

Cisco Virtual Office: Deploying DMVPN for IPv6

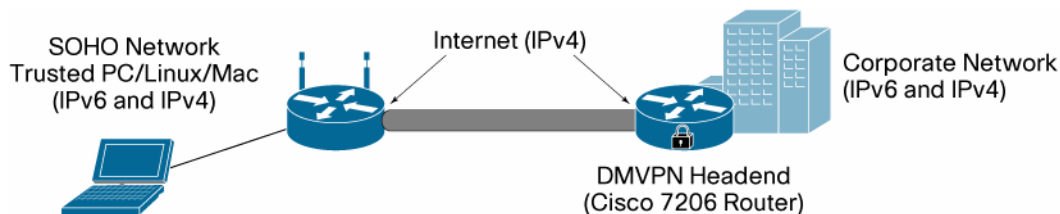
This white paper provides detailed design and implementation information relating to the deployment of Dynamic Multipoint Virtual Private Network (DMVPN) for IPv6 with the Cisco® Virtual Office.

Please refer to the Cisco Virtual Office overview (found at <http://www.cisco.com/go/cvo>) for further information about the solution, its architecture, and all of its components.

Introduction

The Cisco Virtual Office solution includes a Dynamic Multipoint VPN (DMVPN) architecture for data gateway infrastructure. IPv6 is supported on the LAN side of the infrastructure while using the existing IPv4 connectivity for the WAN side. This allows enterprises to convert their internal networks to IPv6 while using the existing IPv4 Internet/WAN infrastructure to connect to other sites that are not yet IPv6-compatible.

Figure 1. DMVPN for IPv6 Network Topology



In Figure 1, the small office or home office (SOHO) network behind the spoke router and the corporate network behind the DMVPN hub router can have either IPv6 or IPv4 devices. However, the Internet connection between spoke and hub must be an IPv4 connection.

This guide assumes basic knowledge about DMVPN for IPv4 deployment and basic IPv6 addressing.

Recommended Platforms and Images

Cisco IOS® Software Release 12.4(20)T or later is required to support DMVPN for IPv6. The following platforms are recommended for various roles:

- DMVPN hubs: Cisco 7200 Series Routers with the Cisco VPN Services Adapter
- DMVPN spokes: Cisco 800 Series, 1800 Series, and 2800 Series Integrated Services Routers

The configuration example in this guide uses a Cisco 7206VXR Router as hub and a Cisco 871W Integrated Services Router as spoke. For other Cisco router platforms, the sample configuration may differ.

Benefits of Using IPv6

The major advantage of IPv6 over IPv4 is the larger address space. IPv6 quadruples the number of network address bits from 32 bits (in IPv4) to 128 bits, or approximately 3.4×10^{38} addressable nodes, which provides more than enough globally unique IP addresses for every network device on the planet. As more and more mobile devices are added to the SOHO network, the need for individual IP addresses is increasing. IPv6 allows the growth of IP networking to continue.

Other benefits of using IPv6 include:

- Better network layer security is ensured by mandatory IP Security (IPsec) integration in IPv6 (optional in IPv4)
- Simpler header compared to IPv4 improves routing efficiency, performance, and forwarding rate scalability

Migration Steps (IPv4 to IPv6)

The following describes how to migrate from a DMVPN IPv4 deployment to a DMVPN IPv6 deployment:

- Enable IPv6 in the upstream corporate network for the DMVPN hub routers. In particular, a Domain Name System (DNS) server to manage IPv6 addresses is required.
- Upgrade the hub and spoke routers to Cisco IOS Software Release 12.4(20)T or later.
- Apply DMVPN for IPv6 configurations on hub and spoke routers.
- Enable IPv6 on host devices behind the spoke routers.

Deployment Considerations

Things to consider before starting the deployment of DMVPN for IPv6:

- The WAN connection between the hub and spoke routers is IPv4 only. Routers in between do not need IPv6 capability.
- Since most websites/DNS servers continue to use IPv4 addresses, it is mandatory to have IPv4 and IPv6 addresses on the host devices behind the spoke router for connectivity to all websites.
- For the LAN side, use IPv6 stateless autoconfiguration (RFC 2462). It requires a 64-bit network prefix. Use stateless autoconfiguration on all devices behind the hub and spoke to avoid manual assignment of IPv6 addresses. This allows easy transition from IPv4 to IPv6.
- IPv6 is not supported on Bridge Group Virtual Interface (BVI).

Configuring DMVPN for IPv6

The following explains how to configure DMVPN hub and spoke routers for IPv6. It covers only the necessary configuration for enabling DMVPN and IPv6. This is a sample configuration; it needs to be customized to your correct corporate subnets and servers.

```
Hub-side LAN (corporate) subnet: 10.1.0.0/16
Spoke-side LAN subnet: 10.10.0.0/20 and 10.20.0.0/20
DMVPN tunnel subnet: 192.168.0.0/24
Hub NBMA address: 172.16.0.100
Corporate upstream v6 prefix: 2001:db8:1111::/64
```

Spoke-side LAN v6 prefix: 2001:db8:BBBB::/48 and 2001:db8:CCCC::/48
 DMVPN v6 tunnel prefix: 2001:db8:AAAA::/64

Sample DMVPN hub configuration for IPv6

```

!!! Hostname and domain name form a fully qualified domain name in
certificates !!!
hostname dmvpn-hub
ip domain-name cisco.com
!
!!! Make sure clock and timezone are in sync !!!
clock timezone PST -8
clock summer-time PDT recurring
ntp server 10.1.1.101
!
!!! Public Key Infrastructure (PKI) configuration !!!
ip host cvo-pki-cs 10.1.1.105
!
crypto pki trustpoint cvo-pki-cs
  enrollment url http://cvo-pki-cs:80
  serial-number
  revocation-check none
  auto-enroll 75
!
!!! Enable IPv6 unicast routing !!!
ipv6 unicast-routing
!
!!! The following routing protocols are supported: Border Gateway
Protocol (BGP), Enhanced Interior Gateway Routing Protocol (EIGRP),
On-Demand Routing (ODR), Open Shortest Path First (OSPF), and Routing
Information Protocol (RIP) !!!
ipv6 router eigrp 6
  no shutdown
!
router eigrp 7
  network 10.1.0.0 0.0.255.255
  network 192.168.0.0 0.0.0.255
  no auto-summary
!
!!! IKE/IPSec Configuration !!!
crypto isakmp policy 1
  encr 3des
crypto ipsec transform-set t1 esp-3des esp-sha-hmac
  mode transport
crypto ipsec profile cvo-profile-1
  set transform-set t1
!
!!! Enable IPv6 on upstream interface (connecting to corporate
network) !!!
interface GigabitEthernet0/1

```

```
description dmvpn-hub to upstream gateway
ip address 10.1.2.2 255.255.255.252
!!! Configure IPv6 address using EUI-64 !!!
ipv6 address 2001:db8:1111::/64 eui-64
!!! Auto-generate a link-local address !!!
ipv6 enable
!!! Enable EIGRP on the interface !!!
ipv6 eigrp 6
!
!!! Loopback used as NBMA address !!!
interface Loopback0
 ip address 172.16.0.100 255.255.255.255
!
!!! Tunnel Configuration !!!
interface Tunnel0
 description DMVPN IPv6 Phase 3
 bandwidth 2000
 ip address 192.168.0.1 255.255.255.0
 no ip redirect
 ip mtu 1400
 ip nhrp map multicast dynamic
 ip nhrp network-id 6000
 ip nhrp redirect
 ip tcp adjust-mss 1360
!!! EIGRP 7 is the IPv4 EIGRP !!!
 no ip split-horizon eigrp 7
 ip summary-address eigrp 7 10.10.0.0 255.255.240.0 5
 ip summary-address eigrp 7 10.20.0.0 255.255.240.0 5
 delay 2000
!!! Every IPv6 NHRP interface is configured with one IPv6 unicast
address. This address can be a globally reachable or unique local
address. A static IPv6 address is configured here !!!
ipv6 address 2001:db8:AAAA::1/64
ipv6 enable
ipv6 mtu 1400
ipv6 eigrp 6
!!! Summary address used in DMVPN Phase 3 !!!
no ipv6 split-horizon eigrp 6
ipv6 summary-address eigrp 6 2001:db8:BBBB::/48 5
ipv6 summary-address eigrp 6 2001:db8:CCCC::/48 5
ipv6 nhrp map multicast dynamic
ipv6 nhrp network-id 6000
ipv6 nhrp redirect
 qos pre-classify
 tunnel source Loopback0
 tunnel mode gre multipoint
 tunnel key 600
 tunnel protection ipsec profile cvo-profile-1
!
```

Sample DMVPN spoke configuration for IPv6

```
ip hostname dmvpn-spoke
ip domain-name cisco.com
!
clock timezone PST -8
clock summer-time PDT recurring
ntp server 10.1.1.101
!
ip host cvo-pki-cs 10.1.1.105
!
crypto pki trustpoint cvo-pki-cs
  enrollment url http://cvo-pki-cs:80
  serial-number
  revocation-check crl
  source interface Vlan1
  auto-enroll 60
!
!!! Enable IPv6 unicast routing !!!
ipv6 unicast-routing
!
ipv6 router eigrp 6
  no shutdown
!
router eigrp 7
  network 192.168.0.0 0.0.0.255
  network 10.10.0.0 0.0.0.15
  no auto-summary
!
crypto isakmp policy 1
  encr 3des
crypto ipsec transform-set t1 esp-3des esp-sha-hmac
  mode transport
crypto ipsec profile cvo-profile-1
  set transform-set t1
!
!!! Outside Interface is IPv4 only !!!
interface FastEthernet4
  description WAN interface
  ip address dhcp
!
!!! Enable IPv6 on LAN side !!!
interface Vlan1
  description LAN interface
  ip address 10.10.0.1 255.255.255.240
  !!! Statically assigned IPv6 address (EUI-64 can be used instead).
  Note: A 64-bit
  prefix is used to allow stateless autoconfiguration !!!
```

```
    ipv6 address 2001:db8:BBBB:1::1/64
    ipv6 enable
    ipv6 eigrp 6
!
!!! Tunnel Configuration !!!
interface Tunnel0
    description DMVPN IPv6 Phase 3
    bandwidth 2000
    ip address 192.168.0.2 255.255.255.0
    no ip redirect
    ip mtu 1400
    ip nhrp map multicast 172.16.0.100
    ip nhrp map 192.168.0.1 172.16.0.100
    ip nhrp network-id 6000
    ip nhrp nhs 192.168.0.1
    ip nhrp shortcut
    ip nhrp redirect
    ip tcp adjust-mss 1360
    delay 2000
    !!! Tunnel IPv6 unicast address !!!
    ipv6 address 2001:db8:AAAA::2/64
    ipv6 enable
    ipv6 mtu 1400
    ipv6 eigrp 6
    !!! The NBMA address is IPv4 only !!!
    ipv6 nhrp map multicast 172.16.0.100
    ipv6 nhrp map 2001:db8:AAAA::1/64 172.16.0.100
    ipv6 nhrp network-id 6000
    ipv6 nhrp nhs 2001:db8:AAAA::1
    ipv6 nhrp shortcut
    ipv6 nhrp redirect
    qos pre-classify
    tunnel source FastEthernet4
    tunnel mode gre multipoint
    tunnel key 600
    tunnel protection ipsec profile cvo-profile-1
!
```

Verification and Troubleshooting

For DMVPN, the following commands are used to verify and monitor the connection/configuration:

- `show dmvpn`—Displays DMVPN-specific session information
- `show ipv6 nhrp`—Displays Next Hop Resolution Protocol (NHRP) mapping information
- `show ipv6 nhrp multicast`—Displays NHRP multicast mapping information
- `show ipv6 nhrp summary`—Displays NHRP mapping summary information
- `show ipv6 nhrp traffic`—Displays NHRP traffic statistics information
- `clear dmvpn session`—Clears DMVPN sessions
- `clear ipv6 nhrp`—Clears all dynamic entries from the NHRP cache
- `debug dmvpn`—Displays debug DMVPN session information
- `debug nhrp ipv6`—Enables NHRP debugging
- `debug nhrp condition`—Enables NHRP conditional debugging
- `debug ipv6 nhrp error`—Displays NHRP error-level debugging information

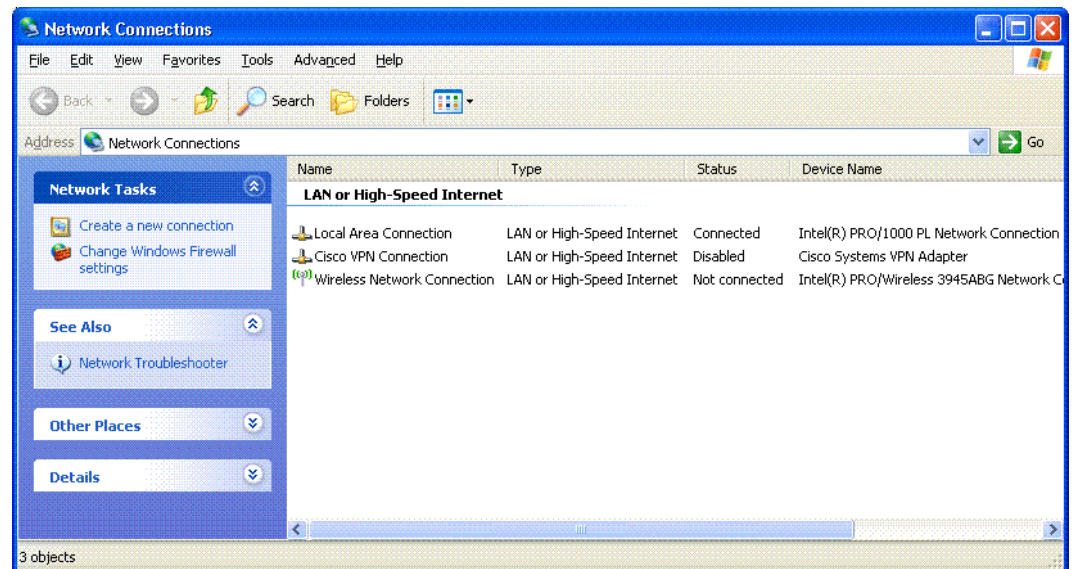
References

- Cisco Virtual Office solution guides and information: <http://www.cisco.com/go/cvo>
- Cisco Feature Navigator: <http://www.cisco.com/go/fn>
- DMVPN: <http://www.cisco.com/go/dmvpn>
- Cisco IPv6: <http://www.cisco.com/ipv6>
- Implementing DMVPN for IPv6:
<http://www.cisco.com/en/US/docs/ios/ipv6/configuration/guide/ip6-dmvpn.html>
- Cisco Integrated Services Routers: <http://www.cisco.com/go/isr>
- Cisco IOS Software documentation page:
<http://www.cisco.com/univercd/cc/td/doc/product/software/index.htm>
- IPv6 for Microsoft Windows—FAQ:
<http://www.microsoft.com/technet/network/ipv6/ipv6faq.msp>

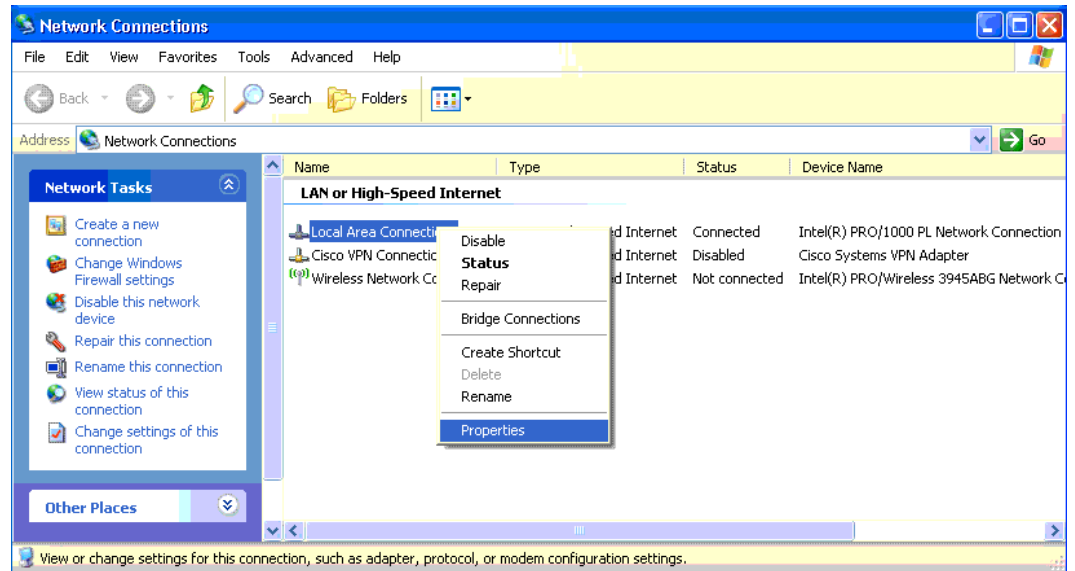
Appendix A

This following describes how to install IPv6 for Windows XP.

1. Click **Start**, click **Control Panel**, and then double-click **Network Connections**.

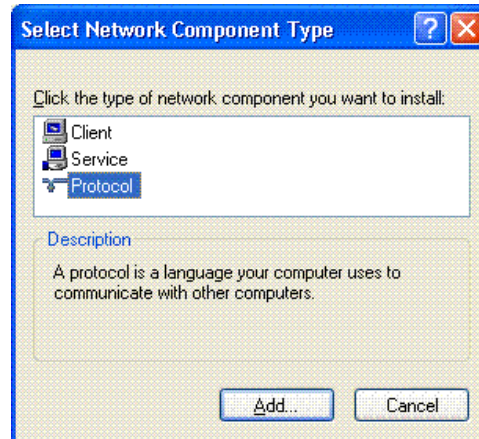


- Right-click any local area connection, and then click **Properties**.

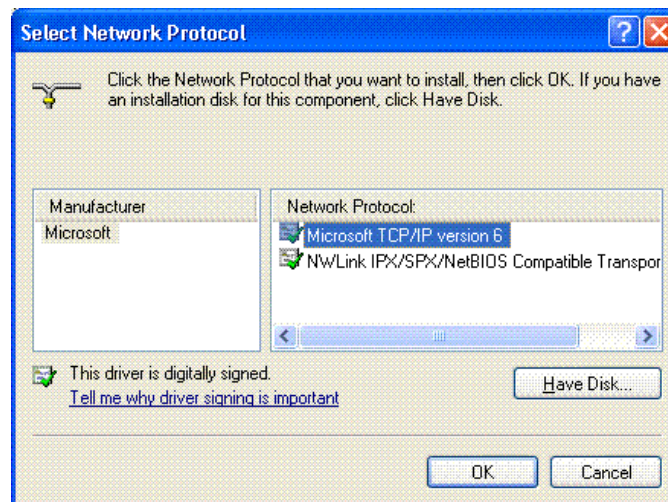


- Click **Install**.

- In the **Select Network Component Type** dialog box, click **Protocol**, and then click **Add**.



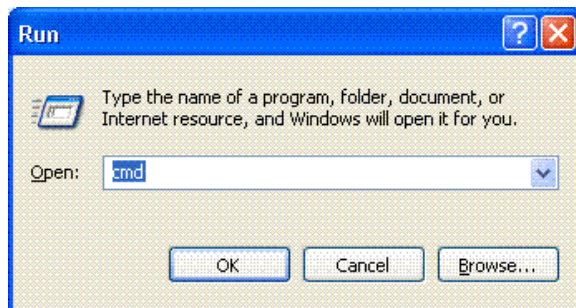
- In the **Select Network Protocol** dialog box, click **Microsoft TCP/IP version 6** (for SP2 or later)/**Microsoft IPv6 Developer Edition** (for SP1), and then click **OK**.



6. Click **Close** to save changes to your network connection.

Alternatively, you can install IPv6 from the **Command Prompt**.

1. Click **Start**, click **Run...**, type **cmd**, and then click **OK**.



2. For Windows XP with SP1 or later, type **netsh interface ipv6 install**; for Windows XP with no service packs installed, type **ipv6 install**.



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