CS321: Computer Networks

DHCP and NAT

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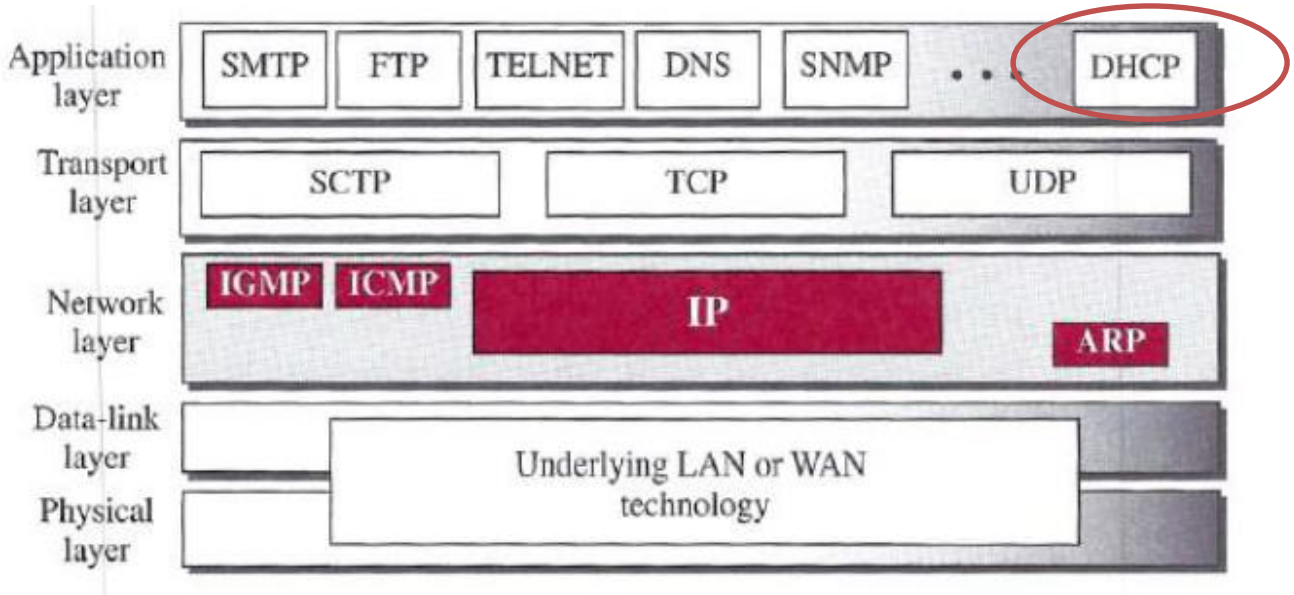
DHCP in TCP/IP Suite

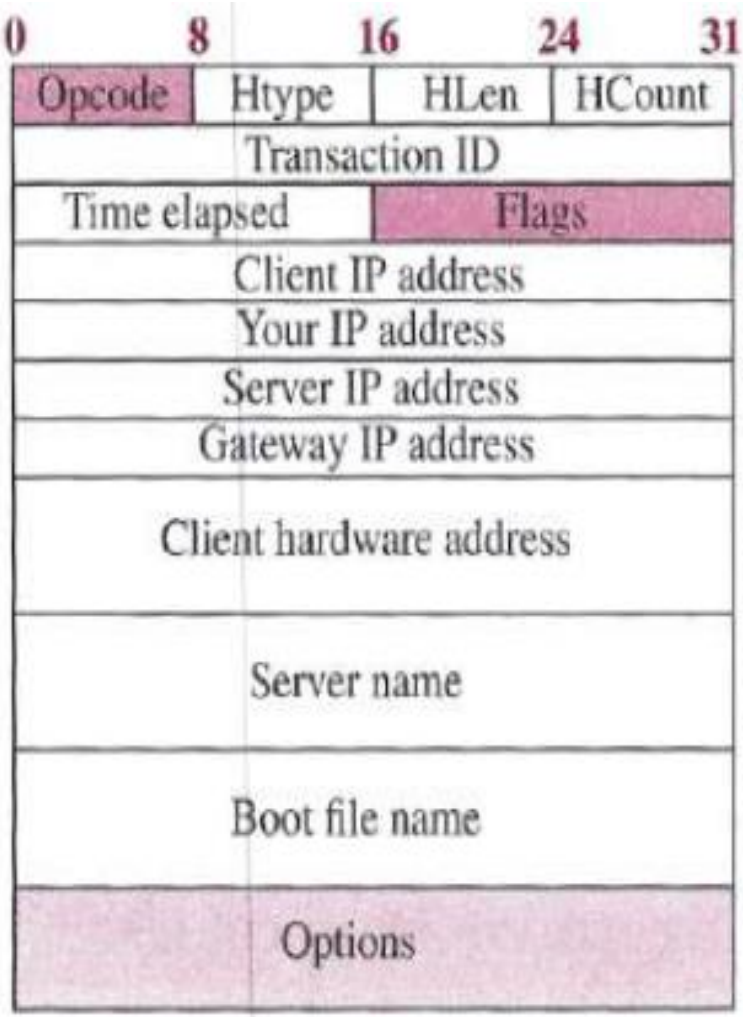


Dynamic Host Configuration Protocol (DHCP)

- is an application-layer program,
- using the client-server paradigm,
- actually helps TCP/IP at the network layer.
- Automatically assigns IP addresses to the host and routers.
- Ideally, every network should have at least one DHCP server

Earlier versions of DHCP was BOOTP (Bootstrap Protocol)

DHCP Frame Format



Fields:

Opcode: Operation code, request (1) or reply (2)

Htype: Hardware type (Ethernet, ...)

HLen: Length of hardware address

HCount: Maximum number of hops the packet can travel

Transaction ID: An integer set by the client and repeated by the server

Time elapsed: The number of seconds since the client started to boot

Flags: First bit defines unicast (0) or multicast (1); other 15 bits not used

Client IP address: Set to 0 if the client does not know it

Your IP address: The client IP address sent by the server

Server IP address: A broadcast IP address if client does not know it

Gateway IP address: The address of default router

Server name: A 64-byte domain name of the server

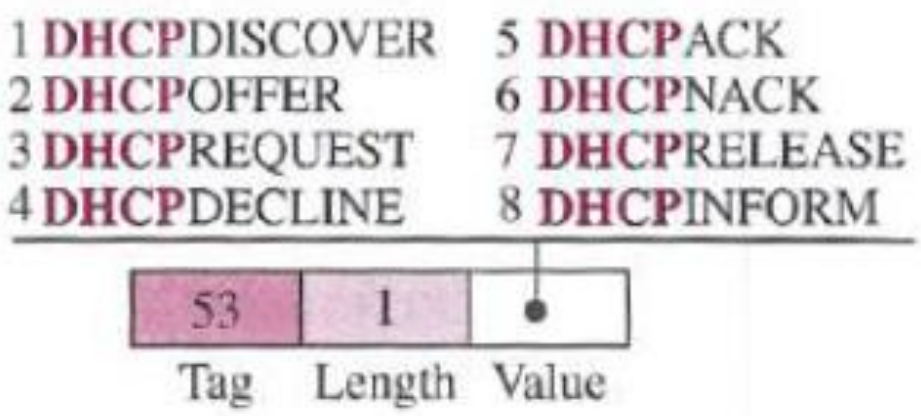
Boot file name: A 128-byte file name holding extra information

Options: A 64-byte field with dual purpose described in text

Options Field

Options: 64 Byte field with dual purpose

- 1 Byte Tag/ Code; specifies the option type.
- 1 Byte Length; specifies the number of bytes in this particular option
- 0-58 Byte value; specifies the data being sent
- 4 Byte magic cookie (99.130.83.99); to identify the information as vendor-independent option fields.



DHCP Scenario

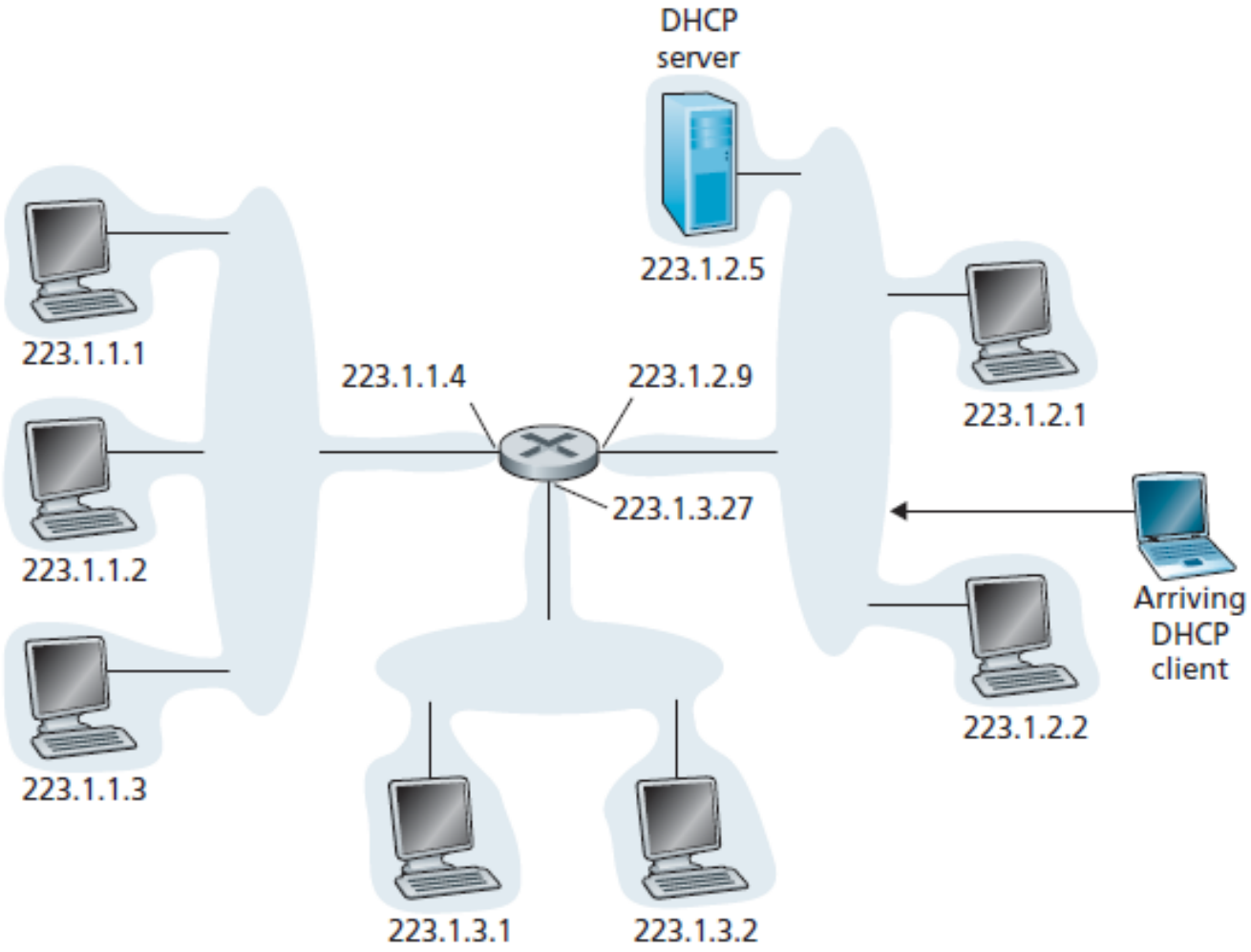


Figure 4.20 ♦ DHCP client-server scenario

DHCP Steps

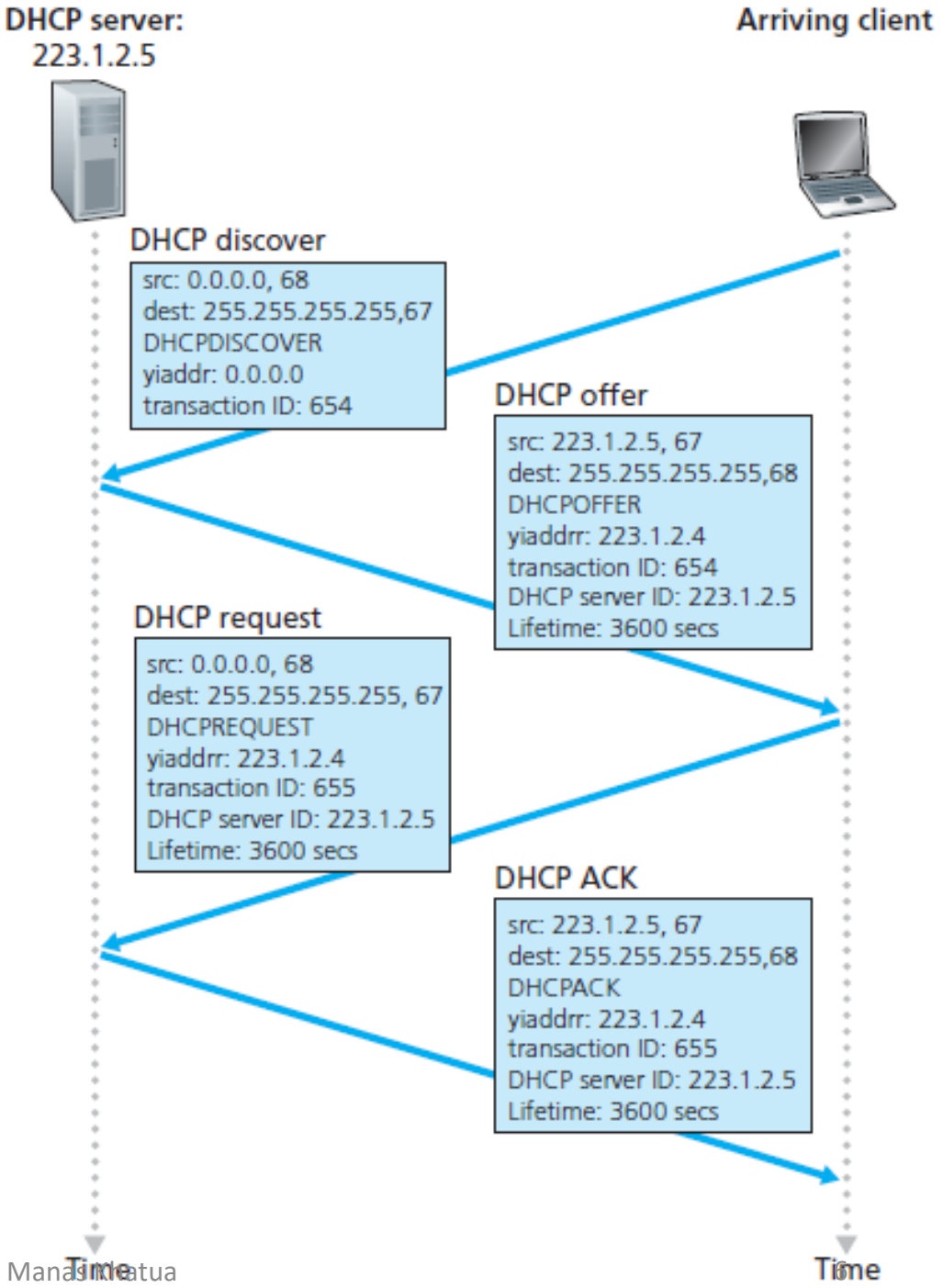
4 step process

1. *DHCP server discover*
   UDP packet to port 67.
   This host IP: 0.0.0.0, Port: 68
   Broadcast IP: 255.255.255.255
   Transaction ID: 654 (set by client)

2. *DHCP server offer(s)*
   Transaction ID: 654
   Your IP: 223.1.2.4
   Mask, DHCP server IP,
   Lifetime: 3600 sec

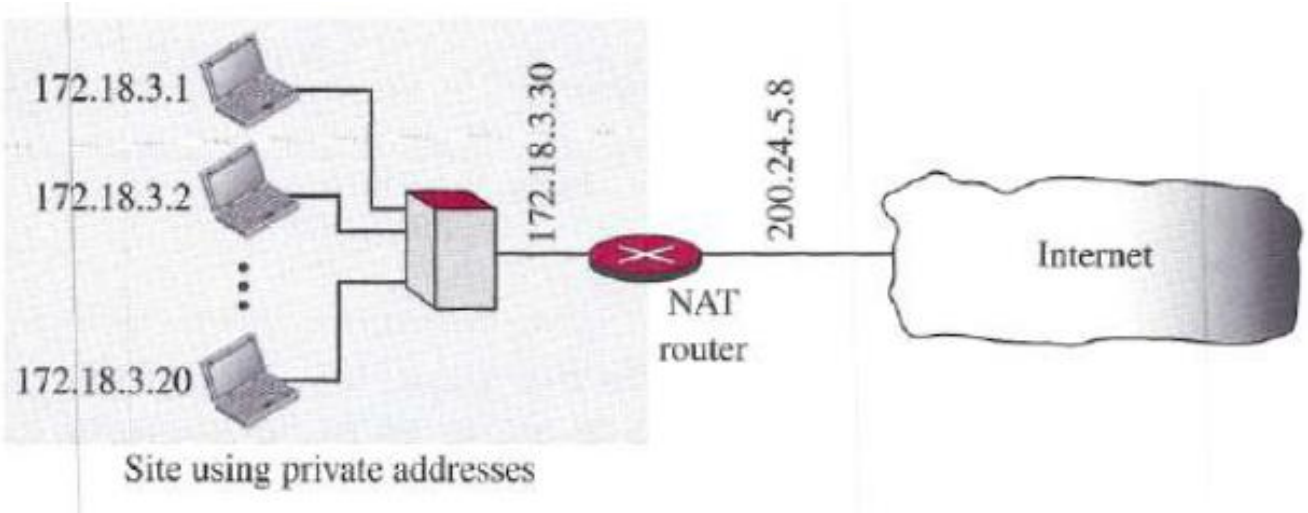
3. *DHCP request*
   Select one offer and request to grant

4. *DHCP ACK*
   Server confirms the request



Network Address Translation (NAT)

- Problem: after a period, business grows or the household needs a larger range of IP
- Expensive Naïve Solution: get more IP from the ISP
- Better Solution: NAT.
  - use a set of private addresses for internal communication, and
  - a set of global addresses (at least one) for communication with the world.



NAT Operations

Private IP Addresses: 10.0.0.0/8, *172.16.0.0/12, 192.168.0.0/16,* and 169.254.0.0/16

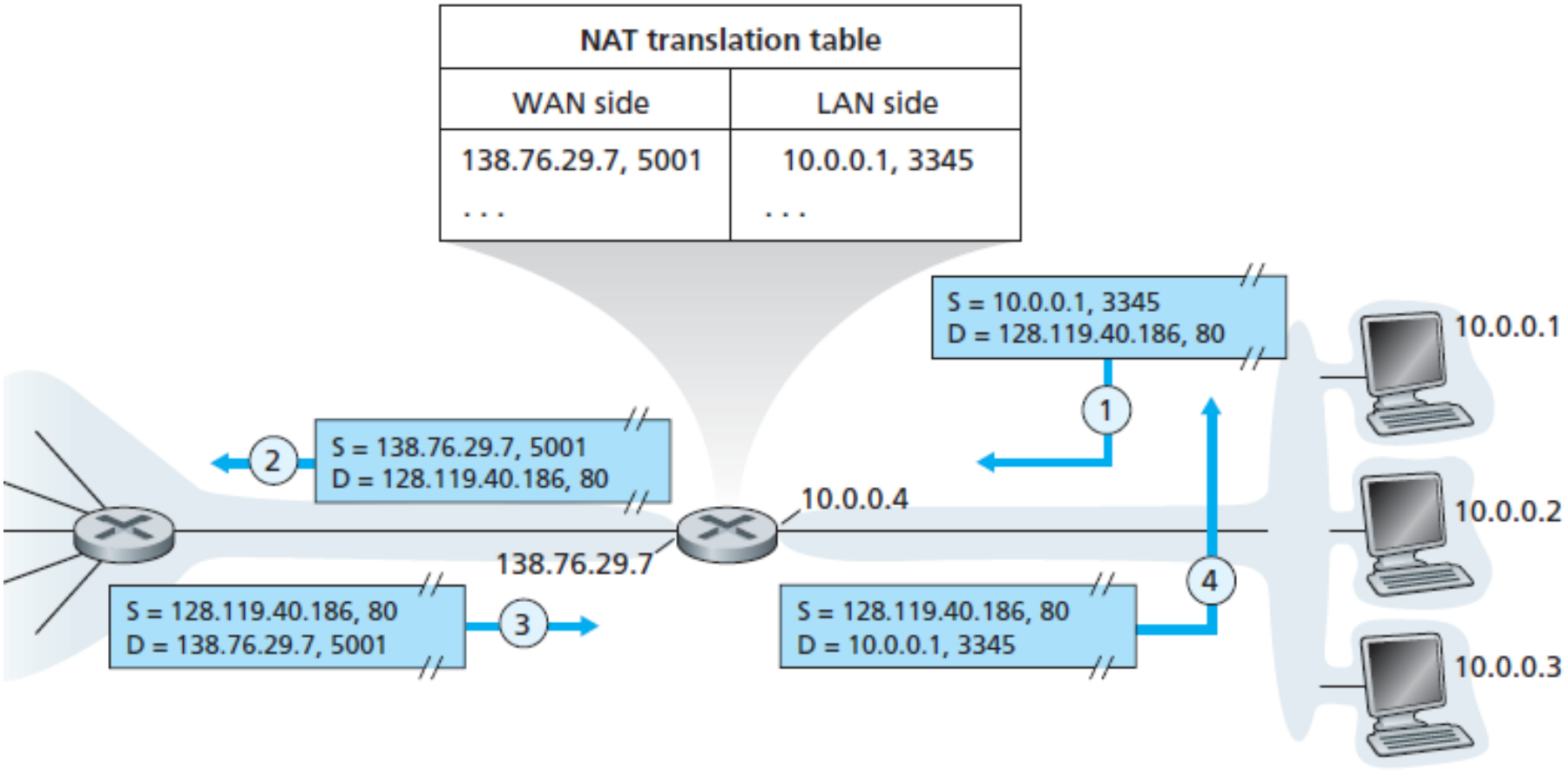


Figure 4.22 ♦ Network address translation

NAT

- The NAT-enabled router does not *look* like a router to the outside world
- Instead the NAT router behaves to the outside world as a *single* device with a *single* IP
- The NAT-enabled router is hiding the details of the home network from the outside world.

- The router runs a DHCP server to provide addresses to computers within the NAT-DHCP-router-controlled home network's address space.

- NAT has enjoyed widespread deployment. It has few objections:
  - port numbers are meant to be used for addressing processes, not for addressing hosts.
  - Routers are supposed to process packets only up to layer 3, not up to layer 4
  - the NAT protocol violates the so-called end-to-end argument; that is, hosts should be talking directly with each other, without interfering nodes modifying IP addresses and port numbers.
  - we should use IPv6 to solve the shortage of IP addresses, rather than NAT
  - another major problem with NAT is that it interferes with P2P applications
    - if Peer B is behind a NAT, it cannot act as a server and accept TCP connection from Peer A

Thanks!