To view the document go to View > Document Map

Modes: (find and remove all modes and edit to create complete config)

```
(config)#
(config-if)#
(config-subif)#
(config-controller)#
(config-map-list)#
(config-map-class)#
(config-line)#
(config-router)#
(config-ipx-router)#
(config-route-map)#
rommon 1>
```

Router Recovery

If IOS is corrupt:

```
rommon 1>dir flash:c2800nm-advipservicesk9-mz.124-8a.bin
Directory of flash:/c2800nm-advipservicesk9-mz.124-8a.bin
   2  -rw-    31917680  Jul 25 2006 17:34:28 -04:00  c2800nm-advipservicesk9-mz.124-8a.bin
```

(attempt to boot from that image).

```
rommon 1>boot flash:c2600-is-mz.121-5
```

password recovery

at bootstrap Ctrl + Break

```
rommon 1>confreg 0x2142 (the router will not load the configuration file.)
rommon 1>reset
Router> en
Router#copy st run
Router#config t
Router#enable secret <secret>
Router#config-register <orig working value>
Router#wr
Router#sh ver Configuration register is 0x2142 (will be 0x2102 at next reload).
Router#reload
```

Rommon tftp

The minimum variables required to use **tftpdnld**

```
rommon 1>IP_ADDRESS=<IP add>
rommon 1>IP_SUBNET_MASK=<mask>
rommon 1>DEFAULT_GATEWAY=<IP add>
rommon 1>TFTP_SERVER=<IP add>
rommon 1>TFTP_FILE=<file name>
rommon 1>tftpdnld
```

xmodem recovery

reload > Ctrl + Break

```
rommon 1 >dir flash: (look for valid flash - c1700-ny-mz.121-6.bin )
rommon 1 >boot flash: c1700-ny-mz.121-6.bin (attempt to boot flash sh ver to verify fl and config reg)
rommon 1 >confreg
```

```
do you wish to change the configuration? y/n [n]: y
enable "diagnostic mode"? y/n [n]:[Enter]
enable "use net in IP bcast address"? y/n [n]: [Enter]
enable "load rom after netboot fails"? y/n [n]: [Enter]
enable "use all zero broadcast"? y/n [n]: [Enter]
disable "break/abort has effect"? y/n [n]: y
enable "ignore system config info"? y/n [n]: [Enter]
change console baud rate? y/n [n]: y
enter rate: 0 = 9600, 1 = 4800, 2 = 1200, 3 = 2400
4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200 [0]: 7
change the boot characteristics? y/n [n]: [Enter]
(Virtual Configuration Register: 0x1920)
enabled are:
console baud: 115200
boot: the ROM Monitor
do you wish to change the configuration? y/n [n]: n
You must reset or power cycle for new config to take effect
rommon 3 >xmodem c1700-y-mz.122-11.T.bin
HyperTerm  Select Transfer > Send File > Send
rommon 1 >reset ( HyperTerminal must be changed to new speed 115200, instead of 9600 baud)
Router(config)#config-register 0x2102
Router(config)#exit
Router#show flash
Router(config)#line con 0
Router(config-line)#speed 9600
Router#copy running-config startup-config
```

Basic Router Config

First time setup

```
Router#copy flash tftp  (**first bkup IOS)
Router#erase startup-config (start fresh)
Router#reload
Router#copy running-config startup-config
Router#copy running-config tftp (for config to a TFTP server- reverse= copy tftp running-config )

Router(config)#banner motd # <message of the day > #
Router(config)# enable password <word> (not encrypted)
Router(config)# enable secret <word> (strong MD5 encryption, overrides en pwd)
Router(config)# service password-encryption (weak encryption for all pwds)
Router# terminal no editing (disables enhanced editing mode)
Router# terminal history size (chs # of cmd line recorded each session, max 256)
Router# show history (shows the buffer)
Router# clock set 13:32:00 23 February 1999
```

hostnames/logins

```
Router(config)# hostname Tokyo
Router(config)#line console 0
Router(config-line)#login
Router(config-line)#password <password > (optional)
Router(config)#line vty 0 4 (A password must be set forTelnet)
Router(config-line)#login
Router(config-line)#password <password >
```

To set timeouts for router lines

```
router(config)# line vty start-line-number end-line-number
router(config-line)# exec-timeout  mins[secs]
```

vty lines accept only ssh

```
router(config)# line vty start-line-number end-line-number
router(config-line)# transport input ssh
```

vty / console access list

```
router(config)# line con 0/ line vty 0 4
router(config-line)# access-list 1 permit 192.168.1.0
router(config-line)#lline con 0/line vty 0 4
router(config-line)#access-class 1 in
router(config-line)#login local
```

To configure aux lines

to on local asynchronous terminals to log in before using the system

```
router(config)# line aux line-number
router(config-line)# login
router(config-line)# password password
```

To set the name server addresses

```
router(config)#ip name-server addresses. (Otherwise, turn off DNS)
router(config)#no ip domain-lookup
```

Basic interfaces/IP addressing

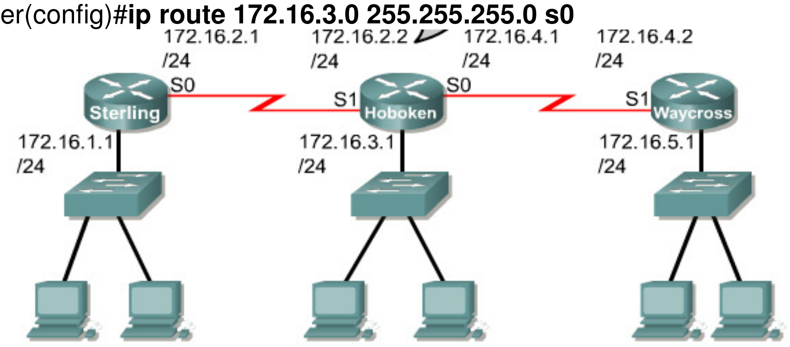
```
Router(config)#interface serial 0/0 (By default, Cisco routers are DTE)
Router(config-if)#ip address <ip address > <netmask >
Router(config-if)#clock rate 56000 (must set for DCE int)
Router(config-if)#description <room floor>
Router(config-if)#no shutdown
Router(config)#ip host hostnametoIP 172.16.1.20
Router(config)#do sh hosts
```

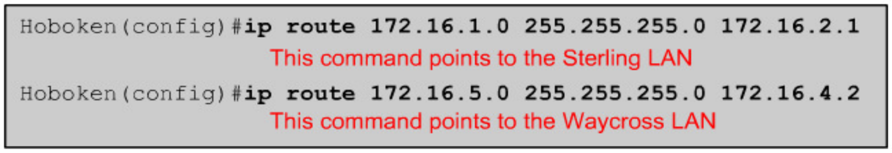
Static Routes

cmd<dest ntwk> <mask of dest> <gw-next hop>

cmd <dest ntwk> <mask of dest><int>

```
router(config)#ip route 172.16.3.0 255.255.255.0 172.16.4.1 130
router(config)#ip route 172.16.3.0 255.255.255.0 s0
```





```
Hoboken(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.1
```

This command points to the Sterling LAN

```
Hoboken(config)#ip route 172.16.5.0 255.255.255.0 172.16.4.2
```

This command points to the Waycross LAN

```
router(config)#ip route 0.0.0.0 0.0.0.0 <gw-next hop/int> (default route for non connected ntwks)
router(config)#no ip route (removes all static routes)
router#show ip route <address>
router#show running-config
```

Dynamic Routes and Routing protocols

Rip (distance vector interior)

if hop is >15 drop./ Updates broadcast every 30 sec/.v2 does VLSM./ split Verizon, holddown timers and triggered updates. load balances over 6 equal-cost(hop) paths

router(config)#**router rip**

router(config-router)#**network 172.16.0.0**

router(config-router)**redistribute static** (If a static route is assigned to an int that is not in a network command, this must be set before RIP will advertise the route.—floating static)

router(config-router)#**passive-interface** fa0/0 *(stops sending RIP packets but still listens)*

router(config-router)#**neighbor** *IP Add (exchange RIP with the IP)*

router(config-router)#**ver** 1 or 2 (or 1 2 for both)

router(config-router)#**timers basic** {update, invalid, and flush timers} (prevent count to infinity, increases convergence times, default for rip = 180 sec)

Router(config-router)#**maximum-paths** [*number*]

router(config-if)#**ip rip send ver** 1 or 2 (or 1 2 for both)

router(config-if)#**ip rip receive ver** 1 or 2

router(config-if)#**no ip split-horizon** *(SH stops it from sending info about a route back in the direction that it came.)*

router#**sh ip protocols**{summary}

router#**sh int**

router#**sh ip int br**

router#**sh run**

router#**show ip rip database**

router#**show ip route**

router#**debug ip rip {events}**

no ip route-cache will cause traffic to be load balanced on a per-packet basis no per dest.

IGRP – distance vector interior (cisco)

BW, load, delay, + reliability to create metric. Updates broadcast 90 sec./ AS must have a 16-bit ID/ Uses BW to load balance. K1 to K5 factors used to calculate metric/ Default K1 and K3 are set to 1, and K2, K4, and K5 are set to 0./ smallest value best/

RouterA(config)#**router igrp***as-number* (AS number identifies the IGRP process)

RouterA(config)#**no router igrp***as-number*

router(config-router)#**passive-interface** fa0/0 *(stops sending IGRP packets but still listens)*

Router(config-router)#**maximum-paths** [*number*]

no ip route-cache will cause traffic to be load balanced on a per-packet basis not per dest.

OSPF – link-state interior

open standard. SPF algorithm for lowest cost. Updates flooded when change occurs.

Router(config-router)#**maximum-paths** [*number*]

no ip route-cache will cause traffic to be load balanced on a per-packet basis not per dest.

EIGRP – distance vector interior (cisco)

hybrid distance/link state. Unequal cost load balancing-max 4 equal cost LB. DUAL for shortest path. Updates multicasted on 224.0.0.10 when changes occur. AS must have a 16-bit ID number

Router(config-router)#**maximum-paths** [*number*]

no ip route-cache will cause traffic to be load balanced on a per-packet basis not per dest.

BGP – distance vector exterior

between ISPs, ISPs and clients, or route Internet traffic between autonomous systems. Only 1 path to dest.

To Configure SSH access

```
router(config)# hostname hostname
router(config)# ip domain-name domainname
router(config)#crypto key generate rsa
```

How many bits: 1024 is recommended. 768 minimum

```
router(config)# ip ssh time-out 90
router(config)# ip ssh authentication-retries 4
router(config)# username cisco password class
router(config)# line vty 0 4
router(config-line)# transport input ssh (configs all vty lines w/ssh)
router(config-line)#login local
```

To troubleshoot ssh:

```
Router# show crypto key mypubkey rsa (rsa key info)
Router# debug ip ssh (debug msgs for ssh)
Router# show ssh (ssh server connections status)
Router# show ip ssh (ver and config data for ssh)
```

To disable SSH server

and delete the rsa key pair

```
router(config)# crypto key zeroize rsa
```

To enable passwords

```
router(config)# enable secret secret
router(config)# no enable password
router(config)# service password-encryption
router(config)#security passwords min-length 10
router(config)#no service password-recovery (disables rommon)
```

To create user accounts:

```
router(config)# username name password password
router(config)# username name privilege 1
router(config)# no username name
```

To set privilege level of different commands.

(user exec commands are L1 + privileged exec are 15 by default)

```
router(config)# privilege exec level 15 connect
router(config)# privilege exec level 15 telnet
router(config)# privilege exec level 15 show ip access-list
router(config)# privilege exec level 1 show ip
```

To disable services on router:

```
router# show proc
router(config)# no ip bootp server
router(config)# no ip source-route
router(config)# no ip proxy-arp (ad-hoc routing)
router(config)# no service tcp-small-servers (disables tcp servers)
router(config)# no service udp-small-servers (disables udp servers)
router(config)# no ip finger
router(config)# no service finger
router(config)# no ip http server
router(config)# no cdp run
router(config)# no boot network (disables bootp)
router(config)# no service config (disables network boot)
router(config)# no ip classless
router(config)# no ip name-server
router(config)# no ip unreachable (stops icmp msgs)
router(config-if)# no ip redirect (disables icmp redirect msgs)
router(config-if)# no ip mask-reply (stops reply's in response to icmp mask req)
router(config-if)# no ip directed-broadcast (stops smurfs)
```

Config NAT

1 To make pool of addresses

```
Router(config)#ip nat pool name start-ip end-ip netmask netmask |prefix-length /?
```

2 To make static translation- inside local to inside global:

```
Router(config)#ip nat inside source static local-ip global-ip
```

3 To create st access list

```
Router(config)#access-list acl# permit source [scr wcm]
```

4 Use access list for translation

```
Router(config)#ip nat inside source list 1 pool nat-pool
```

5 Specify the inside interface

```
Router(config)#int type
```

6 Connect to inside

```
Router(config-if)#ip nat inside.
Router (config-if)#exit
```

7 Specify outside int

```
Router(config)#int type #
```

8 Connect to outside

```
Router(config-if)#ip nat outside
```

Config PAT

1 Make acl permitting add to be translated

```
Router(config)#access-list acl # source [scr wcm]
```

2 Specify acl in step 1

```
Router(config)#ip nat inside source list acl# int int overload
```

2 Specify global address as pool for overloading

```
Router(config)#ip nat pool name start-ip end ip netmask mask | prefix-length /?
```

2 Establish overload translation

```
Router(config)#ip nat inside source list acl# pool name overload
```

3 Specify inside int

```
Router(config)#int type#
Router(config-if)#ip nat inside
Router(config-if)#exit
```

4 Specify ouside int

```
Router(config)#int type#
Router(config-if)#ip nat outside
Router(config-if)#exit
```

Config DHCP

To exclude an individual address

```
Router(config)#ip dhcp excluded-address
```

To define a pool of addresses, set the default gateway , dns-server , WINS server, netbios

```
Router(config)#ip dhcp pool name of pool
Router(dhcp-config)#network ip add
Router(dhcp-config)#default-router ip add
Router(dhcp-config)#dns-server ip add
Router(dhcp-config)#netbios-name-server ipadd
Router(dhcp-config)#domain-name name
Router(dhcp-config)#lease {days [hours] [minutes] | infinite}
```

To disable DHCP

Router(config)#**no service dhcp** command **service dhcp** to re-enable

Advanced Router Config/Security

Configure CBAC audit trails and alerts (logging)

```
Router(config)# logging on
Router(config)# logging 10.0.1.3
Router(config)# ip inspect audit-trail
Router(config)# no ip inspect alert-off
Router# show ip inspect config
Router(config)#  ip inspect tcp synwait-time<60>
Router(config)#  ip inspect tcp finwait-time<60>
Router(config)#  ip inspect tcp idle-time<60>
Router(config)#  ip inspect udp idle-time<60>
Router(config)#  ip inspect dns-timeout <60>
Router(config)#  ip inspect max-incomplete high <500> (# of existing half-open sessions—incomplete 3way shake)
Router(config)# ip inspect max-incomplete low <400> (# of halp open sessions allowed—not deleted)
Router(config)#  ip inspect one-minute high <500> (# of new half-open sessions)
Router(config)#  ip inspect one-minute low <400> (# not deleted if under)
Router(config)#  ip inspect tcp max-incomplete host <50> block-time<0>
```

Config SNMP:

To set the read-only community string used by the agent-default = public

```
Router(config)#snmp-server community string ro|rw (default rw =private)
```

To specify location of the managed device and the main system contact for the device

```
Router(config)#snmp-server location text
Router(config)#snmp-server contact text
```

To enable logging to all supported destinations:

```
Router(config)#logging on
```

To send log messages to a syslog server host, such as CiscoWorks2000:

```
Router(config)#logging hostname | ip address
```

To set logging severity level to level 6, informational:

```
Router(config)#logging trap informational
```

To include timestamp with syslog message:

```
Router(config)#service timestamps log datetime
```

AAA setup w/ACS Step by Step

```
Router(config)#username admin password cisco
Router(config)#aaa new-model
Router(config)#aaa authentication login default group tacacs+
Router(config)#aaa authentication login vty-in group tacas+ local
Router(config)#aaa authentication login console-in group tacacs+ local
Router(config)#aaa authentication enable default group tacacs+ enable
Router(config)#tacacs-server host 192.168.1.5
Router(config)#tacacs-server key secretkey
Router(config)#line console 0
Router(config-line)#login authentication console-in
Router(config-line)#exit
Router(config)#line vty 0 4
Router(config-line)#login authentication vty-in
```

Install Cisco Secure ACS on 2000 server
Cisco Secure ACS Network Access Server Details:
Authenticate users using= TACACS+
Access Server Name= Routers hostname
Access Server IP Add= Routers IP add
Windows Server IP Add= IP add of PC w/ACS installed
TACACS+ or RADIUS Key= password (must match pwd on router)
Select which advanced options to be displayed in the CiscoSecure ACS interface= Check all
Setup can help you configure a single network access server….= NOT
Setup has finished installing…= Only check yes to start the service now
Open the shortcut on the desktop
Click on usersetup
Add name of user in user box

give Real Name and description (this is the name to log into cisco with now.)

enter password

Hit submit

search for name to confirm

(DO NOT CHANGE NIC/SETTINGS ON SERVER AFTER INSTALL)

To enable Authentication Proxy using HTTP or HTTPS

Router(config)# **aaa new-model** (to enable the AAA. After AAA is enabled, TACACS commands are no longer available.

Router(config)# **aaa authentication login default group** tacacs+/radius(To set AAA authentication)

Router(config)# **aaa authorization auth-proxy default group** tacacs+/radius(To set AAA authentication)

Router(config)# **tacacs-server host** (To specify the IP address of a TACACS+ server)

Router(config)# **tacacs-server key** (To set the authentication encryption key used for all TACACS+)

or

Router(config)# **radius-server host** (To specify the IP address of a RADIUS server)

Router(config)# **radius-server key** (set the authentication encryption key used for all RADIUS)

The key entered for either the tacacs-server key or the radius-server key command must match the key used on the AAA server

```
router(config)# ip http server
router(config)# ip http authentication aaa
```

To set the global authentication proxy inactivity timeout value

```
router(config)#ip auth-proxy inactivity-timer
```

router(config)# **ip auth-proxy name** overrides the absolute timeout value

router(config)# **ip auth-proxy inactivity-timer** 120(To set the global auth proxy inactivity timeout)

router(config)# **absolute-timer** *min* (allows administrators to configure a window during which the auth proxy on the enabled interface is active.. turned off by default)

To Allow AAA traffic to a router

should be applied to the inbound direction

```
router(config)# access-list 111 permit tcp host 10.0.0.3 eq tacacs host 10.0.0.1
router(config)# accss-list 111 permit icmp any any
router(config)#access-list 111 deny ip any any
router(config)# interface ethernet 0/0
router(config-if)# ip access-group 111 in
```

To enable TCP keepalives

on incoming connections (guard against both attacks and orphaned sessions caused by remote system crashes)

router(config-line)# **service tcp-keepalives-in**

To protect routing table integrity (eigrp):

Use only static routes

router(config)# **ip route** [from ip] [snm].[to ip add]

or authenticate route table updates by using routing protocols with authentication.

```
router(config)# router eigrp 10
router(config)# network 192.168.1.0
router(config)# network 10.1.1.0
router(config)# no auto-summary
router(config)# eigrp log-neighbor-changes
router(config)# key chain routername
router(config)# key 1
router(config)# key-string cisco
router(config)# int fa0/1
router(config-if)# ip authen mode eigrp 10 md5
router(config-if)# ip authen key-chain eigrp 10 routername
```

*The **passive-interface** command is used to prevent other routers on the network from learning about routes dynamically*

To enable MD5 for RIP

```
router(config)# router rip
router(config)# version 2
router(config)# network 10.0.0.0
router(config)# network 172.30.0.0
router(config)# no auto-summary (f you have disconnected subnets, disable automatic route
summarization to advertise the subnets. When route summarization is disabled, the software transmits
subnet and host routing information across classful network boundaries)
router(config-if)# ip rip authentication mode md5.
router(config-if)# ip rip authentication key-chain routername
(Configure Key Chain)
router(config)# key chain routername
router(config)# key 1
router(config)# key-string 123456789
```

To control networks a router will accept updates from.

a combination of an access list and a distribute list applied in the inbound direction is used.

```
router(config-if)# access-list 10 permit 172.30.0.0 0.0.255.255
```

To tie the access list to the interface in the correct direction.

```
router(config-if)# router rip distribute-list 10 in fa0/1
```

To stop routing updates from being sent by the inside interface.

```
router(config-if)# passive-interface fa0/0
```

To disable NTP

if NTP hierarchy is not available:

```
router(config)# int e0/0
router(config-if)# ntp disable
```

(To disable all NTP msgs use access list)

To disable SNMP if there is an absence of a deployed SNMP scheme

Erase existing community strings, and set a hard-to-guess, read-only community string.
Apply a simple IP access list to SNMP denying all traffic.
Disable SNMP system shutdown and trap features.

```
router(config)# no snmp-server community public ro
router(config)# no snmp-server community config rw
router(config)# no access-list 60
router(config)# access-list 60 deny any
router(config)# snmp-server community dj1973 ro 60
router(config)# no snmp-server enable traps
router(config)# no snmp-server system-shutdown
router(config)# no snmp-server
```

To configure SDM for the first time:

Step 1--Connect a PC to the lowest number LAN Ethernet port of the router using a cross-over cable.
Step 2--Assign a static IP address to the PC. It is recommended to use 10.10.10.2 with a 255.255.255.0 subnet mask.
Step 3--Launch a supported web browser.
Step 4--Use the URL https://10.10.10.1. A login prompt will appear.
Step 5--Log in using the default user account:
  Username: sdm
  Password: sdm
Once the WAN interface is configured, SDM is accessible through a LAN or WAN interface.

Troubleshooting SDM Access

1. First determine if there is a web browser problem.
2. Are Java and JavaScript enabled on the browser? Enable them.

3. Are popup windows being blocked? Disable popup blockers on the PC, since SDM requires popup windows.
4. Are there any unsupported Java plug-ins installed and running? Disable them using the Windows Control Panel.
5. Is the router preventing access? Remember that certain configuration settings are required for SDM to work. Check the following:
    1. Is one of the default configurations being used, or is an existing router configuration being used? Sometimes new configurations disable SDM access.
    2. Is HTTP server enabled on the router?
    3. Did SDM access work before, but now its not? Ensure that the PC is not being blocked by a new ACL.
    4. Is SDM installed? The quickest way to determine this is to access it using the appropriate HTTP or HTTPS method https://<router IP address>/flash/sdm.shtml.
    5. Use the show flash command to view the flash file system and make sure that the required SDM files are present.

Router IDS-IPS

Install IOS IPS on Router

to load the default, built-in signatures or the attack-drop.sdf file, but not both

```
router(config)# ip ips sdf location url
OR
router(config)# ip ips sdf location disk2:attack-drop.sdf (specify's location of SDF)
router(config)# ip ips name ips-name [list acl] (creates an ips rule that will be applied to an int.)
router(config)# ip ips signature signature-id sig-#-ie:1000 disable (attaches policy to a sig(optional.)
router(config-if)# ip ips ips-name [in | out]
```

specify syslog:

```
ip audit notify
logging (ip add)
```

start audit service:

```
ip audit po local
```

how many events to monitor:

```
ip audit max-events #
```

specify protected networks:

```
ip audit protected (ip) to (ip)
```

define what to do with info and attacks:

```
ip audit name (name) info action (alarm,reset,drop)
ip audit name (name) attack action (alarm,reset,drop)
```

appy the config to interface:

```
interface X
ip audit (name) (in,out)
```

config router to ignore certain sigs:

```
ip audit signature # disable
ip audit signature # list #
```

define netword to not be protected:

```
access-list # deny (trusted network)
access-list # permit any
```

verify config:

```
show ip audit statistics
show ip audit config
show ip audit interface
show ip audit debug
```

Clear commands:

```
clear ip audit stats
clear ip audit config (removes all ids)
```

To shun

```
shun (network or IP) (dest IP) (src port) (dst port) protocol)
```

Pix commands:

help? is entered, all commands that are available in the current privilege level and mode are displayed

To save config

```
Hostname(config)#write terminal
```

To erase the running configuration, enter the following command:

```
hostname(config)# write erase
```

In order to Ping:

```
pixfirewall(config)# conduit permit icmp any any
```

To enable / view passwords:

```
pixfirewall(config)# enable secret password
pixfirewall(config)# show enable password
```

To apply hostname:

```
pixfirewall(config)# hostname fw1
Fw1(config)# default names: PIX-pixfirewall…ASA-ciscoasa
```

To config interfaces:

```
Pixfirewall# config t
pixfirewall(config)# conduit permit icmp any any
pixfirewall(config)# hostname Pix2
Pix2(config)ip address inside 192.168.1.1 255.255.255.0
Pix2(config)# interface eth1 10baset
Pix2(config)# ip address outside 1.1.2.1 255.255.255.0
Pix2(config)# int e1 10baset
Pix2(config)# static (inside,outside) 1.1.1.3 192.168.2.2 netmask 255.255.255.255
Pix2(config)# route outside 0.0.0.0 0.0.0.0 1.1.1.2
```

pixfirewall(config)nameif *assigns description/name to interface.*

pixfirewall(config)security-level 0-100 *The inside int has a default of 100 and the outside int has a default of 0. As other interfaces are named, the system assigns a*

To configure dynamic NAT

Pix (config)#nat-control *–makes all packets require a NAT rule*

After adding, changing, or removing a global statement, use the clear xlate command to make the IP addresses available in the translation table.

```
Pix(config)# nat (inside) 1 10.0.0.0 255.255.255.0
Pix(config)# nat (inside) 2 10.2.0.0 255.255.255.0 (for 2 interfaces)
Pix(config)# nat (dmz) 1 172.16.0.0 255.255.255.0 (for dmz zone)

Pix(config)# global (outside) 1 192.168.0.1 - 192.168.0.14 netmask 255.255.255.0
Pix(config)# global (outside) 2 192.168.0.17 - 192.168.0.30 netmask 255.255.255.0
Pix(config)# global (dmz) 1 172.16.0.20 - 172.16.0.254 netmask 255.255.255.0
```

To enable telnet:

```
Pix (config)# telnet netadd netmask inside
Pix (config)# password cisco
Pix (config)# telnet timeout 5
```

To enable ssh

Pix (config)# ssh netadd netmask inside *(netadd is add that is allowed to connect/ inside is the int that is allowed to connect)*

```
Pix (config)# ssh timout 5
Pix (config)# passwd cisco
Pix (config)\# domain-name cisco.com
Pix (config)# ca zeroize rsa
Pix (config)# ca generate rsa key 512
Pix (config)# ca save all
Pix(config)#aaa authentication ssh console LOCAL
```

Static routes:

```
Pix (config)# route inside 10.0.1.0 255.255.255.0 10.0.0.102 1.
Pix (config)# route outside 0.0.0.0 0.0.0.0 1.1.1.1 (no wcm on pix)
```

Setting the clock

```
Pix (config)# clock set hh:mm:ss {md|dm}year
Pix (config)# logging timestamp  adds time to syslog event msgs
Pix (config)# show clock
Pix (config)# clear configure clock
Pix (config)# clock summer-time zone recurring (only displays time zones)
Pix (config)# clock timezone zone hours [mins] (to display zone)
Pix (config)# ntp server ip_add [auth_key number] source if-name [prefer] (takes time from a server)
Pix (config)# show run ntp shows current config
Pix (config)# show ntp status shows ntp clock info
Pix (config)# clear configure ntp removes config
```

To config message output logging

Use Kiwi logging software to monitor

```
Pix (config)# logging on
Pix (config)# logging host inside 10.0.1.11
Pix (config)# logging trap warnings
Pix (config)# logging timestamp
Pix (config)# logging device-id pix6
Pix (config)# show logging/clear logging buffer
```

To configure ASDM

```
enable password password [encrypted]
clock set hh:mm:ss day month year
ip address ip_address [netmask]
hostname newname
domain-name name
http ip_address [netmask] [if_name] IP address of the host running ASDM
http server enable.
```

To view commands ignored by ASDM—Options > View Unparsed Commands.

To configure VLAN Tagging on PIX

VLANs are not supported on the PIX Security Appliance 501 and 506/ 506E models.

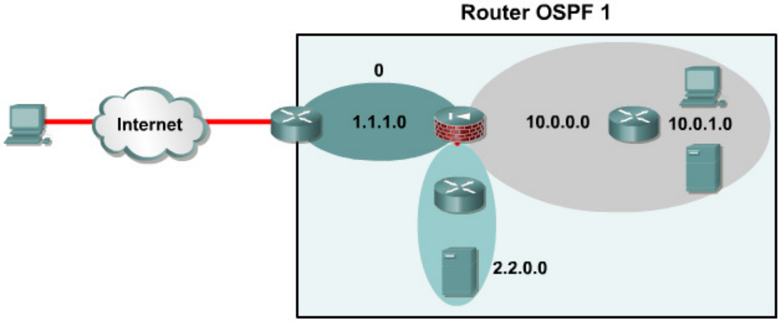
```
Pix(config)# interface ethernet3
Pix(config-if)# speed auto
Pix(config-if)#duplex auto
Pix(config-if)#no nameif
Pix(config-if)#no security-level
Pix(config-if)#no ip address

Pix(config)# interface ethernet3.1
Pix(config-subif)# vlan 10
Pix(config-subif)# nameif dmz1
Pix(config-subif)# security-level 10
Pix(config-subif)# ip address 172.16.10.1

Pix(config)# interface ethernet3.2
Pix(config-subif)# vlan 20
Pix(config-subif)# nameif dmz2
Pix(config-subif)# security-level 20
Pix(config-subif)# ip address 172.16.20.1
Pix(config)# interface ethernet3.3
Pix(config-subif)# vlan 30
Pix(config-subif)# nameif dmz3
Pix(config-subif)# security-level 30
Pix(config-subif)# ip address 172.16.30.1
```

To enter a default route,

```
Pix2(config)# route outside 0.0.0.0 0.0.0.0 1.1.1.2
show run route
```

routes can be cleared by using the **clear configure route**

To configure OSPF



```
Pix(config)# router ospf pid
Pix(config)# network 1.1.1.0 255.255.255.0 area 0
Pix(config)# network 2.2.1.0 255.255.255.0 area 2.2.0.0
Pix(config)# network 10.0.0.0 255.255.255.0 area 10.0.0.0
```

To configure OSPF with two OSPF processes when

NAT is used. OSPF is operating on the public and private interfaces.LSA type 3 advertisement filtering is required.

```
Pix(config)# router ospf 1 //public AS
Pix(config-router)# network 1.1.1.0 255.255.255.0 area 0
Pix(config)# router ospf 2 //private AS
Pix(config-router)# network 10.0.0.0 255.255.255.0 area 10.0.0.0
Pix(config-router)# network 192.168.1.0 255.255.255.0 area 192.168.1.0
```

To allow hosts to receive multicast transmissions through the PIX

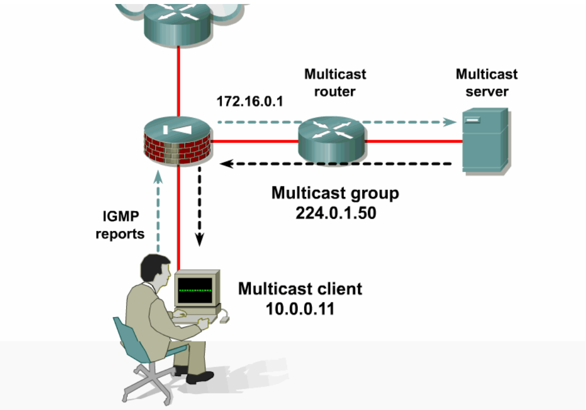
Configuring the Outside Interface

```
1 Pix(config)# interface Ethernet 0
2 Pix(config-if)# igmp access-group 110
3 Pix(config)# access-list 110 permit udp any host 224.0.1.50
```

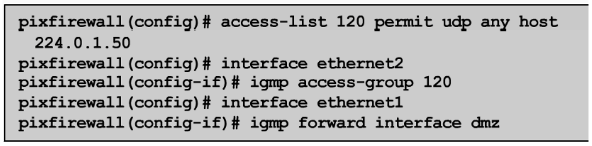
Configuring the Inside Interface

```
4 Pix(config)# interface ethernet1
5 Pix(config-if)# igmp forward interface outside
6 Pix(config-if)# igmp join-goup 224.0.1.50
```

Optional: igmp ver 2/ igmp query-interval 120/ igmp query-max-response-time 50



1 Host 10.0.0.11 sends an IGMP report:
   Source 10.0.0.11
   Destination 224.0.1.50
   IGMP group 224.0.1.50
2. The firewall appliance accepts the packet, and IGMP places the inside interface on the output list for the group.
3. The firewall appliance forwards the IGMP packet to the multicast router:
   Source 172.16.0.1
   Destination 224.0.1.50
   IGMP group 224.0.1.50
4. The router places the input interface on the output list for the group.
5. Packets from the multicast server arrive at the router, which forwards them to the necessary interfaces.
6. The firewall appliance accepts the packets and forwards them to the interfaces for the group.



```
pixfirewall(config)# access-list 120 permit udp any host
  224.0.1.50
pixfirewall(config)# interface ethernet2
pixfirewall(config-if)# igmp access-group 120
pixfirewall(config)# interface ethernet1
pixfirewall(config-if)# igmp forward interface dmz
```

To enable AAA on PIX

Pix(config)# **aaa-server** <name of server> **protocol** tacacs+/radius
Pix(config)# **aaa-server** server-tag **host** host ip
Pix(config)# **aaa authentication serial console** (to access the console) [serial | enable | telnet | ssh] console
Pix(config)# **username** admin **password** cisco
Pix(config)# **aaa authentication** telnet console local
Pix(config)# **aaa local authentication attempts max-fail** # of tries
Pix(config)# **auth-prompt prompt** Please Authenticate
Pix(config)# **auth-prompt reject** Authentication Failed
Pix(config)# **auth-prompt accept** Login successful
Pix(config)# **timeout uauth** 3:00:00 **absolute** (from time at login)
Pix(config)# **timeout uauth** 0:30:00 **inactivity** (when traffic stops)
Pix(config)# **radius-server key** string (specifys aaa group)

Block Active X / Java

Pix(config)# filter activex 80 0.0.0.0 0.0.0.0. 0.0.0.0. 0.0.0.0.
Pix(config)# filter java 80 0.0.0.0 0.0.0.0. 0.0.0.0. 0.0.0.0.

URL filtering

Pix(config)# **url-server** (interface) **host** [ip of websense server] **timeout** 10 **protocol** TCP version 4
Pix(config)# **filter url** http 0 0 0 0 **allow** (the allow says if websense server goes down, allow…if not

Filtering http/https/ftp 6.3 and later

Pix(config)# filter https 0 0 0 0 allow

Pix ACL's

Pix(config)# **access-list** DMZ1 **deny tcp** 192.168.1.0 255.255.255.0 **host** 192.168.0.1 **lt** 1025
(denies access from the 1.0 network to tcp ports less than 1025 to DMZ host 0.1)
Pix(config)# **access-group** DMZ1 **in interface** dmz
(binds ACL DMZ1 to interface dmz)

Pix(config)# **Access-list** NONAT **permit ip host** 10.0.0.11 **host** 10.2.1.3
Pix(config)# **nat** (inside) 0 **access-list** NONAT
(allows the ACL to define traffic that is to be excluded from the NAT process)
Pix(config)# **show access-list**
Pix(config)# **clear access-list**
Pix(config)# **no access-list**
Pix(config)# **access-list mode** auto-commit|manual-commit
(auto= any acl entered will take effect immediately…. Manual= any acl entered will take effect when the access-list commit command is used.)
Pix(config)# **access-list DMZ1 line** 2 **permit tcp any host** 192.168.0.1 **eq www**
(inserts a new line into exsisting acl. This line will now be 2 and line 2 in the list will now be 3)

<u>In order to Ping:</u>
pixfirewall(config)# conduit permit icmp any any
or
pixfirewall(config)# icmp deny any echo outside (all pings denied at outside int)
pixfirewall(config)# icmp permit any unreachable outside (all unreachable allowed at outside int)

VPN ACL's
pixfirewall(config)# access-list [name of acl] permit ip [source/snm] [destination/snm]
pixfirewall(config)# nat (inside) 0 access-list [name of acl for vpn]

Turbo ACL
Sorts acl's over 19 entries long into table for faster processing
pixfirewall(config)# access-list compiled (all acl's will be scanned)
pixfirewall(config)# access-list [acl name] (only that acl will be compiled)

Configure Groups for ACLs

```
Usage:  [no] object-group protocol | network | icmp-type <obj_grp_id>
        [no] object-group service <obj_grp_id> tcp|udp|tcp-udp
        show object-group [protocol | service | icmp-type | network]
        show object-group id <obj_grp_id>
        clear object-group [protocol | service | icmp-type | network]
```

Switches
To enable port security/stop CAM overflow-MAC,ARP,DHCP Vulnerabilitys
Switch(config)# **interface** int_id
Switch(config-if)# **switchport mode access**
Switch(config-if)# **switchport port-security**
Switch(config-if)# **switchport port-security** 00.0F.A2.13.D6.7F (set's 1 mac only to port)
OR
Switch(config-if)# **switchport port-security maximum** 1-132 (sets max # of mac's allowed)
Switch(config-if)# **switchport port-security violation** [protect|restrict|shutdown]
Switch# **show port-security int** int_id
Switch# **show port-security** address

To Stop MAC Spoofing
Switch(config-if)# **port security max-mac-count** (1-132)
Switch(config-if)# **port security action** [shutdown|trap]
Switch(config-if)# **arp timeout** 30 (seconds)

To config DHCP Snooping (stops false arp's from non dhcp servers)
Switch(config)# **ip dhcp snooping** (enables it globally)
Switch(config)# **ip dhcp snooping vlan** 10 (enables on a vlan OR range of vlans *must have*)
Switch(config)# **interface** int_id
Switch(config-if)# **ip dhcp snooping trust** (a dhcp server is on this port)
Switch(config-if)# **ip dhcp snooping limit rate** 100 (per second)
Switch# **show ip dhcp snooping**
Switch# **show ip dhcp snooping binding**

To verify new module installation of FWSM
is online Enter the **show module** command on the switch.

To configure the FWSM on the switch:

1st: config the switch:

```
Switch(config)# vlan 100
Switch(config-vlan)# no shutdown
Switch(config)# int vlan 100
Switch(config-if)# ip add 192.168.1.2.255.255.255.0
Switch(config-if)# no shut down
```

2nd : associate VLANs to be inspected by the FWSM

```
Switch(config)# firewall vlan-group 1 100 (200, 300 etc)
Switch(config)# firewall module 4 vlan-group 1
```

3rd: Verify the MSFC Configuration

```
Switch(config)# show firewall vlan-group
Switch(config)# show firewall module.
```

4th: Configure the security policy on the FWSM

```
Switch(config)# session slot 4 processor 1
Fwsm(config)# nameif 100 outside 0
Fwsm(config)# ip add outside 192.168.1.2 255.255.255.0
Fwsm(config)# nameif 200 inside 100
Fwsm(config)# ip add inside 10.0.1.1 255.255.255.0
Fwsm(config)# nameif 300 dmz 50
Fwsm(config)# ip add dmz 172.16.1.1 255.255.255.0
```

5th: Configure a default route
(static routes must be used to reach any networks to which the FWSM is not directly connected)

```
Fwsm(config)# route outside 0.0.0.0 0.0.0.0 192.168.1.1
```

6th: Configure access-lists
(by default all traffic is denied throught the fwsm)

```
Fwsm(config)# access-list 200 permit ip 10.1.1.0 255.255.255.0 any
Fwsm(config)# access-group 200 in interface inside
```

Use PDM to configure FWSM
copy the PDM image into FWSM flash
copy tftp flash

```
  copy tftp://10.1.1.1/pdm-XXX.bin flash:pdm
  (where XXX = pdm image version number)
* Enable the http server on the FWSM. Without it, PDM will not start.
  http server enable
* Identify the specific hosts/networks that can access the FWSM using HTTP.
  http 1.1.1.0 255.255.255.0 inside
  Hosts from network 10.1.1.0 (on the inside interface) are permitted http access.
* Launch the browser and enter the following address:
  https://10.1.1.1 (FWSM inside interface)
```

Resetting and Rebooting the FWSM
When FWSM boots, it runs a partial memory test. To perform a full memory tes

```
hw-module module # reset
hw-module module # mem-test-full
```

To configure 802.1x on Switch

Enable aaa on switch

```
Switch# config t
Switch (config)# aaa new-model
Switch (config)# aaa authentication dot1x default group radius
Switch (config)# interface fastethernet 0/12
Switch (config-if)# dot1x port-control auto
Switch (config-if)# end
```

Config radius server on switch

```
Switch (config)# radius-server host <ip add of acs> auth-port <1812 default udp port> key secret
```

Set the IP of switch and key string on the RADIUS server

To set Periodic 802.1x client re-authentication

```
Switch (config)# dot1x re-authentication
Switch (config)# dot1x timeout re-authperiod <time>
```

To manually re-authenticate a client

```
Switch (config)# dot1x re-authenticate interface fastethernet 0/12
```

To enable multiple host on one port

```
Switch (config)# interface fastethernet 0/1
Switch (config-if)# dot1x port-control auto
Switch (config-if)# dot1x multiple-hosts
```

To reset all dot1x to default

```
Switch (config)# dot1x default
Switch# show dot1x
Switch# show dot1x statistics
Switch# show dot1x statistics interface fastethernet 0/1
```

VPN's

Router with IKE Using Pre-shared Keys

Prepare IKE pre-shared keys in Cisco routers

Build a site-to-site IPSec VPN or a router-to-router IPSec VPN. Site-to-site IPSec VPNs can be established between any combination of routers, PIX Security Appliances, VPN concentrators, VPN clients, and other devices that are IPSec compliant…Based on a pre-shared secret. Both peers share a secret password string between them:

(Authentication is based on the IP address of the remote peer, not its IKE identity-significant problems with dynamic addresses)

A chooses a string and sends it to B.
B hashes the string with the pre-shared secret and yields a hash value
B sends the hashing back to A.
A calculates its own hash and matches it with the result from B
If they match, B is considered authenticated.
B chooses a different random string and sends it to A.
A also hashes the string with the pre-shared secret.
A sends the hash back to B.
B locally hashes the value and the secret and matches it against the received authenticated hash. If they match, A is authenticated.

Prepare:

Step 1 –Determine IKE phase one policy between IPSec peers based on the # and location of the peers:
Determine the key distribution method
Determine the authentication method
Identify IPSec peer IP addresses and host names
Determine ISAKMP policies for peers

Step 2 – Determine IKE phase two policy . Identify IPSec peer details such as IP addresses, IPSec transform sets, and IPSec modes , . Crypto maps will be used to gather all IPSec policy details together during the configuration phase .

RouterA(config)# crypto ipsec transform-set [set-name]
(AH is not compatible with NAT or PAT.)

Step 3 – Check the current configuration . **show**:
Crypto ipsec transform-set [name] (view previously configured transform sets)
Crypto map (viewing any previously configured crypto maps)
Run
Crypto isakmp policy (examine IKE policies)

Step 4 – Ensure that the network works without encryption. **Ping**
.
Step 5 – Ensure that the ACLs are compatible with IPSec. Ensure that perimeter routers and the IPSec peer router permit IPSec traffic. Use the **show access-lists** command for this step.
<u>To add ACL entries to permit IPSec traffic:</u>
Copy the existing ACL configuration and paste it into a text editor.
Add the ACL entries to the top of the list in the text editor.

```
RouterA(config)# access-list 102 permit ahp host [A’s IP-add] host [B’s IP-add]
RouterA(config)# access-list 102 permit esp host [A’s IP-add] host [B’s IP-add]
RouterA(config)# access-list 102 permit udp host [A’s IP-add] host [B’s IP-add] eq isakmp

RouterB(config)# access-list 102 permit ahp host [B’s IP-add] host [A’s IP-add]
RouterB(config)# access-list 102 permit esp host [B’s IP-add] host [A’s IP-add]
RouterB(config)# access-list 102 permit udp host [B’s IP-add] host [A’s IP-add] eq isakmp
```

Delete the existing ACL with the no access-list access-list number command.
Enter configuration mode and copy and paste the new ACL into the router.
Verify that the ACL is correct with the show access-lists command.

```
RouterA(config)# show run
RouterA(config)# show crypto isakmp policy
RouterA(config)# show crypto map
RouterA(config)# ping
RouterA(config)# show access-list
```

Create isakmp policy
RouterA(config)# crypto isakmp enable (globally enables/disables.)
RouterA(config)# crypto isakmp policy # (creates a policy)
RouterA(config-isakmp)# **encryption** [**des**|3des] (sets algorithm)
RouterA(config-isakmp)# **hash** [sha|**md5**] (sets hash algorithm)
RouterA(config-isakmp)# **authentication** [rsa-sig|rsa-encr|**pre-shar**] (sets auth method)
RouterA(config-isakmp)# **group** [**1**|2|5] (sets diffie group ID)
RouterA(config-isakmp)# **lifetime** [secs] (sets lifetime of SA. ie: 86400)
RouterA(config)# crypto isakmp identity [int-IP-add|hostname] (By default, a peer's identity is the IP address of the peer. Either all peers should use their IP addresses or all peers should use their host names)
Config Pre-Shared Keys:
RouterA(config)# **crypto isakmp key** [string] **address** [peer-address] (assigns a keystring and the peer’s add)
OR
RouterA(config)# **crypto isakmp key** [keystring] **hostname** [hostname] (the peer’s IP add or hostname can be used)
Repeat for each remote peer
RouterA# show crypto isakmp policy
Configure a Router with <u>IPSec</u> Using Pre-shared Keys
Step 1 Configure transform set suites with the crypto ipsec transform-set command.

Step 2 Configure global IPSec security association lifetimes with the crypto ipsec security-association lifetime command.
Step 3 Configure crypto ACLs with the access-list command.
Step 4 Configure crypto maps with the crypto map command.
Step 5 Apply the crypto maps to the terminating/originating interface with the interface and crypto map commands.

Configure transform set suites

During IPSec security association negotiations with IKE, the peers search for a transform set that is the same at both peers.
RouterA(config)# **crypto ipsec transform-set** [name] [transoform1|trans2|trans3] (defines set.)
RouterA(cfg-crypto-trans)# **mode** [**tunnel | transport**] (optional: changes mode of trans set only applicable to traffic whose src and dst are the IPSec peer add.)

To edit a Transform Set:

Config trans set suites
Delete the trans set from crypto map
Delete trans set from global config
Reenter the trans set
Assign the set to a crypto map
Clear SA DB

To force the new settings to take effect

RouterA(config)# clear crypto sa

Configure global IPSec SA lifetimes

only apply to security associations established via IKE-- default -3,600 seconds, and 4,608,000 kilobytes per/hour.
routerA(config)# **crypto ipsec security-association lifetime** [secs|**kilobytes** bytes](configs global SA lifetime. Crypto maps lifetimes will override these)

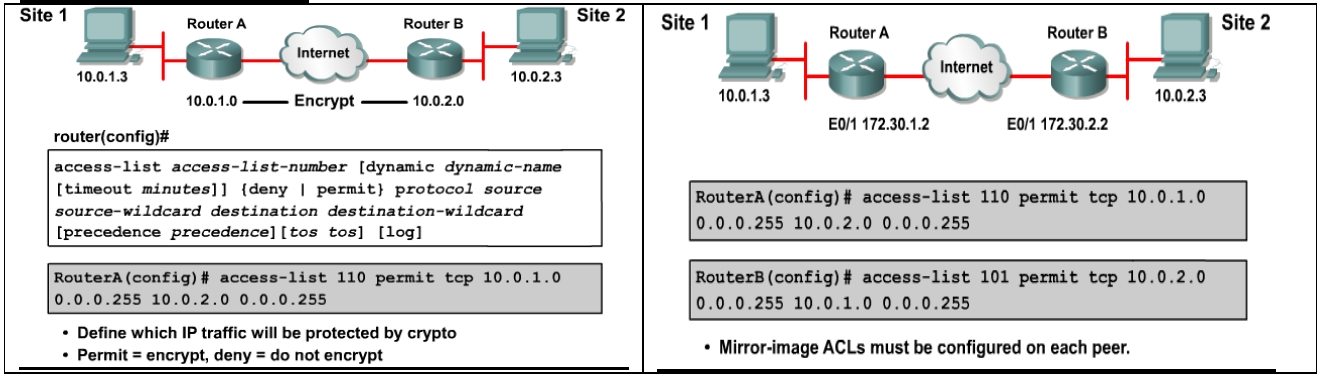
To use the new values immediately

routerA(config)# **clear crypto sa** (Associations established manually, marked as **ipsec-manual**, have an infinite lifetime.)

Config Crypto access lists

To define which IP traffic will be protected by IPSec and which traffic will not. Note: **permit** specifies that matching packets must be encrypted. **deny** specifies that matching packets need not be encrypted. Any unprotected inbound traffic that matches a permit entry in the crypto ACL for a crypto map entry flagged as IPSec will be dropped, because this traffic was expected to be protected by IPSec. permit **any any** statement is strongly discouraged, as this will cause all outbound traffic to be protected, and will require protection for all inbound traffic.

Use symmetrical ACLs



router(config)#

```
access-list access-list-number [dynamic dynamic-name
[timeout minutes]] {deny | permit} protocol source
source-wildcard destination destination-wildcard
[precedence precedence][tos tos] [log]
```

```
RouterA(config)# access-list 110 permit tcp 10.0.1.0
0.0.0.255 10.0.2.0 0.0.0.255
```

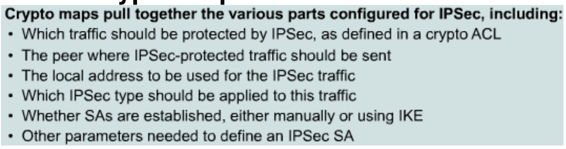
- Define which IP traffic will be protected by crypto
- Permit = encrypt, deny = do not encrypt

```
RouterA(config)# access-list 110 permit tcp 10.0.1.0
0.0.0.255 10.0.2.0 0.0.0.255
```

```
RouterB(config)# access-list 101 permit tcp 10.0.2.0
0.0.0.255 10.0.1.0 0.0.0.255
```

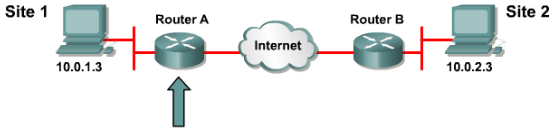
- Mirror-image ACLs must be configured on each peer.

Create crypto maps



Crypto maps pull together the various parts configured for IPSec, including:

- Which traffic should be protected by IPSec, as defined in a crypto ACL
- The peer where IPSec-protected traffic should be sent
- The local address to be used for the IPSec traffic
- Which IPSec type should be applied to this traffic
- Whether SAs are established, either manually or using IKE
- Other parameters needed to define an IPSec SA

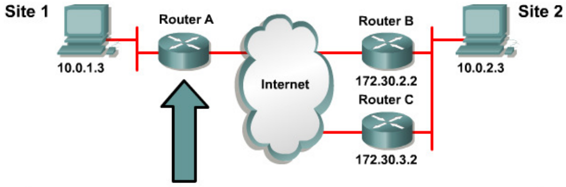


```
crypto map map-name seq-num ipsec-manual
```

```
crypto map map-name seq-num ipsec-isakmp [dynamic
dynamic-map-name]
```

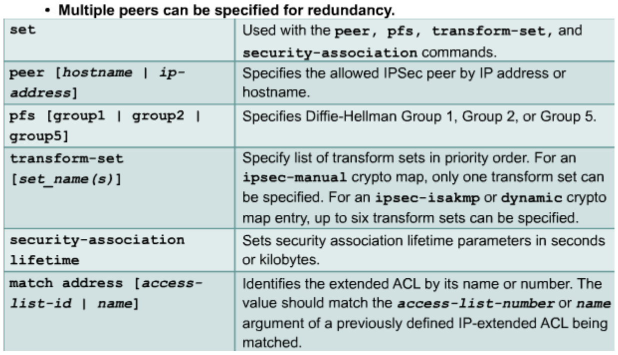
```
RouterA(config)# crypto map MYMAP 110 ipsec-isakmp
```

- Use a different sequence number for each peer.
- Multiple peers can be specified in a single crypto map for redundancy.
- One crypto map per interface.



```
RouterA(config)# crypto map MYMAP 110 ipsec-isakmp
RouterA(config-crypto-map)# match address 110
RouterA(config-crypto-map)# set peer 172.30.2.2
RouterA(config-crypto-map)# set peer 172.30.3.2
RouterA(config-crypto-map)# set pfs group1
RouterA(config-crypto-map)# set transform-set MINE
RouterA(config-crypto-map)# set security-association
lifetime seconds 86400
```

- Multiple peers can be specified for redundancy.



set	Used with the **peer, pfs, transform-set,** and **security-association** commands.
peer [*hostname* | *ip-address*]	Specifies the allowed IPSec peer by IP address or hostname.
pfs [group1 | group2 | group5]	Specifies Diffie-Hellman Group 1, Group 2, or Group 5.
transform-set [*set_name(s)*]	Specify list of transform sets in priority order. For an **ipsec-manual** crypto map, only one transform set can be specified. For an **ipsec-isakmp** or **dynamic** crypto map entry, up to six transform sets can be specified.
security-association lifetime	Sets security association lifetime parameters in seconds or kilobytes.
match address [*access-list-id* | *name*]	Identifies the extended ACL by its name or number. The value should match the ***access-list-number*** or ***name*** argument of a previously defined IP-extended ACL being matched.

Apply crypto maps to interfaces

If the same crypto map set is applied to multiple interfaces for redundancy, an identifying interface needs to be specified. suggestion is to use a loopback

To specify redundant interfaces and name an identifying interface

Router(config)# **int** eth0/1
Router(config-if) **crypto map** MYMAP (apply's to interface/activates the IPSec policy)
Router(config)# **crypto map** *MYMAP* **local-address** *interface-id*

Show Commands

Test and Verify the IPSec Configuration of the Router
 * Display the configured ISAKMP policies using the **show crypto isakmp policy** command.
 * Display the configured transform sets using the **show crypto ipsec transform-set** command.
 * Display the current state of the IPSec SAs with the **show crypto ipsec sa** command.
 * View the configured crypto maps with the **show crypto map** command.
 * Debug ISAKMP and IPSec traffic through the Cisco IOS with the **debug crypto ipsec** and **debug crypto isakmp** commands. Example:

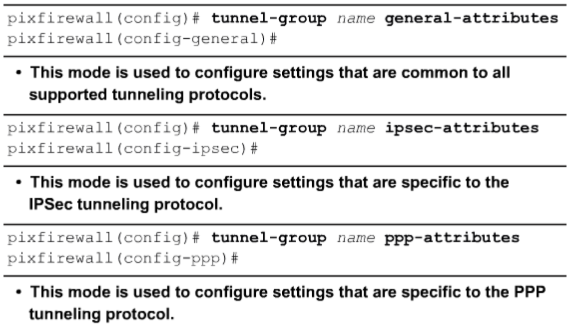
- %CRYPTO-6-IKMP_SA_NOT_AUTH: Cannot accept Quick Mode exchange from %15i if SA is not authenticated!
  The ISAKMP security association with the remote peer was not authenticated yet the peer attempted to begin a Quick Mode exchange. This exchange must only be done with an authenticated security association. The recommended action is to contact the administrator of the remote peer to resolve the improper configuration.

- %CRYPTO-6-IKMP_SA_NOT_OFFERED: Remote peer %15i responded with attribute [chars] not offered or changed
  ISAKMP peers negotiate policy by the initiator offering a list of possible alternate protection suites. The responder responded with an ISAKMP policy that the initiator did not offer. The recommended action is to contact the administrator of the remote peer to resolve the improper configuration.

PIX Site-to-Site VPN using Pre-shared Keys

Prepare to configure VPN support
Determine the IKE policies between peers based on the number and location of IPSec peers.
Identify IPSec peer details such as IP addresses and IPSec modes. Determine the IPSec policies applied to the encrypted data passing between peers.
Ensure that basic connectivity has been achieved between IPSec peers using the desired IP services before configuring firewall appliance IPSec.
Implicitly permit IPSec packets to bypass PIX Secuity Appliance ACLs and access groups. This can be done with the **sysopt connection permit-ipsec** command.
Configure IKE parameters
Enable IKE
Pix(config)# **isakmp enable** outside (disables IKE on int not for IPSec
Pix(config)# **isakmp policy** 10 **encryption** des (10=priority)
Pix(config)# **isakmp policy** 10 **hash** share (default is sha)
Pix(config)# **isakmp policy** 10 **authentication** pre-share
Pix(config)# **isakmp policy** 10 **group** 1 (specifies the DH group ID. 1 = default)
Pix(config)# **isakmp policy** 10 **lifetime** 86400 (lifetime in secs..86400 =default)
Config tunnel group:
Pix(config)# **tunnel-group** name **type** type (names the tunnel + says the type of VPN)
Ie Pix(config)# **tunnel-group** 192.168.6.2 **type** IPSec-L2L
Config tunnel group attributes- pre-shared key:
Pix(config)# **tunnel-group** name [**general-attributes | IPSec-att | pppattributes**]
Pix(config-ipsec)# **pre-shared-key** cisco123 (associates the key w/the policy)

The tunnel group Command Variations



```
pixfirewall(config)# tunnel-group name general-attributes
pixfirewall(config-general)#
```

- This mode is used to configure settings that are common to all supported tunneling protocols.

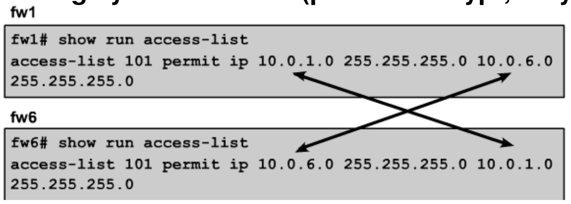
```
pixfirewall(config)# tunnel-group name ipsec-attributes
pixfirewall(config-ipsec)#
```

- This mode is used to configure settings that are specific to the IPSec tunneling protocol.

```
pixfirewall(config)# tunnel-group name ppp-attributes
pixfirewall(config-ppp)#
```

- This mode is used to configure settings that are specific to the PPP tunneling protocol.

Verify IKE policies
Pix# **show run crypto isakmp** (displays configured and default policies)
Pix# **show run tunnel-group** (displays tunnel group information about all or a specified tunnel group and tunnel group attributes)
Configure IPSec parameters
Config symetrical acl's (permit=encrypt,deny=don't encrypt)



fw1

```
fw1# show run access-list
access-list 101 permit ip 10.0.1.0 255.255.255.0 10.0.6.0
255.255.255.0
```

fw6

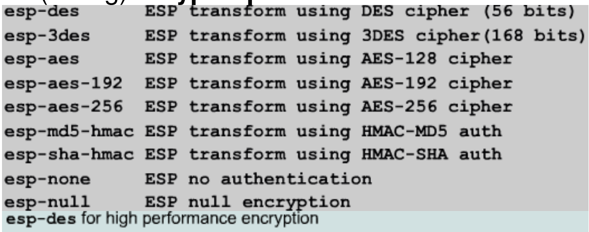
```
fw6# show run access-list
access-list 101 permit ip 10.0.6.0 255.255.255.0 10.0.1.0
255.255.255.0
```

Exclude traffic w/nat0

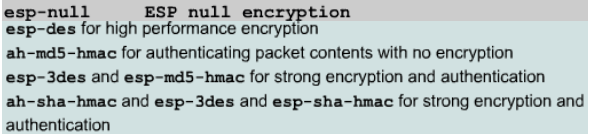
Pix(config)# **nat** (inside) **0 access-list** 101 (do not translate these addresses)

Config an IPSec transform Set

Pix(config)# **crypto ipsec transform-set** *name-set* **esp-des**



```
esp-des       ESP transform using DES cipher (56 bits)
esp-3des      ESP transform using 3DES cipher(168 bits)
esp-aes       ESP transform using AES-128 cipher
esp-aes-192   ESP transform using AES-192 cipher
esp-aes-256   ESP transform using AES-256 cipher
esp-md5-hmac  ESP transform using HMAC-MD5 auth
esp-sha-hmac  ESP transform using HMAC-SHA auth
esp-none      ESP no authentication
esp-null      ESP null encryption
```



esp-des for high performance encryption

ah-md5-hmac for authenticating packet contents with no encryption

esp-3des and **esp-md5-hmac** for strong encryption and authentication

ah-sha-hmac and **esp-3des** and **esp-sha-hmac** for strong encryption and authentication

Config the crypto map:

Pix(config)# **crypto map** *map-name seq-num* [**ipsec-isakmp** |**ipsec-manual** | **[dynamic** *dynamic-map-name*]

Ipsec-isakmp= IKE will be used to protect traff

Ipsec-maual=IKE will not be used. (not on 501)

Pix(config)# **crypto map** *name seq#* **match address** *access-list-name* (assign an ACL to map)

Pix(config)# **crypto map** *name seq#* **set peer** [hostname |ip-add] (sets peer name /add, multi can be used)

Pix(config)# **crypto map** *name seq#* **set transform-set** [transform-set-name1-6] (up to 6, list in order of priority)

Apply map to interface:

Pix(config)# **crypto map** *name* **interface** *int-name*

Ie: crypto map fw1map interface outside

Test

- Verify ACLs and select interesting traffic with the **show run access-list** command.
- Verify correct IKE configuration with the **show run isakmp** and **show run tunnel-group** commands.
- Verify correct IPSec configuration of transform sets with the **show run ipsec** command.
- Verify the correct crypto map configuration with the **show run crypto map** command.
- Clear IPSec SAs for testing of SA establishment with the **clear crypto ipsec sa** command.
- Clear IKE SAs for testing of IKE SA establishment with the **clear crypto isakmp sa** command.
- Debug IKE and IPSec traffic with the **debug crypto ipsec** and **debug crypto isakmp** commands.

Example config

Show commands

Show static

Show isakmp policy

```
Pix2(config)# access-list 102 permit ah host 1.1.1.1 host 1.1.1.2
Pix2(config)# access-list 102 permit esp host 1.1.1.1 host 1.1.1.2
Pix2(config)# access-list 102 permit udp host 1.1.1.1 host 1.1.1.2 eq isakmp
Pix2(config)# sysopt connection permit-ipsec
Pix2(config)# isakmp enable outside
Pix2(config)# isakmp policy 10 authentication pre-share
Pix2(config)# isakmp policy 10 encrypt des
Pix2(config)# isakmp policy 10 hash md5
Pix2(config)# isakmp policy 10 group 1
Pix2(config)# isakmp policy 10 lifetime 86400
Pix2(config)# isakmp identity address
Pix2(config)# name 1.1.1.1 Pix1
Pix2(config)# isakmp key cisco123 address 1.1.1.1 netmask 255.255.255.255
```

```
Pix2(config)# crypto ipsec transform-set MYIPSEC esp-des
Pix2(config)# static (inside,outside) 1.1.1.5 192.168.2.5 netmask 255.255.255.255
Pix2(config)# access-list 102 permit ip host 1.1.1.5 host 1.1.1.5
Pix2(config)# crypto map MYMAP 10 ipsec-isakmp
Pix2(config)# crypto map MYMAP 10 match address 102
WARNING: access-list has port selectors may have performance impact
Pix2(config)# crypto map MYMAP 10 set peer 1.1.1.1
Pix2(config)# crypto map MYMAP 10 set transform-set MYIPSEC
Pix2(config)# crypto map MYMAP interface outside
```

Router Site to Site VPN using Digital Certificates

Basic steps:

manage NVRAM (date/time)

set router time and date

a. router(config)#**clock timezone** *zone* **hours** [mins]

b. router(config)#**clock set** *hh:mm:ss day month year* or

c. router(config)#**clock set** *hh:mm:ss month day year*

The router can optionally be set to automatically update the calendar and time from a Network Time Protocol (NTP) server with the **ntp** series of commands.

config hostname and domain name

d. router(config)#**hostname** *name*

e. router(config)#**ip domain-name** *name*

f. router(config)#**ip host** *name ip-add-of-CAserver* (if domain name is not resolvable)

To define a default domain name that the Cisco IOS software uses to complete unqualified hostnames use the **ip domain-name global** configuration command. Unqualified names are names without a dotted-decimal domain name

generate RSA key pair

g. router(config)#**crypto key generate rsa** [*general-keys* | *usage-keys*]

using the keyword 'usage-keys' generates two sets of rsa keys. Use on set for rsa signatures and rsa encrypted nonces. 512 = default bits 1024= recommended.

Declare a CA

Note that in 12.3(7)T, crypto pki trustpoint replaces the crypto ca trustpoint command from previous Cisco IOS software releases. The crypto ca trustpoint command can be entered, but the command will be written in the configuration as crypto pki trustpoint.

h. Router(config)# **crypto pki trustpoint** *name* (will allow the router to re-enroll to the CA server automatically when its certificates expire)

i. Router(ca-trustpoint)# **enrollment** url http://vpnca/certsrv/mscep/mscep.dll

j. Router(ca-trustpoint)# **enrollment** mode ra

k. Router(ca-trustpoint)# **crl** optional

This example declares an Entrust CA and identifies characteristics of the CA. In this example, the name vpnca is created for the CA, which is located at http://vpnca. The example also declares a CA using an RA. The scripts for the CA are stored in the default location, and the CA uses SCEP instead of LDAP. This is the minimum possible configuration required to declare a CA that uses an RA. Note that the enrollment URL points to the MSCEP DLL.

Authenticate the CA

To get the public key of the CA, use the **crypto pki authenticate**name command in global configuration mode. Use the same name that was used when declaring the CA with the **crypto pki trustpoint** command in step 5.

l. Router(config)# **crypto pki authenticate** *name*

Request a certificate for the router.

m. Router(config)# **crypto pki enroll** *name* (request signed certificates from the CA)

Save the config

n. Router# **wr**

Use the **copy system:running-config nvram:startup-config** command to save the configuration. This command includes saving RSA keys to private NVRAM. RSA keys are not saved with the configuration when a **copy system:running-config rcp:** or **copy system:running-config tftp:** command is issued.

optional: monitor and maintain CA interoperability

o. crypto pki trustpoint *name*

Verify config

p. Show crypto pki certificates

q. Show crypto key *mypubkey* | pubkey-chain

To specify that certificates and CRLs should not be stored locally on the router, but should be retrieved when required, turn on query mode by using the **crypto ca certificate query**

If query mode is turned on initially, it can turned off later. If query mode is turned off later, the **copy system:running-config nvram:startup-config** command can be issued beforehand to save all current certificates and CRLs to NVRAM.

Easy VPN Server for XAUTH with Easy VPN Remote clients :

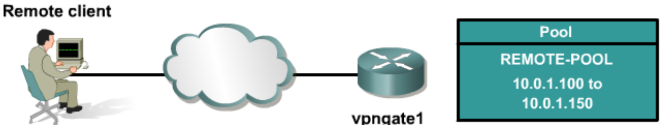
1 – Create an IP address pool.

router(config)#

```
ip local pool {default | pool-name low-ip-
  address [high-ip-address]}
```

```
vpngate1(config)# ip local pool REMOTE-POOL
  10.0.1.100 10.0.1.150
```

- Creating a local address pool is optional if an external DHCP server is in use on the network.



2 – Configure group policy lookup.

router(config)#

```
aaa new-model
```

router(config)#

```
aaa authorization network list-name local
[method1 [method2…]]
```

```
vpngate1(config)# aaa new-model
vpngate1(config)# aaa authorization network
 VPN-REMOTE-ACCESS local
```

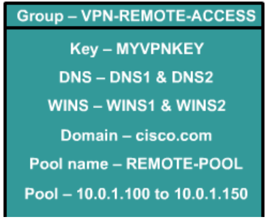
- Creates a user group for local AAA policy lookup

3 – Create an ISAKMP policy for remote VPN client access.

```
vpngate1(config)# crypto isakmp enable
vpngate1(config)# crypto isakmp policy 1
vpngate1(config-isakmp)# authen pre-share
vpngate1(config-isakmp)# encryption 3des
vpngate1(config-isakmp)# group 2
vpngate1(config-isakmp)# exit
```

- Use standard ISAKMP configuration commands.

4 – Define a group policy for a mode configuration push.



Group – VPN-REMOTE-ACCESS

Key – MYVPNKEY

DNS – DNS1 & DNS2

WINS – WINS1 & WINS2

Domain – cisco.com

Pool name – REMOTE-POOL

Pool – 10.0.1.100 to 10.0.1.150

router(config)#

```
crypto isakmp client configuration group
{group-name | default}
```

```
vpngate1(config)# crypto isakmp client
configuration group VPN-REMOTE-ACCESS
vpngate1(config-isakmp-group)#
```

```
vpngate1(config-isakmp-group)# key MYVPNKEY
```

router(config-isakmp-group)#

```
dns primary-server secondary-server
```

```
vpngate1(config-isakmp-group)# dns DNS1 DNS2
```

```
vpngate1(config-isakmp-group)# dns
172.26.26.120 172.26.26.130
```

router(config-isakmp-group)#

```
wins primary-server secondary-server
```

```
vpngate1(config-isakmp-group)# wins WINS1 WINS2
```

```
vpngate1(config-isakmp-group)# wins
172.26.26.160 172.26.26.170
```

```
vpngate1(config-isakmp-group)# domain cisco.com
```

```
vpngate1(config-isakmp-group)# pool REMOTE-POOL
```

5 – Create a transform set.

router(config)#

```
crypto ipsec transform-set transform-set-name
transform1 [transform2 [transform3]]
```

```
vpngate1(config)# crypto ipsec transform-set
VPNTRANSFORM esp-3des esp-sha-hmac
vpngate1(cfg-crypto-trans)# exit
```

6 – Create a dynamic crypto map with RRI.

router(config)#

```
crypto dynamic-map dynamic-map-name
 dynamic-seq-num
```

```
vpngate1(config)# crypto dynamic-map DYNMAP 1
vpngate1(config-crypto-map)#
```

router(config-crypto-map)#

```
set transform-set transform-set-name
 [transform-set-name2…transform-set-name6]
```

```
vpngate1(config-crypto-map)# set transform-set
 VPNTRANSFORM
```

```
vpngate1(config-crypto-map)# reverse-route
vpngate1(config-crypto-map)# exit
```

7 – Apply a mode configuration to the dynamic crypto map.

router(config)#

```
crypto map map-name client configuration
address {initiate | respond}
```

```
vpngate1(config)# crypto map CLIENTMAP client
configuration address respond
```

router(config-crypto-map)#

```
crypto map map-name isakmp authorization list
list-name
```

```
vpngate1(config)# crypto map CLIENTMAP isakmp
authorization list VPN-REMOTE-ACCESS
```

router(config)#

```
crypto map map-name seq-num ipsec-isakmp
dynamic dynamic-map-name
```

```
vpngate1(config)# crypto map CLIENTMAP 65535
ipsec-isakmp dynamic DYNMAP
```

8 – Apply the crypto map to the router interface.

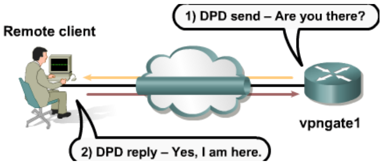
```
vpngate1(config)# interface ethernet0/1
vpngate1(config-if)# crypto map CLIENTMAP
vpngate1(config-if)# exit
```

9 – Enable IKE dead peer detection (DPD).

router(config)#

```
crypto isakmp keepalive secs retries
```

```
vpngate1(config)# crypto isakmp keepalive 20 10
```



10 – Configure XAUTH. XAUTH is not required when using Easy VPN. This option can be disabled.

```
aaa authentication login list-name method1
[method2...]
```

```
vpngate1(config)# aaa authentication login
VPNUSERS local
```

```
crypto isakmp xauth timeout seconds
```

```
vpngate1(config)# crypto isakmp xauth timeout 20
```

```
crypto map map-name client authentication list
list-name
```

```
vpngate1(config)# crypto map CLIENTMAP
client authentication list VPNUSERS
```

11 – (Optional) Enable XAUTH save password feature.

```
vpngate1(config)# crypto isakmp client
 configuration group VPN-REMOTE-ACCESS
vpngate1(config-isakmp-group)# save-password
```

- This step could have been completed in Step 1 of Task 4 following the `crypto isakmp client configuration group` command.

Cisco VPN Client 4.x for Easy VPN Remote access:

1 – Install the Cisco VPN Client 4.x on the remote user's PC.

2 – Create a new client connection entry.

at least one connection entry must be created, which identifies the following information:
* The VPN device, also known as the remote server, to access
* Preshared keys – The IPSec group to which the user is assigned to. The group determines how the user can access and use the remote network. For example, the group specifies access hours, number of simultaneous logins, user authentication method, and the IPSec algorithms that the VPN Client uses.
* Certificates – The name of the certificate that will be used for authentication
Multiple connection entries can be created if the VPN Client is used to connect to multiple networks, though not simultaneously, or if the remote user belongs to more than one VPN remote access group.

Creating a New Connection Entry

Step 1 Start the VPN Client by choosing Start > Programs > Cisco Systems VPN Client > VPN Client.
Step 2 The VPN Client application starts and displays the advanced mode main window. If necessary, open the Options menu in simple mode and choose Advanced Mode or press Ctrl-M.
Step 3 Select New from the toolbar or the Connection Entries menu. The VPN Client displays a form.
Step 4 Enter a unique name for this new connection. Any name can be used to identify this connection.
Step 5 Enter a description of this connection. This field is optional, but it helps to further identify this connection.
Step 6 Enter the hostname or IP address of the remote VPN device that the client will connect to.

3 – Choose an authentication method.

Under the Authentication tab, enter the information for the authentication method that will be used.

Group Authentication

The network administrator usually configures group authentication for the remote user. If this is not the case, use the following procedure:
Step 1 Click the Group Authentication radio button.
Step 2 In the Name field, enter the name of the IPSec group to which the remote user belongs. This entry is case-sensitive.

Step 3 In the Password field, enter the password, which is also case-sensitive, for the IPSec group to which the remote user belongs. The field displays only asterisks.

Step 4 Verify the password by entering it again in the Confirm Password field.

Mutual Group Authentication

To use mutual group authentication, a root certificate that is compatible with the central-site VPN installed on the system is needed.

Certificate Authentication

Step 1 Click the Certificate Authentication radio button.

Step 2 Choose the name of the certificate that is being used from the menu.

4 – Configure transparent tunneling.

1. The most common application for transparent tunneling is behind a home router performing PAT. Some vendors support ESP PAT, also known as IPSec passthrough, which might let the VPN Client operate without enabling transparent tunneling. To use transparent tunneling, the central-site VPN device must be configured to support it.
2. Transparent tunneling can be done over UDP or over TCP. The mode used must match that used by the secure gateway to which the VPN Client is connecting. UDP does not operate with statefull firewalls, so in this case, TCP should be used.
3. To enable IPSec over TCP, click the radio button. When using TCP, the port number for TCP must also be enteredin the TCP port field. This port number must match the port number configured on the secure gateway. The default port number is 10000.
4. The Allow Local LAN Access parameter gives the remote user access to the resources -- resources could include printers, fax machines, shared files, or other systems, When this parameter is enabled and the central site is configured to permit it, remote users can access local resources while connected. When this parameter is disabled, all traffic from the Client system goes through the IPSec connection to the secure gateway. If the local LAN that the remote user is on is not secure, this feature should be disabled. For example, this feature would be disabled when the local LAN is in a hotel or airport. When this feature is enabled and configured on the VPN Client and permitted on the central-site VPN device, the remote user can see a list of the local LANs available by looking at the Routes table in the VPN Client statistics.

To display the Routes table, use the following procedure:

Step 1 Display the Status menu and choose Statistics.

Step 2 Choose Route Details from the Statistics dialog box.

The routes table shows local LAN routes, which do not traverse the IPSec tunnel, and secured routes, which do traverse an IPSec tunnel to a central-site device. The routes in the local LAN routes column are for locally available resources.

5 – Enable and add backup servers.

The private network may include one or more backup VPN servers to use if the primary server is not available. The system administrator should tell the remote user whether to enable backup servers. Information on backup servers can download automatically from the VPN Concentrator, or this information can be entered manually.

To enable backup servers from the VPN Client, use the following procedure:

Step 1 Open the Backup Servers tab.

Step 2 Check Enable Backup Server(s). This is not checked by default.

Step 3 Click Add to enter the address of a backup server.

Step 4 Enter the hostname or IP address of the backup server. Use a maximum of 255 characters.

Step 5 To add more backup devices, repeat Steps 2, 3, and 4.

6– Configure a connection to the Internet through dial-up networking.

To connect to a private network using a dial-up connection, perform the following steps:

Step 1 Use a dial-up connection to an Internet service provider (ISP) to connect to the Internet.

Step 2 Use the VPN Client to connect to the private network through the Internet.

To enable and configure this feature, check the Connect to the Internet via dial-up check box. This feature is not checked by default.

Remote users can connect to the Internet using the VPN Client application in either of the following ways:

* Microsoft Dial-up Networking (DUN)
* Third party dial-up program

Configure Cisco Easy VPN Remote for Access Routers

Configure the PIX Security Appliance as an Easy VPN Server

Configure a PIX 501 or 506E as an Easy VPN Client

Configure the Adaptive Security Appliance to Support WebVPN

Shortcuts

Ctrl-P or the **Up Arrow** to repeat the previous command
disable To return to the user EXEC mode from the privileged EXEC
exit or **end** or press **Ctrl-Z** to return to privileged EXEC mode from global configuration mode.
Ctrl-Z to return directly to the privileged EXEC mode from any sub-mode
(**$**) indicates that the line has been scrolled to the left.
Ctrl-B or the **Left Arrow** To scroll back, press key repeatedly
Ctrl-A will return to the beginning of the line.
Ctrl-E moves to the end of the line.
Esc-B moves back one word.
Ctrl-F or right arrow goes fwd one char.
Esc-F moves fwd one word.

Notes

1. The IOS is stored in flash
2. the IOS is copied into and run from RAM.
3. A copy of the configuration file is stored in NVRAM to be used during startup
4. the active configuration is in RAM and the default location for the startup configuration is NVRAM
5. The encryption designators for Cisco IOS Release 12.2 or later are k8 and k9:
   —**k8** - Less than or equal to 64-bit encryption in IOS version 12.2 and later
   —**k9** - Greater than 64-bit encryption in IOS version 12.2 and later
6. c2600-js-l_121-3.bin
   ^(c2600)Hardware platform
   ^(js)Feature Set
   ^(l)File Format (re-locatable, not compressed. If compressed, IOS must be expanded during boot as it is copied to RAM. A re-locatable image is copied from flash into RAM to run. A non-re-locatable image is run directly from flash.)
   ^(121-3)Version (12.13)
7. A router makes decisions based upon the destination IP address
8. An AS is a collection of networks under a common administration that share a common routing strategy.
9. When all routers in an internetwork operate with the same knowledge, the internetwork is said to have converged.
10. **Distance vector** routing determines direction, or vector, and distance to any link in an internetwork. Bellman-Ford algorithm, each router only sees its neighbor routers. Each router receives the entire routing table routing table from its directly connected neighbor routers. The interface that leads to each directly connected network has a distance of 0. Routing table updates occur when the topology changes. routing tables include total path cost defined by metric and logical address of the first router on the path to each network in the table. An analogy is signs on a highway intersection. A sign points toward a destination and indicates the distance to the destination. Further down another sign, but now the distance is shorter. As long as the distance is shorter, the traffic is on the best path.

11. **Link-state** recreates exact topology of an entire internetwork. Dijkstra's algorithm or shortest path first (SPF) algorithm. Complex database of topology built from LSA's and maintains full knowledge of distant routers and how they interconnect. Constructs logical topology as a tree, with itself as the root. Each router learns the name of each neighbor router, the interface status, and the cost of the link to the neighbor. When a router receives an LSA due to network change, it updates the routing table with the most recent information only. Requires more memory and processes more data. Initial link-state packet flooding consumes bandwidth.
12. A **routing loop** problem can require a count to infinity. To avoid-distance vector protocols define infinity as a specific max #- a routing metric-, which may simply be the hop count. **Split horizon** is used to avoid this situation. If a routing update about Network 1 arrives from Router A, Router B or Router D cannot send information about Network 1 back to Router A.
13. **Route poisoning**. Overcomes large routing loops   hop count is usually set to one more than the maximum. When Network X goes down, Router E will set a distance of 16 for Network X to poison the route. This indicates that the network is unreachable. After Router C receives a route poisoning from Router E, it sends an update, which is called a poison reverse, back to Router E. This makes sure all routers on the segment have received the poisoned route information. It will speed up convergence time because neighboring routers do not have to wait 30 seconds before they advertise the poisoned route.
14. **Holddown timers**—a router marks a route as bad, starts a **holddown timer**. Before the timer expires, if an update is received from the same neighbor, which indicates that the network is accessible, the router removes the holddown timer. If an update arrives from a different neighbor with a better metric, the router removes the holddown timer. but, if it's with a higher metric, the update is ignored.
15. **ip classless** command to forward packets destined for an unknown subnet to the best supernet route. If a packet is received with an unknown destination address within an unknown subnet of a directly attached network, the router assumes that the subnet does not exist so the router will drop the packet even if there is a default route.
16. **Load Balancing** two methods -per-packet and per-destination.
    a. If **process switching** is enabled, the router will alternate paths on a per-packet basis.
    b. If **fast switching (default)** is enabled, only one alternate route will be cached for the destination address. Traffic is load balanced on a per-destination basis**. no ip route-cache** will cause traffic to be load balanced on a per-packet basis.

Administrative distances default values

Connected interface	0
Static route	1
Enhanced Interior Gateway Routing Protocol (EIGRP) summary route	5
External Border Gateway Protocol (BGP)	20
Internal EIGRP	90
IGRP	100
OSPF	110
Intermediate System-to-Intermediate System (IS-IS)	115
Routing Information Protocol (RIP)	120
Exterior Gateway Protocol (EGP)	140
On Demand Routing (ODR)	160
External EIGRP	170
Internal BGP	200
Unknown*	255

17.

OSI

Application
Presentation
Session
Transport
Network

1. Path determination occurs at the network layer, The router uses the network portion of the address to fwd the packet

Datalink
Physical

Troubleshooting

T1/Serial Interfaces

On a serial interface:

This interface has had **carrier transitions**.
TRY THIS: Use the 'clear counters Serial0/0/0:0' command to ensure current information is being displayed. Check interface resets as well. If they are high while carrier transitions are being registered, the problem is most likely a bad link to the Frame Relay switch. Contact your service provider and swap faulty equipment as necessary.

underruns have been reported.
This is because, the far-end transmitter runs faster than the receiver of the near-end router can handle.
TRY THIS: This problem can occur because the router is not powerful enough, and/or the interface runs at a slower speed. Analyze traffic patterns to determine the source of large amounts of traffic received by the interface. However, this may not always be possible because, these counters could have been incremented at some point in the past. Paste the output of the 'show buffer' command into the Output Interpreter to check whether the buffers can be tuned.
REFERENCE: For more information, see Performance Tuning Basics

Interface has had **interface resets**.
This may occur if packets queued for transmission were not sent within several seconds. This may be caused by a malfunctioning modem which is not supplying the transmit clock signal, or by a cable problem. If the IOS device notices that the Carrier Detect signal of the serial interface is up, but the line protocol is down, it periodically resets the interface in an effort to restart it. Interface resets may also occur when an interface is looped or shutdown.
TRY THIS: Use the 'clear counters Serial0/0/0:0' command to ensure current information is being displayed. Check carrier transitions as well. If they are high while interface resets are being registered, the problem is most likely a bad link or CSU/DSU. Contact your service provider and swap faulty equipment as necessary.

Interface has received a high number of packets with **incorrect CRCs** (corrupted data) (> 0.1%).
Problems that may cause this symptom include:
a. Noisy serial line
b. Serial cable is too long or cable from the CSU/DSU to the router is not shielded
c. SCTE mode is not enabled on the DSU

d. The CSU line clock is incorrectly configured
e. A Ones density problem on the link (incorrect framing or coding specification), exists
f. Verify the queuing strategies are the same on both ends of the link.
TRY THIS:
1. Ensure that the line is clean enough for transmission requirements. Shield the cable if necessary.
2. Make sure the cable is within the recommended length (no more than 50 feet [15.24 meters], or 25 feet [7.62 meters] for the link).
3. Ensure that all devices are properly configured for a common line clock. Set serial clock transmit external (SCTE) on the local and remote DSU. If you are attempting serial connections at speeds greater than 64 kbps with a CSU/DSU that does not support (SCTE), you might have to invert the transmit clock on the router. Inverting the transmit clock compensates for phase-shifts between the data and clock signals.
4. Make certain that the local and remote CSU/DSU are configured for the same framing and coding scheme as that used by the leased-line or other carrier service (for example, ESF/B8ZS).
5. Contact your leased-line or other carrier service and have them perform integrity tests on the line.

Interface has received a high number of packets with **framing errors**.
A framing error occurs when a packet does not end on an 8-bit byte boundary.
Problems that may cause this symptom include:
a. Noisy serial line
b. Improperly designed cable; serial cable is too long; the cable from the CSU or DSU to the router is not shielded
c. SCTE (serial clock transmit external) mode is not enabled on the DSU; the CSU line clock is incorrectly configured; one of the clocks is configured for local clocking
d. There is a Ones density problem on the link (incorrect framing or coding specification)
TRY THIS:
1. Ensure that the line is clean enough for transmission requirements. Shield the cable if necessary.
2. Make sure the cable is within the recommended length (no more than 50 feet [15.24 meters], or 25 feet [7.62 meters] for the link).
3. Ensure all devices are properly configured for a common line clock. Set serial clock transmit external (SCTE) on the local and remote DSU. If you are attempting serial connections at speeds greater than 64 kbps with a CSU/DSU that does not support (SCTE), you might have to invert the transmit clock on the router. Inverting the transmit clock compensates for phase-shifts between the data and clock signals.
4. Make certain that the local and remote CSU/DSU are configured for the same framing and coding scheme as that used by the leased-line or other carrier service (for example, ESF/B8ZS).
5. Contact your leased-line or other carrier service and have them perform integrity tests on the line.

Interface has received a high number of packets with **abort errors**.
Aborts indicate an illegal sequence of one bits (more than 7 in a row).
Problems that may cause this symptom include:
a. SCTE (serial clock transmit external) mode is not enabled on DSU
b. The CSU line clock is incorrectly configured
c. The Serial cable is too long or the cable from the CSU or DSU to the router is not shielded

d. There is a ones density problem on the link (incorrect framing or coding specification)
e. The packet terminated in the middle of transmission (typical cause is an interface reset or a framing error)
f. Hardware problem: bad circuit, bad CSU/DSU, or bad sending interface on remote router

TRY THIS:

1. Ensure that all devices are properly configured for a common line clock. Set serial clock transmit external (SCTE) on the local and remote DSU. If you are attempting serial connections at speeds greater than 64 kbps with a CSU/DSU that does not support (SCTE), you might have to invert the transmit clock on the router. Inverting the transmit clock compensates for phase-shifts between the data and clock signals.
2. Make sure the cable is within the recommended length (no more than 50 feet [15.24 meters], or 25 feet [7.62 meters] for the link). Ensure all connections are good. Shield the cable of necessary.
3. Check the hardware at both ends of the link. Swap faulty equipment as necessary.
4. Lower data rates and determine if aborts decrease.
5. Use local and remote loopback tests to determine where aborts are occurring.
6. Contact your leased-line or other carrier service and have them perform integrity tests on the line.

Overruns have been reported.
This is because, the input rate exceeds the ability of the receiver to handle data.
TRY THIS: This problem can occur due to massive amounts of traffic, and/or because the router is not powerful enough. Analyze traffic patterns on this interface to determine the source of large amounts of traffic. However, this may not always be possible, because these counters could have been incremented at some point in the past. Paste the output of the 'show buffer' command output into the Output Interpreter to check whether the buffers can be tuned. Also, try to reduce the number of hosts in the segment.

Packets have been ignored by the interface because the interface hardware ran low on internal buffers.
TRY THIS: If this is incrementing, paste the output from the 'show buffers' command into Output Interpreter to see if the buffers can be tuned. Also compare with the 'no buffer' counter and input/output queue drops. Broadcast storms and bursts of noise can cause the 'ignored' counter to increment.

Interface has had **'throttles'** and may be in a 'throttled' condition, ignoring all received packets until it is unthrottled.
There are no counters to keep track of the number of packets dropped due to an interface throttling.
TRY THIS: If this appears to be a repeating condition, investigate the following modifications:

1. Determine if the switching path is optimized. See if you can fastswitch traffic without causing other problems.
2. Increase the input queue.
3. Monitor the input queue. If it never returns to 0, then packets might be stuck in the queue. Use the 'show buffer old' or 'show buffer input-interface Serial0/0/0:0' to determine what packets are stuck.

Interface has had **'Input errors'**. This error includes runts, giants, no buffer, CRC, frame, overrun, and ignored counts. Other input-related errors can also cause the input error count to increase. Some datagrams can have more than one error. Therefore, this sum may not be equal to the sum of enumerated input error counts.

Packets were discarded because they **exceed the medium's maximum packet size.** For example, any Ethernet packet that is greater than 1,518 bytes is considered a giant.

Packets were discarded because they are **smaller than the medium's minimum packet size.** For instance, any Ethernet packet that is less than 64 bytes is considered a runt.

Interface has reported **output buffers swapped out counter**.
If the Transmit Queue of the outbound interface is full, the packet is copied from a hardware buffer to DRAM, and then copied back to the Transmit Queue when there is room. If a fancy Queuing strategy is used (such as Weighted-Fair, Custom or Priority), you cannot disable this feature. However, if you do not use a fancy queueing strategy, you can disable buffer swap-outs. To do so, use the 'no transmit-buffers backing-store' interface configuration command. This prevents packets from being dropped in the output path. However it can add latency to the packet transit time. If you use time-sensitive applications, you may prefer to disable this feature.

On a T1/E1 interface

Controller T1 0/0/0 (up)
Controller appears to have **excessive line code errors** .
TRY THIS: Clear the counters and continue to monitor the show controller output.
If problems persist, confirm the line coding with the carrier.

Controller appears to have **excessive framing errors** .
TRY THIS: Clear the counters and continue to monitor the show controller output.
If problems persist, confirm the framing with the carrier.

Controller appears to have **excessive clock slips** .
TRY THIS: Clear the counters and continue to monitor the 'show controller' output.
If problems persist, confirm the clock source with the carrier.

Controller appears to have **unavailable seconds errors**.
'Unavailable Seconds' are the number of 1-second intervals in which the controller was down.
TRY THIS: Clear the counters and continue to monitor the controller using the 'show controller' command. Ensure that the local interface port configuration corresponds with the far-end equipment configuration. Identify the alarm on the local end and execute the actions as suggested. Consider inserting an external loopback cable into the port.