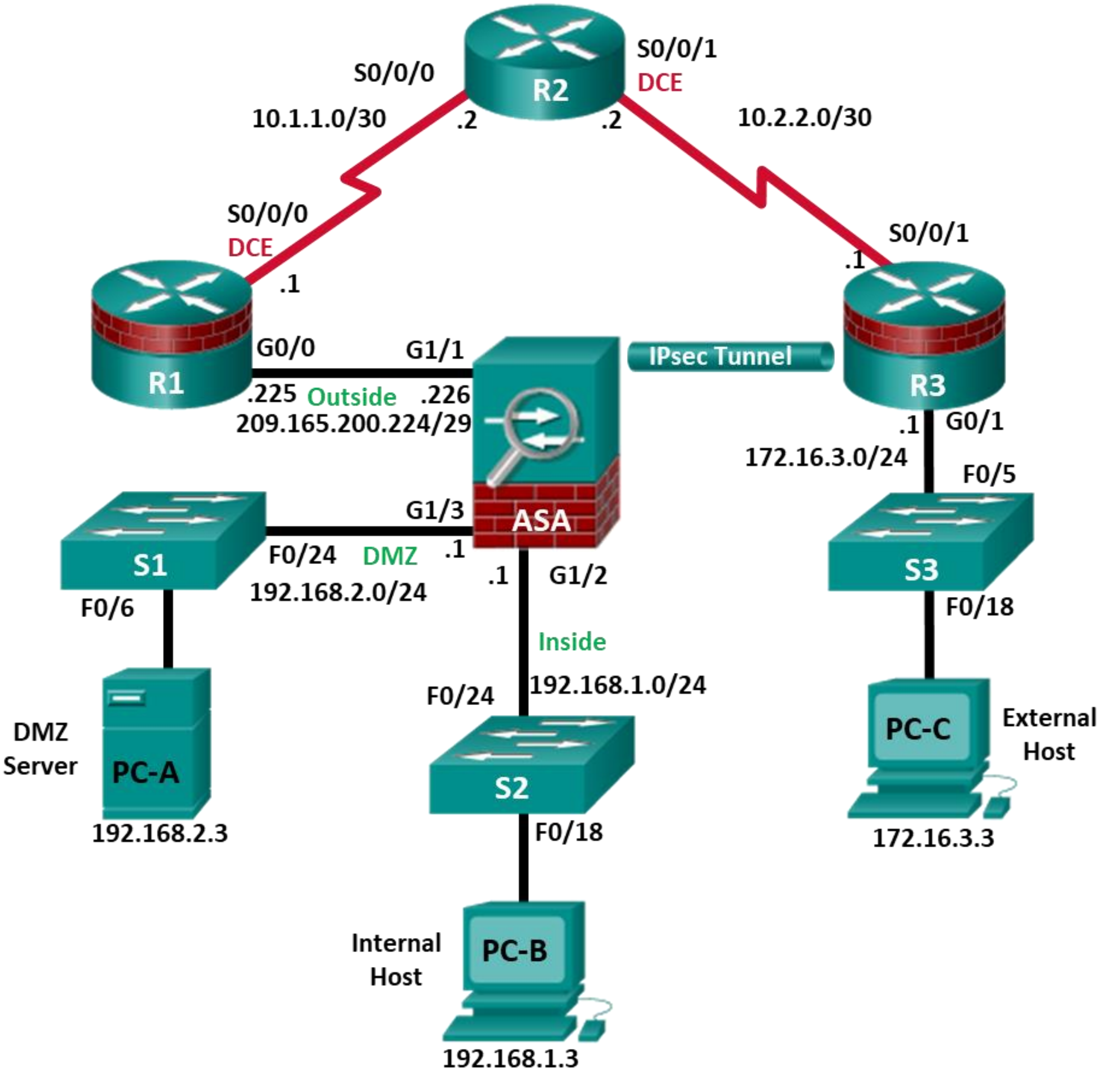
CCNA Security

Lab - Configure a Site-to-Site IPsec VPN Using ISR CLI and ASA 5506-X ASDM (Instructor Version)

Instructor Note: Red font color or gray highlights indicate text that appears in the instructor copy only.

Topology



Note: ISR G2 devices use GigabitEthernet interfaces instead of FastEthernet interfaces.

IP Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway	Switch Port
R1	G0/0	209.165.200.225	255.255.255.248	N/A	ASA G1/1
R1	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A	N/A
R2	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A	N/A
R3	G0/1	172.16.3.1	255.255.255.0	N/A	S3 F0/5
R3	S0/0/1	10.2.2.1	255.255.255.252	N/A	N/A
ASA	G1/1 (outside)	209.165.200.226	255.255.255.248	NA	R1 G0/0
ASA	G1/2 (inside)	192.168.1.1	255.255.255.0	NA	S2 F0/24
ASA	G1/3 (dmz)	192.168.2.1	255.255.255.0	NA	S1 F0/24
PC-A	NIC	192.168.2.3	255.255.255.0	192.168.2.1	S1 F0/6
PC-B	NIC	192.168.1.3	255.255.255.0	192.168.1.1	S2 F0/18
PC-C	NIC	172.16.3.3	255.255.255.0	172.16.3.1	S3 F0/18

Objectives

Part 1: Configure Basic Device Settings

- Cable the network and clear previous device settings, as shown in the topology.
- Configure basic settings for routers.
- Configure PC host IP settings.
- Verify connectivity.
- Save the basic running configuration for each router and switch.

Part 2: Access the ASA Console and ASDM

- Access the ASA console.
- Clear the previous ASA configuration settings.
- Bypass Setup mode.
- Use the CLI command script to configure the ASA.
- Verify HTTP ASDM access.

Part 3: Configure the ISR as a Site-to-Site IPsec VPN Endpoint Using the CLI

- Configure basic VPN connection information settings.
- Specify IKE policy parameters.
- Configure a transform set.
- Specify traffic to protect.
- Review the summary of the configuration.
- Review the site-to-site VPN tunnel configuration.

Part 4: Configure the ASA as a Site-to-Site IPsec VPN Endpoint Using ASDM

- Access ASDM.
- Review the ASDM Home screen.
- Start the VPN wizard.
- Configure peer device identification.
- Specify the traffic to protect.
- Configure authentication.
- Configure miscellaneous settings.
- Review the configuration summary and deliver the commands to the ASA.
- Verify the ASDM VPN connection profile.
- Test the VPN configuration from R3.
- Use ASDM monitoring to verify the tunnel.

Background/Scenario

In addition to acting as a remote access VPN concentrator, the ASA can provide site-to-site IPsec VPN tunneling. The tunnel can be configured between two ASAs or between an ASA and another IPsec VPN-capable device, such as an ISR, as is the case with this lab.

In this scenario, your company has two locations connected to an ISP. R1 represents a customer-premise equipment (CPE) device managed by the ISP. R2 represents an intermediate Internet router. R3 connects users at the remote branch office to the ISP. The ASA is an edge security device that connects the internal corporate network and DMZ to the ISP while providing NAT services to inside hosts.

Management has asked you to provide a dedicated site-to-site IPsec VPN tunnel between the ISR router at the remote branch office and the ASA device at the corporate site. This tunnel will protect traffic between the branch office LAN and the corporate LAN, as it passes through the Internet. The site-to-site VPN does not require a VPN client on the remote or corporate site host computers. Traffic from either LAN to other Internet destinations is routed by the ISP and is not protected by the VPN tunnel. The VPN tunnel will pass through R1 and R2; both routers are not aware of the tunnel’s existence.

In Part 1 of this lab, you will configure the topology and non-ASA devices. In Part 2, you will prepare the ASA for ASDM access. In Part 3, you will use the CLI to configure the R3 ISR as a site-to-site IPsec VPN endpoint. In Part 4, you will configure the ASA as a site-to-site IPsec VPN endpoint using the ASDM VPN wizard.

Note: The router commands and output in this lab are from a Cisco 1941 router with Cisco IOS Release 15.4(3)M2 (with a Security Technology Package license). Other routers and Cisco IOS versions can be used. See the Router Interface Summary Table at the end of this lab to determine which interface identifiers to use based on the equipment in the lab. Depending on the router model and Cisco IOS version, the commands available and the output produced might vary from what is shown in this lab.

The ASA used with this lab is a Cisco model 5506-X with an 8-port integrated switch, running OS version 9.10(1), Adaptive Security Device Manager (ASDM) version 7.10(1), and comes with a Base license that allows a maximum of five VLANs.

Note: Before beginning, ensure that the routers and switches have been erased and have no startup configurations.

Instructor Note: Instructions for erasing switches and routers are provided in Chapter 0.0.0.0. Instructions for erasing the ASA, accessing the console, and accessing ASDM are provided in this lab.

Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.4(3)M2 image with a Security Technology Package license)
- 3 Switches (Cisco 2960 with cryptography IOS image for SSH support – Release 15.0(2)SE7 or comparable) (not required)
- 1 ASA 5506-X (OS version 9.10(1) and ASDM version 7.10(1) and Base license or comparable)
- 3 PCs (Windows, SSH Client and Java version compatible with installed ASDM version)
- Serial and Ethernet cables, as shown in the topology
- Console cables to configure Cisco networking devices

Instructor Notes:

- This lab has four main parts. Parts 1 and 2 can be performed separately but must be performed before parts 3 and 4. Part 2 prepares the ASA for ASDM access. Part 3 configures the R3 ISR as a site-to-site IPsec VPN endpoint using the CLI. Part 4 configures the opposite end of the tunnel on the ASA using ASDM. Parts 3 and 4 should be performed sequentially. Each part will use CLI and ASDM as required to verify the configuration.
- The main goal is to configure a site-to-site IPsec VPN between two sites using an ISR at one end of the tunnel and an ASA at the other end.
- The final running configs for all devices are found at the end of the lab.

Part 1: Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the routers, such as IP addresses and static routing.

Note: Do not configure any ASA settings at this time.

Step 1: Cable the network and clear previous device settings.

Attach the devices shown in the topology diagram and cable as necessary. Ensure that the routers and switches have been erased and have no startup configurations.

Step 2: Configure R1 using the CLI script.

In this step, you will use the following CLI script to configure basic settings on R1. Copy and paste the basic configuration script commands listed below. Observe the messages as the commands are applied to ensure that there are no warnings or errors.

Note: Depending on the router model, interfaces might be numbered differently than those listed. You might need to alter the designations accordingly.

Note: Passwords in this task are set to a minimum of 10 characters and are relatively simple for the purposes of performing the lab. More complex passwords are recommended in a production network.

```
hostname R1
security passwords min-length 10
enable algorithm-type scrypt secret cisco12345
username admin01 algorithm-type scrypt secret admin01pass
ip domain name ccnasecurity.com
line con 0
 login local
 exec-timeout 5 0
 logging synchronous
exit
line vty 0 4
 login local
 transport input ssh
 exec-timeout 5 0
 logging synchronous
exit
interface gigabitethernet 0/0
 ip address 209.165.200.225 255.255.255.248
 no shut
exit
interface serial 0/0/0
 ip address 10.1.1.1 255.255.255.252
 clock rate 2000000
 no shut
exit
ip route 0.0.0.0 0.0.0.0 Serial0/0/0
crypto key generate rsa general-keys modulus 1024
```

Step 3: Configure R2 using the CLI script.

In this step, you will use the following CLI script to configure basic settings on R2. Copy and paste the basic configuration script commands listed below. Observe the messages as the commands are applied to ensure that there are no warnings or errors.

```
hostname R2
security passwords min-length 10
enable algorithm-type scrypt secret cisco12345
username admin01 algorithm-type scrypt secret admin01pass
ip domain name ccnasecurity.com
line con 0
 login local
 exec-timeout 5 0
 logging synchronous
exit
line vty 0 4
 login local
 transport input ssh
 exec-timeout 5 0
 logging synchronous
exit
interface serial 0/0/0
 ip address 10.1.1.2 255.255.255.252
 no shut
exit
```

```
interface serial 0/0/1
 ip address 10.2.2.2 255.255.255.252
 clock rate 2000000
 no shut
exit
ip route 209.165.200.224 255.255.255.248 Serial0/0/0
ip route 172.16.3.0 255.255.255.0 Serial0/0/1
crypto key generate rsa general-keys modulus 1024
```

Step 4: Configure R3 using the CLI script.

In this step, you will use the following CLI script to configure basic settings on R3. Copy and paste the basic configuration script commands listed below. Observe the messages as the commands are applied to ensure that there are no warnings or errors.

```
hostname R3
security passwords min-length 10
enable algorithm-type scrypt secret cisco12345
username admin01 algorithm-type scrypt secret admin01pass
ip domain name ccnasecurity.com
line con 0
 login local
 exec-timeout 5 0
 logging synchronous
exit
line vty 0 4
 login local
 transport input ssh
 exec-timeout 5 0
 logging synchronous
exit
interface gigabitethernet 0/1
 ip address 172.16.3.1 255.255.255.0
 no shut
exit
int serial 0/0/1
 ip address 10.2.2.1 255.255.255.252
 no shut
exit
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
crypto key generate rsa general-keys modulus 1024
```

Step 5: Configure PC host IP settings.

Configure a static IP address, subnet mask, and default gateway for PC-A, PC-B, and PC-C as shown in the IP Addressing table.

Step 6: Verify connectivity.

Because the ASA is the focal point for the network zones, and it has not yet been configured, there will be no connectivity between devices that are connected to it. However, PC-C should be able to ping the R1 interface G0/0. From PC-C, ping the R1 G0/0 IP address (**209.165.200.225**). If these pings are unsuccessful, troubleshoot the basic device configurations before continuing.

Note: If you can ping from PC-C to R1 G0/0 and S0/0/0, you have demonstrated that static routing is configured and functioning correctly.

Save the **running configuration** for each router.

Part 2: Access the ASA Console and ASDM

Step 1: Clear the previous ASA configuration settings.

a. Use the **write erase** command to remove the **startup-config** file from flash memory.

   Note: The **erase startup-config** IOS command is not supported on the ASA.

b. Use the **reload** command to restart the ASA. This causes the ASA to display in CLI Setup mode. If you see the **System config has been modified. Save? [Y]es/[N]o:** message, type **n**, and press **Enter**.

Step 2: Bypass Setup mode.

When the ASA completes the reload process, it should detect that the startup configuration file is missing and go into Setup mode. If it does go into Setup mode, repeat Step 2.

a. When prompted to preconfigure the firewall through interactive prompts (Setup mode), respond with **no**. If you have inadvertently started the setup wizard, press **CTRL-Z** to exit it. The terminal screen should display the default ASA user EXEC hostname and prompt ciscoasa>.

b. Enter privileged EXEC mode with the **enable** command. The password should be kept blank (no password).

Step 3: Configure the ASA by using the CLI script.

In this step, you will use a CLI script to configure basic settings, the firewall, and the DMZ.

a. Use the **show run** command to confirm that there is no previous configuration in the ASA other than the defaults that the ASA automatically inserts.

b. Enter global configuration mode. When prompted to enable anonymous call-home reporting, respond **no**.

c. Copy and paste the Pre-VPN Configuration Script commands listed below at the ASA global configuration mode prompt to start configuring the SSL VPNs. Observe the messages as the commands are applied to ensure that there are no warnings or errors. If prompted to replace the RSA key pair, respond **yes**.

```
hostname CCNAS-ASA
domain-name ccnasecurity.com
enable password cisco12345
interface G1/2
 nameif inside
 security-level 100
 ip address 192.168.1.1 255.255.255.0
 no shutdown
interface G1/1
 nameif outside
 security-level 0
 ip address 209.165.200.226 255.255.255.248
 no shutdown
interface G1/3
 nameif dmz
 security-level 70
 ip address 192.168.2.1 255.255.255.0
 no shutdown
object network inside-net
 subnet 192.168.1.0 255.255.255.0
object network dmz-server
 host 192.168.2.3
access-list OUTSIDE-DMZ extended permit ip any host 192.168.2.3
object network inside-net
 nat (inside,outside) dynamic interface
object network dmz-server
 nat (dmz,outside) static 209.165.200.227
access-group OUTSIDE-DMZ in interface outside
route outside 0.0.0.0 0.0.0.0 209.165.200.225 1
username admin01 password admin01pass
aaa authentication ssh console LOCAL
aaa authentication http console LOCAL
http server enable
http 192.168.1.0 255.255.255.0 inside
ssh 192.168.1.0 255.255.255.0 inside
ssh timeout 10
class-map inspection_default
 match default-inspection-traffic
policy-map global_policy
 class inspection_default
   inspect icmp
crypto key generate rsa modulus 1024
```

d. At the privileged EXEC mode prompt, issue the **write mem** (or **copy run start**) command to save the running configuration to the startup configuration and the RSA keys to non-volatile memory.

Part 3: Configure the ISR as a Site-to-Site IPsec VPN Endpoint Using the CLI

In Part 3 of this lab, you will configure R3 as an IPsec VPN endpoint for the tunnel between R3 and the ASA. R1 and R2 are unaware of the tunnel.

Step 1: Verify connectivity from the R3 LAN to the ASA.

In this step, you will verify that PC-C on the R3 LAN can ping the ASA outside interface.

Ping the ASA IP address of **209.165.200.226** from PC-C.

```
PC-C:\> ping 209.165.200.226
```

If the pings are unsuccessful, troubleshoot the basic device configurations before continuing.

Step 2: Enable IKE policies on R3.

IPsec is an open framework that allows for the exchange of security protocols as new technologies and encryption algorithms are developed.

There are two central configuration elements in the implementation of an IPsec VPN:

- Implement Internet Key Exchange (IKE) parameters.
- Implement IPsec parameters.

a. Verify that IKE is supported and enabled.

IKE Phase 1 defines the key exchange method used to pass and validate IKE policies between peers. In IKE Phase 2, the peers exchange and match IPsec policies for the authentication and encryption of data traffic.

IKE must be enabled for IPsec to function. IKE is enabled, by default, on IOS images with cryptographic feature sets. If it is disabled, you can enable it with the **crypto isakmp enable** command. Use this command to verify that the router IOS supports IKE and that it is enabled.

```
R3(config)# crypto isakmp enable
```

Note: If you cannot execute this command on the router, you must upgrade to the IOS image that includes the Cisco cryptographic services.

b. Establish an ISAKMP policy and view the available options.

To allow IKE Phase 1 negotiation, you must create an ISAKMP policy and configure a peer association involving that ISAKMP policy. An ISAKMP policy defines the authentication and encryption algorithms, and the hash function used to send control traffic between the two VPN endpoints. When an ISAKMP security association has been accepted by the IKE peers, IKE Phase 1 has been completed. IKE Phase 2 parameters will be configured later.

Issue the **crypto isakmp** *policy number* global configuration mode command on R1 for policy 10.

```
R1(config)# crypto isakmp policy 10
```

c. View the various IKE parameters available using Cisco IOS help by typing a question mark (**?**).

```
R1(config-isakmp)# ?
ISAKMP commands:
  authentication  Set authentication method for protection suite
  default         Set a command to its defaults
  encryption      Set encryption algorithm for protection suite
  exit            Exit from ISAKMP protection suite configuration mode
  group           Set the Diffie-Hellman group
  hash            Set hash algorithm for protection suite
  lifetime        Set lifetime for ISAKMP security association
  no              Negate a command or set its defaults
```

Step 3: Configure ISAKMP policy parameters on R3.

The encryption algorithm determines how confidential the control channel between the endpoints is. The hash algorithm controls data integrity, which ensures that the data received from a peer has not been tampered with in transit. The authentication type ensures that the packet was sent and signed by the remote peer. The Diffie-Hellman group is used to create a secret key shared by the peers that has not been sent across the network.

a. Configure an ISAKMP policy with a priority of **10**. Use **pre-shared key** as the authentication type,.**3des** for the encryption algorithm, **sha** as the hash algorithm, and the Diffie-Hellman group **2** key exchange.

Note: Older versions of Cisco IOS do not support AES 256 encryption and SHA as a hash algorithm. Substitute whatever encryption and hashing algorithm your router supports. Ensure that the same changes are made on R3 in order to be in sync.

```
R3(config)# crypto isakmp policy 10
R3(config-isakmp)# authentication pre-share
R3(config-isakmp)# encryption 3des
R3(config-isakmp)# hash sha
R3(config-isakmp)# group 2
R3(config-isakmp)# end
```

b. Verify the IKE policy with the **show crypto isakmp policy** command.

```
R3# show crypto isakmp policy
Global IKE policy
Protection suite of priority 10
        encryption algorithm:   Three key triple DES
        hash algorithm:         Secure Hash Standard
        authentication method:  Pre-Shared Key
        Diffie-Hellman group:   #2 (1024 bit)
        lifetime:               86400 seconds, no volume limit
```

Step 4: Configure pre-shared keys.

Because pre-shared keys are used as the authentication method in the IKE policy, a key must be configured on each router that points to the other VPN endpoint. These keys must match for authentication to be successful. The **crypto isakmp key** *key-string* **address** *ip-address* global configuration command is used to enter a pre-shared key and identify the IP address of the remote VPN peer.

Which IP address should you use to configure the IKE peer, given the topology diagram and IP addressing table?

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The IP address should be the ASA outside IP address of 209.165.200.226.

Each IP address that is used to configure the IKE peers is also referred to as the IP address of the remote VPN endpoint. Configure the pre-shared key of **SECRET-KEY** on R3. Production networks should use a complex key. This command points to the remote ASA outside IP address.

```
R3(config)# crypto isakmp key SECRET-KEY address 209.165.200.226
```

Step 5: Configure the IPsec transform set and lifetime.

a. The IPsec transform set is another crypto configuration parameter that routers negotiate to form a security association. It is configured using the **crypto ipsec transform-set** *tag* global configuration command. Configure the transform set with the tag **ESP-TUNNEL**. Use **?** to see which parameters are available.

```
R3(config)# crypto ipsec transform-set ESP-TUNNEL ?
  ah-md5-hmac      AH-HMAC-MD5 transform
  ah-sha-hmac      AH-HMAC-SHA transform
  ah-sha256-hmac   AH-HMAC-SHA256 transform on R3
  ah-sha384-hmac   AH-HMAC-SHA384 transform
  ah-sha512-hmac   AH-HMAC-SHA512 transform
```

```
comp-lzs         IP Compression using the LZS compression algorithm
esp-3des         ESP transform using 3DES(EDE) cipher (168 bits)
esp-aes          ESP transform using AES cipher
esp-des          ESP transform using DES cipher (56 bits)
esp-gcm          ESP transform using GCM cipher
esp-gmac         ESP transform using GMAC cipher
esp-md5-hmac     ESP transform using HMAC-MD5 auth
esp-null         ESP transform w/o cipher
esp-seal         ESP transform using SEAL cipher (160 bits)
esp-sha-hmac     ESP transform using HMAC-SHA auth
esp-sha256-hmac  ESP transform using HMAC-SHA256 auth
esp-sha384-hmac  ESP transform using HMAC-SHA384 auth
esp-sha512-hmac  ESP transform using HMAC-SHA512 auth
```

b. In our Site-to-site VPN with the ASA, we will use the two highlitghed parameters. Complete the command by entering the two highlighted parameters.

```
R3(config)# crypto ipsec transform-set ESP-TUNNEL esp-3des esp-sha-hmac
```

What is the function of the IPsec transform set?

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The IPsec transform set specifies the cryptographic algorithms and functions (transforms) that a router employs on the data packets sent through the IPsec tunnel. These algorithms include the encryption, encapsulation, authentication, and data integrity services that IPsec can apply.

Step 6: Define interesting traffic.

To make use of the IPsec encryption with the VPN, it is necessary to define extended access lists to tell the router which traffic to encrypt. A packet that is permitted by an access list used for defining IPsec traffic is encrypted if the IPsec session is configured correctly. A packet that is denied by one of these access lists is not dropped. The packet is sent unencrypted. Also, like any other access list, there is an implicit deny at the end, which means the default action is to not encrypt traffic. If there is no IPsec security association correctly configured, no traffic is encrypted and traffic is forwarded unencrypted.

In this scenario, from the perspective of R3, the traffic you want to encrypt is traffic going from R3's Ethernet LAN to the ASA inside LAN or vice versa from the perspective of the ASA.

a. Configure the IPsec VPN interesting traffic ACL on R3.

```
R3(config)# ip access-list extended VPN-ACL
R3(config-ext-nacl)# remark Link to the CCNAS-ASA
R3(config-ext-nacl)# permit ip 172.16.3.0 0.0.0.255 192.168.1.0 0.0.0.255
R3(config-ext-nacl)# exit
```

Does IPsec evaluate whether the access lists are mirrored as a requirement to negotiate its security association?

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Yes. IPsec does evaluate whether access lists are mirrored. IPsec does not form a security association if the peers do not have mirrored access lists to select interesting traffic.

Step 7: Create and apply a crypto map.

A crypto map associates traffic that matches an access list to a peer and various IKE and IPsec settings. After the crypto map is created, it can be applied to one or more interfaces. The interfaces that it is applied to should be the interfaces facing the IPsec peer.

To create a crypto map, use the **crypto map** *name sequence-num type* global configuration command to enter crypto map configuration mode for that sequence number. Multiple crypto map statements can belong to the same crypto map and are evaluated in ascending numerical order.

a. Create the crypto map on R3, name it **S2S-MAP**, and use **10** as the sequence number. Use a type of **ipsec-isakmp**, which means IKE is used to establish IPsec security associations. A message displays after the command is issued.

```
R3(config)# crypto map S2S-MAP 10 ipsec-isakmp
% NOTE: This new crypto map will remain disabled until a peer
        and a valid access list have been configured.
R3(config-crypto-map)#
```

b. Use the **match address** *access-list* command to specify which access list defines which traffic to encrypt.

```
R3(config-crypto-map)# match address VPN-ACL
```

c. Setting a peer IP or hostname is required. Set it to the ASA remote VPN endpoint interface using the following command.

```
R3(config-crypto-map)# set peer 209.165.200.226
```

d. Use the **set transform-set** *tag* command to hard code the transform set to be used with this peer.

```
R3(config-crypto-map)# set transform-set ESP-TUNNEL
R3(config-crypto-map)# exit
```

e. Apply the crypto map to interfaces.

Note: The SAs are not established until the crypto map has been activated by interesting traffic. The router generates a notification that crypto is now on.

Apply the crypto maps to the R3 Serial 0/0/1 interface.

```
R3(config)# interface Serial0/0/1
R3(config-if)# crypto map S2S-MAP
R3(config-if)# end
R3#
*Feb 29 06:23:03.863: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is ON
```

Part 4: Configure the ASA as a Site-to-Site IPsec VPN Endpoint Using ASDM

In Part 4 of this lab, you will configure the ASA as an IPsec VPN tunnel endpoint. The tunnel between the ASA and R3 passes through R1 and R2.

Step 1: Access ASDM.

a. On PC-B, start ASDM using the ASDM application or by using a browser and connecting to **https://192.168.1.1** and then choosing **Run ASDM**.

Please refer to the previous lab for more detailed instructions.

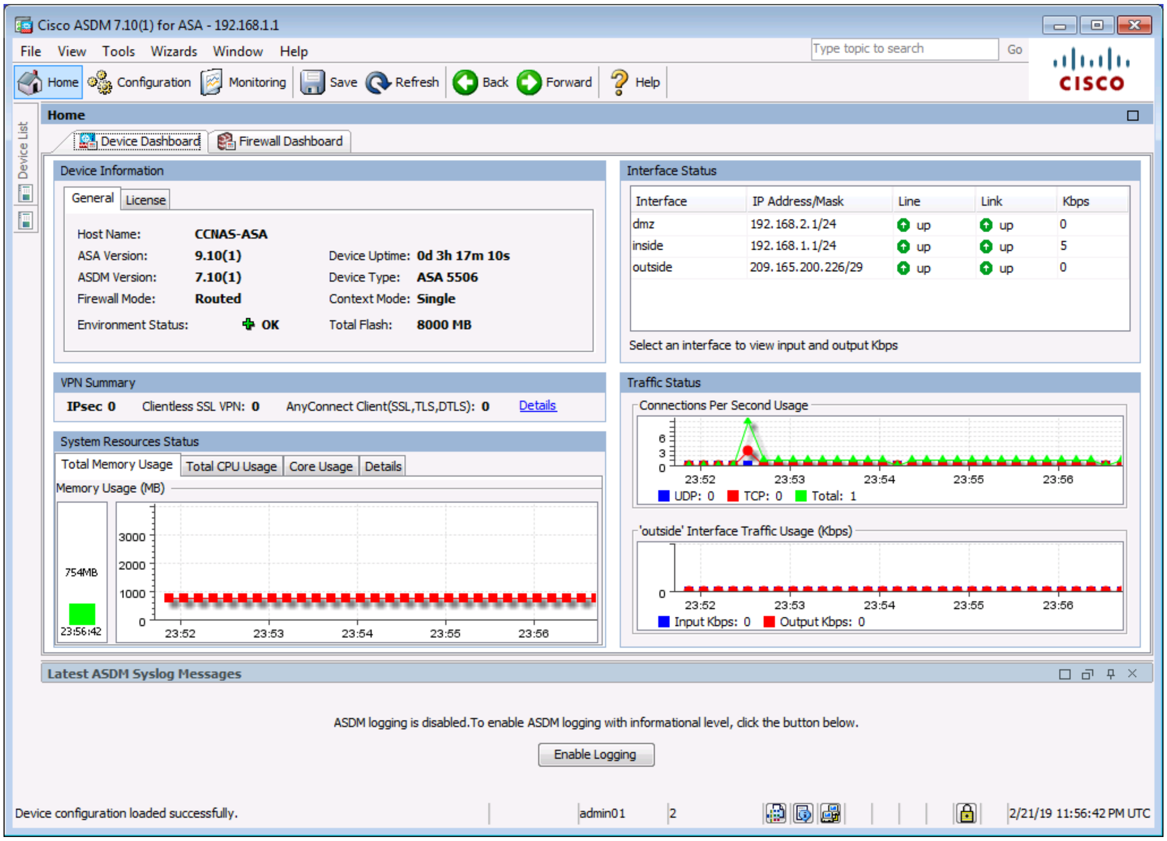
Note: If one of the choices is **Install Java Web Start**, you will need to input https://192.168.1.1/admin/public/startup.jnlp in a browser if you do not want to install the Launcher.

b. After the ASDM Launcher starts, log in as user **admin01** with password **admin01pass**.

c. Exit the Startup Wizard if it starts.

Step 2: Review the ASDM Home screen.

The Home screen displays and shows the current ASA device configuration and traffic flow statistics. Notice the inside, outside, and dmz interfaces that were configured in Part 2 of this lab.



Cisco ASDM 7.10(1) for ASA - 192.168.1.1

Device Information

Host Name: **CCNAS-ASA**
ASA Version: **9.10(1)**
ASDM Version: **7.10(1)**
Firewall Mode: **Routed**
Environment Status: **OK**
Device Uptime: **0d 3h 17m 10s**
Device Type: **ASA 5506**
Context Mode: **Single**
Total Flash: **8000 MB**

Interface Status

Interface	IP Address/Mask	Line	Link	Kbps
dmz	192.168.2.1/24	up	up	0
inside	192.168.1.1/24	up	up	5
outside	209.165.200.226/29	up	up	0

Select an interface to view input and output Kbps

VPN Summary

IPsec 0 Clientless SSL VPN: **0** AnyConnect Client(SSL,TLS,DTLS): **0** Details

Traffic Status

UDP: 0 TCP: 0 Total: 1

Input Kbps: 0 Output Kbps: 0

ASDM logging is disabled.To enable ASDM logging with informational level, click the button below.

Device configuration loaded successfully. admin01 2 2/21/19 11:56:42 PM UTC

Step 3: Start the VPN wizard.

a. On the ASDM main menu, click **Wizards** > **VPN Wizards** > **Site-to-site VPN Wizard** to open the Site-to-site VPN Connection Setup Wizard Introduction window. Review the on-screen text and topology diagram.

b. Click **Next** to continue and open the Peer Device Identification window.

Step 4: Configure peer device identification.

a. The VPN tunnel will be between R3 S0/0/1 and the ASA outside interface (G1/1). Therefore, in the Peer IP Address field, enter **10.2.2.1** which is the IP address of the R3 Serial0/0/1 interface. Leave the default VPN Access Interface set to **outside**.

b. Click **Next** to continue and open the Traffic to protect window.

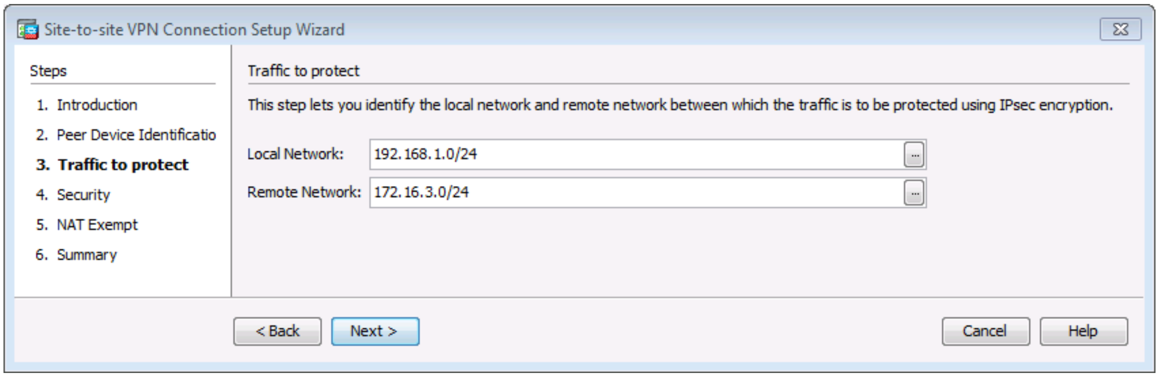
Step 5: Specify the traffic to protect.

a. Click on the Local Network field ellipsis to list possible network objects and double-click on the **inside-network/24** (192.168.1.0/24) option.

b. Click **OK** to continue.

c. Click in the Remote Network field and type in **172.16.3.0/24** to identify the R3 LAN as the remote network.

d. Click **Next** to continue and open the Security window. A message may display stating that the certificate information is being retrieved.



Traffic to protect

This step lets you identify the local network and remote network between which the traffic is to be protected using IPsec encryption.

Local Network: 192.168.1.0/24

Remote Network: 172.16.3.0/24

Note: If the ASA does not respond, you may need to close the window and continue to the next step. If prompted to authenticate, log in again as **admin01** with the password **admin01pass**.

Step 6: Configure authentication.

a. In the Security window, we need to enter the same shared secret as R3. Therefore, enter **SECRET-KEY**. You will not be using a device certificate.

b. Click **Next** to continue and open the NAT Exempt window.

Step 7: Configure miscellaneous settings.

a. We do now want tunnel traffic to use NAT. Therefore, click the **Exempt ASA** check box for the **inside** interface.

b. Click **Next** to continue and open the Summary window.

Step 8: Review the configuration summary and deliver the commands to the ASA.

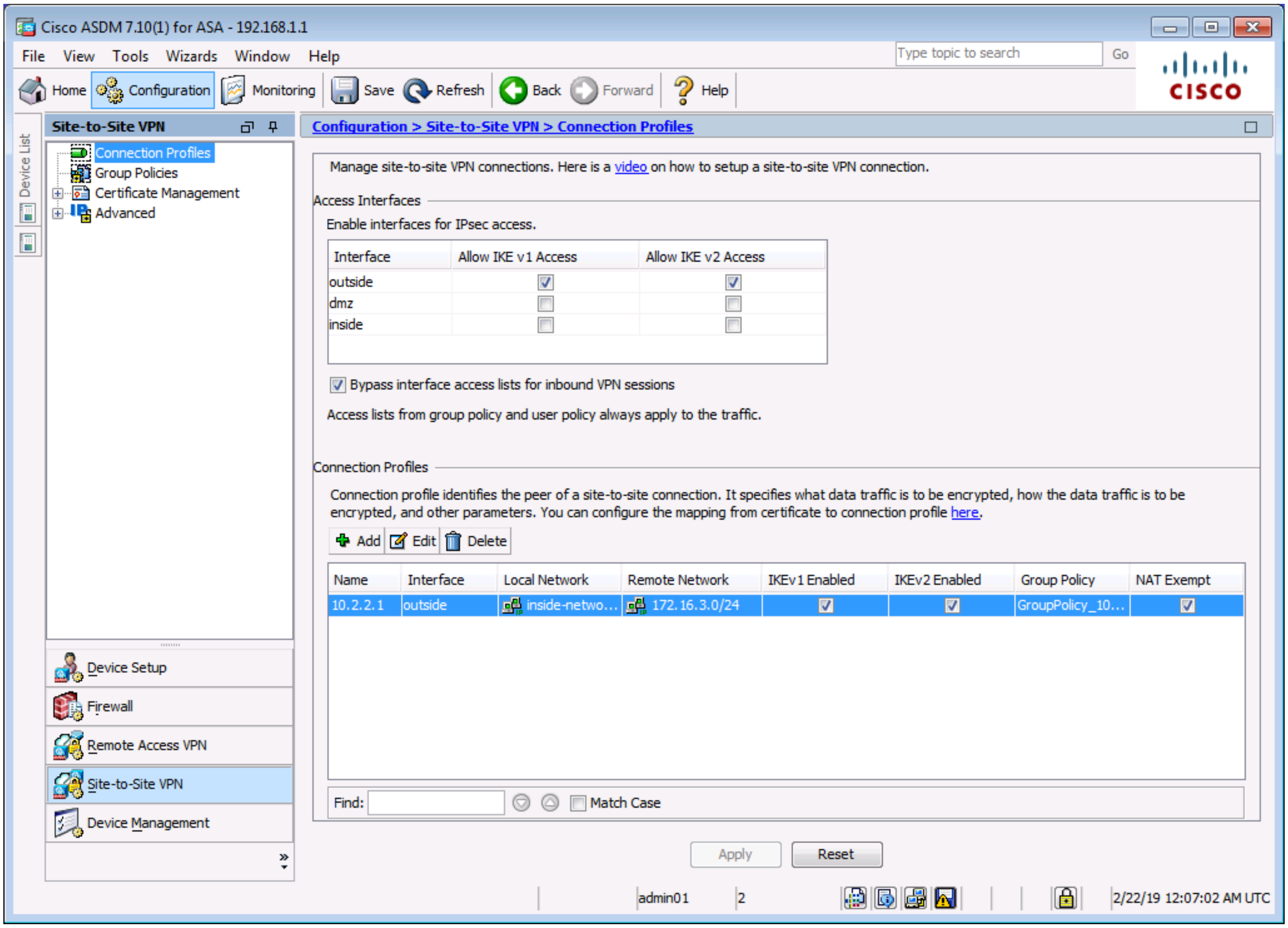
a. Verify that the information configured is correct. You can click **Back** to make changes, or click **Cancel** and restart the VPN wizard (recommended).

b. Click **Finish** to complete the process and deliver the commands to the ASA.

Note: If prompted to authenticate, log in again as **admin01** with the password **admin01pass**.

Step 9: Verify the ASDM VPN connection profile.

The ASDM **Configurations** > **Site-to-Site VPN** > **Connection Profiles** screen displays the settings you configured. From this window, the VPN configuration can be verified and edited.



Manage site-to-site VPN connections. Here is a video on how to setup a site-to-site VPN connection.

Access Interfaces

Enable interfaces for IPsec access.

Interface	Allow IKE v1 Access	Allow IKE v2 Access
outside	☑	☑
dmz	□	□
inside	□	□

☑ Bypass interface access lists for inbound VPN sessions

Access lists from group policy and user policy always apply to the traffic.

Connection Profiles

Connection profile identifies the peer of a site-to-site connection. It specifies what data traffic is to be encrypted, how the data traffic is to be encrypted, and other parameters. You can configure the mapping from certificate to connection profile here.

Name	Interface	Local Network	Remote Network	IKEv1 Enabled	IKEv2 Enabled	Group Policy	NAT Exempt
10.2.2.1	outside	inside-netwo...	172.16.3.0/24	☑	☑	GroupPolicy_10...	☑

Step 10: Use ASDM monitoring to verify the tunnel.

a. On the ASDM menu bar, click **Monitoring** > **VPN** from the panels at the lower left of the screen.

b. Click **VPN Statistics** > **Sessions**. Notice how there is no active session. This is because the VPN tunnel has not been established.

Step 11: Test the VPN configuration from PC-B.

a. To establish the VPN tunnel, interesting traffic must be generated. From PC-B, ping PC-C.

b. This generates interesting traffic. Notice how one or two pings failed before being successful. This is because the tunnel first had to be negotiated and established before the ICMP packets could be successful.

c. The VPN information is now being displayed on the ASDM **Monitoring** > **VPN** > **VPN Statistics** > **Sessions** page.

Note: You may need to click **Refresh** before the statistics will display.

d. Click **Encryption Statistics** under **VPN Statistics**. You should see one or more sessions using the 3DES encryption algorithm.

e. Click **Crypto Statistics** under **VPN Statistics**. You should see values for the number of packets encrypted and decrypted, security association (SA) requests, etc.

Reflection

Describe a situation where a site-to-site IPsec VPN would be preferable over other VPN options.

____

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When a large number of hosts exist at a remote office and traffic between the office and a central site needs to be protected. One disadvantage of the site-to-site VPN is that traffic on the remote network (connecting host) is not protected. Only the traffic between the site-to-site tunnel endpoints is protected.

Router Interface Summary Table

Router Interface Summary				
Router Model	**Ethernet Interface #1**	**Ethernet Interface #2**	**Serial Interface #1**	**Serial Interface #2**
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.				

Device Configs

ASA 5506-X Config

```
CCNAS-ASA# show run
: Saved
```

```
:
: Hardware:   ASA5506, 4096 MB RAM, CPU Atom C2000 series 1250 MHz, 1 CPU (4 cores)
:
ASA Version 9.10(1)
!
hostname CCNAS-ASA
domain-name ccnasecurity.com
enable password ***** pbkdf2
names
no mac-address auto

!
interface GigabitEthernet1/1
 nameif outside
 security-level 0
 ip address 209.165.200.226 255.255.255.248
!
interface GigabitEthernet1/2
 nameif inside
 security-level 100
 ip address 192.168.1.1 255.255.255.0
!
interface GigabitEthernet1/3
 nameif dmz
 security-level 70
 ip address 192.168.2.1 255.255.255.0
!
interface GigabitEthernet1/4
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet1/5
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet1/6
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet1/7
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet1/8
 shutdown
 no nameif
 no security-level
 no ip address
!
interface Management1/1
 management-only
 shutdown
 no nameif
 no security-level
 no ip address
!
ftp mode passive
dns server-group DefaultDNS
 domain-name ccnasecurity.com
object network inside-net
 subnet 192.168.1.0 255.255.255.0
object network dmz-server
 host 192.168.2.3
object network NETWORK_OBJ_172.16.3.0_24
 subnet 172.16.3.0 255.255.255.0
object network NETWORK_OBJ_192.168.1.0_24
 subnet 192.168.1.0 255.255.255.0
access-list OUTSIDE-DMZ extended permit ip any host 192.168.2.3
access-list outside_cryptomap extended permit ip 192.168.1.0 255.255.255.0
172.16.3.0 255.255.255.0
pager lines 24
mtu inside 1500
mtu outside 1500
mtu dmz 1500
icmp unreachable rate-limit 1 burst-size 1
no asdm history enable
arp timeout 14400
no arp permit-nonconnected
arp rate-limit 16384
nat (inside,outside) source static NETWORK_OBJ_192.168.1.0_24
NETWORK_OBJ_192.168.1.0_24 destination static NETWORK_OBJ_172.16.3.0_24
NETWORK_OBJ_172.16.3.0_24 no-proxy-arp route-lookup
!
object network inside-net
 nat (inside,outside) dynamic interface
object network dmz-server
 nat (dmz,outside) static 209.165.200.227
access-group OUTSIDE-DMZ in interface outside
route outside 0.0.0.0 0.0.0.0 209.165.200.225 1
timeout xlate 3:00:00
timeout pat-xlate 0:00:30
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 sctp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
timeout conn-holddown 0:00:15
timeout igp stale-route 0:01:10
user-identity default-domain LOCAL
aaa authentication ssh console LOCAL
aaa authentication http console LOCAL
aaa authentication login-history
http server enable
http 192.168.1.0 255.255.255.0 inside
no snmp-server location
no snmp-server contact
service sw-reset-button
crypto ipsec ikev1 transform-set ESP-AES-128-SHA esp-aes esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-128-MD5 esp-aes esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-192-SHA esp-aes-192 esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-192-MD5 esp-aes-192 esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-256-SHA esp-aes-256 esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-256-MD5 esp-aes-256 esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-128-SHA-TRANS esp-aes esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-128-SHA-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-AES-128-MD5-TRANS esp-aes esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-128-MD5-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-AES-192-SHA-TRANS esp-aes-192 esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-192-SHA-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-AES-192-MD5-TRANS esp-aes-192 esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-192-MD5-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-AES-256-SHA-TRANS esp-aes-256 esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-AES-256-SHA-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-AES-256-MD5-TRANS esp-aes-256 esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-AES-256-MD5-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-3DES-SHA esp-3des esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-3DES-MD5 esp-3des esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-3DES-SHA-TRANS esp-3des esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-3DES-SHA-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-3DES-MD5-TRANS esp-3des esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-3DES-MD5-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-DES-SHA esp-des esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-DES-MD5 esp-des esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-DES-SHA-TRANS esp-des esp-sha-hmac
crypto ipsec ikev1 transform-set ESP-DES-SHA-TRANS mode transport
crypto ipsec ikev1 transform-set ESP-DES-MD5-TRANS esp-des esp-md5-hmac
crypto ipsec ikev1 transform-set ESP-DES-MD5-TRANS mode transport
crypto ipsec ikev2 ipsec-proposal AES256
```

```
 protocol esp encryption aes-256
 protocol esp integrity sha-1 md5
crypto ipsec ikev2 ipsec-proposal AES192
 protocol esp encryption aes-192
 protocol esp integrity sha-1 md5
crypto ipsec ikev2 ipsec-proposal AES
 protocol esp encryption aes
 protocol esp integrity sha-1 md5
crypto ipsec ikev2 ipsec-proposal 3DES
 protocol esp encryption 3des
 protocol esp integrity sha-1 md5
crypto ipsec ikev2 ipsec-proposal DES
 protocol esp encryption des
 protocol esp integrity sha-1 md5
crypto ipsec security-association pmtu-aging infinite
crypto map outside_map 1 match address outside_cryptomap
crypto map outside_map 1 set peer 10.2.2.1
crypto map outside_map 1 set ikev1 transform-set ESP-AES-128-SHA ESP-AES-128-MD5 ESP-AES-192-SHA ESP-AES-192-MD5 ESP-AES-256-SHA ESP-AES-256-MD5 ESP-3DES-SHA ESP-3DES-MD5 ESP-DES-SHA ESP-DES-MD5
crypto map outside_map 1 set ikev2 ipsec-proposal AES256 AES192 AES 3DES DES
crypto map outside_map interface outside
crypto ca trustpool policy
crypto ikev2 policy 1
 encryption aes-256
 integrity sha
 group 5 2
 prf sha
 lifetime seconds 86400
crypto ikev2 policy 10
 encryption aes-192
 integrity sha
 group 5 2
 prf sha
 lifetime seconds 86400
crypto ikev2 policy 20
 encryption aes
 integrity sha
 group 5 2
 prf sha
 lifetime seconds 86400
crypto ikev2 policy 30
 encryption 3des
 integrity sha
 group 5 2
 prf sha
 lifetime seconds 86400
crypto ikev2 policy 40
 encryption des
 integrity sha
 group 5 2
 prf sha
 lifetime seconds 86400
crypto ikev2 enable outside
crypto ikev1 enable outside
crypto ikev1 policy 10
 authentication pre-share
 encryption aes-256
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 20
 authentication rsa-sig
 encryption aes-256
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 40
 authentication pre-share
 encryption aes-192
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 50
 authentication rsa-sig
 encryption aes-192
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 70
 authentication pre-share
 encryption aes
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 80
 authentication rsa-sig
 encryption aes
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 100
 authentication pre-share
 encryption 3des
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 110
```

```
 authentication rsa-sig
 encryption 3des
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 130
 authentication pre-share
 encryption des
 hash sha
 group 2
 lifetime 86400
crypto ikev1 policy 140
 authentication rsa-sig
 encryption des
 hash sha
 group 2
 lifetime 86400
telnet timeout 5
ssh stricthostkeycheck
ssh 192.168.1.0 255.255.255.0 inside
ssh timeout 10
ssh version 2
ssh key-exchange group dh-group1-sha1
console timeout 0

threat-detection basic-threat
threat-detection statistics access-list
no threat-detection statistics tcp-intercept
group-policy GroupPolicy_10.2.2.1 internal
group-policy GroupPolicy_10.2.2.1 attributes
 vpn-tunnel-protocol ikev1 ikev2
dynamic-access-policy-record DfltAccessPolicy
username admin01 password ***** pbkdf2
tunnel-group 10.2.2.1 type ipsec-l2l
tunnel-group 10.2.2.1 general-attributes
 default-group-policy GroupPolicy_10.2.2.1
tunnel-group 10.2.2.1 ipsec-attributes
 ikev1 pre-shared-key *****
 ikev2 remote-authentication pre-shared-key *****
 ikev2 local-authentication pre-shared-key *****
!
class-map inspection_default
 match default-inspection-traffic
!
!
policy-map type inspect dns preset_dns_map
 parameters
  message-length maximum client auto
  message-length maximum 512
  no tcp-inspection
policy-map global_policy
 class inspection_default
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
  inspect dns preset_dns_map
  inspect icmp
policy-map type inspect dns migrated_dns_map_2
 parameters
  message-length maximum client auto
  message-length maximum 512
  no tcp-inspection
policy-map type inspect dns migrated_dns_map_1
 parameters
  message-length maximum client auto
  message-length maximum 512
  no tcp-inspection
!
service-policy global_policy global
prompt hostname context
no call-home reporting anonymous
call-home
 profile CiscoTAC-1
  no active
  destination address http
https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination address email callhome@cisco.com
  destination transport-method http
  subscribe-to-alert-group diagnostic
  subscribe-to-alert-group environment
  subscribe-to-alert-group inventory periodic monthly
  subscribe-to-alert-group configuration periodic monthly
  subscribe-to-alert-group telemetry periodic daily
Cryptochecksum:1074c3a8cd1c2fac7b700449f04085d3
: end
```

Router R1

```
Building configuration...

Current configuration : 1713 bytes
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
security passwords min-length 10
enable secret 9 $9$xKxfXtYW7haqI.$gLUxyPBS.RKfwGx.5Nc/yaDEMxvUD9HmhyqDqqwRGWE
!
no aaa new-model
memory-size iomem 15
!
ip domain name ccnasecurity.com
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
cts logging verbose
!
!
username admin01 secret 9
$9$5ShIv6PMmhCYYk$oCVgPgvKu80EKQWTWAj2CWyOkwyl2BHh1PlgxShL/8s
!
redundancy
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 209.165.200.225 255.255.255.248
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
```

```
!
interface Serial0/0/0
 ip address 10.1.1.1 255.255.255.252
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Serial0/0/0
!
control-plane
!
line con 0
 exec-timeout 5 0
 logging synchronous
 login local
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 exec-timeout 5 0
 logging synchronous
 login local
 transport input ssh
!
scheduler allocate 20000 1000
!
end
```

Router R2

```
R2# show run
Building configuration...

Current configuration : 1678 bytes
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
```

```
!
hostname R2
!
boot-start-marker
boot-end-marker
!
security passwords min-length 10
enable secret 9 $9$Nb4BPAMsmT24y.$4bn2kyZCwulndKiaU1453lzF4n3ge95hfoFIKrucvpI
!
no aaa new-model
memory-size iomem 15
!
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
cts logging verbose
!
username admin01 secret 9
$9$6PSI5.sujsrgN.$LFz4TeeqS/1FtxvK23Le8jxUAY9sjeedVmyF/PA9sPo
!
redundancy
!
interface Embedded-Service-Engine0/0
 no ip address
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 10.1.1.2 255.255.255.252
!
interface Serial0/0/1
 ip address 10.2.2.2 255.255.255.252
 clock rate 2000000
!
```

```
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 172.16.3.0 255.255.255.0 Serial0/0/1
ip route 209.165.200.224 255.255.255.248 Serial0/0/0
!
control-plane
!
line con 0
 exec-timeout 5 0
 logging synchronous
 login local
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 exec-timeout 5 0
 logging synchronous
 login local
 transport input telnet
!
scheduler allocate 20000 1000
!
end
```

Router R3

```
R3# show run
Building configuration...

Current configuration : 2120 bytes
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
security passwords min-length 10
enable secret 9 $9$bkZXRtRQF6uqE.$MenFawyYEn642ALi3kGNBttfJxBOYk3fScLmuOFO9Tg
```

```
!
no aaa new-model
memory-size iomem 15
!
ip domain name ccnasecurity.com
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
cts logging verbose
!
vtp domain TSHOOT
vtp mode transparent
username admin01 secret 9
$9$3gQ5keGlFNmNx.$YmVC/lGkYSErJRHSxRZl3xek9HBYHOASaKmQjYeHx36
!
redundancy
!
crypto isakmp policy 10
 encr 3des
 authentication pre-share
 group 2
crypto isakmp key SECRET-KEY address 209.165.200.226
!
crypto ipsec transform-set ESP-TUNNEL esp-3des esp-sha-hmac
 mode tunnel
!
crypto map S2S-MAP 10 ipsec-isakmp
 set peer 209.165.200.226
 set transform-set ESP-TUNNEL
 match address VPN-ACL
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 172.16.3.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/0/0
```

```
 no ip address
 shutdown
 clock rate 125000
!
interface Serial0/0/1
 ip address 10.2.2.1 255.255.255.252
 crypto map S2S-MAP
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
!
ip access-list extended VPN-ACL
 permit ip 172.16.3.0 0.0.0.255 192.168.1.0 0.0.0.255
!
control-plane
!
line con 0
 exec-timeout 5 0
 logging synchronous
 login local
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 exec-timeout 5 0
 logging synchronous
 login local
 transport input ssh
!
scheduler allocate 20000 1000
end
```

Switches S1, S2 and S3 – Use default configs, except for host name