IP Addressing: ARP Configuration Guide, Cisco IOS XE Release 2

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Configuring Address Resolution Protocol Options

Address Resolution Protocol (ARP) performs a required function in IP routing. ARP finds the hardware address, also known as Media Access Control (MAC) address, of a host from its known IP address. ARP maintains a cache (table) in which MAC addresses are mapped to IP addresses. ARP is part of all Cisco IOS XE systems running IP.

This document explains ARP for IP routing and the optional ARP features you can configure, such as static ARP entries, time out for dynamic ARP entries, clearing the cache, and Proxy ARP.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Address Resolution Protocol Options

- Serial Line Address Resolution Protocol, page 6

Layer 2 and Layer 3 Addressing

IP addressing occurs at Layer 2 (data link) and Layer 3 (network) of the Open System Interconnection (OSI) reference model. OSI is an architectural network model developed by ISO and ITU-T that consists of seven layers, each of which specifies particular network functions such as addressing, flow control, error control, encapsulation, and reliable message transfer.

Layer 2 addresses are used for local transmissions between devices that are directly connected. Layer 3 addresses are used for indirectly connected devices in an internetwork environment. Each network uses addressing to identify and group devices so that transmissions can be sent and received. Ethernet (802.2, 802.3, Ethernet II, and Subnetwork Access Protocol [SNAP]) use Media Access Control (MAC) addresses that are “burned in” to the Network Interface Card (NIC). The most commonly used network types are Ethernet II and SNAP.

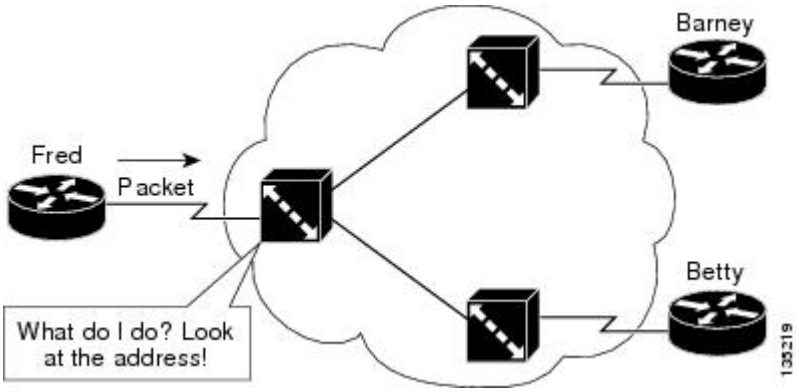
In order for devices to be able to communicate with each when they are not part of the same network, the 48-bit MAC address must be mapped to an IP address. Some of the Layer 3 protocols used to perform the mapping are:

- Address Resolution Protocol (ARP)
- Reverse ARP (RARP)
- Serial Line ARP (SLARP)
- Inverse ARP

For the purposes of IP mapping, Ethernet frames contain the destination and source addresses Frame Relay and Asynchronous Transfer Mode (ATM) networks, which are packet switched, data packets take different routes to reach the same destination. At the receiving end, the packet is reassembled in the correct order.

In a Frame Relay network, there is one physical link that has many logical circuits called virtual circuits (VCs). The address field in the frame contains a data-link connection identifier (DLCI) which identifies each VC. For example, in the figure below, the Frame Relay switch to which router Fred is connected receives frames; the switch forwards the frames to either Barney or Betty based on the DLCI which identifies each VC. So Fred has one physical connection but multiple logical connections.

Figure 1 Frame Relay Network



ATM networks use point-to-point serial links with the High-Level Data Link Control (HDLC) protocol. HDLC includes a meaningless address field included in five bytes of the frame header frame with the recipient implied since there can only be one.

Address Resolution Protocol

Address Resolution Protocol (ARP) was developed to enable communications on an internetwork and is defined by RFC 826. Routers and Layer 3 switches need ARP to map IP addresses to MAC hardware addresses so that IP packets can be sent across networks. Before a device sends a datagram to another device, it looks in its own ARP cache to see if there is a MAC address and corresponding IP address for the destination device. If there is no entry, the source device sends a broadcast message to every device on the network. Each device compares the IP address to its own. Only the device with the matching IP address replies to the sending device with a packet containing the MAC address for the device. The source device adds the destination device MAC address to its ARP table for future reference, creates a data-link header and trailer that encapsulates the packet, and proceeds to transfer the data. The figure below illustrates the ARP broadcast and response process.

Figure 2 ARP Process

When the destination device lies on a remote network, one beyond another router, the process is the same except that the sending device sends an ARP request for the MAC address of the default gateway. After the address is resolved and the default gateway receives the packet, the default gateway broadcasts the destination IP address over the networks connected to it. The router on the destination device network uses ARP to obtain the MAC address of the destination device and delivers the packet.

Encapsulation of IP datagrams and ARP requests and replies on IEEE 802 networks other than Ethernet use Subnetwork Access Protocol (SNAP).

The ARP request message has the following fields:

- HLN--Hardware address length. Specifies how long the hardware addresses are in the message. For IEEE 802 MAC addresses (Ethernet) the value is 6.
- PLN--Protocol address length. Specifies how long the protocol (Layer 3) addresses are in the message. For IPv4, the value is 4.
- OP--Opcode. Specifies the nature of the message by code:
  - 1--ARP request.
  - 2--ARP reply.
  - 3 through 9--RARP and Inverse ARP requests and replies.
- SHA--Sender hardware address. Specifies the Layer 2 hardware address of the device sending the message.
- SPA--Sender protocol address. Specifies the IP address of the sending device.
- THA--Target hardware address. Specifies the Layer 2 hardware address of the receiving device.
- TPA--Target protocol address. Specifies the IP address of the receiving device.

ARP Caching

Because the mapping of IP addresses to MAC addresses occurs at each hop (router) on the network for every datagram sent over an internetwork, performance of the network could be compromised. To minimize broadcasts and limit wasteful use of network resources, ARP caching was implemented.

ARP caching is the method of storing network addresses and the associated data-link addresses in memory for a period of time as the addresses are learned. This minimizes the use of valuable network resources to broadcast for the same address each time a datagram is sent. The cache entries must be maintained because the information could become outdated, so it is critical that the cache entries are set to expire periodically. Every device on a network updates its tables as addresses are broadcast.

There are static ARP cache entries and dynamic ARP cache entries. Static entries are manually configured and kept in the cache table on a permanent basis. They are best for devices that have to communicate with other devices usually in the same network on a regular basis. Dynamic entries are added by the Cisco IOS XE software and kept for a period of time, then removed.

Static and Dynamic Entries in the ARP Cache

Static routing requires an administrator to manually enter IP addresses, subnet masks, gateways, and corresponding MAC addresses for each interface of each router into a table. Static routing enables more control but requires more work to maintain the table. The table must be updated each time routes are added or changed.

Dynamic routing uses protocols that enable the routers in a network to exchange routing table information with each other. The table is built and changed automatically. No administrative tasks are needed unless a time limit is added, so dynamic routing is more efficient than static routing. The default time limit is 4 hours.If the network has a great many routes that are added and deleted from the cache, the time limit should be adjusted.

The routing protocols that dynamic routing uses to learn routes, such as distance-vector and link-state, is beyond the scope of this document. For more information, refer to Cisco IOS XE IP Routing Protocols Configuration Guide.

Devices That Do Not Use ARP

When a network is divided into two segments, a bridge joins the segments and filters traffic to each segment based on MAC addresses. The bridge builds its own address table, which uses MAC addresses only, as opposed to a router, which has a ARP cache that contains both IP addresses and the corresponding MAC addresses.

Passive hubs are central-connection devices that physically connect other devices in a network. They send messages out all of their ports to the devices and operate at Layer 1, but do not maintain an address table.

Layer 2 switches determine which port is connected to a device to which the message is addressed and send only to that port, unlike a hub, which sends the message out all its ports. However, Layer 3 switches are routers that build an ARP cache (table).

Inverse ARP

Inverse ARP, which is enabled by default in ATM networks, builds an ATM map entry and is necessary to send unicast packets to a server (or relay agent) on the other end of a connection. Inverse ARP is only supported for the **aal5snap** encapsulation type.

For multipoint interfaces, an IP address can be acquired using other encapsulation types because broadcast packets are used. However, unicast packets to the other end will fail because there is no ATM map entry and thus DHCP renewals and releases also fail.

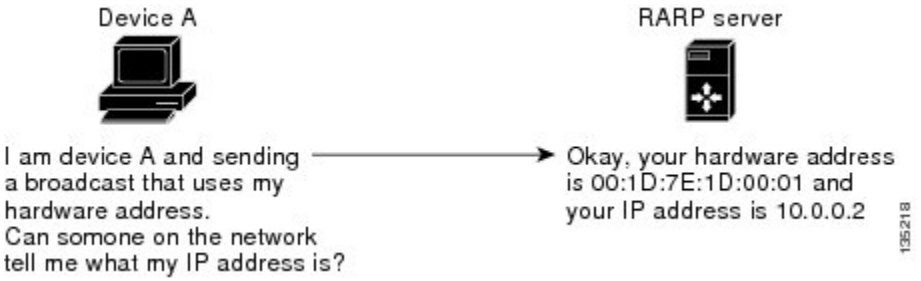
For more information about Inverse ARP and ATM networks, refer to the “Configuring ATM” chapter of the Cisco IOS XE Wide-Area Networking Configuration Guide.

Reverse ARP

Reverse ARP (RARP) as defined by RFC 903 works the same way as ARP, except that the RARP request packet requests an IP address instead of a MAC address. RARP often is used by diskless workstations because this type of device has no way to store IP addresses to use when they boot. The only address that is known is the MAC address because it is burned into the hardware.

Use of RARP requires an RARP server on the same network segment as the router interface. The figure below illustrates how RARP works.

Figure 3 RARP Process



There are several limitations of RARP. Because of these limitations, most businesses use DHCP to assign IP addresses dynamically. DHCP is cost effective and requires less maintenance than RARP. The most important limitations are as follows:

- Since RARP uses hardware addresses, if the internetwork is large with many physical networks, a RARP server must be on every segment with an additional server for redundancy. Maintaining two servers for every segment is costly.
- Each server must be configured with a table of static mappings between the hardware addresses and IP addresses. Maintenance of the IP addresses is difficult.
- RARP only provides IP addresses of the hosts and not subnet masks or default gateways.

The Cisco IOS XE software attempts to use RARP if it does not know the IP address of an interface at startup to respond to RARP requests that they are able to answer. A feature of Cisco IOS XE software automates the configuration of Cisco devices and is called AutoInstall.

AutoInstall supports RARP and enables a network manager to connect a new router to a network, turn it on, and load a pre-existing configuration file automatically. The process begins when no valid configuration file is found in NVRAM. For more information about AutoInstall, refer to the Cisco IOS XE Configuration Fundamentals Configuration Guide.

Proxy ARP

Proxy ARP, as defined in RFC 1027, was implemented to enable devices that are separated into physical network segments connected by a router in the same IP network or subnetwork to resolve the IP-to-MAC addresses. When devices are not in the same data link layer network but in the same IP network, they try to

transmit data to each other as if they are on the local network. However, the router that separates the devices will not send a broadcast message because routers do not pass hardware-layer broadcasts. The addresses cannot be resolved.

Proxy ARP is enabled by default so the “proxy router” that resides between the local networks will respond with its MAC address as if it is the router to which the broadcast is addressed. When the sending device receives the MAC address of the proxy router, it sends the datagram to the proxy router that in turns sends the datagram to the designated device.

Proxy ARP is invoked by the following conditions:

- The target IP address is not on the same physical network (LAN) on which the request is received.
- The networking device has one or more routes to the target IP address.
- All of the routes to the target IP address go through interfaces other than the one on which the request is received.

When proxy ARP is disabled, a device will respond to ARP requests received on its interface only if the target IP address is the same as its IP address, or the target IP address in the ARP request has a statically configured ARP alias.

Serial Line Address Resolution Protocol

Serial Line ARP (SLARP) is used for serial interfaces that use High-Level Data Link Control (HDLC) encapsulation. A SLARP server, intermediate (staging) router, and another router providing a SLARP service may be required in addition to a TFTP server. If an interface is not directly connected to a server, the staging router is required to forward the address resolution requests to the server, otherwise a directly connected router with SLARP service is required. The Cisco IOS XE software attempts to use SLARP if it does not know the IP address of an interface at startup to respond to SLARP requests that software is able to answer.

A feature of Cisco IOS XE software automates the configuration of Cisco devices and is called AutoInstall. AutoInstall supports SLARP and enables a network manager to connect a new router to a network, turn it on, and load a pre-existing configuration file automatically. The process begins when no valid configuration file is found in NVRAM. For more information about AutoInstall, refer to the Cisco IOS XE Configuration Fundamentals Configuration Guide.

Note Serial interfaces that use Frame Relay encapsulation are supported by AutoInstall.

How to Configure Address Resolution Protocol Options

ARP is enabled by default and is set to use Ethernet encapsulation by default. Perform the following tasks to change or verify ARP functionality:

- Enabling the Interface Encapsulation, page 7
- Defining Static ARP Entries, page 8
- Setting an Expiration Time for Dynamic Entries in the ARP Cache, page 9
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- Configuring Sticky ARP, page 12
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- Verifying the ARP Configuration, page 14

Enabling the Interface Encapsulation

Perform this task to support a type of encapsulation for a specific network, such as Ethernet or Frame Relay. When Frame Relay encapsulation is specified, the interface is configured for a Frame Relay subnetwork in which there is one physical link that has many logical circuits called virtual circuits (VCs). The address field in the frame contains a data-link connection identifier (DLCI) which identifies each VC. When SNAP encapsulation is specified, the interface is configured for FDDI or Token Ring networks.

Note The encapsulation type specified in this task should match the encapsulation type specified in "Defining Static ARP Entries".

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **arp** {**arpa** | **frame-relay** | **snap**}
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet0/0/0`	Enters interface configuration mode.

	Command or Action	Purpose
Step 4	**arp** {**arpa** | **frame-relay** | **snap**} **Example:** `Router(config-if)# arp arpa`	Specifies the encapsulation type for an interface by type of network, such as Ethernet, FDDI, Frame Relay, and Token Ring. The keywords are as follows: • **arpa** --Standard ARP. • **frame-relay** --Enables ARP for a Frame Relay network. • **snap** --IEEE 802.3 style ARP.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits to global and configuration mode.

Defining Static ARP Entries

Perform this task to define static mapping between IP addresses (32-bit address) and a MAC address (48-bit address) for hosts that do not support dynamic ARP. Because most hosts support dynamic address resolution, defining static ARP cache entries is usually not required. Performing this task installs a permanent entry in the ARP cache that never times out. The entries remain in the ARP table until they are removed using the **no arp** command or the **clear arp interface** command for each interface.

Note The encapsulation type specified in this task should match the encapsulation type specified in the "Enabling the Interface Encapsulation".

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **arp** {*ip-address*| **vrf** *vrf-name*} *hardware-address encap-type* [*interface-type*]
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**arp** {*ip-address*| **vrf** *vrf-name*} *hardware-address encap-type* [*interface-type*] **Example:** `Router(config)# arp 10.0.0.0 aabb.cc03.8200 arpa`	Globally associates an IP address with a MAC address in the ARP cache. The arguments and keyword are as follows: • *ip-address* --IP address in four-part dotted decimal format corresponding to the local data-link address. • **vrf** *vrf-name* --Virtual routing and forwarding instance for a Virtual Private Network (VPN). The *vrf-name* argument can be any name. • *hardware-address* --Local data-link address (a 48-bit address). • *encap-type* --Encapsulation type for the static entry. The keywords are as follows: ◦ **arpa**--For Ethernet interfaces. ◦ **sap**--For Hewlett Packard interfaces. ◦ **smds**--For Switched Multimegabit Data Service (SMDS) interfaces. ◦ **srp-a**--Switch route processor-side A (SRP-A) interfaces. ◦ **srp-b**--Switch route processor-side B (SRP-B) interfaces. • *interface-type* --(Optional) Interface type.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits to privileged EXEC mode.

Setting an Expiration Time for Dynamic Entries in the ARP Cache

Perform this task to set a time limit for dynamic entries in the ARP cache.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **arp timeout** *seconds*
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet0/0/0`	Enters interface configuration mode.
Step 4	**arp timeout** *seconds* **Example:** `Router(config-if)# arp timeout 30`	Sets the length of time, in seconds, an ARP cache entry will stay in the cache. A value of zero means that entries are never cleared from the cache. The default is 14400 seconds (4 hours). **Note** If the network has frequent changes to cache entries, the default should be changed to a shorter time period.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits to global configuration mode.

Globally Disabling Proxy ARP

Proxy ARP is enabled by default; perform this task to globally disable proxy ARP on all interfaces.

The Cisco IOS XE software uses proxy ARP (as defined in RFC 1027) to help hosts with no knowledge of routing determine the MAC addresses of hosts on other networks or subnets. For example, if hosts A and B are on different physical networks, host B will not receive the ARP broadcast request from host A and cannot respond to it. However, if the physical network of host A is connected by a gateway to the physical network of host B, the gateway will see the ARP request from host A.

Assuming that subnet numbers were assigned to correspond to physical networks, the gateway can also tell that the request is for a host that is on a different physical network. The gateway can then respond for host B, saying that the network address for host B is that of the gateway itself. Host A will see this reply, cache it, and send future IP packets for host B to the gateway.

The gateway will forward such packets to host B by using the configured IP routing protocols. The gateway is also referred to as a transparent subnet gateway or ARP subnet gateway.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip arp proxy disable**
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip arp proxy disable** **Example:** `Router(config)# ip arp proxy disable`	Disables proxy ARP on all interfaces. • The **ip arp proxy disable** command overrides any proxy ARP interface configuration. • To reenable proxy ARP, use the **no ip arp proxy disable** command. • You can also use the **default ip proxy arp** command to return to the default proxy ARP behavior, which is enabled.
Step 4	**exit** **Example:** `Router(config-if)# exit`	Exits to global configuration mode.

Disabling Proxy ARP on an Interface

Proxy ARP is enabled by default; perform this task to disable proxy ARP on an interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **no ip proxy-arp**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet0/0/0`	Enters interface configuration mode.
Step 4	**no ip proxy-arp** **Example:** `Router(config-if)# ip proxy-arp`	Disables proxy ARP on the interface. • To reenable proxy ARP, use the **ip proxy-arp**command. • You can also use the **default ip proxy-arp**command to return to the default proxy ARP behavior on the interface, which is enabled.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits to global configuration mode.

Configuring Sticky ARP

Sticky ARP prevents MAC address spoofing by ensuring that ARP entries (IP address, MAC address, and source VLAN) do not get overridden. The router maintains ARP entries in order to forward traffic to end devices or other routers. ARP entries are usually updated periodically or modified when ARP broadcasts are received. During an attack, ARP broadcasts are sent using a spoofed MAC address (with a legitimate IP

address) so that the router learns the legitimate IP address with the spoofed MAC address and begins to forward traffic to that MAC address. With sticky ARP enabled, the router learns the ARP entries and does not accept modifications received through ARP broadcasts. If you attempt to override the sticky ARP configuration, you will receive an error message.

Perform this task to configure sticky ARP on an interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip sticky-arp**
5. **ip sticky-arp ignore**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet0/0/0`	Enters interface configuration mode.
Step 4	**ip sticky-arp** **Example:** `Router(config-if)# ip sticky-arp`	Enables sticky ARP. • The **no ip sticky-arp** command removes the previously configured sticky ARP command.
Step 5	**ip sticky-arp ignore** **Example:** `Router(config-if)# ip sticky-arp ignore`	Disables sticky ARP.

Clearing the ARP Cache

Perform the following tasks to clear the ARP cache of entries associated with an interface and to clear all dynamic entries from the ARP cache, the fast-switching cache, and the IP route cache.

SUMMARY STEPS

1. **enable**
2. **clear arp interface** *type number*
3. **clear arp-cache**
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**clear arp interface** *type number* **Example:** `Router# clear arp interface GigabitEthernet0/0/0`	Clears the entire ARP cache on the interface. The *type* and *number* arguments are the type of interface and the assigned number for the interface.
Step 3	**clear arp-cache** **Example:** `Router# clear arp-cache`	Clears all dynamic entries from the ARP cache, the fast-switching cache, and the IP route cache.
Step 4	**exit** **Example:** `Router# exit`	Exits to user EXEC mode.

Verifying the ARP Configuration

To verify the ARP configuration, perform the following steps.

SUMMARY STEPS

1. **show interfaces**
2. **show arp**
3. **show ip arp**
4. **show processes cpu | include (ARP | PID)**

DETAILED STEPS

Step 1 **show interfaces**

To display the type of ARP being used on a particular interface and also display the ARP timeout value, use the **show interfaces** EXEC command.

Example:

```
Router# show interfaces GigabitEthernet0/0/0
GigabitEthernet0/0/0 is up, line protocol is up
 Hardware is SPA-8X1GE-V2, address is 001a.3045.4100 (bia 001a.3045.4100)
 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
 reliability 255/255, txload 1/255, rxload 1/255
 Encapsulation ARPA, loopback not set
 Keepalive not supported
 Full Duplex, 1000Mbps, link type is auto, media type is SX
 output flow-control is off, input flow-control is off
 ARP type: ARPA, ARP Timeout 04:00:00
 Last input never, output 00:00:50, output hang never
 Last clearing of ''show interface'' counters never
 Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
 Queueing strategy: fifo
 Output queue: 0/40 (size/max)
 5 minute input rate 0 bits/sec, 0 packets/sec
 5 minute output rate 0 bits/sec, 0 packets/sec
 0 packets input, 0 bytes, 0 no buffer
 Received 0 broadcasts (0 IP multicasts)
 0 runts, 0 giants, 0 throttles
 0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
 0 watchdog, 0 multicast, 0 pause input
 7998 packets output, 3074275 bytes, 0 underruns
 0 output errors, 0 collisions, 4 interface resets
 0 babbles, 0 late collision, 0 deferred
 0 lost carrier, 0 no carrier, 0 pause output
 0 output buffer failures, 0 output buffers swapped out
```

Step 2 **show arp**

Use the **show arp** EXEC command to examine the contents of the ARP cache.

Example:

```
Router# show arp
Protocol    Address       Age (min)   Hardware Addr      Type    Interface
Internet    10.1.1.1      43          001b.53e1.7201     ARPA    GigabitEthernet0/0/6
Internet    10.1.1.2      29          0021.d8ab.0b00     ARPA    GigabitEthernet0/0/6
Internet    10.1.2.1      80          001a.3045.4107     ARPA    GigabitEthernet0/0/7
Internet    10.1.2.1       -          0000.0c02.a03c     ARPA    GigabitEthernet0/0/7
```

Step 3 **show ip arp**

Use the **show ip arp** EXEC command to show IP entries. To remove all nonstatic entries from the ARP cache, use the **clear arp-cache**privileged EXEC command.

Example:

```
Router# show ip arp
Protocol    Address       Age (min)   Hardware Addr      Type    Interface
Internet    10.1.1.1      43          001b.53e1.7201     ARPA    GigabitEthernet0/0/6
Internet    10.1.1.2      29          0021.d8ab.0b00     ARPA    GigabitEthernet0/0/6
Internet    10.1.2.1      80          001a.3045.4107     ARPA    GigabitEthernet0/0/7
Internet    10.1.2.1       -          0000.0c02.a03c     ARPA    GigabitEthernet0/0/7
```

Step 4 **show processes cpu | include (ARP | PID)**

Use the **show processes cpu | include (ARP | PID)** command to display ARP and RARP processes.

Example:

```
Router# show processes cpu | include (ARP | PID)

PID  Runtime(ms)   Invoked      uSecs   5Sec   1Min   5Min TTY Process
   9          46       515         89  0.00%  0.00%  0.00%   0  ARP Input
  10           7     19078          0  0.00%  0.00%  0.00%   0  ARP Background
 110           1         2        500  0.00%  0.00%  0.00%   0  IP ARP Adjacency
 136           0         7          0  0.00%  0.00%  0.00%   0  ARP HA
 182           0         8          0  0.00%  0.00%  0.00%   0  RARP Input
```

Configuration Examples for Address Resolution Protocol Options

Static ARP Entry Configuration Example

The following example shows how to configure a static ARP entry in the cache and by using the **alias** keyword, Cisco IOS XE software can respond to ARP requests as if it were the interface of the specified address:

```
arp 10.0.0.0 aabb.cc03.8200 alias
interface GigabitEthernet0/0/0
```

Proxy ARP Configuration Example

The following example shows how to configure proxy ARP because it was disabled for Gigabit Ethernet interface 0/0/0:

```
interface GigabitEthernet 0/0/0
 ip proxy-arp
```

Sticky ARP Configuration Example

The following example shows how to enable sticky ARP on Gigbit Ethernet interface 0/0/0:

```
interface GigabitEthernet0/0/0
 ip sticky-arp
```

Clearing the ARP Cache Example

The following example shows how to clear all of the entries in the ARP cache associated with an interface:

```
Router# clear arp interface GigabitEthernet0/0/0
```

The following example shows how to clear all of the dynamic entries in the ARP cache:

```
Router# clear arp-cache
```

Additional References

The following sections provide references related to configuring Address Resolution Protocol Options.

Related Documents

Related Topic	Document Title
ARP commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Addressing Services Command Reference*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS XE releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 826	*Address Resolution Protocol*
RFC 903	*Reverse Address Resolution Protocol*
RFC 1027	*Proxy Address Resolution Protocol*
RFC 1042	*Standard for the Transmission of IP Datagrams over IEEE 802 Networks*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for Configuring Address Resolution Protocol Options

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1 Feature Information for Configuring Address Resolution Protocol Options

Feature Name	Releases	Feature Information
ARP	Cisco IOS XE Release 2.1	Address Resolution Protocol (ARP) performs a required function in IP routing. ARP finds the hardware address, also known as Media Access Control (MAC) address, of a host from its known IP address. ARP maintains a cache (table) in which MAC addresses are mapped to IP addresses. ARP is part of all Cisco IOS XE systems running IP.
ARP Optimization	Cisco IOS XE Release 2.1	Previously, the ARP table was organized for easy searching on an entry based on the IP address. However, there are cases such as interface flapping on the router and a topology change in the network where all related ARP entries need to be refreshed for correct forwarding. This situation could consume a substantial amount of CPU time in the ARP process to search and clean up all the entries. The ARP Optimization feature improves ARP performance by reducing the ARP searching time by using an improved data structure. The following command was introduced by this feature:**clear arp interface**
Per Interface Sticky ARP	Cisco IOS XE Release 2.1	Sticky ARP prevents MAC address spoofing by ensuring that ARP entries (IP address, MAC address, and source VLAN) do not get overridden. The following command was introduced by this feature:**ip sticky-arp**