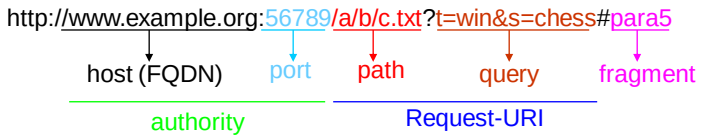
URI

- URI's are of two types:
  - Uniform Resource Name (URN)
    - Can be used to identify resources with unique names, such as books (which have unique ISBN's)
    - Scheme is `urn`
  - Uniform Resource Locator (URL)
    - Specifies location at which a resource can be found
    - In addition to `http`, some other URL schemes are `https`, `ftp`, `mailto`, and `file`

HTTP URL's



- Browser uses authority to connect via TCP
- Request-URI included in start line (/ used for path if none supplied)
- Fragment identifier not sent to server (used to scroll browser client area)

HTTP Request

- Common request methods:
  - GET
    - Used if link is clicked or address typed in browser
    - No body in request with GET method
  - POST
    - Used when submit button is clicked on a form
    - Form information contained in body of request
  - HEAD
    - Requests that only header fields (no body) be returned in the response

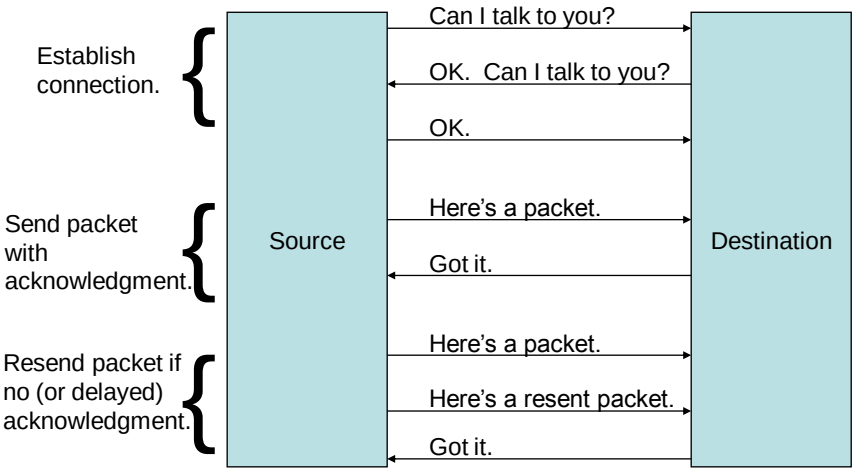
HTTP Request

- Common header fields:
  - Host: host name from URL (required)
  - User-Agent: type of browser sending request
  - Accept: MIME types of acceptable documents
  - Connection: value `close` tells server to close connection after single request/response
  - Content-Type: MIME type of (POST) body, normally application/x-www-form-urlencoded
  - Content-Length: bytes in body
  - Referer: URL of document containing link that supplied URI for this HTTP request

Transmission Control Protocol (TCP)

- Limitations of IP:
  - No guarantee of packet delivery (packets can be dropped)
  - Communication is one-way (source to destination)
- TCP adds concept of a connection on top of IP
  - Provides guarantee that packets delivered
  - Provide two-way (full duplex) communication

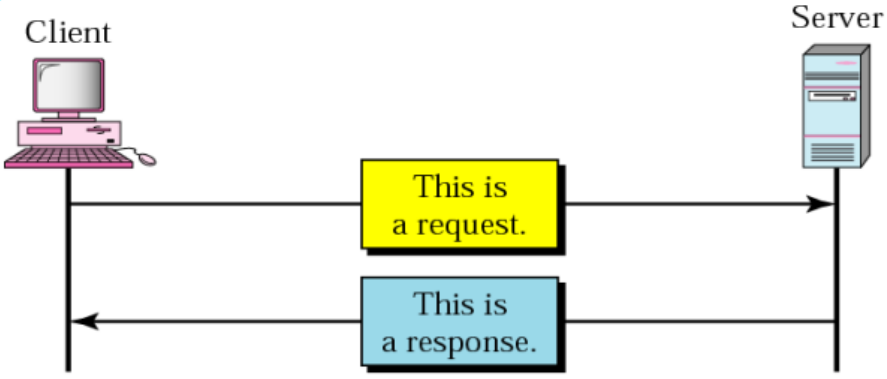
TCP



TCP

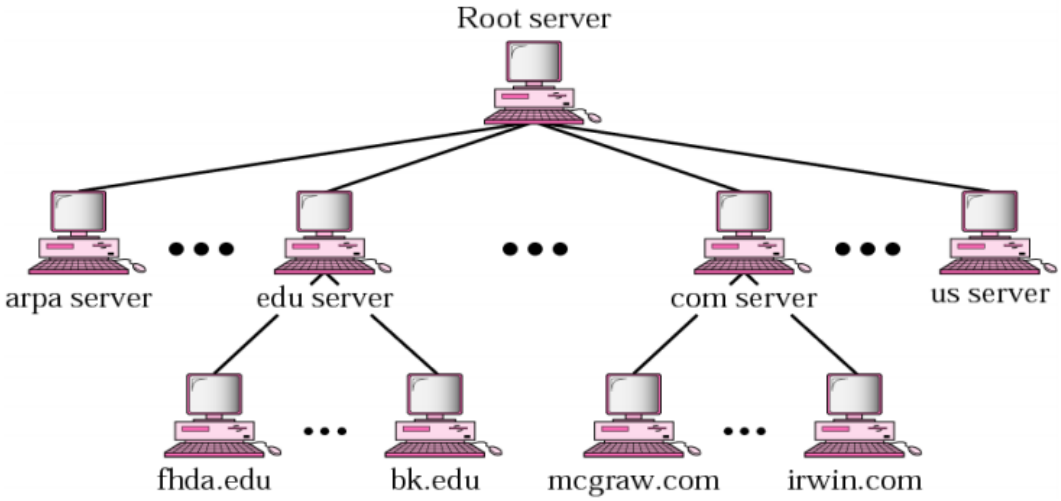
- TCP also adds concept of a port
  - TCP header contains port number representing an application program on the destination computer
  - Some port numbers have standard meanings
    - Example: port 25 is normally used for email transmitted using the Simple Mail Transfer Protocol (SMTP)
  - Other port numbers are available first-come-first served to any application

- Client-server model
  - client: browser that requests, receives, "displays" web objects
  - server: Web server sends objects in response to request
- uses TCP connection on the well-known port 80



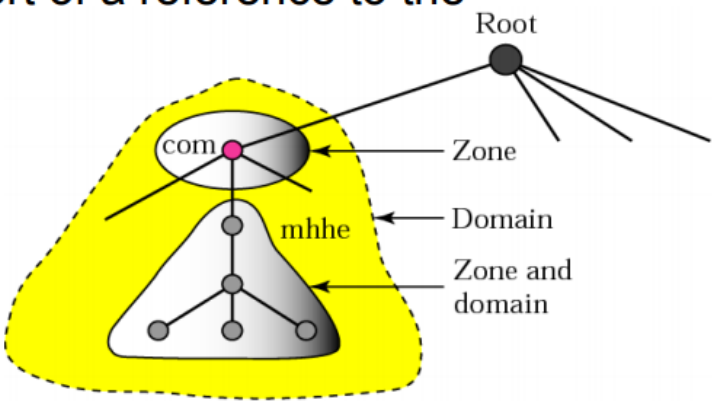
DNS Domain name System

- Solution for huge amount of information:
  - divide it into smaller parts and store each part on different computer—called DNS Server
  - Host needs name resolution contacts nearest DNS Server
  - if one DNS server doesn't know how to translate a particular domain name, it asks another one, and so on, until the correct IP address is returned.
- Hierarchy of Name Servers



DNS zones, servers –

original server keeps a sort of a reference to the lower-level servers



Root servers

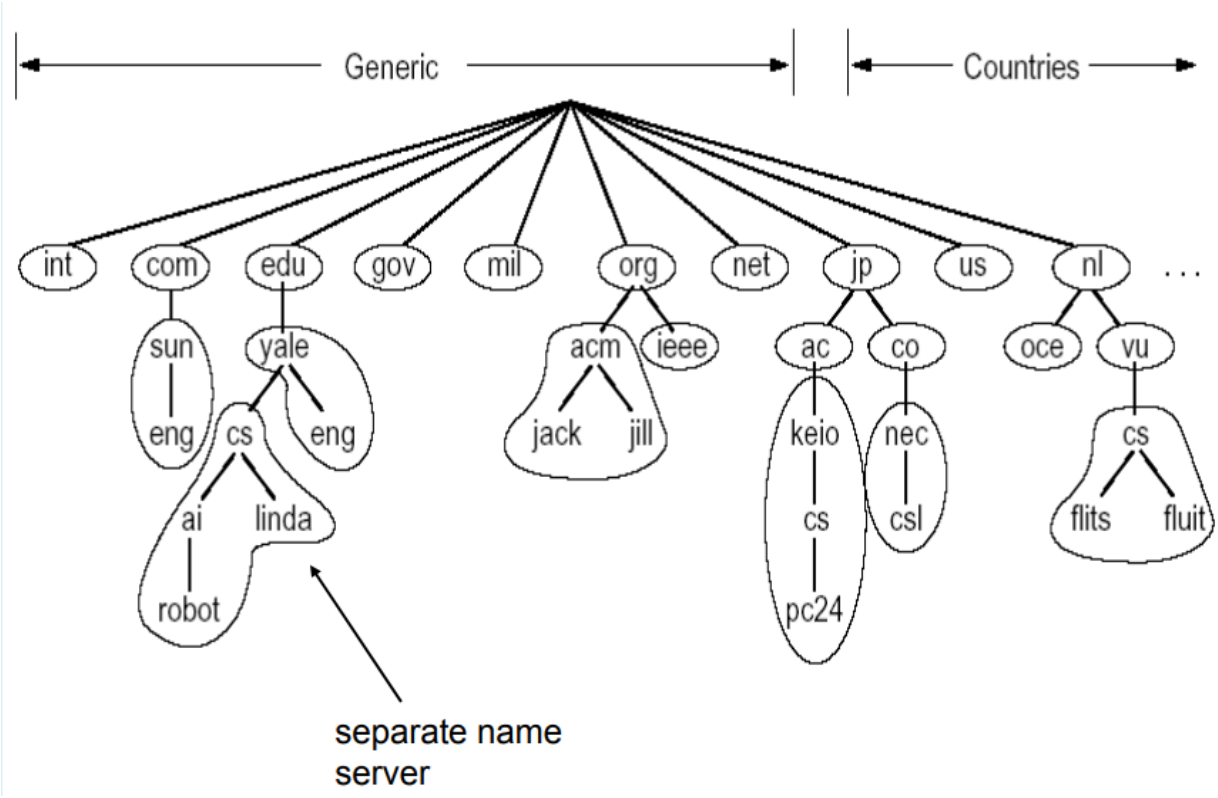
- zone is a whole tree
- 13 in the world

Primary server

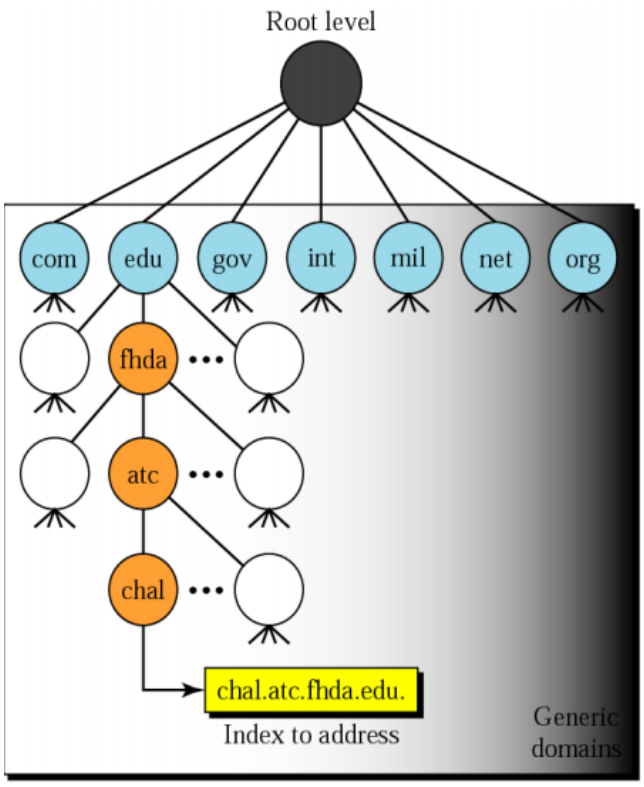
- loads the information about the the zone from the disk

Secondary server

- loads the info from the primary server
  - redundancy against failure



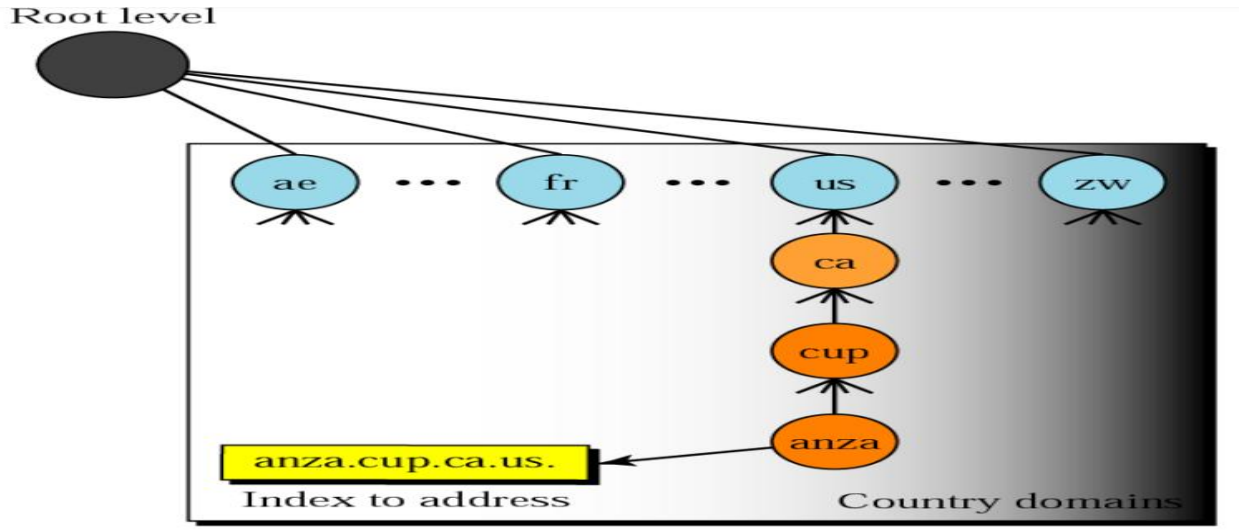
Generic domain



Label	Description
com	Commercial organizations
edu	Educational institutions
gov	Government institutions
int	International organizations
mil	Military groups
net	Network support centers
org	Nonprofit organizations

aero	Airlines and aerospace companies
biz	Businesses or firms (similar to 'com')
coop	Cooperative business organizations
info	Information service providers
museum	Museums and other nonprofit organizations
name	Personal names (individuals)
pro	Professional individual organizations

Country domains

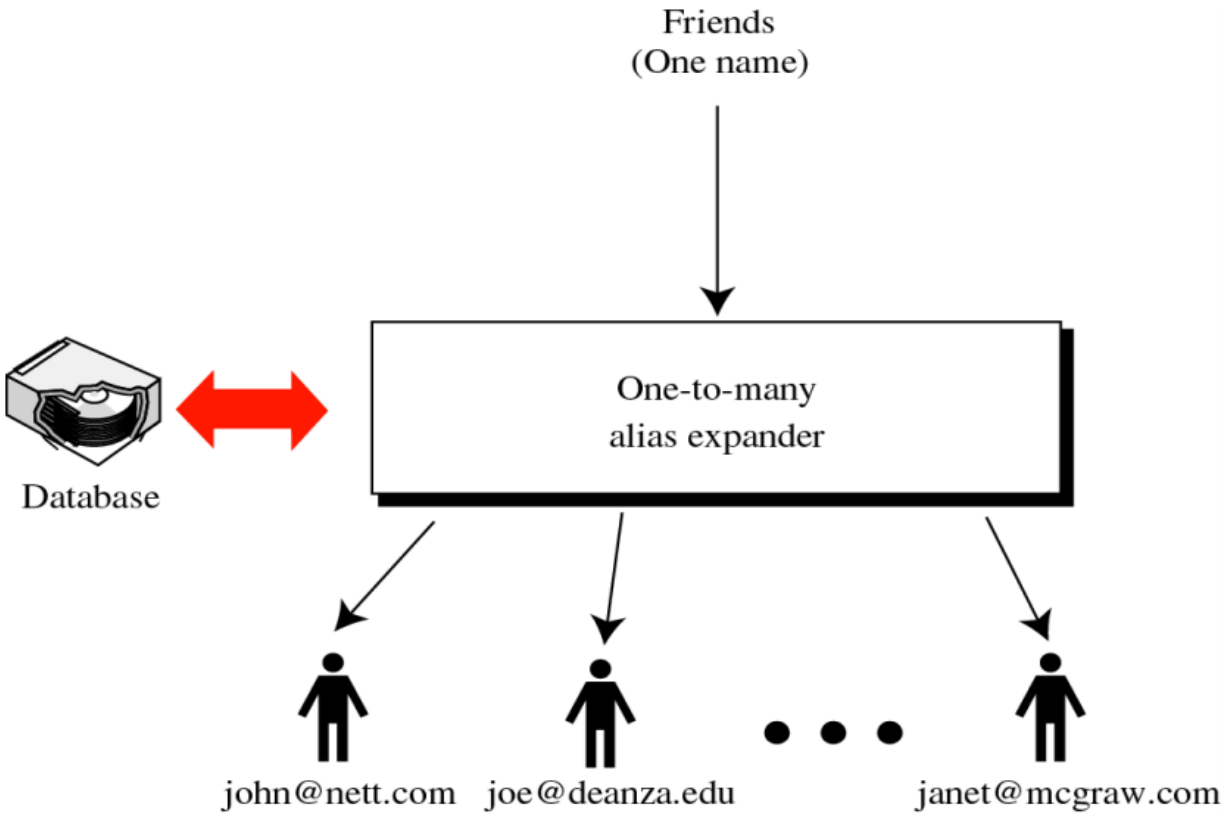


SMTP

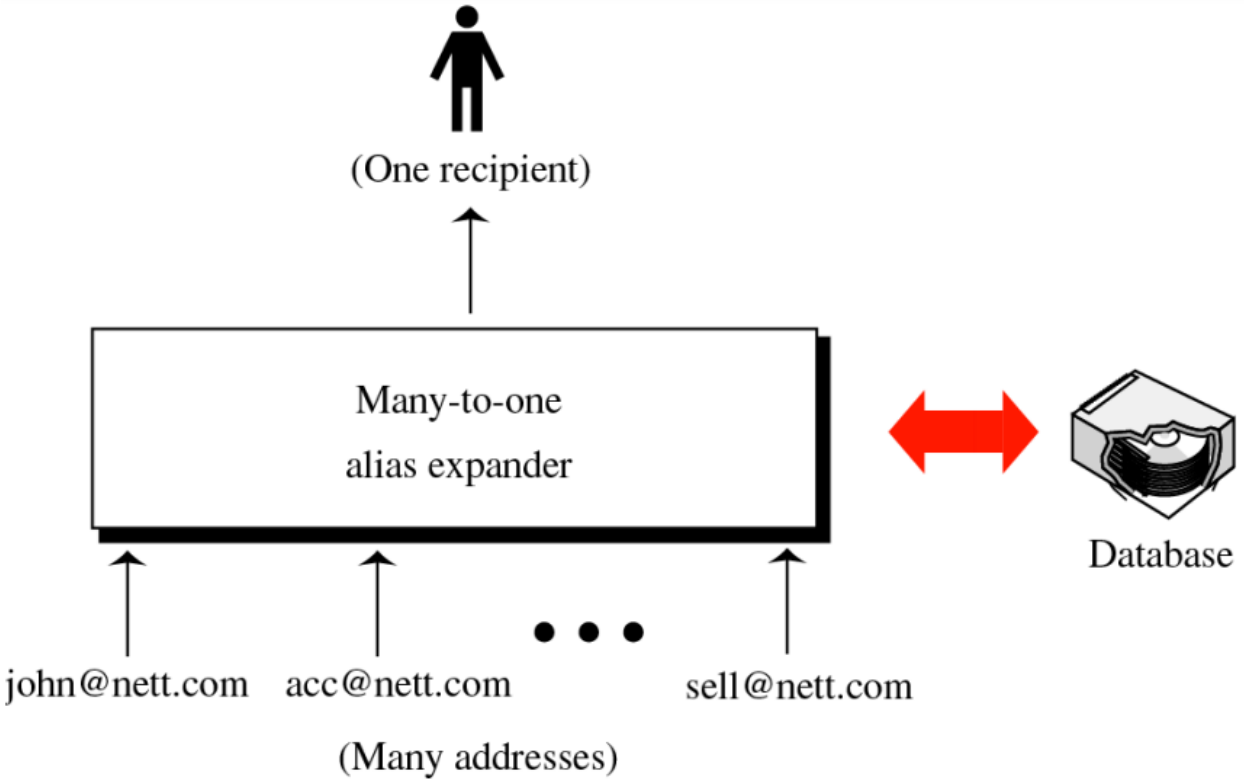
Provides electronic mail(email) services using email addresses

- Sending a single message to one or more recipients
- Sending messages that include text, graphics, voice and video

One-to-many expansion



Many-to-one expansion



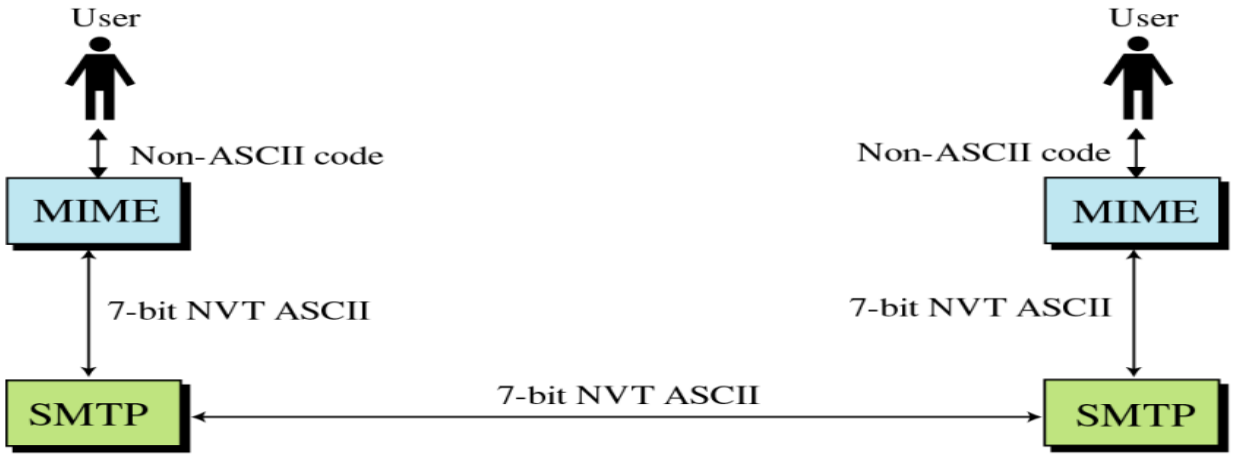
MIME

SMTP uses NVT 7-bit ASCII character set

- Can not be used for languages that are not supported by 7-bit ASCII characters. E.g French, German, Hebrew, Russian, Chinese, Japanese etc.
- Can not be used to send binary data or audio or video

MIME(Multipurpose Internet Mail Extension)

- A supplementary protocol that allows non-ASCII data to be sent SMTP
- Can be thought of as software functions that transform non-ASCII to ASCII and vice versa

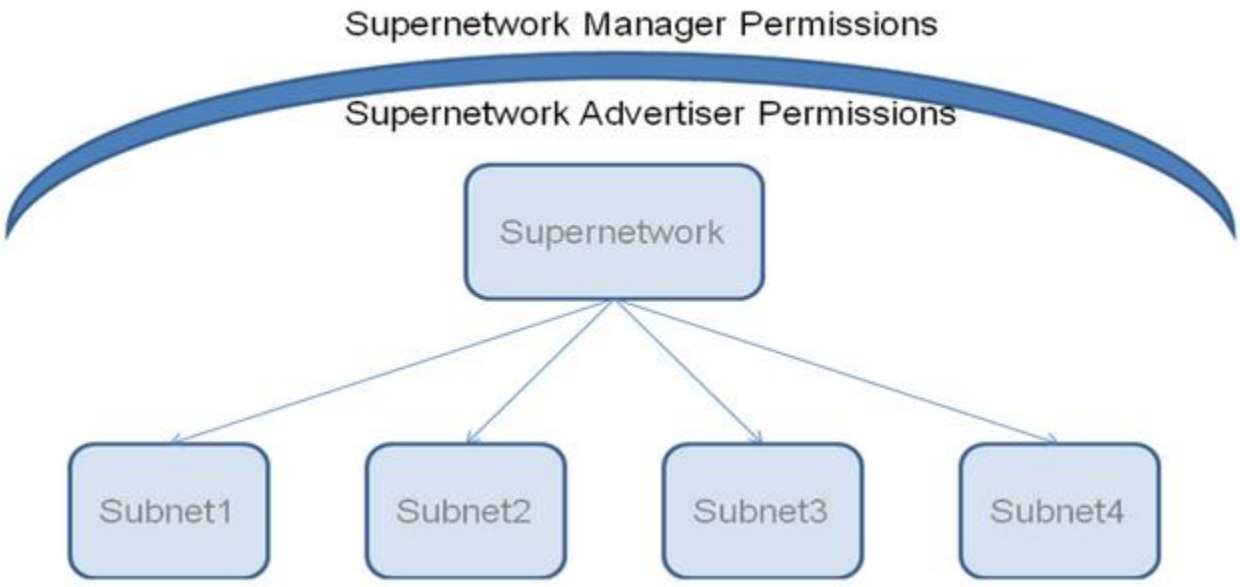


Subnet

A subnetwork or **subnet** is a logical subdivision of an IP network. The practice of dividing a network into two or more networks is called **subnetting**. Computers that belong to a **subnet** are addressed with an identical most-significant bit-group in their IP addresses.

Network Bits	Subnet Mask	Bits Borrowed	Subnets	Hosts/Subnet
8	255.0.0.0	0	1	16777214
9	255.128.0.0	1	2	8388606
10	255.192.0.0	2	4	4194302
11	255.224.0.0	3	8	2097150
12	255.240.0.0	4	16	1048574
13	255.248.0.0	5	32	524286
14	255.252.0.0	6	64	262142
15	255.254.0.0	7	128	131070
16	255.255.0.0	8	256	65534
17	255.255.128.0	9	512	32766
18	255.255.192.0	10	1024	16382
19	255.255.224.0	11	2048	8190
20	255.255.240.0	12	4096	4094
21	255.255.248.0	13	8192	2046
22	255.255.252.0	14	16384	1022
23	255.255.254.0	15	32768	510
24	255.255.255.0	16	65536	254
25	255.255.255.128	17	131072	126
26	255.255.255.192	18	262144	62
27	255.255.255.224	19	524288	30
28	255.255.255.240	20	1048576	14
29	255.255.255.248	21	2097152	6
30	255.255.255.252	22	4194304	2

Supernetting is the opposite of Subnetting. In subnetting, a single big network is divided into multiple smaller subnetworks. In **Supernetting**, multiple networks are combined into a bigger network termed as a Supernetwork or **Supernet**.



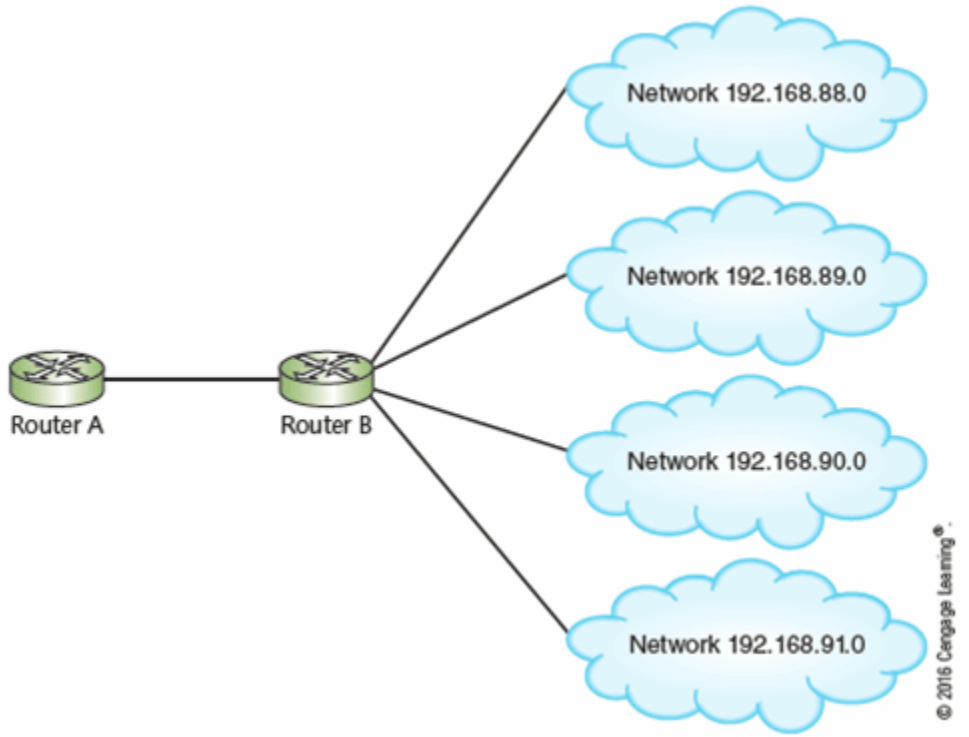


Figure 10-7 Supernetting reduces entries in router A's routing tables

Variable-Length Subnet Masking (**VLSM**) amounts to "subnetting subnets," which means that **VLSM** allows network engineers to divide an IP address space into a hierarchy of subnets

of different sizes, making it possible to create subnets with very different host counts without wasting large numbers of addresses.