http://www.erg.abdn.ac.uk/users/gorry/course/inet-pages/arp.html Address Resolution Protocol (arp)
http://www.bb-zone.com/SLGFG/chapter9.html
http://cne.gmu.edu/modules/network/telnet.html

The address resolution protocol (arp) is a protocol used by the Internet Protocol (IP), specifically IPv4, to map IP network addresses to the hardware addresses used by a data link protocol. The protocol operates below the network layer as a part of the interface between the OSI (***O**pen **S**ystem **I**nterconnection*) network and OSI link layer. It is used when IPv4 is used over Ethernet.

There are four types of arp messages that may be sent by the arp protocol.

1. ARP request 2. ARP reply 3. RARP request 4. RARP reply

General	Use	Size in bytes	Typical values
Ethernet Header	Ethernet Destination Address	6	A broadcast address
	Ethernet Source Address	6	Identifies computer making request
	Frame Type	2	Set to 0x0806 for ARP request and 0x8035 for an ARP reply
ARP request/reply	Hardware Type	2	Set to 1 for an Ethernet
	Protocol Type	2	Set to 0x0800 for IP addresses
	Hardware Address Size in bytes	1	Set to 6 for Ethernet
	Protocol Address Size in bytes	1	Set to 4 for IP
	Operation	2	1 for request, 2 for reply
	Sender Ethernet Address	6	-
	Sender IP Address	4	-
	Destination Ethernet Address	6	Not filled in on ARP request
	Destination IP Address	4	-

```
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|IP address       Ethernet address |
-------------------------------------
|223.1.2.1        08-00-39-00-2F-C3|
|223.1.2.3        08-00-5A-21-A7-22|
|223.1.2.4        08-00-10-99-AC-54|
-------------------------------------
    TABLE 1.  Example ARP Table
```

Every computer's Ethernet interface receives the broadcast Ethernet frame. Each Ethernet driver examines the Type field in the Ethernet frame and passes the ARP packet to the ARP module. The ARP request packet says "If your IP address matches this target IP address, then please tell me your Ethernet address". An ARP request packet looks something like this:

```
---------------------------------------
|Sender IP Address   223.1.2.1        |
|Sender Enet Address 08-00-39-00-2F-C3|
---------------------------------------
|Target IP Address   223.1.2.2        |
|Target Enet Address           |
---------------------------------------
     TABLE 2.  Example ARP Request
```

Each ARP module examines the IP address and if the Target IP address matches its own IP address, it sends a response directly to the source Ethernet address. The ARP response packet says "Yes, that target IP

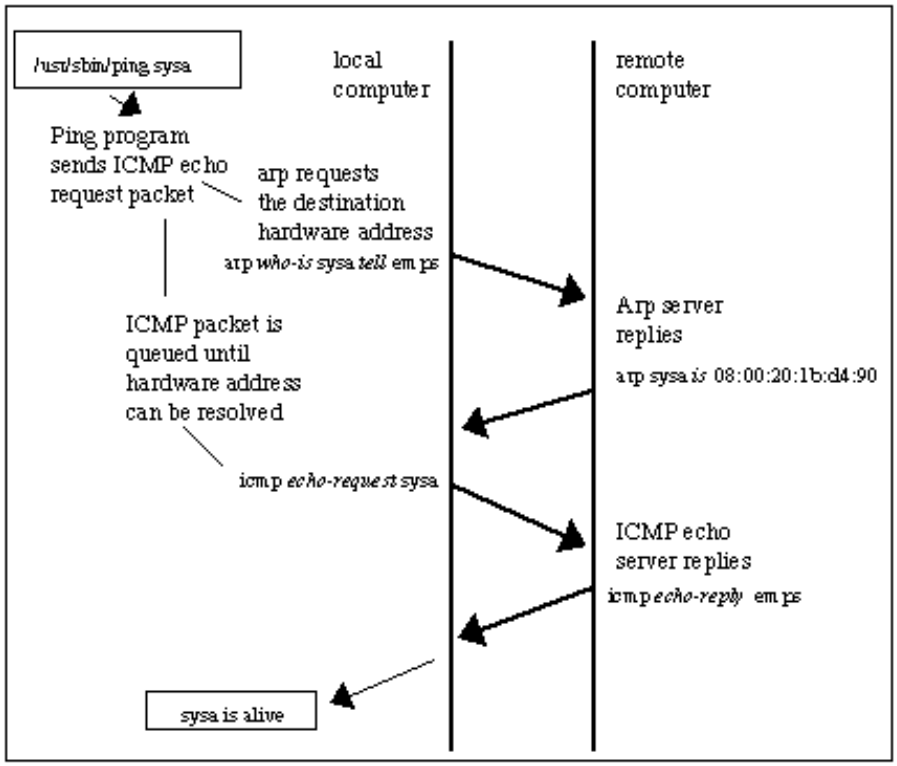
address is mine, let me give you my Ethernet address". An ARP response packet has the sender/target field contents swapped as compared to the request. It looks something like this:

```
--------------------------------------
|Sender IP Address   223.1.2.2        |
|Sender Enet Address 08-00-28-00-38-A9|
--------------------------------------
|Target IP Address   223.1.2.1        |
|Target Enet Address 08-00-39-00-2F-C3|
--------------------------------------
     TABLE 3.  Example ARP Response
```

The response is received by the original sender computer. The Ethernet driver looks at the Type field in the Ethernet frame then passes the ARP packet to the ARP module. The ARP module examines the ARP packet and adds the sender's IP and Ethernet addresses to its ARP table.

The updated table now looks like this:

```
---------------------------------
|IP address     Ethernet address |
---------------------------------
|223.1.2.1      08-00-39-00-2F-C3|
|223.1.2.2      08-00-28-00-38-A9|
|223.1.2.3      08-00-5A-21-A7-22|
|223.1.2.4      08-00-10-99-AC-54|
---------------------------------
TABLE 4.  ARP Table after Response
```



RFC 2131 - Dynamic Host Configuration Protocol (DHCP)

- framework for passing configuration information to hosts on a TCPIP network
- DHCP consists of two components:

1 a protocol for delivering host-specific configuration parameters from a DHCP server to a host
2 a mechanism for allocation of network addresses to hosts.
DHCP supports three mechanisms for IP address allocation
"**automatic allocation**", assigns a permanent IP address to a client.
"**dynamic allocation**", assigns an IP address to a client for a limited period of time (or until the client explicitly relinquishes the address).
"**manual allocation**", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

"DHCP client" is an Internet host using DHCP to obtain configuration parameters such as a network address.
"DHCP server" is an Internet host that returns configuration parameters to DHCP clients.
"BOOTP relay agent" is an Internet host or router that passes DHCP messages between DHCP clients and DHCP servers. (uses BOOTP)
"binding" is a collection of configuration parameters, including at least an IP address, associated with or "bound to" a DHCP client. Bindings are managed by DHCP servers.
Design goals

- DHCP should be a mechanism rather than a policy. local system administrators should be able to enforce local policies concerning allocation and access to local resources where desired.
- Clients should require no manual configuration
- DHCP should not require a server on each subnet. DHCP must work across routers or through the intervention of BOOTP relay agents.

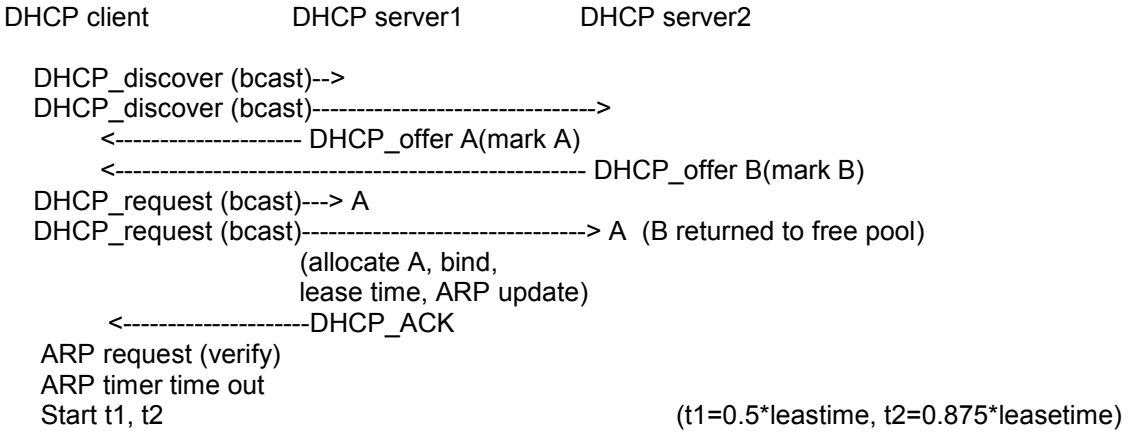
This is how it works.

- Laptop boots up for the first time and request an IP address
- Client comes up without an IP address.
- Client sends out DHCP discovery message.
    - Servers pick up the message.
    - Servers offer IP addresses.
- Client chooses an IP address and sends DHCP Request (BROADCAST! Why?)
    - The chosen DHCP allocates the IP address and stores on the disk with lease time.
    - Non-chosen ones free the offered IPs.
    - Server starts the timer.
    - Server updates ARP cache
    - Sever acknowledge (DHCP_Ack)
- Client verifies the assigned IP is unique by sending out an ARP request for the assigned IP.
- Client starts timers t1, t2 (for renewal).
(t1 to start renewing, t2 to initiate to find any DHCP) t1=0.5*leasetime, t2=0.875*leasetime, typically.
- Client broadcasts a DHCPDISCOVER message on its local physical subnet. (to server Port 67) BOOTP relay agents may pass the message on to DHCP servers not on the same physical subnet.
    - Each server may respond (to host prt 68) with a DHCPOFFER message that includes an available network address
- Client receives one or more DHCPOFFER messages from one or more servers.

- Client chooses one server from which to request configuration parameters, based on the configuration parameters offered in the DHCPOFFER messages.
- Client broadcasts a DHCPREQUEST message that MUST include the 'server identifier' option to indicate which server it has selected, and that MAY include other options specifying desired configuration values.
- Client times out and retransmits the DHCPDISCOVER message if the client receives no DHCPOFFER messages.
    - Servers receive the DHCPREQUEST broadcast from the client. servers not selected by the DHCPREQUEST message use the message as notification that the client has declined that server's offer.
    - Server selected commits the binding for the client to persistent storage and responds with a DHCPACK

- client receives the DHCPACK message with configuration parameters. The client SHOULD perform a final check on the parameters (e.g., ARP for allocated network address), and notes the duration of the lease specified in the DHCPACK message. Now Configured!

The combination of 'client identifier' and assigned network address constitute a unique identifier for the client's lease and are used by both the client and server to identify a lease referred to in any DHCP messages.



Renewal as t1 expires
DHCP_request ----------> A
Rebinding as t2 expires
DHCP_request (bcast)----> A
DHCP_request (bcast)----------> A
<---------- DHCP_ACK (renewed A)
Start t1, t2

Disconnect & Reconnect
DHCP_request ----------> A

If ACK renewed
If Nack, start all over