

IP Addresses

- In TCP/IP a 32 bit number is used to uniquely identify a machine's connection on the network (not the machine itself).
- IP addresses are assigned by the Network Information Center (NIC).
- Identified by four sets of bytes (hence 192.122.34.23).
- There are four formats for an IP address.
- These formats are called Class A, Class B, Class C, Class D.

IP Address Classes (1)

CLASS A

0	Network (7 Bits)	Local Address (24 Bits)
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CLASS B

10	Network (14 Bits)	Local Address (16 Bits)
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CLASS C

110	Network (21 Bits)	Local Address (8 Bits)
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CLASS D

1110	Multicast (28 Bits)	
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IP Address Classes (2)

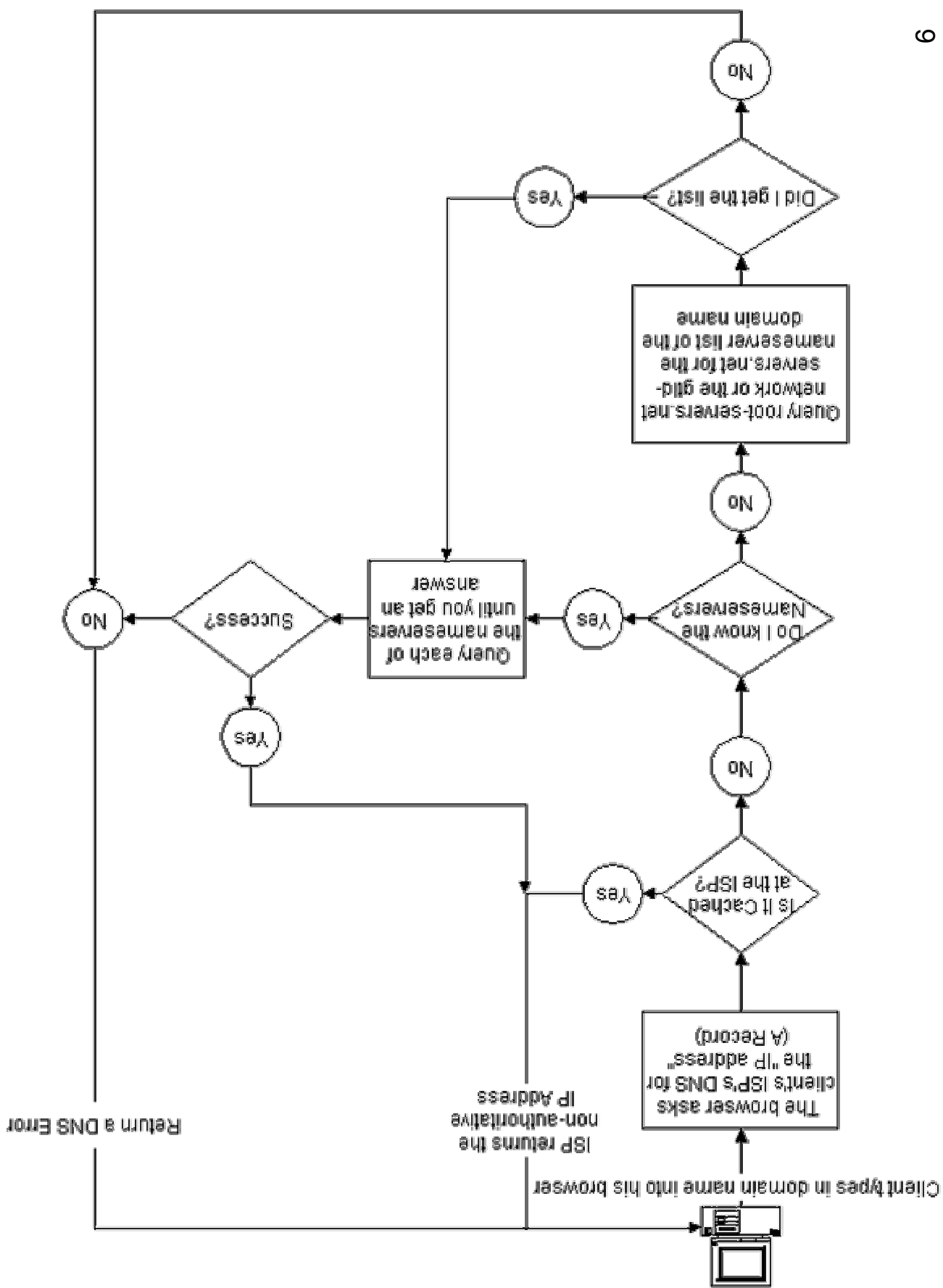
- Class A:
 - Used for large networks (like ISPs).
 - The network address (7 bits) is limited so a few networks may be described, by each network can have many hosts.
- Class B:
 - For mid-sized networks.
- Class C:
 - Has only 8 bits to identify hosts. This limits the number of devices to 256.
- Class D:
 - These networks are used when a general broadcast to many devices is required.

DNS

- Domain Name Service.
- It is useful to address machines by a name rather than by a number.
- DNS is a service that translates symbolic names (e.g. `www.example.com`) to the respective IP Address.

Example DNS Lookup (1)

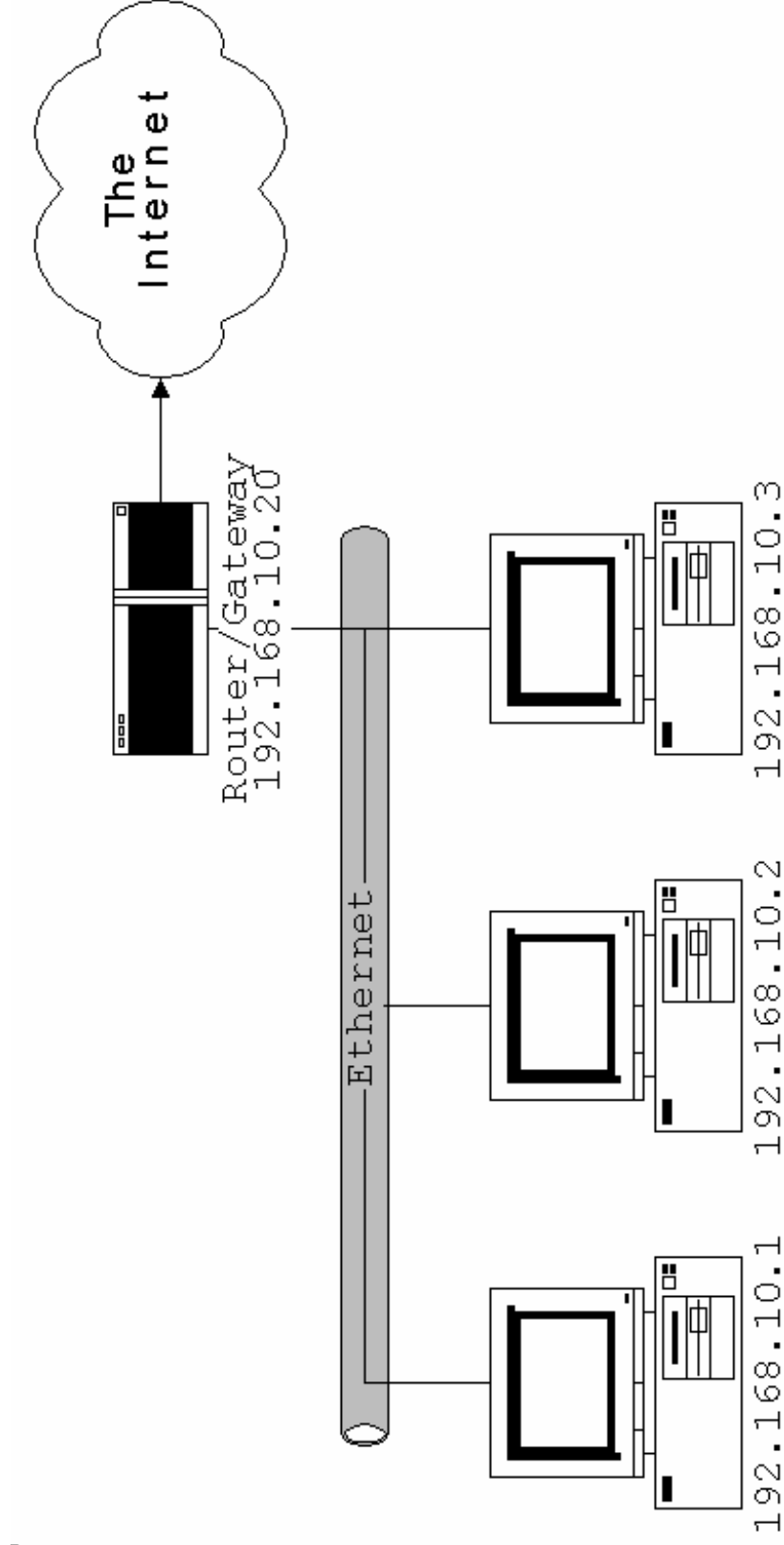
- Client makes a DNS query (www.example.com).
- The query is sent to the client's ISP for the IP address of the domain name.
- The ISP looks for the IP address of the domain name from its cache. If the answer is found – ready!
- If the answer is not found or is too old (past its time-to-live), the ISP's DNS contacts the domain's servers (example.com) directly for the address of www.example.com.
- If the domain server is not known, root servers (e.g. for .com) are forwarded the query.



Routers, Gateways and Bridges (1)

- When messages are forwarded through networks, the destination of the message is compared to the address of the local machine. If there is a match, then the message arrived to destination, otherwise it is passed on to the next.
- This is OK for small networks, but is to inefficient for large networks like the internet.
- Gateways, Routers and Bridges are tools that help establish the best method of moving a message to destination.

Routers, Gateways and Bridges (2)



Sub-Nets and Routing (1)

A **Subnet-Mask** becomes important at this stage. If you now like to connect to 207.68.137.53 TCP/IP checks your own IP-address and the IP-address of the destination against the Subnet-Mask. At binary Level:

System	IP or Sub-Net	Binary
Your PC	192.168.0.1	11000000 10101000 00001010 00000001
Your Server	192.168.0.10	11000000 10101000 00001010 00001010
Destination	207.68.137.53	11001111 01000100 10001001 00110101
Sub-Net	255.255.255.0	11111111 11111111 11111111 00000000

TCP/IP compares the address part defined by the '1's in the subnet-mask:

System	IP or Sub-Net	Binary
Your PC	192.168.0.xxx	11000000 10101000 00001010 xxxxxxxxxx
Your Server	192.168.0.xxx	11000000 10101000 00001010 xxxxxxxxxx
Destination	207.68.137.xxx	11001111 01000100 10001001 xxxxxxxxxx
Sub-Net	255.255.255.0	11111111 11111111 11111111 00000000 ⁹

Sub-Nets and Routing (2)

- If your system connects to another on the same network (the masked part is the same), connection is made directly.
- Otherwise, connection is made via the Gateway/Bridge/Router.
- These devices hold tables which contains addresses of neighbouring ones.
- The request is passed to the next router, which goes to the next, which goes to the next ... until we reach the router on the destination network.

Ports

- Just as IP Addresses are used to uniquely identify a connection on the network, port numbers are used to identify an application using that connection.
- E.g. Port 80 is used for web browsing, 21 for FTP, 23 for Telnet (normally).
- Port numbers over 255 are reserved for private use on the local machine whilst port numbers below 255 are reserved for 'standard' processes. These numbers are published by the **Internet Assigned Numbers Authority**.

Sockets

- Each communication circuit on the internet is identified by two numbers collectively called a socket.
- These two numbers are the IP address of the machine and the port number.
- Both sending and receiving machines have their sockets.
- Because IP addresses are unique on the internet and port numbers are unique on the local machine, individual processes are allowed to communicate over the network.