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Network Security 2

Module 4 – Configure Site-to-Site VPN Using Pre-Shared Keys

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Högskolan Halmstad

Learning Objectives

–4.1 Prepare a Router for Site-to-Site VPN using Pre-shared Keys

–4.2 Configure a Router for IKE Using Pre-shared Keys

–4.3 Configure a Router with IPSec Using Pre-shared Keys

–4.4 Test and Verify the IPSec Configuration of the Router

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Module 4 – Configure Site-to-Site VN using Pre-Shared Keys

4.1 Prepare a Router for Site-to-Site VPN using Pre-shared Keys

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IKE Phase 1 Policy Parameters

•Parameter	•Strong	•Stronger
•Encryption algorithm	•DES	•3DES or AES
•Hash algorithm	•MD5	•SHA-1
•Authentication method	•Pre-shared	•RSA encryption •RSA signature
•Key exchange	•DH Group 1	•DH Group 2 •DH Group 5
•IKE SA lifetime	•86,400 seconds	•Less than 86,400 seconds

IPSec Transforms Supported in Cisco IOS Software

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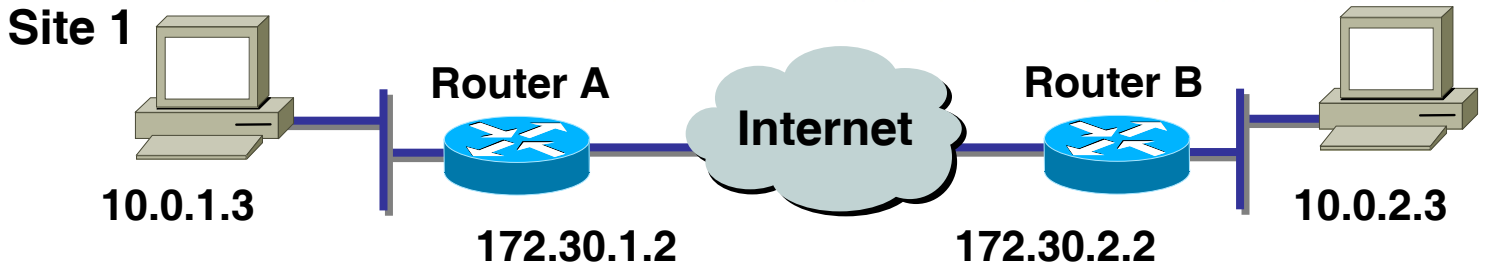
Cisco IOS software supports the following IPSec transforms:

```
RouterA(config)# crypto ipsec transform-set
      transform-set-name ?
ah-md5-hmac   AH-HMAC-MD5 transform
ah-sha-hmac   AH-HMAC-SHA transform
comp-lzs      IP compression using 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-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
```

Step 3 – Check Current Configuration



router#

```
show running-config
```

- View router configuration for existing IPSec policies

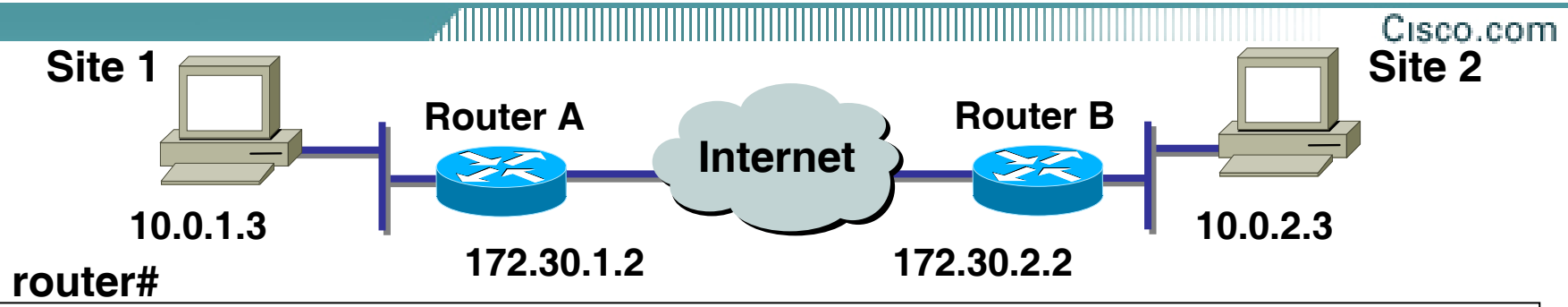
router#

```
show crypto isakmp policy
```

- View default and any configured IKE Phase 1 policies

```
RouterA# show crypto isakmp policy
Default protection suite
    encryption algorithm:   DES - Data Encryption Standard (56 bit keys)
    hash algorithm:         Secure Hash Standard
    authentication method:  Rivest-Shamir-Adleman Signature
    Diffie-Hellman Group:   #1 (768 bit)
    lifetime:               86400 seconds, no volume limit
```

View Configured Crypto Maps



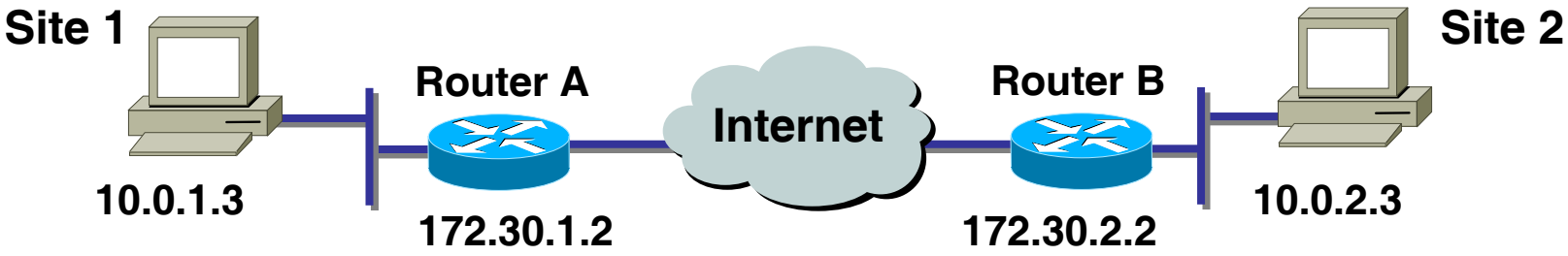
router#

```
show crypto map
```

- View any configured crypto maps

```
RouterA# show crypto map
Crypto Map "mymap" 10 ipsec-isakmp
        Peer = 172.30.2.2
        Extended IP access list 102
             access-list 102 permit ip host 172.30.1.2 host 172.30.2.2
        Current peer: 172.30.2.2
        Security association lifetime: 4608000 kilobytes/3600 seconds
        PFS (Y/N): N
    Transform sets={ mine, }
```

View Configured Transform Sets



router#

```
show crypto ipsec transform-set
```

- **View any configured transform sets**

```
RouterA# show crypto ipsec transform-set mine
Transform set mine: { esp-des  }
   will negotiate = { Tunnel,  },
```

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4.2 Configure a Router for IKE Using Pre-Shared Keys

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Enable or Disable ISAKP

Mode	Command	Description
router (config)#	**[no] crypto isakmp enable**	

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

- This command globally enables or disables IKE at the router
- IKE is enabled by default
- IKE is enabled globally for all interfaces at the router
- Use the no form of the command to disable IKE
- An ACL can be used to block IKE on a particular interface

Create IKE Policy

Mode	Command	Description
`router (config)#`	**`crypto isakmp policy`** ***`priority`***	

- Defines an IKE policy, which is a set of parameters used during IKE negotiation
- Invokes the config-isakmp command mode

```
RouterA(config)#crypto isakmp policy 110
```

ISAKMP Policy Negotiation

RouterA(config)#

```
crypto isakmp policy 100
  hash md5
  authentication pre-share
crypto isakmp policy 200
  authentication rsa-sig
  hash sha
crypto isakmp policy 300
  authentication pre-share
```

RouterB(config)#

```
crypto isakmp policy 100
  hash md5
  authentication pre-share
crypto isakmp policy 200
  authentication rsa-sig
  hash sha
crypto isakmp policy 300
  authentication pre-share
```

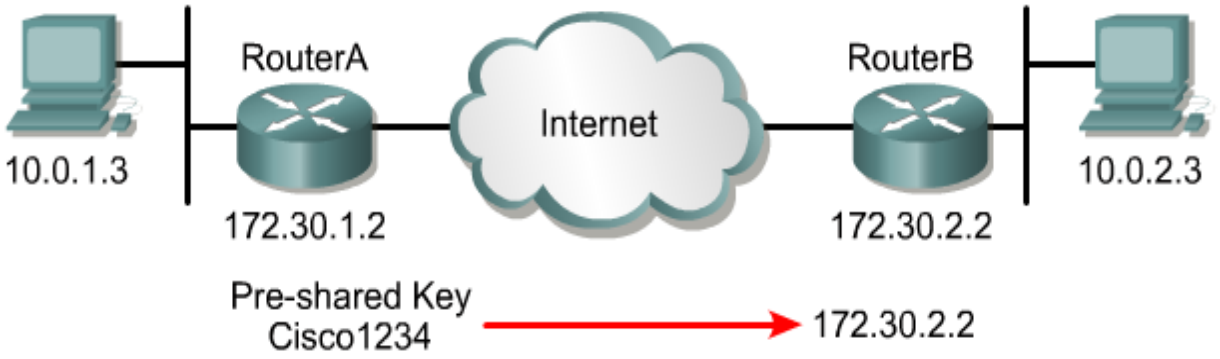
The first two policies in each router can be successfully negotiated while the last one cannot.

Configure ISAKMP Identity

Mode	Command	Description
`router (config)#`	**`crypto isakmp identity`** {*`address`* | *`hostname`*}	• Defines whether ISAKMP identity is done by IP address or hostname • Use consistency across ISAKMP peers

Command	Description
`address`	Sets the ISAKMP identity to the IP address of the interface that is used to communicate to the remote peer during ISAKMP negotiations. The keyword is typically used when there is only one interface that will be used by the peer for ISAKMP negotiations, and the IP address is known.
`hostname`	Sets the ISAKMP identity to the host name concatenated with the domain name (for example, **myhost.domain.com**). The keyword should be used if there is more than one interface on the peer that might be used for ISAKMP negotiations, or if the interface's IP address is unknown (such as with dynamically assigned IP addresses).

Configure Pre-Shared Keys



Mode	Command	Description
router (config)#	**crypto isakmp key** *keystring* **address** *peer-address*	Assigns a keystring and the peer address
router (config)#	**crypto isakmp key** *keystring* **hostname** *hostname*	The peer's IP address or host name can be used

```
RouterA(config)#crypto isakmp key cisco1234 address
 172.30.2.2
```

Verify the ISAKMP Configuration


```
RouterA# show crypto isakmp policy
Protection suite of priority 110
 encryption algorithm:   DES - Data Encryption Standard
                         (56 bit keys).
 hash algorithm:         Message Digest 5
 aunthentication method: Pre-Shared Key
 Diffie-Hellman-group:   #1 (768 bit)
 lifetime:               86400 seconds, no volume limit
```

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4.3 Configure a Router with IPSec Using Pre-Shared Keys

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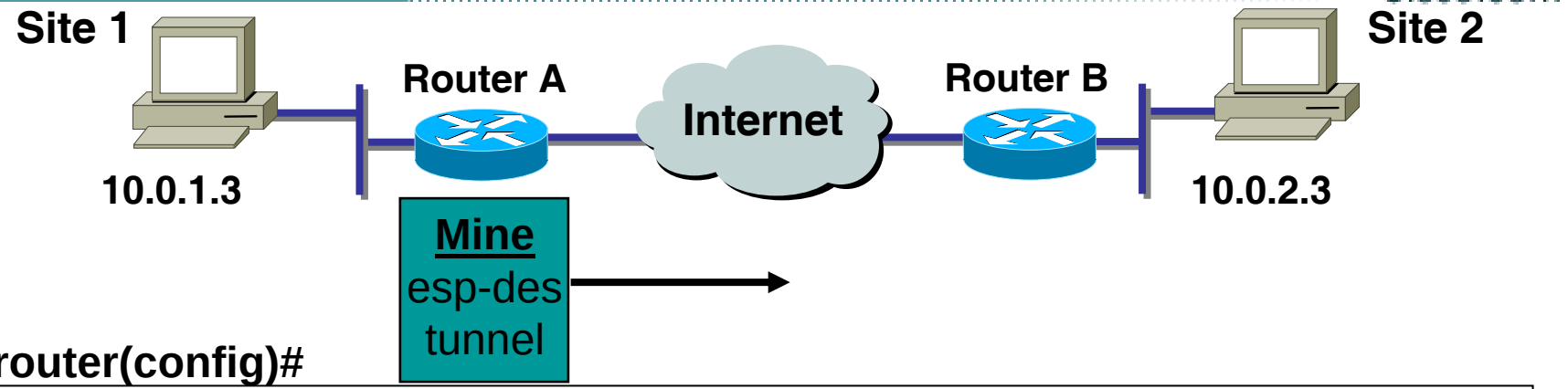
Configure Transform Sets



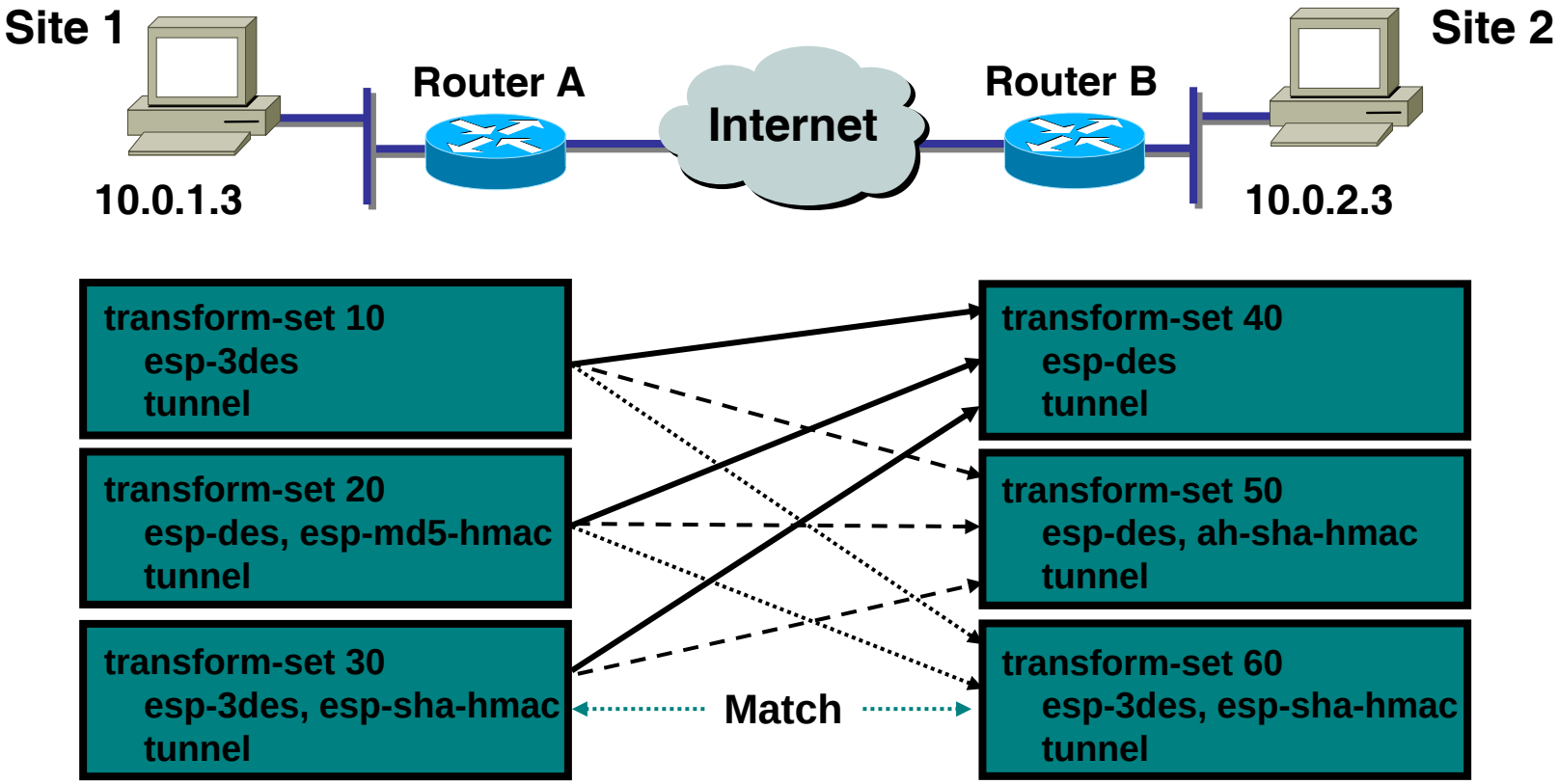
router(config)#

```
crypto ipsec transform-set transform-set-name
transform1 [transform2 [transform3]]
router(cfg-crypto-trans)#
```

```
RouterA(config)# crypto ipsec transform-set MINE
esp-des esp-md5-hmac
```

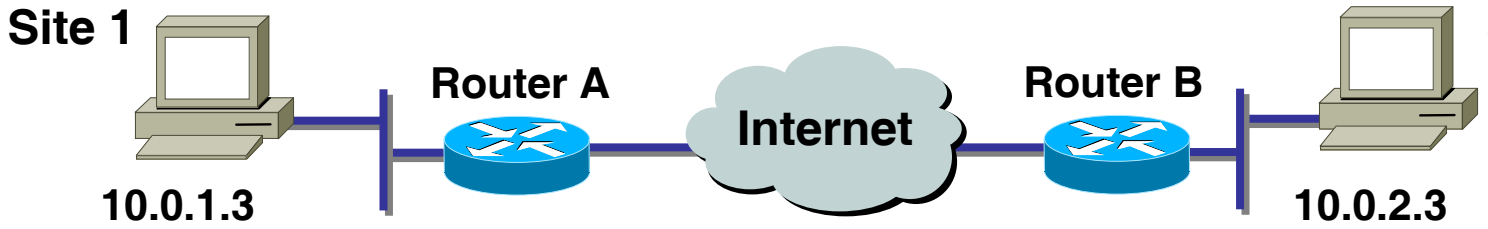
- A transform set is a combination of IPSec transforms that enact a security policy for traffic.
- Sets are limited to up to one AH and up to two ESP transforms.

Transform Set Negotiation



- **Transform sets are negotiated during IKE Phase 2.**

crypto ipsec security-association lifetime Command



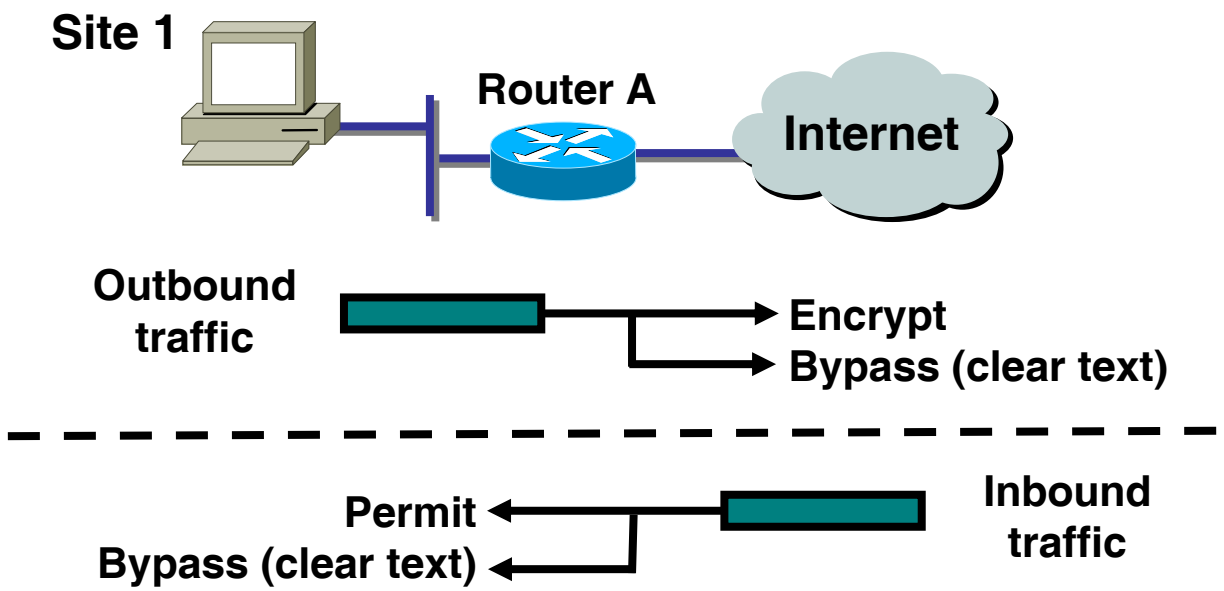
router(config)#

```
crypto ipsec security-association lifetime
     {seconds seconds | kilobytes kilobytes}
```

```
RouterA(config)# crypto ipsec security-association
lifetime seconds 86400
```

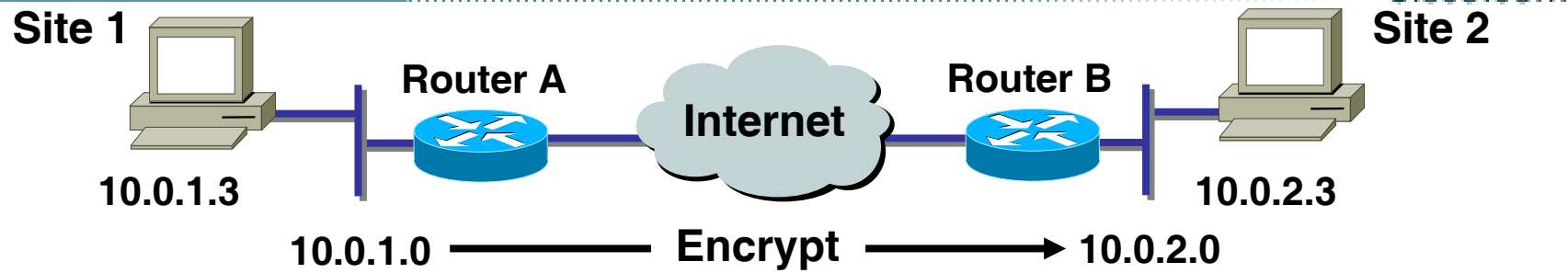
- Configures global IPSec SA lifetime values used when negotiating IPSec security associations.
- IPSec SA lifetimes are negotiated during IKE Phase 2.
- You can optionally configure interface specific IPSec SA lifetimes in crypto maps.
- IPSec SA lifetimes in crypto maps override global IPSec SA lifetimes.

Purpose of Crypto ACLs



- Outbound – Indicate the data flow to be protected by IPSec
- Inbound – Filter out and discard traffic that should have been protected by IPSec

Extended IP ACLs for Crypto ACLs



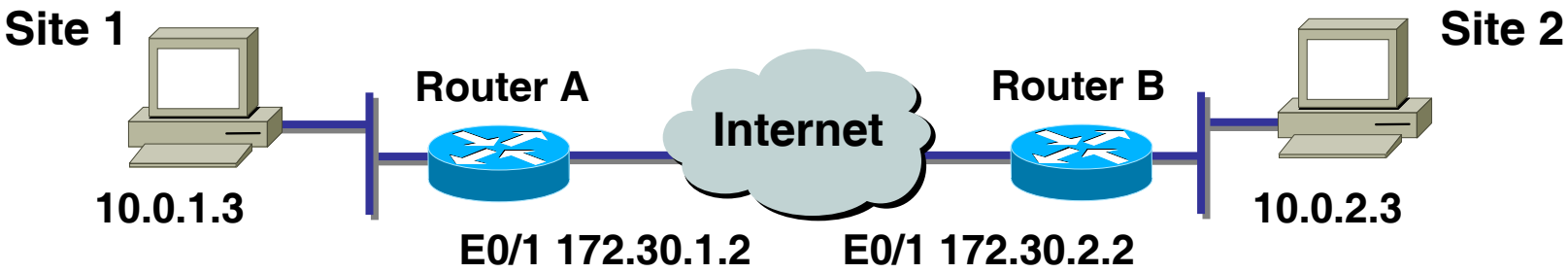
router(config)#

```
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

Configure Symmetrical Peer Crypto ACLs




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

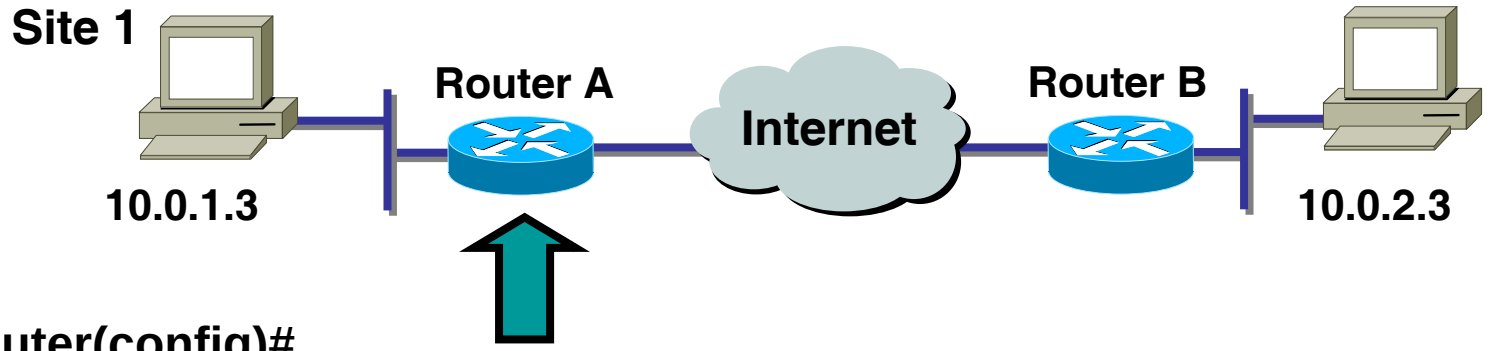
```
RouterB(config)# access-list 101 permit tcp 10.0.2.0  0.0.0.255
10.0.1.0 0.0.0.255
```

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

Purpose of 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

Configure IPSec Crypto Maps



router(config)#

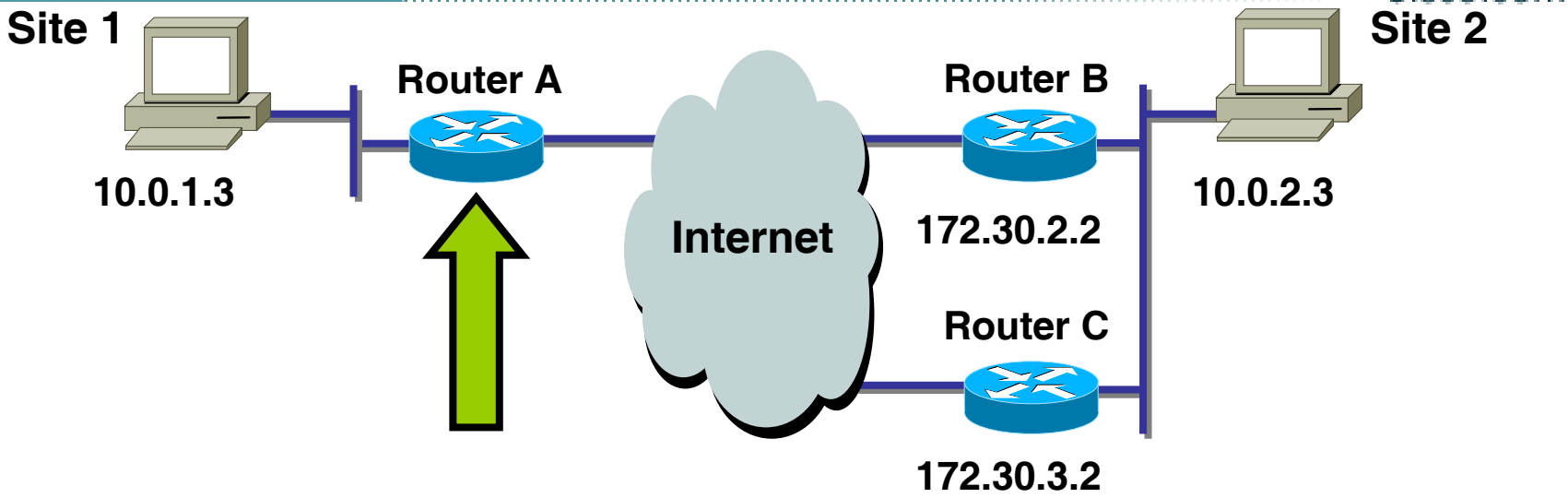
```
crypto map map-name seq-num ipsec-manual
```

```
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.

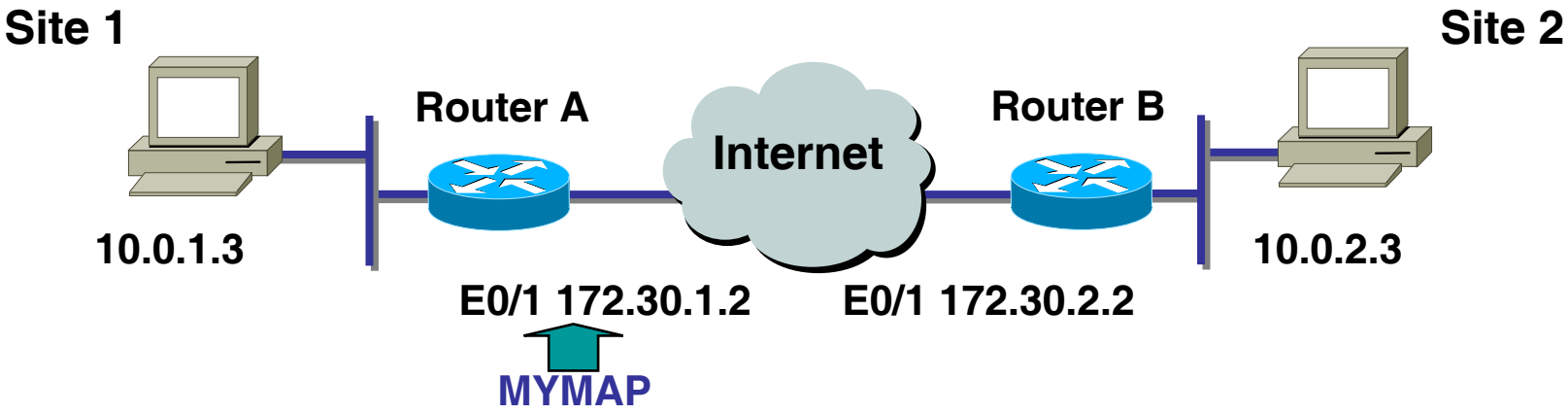
Example Crypto Map Commands




```
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.

Applying Crypto Maps to Interfaces



router(config-if)#

```
crypto map map-name
```

```
RouterA(config)# interface ethernet0/1
RouterA(config-if)# crypto map MYMAP
```

- Apply the crypto map to outgoing interface
- Activates the IPSec policy

Module 4 – Configure Site-to-Site VN using Pre-Shared Keys

4.4 Test and Verify the IPSec Configuration of the Router

Test and Verify IPSec

- Display the configured ISAKMP policies.
  - `show crypto isakmp policy`
- Display the configured transform sets.
  - `show crypto ipsec transform-set`
- Display the current state of the IPSec SAs.
  - `show crypto ipsec sa`

Test and Verify IPSec (Cont.)

- Display the configured crypto maps.
  - `show crypto map`
- Enable debug output for IPSec events.
  - `debug crypto ipsec`
- Enable debug output for ISAKMP events.
  - `debug crypto isakmp`

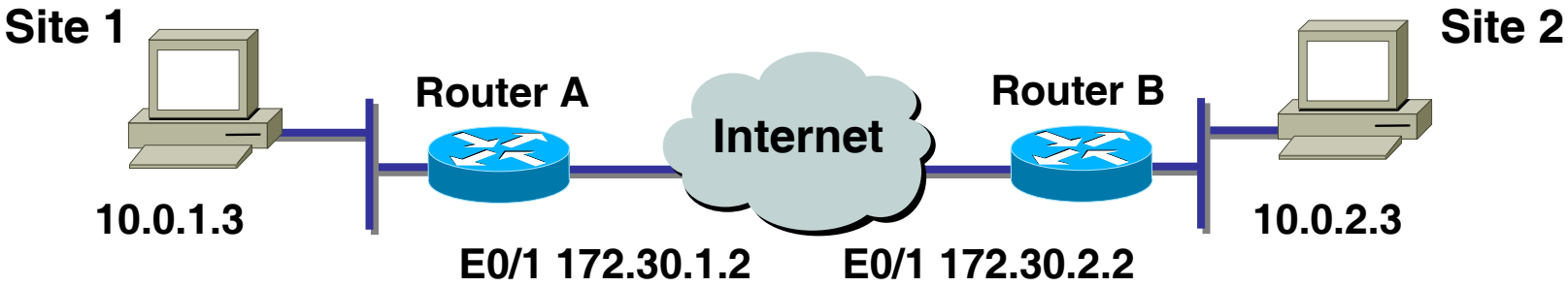
show crypto isakmp policy Command

router#

```
show crypto isakmp policy
```

```
RouterA# show crypto isakmp policy
Protection suite of priority 110
      encryption algorithm:   DES - Data Encryption Standard (56 bit keys).
      hash algorithm:         Message Digest 5
      authentication method:  Rivest-Shamir-Adleman Encryption
      Diffie-Hellman group:   #1 (768 bit)
      lifetime:               86400 seconds, no volume limit
Default protection suite
      encryption algorithm:   DES - Data Encryption Standard (56 bit keys).
      hash algorithm:         Secure Hash Standard
      authentication method:  Rivest-Shamir-Adleman Signature
      Diffie-Hellman group:   #1 (768 bit)
      lifetime:               86400 seconds, no volume limit
```

show crypto ipsec transform-set Command



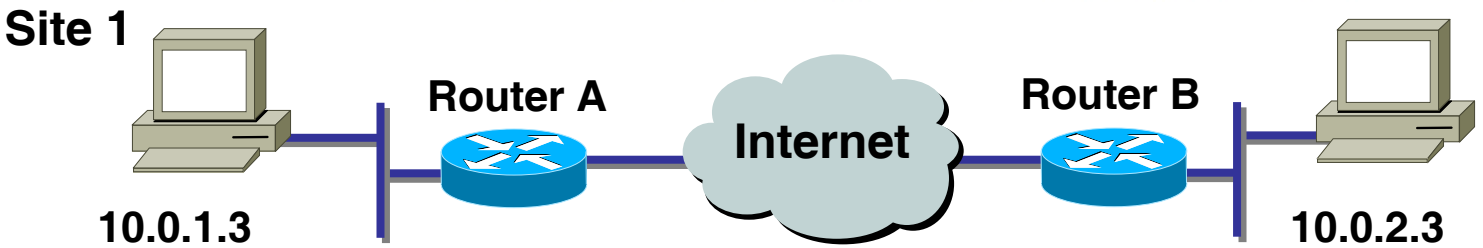
router#

```
show crypto ipsec transform-set
```

```
RouterA# show crypto ipsec transform-set
     Transform set MINE: { esp-des esp-md5-hmac }
     will negotiate = { Tunnel,  },
```

- View the currently defined transform sets

show crypto ipsec sa Command

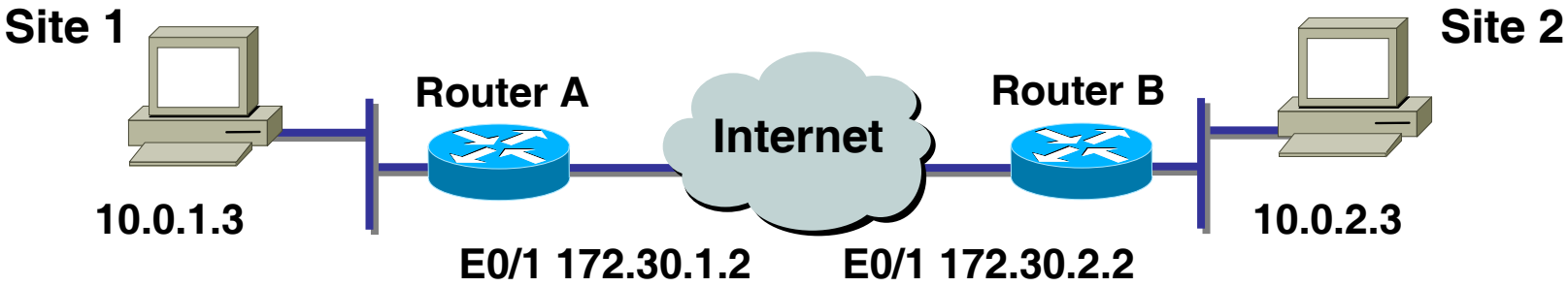


router#

```
show crypto ipsec sa
```

```
RouterA# show crypto ipsec sa
interface: Ethernet0/1
        Crypto map tag: MYMAP, local addr. 172.30.1.2
        local  ident (addr/mask/prot/port): (172.30.1.2/255.255.255.255/0/0)
       remote ident (addr/mask/prot/port): (172.30.2.2/255.255.255.255/0/0)
       current_peer: 172.30.2.2
         PERMIT, flags={origin_is_acl,}
        #pkts encaps: 21, #pkts encrypt: 21, #pkts digest 0
        #pkts decaps: 21, #pkts decrypt: 21, #pkts verify 0
        #send errors 0, #recv errors 0
         local crypto endpt.: 172.30.1.2, remote crypto endpt.: 172.30.2.2
         path mtu 1500, media mtu 1500
         current outbound spi: 8AE1C9C
```

show crypto map Command



router#

```
show crypto map
```

View the currently configured crypto maps

```
RouterA# show crypto map
Crypto Map “MYMAP" 10 ipsec-isakmp
            Peer = 172.30.2.2
            Extended IP access list 102
                 access-list 102 permit ip host 172.30.1.2 host
            172.30.2.2
            Current peer: 172.30.2.2
            Security association lifetime: 4608000 kilobytes/3600 seconds
            PFS (Y/N): N
            Transform sets={ MINE, }
```

debug crypto Commands

router#

```
debug crypto ipsec
```

- **Displays debug messages about all IPSec actions**

router#

```
debug crypto isakmp
```

- **Displays debug messages about all ISAKMP actions**

Crypto System Error Messages for ISAKMP


```
%CRYPTO-6-IKMP_SA_NOT_AUTH: Cannot accept Quick Mode exchange
from %15i if SA is not authenticated!
```

- **ISAKMP SA with the remote peer was not authenticated.**

```
%CRYPTO-6-IKMP_SA_NOT_OFFERED: Remote peer %15i responded with
attribute [chars] not offered or changed
```

- **ISAKMP peers failed protection suite negotiation for ISAKMP.**