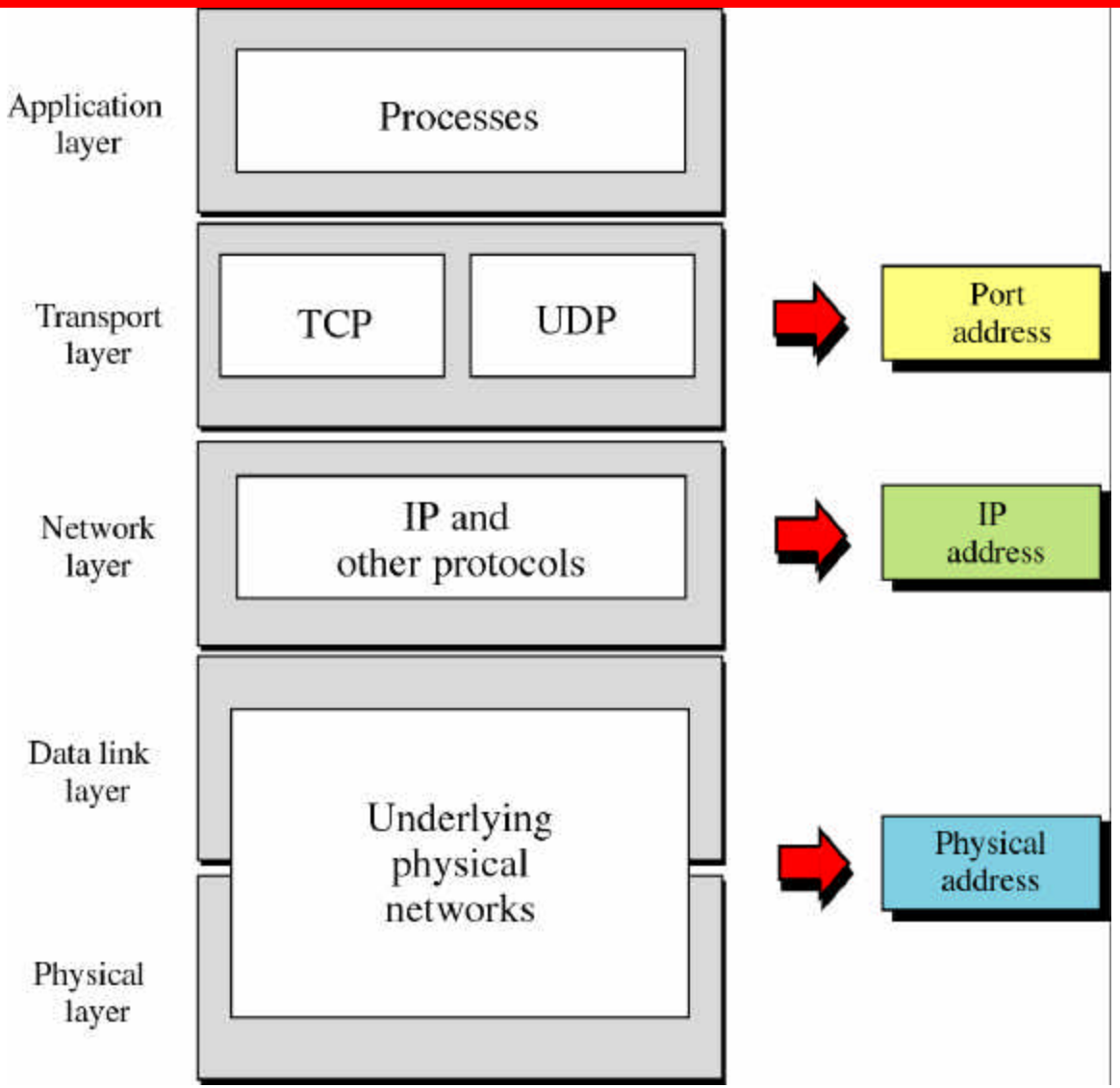
Announcements

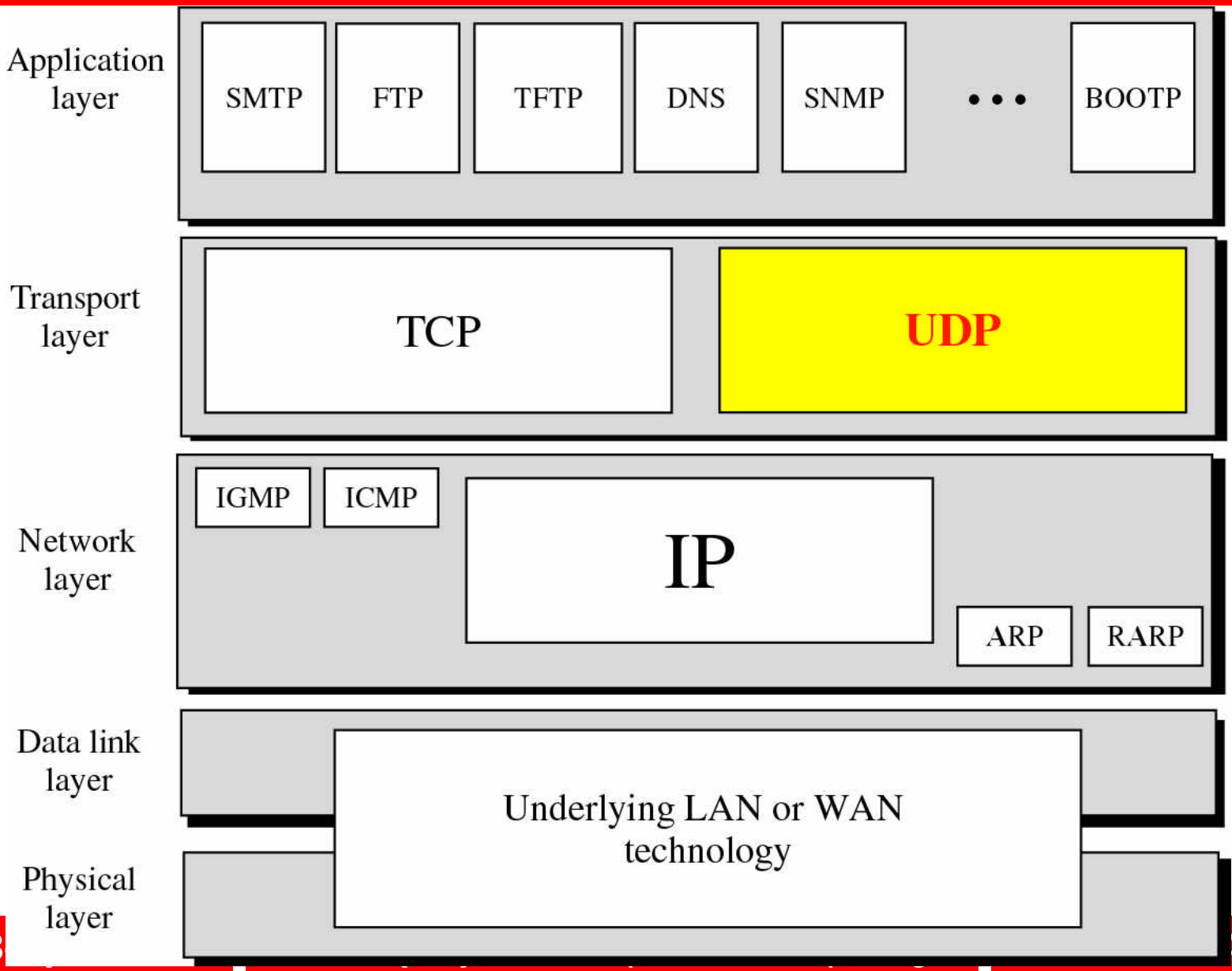
Outline

- Overview of IP (continued)
- IPv6

Addressing



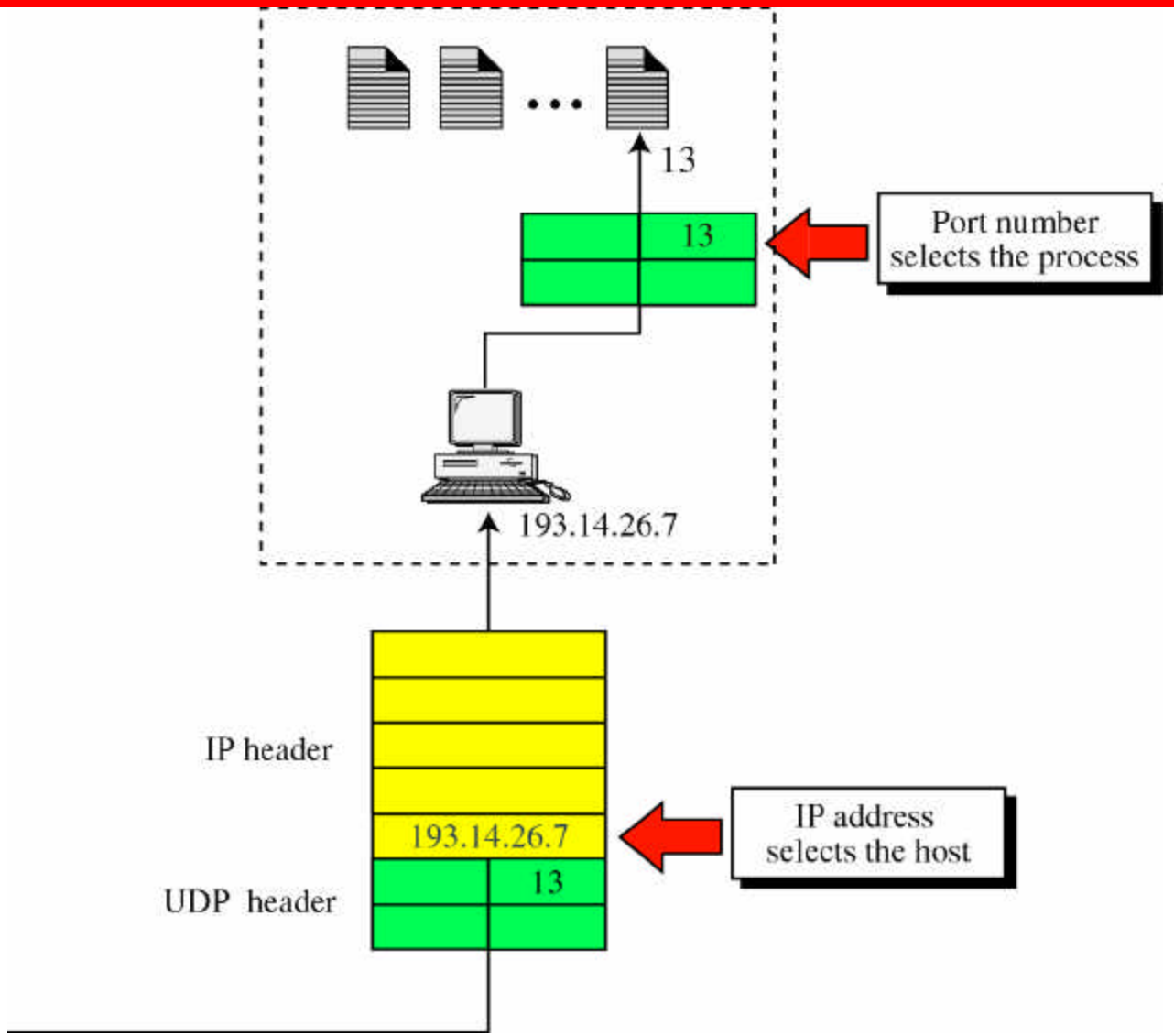
OSI in IP world



User Datagram Protocol (UDP)

- Simple demultiplexing
  - No guarantees about reliability, in-order delivery
- Thin veneer on top of IP adds src/dest port numbers
  - 16 bit port number allows for identification of 65536 unique communication endpoints per host
  - Note that a single process can utilize multiple ports
  - IP addr + port number uniquely identifies all Internet endpoints

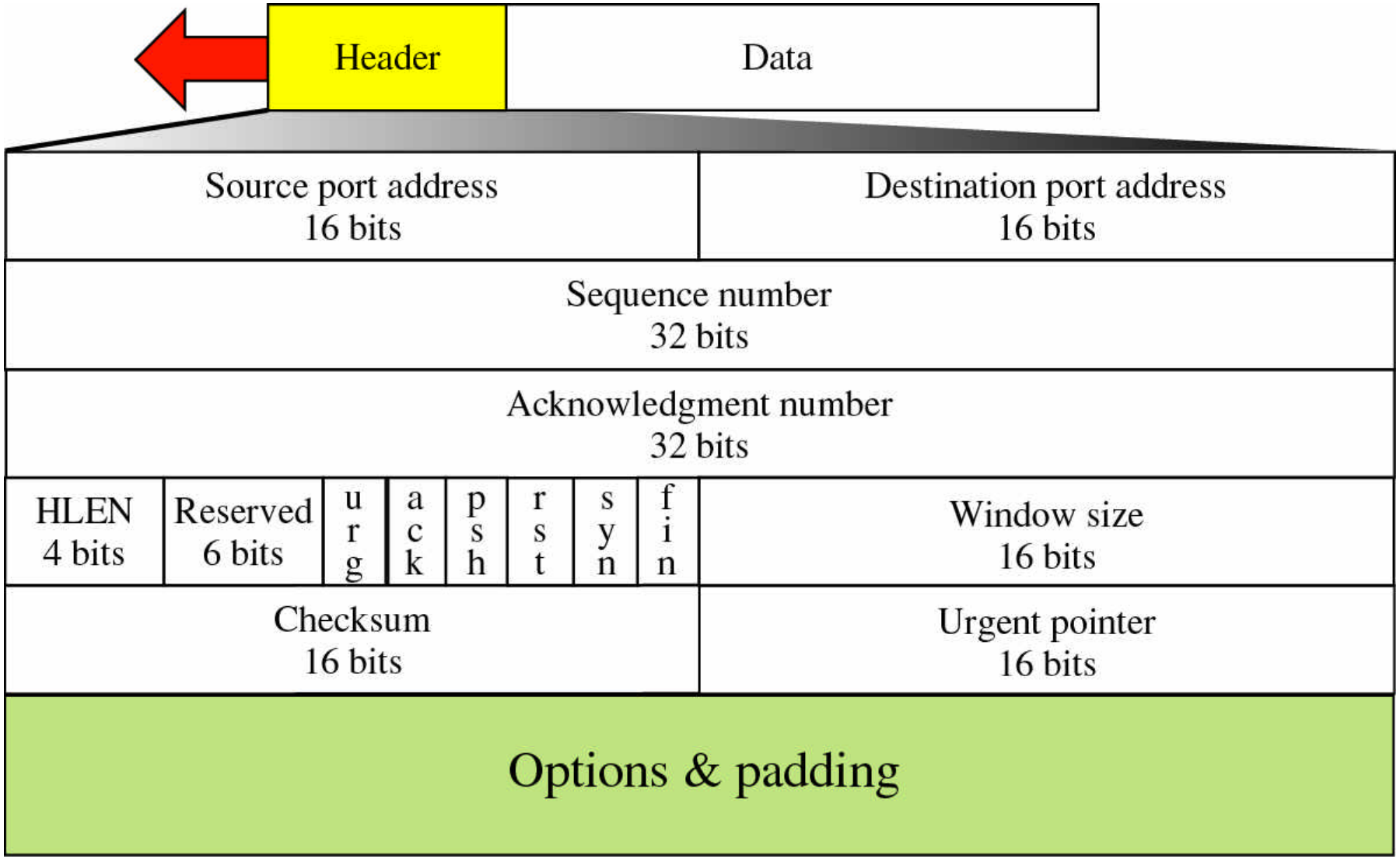
User Datagram Protocol (UDP)



Transmission Control Protocol (tcp)

- Reliable in-order delivery of byte stream
  - Full duplex (endpoints simultaneously send/receive)
  - e.g., single socket for web browser talking to web server
- Flow-control
  - To ensure that sender does not overrun receiver
  - Fast server talking to slow client
- Congestion control
  - Keep the sender from overrunning the network
  - Many simultaneous connections across routers (cross traffic)

TCP headers


Header
Data
Source port address
16 bits
Destination port address
16 bits
Sequence number
32 bits
Acknowledgment number
32 bits
HLEN
4 bits
Reserved
6 bits
urg
ack
psh
rst
syn
fin
Window size
16 bits
Checksum
16 bits
Urgent pointer
16 bits
Options & padding

IPv6

- Large Address space - 128 bit addresses
  - Every toaster can have its own IP address
- Aggregation-based address hierarchy
  - Efficient backbone routing
- Efficient and Extensible IP datagram
  - No fragmentation by routers
  - 64 bits field alignment
  - Simpler basic header
- Auto-configuration
- Security
- IP Renumbering part of the protocol

IPv6 address space

- 128 bits = 3.4 E 38 addresses
- Imagine Bill Gates' fortune is 85 billions $ (8.5 E 10)
  - Take 1 trillion Bill Gates'es
  - Convert their fortune to pennies
  - Assign 1 E 12 addresses to each pennies
  - Takes 8.5 E 36 addresses
  - You've just assigned 2.5% of the entire IPv6 address space

http://www.cnn.com/TECH/computing/9909/21/ip.crunch.idg/index.html

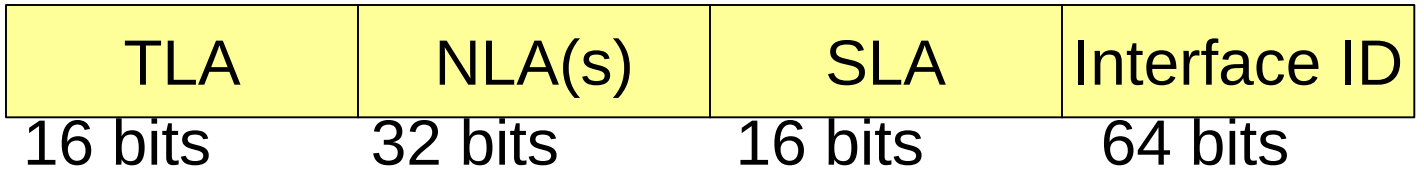
IPv6 address representation

- Format is x:x:x:x:x:x:x:x
  - x is a 16 bit hexadecimal field
  - FEDC:BA98:7654:3210:FEDC:BA98:7654:3210
- Leading zeros in a field are optional
  - :: can be used to represent multiple groups of 16 bits of zero
  - :: can only be used once in an address
  - FF01:0:0:0:0:0:0:101 = FF01::101
  - 0:0:0:0:0:0:0:1 = ::1
  - 0:0:0:0:0:0:0:0 = ::
- Preferred Format for Literal IPv6 Addresses in URL

  http://[1080::8:800:200C:417A]:80/index.html

Global unicast address

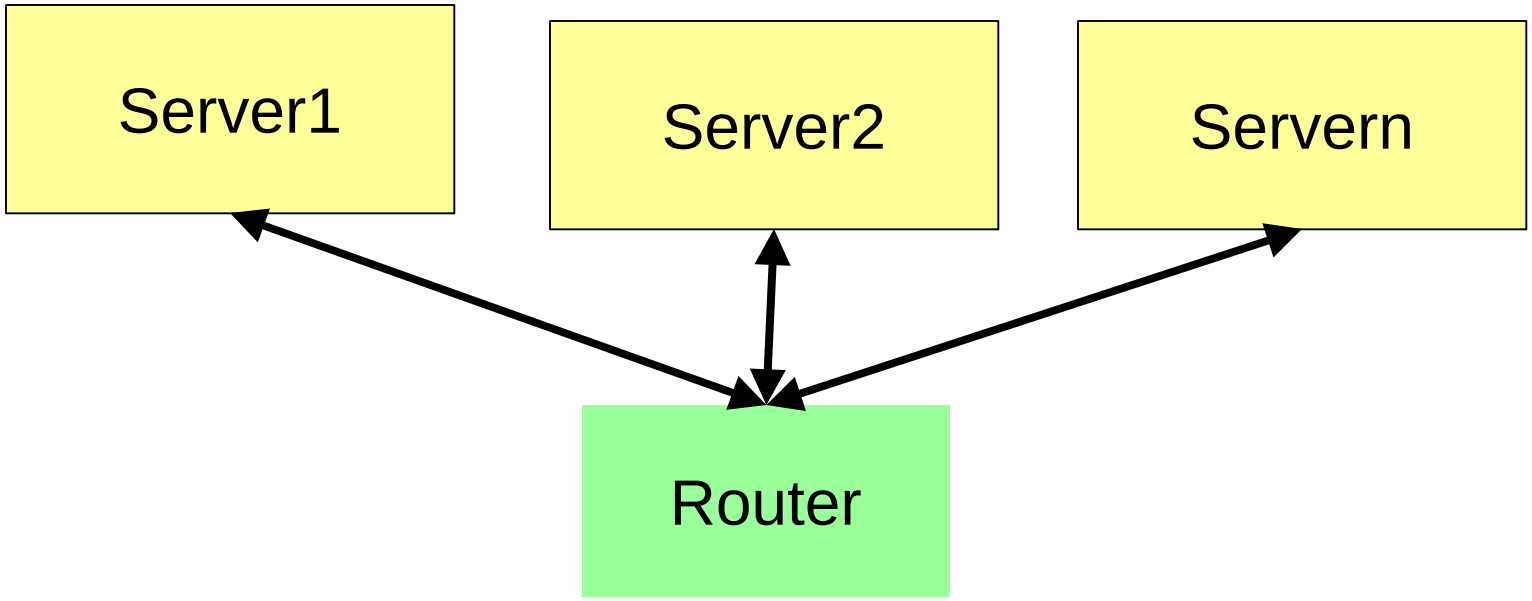
- 3FFE:0B00:0C18:0001:0290:27FF:FE17:FC0F



- TLA – top level aggregator
  - Primary providers
- NLA: Next Level Aggregator
  - Can have multiple NLA as sub-NLA
- SLA: Site Level Aggregator
  - Your site (16 bits)
- Addresses are allocated from your provider
  - If you change provider, your prefix changes
  - But renumbering (of hosts, routers and sites) has been included in the IPv6 protocol

Anycast

- Address assigned to more than one interface and/or node
- Packet sent to anycast address is routed to “closest” interface



IPsec

- Provides authentication (AH) and confidentiality (ESP) at the IP level
  - Mandatory in IPv6
  - IPv6 Next Header defines IPsec AH and ESP

Mobility

- Mobility
  - Allows a mobile node to keep the same IP address
  - Integrated in IPv6

Transition

- Dual stack host
  - Node has both IPv4 and IPv6 stacks and addresses
  - DNS resolver
    - returns IPv6, IPv4 or both to application
  - IPv6 application can use IPv4 mapped addresses to communicate with IPv4 nodes
- Tunneling
  - Encapsulate IPv6 packet within a IPv4 packet while traversing IPv4 network.
    - Configured Tunneling
    - Automatic Tunneling
      - IPv4-compatible IPv6 addresses
    - IPv4 multicast tunneling

Discussion