Introduction to IPv6 Protocol
part 1

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Topics

- End of IPv4
- IPv6 Protocol
- IPv6 Addressing
- IPv6 Auto-configuration
- IPv6-enabled CPE
- IPv6 DNS
- Transition/Translation

End of IPv4

- 32 bits - 4.294.967.296 IP
- Classful → Classless (CIDR)
- Private Addresses + NAT
- Jan 2011 – End of IANA Pool

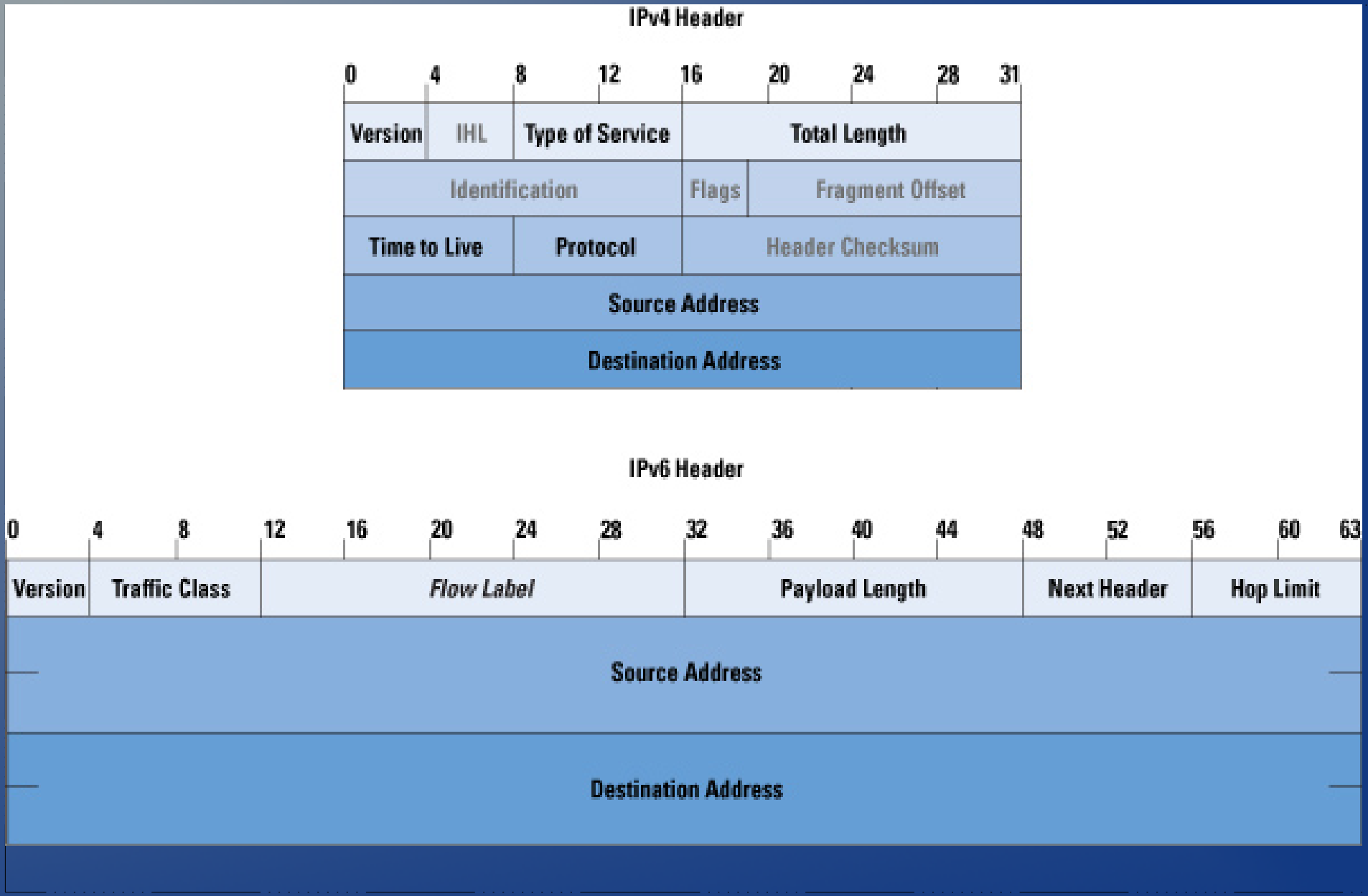
- 2011-2013 – Projected end of LIRs' pools

- ~~Carrier Grade NAT ?~~

IPv6 protocol (1/2)

- IPng→IPv6
- 128 bits – 340.282.366.920.938.463.463.374.607.431.768.211.456 IP
- Hierarchical Address Space
- Multicast (no more broadcast!)
- Network Discovery Protocol
- Multiple IPs per Interface
- Address Auto-configuration
- Simpler Header (no checksum, no fragmentation)

IPv6 protocol (1/2)

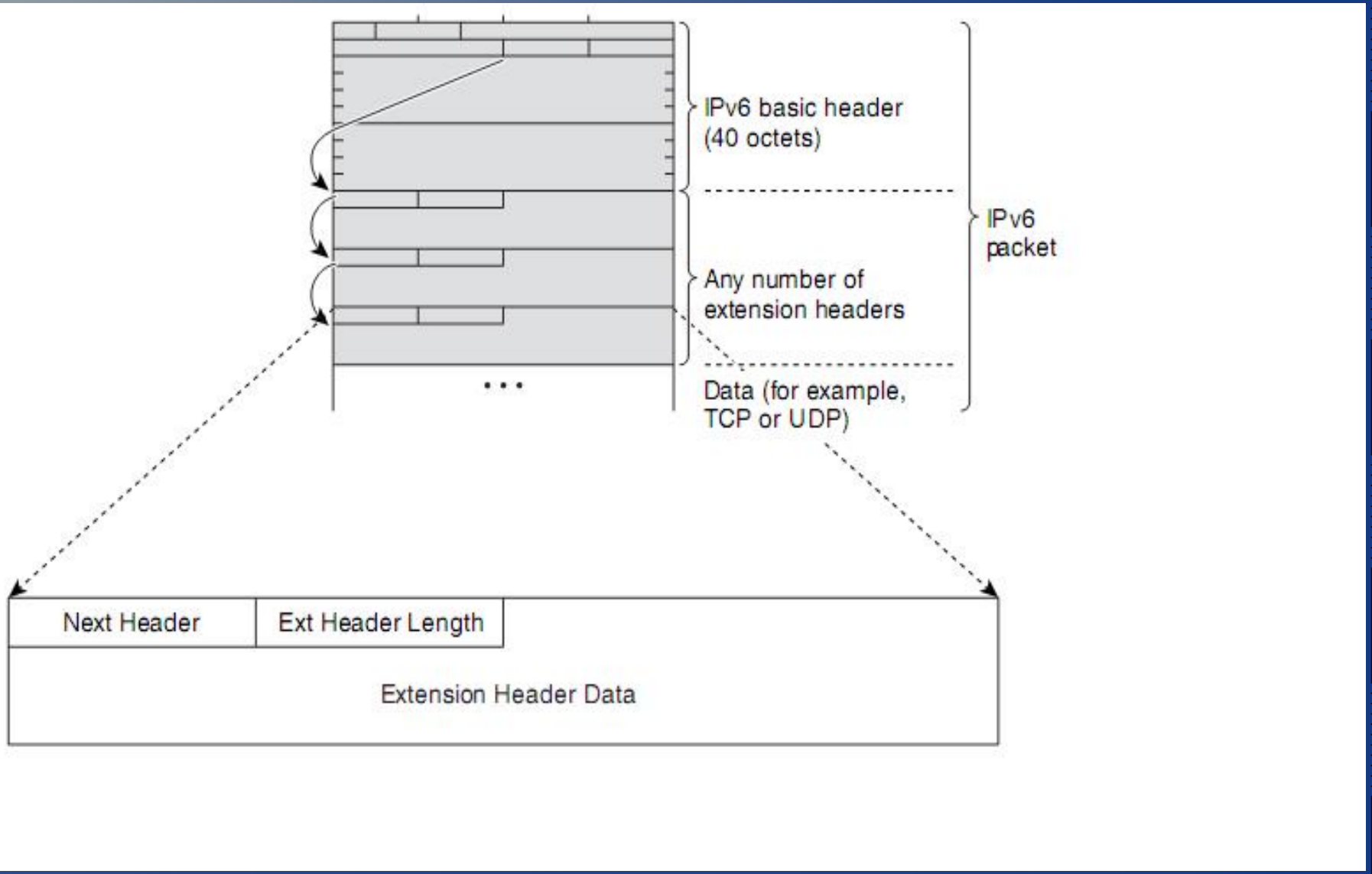


IPv6 protocol (2/2)

- Optional daisy-chained Header Extensions
- Routing→Fragmentation→Authentication→etc)
- IPsec (backported to IPv4)

- ICMPv6

IPv6 protocol (2/2)



IPv6 Addressing (1/3)

- X:X:X:X:X:X:X (8 hexadecimal groups of 16bit)
  2001:db8:55:1a3b:1200:af10:210:98
- CIDR Prefix
- 2 Rules:
  I. Leading 0 within a 16-bit value may be omitted
  II. A single occurrence of consecutive groups of 0s within an address may be replaced by a double colon
- Example: 2001:0db8:abcd:cafe:0000:0000:0000:0005
  I. 2001:db8:abcd:cafe:0:0:0:5
  II. 2001:db8:abcd:cafe::5

IPv6 Addressing (2/3)

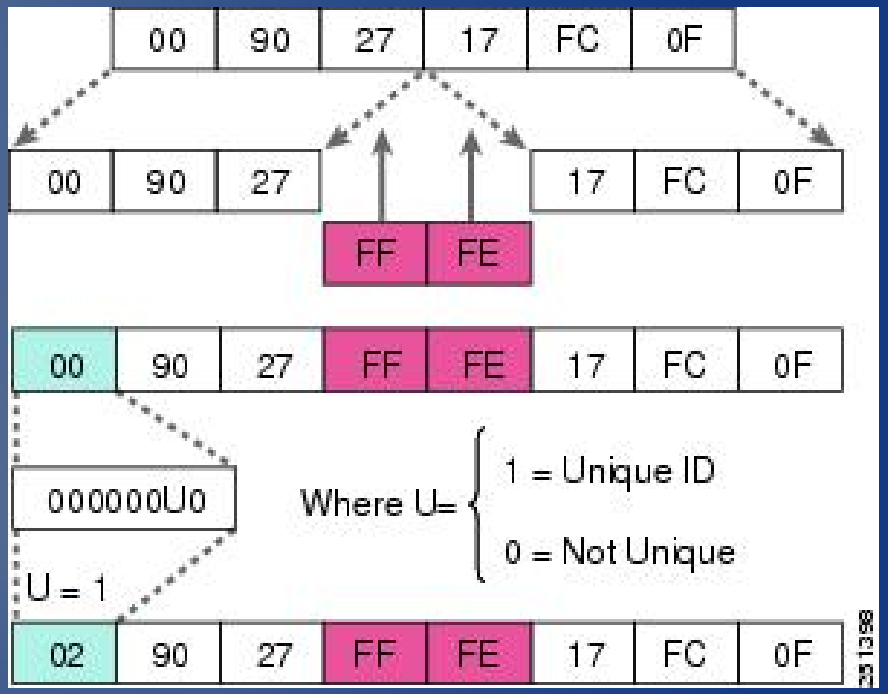
- Address Types
  - Unicast
    - Link Local (fe80::/10)
    - Unique Local (fc00::/7)
    - Global
  - Multicast (ff00::/8)
  - Anycast
  - Reserved

IPv6 Addressing (3/3)

- Unspecified address ::/128
- Localhost ::1/128
- Address = Network ID+Interface ID (64+64 bits)
- Interface ID
  - Auto-configured by MAC address
  - DHCPv6
  - Manual
  - Pseudo-random

IPv6 Auto-configuration (1/3)

- Stateless (SLAAC)
  - IPv6 Prefix(es)
  - Default Router
  - MTU
  - Lifetime
  - Other Config



- Address (128bit) = Link Prefix (64bit) + EUI-64 (64bit)
- Privacy Extensions

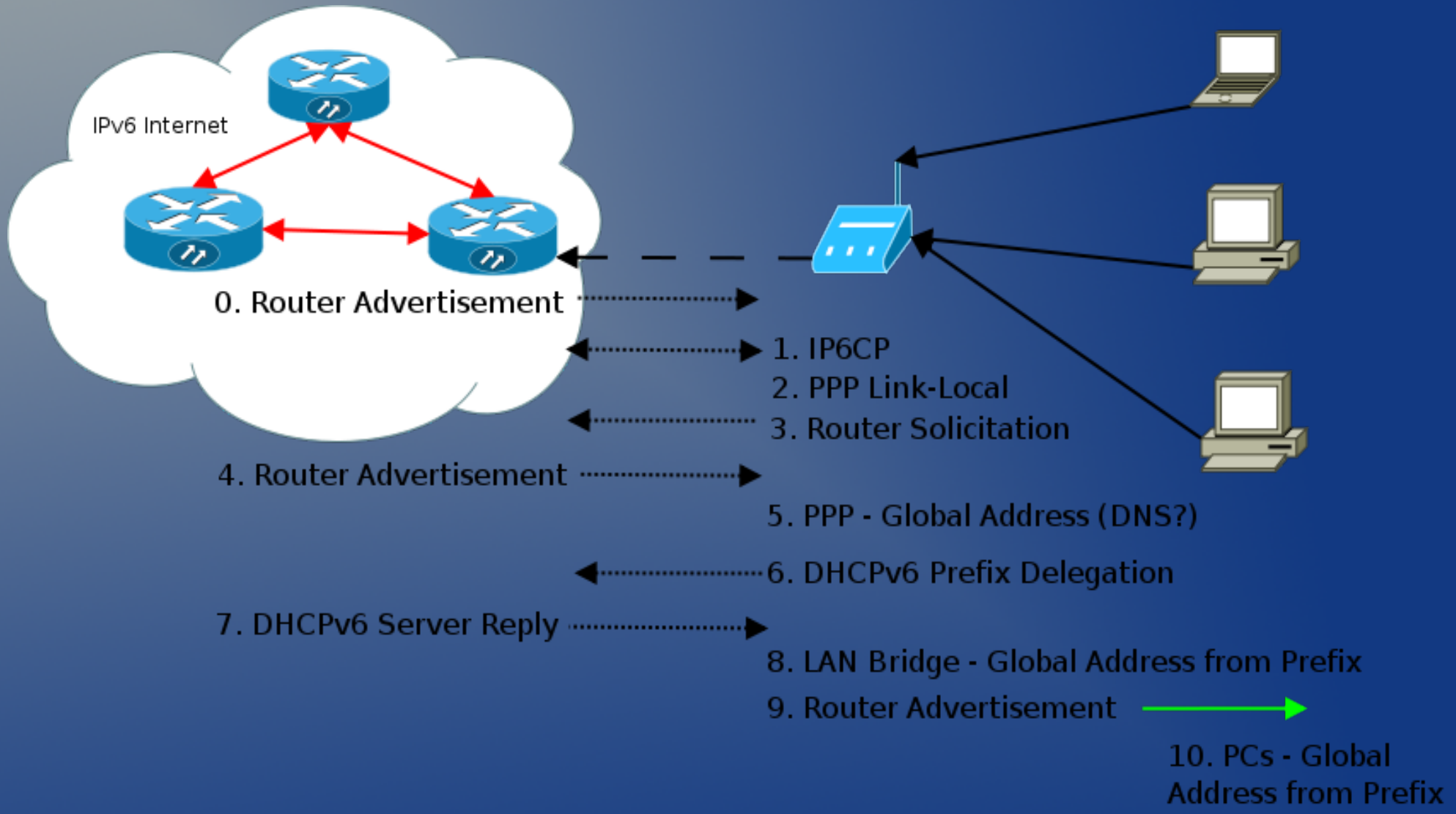
IPv6 Auto-configuration (2/3)

```
# ip address ls dev eth0

2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
pfifo_fast state UP qlen 1000

    link/ether 00:22:41:1e:a8:d5 brd ff:ff:ff:ff:ff:ff          ← MAC

    inet 192.168.1.94/24 brd 192.168.1.255 scope global eth0    ← IPv4

    inet6 2a02:580:8000:9701:222:41ff:fe1e:a8d5/64 scope global dynamic

       valid_lft 86391sec preferred_lft 3591sec                 ← GLOBAL

    inet6 fdbf:468f:aaa0:474d:222:41ff:fe1e:a8d5/64 scope global dynamic

       valid_lft 86391sec preferred_lft 3591sec                 ← ULA

    inet6 fe80::222:41ff:fe1e:a8d5/64 scope link                ← Link-Local

       valid_lft forever preferred_lft forever
```

IPv6 Auto-configuration (3/3)

- Stateful DHCPv6
  - Client/Server
  - Multicast
  - DNS (SIP,NTP,etc)
  - Prefix Delegation
- Stateless DHCPv6
  - Have IP - need parameters

IPv6-enabled CPE



IPv6 DNS

- Extremely important!
  - http://[2001:1af8:4100:a000:4::131]
  - scp kargig@\[2001:1af8:4100:a000:4::131\]:file.ext localpath/
- AAAA forward (name→address)

```
void.gr.        IN   AAAA   2001:1af8:4100:a000:4::131
```

- PTR reverse (address→name) ip6.arpa

```
1.3.1.0.0.0.0.0.0.0.0.0.0.0.4.0.0.0.0.0.0.a.0.0.1.4.8.f.a.1.1.0.0.2.ip6.arpa. IN PTR void.gr
```

Transition/Translation

It's already TOO late!!

- Accessing IPv6 from current IPv4 networks:
  - 6to4 / 6rd / 6in4 (Tunnelbroker.net / Hexago / Sixxs.net)
- Mixed IPv4 / IPv6:
  - Address-plus-port (A+P)
- Accessing IPv4 from future IPv6 networks:
  - NAT64
  - Dual-Stack Lite
  - 4rd

The End

Thanks!

Any Questions ?