



# DMVPN

Dynamic Multipoint (DMVPN) VPN Overview

# In This Section

- + Dynamic Multipoint VPN (DMVPN) Overview
  - + What is DMVPN?
  - + Why use DMVPN?
  - + How DMVPN works

# What is DMVPN?

- + Point-to-multipoint Layer 3 overlay VPN
  - + Logical hub and spoke topology
  - + Direct spoke to spoke traffic is supported
- + DMVPN uses a combination of...
  - + Multipoint GRE Tunnels (mGRE)
  - + Next Hop Resolution Protocol (NHRP)
  - + IPsec Crypto Profiles
  - + Routing

# Why Use DMVPN?

- + Independent of SP access method
  - + Only requirement is IP connectivity
- + Routing policy is not dictated by SP
  - + E.g. MPLS L3VPN restrictions
- + Highly scalable
  - + If properly designed

# How DMVPN Works

- + DMVPN allows on-demand full mesh IPsec tunnels with minimal configuration through usage of...
  - + Multipoint GRE Tunnels (mGRE)
  - + Next Hop Resolution Protocol (NHRP)
  - + IPsec Crypto Profiles
  - + Routing
- + Reduces need for  $n*(n-1)/2$  static tunnel configuration
  - + Uses one mGRE interface for all connections
  - + Tunnels are created on-demand between nodes
  - + Encryption is optional

## How DMVPN (cont.)

- + Creates on-demand tunnels between nodes
  - + Initial tunnel-mesh is hub-and-spoke (always on)
  - + Traffic patterns trigger spoke-to-spoke tunnels
  - + Solves management scalability problem
- + Maintains tunnels based on traffic patterns
  - + Spoke-to-spoke tunnel is on-demand
  - + Spoke-to-spoke tunnel lifetime is based on traffic
- + Requires two IGPs: Underlying and Overlay
  - + IPv4/IPv6 supported for both passenger and transport

# How DMVPN Works – Hub to Spokes

- + Two main components
  - + DMVPN Hub / NHRP Server (NHS)
  - + DMVPN Spokes / NHRP Clients (NHC)
- + Spokes/Clients register with Hub/Server
  - + Spokes manually specify Hub's address
  - + Sent via NHRP Registration Request
  - + Hub dynamically learns Spokes' VPN address & NBMA address
- + Spokes establish tunnels to Hub
  - + Exchange IGP Routing information over the tunnel

# How DMVPN Works – Spoke to Spoke

- + Spoke1 knows Spoke2's routes via IGP
  - + Learned via tunnel to Hub
  - + Next-hop is Spoke2's VPN IP for DMVPN Phase2
  - + Next-hop is Hub's VPN IP for DMVPN Phase3
- + Spoke1 asks for Spoke2's real address
  - + Maps next-hop (VPN) IP to tunnel source (NBMA) IP
  - + Sent via NHRP Resolution Request
- + Spoke to Spoke tunnel is formed
  - + Hub only used for control plane exchange
  - + Spoke-to-spoke data plane may flow through hub initially

# NHRP Important Messages

- + NHRP Registration Request
  - + Spokes register their NBMA and VPN IP to NHS
  - + Required to build the spoke-to-hub tunnels
- + NHRP Resolution Request
  - + Spoke queries for the NBMA-to-VPN mappings of other spokes
  - + Required to build spoke-to-spoke tunnels
- + NHRP Redirect
  - + NHS answer to a spoke-to-spoke data-plane packet through it
  - + Similar to IP redirects, when packet in/out interface is the same
  - + Used only in DMVPN Phase3 to build spoke-to-spoke tunnels



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# DMVPN

DMVPN Phases 1, 2, & 3

# DMVPN Phases

- + DMVPN can be deployed in three “phases”
  - + DMVPN Phase 1
  - + DMVPN Phase 2
  - + DMVPN Phase 3
- + DMVPN phase affects
  - + Spoke to spoke traffic patterns
  - + Supported routing designs
  - + Scalability

# DMVPN Phase 1 (Now obsolete)

- + mGRE on hub and p-pGRE on spokes
  - + NHRP still required for spoke registration to hub
  - + No spoke-to-spoke tunnels
- + Routing
  - + Summarization/default routing at hub is allowed
  - + Next-hop on spokes is always changed by the hub

## DMVPN Phase 2 (Now obsolete)

- + mGRE on hub and spokes
  - + NHRP required for spoke registration to hub
  - + NHRP required for spoke-to-spoke resolution
  - + Spoke-to-spoke tunnel triggered by spoke
- + Routing
  - + Summarization/default routing at hub is NOT allowed
  - + Next-hop on spokes is always preserved by the hub
  - + Multi-level hierarchy requires hub daisy-chaining

## DMVPN Phase 3

- + mGRE on hub and spokes
  - + NHRP required for spoke registration to hub
  - + NHRP required for spoke-to-spoke resolution
- + When a hub receives and forwards packet out of same interface...
  - + Send NHRP redirect message back to packet source
  - + Forward original packet down to spoke via RIB

## DMVPN Phase 3 (cont.)

- + Routing
  - + Summarization/default routing at hub is allowed
    - + Results in NHRP routes for spoke-to-spoke tunnel
    - + With no-summary, NHO is performed for spoke-to-spoke tunnel
      - + Next-hop is changed from hub IP to spoke IP
  - + Next-hop on spokes is always changed by the hub
    - + Because of this, NHRP resolution is triggered by hub
  - + Multi-level hierarchy works without daisy-chaining



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# DMVPN

DMVPN Phase 1 Configuration

# In This Section

- + Routing protocols over DMVPN Phase 1
  - + RIP
  - + EIGRP
  - + OSPF
  - + BGP
  - + ODR

# DMVPN Phase 1 (Now obsolete)

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  - + NHRP still required for spoke registration to hub
  - + No spoke-to-spoke tunnels
- + Routing
  - + Summarization/default routing at hub is allowed
  - + Next-hop on spokes is always changed by the hub





# DMVPN

DMVPN Phase 2 Configuration

# In This Section

- + Routing protocols over DMVPN Phase 2
  - + RIP
  - + EIGRP
  - + OSPF
  - + BGP

## DMVPN Phase 2 (Now obsolete)

- + mGRE on hub and spokes
  - + NHRP required for spoke registration to hub
  - + NHRP required for spoke-to-spoke resolution
  - + Spoke-to-spoke tunnel triggered by spoke
- + Routing
  - + Summarization/default routing at hub is NOT allowed
  - + Next-hop on spokes is always preserved by the hub
  - + Multi-level hierarchy requires hub daisy-chaining



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# DMVPN

DMVPN Phase 3 Configuration

# In This Section

- + Routing protocols over DMVPN Phase 3
  - + RIP
  - + EIGRP
  - + OSPF
  - + BGP
  - + ODR

## DMVPN Phase 3

- + mGRE on hub and spokes
  - + NHRP required for spoke registration to hub
  - + NHRP required for spoke-to-spoke resolution
- + When a hub receives and forwards packet out of same interface...
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## DMVPN Phase 3 (cont.)

- + Routing
  - + Summarization/default routing at hub is allowed
    - + Results in NHRP routes for spoke-to-spoke tunnel
    - + With no-summary, NHO is performed for spoke-to-spoke tunnel
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