

# IPv6

## COMP476 – Networked Computer Systems

### Success of IP version 4

- IP has accommodated dramatic changes since original design
  - Basic principles still appropriate today
  - Many new types of hardware
  - Scale
- Scaling
  - Size - from a few tens to a few tens of millions of computers
  - Speed - from 56Kbps to 1Gbps
  - Increased frame size in hardware

### IPv6

- Internet Protocol version 6 is the latest attempt to extend the limits and capabilities of the IP.
  - The current IP version has been successful in handling heterogeneity, changes in hardware, and increases in scale.
  - Change was needed from the current version to accommodate a larger number of addresses, real time delivery of information, and multiple simultaneous delivery of packets.

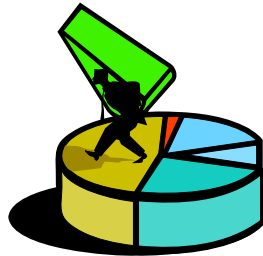
### Goals of IPv6

1. Support billions of hosts
2. Reduce the size of routing tables
3. Simplify IP to allow routers to process packets faster
4. Provide better security
5. Pay attention to service type (good for real time data)
6. Aid multicasting (scopes)
7. Allow for roaming hosts
8. Allow for room to grow
9. Permit old and new protocols to coexist

## Imminent Need for Change

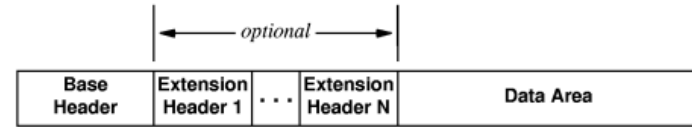
As of 1996:

- 100% of Class A addresses taken
- Nearly all Class B addresses taken
- Most Class C addresses taken



## IPv6 Datagram Format

IPv6 Datagram Format

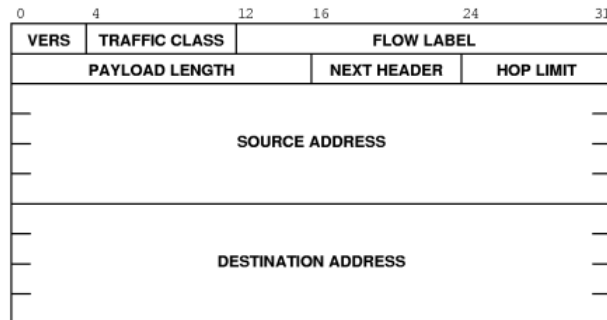


IPv4 Datagram Format

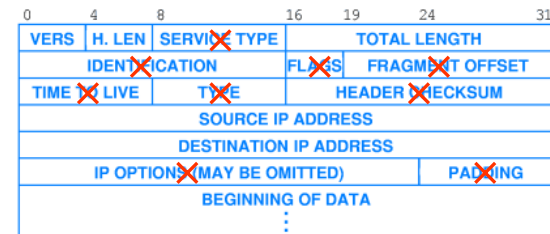


## IPv6 Header

- The IPv6 is twice as large but contains less information than an IPv4 header.



## IPv4 Header



- Items removed from IPv6 include:
  - Checksum
  - Header Length
  - Time to Live
  - Flags
  - Identification
  - Fragment Offset
  - IP options
  - Service Type
  - Padding
  - Type

## Added Features

- Address size is now 128 bits
  - written as 8 sets of 4 hex digits separated by colons
  - Sequences of zeros can be omitted by using 1234::5678
  - Ipv4 address are prefixed with 96 zero bits
  - More possible divisions into Netid and Hostid.
- Group communications support
  - Multicasting sends a packet to all members of a group.
  - Anycast sends a packet to one member of a group (closest)
- Support for mobile systems
- Support for video and audio
  - Quality of Service parameters provided

## Added Features (cont.)

- Extension Headers
  - Base header does not contain fields for every situation.
  - There can be a variable number of extra headers.
  - Extensible protocol — additional features can easily be added.
  - No checksum in the base header to allow for faster processing.
- Fragmentation
  - Fragmentable headers and data are divided into MTU sized fragments.
  - A new base header and fragmentation header is added to each fragment.
  - Source is required to fragment. Routers no longer fragment packets.

## IPv6 Special Address

- IPv6 does not include a special address for broadcasting, Instead each IPv6 address is one of three basic types:

Unicast – address corresponds to a single computer.

Multicast – address corresponds to a set of computers. The set can change at any time. IPv6 delivers one copy of a datagram to each member of the set.

Anycast – address corresponds to a set of computers sharing a common address prefix. A datagram is sent to the address along the shortest path and delivered to only one of the computers.

## Controversies over IPv6

- Hop limit issues
  - Many felt the need to increase maximums for future.
- Checksum removal
  - Removed in this version due to redundancy and to increase speed.
- Address length
  - Compromise achieved to 16 byte fixed length.
- Security
  - Restrictions on cryptography in certain countries is an issue.
- Packet size
  - Compromise achieved at 64Kb for normal but allowance for larger datagrams.

## IPv6 Adoption Rate

- Currently Networks are expected to support both IPv4 and IPv6.
- Inter IP type packets can be converted or tunneled.
- IPv6 is not catching on too fast in the US.
- The federal government has mandated IPv6 for agencies.
- Supported by Microsoft Windows XP