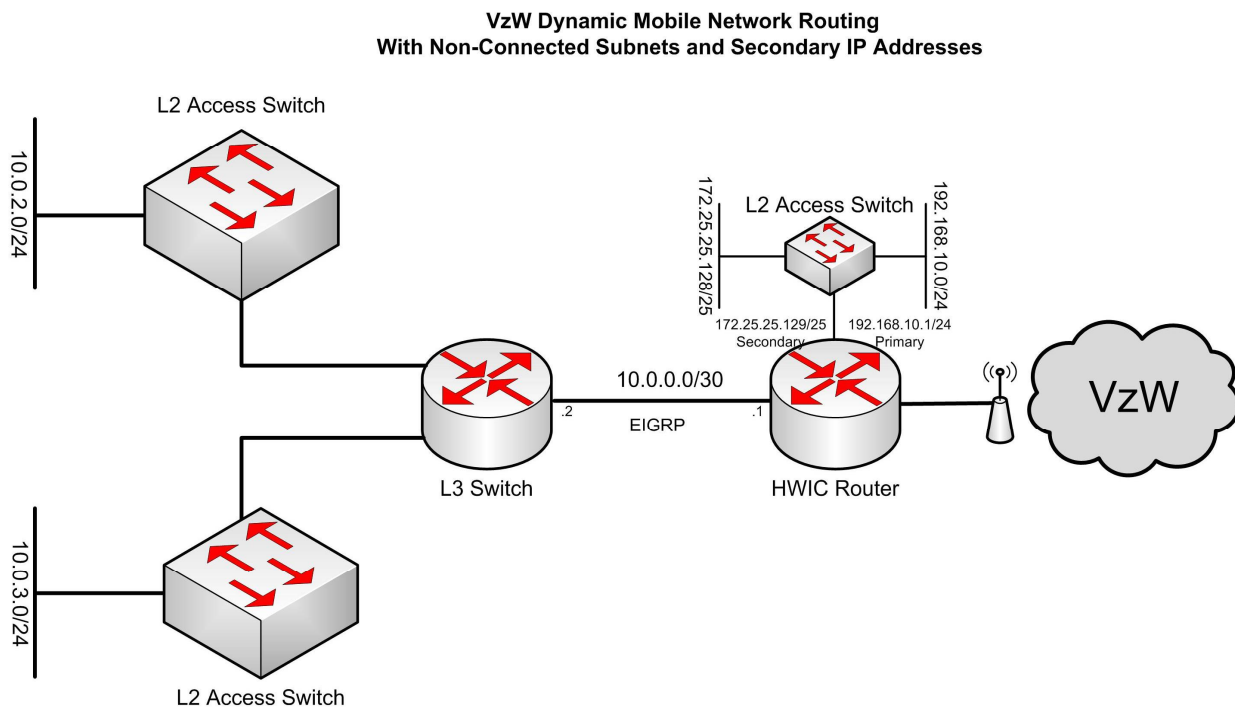
Non-Connected Subnets – Configuration for IOS Releases 15.5(2)T and Later

In prior IOS releases, ISRs only supported advertising of downstream subnets to the MPN by defining the interfaces whose subnets are to be registered. Starting with 15.5(2)T a new command under the "IP Mobile Router" stanza allows for advertising/registering subnets that are not directly connected to the ISR (non-connected-network). This method is recommended for typical deployments. Alternative configurations are also included after the recommended method, in case the current IOS release in use is not yet 15.5(2)T, for example 15.4(3)M2.

To support non-connected subnets, add those subnets to the configuration as shown below in red.

```
### Define NEMO home agent, interfaces, timers, etc.
ip mobile router
 address 1.2.3.4 255.255.255.0
 collocated single-tunnel
 home-agent <home agent IP@>
 mobile-network Vlan1
 non-connected-network 10.0.2.0 255.255.255.0
 non-connected-network 10.0.3.0 255.255.255.0
 register retransmit initial 2000 maximum 2000 retry 2
 register extend expire 40 retry 10 interval 4
 reverse-tunnel
 tunnel mode gre
!
```

Non-Connected Subnets "Show" Commands

```
C819VZ#sh ver | IOS
Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.5(2)T, RELEASE SOFTWARE (fc1)
C819VZ#

C819VZ#show ip mobile router

Mobile Router
    Enabled 05/15/15 16:15:21
    Last redundancy state transition NEVER

Configuration:
    Home Address 1.2.3.4 Mask 255.255.255.0
    Home Agent <home agent IP@> Priority 100 (best) (current)
            XXX.YYY.113.1 Priority 100
    Registration lifetime 180 sec
    Retransmit Init 2000, Max 2000 msec, Limit 2
    Extend Expire 40, Retry 10, Interval 4
    Reverse tunnel required
    Request GRE tunnel
    Multi-path denied by HA, Requested metric: bandwidth
    Mobile Networks: Vlan1 (10.0.0.0/255.255.255.252)
                     non connected subnet (10.0.2.0/255.255.255.0)
                     non connected subnet (10.0.3.0/255.255.255.0)
```

This completes the configuration of non-connected subnets using IOS 15.5(2)T or later release.

Non-Connected Subnets – Configuration for IOS Releases Prior to 15.5(2)T

ISRs support advertising of downstream subnets to the MPN by defining the interfaces whose subnets are to be registered. As an ISR would (by definition) not have a physical interface attached to a non-connected subnet, another advertisement method is needed.

To support non-connected subnets, the 1st part of the configuration entails creating a loopback interface whose IP address is within the non-connected subnet(s) IP address space. The IP address would have a subnet mask that will be a summary address, a "shorter match" compared to the subnet(s) being advertised to the MPN. This requires dedicating an IP address from the non-connected subnet(s), which should not otherwise be used.

The 2nd part of the configuration is optional. If non-connected subnets are contiguous (can be summarized) and an IP routing protocol is running, no additional IP routing definition is needed. If the non-connected subnet is a single class C or smaller, or if there are multiple non-connected subnets that can't be summarized, then static routes are defined, each representing one half of each non-connected subnet. The ISR will use the longest match to route packets. Packets are forwarded to the next hop learned via the IP routing protocol, or defined by the static route.

The 3rd part of the configuration is defining the newly created loopback interface to be registered via NeMo.

This process is actually creating a summary address on the loopback, so can also be used to advertise a summarized address larger than a class C, as in this example (two contiguous /24 addresses advertised as a single /23 address).

```
### Define loopback interface with an IP address that represents the disconnected subnet(s)
interface Loopback100
 ip address 10.0.2.254 255.255.254.0
!
interface GigabitEthernet0
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0.10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
!
interface GigabitEthernet0.25
 encapsulation dot1Q 25
 ip address 172.25.25.129 255.255.255.128
!
### Interface connecting to the L3 device with disconnected subnets to advertise via NEMO
interface Vlan1
 ip address 10.0.0.1 255.255.255.252
!
### Advertise routes learned from NeMo (from the MPN) to disconnected subnets
router eigrp 11
 network 10.0.0.0 0.0.0.3
 redistribute mobile metric 1500 10 255 1 1300
!
### Enable NEMO
router mobile
!
ip mobile secure home-agent <home agent IP@> spi decimal 256 key ascii VzWNeMo algorithm hmac-md5
!
```

```
### Define NEMO home agent, interfaces, timers, etc.
ip mobile router
 address 1.2.3.4 255.255.255.0
 collocated single-tunnel
 home-agent <home agent IP@>
 mobile-network Loopback100
 mobile-network Vlan1
 mobile-network GigabitEthernet0.25
 mobile-network GigabitEthernet0.10
 register retransmit initial 2000 maximum 2000 retry 2
 register extend expire 40 retry 10 interval 4
 reverse-tunnel
 tunnel mode gre
!
```

Non-Connected Subnets "Show" Commands

```
C819VZ#sh ver | IOS
Cisco IOS Software, C800 Software (C800-UNIVERSALK9-M), Version 15.4(3)M, RELEASE SOFTWARE (fc1)
C819VZ#
C819VZ#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

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

M*    0.0.0.0/0 is directly connected, Tunnel1
      1.0.0.0/32 is subnetted, 1 subnets
C        1.2.3.4 is directly connected, Loopback1234
      10.0.0.0/8 is variably subnetted, 8 subnets, 4 masks
C        10.0.0.0/30 is directly connected, Vlan1
L        10.0.0.1/32 is directly connected, Vlan1
C        10.0.2.0/23 is directly connected, Loopback100
D        10.0.2.0/24 [90/156160] via 10.0.0.2, 00:12:03, Vlan1
L        10.0.2.254/32 is directly connected, Loopback100
D        10.0.3.0/24 [90/156160] via 10.0.0.2, 00:11:58, Vlan1
C        10.30.12.1/32 is directly connected, Cellular0
C        10.191.191.191/32 is directly connected, Loopback888
      66.0.0.0/32 is subnetted, 1 subnets
M        <home agent IP@> [3/1], 1d02h, Cellular0
      172.25.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.25.25.128/25 is directly connected, GigabitEthernet0.25
L        172.25.25.129/32 is directly connected, GigabitEthernet0.25
      192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.10.0/24 is directly connected, GigabitEthernet0.10
```

```
L       192.168.10.1/32 is directly connected, GigabitEthernet0.10
C819VZ#
C819VZ#sh ip mob rou

Mobile Router
    Enabled 10/29/14 16:51:02
    Last redundancy state transition NEVER

Configuration:
    Home Address 1.2.3.4 Mask 255.255.255.0
    Home Agent <home agent IP@> Priority 100 (best) (current)
              XXX.YYY.113.1 Priority 100
    Registration lifetime 180 sec
    Retransmit Init 2000, Max 2000 msec, Limit 2
    Extend Expire 40, Retry 10, Interval 4
    Reverse tunnel required
    Request GRE tunnel
    Multi-path denied by HA, Requested metric: bandwidth
    Mobile Networks: Loopback100 (10.0.2.0/255.255.254.0)
                     Vlan1 (10.0.0.0/255.255.255.252)
                     GigabitEthernet0.25 (172.25.25.128/255.255.255.128)
                     GigabitEthernet0.10 (192.168.10.0/255.255.255.0)

Monitor:
    Status -Registered-
    Using collocated care-of address 10.30.12.1
    On interface Cellular0
    Tunnel1 mode GRE/IP
C819VZ#
```

Non-Connected Subnets – Configuration with Static Routes

If the non-connected subnet is a single class C or smaller, or if there are multiple non-connected subnets that can't be summarized, or if no IP routing protocol is in use at the remote site, then static routes are defined, each representing one half of each non-connected subnet.

For example, if there was just one disconnected subnet (192.168.10.0/24):
- Define a loopback within that subnet
    o e.g. loopback100 with 192.168.10.254/24 (and do not otherwise use that address)
- Define the loopback for advertisement via NEMO
    o e.g. "mobile-network lo100" under "ip mobile router"
- Define 2 static routes, each representing one half of the /24 subnet
    o e.g. "ip route 192.168.10.0 255.255.255.128" and "ip route 192.168.10.128 255.255.255.128"

Secondary IP Addressing Configuration

Secondary IP addressing is a useful feature when there is a need to support two subnets (different IP addressing) on the same physical network. For ISRs supporting Ethernet LANs, the feature is generally no longer needed. Ethernet LANs support IEEE 802.1Q VLANs, allowing a physical Ethernet network to support multiple broadcast domains, each with separate IP addressing. This provides for reduced broadcasts per subnet and superior separation.

Use of trunking on ISR routed Ethernet interfaces is the recommended method of supporting multiple subnets on the same Ethernet physical network, although L2 switched trunk or access ports and VLAN interfaces can be used.

As an example, an ISR has an Ethernet interface defined for trunking, supporting 2 VLANs with separate subnets. Below is a portion of the configuration, based on the diagram above:

```
interface Loopback100
 ip address 10.0.2.254 255.255.254.0
!
interface GigabitEthernet0
 no ip address
 duplex auto
 speed auto
!
### Define the sub-interfaces for each VLAN matching the LAN switch definitions (switch not shown)
interface GigabitEthernet0.10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
!
interface GigabitEthernet0.25
 encapsulation dot1Q 25
 ip address 172.25.25.129 255.255.255.128
!
interface Vlan1
 ip address 10.0.0.1 255.255.255.252
!
router eigrp 11
 network 10.0.0.0 0.0.0.3
 redistribute mobile metric 1500 10 255 1 1300
!
router mobile
ip mobile secure home-agent <home agent IP@> spi decimal 256 key ascii VzWNeMo algorithm hmac-md5
!
### Define NEMO home agent, interfaces, timers, etc.
ip mobile router
 address 1.2.3.4 255.255.255.0
 collocated single-tunnel
 home-agent <home agent IP@>
 mobile-network Loopback100
 mobile-network Vlan1
 mobile-network GigabitEthernet0.25
 mobile-network GigabitEthernet0.10
 register retransmit initial 2000 maximum 2000 retry 2
 register extend expire 40 retry 10 interval 4
 reverse-tunnel
 tunnel mode gre
```

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Secondary IP Addressing "Show" Commands

```
C819VZ#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

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

M*     0.0.0.0/0 is directly connected, Tunnel1
       1.0.0.0/32 is subnetted, 1 subnets
C         1.2.3.4 is directly connected, Loopback1234
       10.0.0.0/8 is variably subnetted, 8 subnets, 4 masks
C         10.0.0.0/30 is directly connected, Vlan1
L         10.0.0.1/32 is directly connected, Vlan1
C         10.0.2.0/23 is directly connected, Loopback100
D         10.0.2.0/24 [90/156160] via 10.0.0.2, 00:12:03, Vlan1
L         10.0.2.254/32 is directly connected, Loopback100
D         10.0.3.0/24 [90/156160] via 10.0.0.2, 00:11:58, Vlan1
C         10.30.12.1/32 is directly connected, Cellular0
C         10.191.191.191/32 is directly connected, Loopback888
       66.0.0.0/32 is subnetted, 1 subnets
M         <home agent IP@> [3/1], 1d02h, Cellular0
       172.25.0.0/16 is variably subnetted, 2 subnets, 2 masks
C         172.25.25.128/25 is directly connected, GigabitEthernet0.25
L         172.25.25.129/32 is directly connected, GigabitEthernet0.25
       192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C         192.168.10.0/24 is directly connected, GigabitEthernet0.10
L         192.168.10.1/32 is directly connected, GigabitEthernet0.10
C819VZ#
```

```
C819VZ#sh ip mob rou

Mobile Router
    Enabled 10/29/14 16:51:02
    Last redundancy state transition NEVER

Configuration:
    Home Address 1.2.3.4 Mask 255.255.255.0
    Home Agent <home agent IP@> Priority 100 (best) (current)
             XXX.YYY.113.1 Priority 100
    Registration lifetime 180 sec
    Retransmit Init 2000, Max 2000 msec, Limit 2
    Extend Expire 40, Retry 10, Interval 4
    Reverse tunnel required
    Request GRE tunnel
    Multi-path denied by HA, Requested metric: bandwidth
    Mobile Networks: Loopback100 (10.0.2.0/255.255.254.0)
                     Vlan1 (10.0.0.0/255.255.255.252)
                     GigabitEthernet0.25 (172.25.25.128/255.255.255.128)
                     GigabitEthernet0.10 (192.168.10.0/255.255.255.0)

Monitor:
    Status -Registered-
    Using collocated care-of address 10.30.12.1
    On interface Cellular0
    Tunnel1 mode GRE/IP
C819VZ#
```