IP Addressing

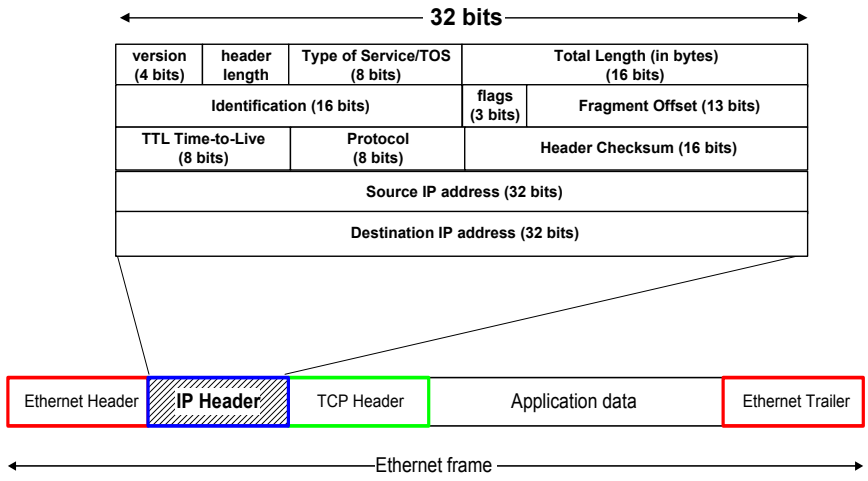
Introductory material.

An entire module devoted to IP addresses.

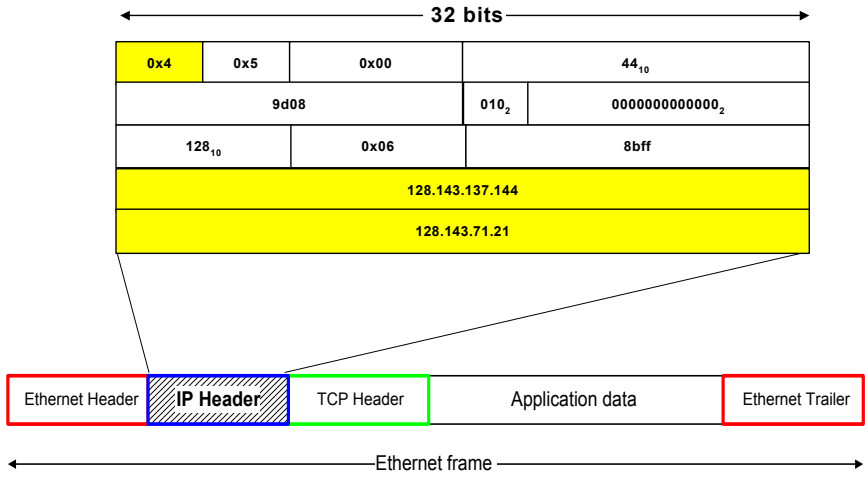
IP Addresses

- Structure of an IP address
- Classful IP addresses
- Limitations and problems with classful IP addresses
- Subnetting
- CIDR
- IP Version 6 addresses

IP Addresses



IP Addresses



What is an IP Address?

- An IP address is a unique global address for a network interface
- Exceptions:
  - Dynamically assigned IP addresses (→ DHCP, Lab 7)
  - IP addresses in private networks (→ NAT, Lab 7)

- An IP address:
  - is a **32 bit long** identifier
  - encodes a network number (**network prefix**) and a **host number**

Network prefix and host number

- The network prefix identifies a network and the host number identifies a specific host (actually, interface on the network).

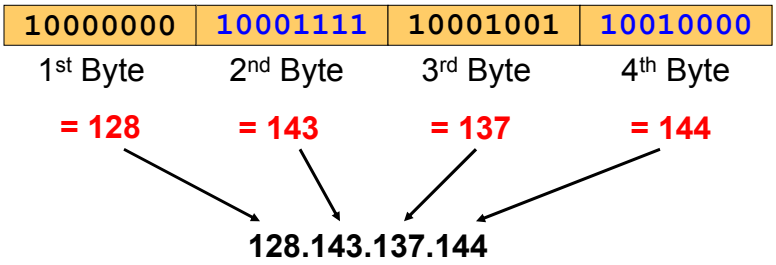
- **How do we know how long the network prefix is?**
  - **Before 1993:** The network prefix is implicitly defined (see **class-based addressing**)

  or
  - **After 1993:** The network prefix is indicated by a **netmask.**

Dotted Decimal Notation

- IP addresses are written in a so-called ***dotted decimal notation***
- Each byte is identified by a decimal number in the range [0..255]:

- **Example:**



Example

- **Example**: ellington.cs.virginia.edu

- Network address is: `128.143.0.0` `(or 128.143)`
- Host number is: `137.144`
- Netmask is: `255.255.0.0` (or `ffff0000`)

- Prefix or CIDR notation: `128.143.137.144/16`
  - » Network prefix is 16 bits long

Special IP Addresses

- **Reserved or (by convention) special addresses:**

  Loopback interfaces
  - all addresses 127.0.0.1-127.0.0.255 are reserved for loopback interfaces
  - Most systems use 127.0.0.1 as loopback address
  - loopback interface is associated with name "localhost"

  IP address of a network
  - Host number is set to all zeros, e.g., 128.143.**0.0**

  Broadcast address
  - Host number is all ones, e.g., 128.143.**255.255**
  - Broadcast goes to all hosts on the network
  - Often ignored due to security concerns

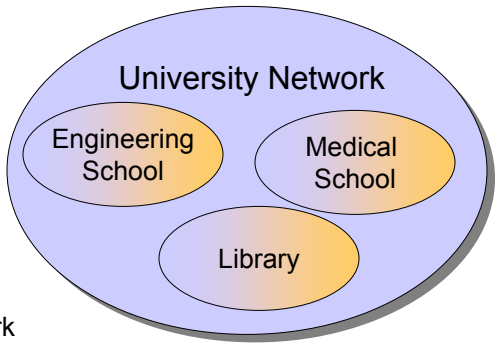
- **Test / Experimental addresses**
  Certain address ranges are reserved for "experimental use". Packets should get dropped if they contain this destination address (see RFC 1918):

10.0.0.0	-	10.255.255.255
172.16.0.0	-	172.31.255.255
192.168.0.0	-	192.168.255.255

- **Convention (but not a reserved address)**
  Default gateway has host number set to '1', e.g., e.g., 192.0.1.**1**

Subnetting

- **Problem**: Organizations have multiple networks which are independently managed
  - **Solution 1:** Allocate a separate network address for each network
    - Difficult to manage
    - From the outside of the organization, each network must be addressable.
  - **Solution 2:** Add another level of hierarchy to the IP addressing structure



→ **Subnetting**