Chapter 5

Hardening VPN and Dial-in Remote Access

- Hardening VPN Connectivity
- Different VPN Connection Types and Technologies
- VPN Device-Hardening Methods
- Hardening IPsec-Based VPNs
- Hardening VPN Clients
- Hardening Dial-in Remote Access

Granting external access to a network has gone from the realm of the sporadic use of pcAnywhere and a modem on a desktop and dial-in remote access to run corporate applications to fully integrated enterprise networks using VPN connections across the Internet to grant full remote office connectivity.

A Virtual Private Network (VPN) involves the use of a public network infrastructure, such as the Internet, to provide remote user and remote site access to a corporate network via a secure connection. Security is provided through authentication and encryption techniques such as RADIUS, TACACS+, PPTP, L2TP, SSL, and IPsec to protect the data. A VPN typically involves taking the original data and encapsulating it within IP packets that are secured by the given VPN technology, such as IPsec.

As these external access technologies have matured, many companies have turned in particular to VPNs as a method to provide all manner of remote connectivity—from individual user access, to remote office networks' access to the corporate internetwork, to initial connections between companies after an acquisition, and even access between strategic business partners' resources and systems.

At the same time, this creates a security issue that must be addressed—namely, how can we provide the kinds of external access that our users require while ensuring that our network remains as hardened as possible. We are going to look at the unique issues of VPN connectivity and how it can be hardened. After that, we are going to look at providing traditional dial-in remote access connectivity and how those connections can be hardened.

Here are the hardware and software I provide specific configuration examples for in this chapter:

- A Cisco Secure VPN 3005 concentrator running Cisco Systems, Inc./VPN 3000 concentrator version 4.0.4.Rel Dec 4, 2003
- A Nortel Contivity 1100 extranet switch running version 4.80.124

Hardening VPN Connectivity

VPN connectivity is commonplace on most corporate networks today. The reason for this is simple. In many cases, the remote client or office already has an Internet connection, and this connection is often at broadband speeds or faster. As a result, instead of putting in an additional and more costly packet switched or dedicated point-to-point connection to provide access to the remote location, the company can establish a VPN connection across the Internet connection that they are already paying for and enjoy many of the same benefits that a packet switched or dedicated connection would provide. Sure, a downside exists in that there is no guaranteed service level for Internet- based connections, but in many cases the cost saving justifies the risk of downtime due to Internet-related outages.

At the same time, providing connections across the Internet introduces a huge security risk—namely that you are now passing private corporate data across the very public Internet. This allows an eavesdropper to potentially view or change your private data.

The technologies that define how VPNs operate address many of these risks through the use of authentication, encryption, and data integrity protocols; however, you can do certain things to ensure your data is as hardened as it possibly can be when traveling across a VPN. At the same time, you also have the risk associated with the need to place the device accepting the VPN connections in a position where it is exposed to the Internet. As with firewalls, this means that you must not only harden the VPN traffic itself from compromise, you also have to harden the VPN devices themselves. In our effort to harden our VPN connectivity, we are going to examine the following topics:

- Different VPN connection types and technologies
- VPN device-hardening methods
- Hardening IPsec-based VPNs
- Hardening VPN clients

Different VPN Connection Types and Technologies

Before we can explore how to harden VPNs, we must first take a look at the types of VPN connections and the VPN technologies that exist. Doing so will allow you to understand not only how you should implement your VPN connections from a design perspective, but will show you which VPN technologies provide you the most security.

Different VPN Connection Types

The two predominant VPN connection types are remote access VPNs and site-to-site VPNs. Remote access VPNs refer to connections that provide individual remote users access to the corporate network via their PC. For example, a user at a hotel using the hotel Internet connection may establish a tunnel over that Internet connection to the corporate network, allowing that user to access corporate resources. Another example, as shown in Figure 5-1, is a user at home telecommuting to the local office via a VPN connection through their dial-up or broadband Internet service provider.

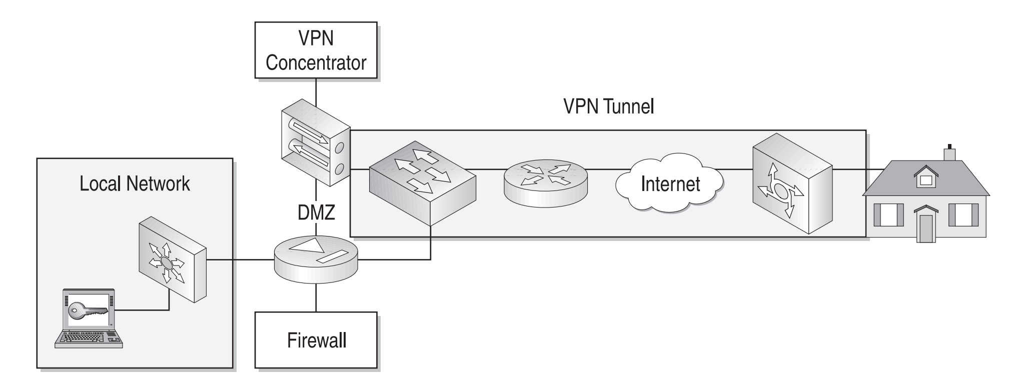


Figure 5-1. Basic remote access VPN

Site-to-site VPNs refer to connections that provide access from an entire remote network, such as a small office or remote branch, to the corporate network through the use of gateway devices. Figure 5-2 shows a network diagram of a site-to-site VPN connection between a local and remote office.

Site-to-site VPN connections can be further broken down into intranet and extranet VPN connections. Intranet VPN connections refer to connections that are part of the same company (for example, a remote branch office). Extranet VPN connections refer to connections between a company and its business partners (for example, between a manufacturing company and their supplier). Extranet VPN connections are generally much more restrictive than intranet VPN connections, and they should only provide remote access to the specific resource or resources that the remote location requires.

Different VPN Technologies

Most devices today support four primary VPN technologies: Point-to-Point Tunneling Protocol (PPTP), Layer 2 Tunneling Protocol (L2TP), IPsec, and Secure Socket Layer (SSL) VPNs.

PPTP is considered a Layer 2 tunneling protocol because it operates at the Data Link layer of the OSI model. The benefit this provides is the ability to tunnel multiple protocols within the VPN tunnel. This allows you to tunnel IPX/SPX and TCP/IP within the same tunnel, for example. PPTP has some drawbacks, however. First, it is not based on an open standard but rather is a proprietary system developed in large part by Microsoft. Second, and more important, PPTP does not provide data encryption by itself, although later versions of PPTP provide some rudimentary data-encryption methods through the use of Microsoft Point-to-Point Encryption (MPPE). Third, PPTP has historically had security problems and has been exposed to significant security vulnerabilities. PPTPv1 was cracked in 1998 and, as a result, should not be used in any circumstances. PPTPv2, although it's much more secure than PPTPv1 and addresses

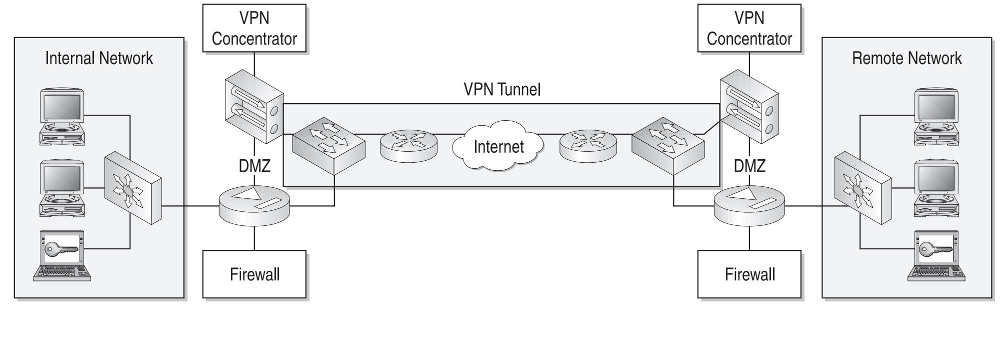


Figure 5-2. Basic site-to-site VPN

many of the security flaws of PPTPv1, is still susceptible to password crackers such as L0phtcrack because key values in PPTP are a function of the user password. This allows a malicious user to gain access to the key values used to protect the data, and thus the data itself, by simply monitoring the network and then executing a dictionary hack using L0phtcrack against the challenge and response data. As a result, although PPTP is generally easier to deploy than other technologies due to being built into many Microsoft operating systems, I do not recommend implementing PPTP-based VPNs. Instead, to harden PPTP, you should use L2TP or IPsec for reasons I will explain in a moment.

L2TP is also considered a Layer 2 tunneling protocol and, in fact, is based on Microsoft's PPTP and Cisco's Layer 2 Forwarding (L2F) protocol, combining the best of both. L2TP provides for multiprotocol VPN tunnels, much like PPTP does, and is based on IETF open standards. Where L2TP differs, and is thus a better solution than PPTP, is the fact that it uses IPsec ESP for data encryption as well as supports more robust authentication methods. If you have to provide a multiprotocol VPN solution, you should use L2TP instead of PPTP.

IPsec is the de facto standard for providing purely IP-based VPN connections. IPsec is a Layer 3 protocol and, as a result, can only be used to tunnel TCP/IP-based traffic in a VPN. IPsec supports a couple of different methods of providing for data encryption, either using Authentication Header (AH) or Encapsulating Security Payload (ESP). IPsec supports multiple authentication and key protocols, although the most commonly used key protocol is the ISAKMP/Oakley protocol. IPsec also supports much more secure encryption methods, including 160-bit 3DES and 256-bit Advanced Encryption Standard (AES) encryption. In environments that do not require multiprotocol VPN support, you should only use IPsec for your VPN connections due to the increased security, better encryption, more robust authentication, and better scalability over PPTP and L2TP. The rest of this chapter will focus on IPsec because it provides the greatest security for our environments and is being used to harden L2TP.

The use of SSL VPNs is an emerging method of providing secure remote access to applications without deploying client VPN software. Most SSL VPNs use a web browser's built-in SSL functionality and Java or ActiveX controls to provide the remote application access. The obvious benefit to this is that you generally do not need to install any kind of client VPN software on the remote system. Your users can connect to your network from public kiosks or wireless hotspots and access the application while still enjoying data security and privacy. A drawback of this type of VPN is that most SSL VPNs require web-based applications in order to be used effectively. Although many companies are working at utilizing proxy servers to provide expanded access to legacy or client/server-based applications, this technology is still in its relative infancy.

Now, you might be reading this and thinking, "OK, but this sounds like what we do to provide secure e-mail access via a web-based e-mail interface," and in many ways you are correct. Some of the hype surrounding SSL VPNs is simply a new marketing spin of an old concept. However, as these application proxies as well as web-based remote access applications, such as Citrix and Microsoft Terminal Server, gain maturity, SSL VPNs will continue to expand beyond the traditional definitions and implementations.

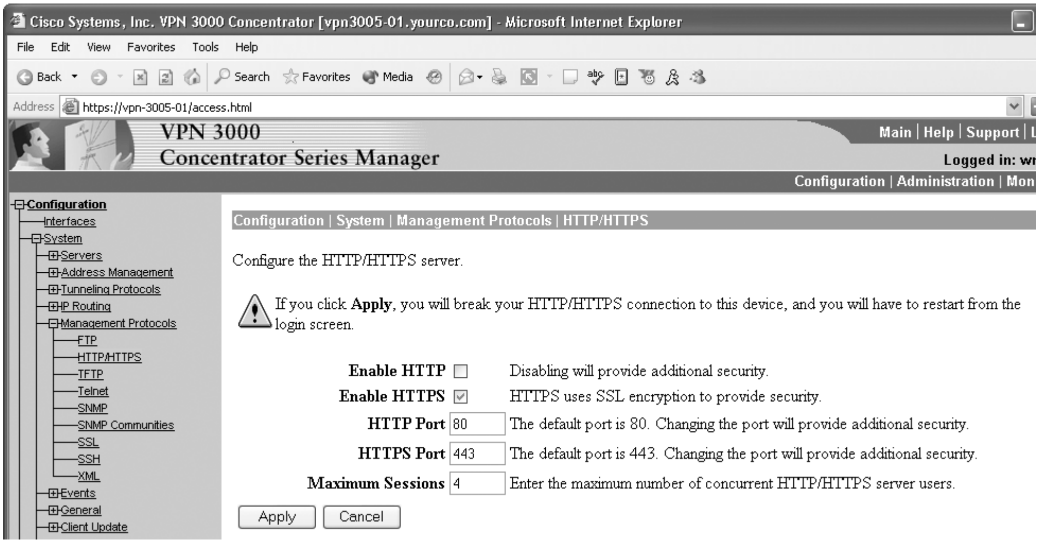
VPN Device-Hardening Methods

Before we can look to harden the VPN tunnels themselves, we must first look at how to harden our VPN devices. The areas to focus on include the following:

- Hardening remote administration
- Implementing authentication and authorization
- Restricting services and protocols
- Providing redundancy and fault tolerance
- Hardening routing protocols

Hardening Remote Administration

Like firewalls, many VPN devices support multiple management protocols, including Telnet, SSH, HTTP, and HTTPS. As was demonstrated with firewalls, you should not use insecure protocols such as Telnet and HTTP to manage your devices. This is also true for your VPN devices. Only use SSH, HTTPS, or a similar encrypted protocol to manage your equipment. For example, with your Cisco VPN 3005, you can disable any management protocol via the web GUI by selecting the appropriate protocol from the Configuration | System | Management Protocols | HTTP/HTTPS screen and unchecking the Enable button.


Cisco Systems, Inc. VPN 3000 Concentrator [vpn3005-01.yourco.com] - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address https://vpn-3005-01/access.html
VPN 3000
Concentrator Series Manager
Main | Help | Support | L
Logged in: wr
Configuration | Administration | Mon
Configuration
Interfaces
System
Servers
Address Management
Tunneling Protocols
IP Routing
Management Protocols
FTP
HTTP/HTTPS
TFTP
Telnet
SNMP
SNMP Communities
SSL
SSH
XML
Events
General
Client Update
Configuration | System | Management Protocols | HTTP/HTTPS
Apply
Cancel

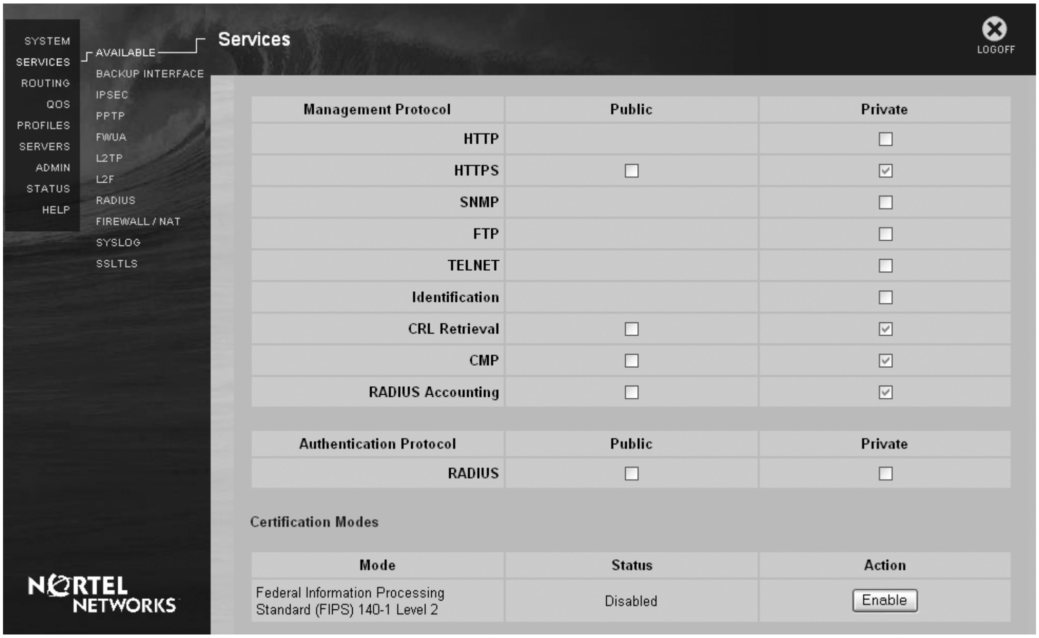
Configure the HTTP/HTTPS server.

If you click **Apply**, you will break your HTTP/HTTPS connection to this device, and you will have to restart from the login screen.

Enable HTTP	□	Disabling will provide additional security.
Enable HTTPS	☑	HTTPS uses SSL encryption to provide security.
HTTP Port	80	The default port is 80. Changing the port will provide additional security.
HTTPS Port	443	The default port is 443. Changing the port will provide additional security.
Maximum Sessions	4	Enter the maximum number of concurrent HTTP/HTTPS server users.

In this case, we have disabled HTTP access, only allowing HTTPS management access. You should enable only the secure management protocols you will use.

Your Nortel Contivity has similar functionality. A Nortel Contivity extranet switch supports HTTP, HTTPS, SNMP, FTP, and Telnet as management protocols. One notable protocol that it does not support is SSH. As a result, if you want to access the device via a CLI, you must use Telnet. Although this may sound like a drawback, the Contivity was designed around a web GUI, so most if not all the functionality you will need is in the GUI. Consequently, you should only manage your Contivity device via the secure web-based administration methods. On your Nortel Contivity VPN, you can configure your remote management protocols at the Services | Available | Services screen, as shown here:



Services

Management Protocol	Public	Private
HTTP		□
HTTPS	□	☑
SNMP		□
FTP		□
TELNET		□
Identification		□
CRL Retrieval	□	☑
CMP	□	☑
RADIUS Accounting	□	☑

Authentication Protocol	Public	Private
RADIUS	□	□

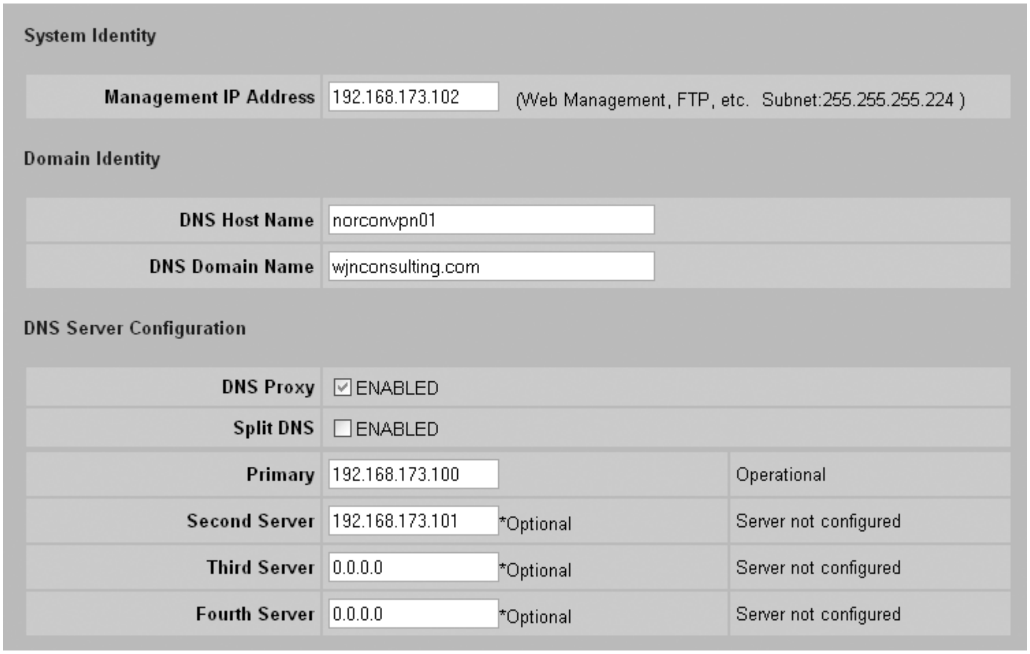
Certification Modes

Mode	Status	Action
Federal Information Processing Standard (FIPS) 140-1 Level 2	Disabled	Enable

You can configure which protocols to support by checking or unchecking the appropriate check box. Because the public interface is inherently insecure, you cannot enable an insecure management protocol, which is a nice feature.

Configuring HTTPS support on your Nortel Contivity is a little bit more complex a process than on the Cisco VPN 3005 due to the fact that Cisco uses an internally generated certificate by default to allow HTTPS access. For the Nortel Contivity, you will need to configure certificates on the device before HTTPS access is allowed. The following steps detail this process:

1. In addition to checking HTTPS, as previously detailed, you must first ensure that the device name and DNS servers are configured properly at the System | Identity | System Identity screen, as shown here:



System Identity

Management IP Address	192.168.173.102	(Web Management, FTP, etc. Subnet:255.255.255.224)

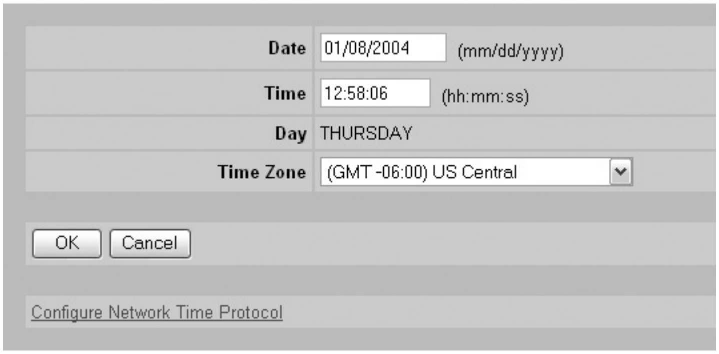
Domain Identity

DNS Host Name	norconvpn01
DNS Domain Name	wjnconsulting.com

DNS Server Configuration

DNS Proxy	☑ ENABLED	
Split DNS	□ ENABLED	
Primary	192.168.173.100	Operational
Second Server	192.168.173.101 *Optional	Server not configured
Third Server	0.0.0.0 *Optional	Server not configured
Fourth Server	0.0.0.0 *Optional	Server not configured

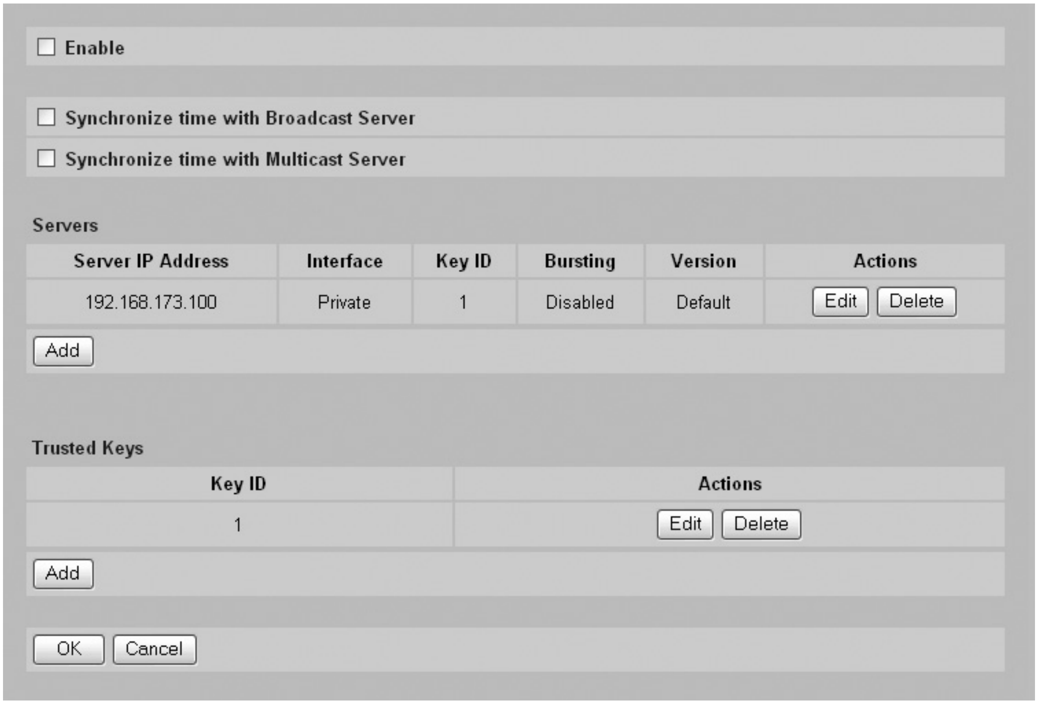
2. Next, make sure your Contivity is configured with the appropriate date and time. You can do this at the System | Date & Time |Date and Time screen, as shown here:



Date	01/08/2004 (mm/dd/yyyy)
Time	12:58:06 (hh:mm:ss)
Day	THURSDAY
Time Zone	(GMT -06:00) US Central

3. I also recommend that you configure the Network Time Protocol (NTP) to allow the Contivity to automatically update its time. You can do this by clicking Configure Network Time Protocol at the System | Date & Time | Date

and Time screen. At the System | Date & Time | Network Time Protocol screen, check the Enable box and add the appropriate NTP servers for your environment, as shown next:



□ Enable

□ Synchronize time with Broadcast Server

□ Synchronize time with Multicast Server

Servers

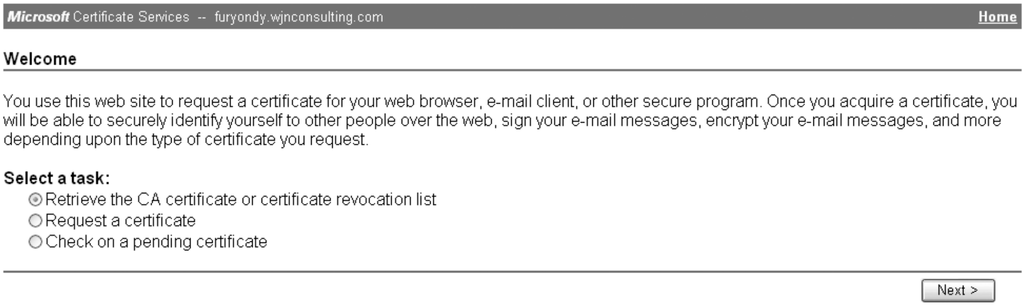
Server IP Address	Interface	Key ID	Bursting	Version	Actions
192.168.173.100	Private	1	Disabled	Default	Edit Delete

Trusted Keys

Key ID	Actions
1	Edit Delete

Ensure that you enable NTP authentication by configuring the appropriate key ID for increased security.

4. The next step is to configure the Contivity with a certificate authority trusted CA certificate. Using Microsoft Certificate Services, you can obtain the trusted CA certificate by selecting the Retrieve the CA Certificate or Certificate Revocation List radio button, as shown here:

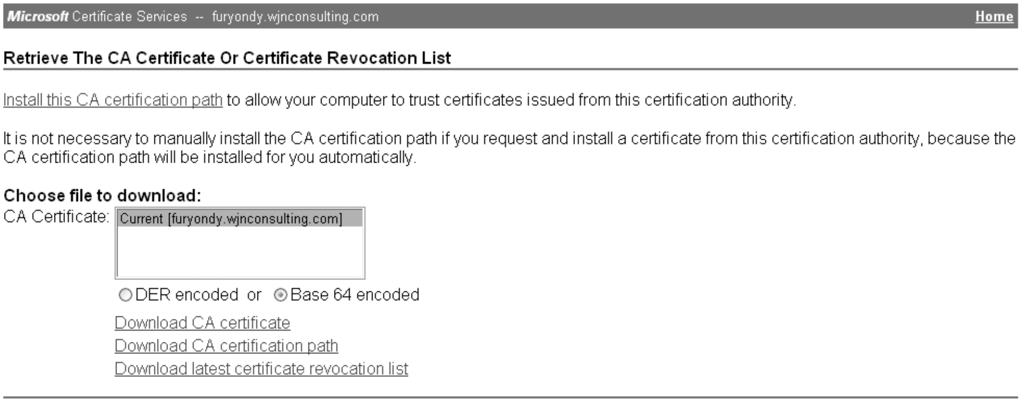


Microsoft Certificate Services -- furyondy.wjnconsulting.com

Welcome

You use this web site to request a certificate for your web browser, e-mail client, or other secure program. Once you acquire a certificate, you will be able to securely identify yourself to other people over the web, sign your e-mail messages, encrypt your e-mail messages, and more depending upon the type of certificate you request.

Select a task:
● Retrieve the CA certificate or certificate revocation list
○ Request a certificate
○ Check on a pending certificate



Microsoft Certificate Services -- furyondy.wjnconsulting.com

Retrieve The CA Certificate Or Certificate Revocation List

Install this CA certification path to allow your computer to trust certificates issued from this certification authority.

It is not necessary to manually install the CA certification path if you request and install a certificate from this certification authority, because the CA certification path will be installed for you automatically.

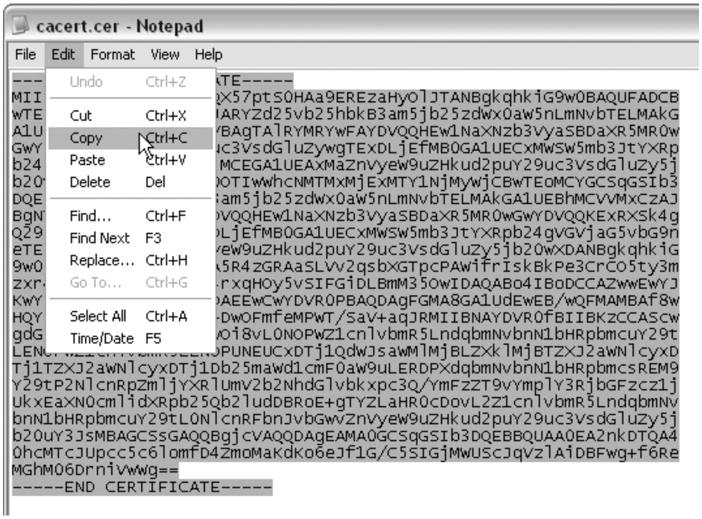
Choose file to download:

CA Certificate: Current [furyondy.wjnconsulting.com]

○ DER encoded or ● Base 64 encoded

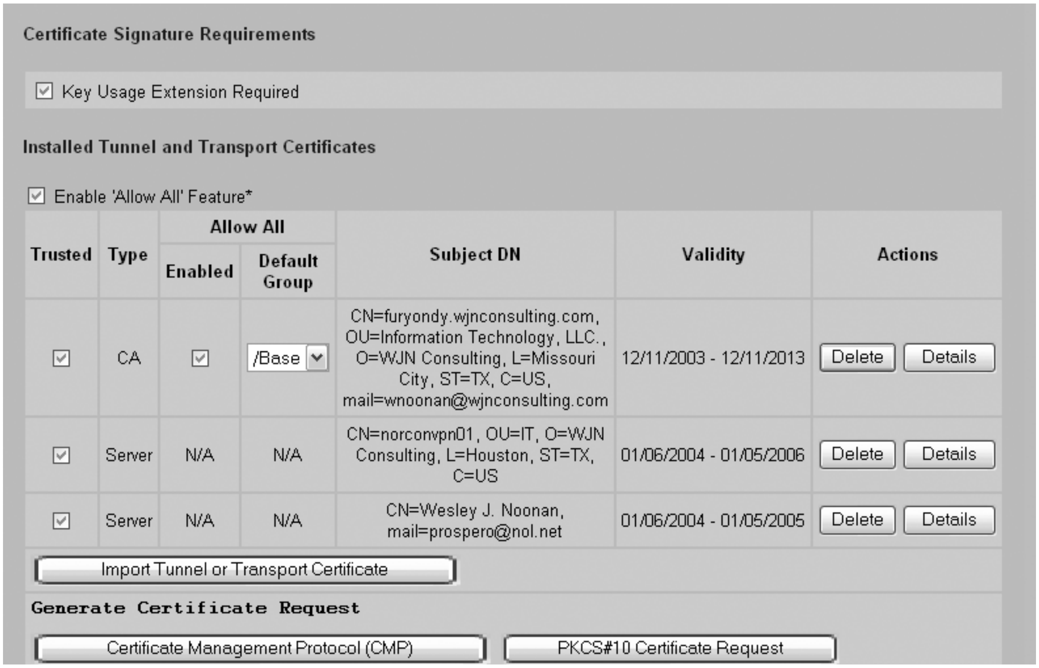
Download CA certificate
Download CA certification path
Download latest certificate revocation list

5. Then select Base 64 Encoded and click the Download CA Certificate button. You will be prompted to save the certificate to your local hard disk. After that, open the file using a text editor such as Microsoft Notepad and copy the contents of the file, as shown here:



```
---                 ATE-----
MII                 qX57ptS0HAa9EREzaHyOlJTANBgkqhkiG9w0BAQUFADCB
WTE                 JARYZd25vb25hbkB3am5jb25zdWx0aW5nLmNvbTELMAkG
A1U                 YBAgTAlRYMRYwFAYDVQQHEw1NaXNzb3VyaSBDaXR5MR0w
GwY                 uc3VsdGluZywgTExDLjEfMB0GA1UECxMWSW5mb3JtYXRp
b24                  MCEGA1UEAxMaZnVyew9uZHkud2puY29uc3VsdGluZy5j
b20                 OOTIwWhcNMTMxMjExMTY1NjMyWjCBwTEoMCYGCSqGSIb3
DQE                 am5jb25zdWx0aW5nLmNvbTELMAkGA1UEBhMCVVMxCzAJ
BgN                 VQQHEw1NaXNzb3VyaSBDaXR5MR0wGwYDVQQKExRXSk4g
Q29                 LjEfMB0GA1UECxMWSW5mb3JtYXRpb24gVGVjaG5vbG9n
eTE                 ew9uZHkud2puY29uc3VsdGluZy5jb20wXDANBgkqhkiG
9w0                 A5R4zGRAaSLVv2qsbXGTpcPAWifrIskBkPe3CrCO5ty3m
zxr                 -rxqHOy5vSIFGiDLBmM35OwIDAQABo4IBoDCCAZwwEwYJ
KwY                 DAEEwCwYDVR0PBAQDAgFGMA8GA1UdEwEB/wQFMAMBAf8w
HQY                 -DwOFmfeMPWT/SaV+aqJRMIIBNAYDVR0fBIIBKzCCAScw
gdG                 Oi8vL0NOPWZ1cnlvbmR5LndqbmNvbnN1bHRpbmcuY29t
LEN                 PUNEUCxDTj1QdWJsaWMlMjBLZXklMjBTZXJ2aWNlcyxD
Tj1TZXJ2aWNlcyxDTj1Db25maWd1cmF0aW9uLERDPXdqbmNvbnN1bHRpbmcsREM9
Y29tP2NlcnRpZmljYXRlUmV2b2NhdGlvbkxpc3Q/YmFzZT9vYmplY3RjbGFzcz1j
UkxEaXN0cmlidXRpb25Qb2ludDBRoE+gTYZLaHR0cDovL2Z1cnlvbmR5LndqbmNv
bnN1bHRpbmcuY29tL0NlcnRFbnJvbGwvZnVyew9uZHkud2puY29uc3VsdGluZy5j
b20uY3JsMBAGCSsGAQQBgjcVAQQDAgEAMA0GCSqGSIb3DQEBBQUAA0EA2nkDTQA4
0hcMTcJUpcc5c6lomfD4ZmoMaKdKo6eJf1G/C5SIGjMWUScJqVzlAiDBFwg+f6Re
MGhM06DrniVwWg==
-----END CERTIFICATE-----
```

6. Next, go to the System | Certificates | Certificate Configuration screen and click Import Tunnel or Transport Certificate, as shown here:



Certificate Signature Requirements

☑ Key Usage Extension Required

Installed Tunnel and Transport Certificates

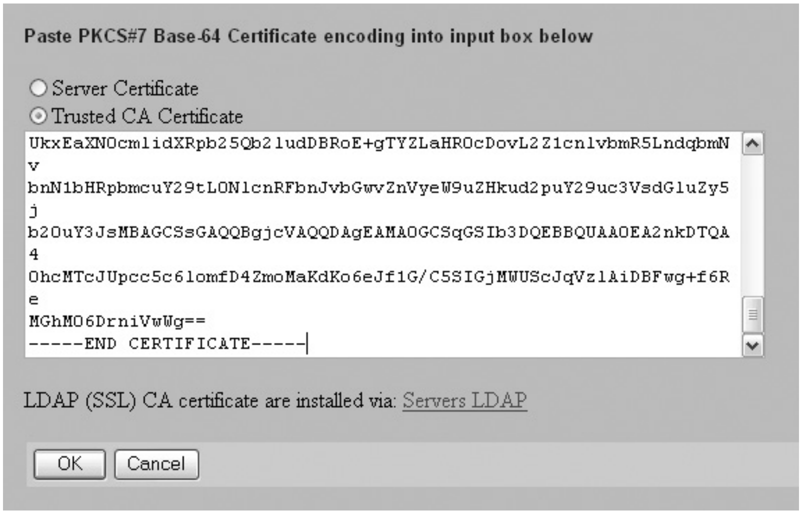
☑ Enable 'Allow All' Feature*

Trusted	Type	Allow All		Subject DN	Validity	Actions
		Enabled	Default Group			
☑	CA	☑	/Base	CN=furyondy.wjnconsulting.com, OU=Information Technology, LLC., O=WJN Consulting, L=Missouri City, ST=TX, C=US, mail=wnoonan@wjnconsulting.com	12/11/2003 - 12/11/2013	Delete Details
☑	Server	N/A	N/A	CN=norconvpn01, OU=IT, O=WJN Consulting, L=Houston, ST=TX, C=US	01/06/2004 - 01/05/2006	Delete Details
☑	Server	N/A	N/A	CN=Wesley J. Noonan, mail=prospero@nol.net	01/06/2004 - 01/05/2005	Delete Details

Generate Certificate Request

Certificate Management Protocol (CMP)
PKCS#10 Certificate Request

7. At the System | Certificates | Import Tunnel or Transport Certificate screen, paste the contents of the certificate file into the dialog box, select Trusted CA Certificate, and then click OK, as shown here:



Paste PKCS#7 Base-64 Certificate encoding into input box below

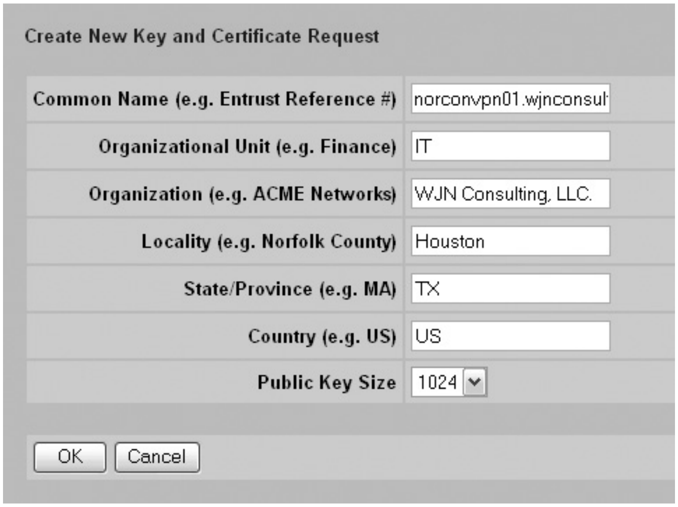
○ Server Certificate
● Trusted CA Certificate

```
UkxEaXNOcmlidXRpb25Qb2ludDBRoE+gTYZLaHROcDovL2Z1cnlvbmR5LndqbmN
v
bnN1bHRpbmcuY29tL0NlcnRFbnJvbGwvZnVyeW9uZHkud2puY29uc3VsdGluZy5
j
b20uY3JsMBAGCSsGAQQBgjcVAQQDAgEAMA0GCSqGSIb3DQEBBQUAA0EA2nkDTQA
4
OhcMTcJUpcc5c6lomfD4ZmoMaKdKo6eJf1G/C5SIGjMWUScJqVzlAiDBFwg+f6R
e
MGhMO6DrniVwWg==
-----END CERTIFICATE-----
```

LDAP (SSL) CA certificate are installed via: Servers LDAP

Make sure that the Trusted and Enabled check boxes are selected for your CA certificate.

8. The next step is to generate a certificate for the Contivity using the CA you added. You can do this by clicking PKCS#10 Certificate Request at the System | Certificates | Certificate Configuration screen. This will take you to the System | Certificates | Certification Request – PKCS#10 screen, as shown here:



Create New Key and Certificate Request

Common Name (e.g. Entrust Reference #): norconvpn01.wjnconsul

Organizational Unit (e.g. Finance): IT

Organization (e.g. ACME Networks): WJN Consulting, LLC.

Locality (e.g. Norfolk County): Houston

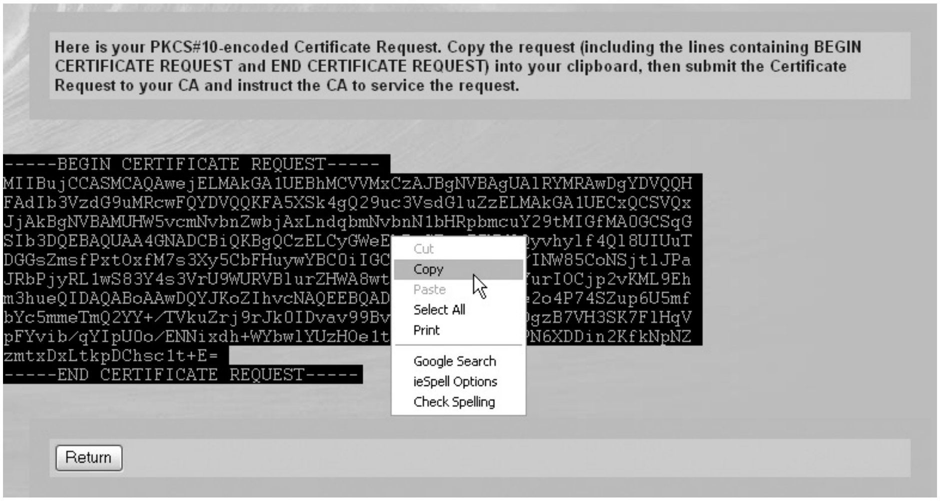
State/Province (e.g. MA): TX

Country (e.g. US): US

Public Key Size: 1024

Fill in the request with the appropriate information. Make sure that you use the correct system name and use a public key size of at least 1024 for security purposes. When this screen is complete, click OK.

9. You will be presented with the System | Certificates | Certification Request screen, as shown here:

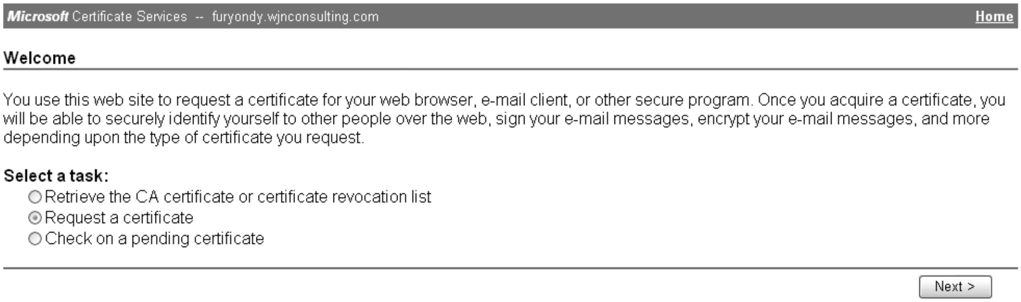


Here is your PKCS#10-encoded Certificate Request. Copy the request (including the lines containing BEGIN CERTIFICATE REQUEST and END CERTIFICATE REQUEST) into your clipboard, then submit the Certificate Request to your CA and instruct the CA to service the request.

```
-----BEGIN CERTIFICATE REQUEST-----
MIIBujCCASMCAQAwejELMAkGA1UEBhMCVVMxCzAJBgNVBAgUAlRYMRAwDgYDVQQH
FAdIb3VzdG9uMRcwFQYDVQQKFA5XSk4gQ29uc3VsdGluZzELMAkGA1UECxQCSVQx
JjAkBgNVBAMUHW5vcmNvbnZwbjAxLndqbmNvbnN1bHRpbmcuY29tMIGfMA0GCSqG
SIb3DQEBAQUAA4GNADCBiQKBgQCzELCyGWeE [illegible] yvhylf4Q18UIUuT
DGGsZmsfPxtOxfM7s3Xy5CbFHuywYBC0iIGC [illegible] INW85CoNSjtlJPa
JRbPjyRL1wS83Y4s3VrU9WURVBlurZHWA8wt [illegible] urIOCjp2vKML9Eh
m3hueQIDAQABoAAwDQYJKoZIhvcNAQEEBQAD [illegible] 2o4P74SZup6U5mf
bYc5mmeTmQ2YY+/TVkuZrj9rJk0IDvav99Bv [illegible] gzB7VH3SK7FlHqV
pFYvib/qYIpU0o/ENNixdh+WYbwlYUzHOe1t [illegible] N6XDDin2KfkNpNZ
zmtxDxLtkpDChsc1t+E=
-----END CERTIFICATE REQUEST-----
```

Highlight the certificate request data and copy it. Click the Return button to return to the System | Certificates | Certificate Configuration screen.

10. The next step is to request a new certificate from your CA. For Microsoft Certificate Services, you can do this by selecting Request a Certificate, as shown here:



Microsoft Certificate Services -- furyondy.wjnconsulting.com

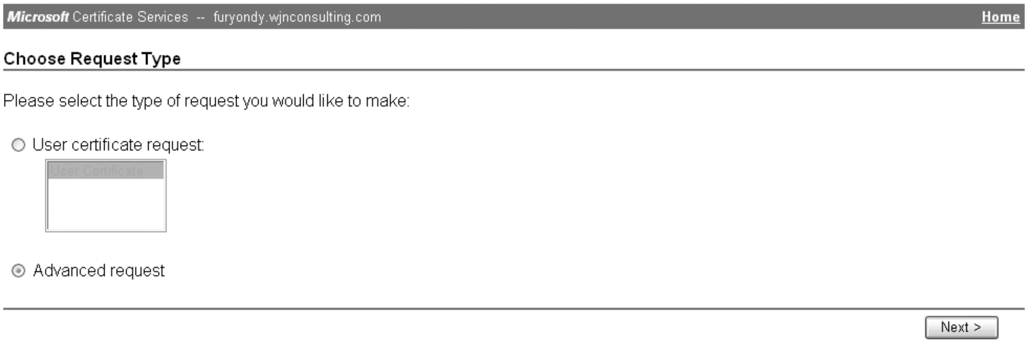
Welcome

You use this web site to request a certificate for your web browser, e-mail client, or other secure program. Once you acquire a certificate, you will be able to securely identify yourself to other people over the web, sign your e-mail messages, encrypt your e-mail messages, and more depending upon the type of certificate you request.

Select a task:

○ Retrieve the CA certificate or certificate revocation list
● Request a certificate
○ Check on a pending certificate

11. At the Choose Request Type screen, select the Advanced Request radio button and click next.



Microsoft Certificate Services -- furyondy.wjnconsulting.com

Choose Request Type

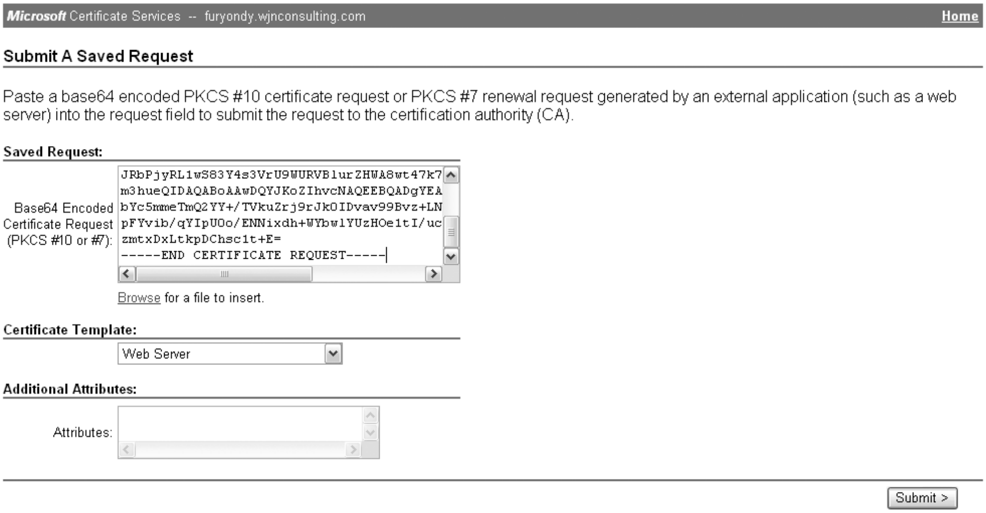
Please select the type of request you would like to make:

○ User certificate request:

● Advanced request

12. At the Advanced Certificate Requests screen, select the option Submit a Certificate Request Using a Base 64 Encoded PKCS #10 File or a Renewal Request Using a Base 64 Encoded PKCS #7 File. Then click Next.

13. At the Submit a Saved Request screen, paste the certificate data into the Saved Request section, select Web Server from the Certificate Template drop-down list, and click Submit, as shown here:



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Home

Submit A Saved Request

Paste a base64 encoded PKCS #10 certificate request or PKCS #7 renewal request generated by an external application (such as a web server) into the request field to submit the request to the certification authority (CA).

Saved Request:

Base64 Encoded Certificate Request (PKCS #10 or #7):

```
JRbPjyRL1wS83Y4s3VrU9WURVBlurZHWA8wt47k7
m3hueQIDAQABoAAwDQYJKoZIhvcNAQEEBQADgYEA
bYc5mmeTmQ2YY+/TVkuZrj9rJkOIDvav99Bvz+LN
pFYvib/qYIpUOo/ENNixdh+WYbwlYUzHOe1tI/uc
zmtxDxLtkpDChsc1t+E=
-----END CERTIFICATE REQUEST-----
```

Certificate Template:

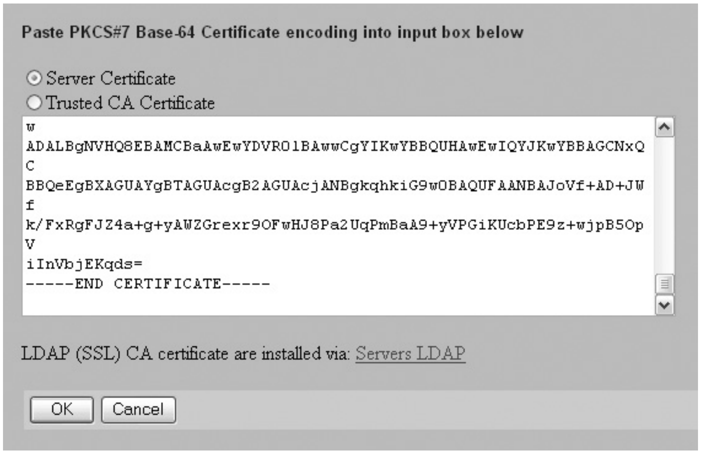
Web Server

Additional Attributes:

Attributes:

14. At the Certificate Issued screen, select Base 64 Encoded and click the Download CA Certificate button. When prompted, save the certificate to an appropriate location. After that, open the file using a text editor such as Microsoft Notepad and copy the contents of the file.

15. Return to the Contivity and, at the System | Certificates | Certificate Configuration screen, click Import Tunnel or Transport Certificate. At the System | Certificates | Import Tunnel or Transport Certificate screen, paste the contents of the certificate request file into the text field, select Server Certificate, and click OK, as shown here:



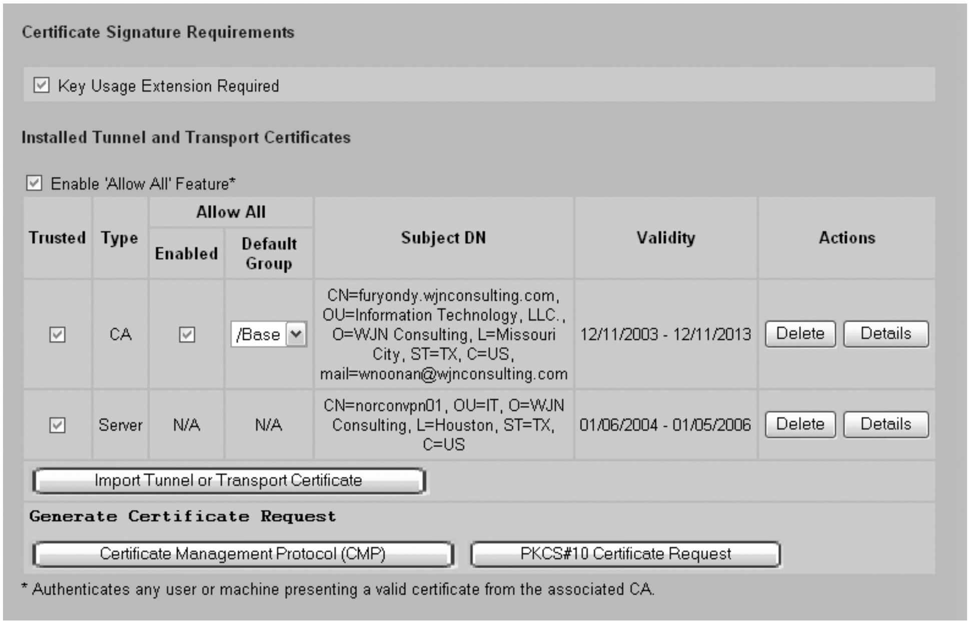
Paste PKCS#7 Base-64 Certificate encoding into input box below

● Server Certificate
○ Trusted CA Certificate

```
w
ADALBgNVHQ8EBAMCBaAwEwYDVR0lBAwwCgYIKwYBBQUHAwEwIQYJKwYBBAGCNxQ
C
BBQeEgBXAGUAYgBTAGUAcgB2AGUAcjANBgkqhkiG9w0BAQUFAANBAJoVf+AD+JW
f
k/FxRgFJZ4a+g+yAWZGrexr9OFwHJ8Pa2UqPmBaA9+yVPGiKUcbPE9z+wjpB5Op
V
iInVbjEKqds=
-----END CERTIFICATE-----
```

LDAP (SSL) CA certificate are installed via: Servers LDAP

At this point, your certificate configuration should appear as follows:



Certificate Signature Requirements

☑ Key Usage Extension Required

Installed Tunnel and Transport Certificates

☑ Enable 'Allow All' Feature*

Trusted	Type	Allow All		Subject DN	Validity	Actions
		Enabled	Default Group			
☑	CA	☑	/Base	CN=furyondy.wjnconsulting.com, OU=Information Technology, LLC., O=WJN Consulting, L=Missouri City, ST=TX, C=US, mail=wnoonan@wjnconsulting.com	12/11/2003 - 12/11/2013	Delete Details
☑	Server	N/A	N/A	CN=norconvpn01, OU=IT, O=WJN Consulting, L=Houston, ST=TX, C=US	01/06/2004 - 01/05/2006	Delete Details

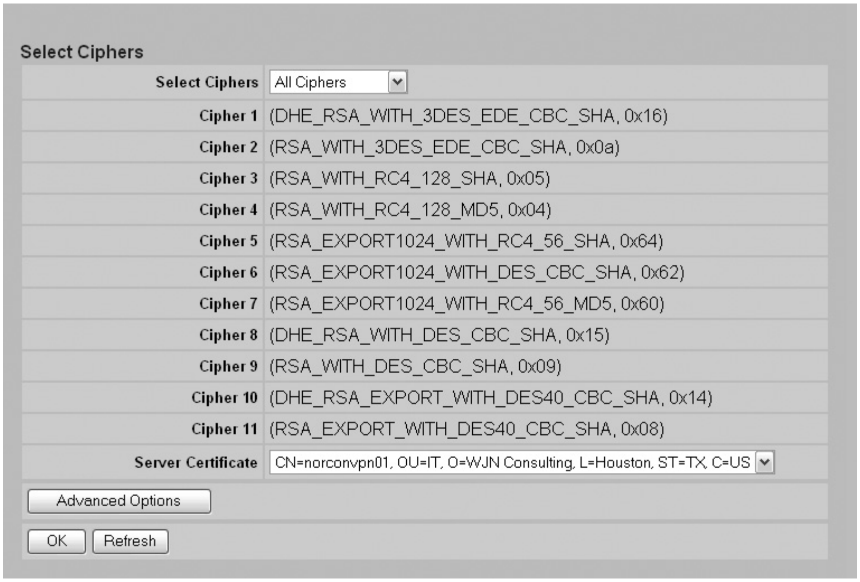
Generate Certificate Request

Certificate Management Protocol (CMP)
PKCS#10 Certificate Request

* Authenticates any user or machine presenting a valid certificate from the associated CA.

Make sure your CA certificate has the Trusted and Enabled boxes checked. Make sure that your server certificate has the Trusted box checked.

16. The final step is to configure SSL/TLS to use the certificate for authentication. This is performed at the Services | SSLTLS | SSL screen, as shown here:

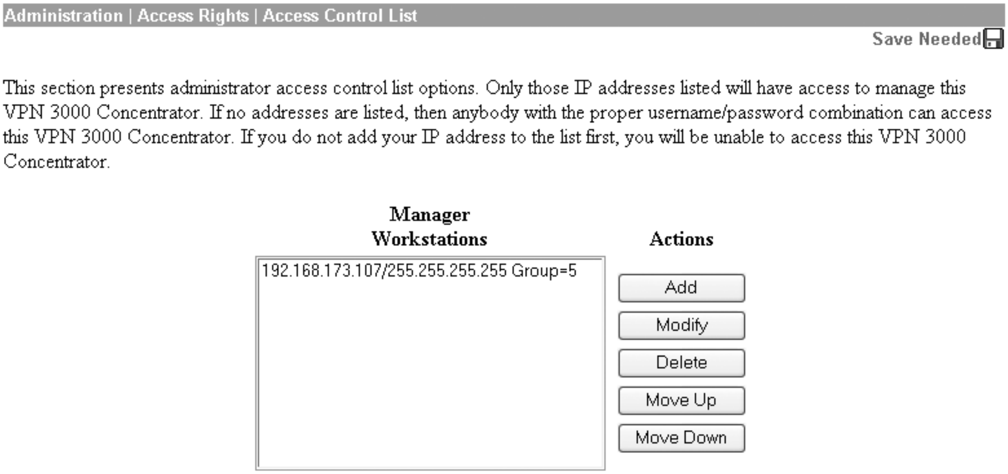


Select Ciphers

Select Ciphers	All Ciphers
Cipher 1	(DHE_RSA_WITH_3DES_EDE_CBC_SHA, 0x16)
Cipher 2	(RSA_WITH_3DES_EDE_CBC_SHA, 0x0a)
Cipher 3	(RSA_WITH_RC4_128_SHA, 0x05)
Cipher 4	(RSA_WITH_RC4_128_MD5, 0x04)
Cipher 5	(RSA_EXPORT1024_WITH_RC4_56_SHA, 0x64)
Cipher 6	(RSA_EXPORT1024_WITH_DES_CBC_SHA, 0x62)
Cipher 7	(RSA_EXPORT1024_WITH_RC4_56_MD5, 0x60)
Cipher 8	(DHE_RSA_WITH_DES_CBC_SHA, 0x15)
Cipher 9	(RSA_WITH_DES_CBC_SHA, 0x09)
Cipher 10	(DHE_RSA_EXPORT_WITH_DES40_CBC_SHA, 0x14)
Cipher 11	(RSA_EXPORT_WITH_DES40_CBC_SHA, 0x08)
Server Certificate	CN=norconvpn01, OU=IT, O=WJN Consulting, L=Houston, ST=TX, C=US

Simply select the server certificate from the drop-down list, enable your ciphers, and click OK. You should be able to connect to the Contivity using HTTPS at this time.

In addition to restricting the management protocols allowed, you should also restrict what systems can connect to and manage the VPN device by permitting only designated management workstations to connect to the VPN device. This can be done on your Cisco VPN 3005 by specifying a manager workstation in the Administration | Access Rights | Access Control List screen of the web GUI, as demonstrated here:



Administration | Access Rights | Access Control List

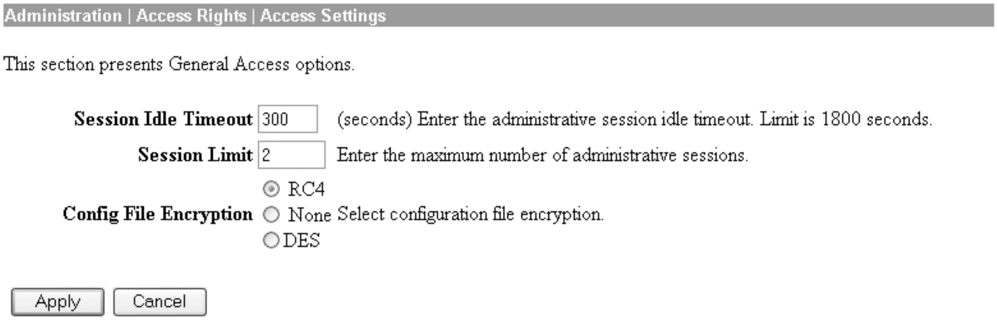
This section presents administrator access control list options. Only those IP addresses listed will have access to manage this VPN 3000 Concentrator. If no addresses are listed, then anybody with the proper username/password combination can access this VPN 3000 Concentrator. If you do not add your IP address to the list first, you will be unable to access this VPN 3000 Concentrator.

Manager Workstations

192.168.173.107/255.255.255.255 Group=5

The Nortel Contivity lacks the ability to restrict management workstations in this manner.

Another aspect of hardening remote administration is to specify a session timeout value as well as the maximum number of sessions allowed. You can configure these on the Cisco VPN 3005 at the Administration | Access Rights | Access Settings screen, as demonstrated here:



Administration | Access Rights | Access Settings

This section presents General Access options.

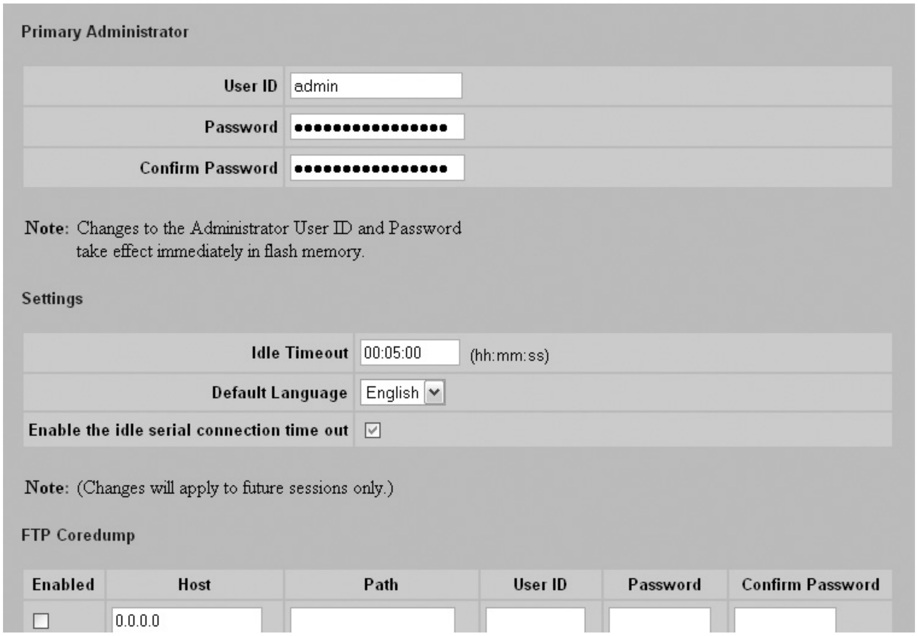
Session Idle Timeout 300 (seconds) Enter the administrative session idle timeout. Limit is 1800 seconds.

Session Limit 2 Enter the maximum number of administrative sessions.

Config File Encryption ● RC4 ○ None ○ DES Select configuration file encryption.

In this case, I have specified a Session Idle Timeout value of 300 seconds (5 minutes). I also specified two administrative sessions so that if, for some reason, an administrative session locks up, I can connect via a different session. I recommend that you allow only two administrative sessions to reduce the likelihood of multiple administrators interfering with each other. Finally, I have specified that the config file should be encrypted for an additional measure of security.

For the Nortel Contivity, you can specify idle timeout configuration at the Admin | Administrator | Administrator screen, as shown here:



Primary Administrator

User ID	admin
Password	●●●●●●●●●●●●●●●●●
Confirm Password	●●●●●●●●●●●●●●●●●

Note: Changes to the Administrator User ID and Password take effect immediately in flash memory.

Settings

Idle Timeout	00:05:00 (hh:mm:ss)
Default Language	English
Enable the idle serial connection time out	☑

Note: (Changes will apply to future sessions only.)

FTP Coredump

Enabled	Host	Path	User ID	Password	Confirm Password
☐	0.0.0.0				

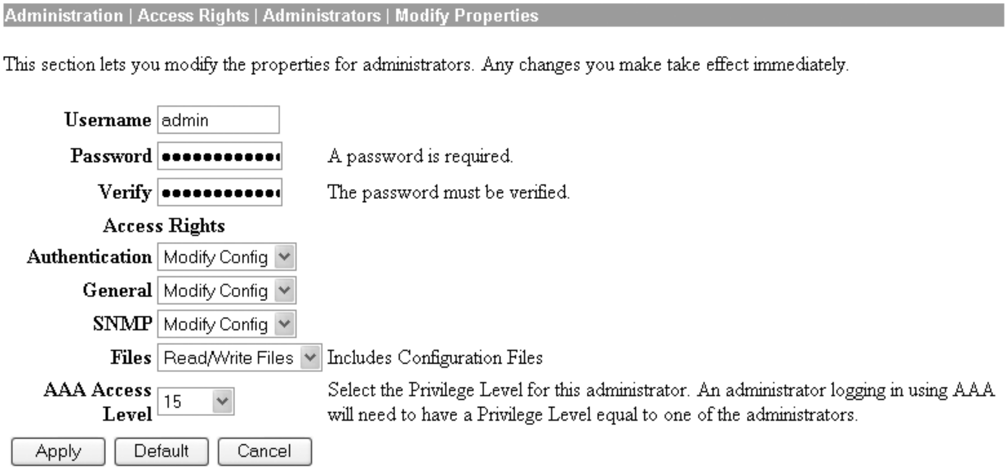
The default is 15 minutes. In this example, I have configured a 5-minute timeout value and applied that timeout to the serial (hard console) connection as well as the remote administrative connections.

Implementing Authentication and Authorization

Another aspect of hardening your VPN devices is to only allow authenticated users to manage each device and to ensure that they are only authorized to run the appropriate commands. Avoid using common usernames and passwords and instead implement individual usernames. For example, Cisco and Nortel both ship with a default username of “admin.” You should change this username for the same reasons you change the administrator account name on Microsoft Windows. If someone is trying to hack your VPN device, they are always going to start by using default usernames. In addition, your passwords should conform to your environment’s password security policy, requiring at a minimum the use of alphanumeric characters, special characters, and upper- and lowercase characters.

For additional scalability and security, you can implement an AAA server to authenticate your users and authorize the commands they can run. We will discuss AAA mechanisms in more detail in Chapter 9.

For a Cisco VPN 3005 concentrator, this is a two-step process that requires you to first specify what the AAA access level is for a user at the Administration | Access Rights | Administrators | Modify Properties screen, as demonstrated here:

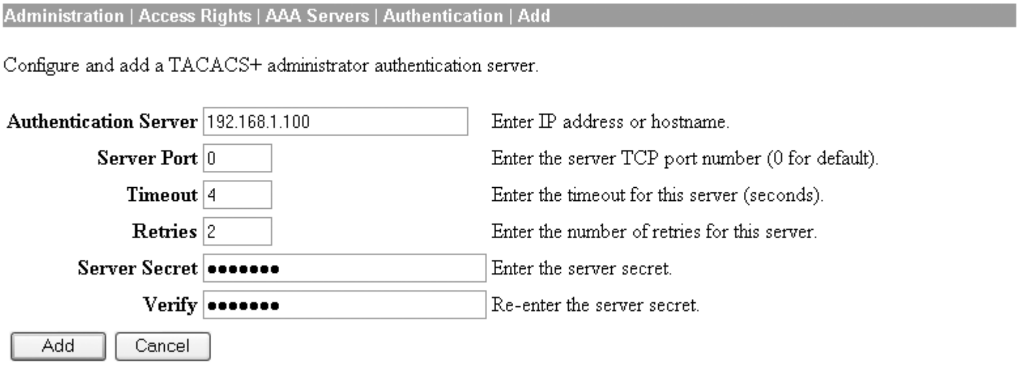


Administration | Access Rights | Administrators | Modify Properties

This section lets you modify the properties for administrators. Any changes you make take effect immediately.

Username	admin	
Password	●●●●●●●●●●●●	A password is required.
Verify	●●●●●●●●●●●●	The password must be verified.
Access Rights		
Authentication	Modify Config	
General	Modify Config	
SNMP	Modify Config	
Files	Read/Write Files	Includes Configuration Files
AAA Access Level	15	Select the Privilege Level for this administrator. An administrator logging in using AAA will need to have a Privilege Level equal to one of the administrators.

In this case, we have granted the user full command authorization by specifying access level 15. The next step is to specify the appropriate TACACS+ server to use for administrative user authentication at the Administration | Access Rights | AAA Servers | Authentication | Add screen, as demonstrated here:

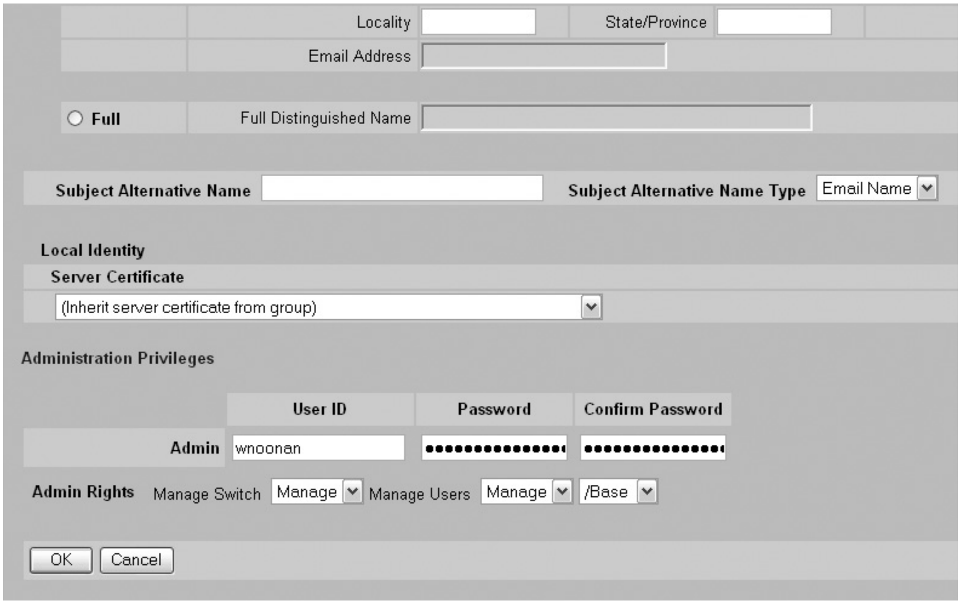


Administration | Access Rights | AAA Servers | Authentication | Add

Configure and add a TACACS+ administrator authentication server.

Authentication Server	192.168.1.100	Enter IP address or hostname.
Server Port	0	Enter the server TCP port number (0 for default).
Timeout	4	Enter the timeout for this server (seconds).
Retries	2	Enter the number of retries for this server.
Server Secret	●●●●●●●	Enter the server secret.
Verify	●●●●●●●	Re-enter the server secret.

The Nortel Contivity does not support using any kind of external authentication for administrative users. Instead, you can define additional administrators as a function of the user properties at the Profiles | Users | User Management --> Edit User screen, as shown here:



Locality:
State/Province:
Email Address:

○ Full — Full Distinguished Name:

Subject Alternative Name:
Subject Alternative Name Type: Email Name

Local Identity
Server Certificate: (Inherit server certificate from group)

Administration Privileges

	User ID	Password	Confirm Password
Admin	wnoonan	●●●●●●●●●●●●●●●	●●●●●●●●●●●●●●●

Admin Rights: Manage Switch: Manage; Manage Users: Manage; /Base

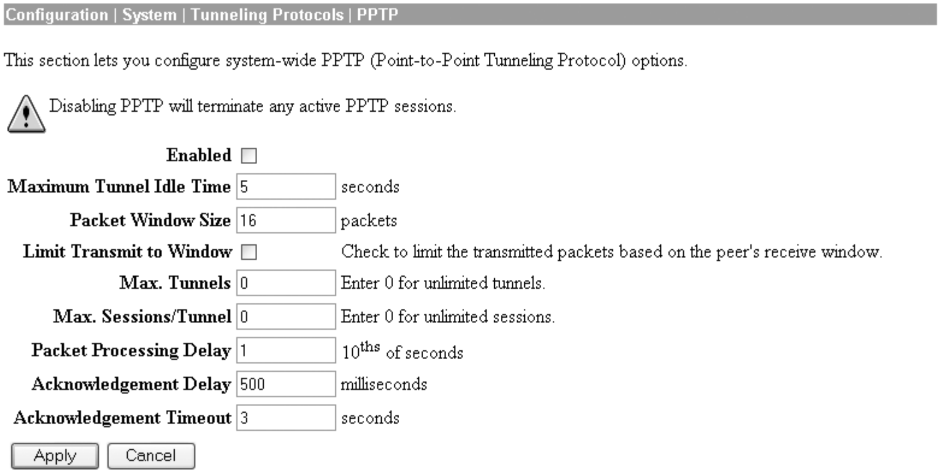
A note of caution when configuring external AAA for your device: Where possible, you should have at least one emergency local account with some impossibly difficult password that only a few select people know in case the AAA server is unavailable (failure, DoS, network problems, and so on). This is to be used only as a last resort, not for day-to-day activities. This will prevent a situation where a network problem is keeping you from getting to the AAA server and being able to get into your own routers to fix the problem because you can't authenticate.

Restricting Services and Protocols

Restricting the services and protocols running on your VPN device is one of the best methods for hardening it, especially if you have a dedicated VPN device. Your VPN device should only run the minimum protocols required for it to be able to accept and terminate VPN connections, especially on the external interfaces.

Removing Unnecessary Tunneling Protocols Many VPN devices are configured to accept all three connection methods—PPTP, L2TP, and IPsec—by default. If you only require IPsec, you should disable the other connection types. To disable PPTP on your Cisco

VPN 3005, you can uncheck Enabled at the Configuration | System | Tunneling Protocols | PPTP screen, as shown here:



Configuration | System | Tunneling Protocols | PPTP

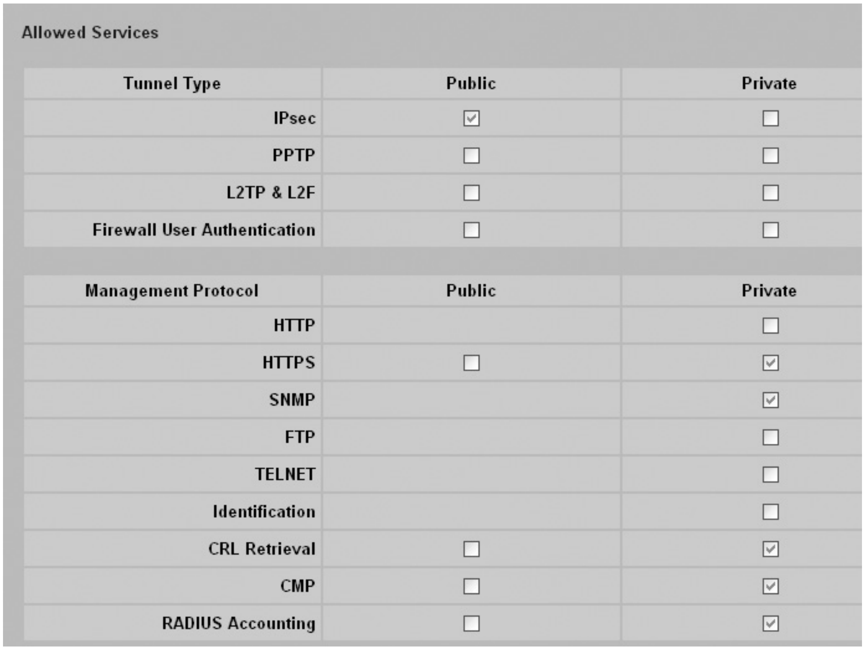
This section lets you configure system-wide PPTP (Point-to-Point Tunneling Protocol) options.

⚠ Disabling PPTP will terminate any active PPTP sessions.

Enabled	□	
Maximum Tunnel Idle Time	5	seconds
Packet Window Size	16	packets
Limit Transmit to Window	□	Check to limit the transmitted packets based on the peer's receive window.
Max. Tunnels	0	Enter 0 for unlimited tunnels.
Max. Sessions/Tunnel	0	Enter 0 for unlimited sessions.
Packet Processing Delay	1	10ths of seconds
Acknowledgement Delay	500	milliseconds
Acknowledgement Timeout	3	seconds

Repeat this step for L2TP if you want to disable it as well.

The Nortel Contivity uses a central screen for enabling and disabling many protocols and services. You can remove a tunneling protocol from being supported on an interface by unchecking the relevant protocol at the Services | Available | Services screen, as shown here:



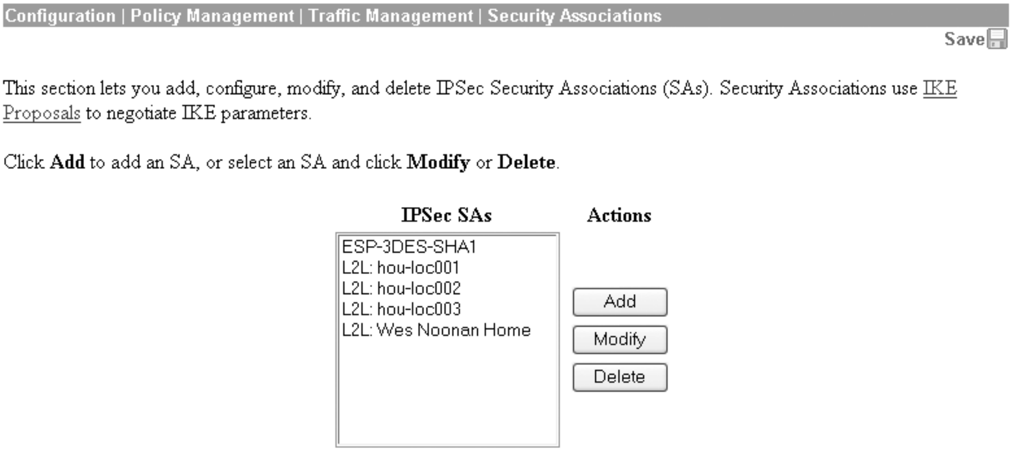
Allowed Services

Tunnel Type	Public	Private
IPsec	☑	□
PPTP	□	□
L2TP & L2F	□	□
Firewall User Authentication	□	□

Management Protocol	Public	Private
HTTP		□
HTTPS	□	☑
SNMP		☑
FTP		□
TELNET		□
Identification		□
CRL Retrieval	□	☑
CMP	□	☑
RADIUS Accounting	□	☑

In this case, I am allowing only IPsec, and only on the external interface.

Removing Unnecessary Security Associations and IKE Proposals In addition to disabling unnecessary tunneling protocols, you should also disable or remove any security associations (SAs) and IKE proposals you are not actively using. This allows you to limit your connections to the more secure connection options, such as using 3DES and SHA-1, as well as to prevent someone from inadvertently connecting using a protocol that you do not want to permit. You can remove unnecessary SAs on your Cisco VPN 3005 at the Configuration | Policy Management | Traffic Management | Security Associations screen, as shown here:



Configuration | Policy Management | Traffic Management | Security Associations

This section lets you add, configure, modify, and delete IPSec Security Associations (SAs). Security Associations use IKE Proposals to negotiate IKE parameters.

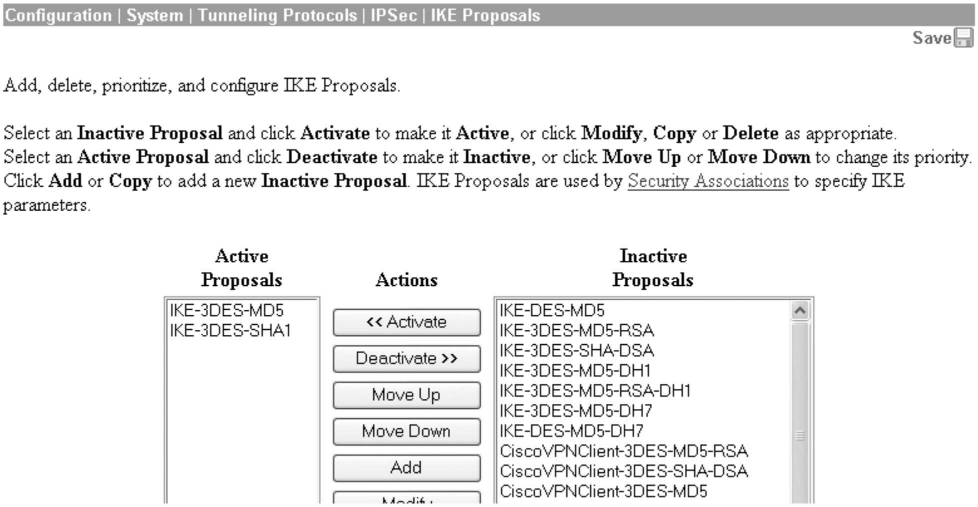
Click **Add** to add an SA, or select an SA and click **Modify** or **Delete**.

IPSec SAs

ESP-3DES-SHA1
L2L: hou-loc001
L2L: hou-loc002
L2L: hou-loc003
L2L: Wes Noonan Home

In this example, I am only allowing the SAs associated with active VPN connections that are in use or will be in use. You can add or remove SAs by clicking the appropriate button.

To remove unnecessary IKE proposals on your Cisco VPN 3005, go to the Configuration | System | Tunneling Protocols | IPSec | IKE Proposals screen and deactivate any unnecessary proposals, as demonstrated next.



Configuration | System | Tunneling Protocols | IPSec | IKE Proposals

Save

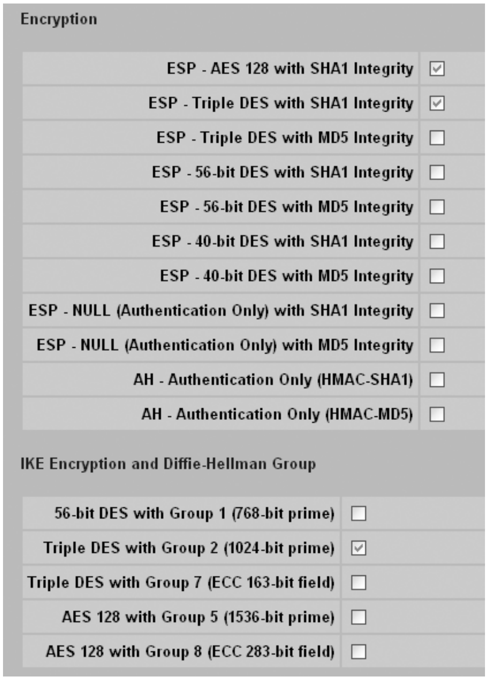
Add, delete, prioritize, and configure IKE Proposals.

Select an **Inactive Proposal** and click **Activate** to make it **Active**, or click **Modify**, **Copy** or **Delete** as appropriate.
Select an **Active Proposal** and click **Deactivate** to make it **Inactive**, or click **Move Up** or **Move Down** to change its priority.
Click **Add** or **Copy** to add a new **Inactive Proposal**. IKE Proposals are used by Security Associations to specify IKE parameters.

Active Proposals	Actions	Inactive Proposals
IKE-3DES-MD5 IKE-3DES-SHA1	<< Activate Deactivate >> Move Up Move Down Add	IKE-DES-MD5 IKE-3DES-MD5-RSA IKE-3DES-SHA-DSA IKE-3DES-MD5-DH1 IKE-3DES-MD5-RSA-DH1 IKE-3DES-MD5-DH7 IKE-DES-MD5-DH7 CiscoVPNClient-3DES-MD5-RSA CiscoVPNClient-3DES-SHA-DSA CiscoVPNClient-3DES-MD5

In this example, I am only allowing two IKE proposals that support MD5 for legacy interoperability purposes only because MD5 is not as secure as SHA-1.

The Nortel Contivity refers to security associations as *encryption* and IKE proposals as *IKE encryption and Diffie-Hellman group*. Both can be configured at the Services | IPSec | IPSec Settings screen shown next. Simply uncheck the values you do not want to use. In this case, I am only allowing AES 128 and 3DES with SHA-1 for my encryption protocol and 3DES with Diffie-Hellman group 2 for my IKE proposal.



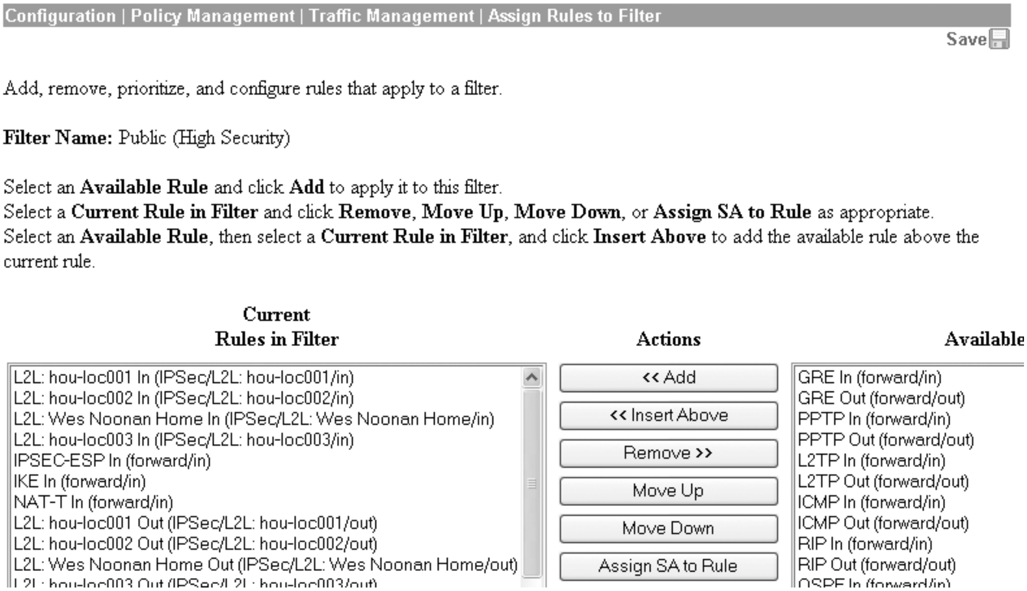
Encryption

ESP - AES 128 with SHA1 Integrity	☑
ESP - Triple DES with SHA1 Integrity	☑
ESP - Triple DES with MD5 Integrity	□
ESP - 56-bit DES with SHA1 Integrity	□
ESP - 56-bit DES with MD5 Integrity	□
ESP - 40-bit DES with SHA1 Integrity	□
ESP - 40-bit DES with MD5 Integrity	□
ESP - NULL (Authentication Only) with SHA1 Integrity	□
ESP - NULL (Authentication Only) with MD5 Integrity	□
AH - Authentication Only (HMAC-SHA1)	□
AH - Authentication Only (HMAC-MD5)	□

IKE Encryption and Diffie-Hellman Group

56-bit DES with Group 1 (768-bit prime)	□
Triple DES with Group 2 (1024-bit prime)	☑
Triple DES with Group 7 (ECC 163-bit field)	□
AES 128 with Group 5 (1536-bit prime)	□
AES 128 with Group 8 (ECC 283-bit field)	□

Assigning Filtering Rules to Interfaces Among the most important hardening steps you can perform with your VPN devices is to filter the traffic that is permitted on any given interface. Your VPN devices exist for one purpose—to accept and terminate VPN tunnels using only the protocols you have defined. As a result, you should permit only the traffic directly related to tunnel establishment and termination and deny every other protocol and port number. Many VPN devices ship with HTTP, ICMP, and every VPN tunnel protocol enabled by default on the external interface. This is a security oversight on the part of the vendors. It is what I like to call "lowest common denominator" development. The vendors have no idea what protocols you require, so they permit anywhere from a few protocols to all protocols to make it easy to connect. You should review what protocols your vendor has enabled by default and filter out all unnecessary protocols. You can do this for your Cisco VPN 3005 at the Configuration | Policy Management | Traffic Management | Assign Rules to Filter screen, as demonstrated next.



Configuration | Policy Management | Traffic Management | Assign Rules to Filter

Add, remove, prioritize, and configure rules that apply to a filter.

Filter Name: Public (High Security)

Select an **Available Rule** and click **Add** to apply it to this filter.
Select a **Current Rule in Filter** and click **Remove**, **Move Up**, **Move Down**, or **Assign SA to Rule** as appropriate.
Select an **Available Rule**, then select a **Current Rule in Filter**, and click **Insert Above** to add the available rule above the current rule.

Current Rules in Filter

L2L: hou-loc001 In (IPSec/L2L: hou-loc001/in)
L2L: hou-loc002 In (IPSec/L2L: hou-loc002/in)
L2L: Wes Noonan Home In (IPSec/L2L: Wes Noonan Home/in)
L2L: hou-loc003 In (IPSec/L2L: hou-loc003/in)
IPSEC-ESP In (forward/in)
IKE In (forward/in)
NAT-T In (forward/in)
L2L: hou-loc001 Out (IPSec/L2L: hou-loc001/out)
L2L: hou-loc002 Out (IPSec/L2L: hou-loc002/out)
L2L: Wes Noonan Home Out (IPSec/L2L: Wes Noonan Home/out)
L2L: hou-loc003 Out (IPSec/L2L: hou-loc003/out)

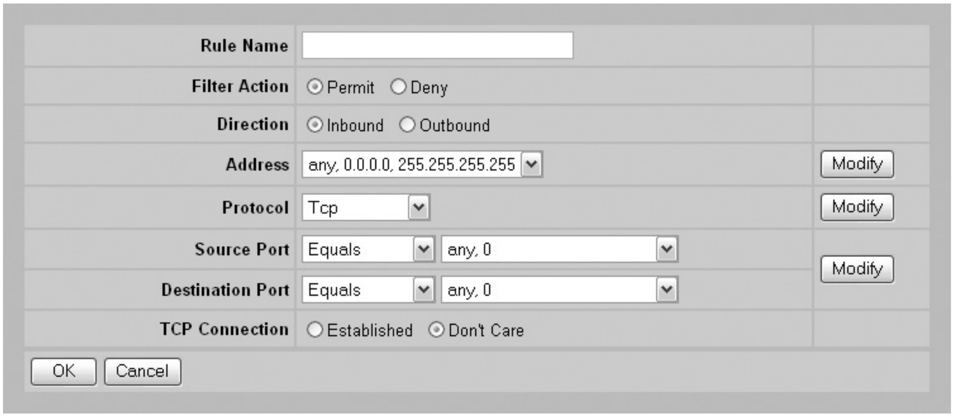
Available

GRE In (forward/in)
GRE Out (forward/out)
PPTP In (forward/in)
PPTP Out (forward/out)
L2TP In (forward/in)
L2TP Out (forward/out)
ICMP In (forward/in)
ICMP Out (forward/out)
RIP In (forward/in)
RIP Out (forward/out)
OSPF In (forward/in)

In this example, I am permitting only the traffic from my remote LAN-to-LAN VPN sites as well as IPsec, IKE, and NAT-T (to support IPsec NAT traversal) to support my remote access VPN connections. If any other protocol is used to connect to the external interface, it will be dropped by the VPN device. You can add or remove the permitted protocols by selecting each protocol and using the appropriate button.

The Nortel Contivity uses a slightly different filtering methodology than the Cisco VPN 3005. The Cisco VPN 3005 filters based on protocol rules for all protocols. The Nortel Contivity, however, only supports basic port filtering rules using TCP, UDP, ICMP, and IP by default.

The Nortel Contivity also supports two types of filters: a tunnel filter and an interface filter. You can configure your filters in either location, as you deem appropriate, and can copy a filter between the two filtering types with the click of a button. You can configure additional ports and protocols to be supported for filtering at the Profiles | Filters | Interface Filters --> Rules --> Create screen by selecting to modify the protocol or port, as shown here:



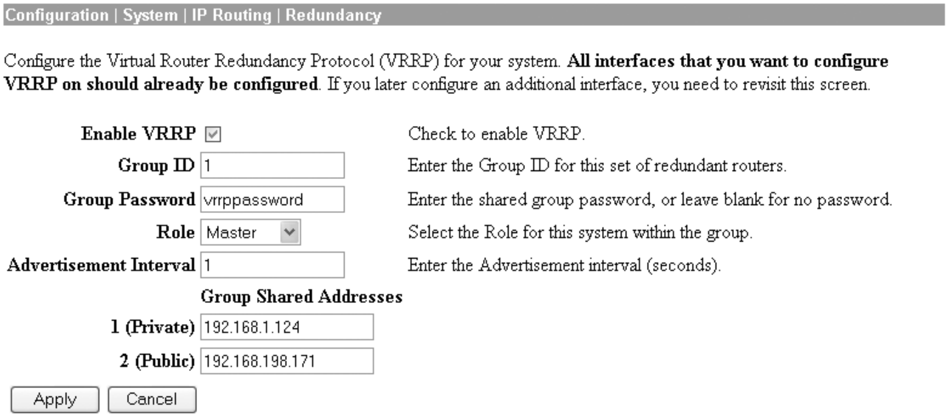
Rule Name		
Filter Action	● Permit ○ Deny	
Direction	● Inbound ○ Outbound	
Address	any, 0.0.0.0, 255.255.255.255	Modify
Protocol	Tcp	Modify
Source Port	Equals any, 0	Modify
Destination Port	Equals any, 0	
TCP Connection	○ Established ● Don't Care	

By default, the Nortel Contivity will accept all protocols. Because of the way the Nortel Contivity is designed, you would need to add individual “permit” and “deny” rules for all protocols other than TCP, UDP, ICMP, and IP that you want to control. For example, if you only wanted to allow ESP (protocol 50) and IKE (UDP port 500), you would need to create a permit rule allowing ESP and IKE, then a deny protocol rule for all the other (254) protocols, with the exception of TCP, UDP, ICMP, and IP, which are created by default. It is impractical to demonstrate the adding of all the protocols that would need to be denied, but a high-security filter that allows only ESP and IKE might be configured to only permit ESP and IKE and deny every other protocol that you added, including the default protocols of IP, TCP, UDP, and ICMP.

Providing Redundancy and Fault Tolerance

As with many devices, you can harden your VPN devices against failure by implementing a redundant and fault-tolerant configuration. The benefit of this type of implementation is the ability to continue to accept incoming VPN tunnels in the event of a device failure. This is done by implementing multiple VPN devices in a pool on your network, as shown in Figure 5-3.

Cisco utilizes Virtual Router Redundancy Protocol (VRRP) to provide VPN redundancy. VRRP can be configured at the Configuration | System | IP Routing | Redundancy screen of your VPN device, as shown here:



Configuration | System | IP Routing | Redundancy

Configure the Virtual Router Redundancy Protocol (VRRP) for your system. **All interfaces that you want to configure VRRP on should already be configured**. If you later configure an additional interface, you need to revisit this screen.

Enable VRRP	☑	Check to enable VRRP.
Group ID	1	Enter the Group ID for this set of redundant routers.
Group Password	vrrppassword	Enter the shared group password, or leave blank for no password.
Role	Master	Select the Role for this system within the group.
Advertisement Interval	1	Enter the Advertisement interval (seconds).
	Group Shared Addresses	
1 (Private)	192.168.1.124	
2 (Public)	192.168.198.171	

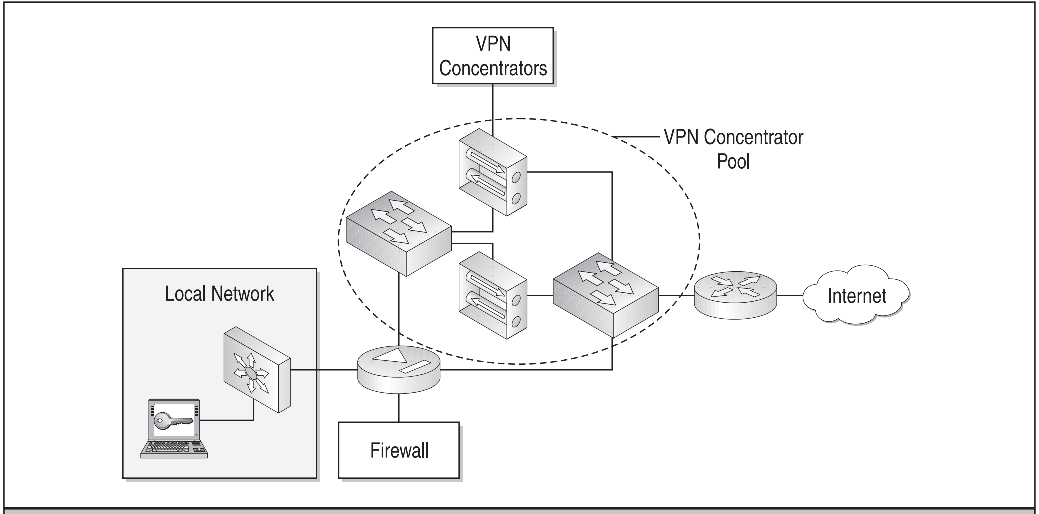
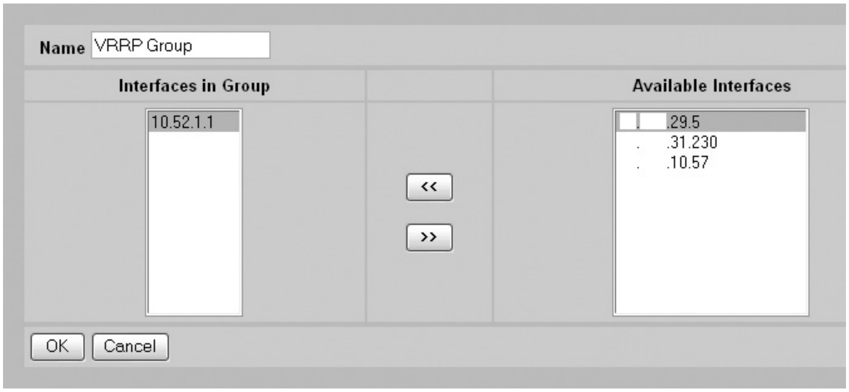


Figure 5-3. Simple VPN redundancy

In this case, I have defined this system as the master role in the VRRP group. I would configure the remaining systems as backup roles, ensuring that the rest of the settings are the same on all systems. Although the password is displayed in clear text in the management console—which is not a very secure implementation on Cisco's part—you should use a password to ensure that only VPN devices that share a common password will join the VRRP pool.

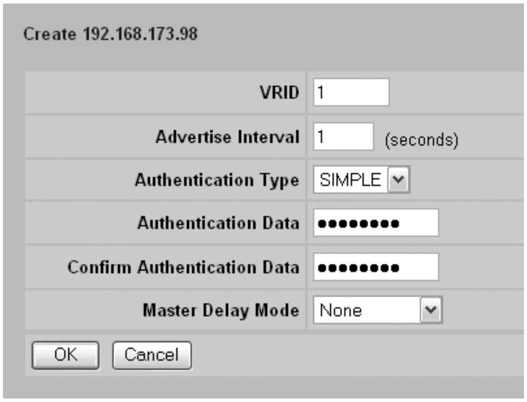
The Nortel Contivity also supports VRRP for redundancy. The first step is to create an interface group at the Routing | Interface GRP | Interface Group --> Add, screen as shown here:



Name VRRP Group

Interfaces in Group	Available Interfaces
10.52.1.1	.29.5 .31.230 .10.57

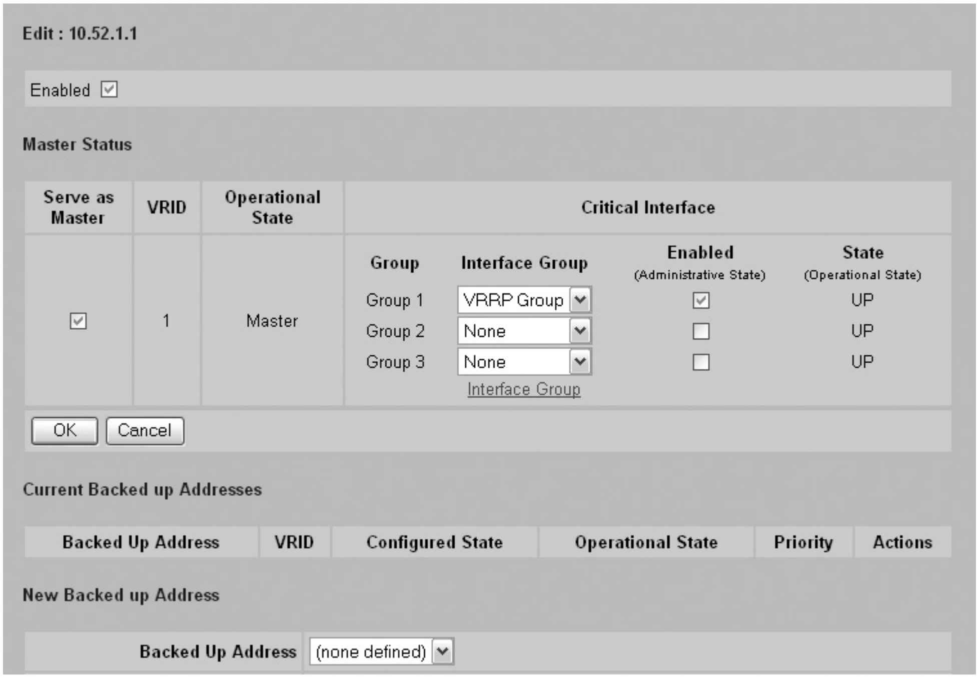
The next step is to enable and configure VRRP at the Routing | VRRP | VRRP screen by checking to enable VRRP and adding the relevant address. When you click Create for the IP address, you will be taken to the Routing | VRRP | VRRP --> Create VRRP IP Address screen, as shown next. Select the appropriate VRID, select to use simple authentication, and enter the authentication data. Notice how Nortel, unlike Cisco, masks this data onscreen.



Create 192.168.173.98

VRID	1
Advertise Interval	1 (seconds)
Authentication Type	SIMPLE
Authentication Data	●●●●●●●●●
Confirm Authentication Data	●●●●●●●●●
Master Delay Mode	None

The final step is configure VRRP on the interface by going to the Routing | Interfaces | Routing Interfaces screen and clicking Configure. This will take you to the Routing | Interfaces | Routing Interfaces --> Configure VRRP screen, as shown next. Configure your system to enable VRRP, and with the appropriate master status. If this is the master device, make sure you have selected the appropriate group, selected to serve as the master, and enabled the administrative state.



Edit : 10.52.1.1

Enabled ☑

Master Status

Serve as Master	VRID	Operational State	Critical Interface			
			Group	Interface Group	Enabled (Administrative State)	State (Operational State)
☑	1	Master	Group 1	VRRP Group	☑	UP
			Group 2	None	☐	UP
			Group 3	None	☐	UP

Current Backed up Addresses

Backed Up Address	VRID	Configured State	Operational State	Priority	Actions

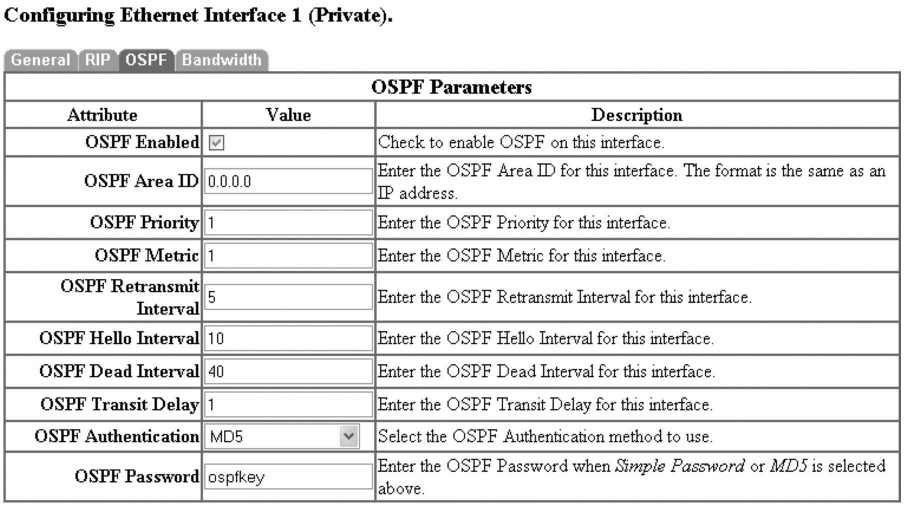
New Backed up Address

Backed Up Address (none defined)

Hardening Routing Protocols

Like your routers, it may be necessary for your VPN device to be able to route data. As we previously discussed with firewalls, static routing is the most secure method to provide routing information due to the fact that the device is not susceptible to invalid route statements. If you do require the use of a routing protocol, however, you should only use routing protocols that support authentication, such as RIP version 2, OSPF, and BGP, to ensure that they only accept route updates from authorized partners. The Cisco VPN 3005 only supports OSPF as an authenticated routing protocol; therefore, I recommend that you only use OSPF. You can configure OSPF for the interface at the

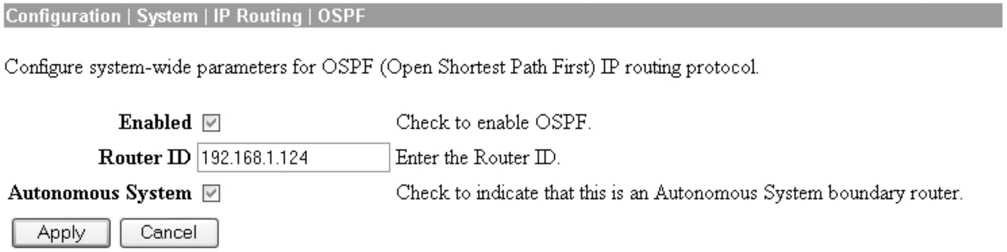
Configuration | Interfaces | Interface screen (in this case, the Ethernet 1 interface), as demonstrated here:



Configuring Ethernet Interface 1 (Private).

OSPF Parameters		
Attribute	**Value**	**Description**
OSPF Enabled	☑	Check to enable OSPF on this interface.
OSPF Area ID	0.0.0.0	Enter the OSPF Area ID for this interface. The format is the same as an IP address.
OSPF Priority	1	Enter the OSPF Priority for this interface.
OSPF Metric	1	Enter the OSPF Metric for this interface.
OSPF Retransmit Interval	5	Enter the OSPF Retransmit Interval for this interface.
OSPF Hello Interval	10	Enter the OSPF Hello Interval for this interface.
OSPF Dead Interval	40	Enter the OSPF Dead Interval for this interface.
OSPF Transit Delay	1	Enter the OSPF Transit Delay for this interface.
OSPF Authentication	MD5	Select the OSPF Authentication method to use.
OSPF Password	ospfkey	Enter the OSPF Password when *Simple Password* or *MD5* is selected above.

In this case, I have selected to use an MD5 hash with the key value "ospfkey" to authenticate with my other OSPF-enabled devices. The next step is to enable OSPF at the Configuration | System | IP Routing | OSPF screen, as demonstrated here:



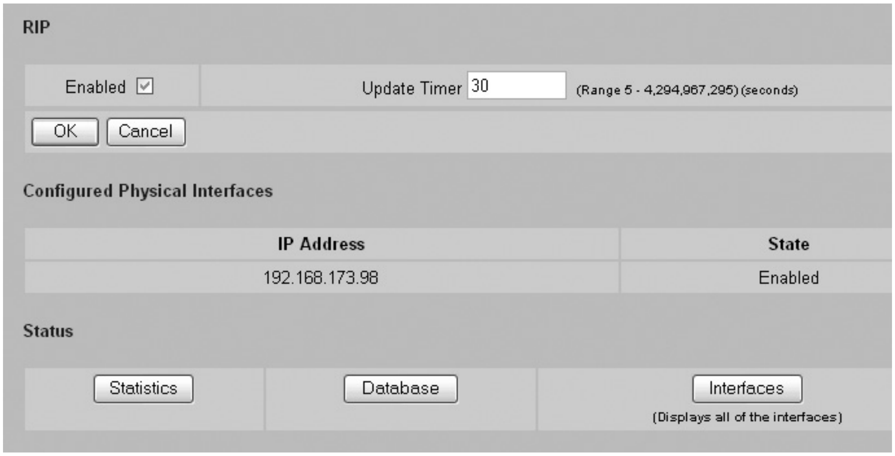
Configuration | System | IP Routing | OSPF

Configure system-wide parameters for OSPF (Open Shortest Path First) IP routing protocol.

Enabled	☑	Check to enable OSPF.
Router ID	192.168.1.124	Enter the Router ID.
Autonomous System	☑	Check to indicate that this is an Autonomous System boundary router.

In this case, I have configured the VPN device as an autonomous system boundary router so that it will update the OSPF routing tables with the remote LAN-to-LAN subnets. Note that Cisco displays the password in clear text in the console, so you should ensure that no one is looking over your shoulder while you configure this.

The Nortel Contivity supports RIP and OSPF as routing protocols. Configuring RIP is a two-step process. First, you need to enable RIP. This can be done at the Routing | RIP | RIP screen, as shown next.



RIP

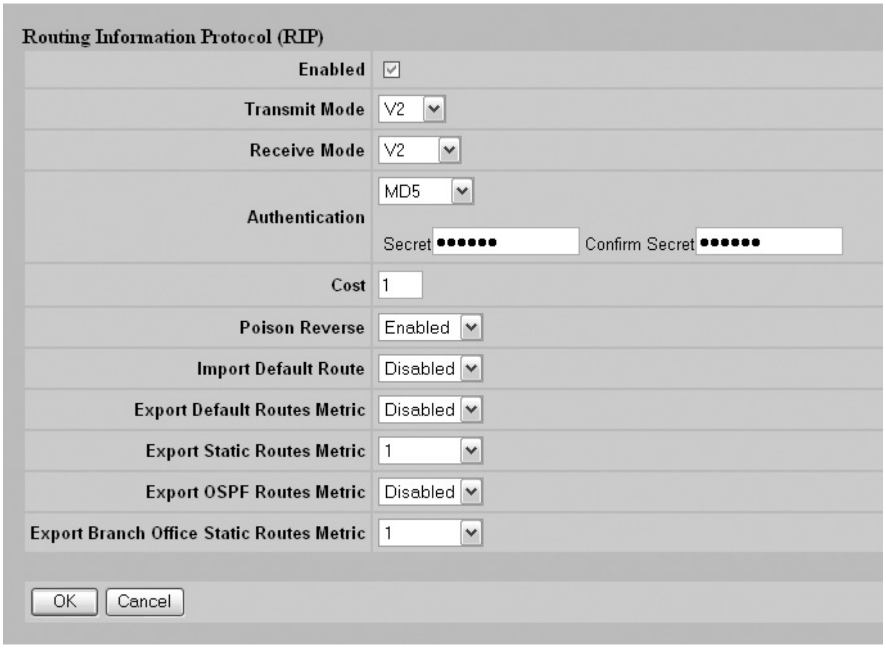
Enabled ☑ Update Timer 30 (Range 5 - 4,294,967,295) (seconds)

Configured Physical Interfaces

IP Address	State
192.168.173.98	Enabled

Status

The next step is to configure RIP on the interface at the Routing | Interfaces | Routing Interfaces screen. Click Configure and you will be taken to the Configure RIP screen. You should make sure that you only use RIP version 2 and that you select to use MD5 authentication and specify the appropriate secret, as shown here:

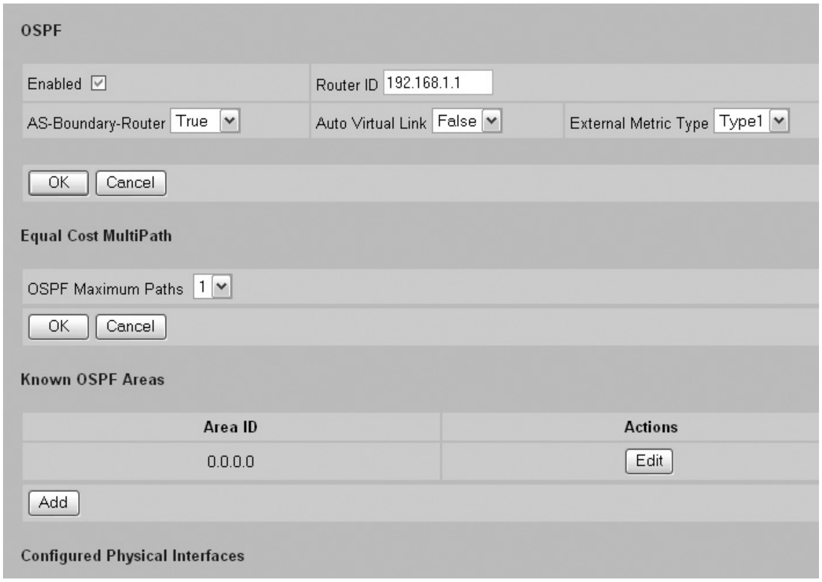


Routing Information Protocol (RIP)

Enabled	☑
Transmit Mode	V2
Receive Mode	V2
Authentication	MD5 Secret •••••• Confirm Secret ••••••
Cost	1
Poison Reverse	Enabled
Import Default Route	Disabled
Export Default Routes Metric	Disabled
Export Static Routes Metric	1
Export OSPF Routes Metric	Disabled
Export Branch Office Static Routes Metric	1

Configuring OSPF on your Nortel Contivity is very similar to configuring RIP. First you want to enable OSPF at the Routing | OSPF | OSPF screen, as shown next.

Make sure that you add the necessary OSPF areas, configure the appropriate router ID, and set the AS-Boundary-Router value as appropriate for your environment.



OSPF

Enabled ☑ | Router ID 192.168.1.1

AS-Boundary-Router True | Auto Virtual Link False | External Metric Type Type1

Equal Cost MultiPath

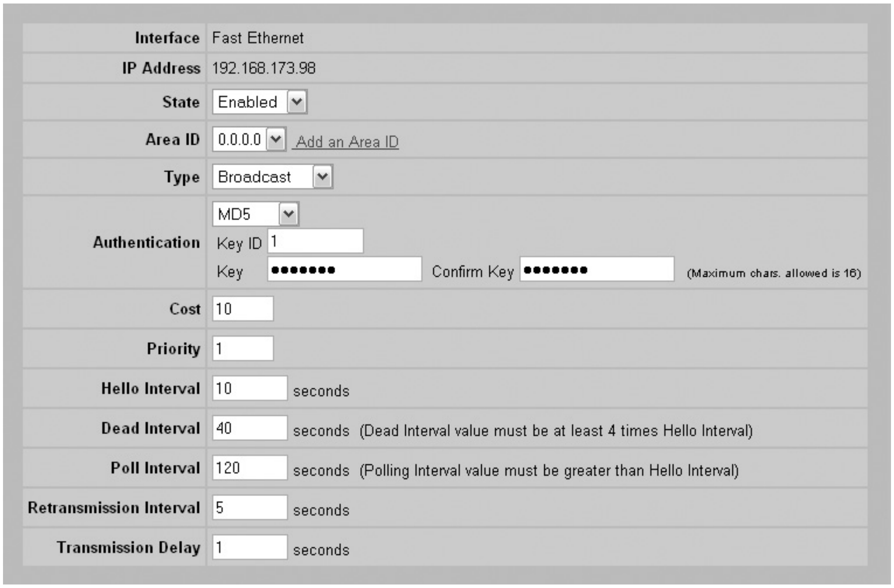
OSPF Maximum Paths 1

Known OSPF Areas

Area ID	Actions
0.0.0.0	Edit

Configured Physical Interfaces

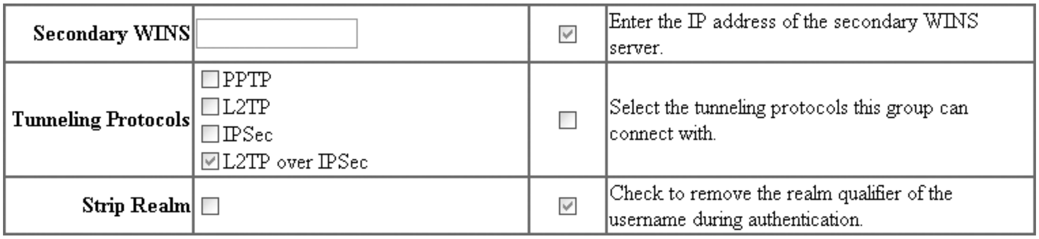
The next step is to configure OSPF on the interface at the Routing | Interface | Routing Interfaces screen. Click Configure and you will be taken to the Configure OSPF screen. Configure OSPF, as shown next, making sure that you select MD5 authentication and enter the appropriate key ID and key value as well as any other configuration requirements for your environment.



Interface	Fast Ethernet
IP Address	192.168.173.98
State	Enabled
Area ID	0.0.0.0 Add an Area ID
Type	Broadcast
Authentication	MD5 Key ID 1 Key ••••••• Confirm Key ••••••• (Maximum chars. allowed is 16)
Cost	10
Priority	1
Hello Interval	10 seconds
Dead Interval	40 seconds (Dead Interval value must be at least 4 times Hello Interval)
Poll Interval	120 seconds (Polling Interval value must be greater than Hello Interval)
Retransmission Interval	5 seconds
Transmission Delay	1 seconds

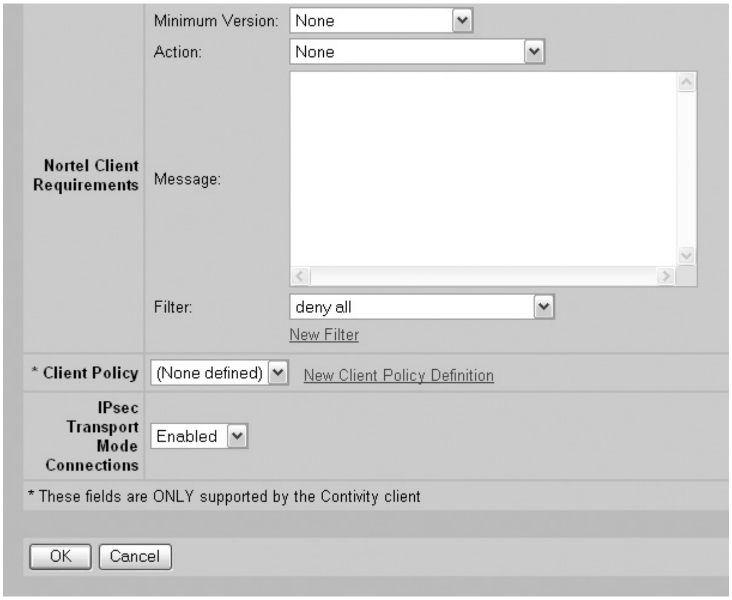
Hardening IPsec-Based VPNs

As previously mentioned, you should not implement PPTP-based VPNs because they are not as secure as the alternatives. If you need to support multiple protocols across your VPN, you should use L2TP. Although L2TP is more secure than PPTP, it is less secure than an IPsec-based VPN can be configured, as shown previously. The nice thing about this, however, is that L2TP supports IPsec ESP encapsulation, thereby providing all the functionality of L2TP with all the encryption and security of IPsec. L2TP is encapsulated with an IPsec ESP session/tunnel. You can enable this on your Cisco VPN 3005 concentrator at the Configuration | User Management | Groups | Modify <Group or Username> screen on the General tab in the "Tunneling Protocols" section, as shown next:



Secondary WINS		☑	Enter the IP address of the secondary WINS server.
Tunneling Protocols	□ PPTP □ L2TP □ IPSec ☑ L2TP over IPSec	□	Select the tunneling protocols this group can connect with.
Strip Realm	□	☑	Check to remove the realm qualifier of the username during authentication.

On your Nortel Contivity, you can enable L2TP over IPsec as a part of your group configuration settings. The first step is to configure IPsec to provide transport mode connections. This is enabled by default, but it can be configured at the Profiles | Groups | Groups --> Edit --> IPSec screen, as shown here:



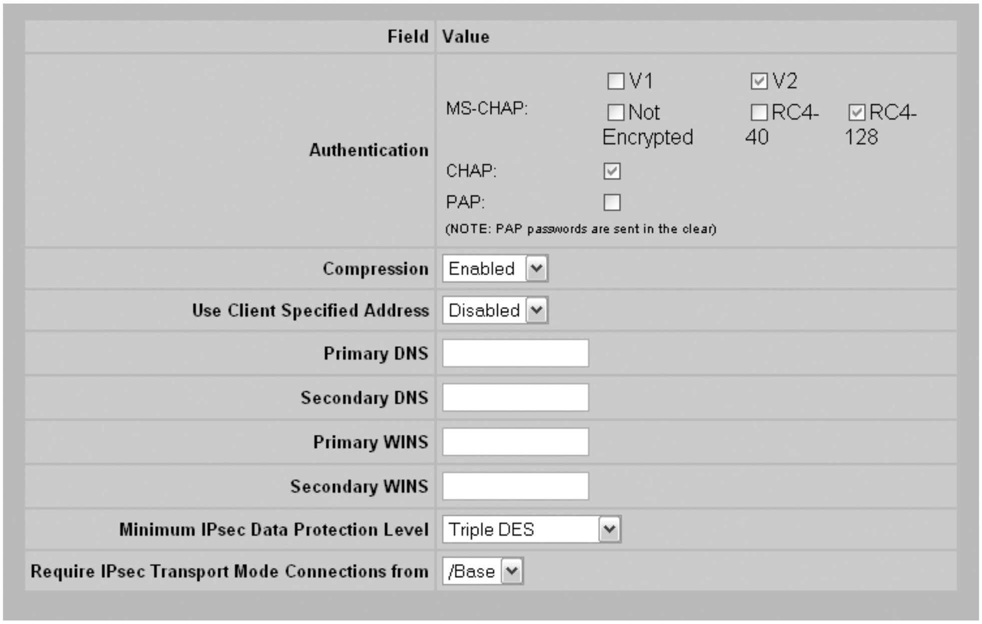
Nortel Client Requirements
Minimum Version: None
Action: None
Message:
Filter: deny all
New Filter

*** Client Policy** (None defined) New Client Policy Definition

IPsec Transport Mode Connections Enabled

* These fields are ONLY supported by the Contivity client

The next step is to configure your L2TP settings to use IPsec. This can be done at the user or group configuration screen. The benefit of configuring these settings at the group level is the ability to effectively modify the functionality of multiple users. This can be done at the Profiles | Groups | Groups --> Edit --> L2TP screen, as shown next. Select the appropriate IPsec data protection level (I recommend Triple DES due to the increased security) and make sure that the appropriate group is selected for the Require IPsec Transport Mode Connections From data field.



Field	Value
Authentication	MS-CHAP: □ V1 ☑ V2 □ Not Encrypted □ RC4-40 ☑ RC4-128 CHAP: ☑ PAP: □ (NOTE: PAP passwords are sent in the clear)
Compression	Enabled
Use Client Specified Address	Disabled
Primary DNS	
Secondary DNS	
Primary WINS	
Secondary WINS	
Minimum IPsec Data Protection Level	Triple DES
Require IPsec Transport Mode Connections from	/Base

Because L2TP supports being tunneled within IPsec, we will now focus on hardening IPsec-based VPNs to protect your environment.

Traffic Security Protocols

IPsec uses two traffic security protocols to provide data security: Authentication Header (AH) and Encapsulating Security Payload (ESP). AH is defined in RFCs 1826 and 2402 and provides authentication, integrity, and anti-replaying functionality. Figure 5-4 shows the format of an AH-formatted packet. Notice that AH simply splits the original IP header and transport header and inserts the AH information between them. A major drawback of AH, however, is that it does not encrypt the data contents and therefore provides no data confidentiality. AH also does not support functioning in a NAT environment because when NAT changes the IP header, it invalidates the AH signature checksum. You should not use AH because it does not encrypt the original data.

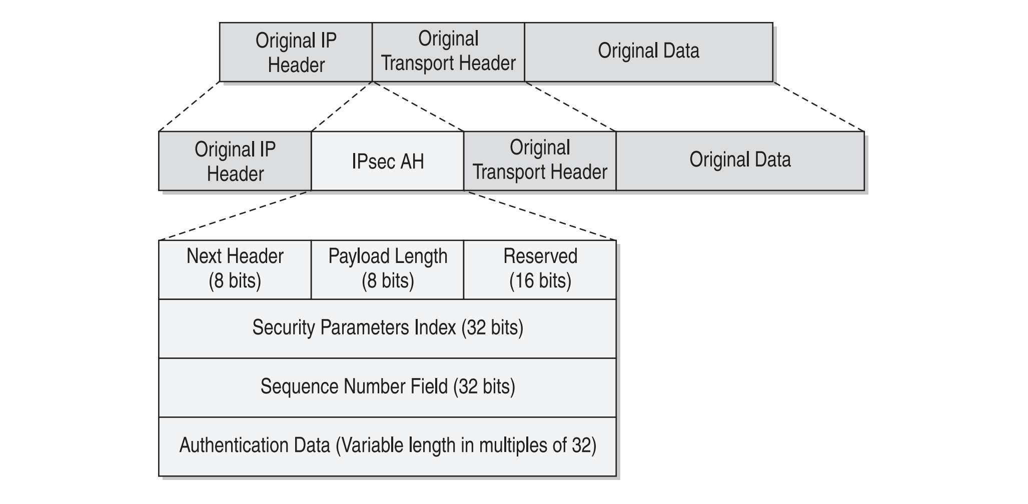

Original IP Header
Original Transport Header
Original Data
Original IP Header
IPsec AH
Original Transport Header
Original Data
Next Header (8 bits)
Payload Length (8 bits)
Reserved (16 bits)
Security Parameters Index (32 bits)
Sequence Number Field (32 bits)
Authentication Data (Variable length in multiples of 32)

Figure 5-4. IPsec AH-formatted packet

ESP, on the other hand, provides for authentication, integrity, and anti-replaying functionality as well as for data confidentiality by encrypting the original packet's data contents. As you can see in Figure 5-5, ESP actually encapsulates the original transport header and data between an ESP header and trailer. This causes the original data to be encrypted as an encapsulated payload within the ESP header and trailer. ESP also functions within a NAT environment through the use of NAT Transparency (sometimes referred to as *NAT Traversal)*.

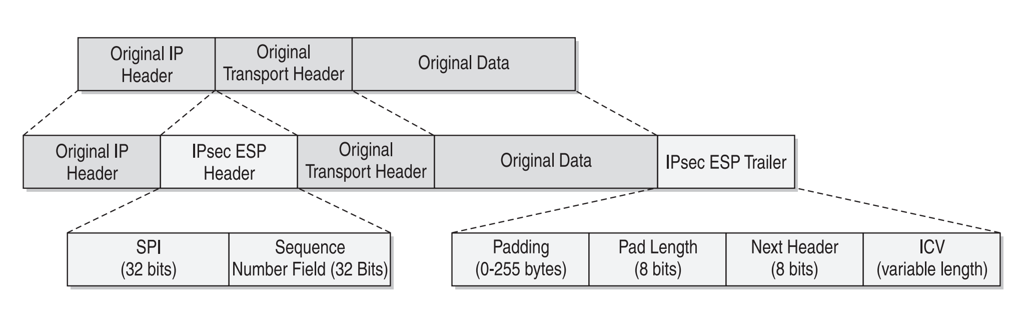
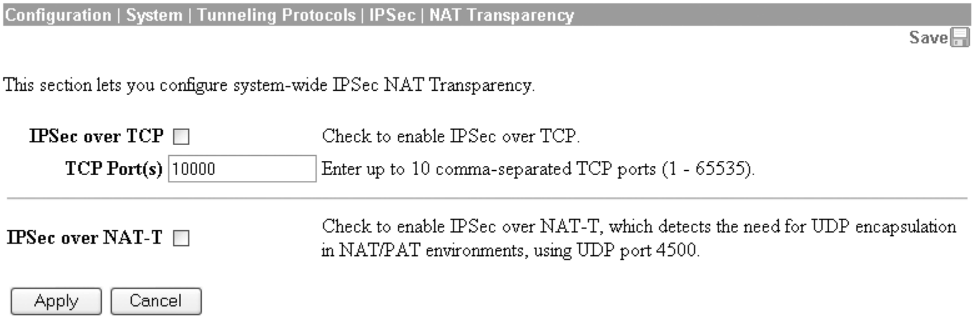


Figure 5-5. IPsec ESP-formatted packet

You can enable NAT Traversal functionality on your Cisco VPN 3005 at the Configuration | System | Tunneling Protocols | IPSec | NAT Transparency screen, as shown here:



Configuration | System | Tunneling Protocols | IPSec | NAT Transparency

This section lets you configure system-wide IPSec NAT Transparency.

IPSec over TCP □ Check to enable IPSec over TCP.

TCP Port(s) 10000 Enter up to 10 comma-separated TCP ports (1 - 65535).

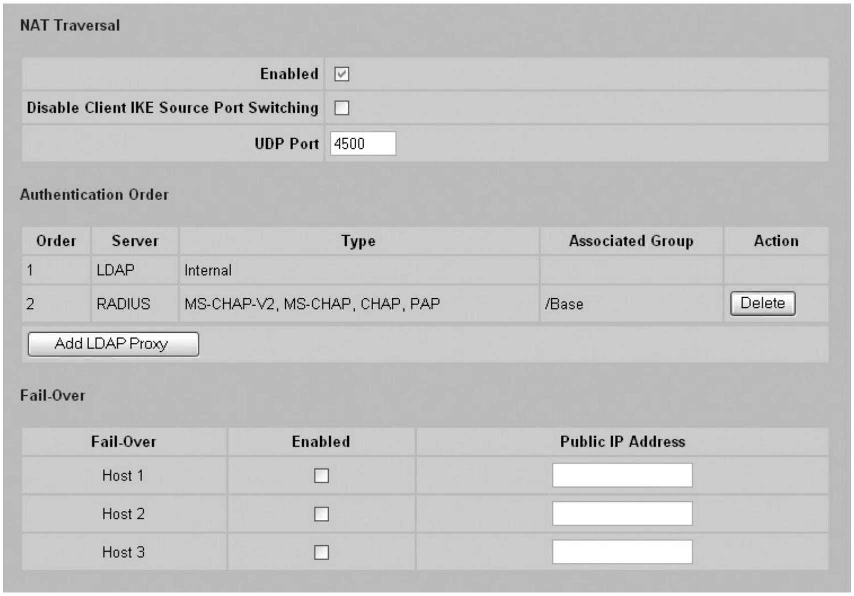
IPSec over NAT-T □ Check to enable IPSec over NAT-T, which detects the need for UDP encapsulation in NAT/PAT environments, using UDP port 4500.

ONE STEP FURTHER

Cisco has an excellent whitepaper on NAT Traversal and how it works located at http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122newft/122t/122t13/ftipsnat.htm.

Specifically, it is important to understand that although NAT Traversal can help you tremendously in dealing with IPsec traffic, there are some items you need to be aware of. If an IP address is used as a search key to find a pre-shared key, you will not be able to use NAT Traversal because the NAT function will result in a mismatch between the IP address and pre-shared key. In addition, any protocols that use embedded IP addresses will not function with NAT Traversal. These protocols include File Transfer Protocol (FTP), Internet Relay Chat (IRC), Simple Network Management Protocol (SNMP), Lightweight Directory Access Protocol (LDAP), H.323, and Session Initiation Protocol (SIP).

For the Nortel Contivity, NAT Traversal is configured as a property of IPsec at the Services | IPSec | IPSec Settings screen, as shown next.



NAT Traversal

Enabled	☑
Disable Client IKE Source Port Switching	□
UDP Port	4500

Authentication Order

Order	Server	Type	Associated Group	Action
1	LDAP	Internal		
2	RADIUS	MS-CHAP-V2, MS-CHAP, CHAP, PAP	/Base	Delete

Add LDAP Proxy

Fail-Over

Fail-Over	Enabled	Public IP Address
Host 1	□	
Host 2	□	
Host 3	□	

You should use ESP for your IPsec-based VPNs due to the increased security that the data encryption provides; in fact, the Cisco VPN 3000 concentrator does not even support AH.

AH and ESP both use two modes of operation that define how they function: transport mode and tunnel mode. In transport mode, the original packet header and data are separated, and the original IP header is used for the new packet, followed by the AH and the original data (unencrypted) or the ESP header and encrypted data, as shown in Figures 5-6 and 5-7.

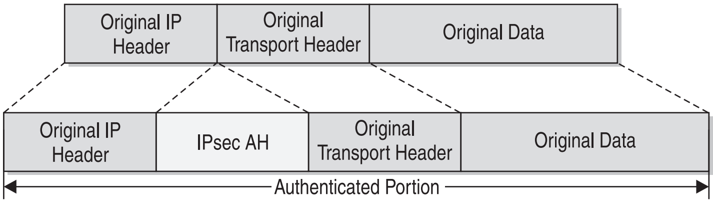


Figure 5-6. AH transport mode

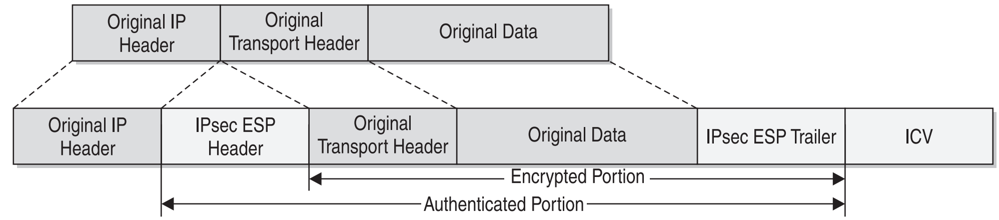


Figure 5-7. ESP transport mode

In tunnel mode, the original packet is completely encapsulated in a new IP header, including the AH or ESP header information, as shown in Figures 5-8 and 5-9. Transport mode is typically used for end-to-end connections between hosts, whereas tunnel mode is used for pretty much everything else. In most cases, you will use tunnel mode.

Security Associations

Security associations are simply a combination of the protocols, rules, and policies that two hosts use to negotiate their security service relationship. These security associations define the encryption protocols, the message integrity methods, and the authentication methods to be used by the hosts. The IETF has established a standard method of security association and key exchange resolution combining the Internet Security Association and Key Management Protocol (ISAKMP) and the Oakley key-generation protocol. ISAKMP centralizes security association management, thus reducing connection time. Oakley generates and manages the authenticated keys used to secure the information.

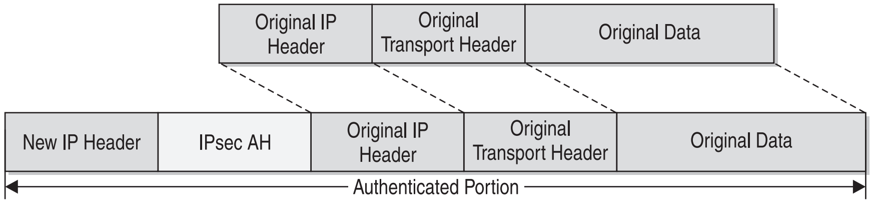


Figure 5-8. AH tunnel mode

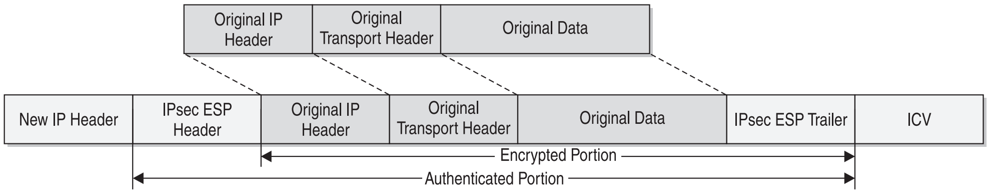


Figure 5-9. ESP tunnel mode

A benefit of this process is that not only are the computer-to-computer communications protected, but remote computers that are requesting secure access to a corporate network or any situations in which the negotiation for the final destination computer (or endpoint) is actually performed by a security router or other proxy server are also protected. This latter situation is known as *ISAKMP client mode*, and the identities of the endpoints are hidden to further protect the communication and provide transparency to the client.

Encryption Protocols

You can use many different encryption protocols to encrypt your data and ensure confidentiality. Although they all fundamentally function in the same manner, the difference between them is the strength of the encryption. Some of the more common encryption protocols are listed here:

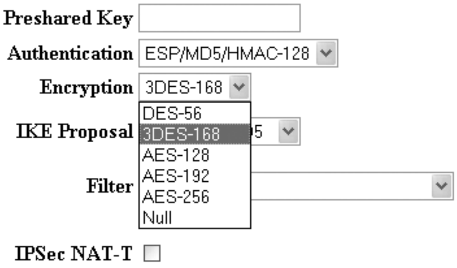
- **DES** Data Encryption Standard (DES) uses a 56-bit key that it applies to every 64 bits of data to provide encryption. This provides 72 quadrillion possible encryption keys, which sounds really good until you realize that DES was cracked in a mere 22 hours and 15 minutes in 1999. Since then, DES has been cracked within similar times using relatively inexpensive equipment. If one is willing to invest a million dollars in equipment, DES can be cracked in under an hour. As a result, you should not use DES encryption.
- **3DES** 3DES is a more robust method of DES, performing three 56-bit encryption operations on the data (hence the name 3DES). This provides an aggregate 168-bit key providing much stronger data encryption, although in actuality it is a 112-bit key. 3DES has not been cracked . . .yet. Some estimates say that it would take trillions of years using today's technology to crack it. At the same time, people made similar claims about DES cracking, and we know what the results were. Keep this in mind any time someone tells you that something is "impossible to crack." You should use 3DES at a minimum for your data encryption.

- **AES-128, AES-192, and AES-256** Advanced Encryption Standard is an encryption method developed by the National Institute of Standard and Technology (NIST). The three key sizes—128, 192, and 256—provide the following key possibilities:

  3.4×10^{38} possible 128-bit keys
  6.2×10^{57} possible 192-bit keys
  1.1×10^{77} possible 256-bit keys

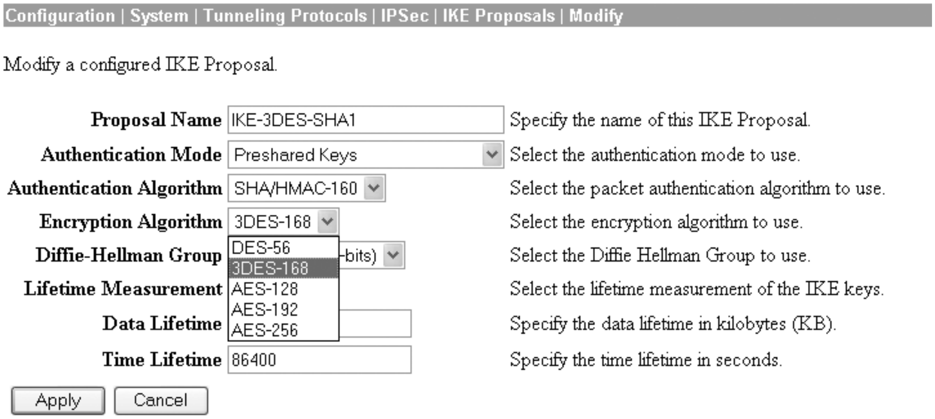
  AES was developed to replace DES encryption and is not very easy to crack. To put this in perspective, according to the NIST website (http://www.nist.gov/public_affairs/releases/aesq&a.htm), "assuming that one could build a machine that could recover a DES key in a *second* (i.e., try 2^{55} keys per second), then it would take that machine approximately 149 thousand-billion (149 trillion) years to crack a 128-bit AES key. To put that into perspective, the universe is believed to be less than 20 billion years old."

3DES and any of the AES encryption protocols should be adequate for most environments. A benefit that 3DES has is very widespread support through all vendors, whereas AES is relatively new and not as widely supported. You can specify the encryption method to use at numerous screens for your Cisco VPN 3005 concentrator. For example, if you were adding a LAN-to-LAN VPN connection, you would specify the encryption from the Encryption drop-down list at the Configuration | System | Tunneling Protocols | IPSec | LAN-to-LAN | Add screen, as shown at right.



Preshared Key	
Authentication	ESP/MD5/HMAC-128
Encryption	3DES-168
IKE Proposal	5
Filter	
IPSec NAT-T	□

You can specify the encryption method for your IKE proposals at the Configuration | System | Tunneling Protocols | IPSec | IKE Proposals | Modify screen, as shown here:

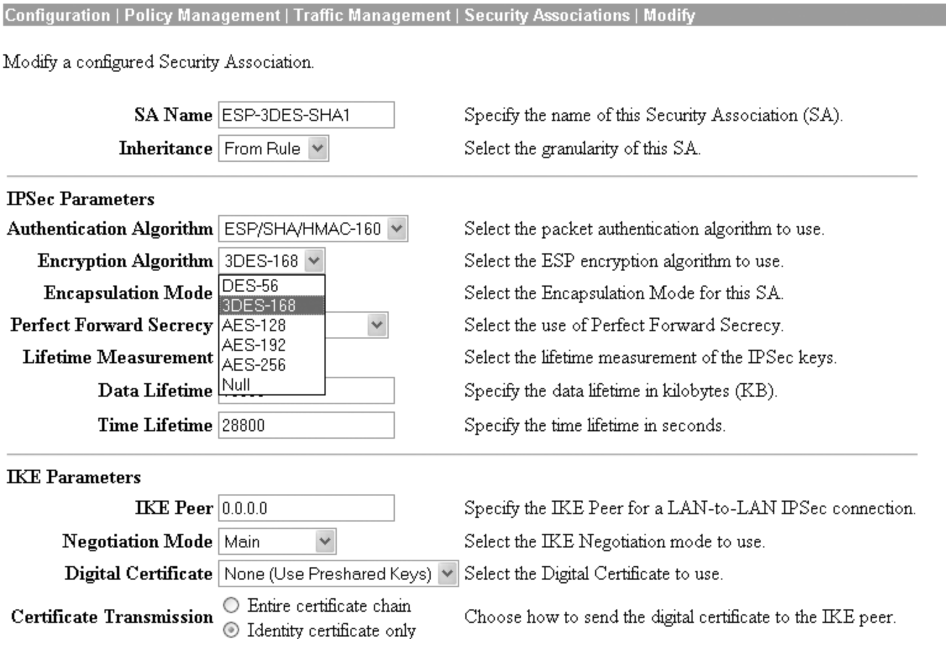


Configuration | System | Tunneling Protocols | IPSec | IKE Proposals | Modify

Modify a configured IKE Proposal.

Proposal Name	IKE-3DES-SHA1	Specify the name of this IKE Proposal.
Authentication Mode	Preshared Keys	Select the authentication mode to use.
Authentication Algorithm	SHA/HMAC-160	Select the packet authentication algorithm to use.
Encryption Algorithm	3DES-168	Select the encryption algorithm to use.
Diffie-Hellman Group	-bits)	Select the Diffie Hellman Group to use.
Lifetime Measurement		Select the lifetime measurement of the IKE keys.
Data Lifetime		Specify the data lifetime in kilobytes (KB).
Time Lifetime	86400	Specify the time lifetime in seconds.

You can specify the encryption method for your security associations at the Configuration | Policy Management | Traffic Management | Security Associations | Modify screen, as shown here:



Configuration | Policy Management | Traffic Management | Security Associations | Modify

Modify a configured Security Association.

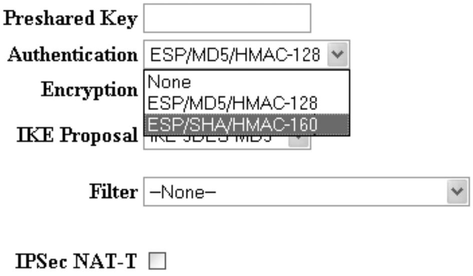
SA Name	ESP-3DES-SHA1	Specify the name of this Security Association (SA).
Inheritance	From Rule	Select the granularity of this SA.
IPSec Parameters		
Authentication Algorithm	ESP/SHA/HMAC-160	Select the packet authentication algorithm to use.
Encryption Algorithm	3DES-168 DES-56 3DES-168 AES-128 AES-192 AES-256 Null	Select the ESP encryption algorithm to use.
Encapsulation Mode		Select the Encapsulation Mode for this SA.
Perfect Forward Secrecy		Select the use of Perfect Forward Secrecy.
Lifetime Measurement		Select the lifetime measurement of the IPSec keys.
Data Lifetime		Specify the data lifetime in kilobytes (KB).
Time Lifetime	28800	Specify the time lifetime in seconds.
IKE Parameters		
IKE Peer	0.0.0.0	Specify the IKE Peer for a LAN-to-LAN IPSec connection.
Negotiation Mode	Main	Select the IKE Negotiation mode to use.
Digital Certificate	None (Use Preshared Keys)	Select the Digital Certificate to use.
Certificate Transmission	○ Entire certificate chain ● Identity certificate only	Choose how to send the digital certificate to the IKE peer.

Message Integrity

Hashing algorithms are used to provide message integrity of the transmitted data. This works by the source system generating a fixed-length message digest that is a condensed representation of the message or data file. This message digest is transmitted with the data to the destination host, which runs the same hashing algorithm on the data to generate its own message digest. The source and destination message digests are then compared, and any deviation means that the data has been altered since the original message digest was created. Most vendors support two primary message digest algorithms: Message Digest 5 (MD5) and Secure Hash Algorithm 1 (SHA-1). Both use hash-keyed message authentication code (HMAC) as their keyed hashing mechanism. HMAC is defined in RFC 2104.

MD5 was developed by Ronald Rivest of MIT and RSA Data Security Corporation. It creates a 128-bit message digest of the data by using a 128-bit secret key. SHA-1 was developed by the NIST and produces a 160-bit message digest using a 160-bit secret key. Because SHA-1 uses a larger secret key, it is considered more secure than MD5. However, this comes at the expense of performance. You should use SHA-1 unless you have a performance issue that precludes its use.

You can configure the message integrity method for your LAN-to-LAN VPN connection at the Configuration | System | Tunneling Protocols | IPSec | LAN-to-LAN | Add screen by selecting the Authentication drop-down list, as shown here:



Preshared Key

Authentication ESP/MD5/HMAC-128

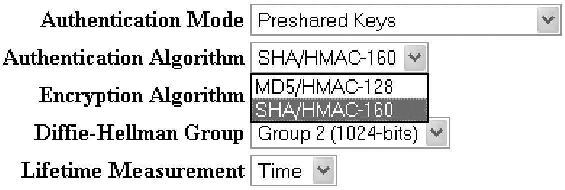
Encryption

IKE Proposal

Filter –None–

IPSec NAT-T □

You can configure the message integrity method for your IKE proposals at the Configuration | System | Tunneling Protocols | IPSec | IKE Proposals | Modify screen by selecting the Authentication Algorithm drop-down list, as shown here:



Authentication Mode Preshared Keys

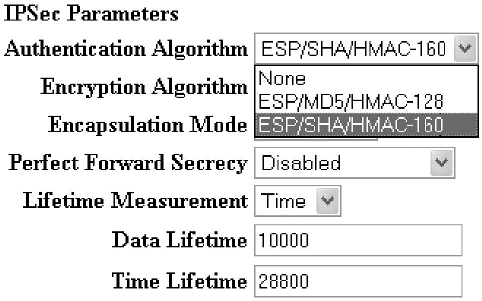
Authentication Algorithm SHA/HMAC-160

Encryption Algorithm

Diffie-Hellman Group Group 2 (1024-bits)

Lifetime Measurement Time

You can configure the message integrity method for your security associations at the Configuration | Policy Management | Traffic Management | Security Associations | Modify screen by selecting the Authentication Algorithm drop-down list, as shown here:



IPSec Parameters

Authentication Algorithm ESP/SHA/HMAC-160

Encryption Algorithm

Encapsulation Mode

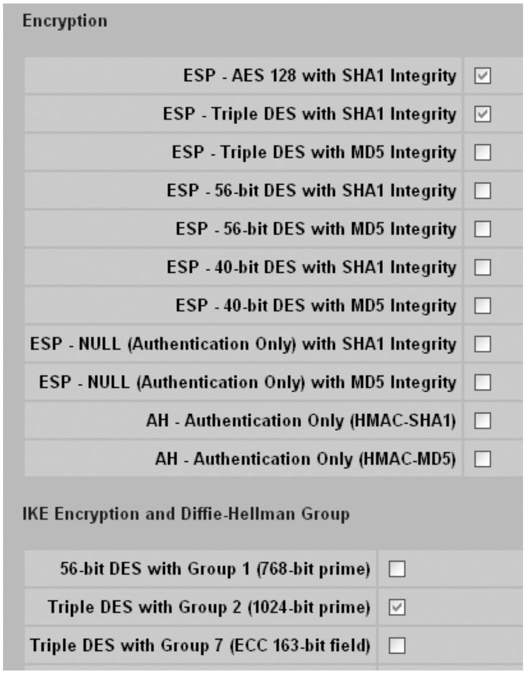
Perfect Forward Secrecy Disabled

Lifetime Measurement Time

Data Lifetime 10000

Time Lifetime 28800

The Nortel Contivity takes a much simpler approach to configuring your encryption protocols and message integrity by using a single global-configuration setting for both. Nortel combines the encryption protocol and message integrity method into a single configuration setting (for example, by specifying 3DES and SHA-1 in a single encryption setting). You can define the supported encryption protocols and message integrity to use at the Services | IPSec | IPSec Settings screen, as shown next.



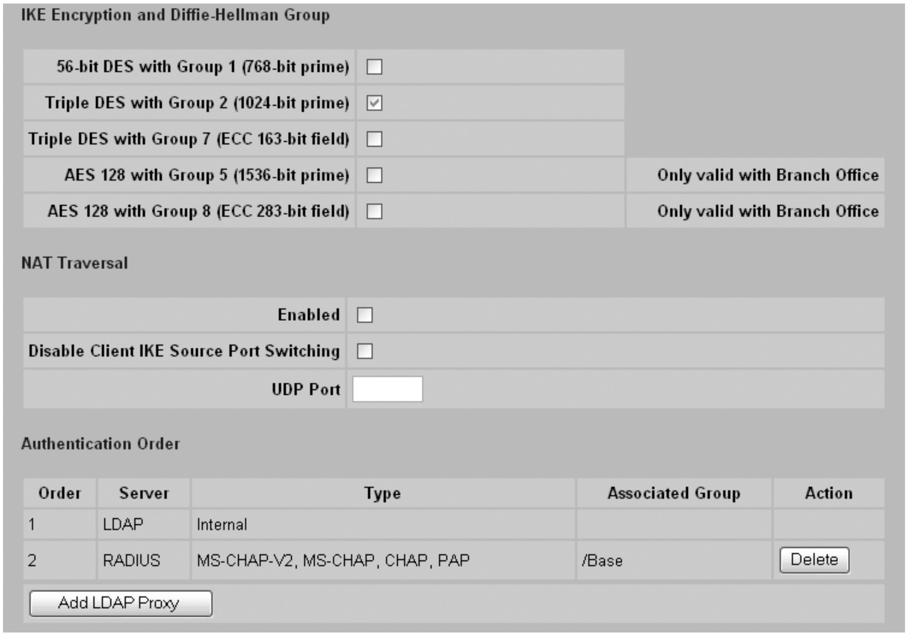
Encryption

ESP - AES 128 with SHA1 Integrity	☑
ESP - Triple DES with SHA1 Integrity	☑
ESP - Triple DES with MD5 Integrity	□
ESP - 56-bit DES with SHA1 Integrity	□
ESP - 56-bit DES with MD5 Integrity	□
ESP - 40-bit DES with SHA1 Integrity	□
ESP - 40-bit DES with MD5 Integrity	□
ESP - NULL (Authentication Only) with SHA1 Integrity	□
ESP - NULL (Authentication Only) with MD5 Integrity	□
AH - Authentication Only (HMAC-SHA1)	□
AH - Authentication Only (HMAC-MD5)	□

IKE Encryption and Diffie-Hellman Group

56-bit DES with Group 1 (768-bit prime)	□
Triple DES with Group 2 (1024-bit prime)	☑
Triple DES with Group 7 (ECC 163-bit field)	□

You can configure your IKE proposals at the same screen by scrolling down to the "IKE Encryption and Diffie-Hellman Group" section, as shown here:



IKE Encryption and Diffie-Hellman Group

56-bit DES with Group 1 (768-bit prime)	□	
Triple DES with Group 2 (1024-bit prime)	☑	
Triple DES with Group 7 (ECC 163-bit field)	□	
AES 128 with Group 5 (1536-bit prime)	□	Only valid with Branch Office
AES 128 with Group 8 (ECC 283-bit field)	□	Only valid with Branch Office

NAT Traversal

Enabled	□
Disable Client IKE Source Port Switching	□
UDP Port	

Authentication Order

Order	Server	Type	Associated Group	Action
1	LDAP	Internal		
2	RADIUS	MS-CHAP-V2, MS-CHAP, CHAP, PAP	/Base	Delete

Authentication

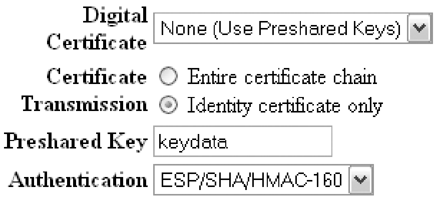
IKE provides for the authentication of peers during IKE phase 1 by using one of three possible key types:

- Preshared keys
- RSA digital signatures
- RSA encrypted nonces (This key type is rarely used and will not be covered in this book.)

The use of pre-shared keys is the most common method of authenticating users. This is due to the fact that it is a relatively simple and straightforward process, even though it is not as secure as the other methods. Pre-shared keys use an authentication mechanism based on both nodes sharing a common key value (the pre-shared key). This key value must be manually entered and, for all intents and purposes, should be treated in the same manner you would treat a password. Because both nodes must be configured with the same key, the same administrator should configure both systems. Alternatively, if the key must be provided to another user to implement, it should be delivered using a secure out-of-band method. For example, you should send the key via certified mail to the remote administrator as opposed to sending it via clear-text e-mail. Once both peers have been configured with a common key value, they use this key to generate authentication hashes that are transmitted to authenticate that both peers are who they claim to be.

Using pre-shared keys does have some drawbacks. As previously mentioned, pre-shared keys are more insecure than digital signatures or nonces. The use of pre-shared keys also does not scale to large environments because the key updates and changes must be manually performed on all equipment. Another drawback is the fact that because pre-shared keys are human generated, they tend to use a much smaller set of bits for the key generation, as compared to a computer-generated method, which might use in excess of 100 bits for the key-generation process. In addition, because the more people who know a secret, the less secret something is, it can be very difficult to update all your systems if one of the trusted users who knows your key values leaves. Finally, Microsoft stores pre-shared keys in an unencrypted format in the Registry, which is a horrible method of key storage quite frankly.

You can specify to use a pre-shared key for your LAN-to-LAN VPN connections on your Cisco VPN 3005 at the Configuration | System | Tunneling Protocols | IPSec | LAN-to-LAN | Add screen by selecting “None (Use Preshared Key)” in the Digital Certificate drop-down list and then entering the key value in the Preshared Key box, as shown next.



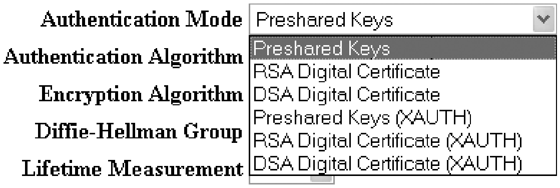
Digital Certificate: None (Use Preshared Keys)

Certificate Transmission: ○ Entire certificate chain ● Identity certificate only

Preshared Key: keydata

Authentication: ESP/SHA/HMAC-160

You can specify to use a pre-shared key with your IKE proposals at the Configuration | System | Tunneling Protocols | IPSec | IKE Proposals | Modify screen by selecting Preshared Keys in the Authentication Mode drop-down box, as shown here:



Authentication Mode: Preshared Keys

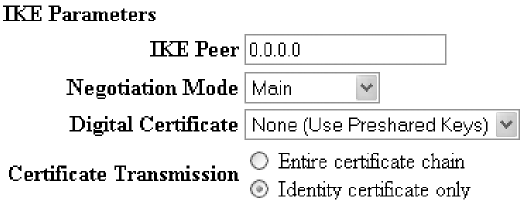
Authentication Algorithm

Encryption Algorithm

Diffie-Hellman Group

Lifetime Measurement

You can specify to use a pre-shared key with your security associations at the Configuration | Policy Management | Traffic Management | Security Associations | Modify screen by selecting "None (Use Preshared Keys)" in the Digital Certificates drop-down box, as shown here:



IKE Parameters

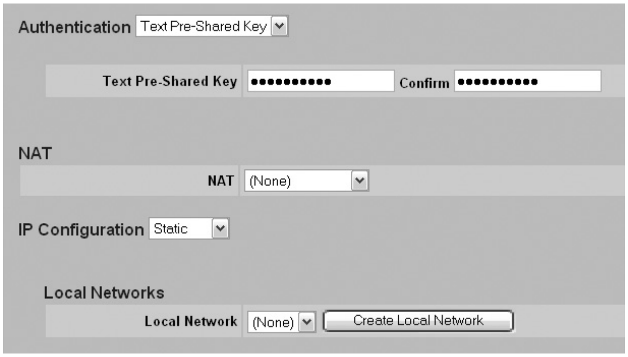
IKE Peer: 0.0.0.0

Negotiation Mode: Main

Digital Certificate: None (Use Preshared Keys)

Certificate Transmission: ○ Entire certificate chain ● Identity certificate only

For your Nortel Contivity, you can specify to use pre-shared keys for your branch office profile configuration. You can specify the pre-shared key at the Profiles | Branch Office | Connection Configuration screen in the "Authentication" section by selecting Text or Hex Pre-Shared Key from the drop-down box and entering the key value, as shown here:



Authentication: Text Pre-Shared Key

Text Pre-Shared Key: ●●●●●●●●●●● Confirm: ●●●●●●●●●●●

NAT

NAT: (None)

IP Configuration: Static

Local Networks

Local Network: (None)

RSA digital signatures are more complex to initially set up and configure because they require the use of a certificate authority to provide digital certificates for hosts that register with that CA. They are much more secure than pre-shared keys, however, because they use a greater number of bits to generate the hash that is used, and they generally remove the human element from the validation, configuration, and distribution of the signatures by using certificate authorities to validate and distribute certificates.

A certificate authority (CA) is a server or host that has been authorized to issue and manage security credentials and public keys for encryption. Certificate authorities can be either external (for example, VeriSign) or internal (for example, Microsoft Certificate Services). The only requirement to use a certificate authority is for all the hosts to trust the certificate authority. For external certificate authorities, the list of trusted certificate authorities is generally handled by the OS vendor and is installed and updated periodically through Windows Update or similar functions. For internal certificate authorities, you will need to manually configure your hosts to recognize the CAs. For more information on how to configure a host operating system to recognize certificate authorities, see the counterpart publications in this series, *Hardening Windows Systems* by Roberta Bragg and *Hardening Linux* by John Terpstra.

Obtaining a certificate is a relatively straightforward process. First, you need to ensure that your VPN device trusts the certificate authority from which you want to obtain a certificate. Next, you will need to generate a certificate request, typically making a manual certificate request using the Public Key Cryptography Standards (PKCS) 10 message format. This typically generates output that looks like the following:

```
-----BEGIN NEW CERTIFICATE REQUEST-----
MIIBKTCB1AIBADB0MSYwJAYDVQQDEx1pZGxlLXZwbjMwMDUtMDEuNGlkbGV0aW1l
LmNvbTELMAkGA1UECxMCSVQxETAPBgNVBAoTCElkbGVUaW1lMRAwDgYDVQQHEwdI
b3VzdG9uMQswCQYDVQQIEwJUWDELMAkGA1UEBhMCVVMwWTANBgkqhkiG9w0BAQEF
AANIADBFAkBRnk0aLy6Nl681wsSvCnPd63u/N30PYZ6jxNexWIwqUoFwzfBnF3V+
8Jsl63SEmjfuMUdfLiG+NkHCHcw8KPPpAgEFMA0GCSqGSIb3DQEBBAUAA0EAQRxG
R/Oirun8nKrv/gS0wgNqLCje7frfR7RsBp7pW5gGA59b8+OBgmikdGZOqClxMg7c
xPShKUGAqJbnoelvYw==
-----END NEW CERTIFICATE REQUEST-----
```

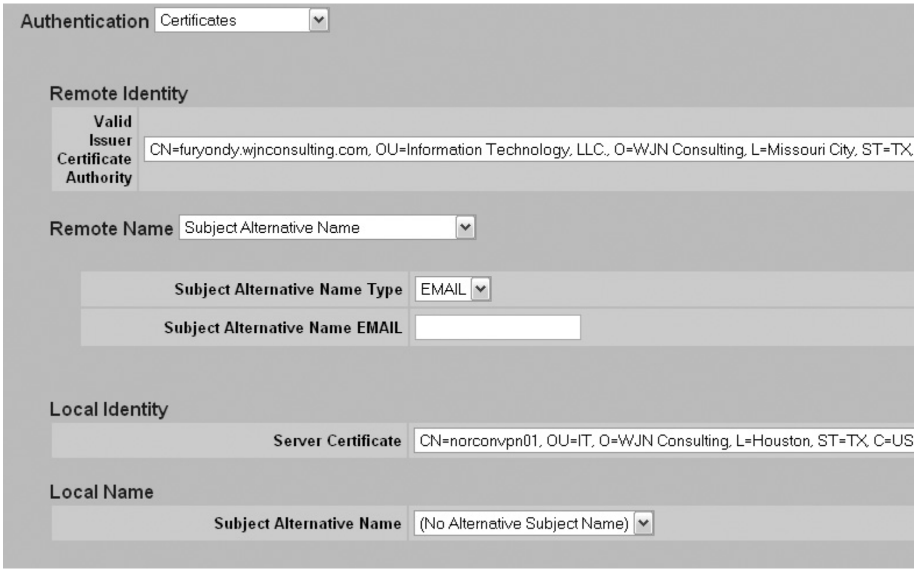
You can either copy and paste this information into your certificate request form or save the output into a text file and upload the text file for your certificate request. The next step is actually to request the certificate using the certificate request information you previously generated. The exact method of doing this depends on whether you are using an external certificate authority such as VeriSign or are using an internal certificate server such as Microsoft Certificate Services. Typically, however, your certificate authority will request that you either upload or paste the certificate request into an online form of some sort. Once your certificate request has been acted upon, you will be provided with a certificate file. The last step is then to install the certificate on your device. This can typically be done by either copying and pasting the certificate data or uploading the certificate to your device. A certificate will typically looks like this:

```
-----BEGIN CERTIFICATE-----
MIIGRTCCBe+gAwIBAgIKIxBNWgAAAAAAETANBgkqhkiG9w0BAQUFADCBwTEoMCYG
CSqGSIb3DQEJARYZd25vb25hbkB3am5jb25zdWx0aW5nLmNvbTELMAkGA1UEBhMC
VVMxCzAJBgNVBAgTAlRYMRYwFAYDVQQHEw1NaXNzb3VyaSBDaXR5MR0wGwYDVQQK
ExRXSk4gQ29uc3VsdGluZywgTExDLjEfMB0GA1UECxMWSW5mb3JtYXRpb24gVGVj
aG5vbG9neTEjMCEGA1UEAxMaZnVyeW9uZHkud2puY29uc3VsdGluZy5jb20wHhcN
MDMxMjIxMjAzNTE2WhcNMDQxMjIwMjAzNTE2WjA8MR8wHQYJKoZIhvcNAQkBFhBw
cm9zcGVyb0Bub2wubmV0MRkwFwYDVQQDExBXZXNsZXkgSi4gTm9vbmFuMFkwDQYJ
KoZIhvcNAQEBBQADSAAwRQJAUZ5NGi8ujZevNcLErwpz3et7vzd9D2Geo8TXsViM
KlKBcM3wZxd1fvCbJet0hJo37jFHXy4hvjZBwh3MPCjz6QIBBaOCBE4wggRKMB0G
A1UdDgQWBBTVb+a9lue8520gKltcQ+SAPuZZYTCB/QYDVR0jBIH1MIHygBSphpyM
Pg8DhZn3jD1k/0mlfmqiUaGBx6SBxDCBwTEoMCYGCSqGSIb3DQEJARYZd25vb25h
bkB3am5jb25zdWx0aW5nLmNvbTELMAkGA1UEBhMCVVMxCzAJBgNVBAgTAlRYMRYw
FAYDVQQHEw1NaXNzb3VyaSBDaXR5MR0wGwYDVQQKExRXSk4gQ29uc3VsdGluZywg
TExDLjEfMB0GA1UECxMWSW5mb3JtYXRpb24gVGVjaG5vbG9neTEjMCEGA1UEAxMa
ZnVyeW9uZHkud2puY29uc3VsdGluZy5jb22CEF+e6bUtBwGvRERM2h8jpSUwggE0
BgNVHR8EggErMIIBJzCB0aCBzqCBy4aByGxkYXA6Ly8vQ049ZnVyeW9uZHkud2pu
Y29uc3VsdGluZy5jb20sQ049ZnVyeW9uZHksQ049Q0RQLENOPVB1YmxpYyUyMEtl
eSUyMFNlcnZpY2VzLENOPVNlcnZpY2VzLENOPUNvbmZpZ3VyYXRpb24sREM9d2pu
Y29uc3VsdGluZyxEQz1jb20/Y2VydGlmaWNhdGVSZXZvY2F0aW9uTGlzdD9iYXNl
P29iamVjdGNsYXNzPWNSTERpc3RyaWJ1dGlvblBvaW50MFGgT6BNhktodHRwOi8v
ZnVyeW9uZHkud2puY29uc3VsdGluZy5jb20vQ2VydEVucm9sbC9mdXJ5b25keS53
am5jb25zdWx0aW5nLmNvbS5jcmwwggFIBggrBgEFBQcBAQSCATowggE2MIG/Bggr
BgEFBQcwAoaBsmxkYXA6Ly8vQ049ZnVyeW9uZHkud2puY29uc3VsdGluZy5jb20s
Q049QUlBLENOPVB1YmxpYyUyMEtleSUyMFNlcnZpY2VzLENOPVNlcnZpY2VzLENO
PUNvbmZpZ3VyYXRpb24sREM9d2puY29uc3VsdGluZyxEQz1jb20/Y0FDZXJ0aWZp
Y2F0ZT9iYXNlP29iamVjdGNsYXNzPWNlcnRpZmljYXRpb25BdXRob3JpdHkwcgYI
KwYBBQUHMAKGZmh0dHA6Ly9mdXJ5b25keS53am5jb25zdWx0aW5nLmNvbS9DZXJ0
RW5yb2xsL2Z1cnlvbmR5LndqbmNvbnN1bHRpbmcuY29tX2Z1cnlvbmR5LndqbmNv
bnN1bHRpbmcuY29tLmNydDAMBgNVHRMBAf8EAjAAMAsGA1UdDwQEAwIFoDApBgNV
HSUEIjAgBgorBgEEAYI3CgMEBggrBgEFBQcDBAYIKwYBBQUHAwIwFwYJKwYBBAGC
NxQCBAoeCABVAHMAZQByMEYGA1UdEQQ/MD2gKQYKKwYBBAGCNxQCA6AbDBl3bm9v
bmFuQHdqbmNvbnN1bHRpbmcuY29tgRBwcm9zcGVyb0Bub2wubmV0MA0GCSqGSIb3
DQEBBQUAA0EAHgrIiOJiDNjhBudDXWJ5McTq/3ZT9zpPfb2abzsVldtpxVRvvVvA
dVVl8EptaAu7d5BAKf5RZDbH9TYEZ7a02Q==
-----END CERTIFICATE-----
```

Once this initial effort of configuring an internal certificate authority or using an external certificate authority, updating your systems to trust the chosen certificate authority, and obtaining a certificate has been made, however, peers using RSA digital certificates can authenticate with one another without user intervention. This allows digital certificates to scale much better in large environments due to the reduced user intervention. Because the infrastructure has been previously implemented, you simply generate a new certificate for the system in question and configure the system to use the certificate.

Configuring your devices to use a digital certificate is generally no different from configuring them to use a pre-shared key. Simply select the certificate from the drop-down list that you want to use instead of selecting "None (Use Preshared Key)" for your Cisco VPN 3005.

For your Nortel Contivity, you would simply select Certificates for the branch office authentication method and specify the appropriate identity information, as shown here:



Authentication: Certificates

Remote Identity

Valid Issuer Certificate Authority: CN=furyondy.wjnconsulting.com, OU=Information Technology, LLC., O=WJN Consulting, L=Missouri City, ST=TX,

Remote Name: Subject Alternative Name

Subject Alternative Name Type: EMAIL

Subject Alternative Name EMAIL:

Local Identity

Server Certificate: CN=norconvpn01, OU=IT, O=WJN Consulting, L=Houston, ST=TX, C=US

Local Name

Subject Alternative Name: (No Alternative Subject Name)

Hardening VPN Clients

One area that is often overlooked in hardening VPNs is the need to harden the client that is accessing your network. A client accessing your network over a VPN is for all intents and purposes on your network. That means that any security problems that client may have just become a security problem on your network.

One simple thing you can do to harden the VPN client is to ensure that all VPN clients are running virus protection per corporate standards. In addition, your remote clients should all run personal firewall software that prevents unauthorized access to these remote clients without the users granting explicit permission to connect. In some cases, you will need to use third-party personal firewall software such as ZoneAlarm to protect the client. However, many vendors are building basic stateful firewall functionality into the VPN client software itself that you can enable.

In addition, many VPN vendors are building enforcement technologies into their VPN client software, or as add-ons to the VPN client software. These technologies will detect whether the client is running the required software (for example, a certain version and signature file for virus protection) and will update the client if it is out of compliance before allowing it to connect to your production network. For example, Nortel has an add-on for their VPN client software called TunnelGuard that can be used to ensure that the client is running the required software. Otherwise, the tunnel is placed in a restricted mode that prevents all traffic other than the TunnelGuard traffic from passing.

Another method of hardening your VPN clients is to restrict the kinds of access the clients will have to other networks while connected to the corporate network. For example, can the clients access the Internet or the local network at the same time they are connected to the corporate network? This is commonly known as *split tunneling*. Although this is certainly convenient for the user, it introduces a security hole in that a client could potentially be used to provide access to your network to other systems by functioning as a router. As a result, you should disable local LAN access while the VPN is connected to your corporate network and require that the VPN client use the VPN and, by extension, your Internet gateway for Internet access.

Some VPN devices support specifying a client policy that can be used to control the types of applications a system connected to the VPN concentrator can run. For your Nortel Contivity, this is known as the Client Policy feature. Client Policy acts in a fashion similar to a personal firewall by shutting down a VPN tunnel if a nonpermitted application is launched. It does this by monitoring the protocols and ports that are active while the tunnel is running.

Finally, your VPN client operating system should be hardened according to your security policy—for example, removing or disabling unnecessary services (Internet Information Services and the Microsoft Server service are two I can think of that should probably be disabled). For more information on hardening Windows and Linux-based clients, see *Hardening Windows Systems* by Roberta Bragg and *Hardening Linux* by John Terpstra.

Hardening Dial-in Remote Access

Dial-in remote access presents a particularly sticky situation regarding the hardening of your network infrastructure. One of the biggest problems is how hard it can be to truly control dial-in access. Even though your security policy should expressly prevent anyone from doing this, people may install modems on their desktops to use pcAnywhere, and suddenly you go from having a couple of highly controlled ingress points on your network to dozens of uncontrolled and largely unprotected ingress points on your network. This problem, as well as the popularity of VPN connections, has caused a marked decline in the use of dial-in connections on corporate networks.

Today you are better served to *not* provide any dial-in access but rather to provide your users with a global Internet dialer and VPN software, allowing them to connect via VPN to your network over their dial-in Internet connection. This allows you to control all your remote access connections at your VPN devices, thus simplifying the management of dial-in users because they effectively become just another VPN connection. In the event that you require dial-in remote access, however, you can do three things to harden that access:

- *Centralize your dial-in access.* By locating your dial-in access to a centralized location, such as a DMZ, you can filter and control the types of traffic you want to allow from your dial-in connections in a much easier fashion using your firewalls and routers for traffic filtering as well as IDS/IPS hardware to detect unauthorized traffic. For example, Figure 5-10 shows how you could locate your dial-in concentrator in a DMZ, allowing you to filter and control the kinds of traffic your remote users can pass to your internal network through your firewall and intrusion-detection system.

- *Require authentication of all connections.* Ensure that every dial-in connection has been authenticated, preferably using RADIUS, TACACS+, Active Directory, NDS, or local user databases, similar to how you configure your VPN connections to only allow authorized users to connect. Authentication will be covered in more detail in Chapter 9.

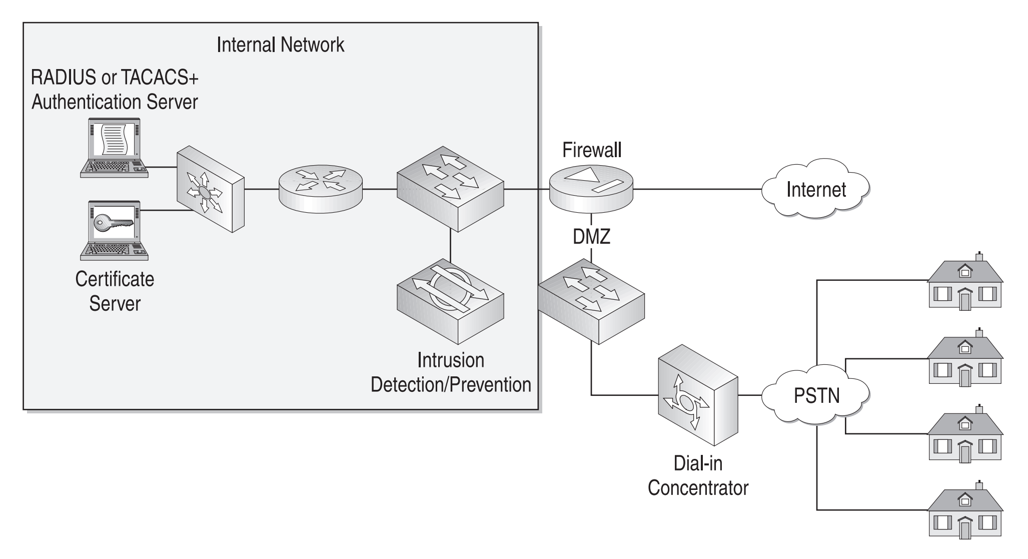


Figure 5-10. Dial-in access network design

- *Require callback or caller ID verification of as many connections as possible.* Unfortunately, because most of your dial-in connections will be traveling users without a designated callback number, this might prove to be an impossible task. However, if you know that a dial-in connection is always going to be initiated from the same phone number, your dial-in access should be configured to drop the initial phone call and dial the user back at the specified location in order to establish a connection. Configuring callback or caller ID verification is typically done on the device, although many authentication servers, such as TACACS+ and Windows Authentication, provide callback and caller ID verification to be configured for the user. For example, if you are using a Windows server to provide dial-in access, you can configure the callback options as part of the user settings in the Active Directory Users and Computers MMC snap-in.

Summary

VPN and dial-in connections provide a means to extend your corporate network to remote users and locations, allowing those remote users and locations to access your corporate resources as if they were local. With this access comes the need to harden these connections to ensure that you maintain the desired level of security on your infrastructure while providing the kind of functionality required by your users and business.

If you are providing VPN connectivity, you should use IPsec for your VPN connection protocol. If you require multiprotocol support, you should use L2TP tunneled within IPsec to provide connectivity. You should not use PPTP.

In providing IPsec VPN connections, you should use the most secure protocols and authentication methods available. Do not use AH as a traffic security protocol due to the fact that it does not encrypt the data. Instead, implement ESP to ensure that the data is encrypted as it is transmitted. For your encryption protocol, you should not use DES but rather should use 3DES or any of the AES encryption protocols. Message integrity should be provided by SHA-1 instead of MD5 because SHA-1 uses a large bit-key and therefore is more secure than MD5. Finally, make sure you authenticate all your connections via the use of pre-shared keys or RSA digital signatures to ensure that only authenticated peers can connect to your network.

Your VPN devices should also be hardened against threats to the devices themselves. You should only allow secure protocols for remote administration, such as SSH and HTTPS. Only authorized users should be able to connect to and manage a device, and these users should not use common passwords. Instead, they should use individual local accounts or RADIUS or TACACS+ to be authenticated and authorized. Any unnecessary services and protocols should be disabled or filtered from the device, providing the minimum required services and protocols. If all you support are IPsec VPN connections, you should disable PPTP and L2TP as unnecessary services. You should also implement redundant devices to address hardware failure scenarios, ensuring that your users obtain the maximum uptime as required by your environment. Finally, ensure that you only support authenticated routing updates with your routing protocols.

Instead of providing dedicated dial-in access, you should implement a global Internet dialer and use VPN connections to provide remote user access. If, however, you are required to provide dial-in access, ensure that all connections are authenticated and that your dial-in access is centralized and managed to make it easier to control and filter that external traffic. Where possible, implement callback against authenticated users to ensure that the connection attempt is coming from an authorized location.

Although providing remote access can invite a multitude of security problems in your environment, if it's done properly, you can ensure that your security posture is fundamentally unchanged after providing the kind of functionality your users and company require.