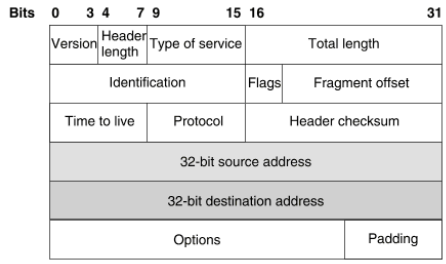
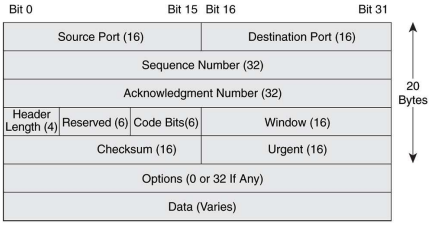
IPv4 & IPv6 & TCP

IPv4



TCP



TCP/IP ECN & other TCP options

Instead of dropping packets to signal congestion, if they go through RED don't drop but mark "Congestion Encountered" in IP. This will be echoed in TCP ECE Bit and acknowledged by sender with CWR bit. ECE sent until CWR

In **IP** 2 bits (after DSCP):

00 - not support
10, **01** - ECN capable (signal capability)
11 - Congestion Encountered (CE) - will be echoed to the sender by TCP

in **TCP** 2 bits:

ECE - Echo (Explicit Congestion Notification) - Echo
CWR - Congestion Window Reduced

ECN negotiated in TCP in SYNs. Same with **MSS** (if not 536) which does not contains headers. **Window Scaling** also and **SelectiveACK.**

IPv6 Packet:

- Ver
- Traffic Class (ToS)
- Flow Label 16b
- Payload Length
- Next Header
- Hop Limit (TTL)
- Source Address
- Dest Address
- Data

Extension Headers:

00 - HopbyHop
(notif. R of special handling)
43 - Routing Header
(source routing, record route)
44 - Fragment Header
(only hosts fragment)
60 - Dest. Options
(for now just padding
51 - Auth
50 - ESP

EUI-64

```
00 0a 27 5c 88 19
02 0a 27 ff fe 5c 88 19
```

Format

```
Global | Subnet | Eui-64
 48b   |   16b  |  64b

Link Local:
 FE80| 54 "0" | EUI-64
  10b |   54b  |   64b

Multicast:
 FF00|FLAGS|SCOPE|Group ID
   8b | 4b  |  4b | 112b
```

Scopes:

1- intf local
2- link local
4- admin local
5- site local
8 - org local
E- Global

IPv6 New Features:

- 128 bit address
- Neighbor Discovery Protoc
- Stateless Autoconfiguration
- Simplified Header
- Extension Headers
- Integrated Auth & encryption
- no broadcast (kind of mcast)
- routers do not fragment (PMTU)
- no checksum included

Addresses:
- Unicast
- Multicast
- Anycast

Transition:

- Dual Stack
- IPv6 over IPv4
- 6-to-4 (6rd)
- Teredo (ipv6 in UDP tunnel)

OSPFv3

- link-local addresses used
- authentication removed
- support for multiple instances/link
- per link vs. per subnet
- send on FF02::5 and FF02::6

ISIS

236 - IPv6 Reachability TLV
232 - IPv6 Interface Address TLV

Stateless Autoconfiguration

1. Determine EUI-64
2. Determine Link-local Address
3. DAD (duplicate address detection) - Neighbor Solicit.
4. Send Router Solicitation FF01::2
5. Routers mcast RouterAdvertisement which contains global prefix

Neighbor Discovery Protocol (NDP)

- uses ICMPv6, messages local-scope,
- **Router Advertisement (RA)**: routers advertise presence and link-specific params. (link prefixes, link MTU, and hop limits). Sent periodically, or response to RS
- **Router Solicitation (RS):** originated by hosts to request that a router send an RA.
- **Neighbor Solicitation (NS):** originated by nodes to request another node's link layer address and for Duplicate Address Detection and Neighbor Unreachability detection.
- **Neighbor Advertisement (NA):** sent in response to NS messages. If a node changes its link-layer address, it can send an unsolicited NA to advertise the new address.
- **Redirect** messages: used the same way as IPv4