

- **Computer Networks**
- **Al-Mustansiryah University**
- **Elec. Eng. Department College of Engineering**
Fourth Year Class

Chapter 7

Network Layer: IP Address assignment

IP Address assignment Methods:

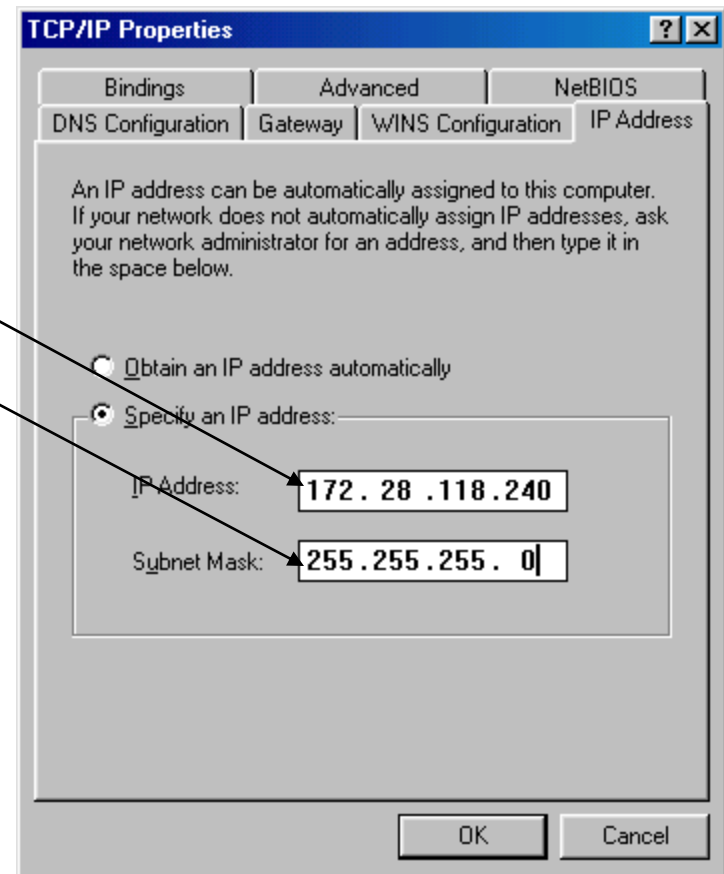
- Manual Host Configuration
- RARP
- BOOTP
- DHCP

Manual Host Configuration

- Required elements:
 - IP Address
 - Subnet Mask
 - Default Gateway

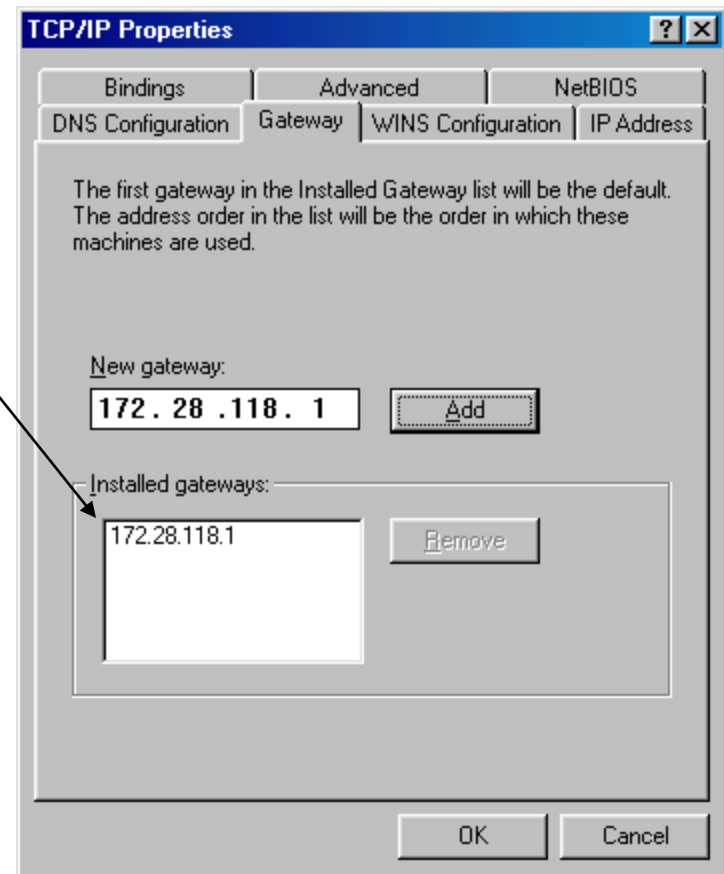
Windows Host Configuration

- On IP Address tab:
 - IP Address
 - Subnet Mask



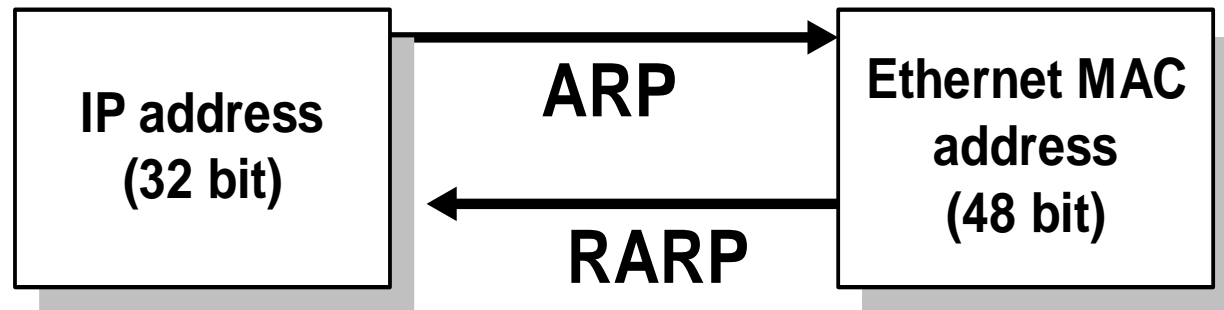
Windows Host Configuration

- On Gateway tab:
 - Default Gateway



ARP and RARP

- The ARP and RARP protocols perform the translation between IP addresses and MAC layer addresses



RARP

- **RARP**, or **R**everse **A**ddress **R**esolution **P**rotocol.
- Like ARP, used to map MAC address to IP addresses.
- Works in **reverse** - used by devices to find their own IP address.
- Typically not used on PCs.

Diskless Workstations

- Diskless workstations have no permanent storage (like a hard drive) to store network configurations.
- Diskless workstations will know their own MAC address because it's burned in to the card, but they have to use RARP to find their IP.

RARP request

- Diskless workstations will send a RARP request, which is a Layer-2 broadcast.

RARP reply

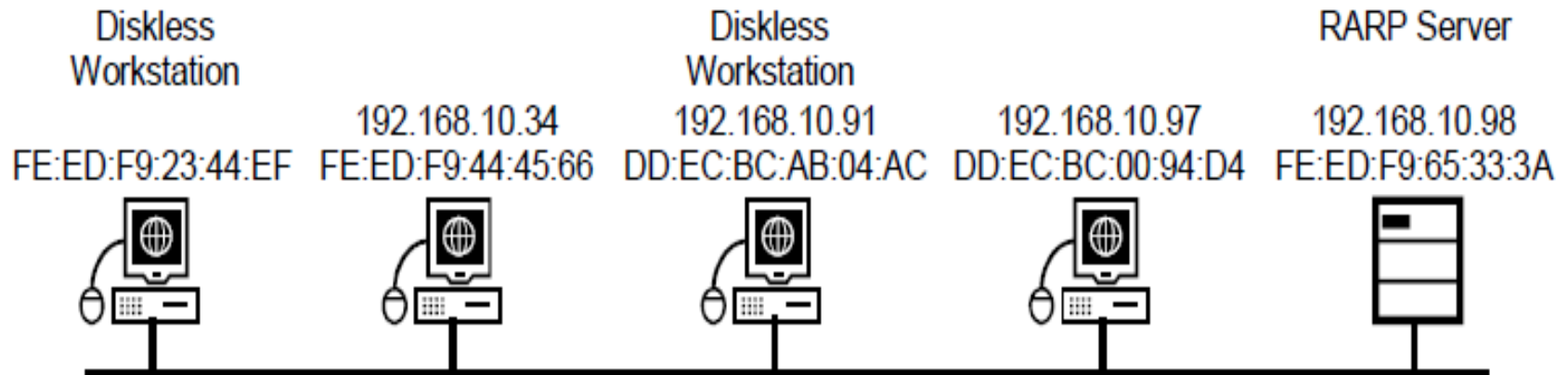
- Only a **RARP server** can respond to a RARP request.
- RARP servers maintain a table of IP to MAC address mappings for RARP clients.
- During the boot process, RARP clients call the RARP server to obtain their IP configuration information.

ARP/RARP Message Structure

0-15 bits		16-31 bits
Hardware Type		Protocol Type
HLen (1 byte)	PLen (1 byte)	operation
Sender HA (bytes 1-4)		
Sender HA (bytes 5-6)		Sender PA (bytes 1-2)
Sender PA (bytes 3-4)		Target HA (bytes 1-2)
Target HA (bytes 3-6)		
Target PA (bytes 1-4)		
RARP Header Structure		

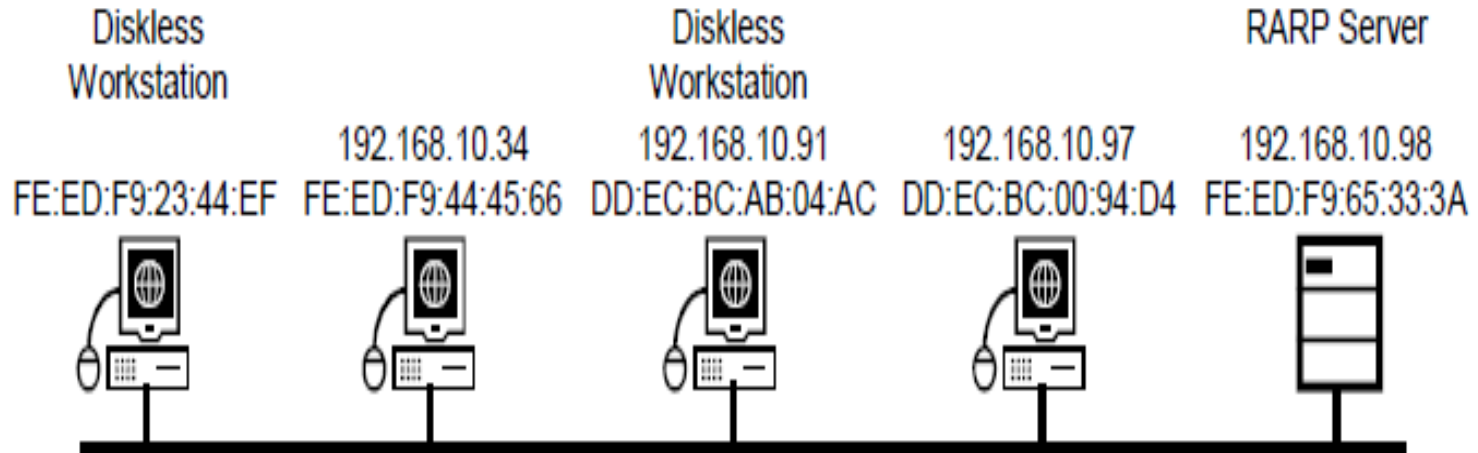
Field	Description
Hardware Type	Specifies a hardware interface type for which the sender requires a response.
Protocol Type	Specifies the type of high-level protocol address the sender has supplied.
HLen	Hardware address length.
PLen	Protocol address length.
Operation	<p>The values are as follows:</p> <ul style="list-style-type: none"> 1 ARP request. 2 ARP response. 3 RARP request. 4 RARP response. 5 Dynamic RARP request. 6 Dynamic RARP reply. 7 Dynamic RARP error. 8 InARP request. 9 InARP reply.
Sender (HA) Hardware Address	HLen bytes in length.
Sender (PA) Protocol Address	PLen bytes in length.
Target (HA) Hardware Address	HLen bytes in length.
Target (PA) Protocol Address	PLen bytes in length.

Computer FE:ED:F9:23:44:EF needs to get its IP address for internal operation



RARP: Request Generation

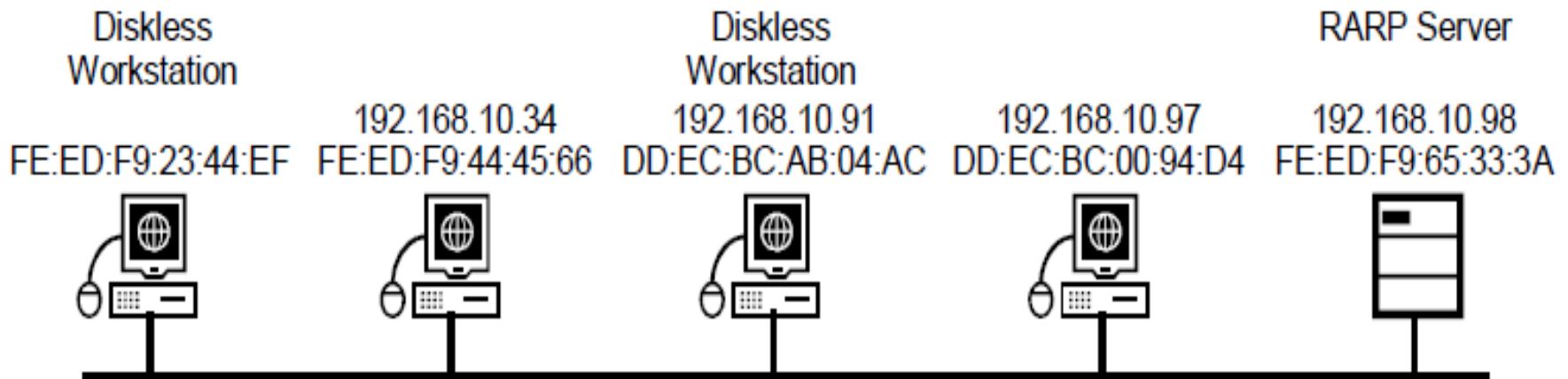
Computer FE:ED:F9:23:44:EF generates a RARP request.



Frame header	1		0800 ₁₆
Source MAC	48	32	3
FE:ED:F9:23:44:EF	FE:ED:F9:23:		
Destination MAC	44:EF		Undefined
FF: FF: FF: FF: FF: FF	Undefined		FF:FF:
Field Type	FF: FF: FF: FF		
0X8035 (Ethernet)	Undefined		

Reply Generation

The RARP server creates a RARP reply message for the requesting client



Frame header	2		0800 ₁₆
Source MAC	48	32	4
FE:ED:F9:65:33:3A	FE:ED:F9:23:		
Destination MAC	44:EF		192.168.
FE: ED: F9: 23: 44: EF	10.36		FE:ED:
Field Type	F9: 65: 33: 3A		
0X8035 (Ethernet)	192.168. 10.98		

BOOTP

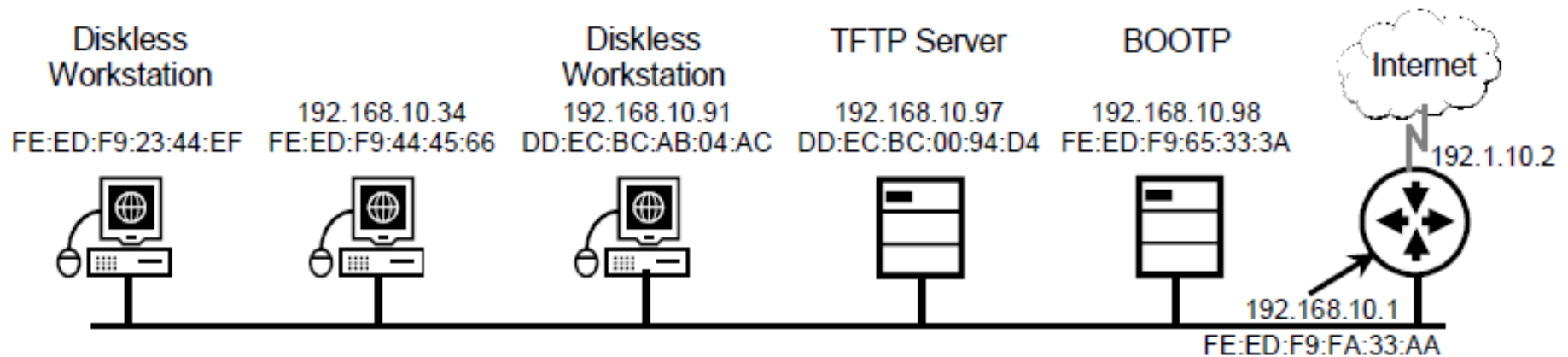
- Client sends a bootrequest packet - a Layer 3 broadcast (255.255.255.255)
- **BOOTP server** responds with a bootreply packet containing client's IP address and gateway IP address.

BOOTP Message Structure

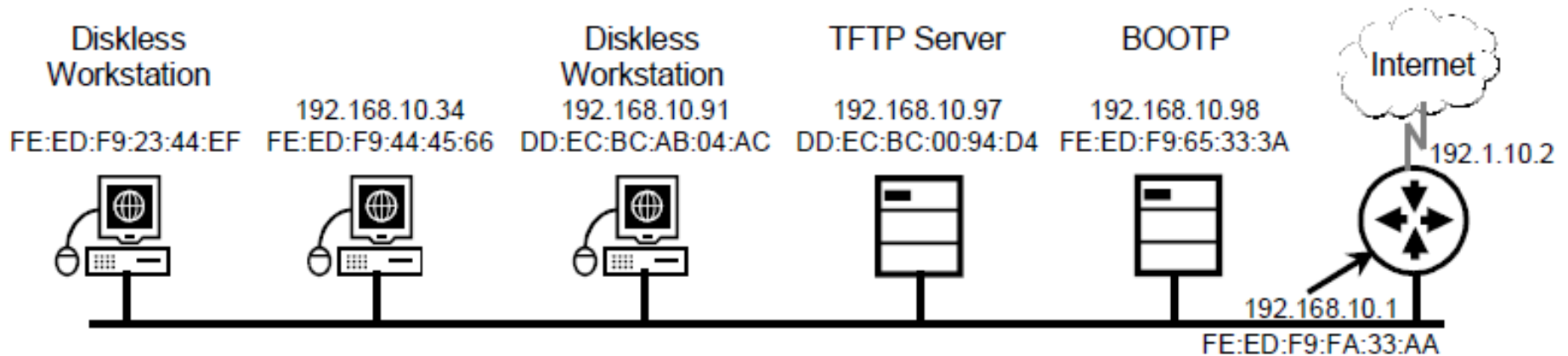
0-7 bits	8-15 bits	16-23 bits	24-31 bits
Op (1)	Htype (1)	HLen (1)	Hops (1)
Xid (4 bytes)			
Seconds (2 bytes)		Unused	
Ciaddr (4 bytes)			
Yiaddr (4 bytes)			
Siaddr (4 bytes)			
Giaddr (4 bytes)			
Chaddr (16 bytes)			
Server Host Name (64 bytes)			
Boot File Name (128 bytes)			
Vendor Specific Area (64 bytes)			
BOOTP Message Structure			

Field	Description
Op	Message operation code. Messages can be either BOOTREQUEST or BOOTREPLY.
Htype	Hardware address type.
HLen	Hardware address length.
Hops	Client places zero, this field is used by BOOTP server to send request to another network.
Xid	Transaction ID.
Secs	Seconds elapsed since the client began the address acquisition or renewal process.
Ciaddr	Client IP address.
Yiaddr	"Your" (client) IP address.
Siaddr	IP address of the next server to use in bootstrap.
Giaddr	Relay agent IP address used in booting via a relay agent.
Chaddr	Client hardware address.
Server Host Name	Specifies particular server to get BOOTP information from.
Boot File Name	Allows for multiple boot files to be used allowing hosts to run different operating systems.
Vendor Specific Area	Contains optional vendor specific information that can be passed to the host.

Computer FE:ED:F9:23:44:EF needs to obtain its IP address for Internet and Internet operation.

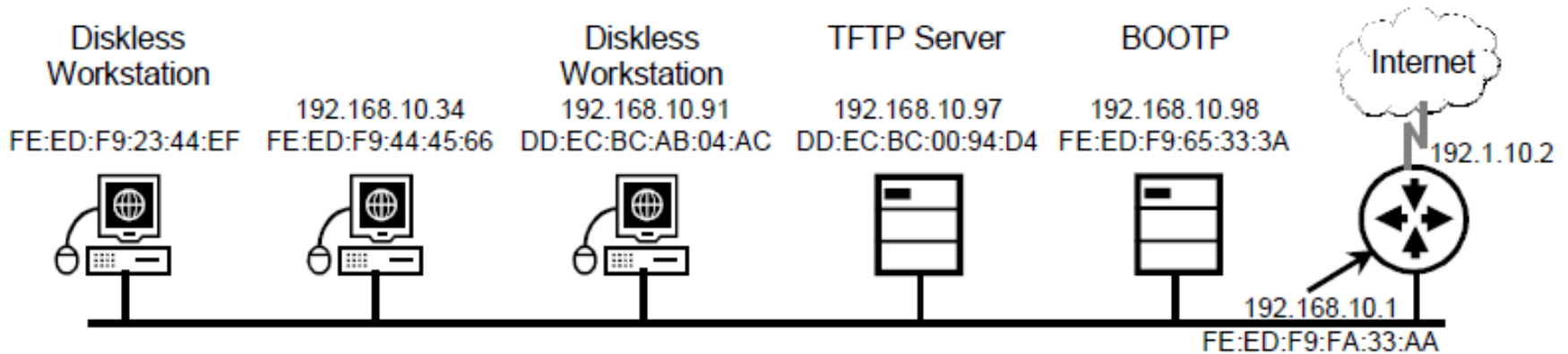


Workstation FE:ED:F9:23:44:EF generates a BOOTP request



Frame header	Packet Header	1	1	6	0	CRC
Source MAC	Source IP	221				Check
FE:ED:F9:23:44:EF	Unknown	2	Unused			:
Destination MAC	Destination IP	0				
FF: FF: FF: FF: FF: FF	225. 225. 225. 225	0				
Field Type		0				
0X8035 (Ethernet)		0				
		FE:ED:F9:23:44:EF				

BOOTP: Reply Creation



Frame header	Packet Header	2	1	6	0	CRC
Source MAC	Source IP	221				Check
FE:ED:F9:65:33:3A	192.168.10.98	2	Unused			:
Destination MAC	Destination IP	0				
FE: ED: F9: 23: 44: EF	225. 225. 225. 225	192.168.10.36				
Field Type		192.168.10.97				
0X8035 (Ethernet)		192.168.10.97				
		FE:ED:F9:23:44:EF				

DHCP

- Like BOOTP:
 - Client sends an IP broadcast datagram.
 - DHCP server returns packet containing IP address of client and gateway.

DHCP

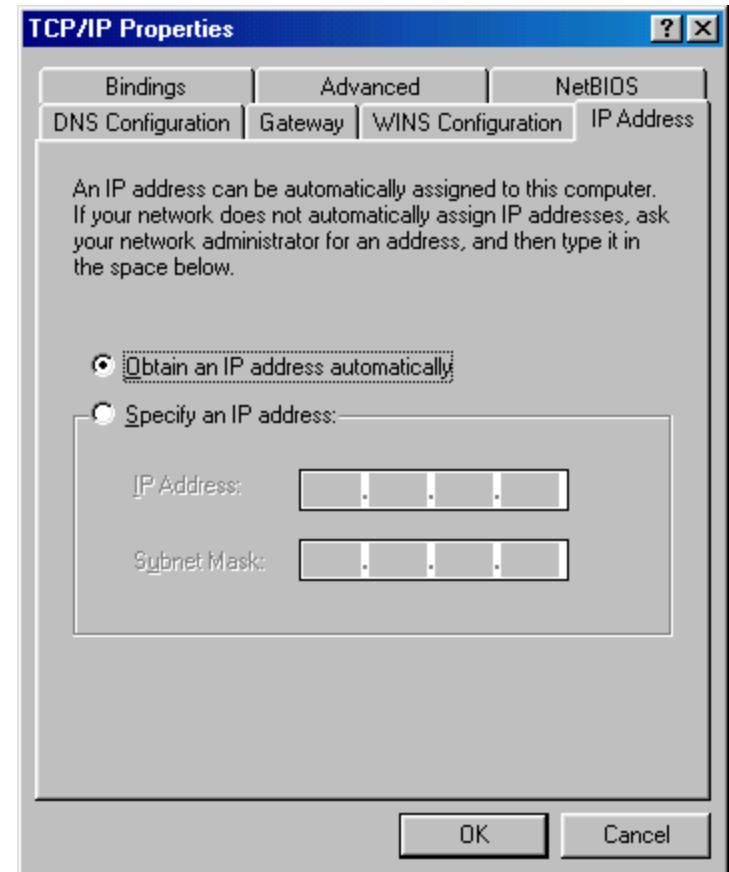
- Unlike BOOTP:
 - Server can return additional information and provide a complete IP configuration:
 - Subnet mask
 - Domain Name Server address

DHCP

- Unlike BOOTP:
 - Addresses are dynamic - they may change each time a host boots.
 - Addresses are granted for a limited period of time - a “lease” time.
 - When a lease expires, the address is available to another host.

Configuring Windows Hosts for DHCP

- Select
Obtain an “IP address automatically”
- Most DHCP servers return a complete TCP/IP configuration.
- You’re done!



DHCP - Benefits

- Low maintenance
- Provides complete IP configuration
- Easy to renumber your network - just change the address range covered by the DHCP server