Dynamic Host Configuration Protocol (DHCP)

- **Dynamic Host Configuration Protocol (DHCP).** DHCP is an application-layer program, using the client-server paradigm, that actually helps TCP/IP at the network layer.
- DHCP has found such widespread use in the Internet that it is often called a *plugandplay protocol*. In can be used in many situations.

DHCP Message Format:

- DHCP is a client-server protocol in which the client sends a request message and theserver returns a response message.

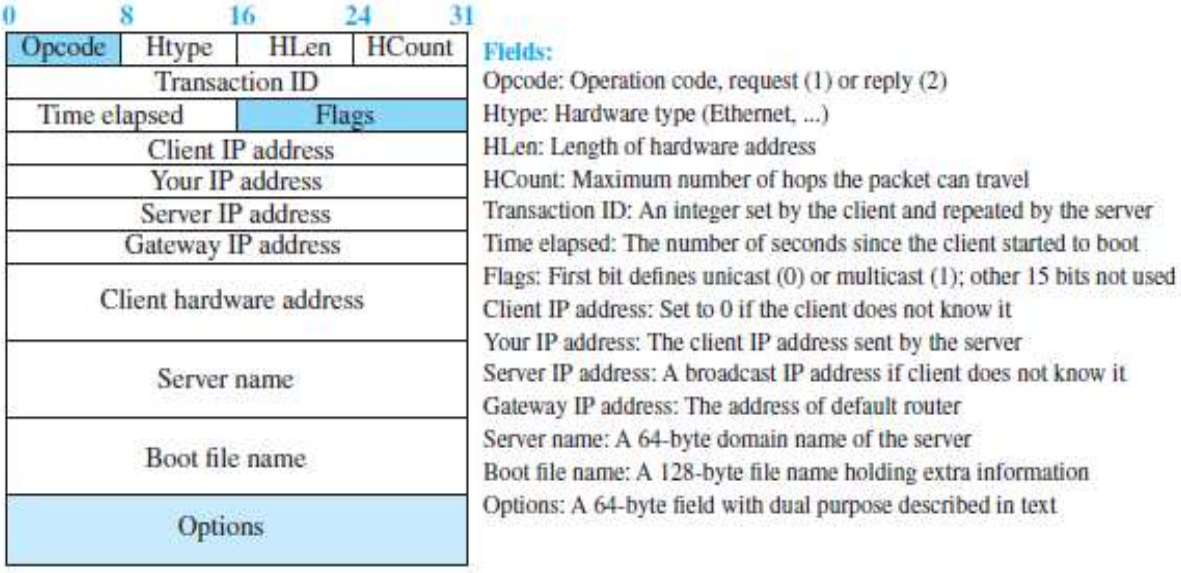

Fig: DHCP message format

- The 64-byte option field has a dual purpose. It can carry either additional informationor some specific vendor information.
- The server uses a number, called a **magiccookie,** in the format of an IP address with the value of 99.130.83.99.When the client finishes reading the message, it looks for this magic cookie.
- If present, the next 60 bytes are options. An option is composed of three fields: a 1-byte tag field, a 1-byte length field, and a variable-length value field.
- There are several tag fields that are mostly used by vendors. If the tag field is 53.

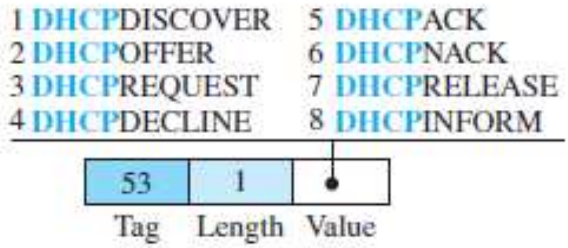

Fig: Option format.

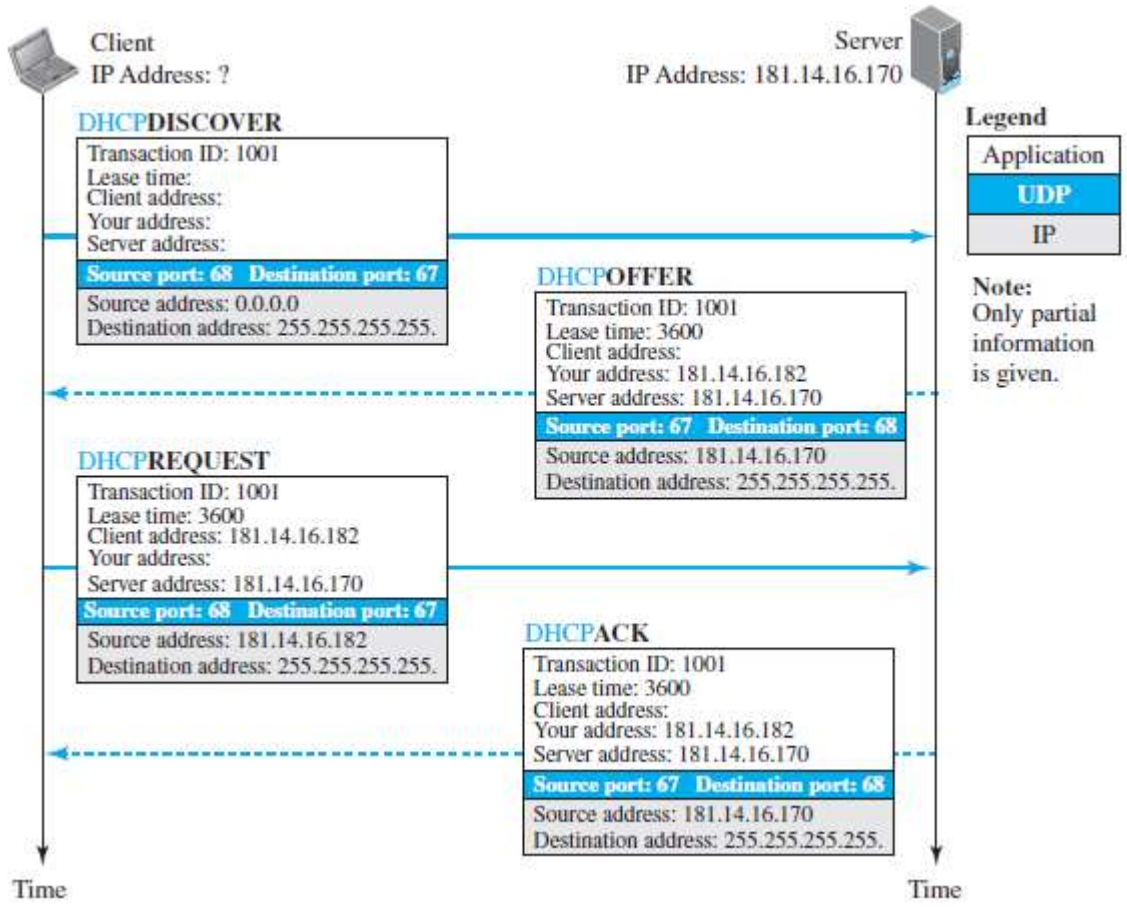

Fig: Operation of DHCP.

1. The joining host creates aDHCPDISCOVER message in which only the transaction-ID field is set to a random number. No other field can be set because the host hasno knowledge with which to do so. This message is encapsulated in a UDP user datagram with the source port set to 68 and the destination port set to 67. We will discuss the reason for using two well-known port numbers later. The user datagram is encapsulated in an IP datagram with the source address set to **0.0.0.0** ("thishost") and the destination address set to **255.255.255.255** (broadcast

address).The reason is that the joining host knows neither its own address nor the server address.

2. The DHCP server or servers (if more than one) responds with a DHCPOFFER message in which the your address field defines the offered IP address for the joining host and the server address field includes the IP address of the server.
3. The joining host receives one or more offers and selects the best of them. The joining host then sends a DHCPREQUEST message to the server that has given the best offer.
4. the server sends a DHCPNACK message and the client needs to repeat the process.

Two Well-Known Ports:

- DHCP uses two well-known ports (68 and 67).

Error Control:

- DHCP uses the service of UDP, which is not reliable. To provide error control, DHCP usestwo strategies.
- First, DHCP requires that UDP use the checksum. the use of the checksum in UDP is optional.
- Second, the DHCP client uses timers and a retransmission policy if it does not receive the DHCP reply to a request.

Transition States:

- The operation of the DHCP were very simple. To provide dynamic address allocation, the DHCP client acts as a state machine that performs transitions from one state to another depending on the messages it receives or sends.

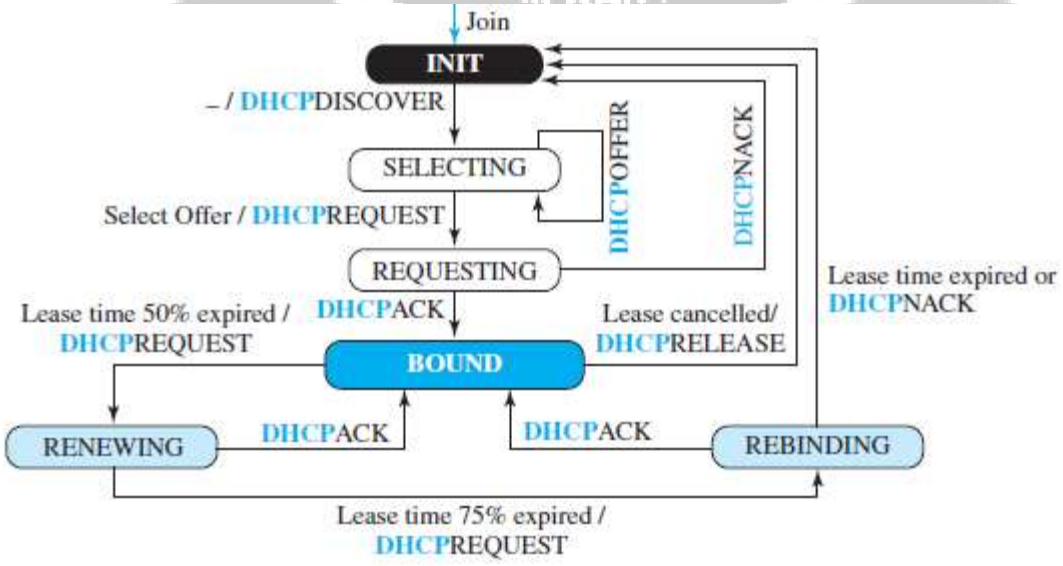

Fig: FSM for the DHCP Client.

- When the DHCP client first starts, it is in the INIT state (initializing state). The client broadcasts a discover message. When it receives an offer, the client goes to the SELECTING state.
- While it is there, it may receive more offers. After it selects an offer, it sends a request message and goes to the REQUESTING state. If an ACK arrives while the client is in this state, it goes to the BOUND state and uses the IP address.
- When the lease is50 percent expired, the client tries to renew it by moving to the RENEWING state. If the server renews the lease, the client moves to the BOUND state again. If the lease is not renewed and the lease time is 75 percent expired, the client moves to the REBINDING state.
- If the server agrees with the lease (ACK message arrives), the client moves to the BOUND state and continues using the IP address; otherwise, the client moves to the INIT state and requests another IP address.
- Note that the client can use the IP address only when it is in the BOUND, RENEWING, or REBINDING state. The above procedure requires that the client uses three timers: *renewal timer* (set to 50 percent of the lease time), *rebinding timer* (set to 75 percent of the lease time), and *expiration timer* (set to the lease time).

Network Address Resolution (NAT):

- The technology allows a site to use a set of private addresses for internal communication and a set of global Internet addresses (at least one) for communication with the rest of the world. The site must have only one connection to the global Internet through a NAT-capable router that runs NAT software.

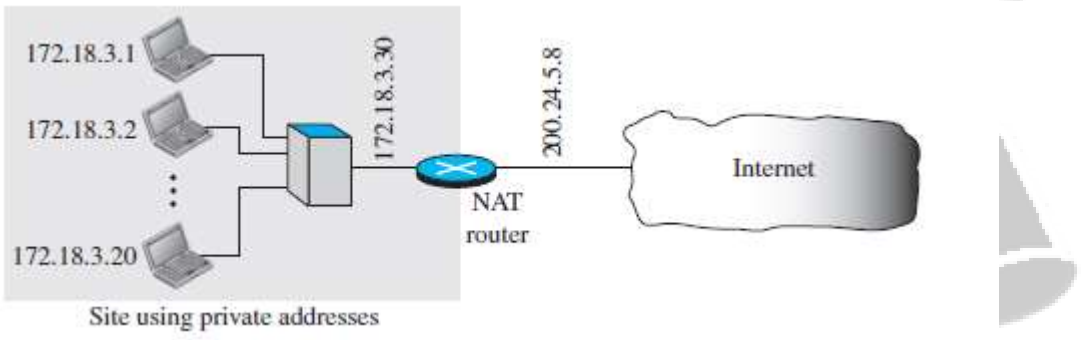

Fig: NAT.

- All of the outgoing packets go through the NAT router, which replaces the source address in the packet with the global NAT address.

- All incoming packets also pass through the NAT router, which replaces the destination address in the packet (the NAT router global address) with the appropriate private address.

Translation Table:

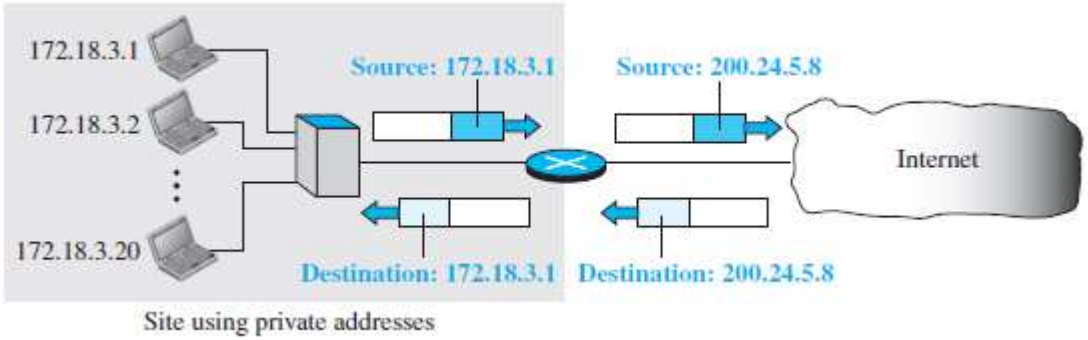

Fig: Address translation

Using One IP Address

- In its simplest form, a translation table has only two columns: the private address and the external address (destination address of the packet).
- When the router translates the source address of the outgoing packet, it also makes note of the destination address—where the packet is going.
- When the response comes back from the destination, the router uses the source address of the packet.

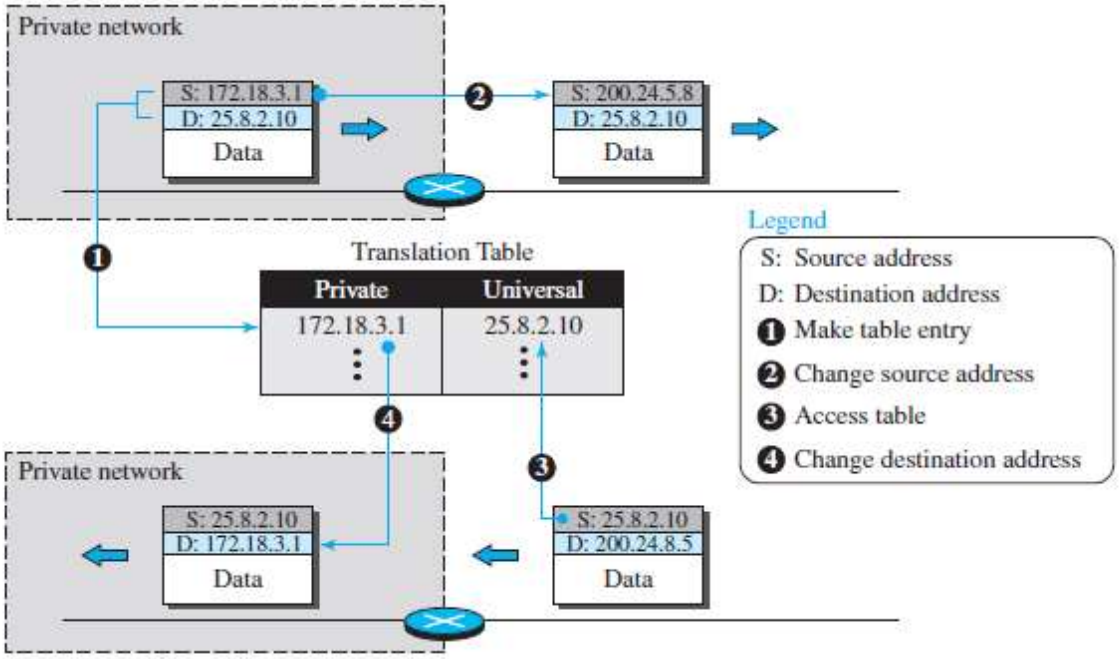

Fig: Translation

Using a Pool of IP Addresses:

- The use of only one global address by the NAT router allows only one private-network host to access a given external host. To remove this restriction, the NAT router can use a pool of global addresses.

Using Both IP Addresses and Port Addresses:

- To allow a many-to-many relationship between private-network hosts and external server programs, we need more information in the translation table.

Table: Five- column translation table

Private Address	Private Port	External Address	External Port	Transport protocol
172.18.3.1	1400	25.8.3.2	80	TCP
172.18.3.2	1401	25.8.3.2	80	TCP
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