VRF-Aware DNS

The VRF-Aware DNS feature enables the configuration of a Virtual Private Network (VPN) routing and forwarding instance (VRF) table so that the domain name system (DNS) can forward queries to name servers using the VRF table rather than the named DNS server in the global IP address space. This feature allows DNS requests to be resolved within the appropriate Multiprotocol Label Switching (MPLS) VPN.

History for the VRF-Aware DNS Feature

Release	Modification
12.4(4)T	This feature was introduced.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Contents

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Information About VRF-Aware DNS

To configure the VRF-Aware DNS feature, you should understand the following concepts:

Domain Name System

Domain Name System (DNS) is a standard that defines a domain naming procedure used in TCP/IP. A domain is a hierarchical separation of the network into groups and subgroups with domain names identifying the structure. The named groups consist of named objects, usually devices like IP hosts, and the subgroups are domains. DNS has three basic functions:

- Name space: This function is a hierarchical space organized from a single root into domains. Each domain can contain device names or more specific information. A special syntax defines valid names and identifies the domain names.
- Name registration: This function is used to enter names into the DNS database. Policies are outlined to resolve conflicts and other issues.
- Name resolution: This function is a distributed client and server name resolution standard. The name servers are software applications that run on a server and contain the resource records (RRs) that describe the names and addresses of those entities in the DNS name space. A name resolver is the interface between the client and the server. The name resolver requests information from the server about a name. A cache can be used by the name resolver to store learned names and addresses.

A DNS server can be a dedicated device or a software process running on a device. The server stores and manages data about domains and responds to requests for name conflict resolutions. In a large DNS implementation, there can be a distributed database over many devices. A server can be a dedicated cache.

VRF Mapping and VRF-Aware DNS

To keep track of domain names, IP has defined the concept of a name server, whose job is to hold a cache (or database) of names appended to IP addresses. The cached information is important because the requesting DNS will not need to query for that information again, which is why DNS works well. If a server had to query each time for the same address because it had not saved any data, the queried servers would be flooded and would crash.

A gateway for multiple enterprise customers can be secured by mapping the remote users to a VRF domain. Mapping means obtaining the IP address of the VRF domain for the remote users. By using VRF domain mapping, a remote user can be authenticated by a VRF domain-specific AAA server so that the remote-access traffic can be forwarded within the VRF domain to the servers on the corporate network.

To support traffic for multiple VRF domains, the DNS and the servers used to resolve conflicts must be VRF aware. VRF aware means that a DNS subsystem will query the VRF name cache first, then the VRF domain, and store the returned RRs in a specific VRF name cache. Users are able to configure separate DNS name servers per VRF.

VRF-aware DNS forwards queries to name servers using the VRF table. Because the same IP address can be associated with different DNS servers in different VRF domains, a separate list of name caches for each VRF is maintained. The DNS looks up the specific VRF name cache first, if a table has been specified, before sending a query to the VRF name server. All IP addresses obtained from a VRF-specific name cache are routed using the VRF table.

How to Configure VRF-Aware DNS

This section contains the following tasks:

Defining a VRF Table and Assigning a Name Server to Enable VRF-Aware DNS

Perform this task to define a VRF table and assign a name server.

A VRF-specific name cache is dynamically created if one does not exist whenever a VRF-specific name server is configured by using the **ip name-server vrf** command option or a permanent name entry is configured by using the **ip host vrf** command option. The VRF name cache is removed whenever all name server and permanent entries in the VRF are disabled.

It is possible that multiple name servers are configured with the same VRF name. The system will send queries to those servers in turn until any of them responds, starting with the server that sent a response the last time.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip vrf** *vrf-name*
4. **rd** *route-distinguisher*
5. **exit**
6. **ip name-server** [**vrf** *vrf-name*] *server-address1* [*server-address2...server-address6*]
7. **ip domain lookup**

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 vrf** *vrf-name* **Example:** `Router(config)# ip vrf vpn1`	Defines a VRF table and enters VRF configuration mode. • The *vrf-name* argument can be up to 32 characters.
Step 4	**rd** *route-distinguisher* **Example:** `Router(config)# rd 100:21`	Creates routing and forwarding tables for a VRF.
Step 5	**exit** **Example:** `Router(config-vrf) exit`	Exits VRF configuration mode.
Step 6	**ip name-server** [**vrf** *vrf-name*] *server-address1* [*server-address2...server-address6*] **Example:** `Router(config)# ip name-server vrf vpn1 172.16.1.111 172.16.1.2`	Assigns the address of one or more name servers to a VRF table to use for name and address resolution. • The **vrf** keyword is optional but must be specified if the name server is used with VRF. The *vrf-name* argument assigns a name to the VRF.
Step 7	**ip domain lookup** **Example:** `Router(config)# ip domain lookup`	(Optional) Enables DNS-based address translation. • DNS is enabled by default. You only need to use this command if DNS has been disabled.

Mapping VRF-Specific Hostnames to IP Addresses

Perform this task to map VRF-specific hostnames to IP addresses.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip domain name** [**vrf** *vrf-name*] *name*
   or
   ip domain list [**vrf** *vrf-name*] *name*

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 domain name** [**vrf** *vrf-name*] *name*
	or
	ip domain list [**vrf** *vrf-name*] *name*
	
	Example:
	`Router(config)# ip domain name vrf vpn1 cisco.com`
	or
	
	Example:
	`Router(config)# ip domain list vrf vpn1 cisco.com`
		Defines a default domain name that the Cisco IOS software will use to complete unqualified hostnames.
		or
		Defines a list of default domain names to complete unqualified hostnames.
		• You can specify a default domain name that the Cisco IOS software will use to complete domain name requests. You can specify either a single domain name or a list of domain names. Any hostname that does not contain a complete domain name will have the default domain name you specify appended to it before the name is looked up.
		• The **vrf** keyword and *vrf-name* argument specify a default VRF domain name.
		• The **ip domain list** command can be entered multiple times to specify more than one domain name to append when doing a DNS query. The system will append each in turn until it finds a match.

Configuring a Static Entry in a VRF-Specific Name Cache

Perform this task to configure a static entry in a VRF-specific name cache.

A VRF-specific name cache is dynamically created if one does not exist whenever a name server is configured for the VRF by using the **ip name-server vrf** command option or a permanent name entry is configured by using the **ip host vrf** command option. The VRF name cache is removed whenever all name server and permanent entries in the VRF are disabled.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip host** [**vrf** *vrf-name*] *name* [*tcp-port-number*] *address1* [*address2...address8*]

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 host** [**vrf** *vrf-name*] *name* [*tcp-port*] *address1* [*address2...address8*] **Example:** `Router(config)# ip host vrf vpn3 company1.com 172.16.2.1`	Defines a static hostname-to-address mapping in the host cache. • If the **vrf** keyword and *vrf-name* arguments are specified, then a permanent entry is created only in the VRF-specific name cache.

Verifying the Name Cache Entries in the VRF Table

Perform this task to verify the name cache entries in the VRF table.

SUMMARY STEPS

1. **enable**
2. **show hosts** [**vrf** *vrf-name*] {**all** | *hostname*} [**summary**]
3. **clear host** [**vrf** *vrf-name*] {**all** | *hostname*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show hosts** [**vrf** *vrf-name*] {**all** | *hostname*} [**summary**] **Example:** `Router# show hosts vrf vpn2`	• Displays the default domain name, the style of name lookup service, a list of name server hosts, the cached list of hostnames and addresses, and the cached list of hostnames and addresses specific to a particular Virtual Private Network (VPN). • The **vrf** keyword and *vrf-name* argument only display the entries if a VRF name has been configured. • If you enter the **show hosts** command without specifying any VRF, only the entries in the global name cache will display.
Step 3	**clear host** [**vrf** *vrf-name*] {**all** | *hostname*} **Example:** `Router# clear host vrf vpn2`	(Optional) Deletes entries from the hostname-to-address global address cache or VRF name cache.

Configuration Examples for VRF-Aware DNS

This section provides the following configuration examples:

VRF-Specific Name Server Configuration: Example

The following example shows how to specify a VPN named vpn1 with the IP addresses of 172.16.1.111 and 172.16.1.2 as the name servers:

```
ip name-server vrf vpn1 172.16.1.111 172.16.1.2
```

VRF-Specific Domain Name List Configuration: Example

The following example shows how to add several domain names to a list in vpn1 and vpn2. The domain name is only used for name queries in the specified VRF.

```
ip domain list vrf vpn1 company.com
ip domain list vrf vpn2 school.edu
```

If there is no domain list, the domain name that you specified with the **ip domain name** global configuration command is used. If there is a domain list, the default domain name is not used. The **ip domain list** command is similar to the **ip domain name** command, except that with the **ip domain list** command you can define a list of domains, each to be tried in turn until a match is found.

VRF-Specific Domain Name Configuration: Example

The following example shows how to define cisco.com as the default domain name for a VPN named vpn1. The domain name is only used for name queries in the specified VRF.

```
ip domain name vrf vpn1 cisco.com
```

Any IP hostname that does not contain a domain name (that is, any name without a dot) will have the dot and cisco.com appended to it before being looked up.

VRF-Specific IP Host Configuration: Example

The following example shows how to define two static hostname-to-address mappings in the host cache for vpn2 and vpn3:

```
ip host vrf vpn2 host2 10.168.7.18
ip host vrf vpn3 host3 10.12.0.2
```

Additional References

The following sections provide references related to the VRF-Aware DNS feature.

Related Documents

Related Topic	Document Title
IP addressing services configuration tasks	*Cisco IOS IP Addressing Services Configuration Guide*, Release 12.4
IP addressing services commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Addressing Services Command Reference*, Release 12.4T

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 releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents modified commands only.

- **clear host**
- **ip domain list**
- **ip domain name**
- **ip host**
- **ip name-server**
- **show hosts**

clear host

To delete entries from the hostname-to-address cache, use the **clear host** command in EXEC mode.

clear host [**vrf** *vrf-name*] {**all** | *hostname*}

Syntax Description

vrf *vrf-name*	(Optional) Virtual Private Network (VPN) routing and forwarding (VRF).
all	Removes all entries.
hostname	Particular hostname to remove.

Command Modes

EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.4(4)T	The **vrf** keyword, *vrf-name* argument, and **all** keyword were added.

Usage Guidelines

The host name entries will not be removed from NVRAM, but will be cleared in running memory.

Examples

The following example shows how to clear all entries from the hostname-to-address cache:

```
Router> clear host all
```

The following example shows how to clear all entries from the hostname-to-address cache in the VPN name vpn1:

```
Router> clear host vrf vpn1
```

Related Commands

Command	Description
ip host	Defines a static host name-to-address mapping in the host cache.
show hosts	Displays the default domain name, the style of name lookup service, a list of name server hosts, and the cached list of host names and addresses.

ip domain list

To define a list of default domain names to complete unqualified names, use the **ip domain list** command in global configuration mode. To delete a name from a list, use the **no** form of this command.

ip domain list [**vrf** *vrf-name*] *name*

no ip domain list [**vrf** *vrf-name*] *name*

Syntax Description

vrf *vrf-name*	(Optional) Defines a Virtual Private Network (VPN) routing and forwarding instance (VRF) table. The *vrf-name* argument specifies a name for the VRF table.
name	Domain name. Do not include the initial period that separates an unqualified name from the domain name.

Defaults

No domain names are defined.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.
12.2	The syntax of the command changed from **ip domain-list** to **ip domain list**.
12.4(4)T	The **vrf** keyword and *vrf-name* argument were added.

Usage Guidelines

If there is no domain list, the domain name that you specified with the **ip domain name** global configuration command is used. If there is a domain list, the default domain name is not used. The **ip domain list** command is similar to the **ip domain name** command, except that with the **ip domain list** command you can define a list of domains, each to be tried in turn until the system finds a match.

If the **ip domain list vrf** command option is specified, the domain names are only used for name queries in the specified VRF.

The Cisco IOS software will still accept the previous version of the command, **ip domain-list**.

Examples

The following example shows how to add several domain names to a list:

```
ip domain list company.com
ip domain list school.edu
```

The following example shows how to add several domain names to a list in vpn1 and vpn2:

```
ip domain list vrf vpn1 company.com
ip domain list vrf vpn2 school.edu
```

Related Commands

Command	Description
ip domain list	Defines a list of default domain names to complete unqualified hostnames.
ip domain lookup	Enables the IP DNS-based hostname-to-address translation.
ip domain retry	Specifies the number of times to retry sending DNS queries.
ip domain timeout	Specifies the amount of time to wait for a response to a DNS query.
ip name-server	Specifies the address of one or more name servers to use for name and address resolution.

ip domain name

To define a default domain name that the Cisco IOS software uses to complete unqualified hostnames (names without a dotted-decimal domain name), use the **ip domain name** command in global configuration mode. To disable use of the Domain Name System (DNS), use the **no** form of this command.

ip domain name [**vrf** *vrf-name*] *name*

no ip domain name [**vrf** *vrf-name*] *name*

Syntax Description

vrf *vrf-name*	(Optional) Defines a Virtual Private Network (VPN) routing and forwarding instance (VRF) table. The *vrf-name* argument specifies a name for the VRF table.
name	Default domain name used to complete unqualified hostnames. Do not include the initial period that separates an unqualified name from the domain name.

Defaults

Enabled

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.
12.2	The syntax of the command changed from **ip domain-name** to **ip domain name**.
12.4(4)T	The **vrf** keyword and *vrf-name* argument were added.

Usage Guidelines

Any IP hostname that does not contain a domain name (that is, any name without a dot) will have the dot and cisco.com appended to it before being added to the host table.

If the **ip domain name vrf** command option is specified, the domain names are only used for name queries in the specified VRF.

The Cisco IOS software will still accept the previous version of the command, which is **ip domain-name**.

Examples

The following example shows how to define cisco.com as the default domain name:

```
ip domain name cisco.com
```

The following example shows how to define cisco.com as the default domain name for vpn1:

```
ip domain name vrf vpn1 cisco.com
```

Related Commands

Command	Description
ip domain list	Defines a list of default domain names to complete unqualified hostnames.
ip domain lookup	Enables the IP DNS-based hostname-to-address translation.
ip domain retry	Specifies the number of times to retry sending DNS queries.
ip domain timeout	Specifies the amount of time to wait for a response to a DNS query.
ip name-server	Specifies the address of one or more name servers to use for name and address resolution.

ip host

To define a static hostname-to-address mapping in the host cache, use the **ip host** command in global configuration mode. To remove the hostname-to-address mapping, use the **no** form of this command.

ip host [**vrf** *vrf-name*] {*name* | **t***modem-telephone-number*} [*tcp-port-number*] *address1* [*address2...address8*]

no ip host [**vrf** *vrf-name*] {*name* | **t***modem-telephone-number*} [*tcp-port-number*] *address1* [*address2...address8*]

Syntax Description

vrf *vrf-name*	(Optional) Defines a Virtual Private Network (VPN) routing and forwarding instance (VRF) table. The *vrf-name* argument specifies a name for the VRF table.
name	Name of the host. The first character can be either a letter or a number. If you use a number, the types of operations you can perform are limited.
t*modem-telephone-number*	Modem telephone number that is mapped to the IP host address for use in Cisco modem user interface mode. You must enter the letter "t" before the telephone number.
tcp-port-number	(Optional) TCP port number to connect to when using the defined hostname in conjunction with an EXEC connect or Telnet command. The default is Telnet (port 23).
address1	Associated IP host address.
address2...address8	(Optional) Additional associated IP addresses. You can bind up to eight addresses to a hostname.

Defaults

Disabled

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.
12.2(4)T	The capability to map a modem telephone number to an IP host was added for the Cisco modem user interface feature.
12.4(4)T	The **vrf** keyword and *vrf-name* argument were added.

Usage Guidelines

The first character can be either a letter or a number. If you use a number, the types of operations you can perform (such as **ping**) are limited.

Examples

The following example shows how to define two static mappings:

```
ip host host2 10.168.7.18
ip host host3 10.2.0.2 192.168.7.33
```

The following example shows how to define two static hostname-to-address mappings in the host cache for vpn2 and vpn3:

```
ip host vrf vpn2 host2 172.16.3.1
ip host vrf vpn3 host3 172.18.4.1
```

The following example shows how to map modem telephone number 555-1234 to IP host address 10.1.5.5 for the Cisco modem user interface mode:

```
ip host t5551234 10.1.5.5
```

ip name-server

To specify the address of one or more name servers to use for name and address resolution, use the **ip name-server** command in global configuration mode. To remove the addresses specified, use the **no** form of this command.

ip name-server [**vrf** *vrf-name*] *server-address1* [*server-address2...server-address6*]

no ip name-server [**vrf** *vrf-name*] *server-address1* [*server-address2...server-address6*]

Syntax Description

vrf *vrf-name*	(Optional) Defines a Virtual Private Network (VPN) routing and forwarding instance (VRF) table. The *vrf-name* argument specifies a name for the VRF table.
server-address1	IPv4 or IPv6 addresses of a name server.
server-address2...server-address6	(Optional) IP addresses of additional name servers (a maximum of six name servers).

Defaults

No name server addresses are specified.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.
12.2(2)T	Support for IPv6 addresses was added.
12.0(21)ST	Support for IPv6 addresses was added.
12.0(22)S	Support for IPv6 addresses was added.
12.2(14)S	Support for IPv6 addresses was added.
12.2(27)SBC	This command was integrated into Cisco IOS Release 12.2(27)SBC.
12.4(4)T	The **vrf** keyword and *vrf-name* argument were added.

Examples

The following example shows how to specify IPv4 hosts 172.16.1.111 and 172.16.1.2 as the name servers:

```
ip name-server 172.16.1.111 172.16.1.2
```

This command will be reflected in the configuration file as follows:

```
ip name-server 172.16.1.111
ip name-server 172.16.1.2
```

The following example shows how to specify IPv4 hosts 172.16.1.111 and 172.16.1.2 as the name servers for vpn1:

```
Router(config)# ip name-server vrf vpn1 172.16.1.111 172.16.1.2
```

The following example shows how to specify IPv6 hosts 3FFE:C00::250:8BFF:FEE8:F800 and 2001:0DB8::3 as the name servers:

```
ip name-server 3FFE:C00::250:8BFF:FEE8:F800 2001:0DB8::3
```

This command will be reflected in the configuration file as follows:

```
ip name-server 3FFE:C00::250:8BFF:FEE8:F800
ip name-server 2001:0DB8::3
```

Related Commands

Command	Description
ip domain-lookup	Enables the IP DNS-based hostname-to-address translation.
ip domain-name	Defines a default domain name to complete unqualified hostnames (names without a dotted decimal domain name).

show hosts

To display the default domain name, the style of name lookup service, a list of name server hosts, the cached list of hostnames and addresses, and the cached list of hostnames and addresses specific to a particular Virtual Private Network (VPN), use the **show hosts** command in EXEC mode.

show hosts [**vrf** *vrf-name*] {**all** | *hostname*} [**summary**]

Syntax Description

vrf *vrf-name*	(Optional) Defines a Virtual Private Network (VPN) routing and forwarding instance (VRF) table. The *vrf-name* argument specifies a name for the VRF table. Only the name cache entries for a particular VRF will be displayed.
all	Displays all name cache entries.
hostname	Displays the name cache entries for a particular hostname.
summary	(Optional) Displays a brief summary of the name caches.

Command Modes

EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.2(4)T	This command was updated to support the Cisco modem user interface feature.
12.4(4)T	The **vrf**, **all**, and **summary** keywords and *vrf-name* and *hostname* arguments were added.

Usage Guidelines

If you specify the **show hosts** command without the optional keywords, only the entries in the global name cache will be displayed.

Examples

The following is sample output from the **show hosts** command:

```
Router# show hosts

Default domain is CISCO.COM
Name/address lookup uses domain service
Name servers are 255.255.255.255
Host              Flag        Age   Type       Address(es)
SLAG.CISCO.COM    (temp, OK)  1     IP         172.20.4.10
CHAR.CISCO.COM    (temp, OK)  8     IP         192.168.7.50
CHAOS.CISCO.COM   (temp, OK)  8     IP         172.20.1.115
DIRT.CISCO.COM    (temp, EX)  8     IP         172.20.1.111
DUSTBIN.CISCO.COM (temp, EX)  0     IP         172.20.1.27
DREGS.CISCO.COM   (temp, EX)  24    IP         172.20.1.30
```

The following is sample output from the **show hosts vrf** command with a VRF name red specified:

```
Router# show hosts vrf red
```

```
Name lookup view: red
Default domain is red.com
Domain list: red1.com, red2.com
Name/address lookup uses domain service
Name servers are 10.0.0.2, 10.0.0.3, 10.0.0.4

Codes: UN - unknown, EX - expired, OK - OK,
        temp - temporary, perm - permanent
         NA - Not Applicable None - Not defined

Host                    Port  Flags     Age   Type   Address(es)
a.red.com               None (temp, OK) 0     IP     10.0.0.2
printer.red.com         None (perm, OK) 0     IP     10.0.0.5
                                                     10.0.0.7
dns.red.com               None (perm, OK)   0      IP     10.0.0.2
```

Table 1 describes the significant fields shown in the display.

Table 1 show hosts Field Descriptions

Field	Description
Flag	A temporary entry is entered by a name server; the Cisco IOS software removes the entry after 72 hours of inactivity. A permanent entry is entered by a configuration command and is not timed out. Entries marked OK are believed to be valid. Entries marked ?? are considered suspect and subject to revalidation. Entries marked EX are expired.
Age	Indicates the number of hours since the software last referred to the cache entry.
Type	Identifies the type of address, for example, IP, Connectionless Network Service (CLNS), or X.121. If you have used the **ip hp-host** global configuration command, the **show hosts** command will display these hostnames as type HP-IP.
Address(es)	Displays the address of the host. One host may have up to eight addresses.

The following is sample output from a router when a modem telephone number is mapped to an IP host address for the Cisco modem user interface feature using the **ip host** global configuration command:

```
Router# show hosts

Default domain is not set
Name/address lookup uses domain service
Name servers are 255.255.255.255

Codes: u - unknown, e - expired, * - OK, ? - revalidate
       t - temporary, p - permanent

   Host                    Age  Type     Address(es)
*p p4085554567               0   IP        10.2.1.6
*p t4085551234               0   IP        10.2.1.5
```

Under the Host field, a “p” preceding the number indicates a pulse-dialed modem telephone number, and a “t” indicates a tone-dialed modem telephone number. The IP address mapped to the telephone number appears under the Address(es) field. See Table 1 for descriptions of the other fields seen in this display.

Related Commands

Command	Description
clear arp interface	Deletes entries from the hostname-to-address cache.
ip helper-address	Defines a static host-name-to-address mapping in the host cache.