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ARP has been implemented with many combinations of network and data link layer technologies, such as [IPv4](#), [Chaosnet](#), [DECnet](#) and Xerox [PARC Universal Packet](#) (PUP) using [IEEE 802](#) standards, [FDDI](#), [X.25](#), [Frame Relay](#) and [Asynchronous Transfer Mode](#) (ATM).

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- ## Operating scope [\[edit \]](#)

Packet structure [\[edit \]](#)

Hardware type (HTYPE)

Protocol type (PTYPE)

Hardware length (HLEN)

Protocol length (PLEN)

Operation

Sender hardware address (SHA)

Sender protocol address (SPA)

Target hardware address (THA)

Target protocol address (TPA)

ARP protocol parameter values have been standardized and are maintained by the [Internet Assigned Numbers Authority \(IANA\)](#).^[6]

Example [\[edit \]](#)

To send the message, it also requires Computer 2's **MAC address**. First, Computer 1 uses a cached ARP table to look up 192.168.0.55 for any existing records of Computer 2's MAC address (00:eb:24:b2:05:ac). If the MAC address is found, it sends an Ethernet **frame** with destination address 00:eb:24:b2:05:ac, containing the IP packet onto the link. If the cache did not produce a result for 192.168.0.55, Computer 1 has to send a broadcast ARP request message (destination FF:FF:FF:FF:FF:FF MAC address), which is accepted by all computers on the local network, requesting an answer for 192.168.0.55.

Computer 2 responds with an ARP response message containing its MAC and IP addresses. As part of fielding the request, Computer 2 may insert an entry for Computer 1 into its ARP table for future use.

Computer 1 receives and caches the response information in its ARP table and can now send the packet.^[7]

ARP probe [edit]

An **ARP probe** is an ARP request constructed with an all-zero SPA. Before beginning to use an IPv4 address (whether received from manual configuration, DHCP, or some other means), a host implementing this specification must test to see if the address is already in use, by broadcasting ARP probe packets.^[8]

ARP announcements [edit]

ARP may also be used as a simple announcement protocol. This is useful for updating other hosts' mappings of a hardware address when the sender's IP address or MAC address changes. Such an announcement, also called a **gratuitous ARP** (GARP) message, is usually broadcast as an *ARP request* containing the SPA in the target field (TPA=SPA), with THA set to zero. An alternative way is to broadcast an *ARP reply* with the sender's SHA and SPA duplicated in the target fields (TPA=SPA, THA=SHA).

The *ARP request* and *ARP reply* announcements are both standards-based methods,^{[9][10]} but the *ARP request* method is preferred.^[11] Some devices may be configured for the use of either of these two types of announcements.^[12]

An ARP announcement is not intended to solicit a reply; instead, it updates any cached entries in the ARP tables of other hosts that receive the packet. The operation code in the announcement may be either request or reply; the ARP standard specifies that the opcode is only processed after the ARP table has been updated from the address fields.^{[13][14][15]}

Many operating systems issue an ARP announcement during startup. This helps to resolve problems which would otherwise occur if, for example, a **network card** was recently changed (changing the IP-address-to-MAC-address mapping) and other hosts still have the old mapping in their ARP caches.

ARP announcements are also used by some network interfaces to provide load balancing for incoming traffic. In a **team** of network cards, it is used to announce a different MAC address within the team that should receive incoming packets.

ARP announcements can be used in the **Zeroconf** protocol to allow automatic assignment of a **link-local IP addresses** to an interface where no other IP address configuration is available. The announcements are used to ensure an address chosen by a host is not in use by other hosts on the network link.^[16]

This function can be dangerous from a cybersecurity viewpoint since an attacker can obtain information about the other hosts of its subnet to save in their ARP cache (**ARP spoofing**) an entry where the attacker MAC is associated, for instance, to the IP of the **default gateway**, thus allowing him to **intercept** all the traffic to external networks.

ARP mediation [edit]

ARP mediation refers to the process of resolving Layer-2 addresses through a **virtual private wire service** (VPWS) when different resolution protocols are used on the connected circuits, e.g., **Ethernet** on one end and **Frame Relay** on the other. In IPv4, each **Provider Edge** (PE) device discovers the IP address of the locally attached **Customer Edge** (CE) device and distributes that IP address to the corresponding remote PE device. Then each PE device responds to local ARP requests using the IP address of the remote CE device and the hardware address of the local PE device. In IPv6, each PE device discovers the IP address of both local and remote CE devices and then intercepts local **Neighbor Discovery** (ND) and **Inverse Neighbor Discovery** (IND) packets and forwards them to the remote PE device.^[17]

Inverse ARP and Reverse ARP [edit]

Inverse Address Resolution Protocol (**Inverse ARP** or **InARP**) is used to obtain **network layer** addresses (for example, **IP addresses**) of other nodes from **data link layer** (Layer 2) addresses. Since ARP translates layer-3 addresses to layer-2 addresses, InARP may be described as its inverse. In addition, InARP is implemented as a protocol extension to ARP: it uses the same packet format as ARP, but different operation codes.

InARP is primarily used in **Frame Relay** (DLCI) and ATM networks, in which layer-2 addresses of **virtual circuits** are sometimes obtained from layer-2 signaling, and the corresponding layer-3 addresses must be available before those virtual circuits can be used.^[18]

The **Reverse Address Resolution Protocol** (Reverse ARP or RARP), like InARP, translates layer-2 addresses to layer-3 addresses. However, in InARP the requesting station queries the layer-3 address of another node, whereas RARP is used to obtain the layer-3 address of the requesting station itself for address configuration purposes. RARP is obsolete; it was replaced by **BOOTP**, which was later superseded by the **Dynamic Host Configuration Protocol** (DHCP).^[19]

ARP spoofing and proxy ARP [edit]

*Main articles: **ARP spoofing** and **Proxy ARP***

Because ARP does not provide methods for authenticating ARP replies on a network, ARP replies can come from systems other than the one with the required Layer 2 address. An ARP *proxy* is a system that answers the ARP request on behalf of another system for which it will forward traffic, normally as a part of the network's design, such as for a dialup internet service. By contrast, in *ARP spoofing* the answering system, or *spoofers*, replies to a request for another system's address with the aim of intercepting data bound for that system. A malicious user may use ARP spoofing to perform a **man-in-the-middle** or **denial-of-service** attack on other users on the network. Various software exists to both detect and perform ARP spoofing attacks, though ARP itself does not provide any methods of protection from such attacks.^[20]

Alternatives to ARP [edit]

IPv6 uses the **Neighbor Discovery Protocol** and its extensions such as **Secure Neighbor Discovery**, rather than ARP.

Computers can maintain lists of known addresses, rather than using an active protocol. In this model, each computer maintains a database of the mapping of **Layer 3** addresses (e.g., **IP addresses**) to **Layer 2** addresses (e.g., **Ethernet MAC addresses**). This data maintained primarily by interpreting ARP packets from the local network link. Thus, it is often called the ***ARP cache***. Since at least the 1980s,^[21] networked computers have a utility called *arp* for interrogating or manipulating this database.^{[22][23][24]}

Historically, other methods were used to maintain the mapping between addresses, such as static configuration files,^[25] or centrally maintained lists.

ARP stuffing [edit]

Embedded systems such as networked cameras^[26] and networked power distribution devices,^[27] which lack a user interface, can use so-called *ARP stuffing* to make an initial network connection, although this is a misnomer, as ARP is not involved.

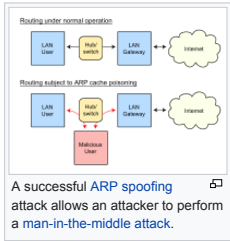
ARP stuffing is accomplished as follows:

- The user's computer has an IP address *stuffed* manually into its address table (normally with the *arp* command with the MAC address taken from a label on the device)
- The computer sends special packets to the device, typically a **ping** packet with a non-default size.
- The device then adopts this IP address
- The user then communicates with it by **telnet** or **web** protocols to complete the configuration.

Such devices typically have a method to disable this process once the device is operating normally, as the capability can make it vulnerable to attack.

Standards documents [edit]

- RFC 826**[ⓘ] - Ethernet Address Resolution Protocol, Internet Standard STD 37.
- RFC 903**[ⓘ] - Reverse Address Resolution Protocol, Internet Standard STD 38.



- [RFC 2390](#) - Inverse Address Resolution Protocol, draft standard
- [RFC 5227](#) - IPv4 Address Conflict Detection, proposed standard

See also [[edit](#)]

- [Arping](#)
- [Arptables](#)
- [Arpwatch](#)
- [Bonjour Sleep Proxy](#)
- [Cisco HDLC](#)

References [[edit](#)]

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4. ↑ IANA - Ehtertype values

5. ↑ RFC 5342

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14. ↑ RFC 2002 Section 4.6

15. ↑ RFC 2131 DHCP -- Last lines of Section 4.4.1

16. ↑ RFC 3927

17. ↑ Shah, H.; et al. (June 2012). *Address Resolution Protocol (ARP) Mediation for IP Interworking of Layer 2 VPNs*. Internet Engineering Task Force. doi:10.17487/RFC6575 . RFC 6575.

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External links [[edit](#)]

- [ARP Sequence Diagram \(pdf\)](#)
- [Gratuitous ARP](#)
- [Information and sample capture from Wireshark](#)
- [ARP-SK ARP traffic generation tools](#)

Wikiversity has learning resources about *Address Resolution Protocol*

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Archiving	expand · extrac32 · extract · makecab · pax · tar
Disk management	chkdsk · convert · defrag · diskcomp · diskcopy · diskpart · diskraid · diskshadow · drvspace · fdisk · format · fsutil · label · manage-bde · subst · scandisk · sys · vol · vssadmin
Processes	at · exit · kill · powercfg · runas · sc · schtasks · shutdown · start · taskkill · tasklist
Registry	assoc · ftype · reg · regini · regsvr32
User environment	chcp · cmdkey · date · graftabl · mode · path · set · setver · setx · time · title · ver · where · whoami
File contents	comp · edit · edlin · fc · find · findstr · print · type
Scripting	choice · clip · cscript · doskey · echo · for · forfiles · goto · if · more · pause · prompt · rem · timeout
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