# APNIC eLearning:
# IPv6 Overview

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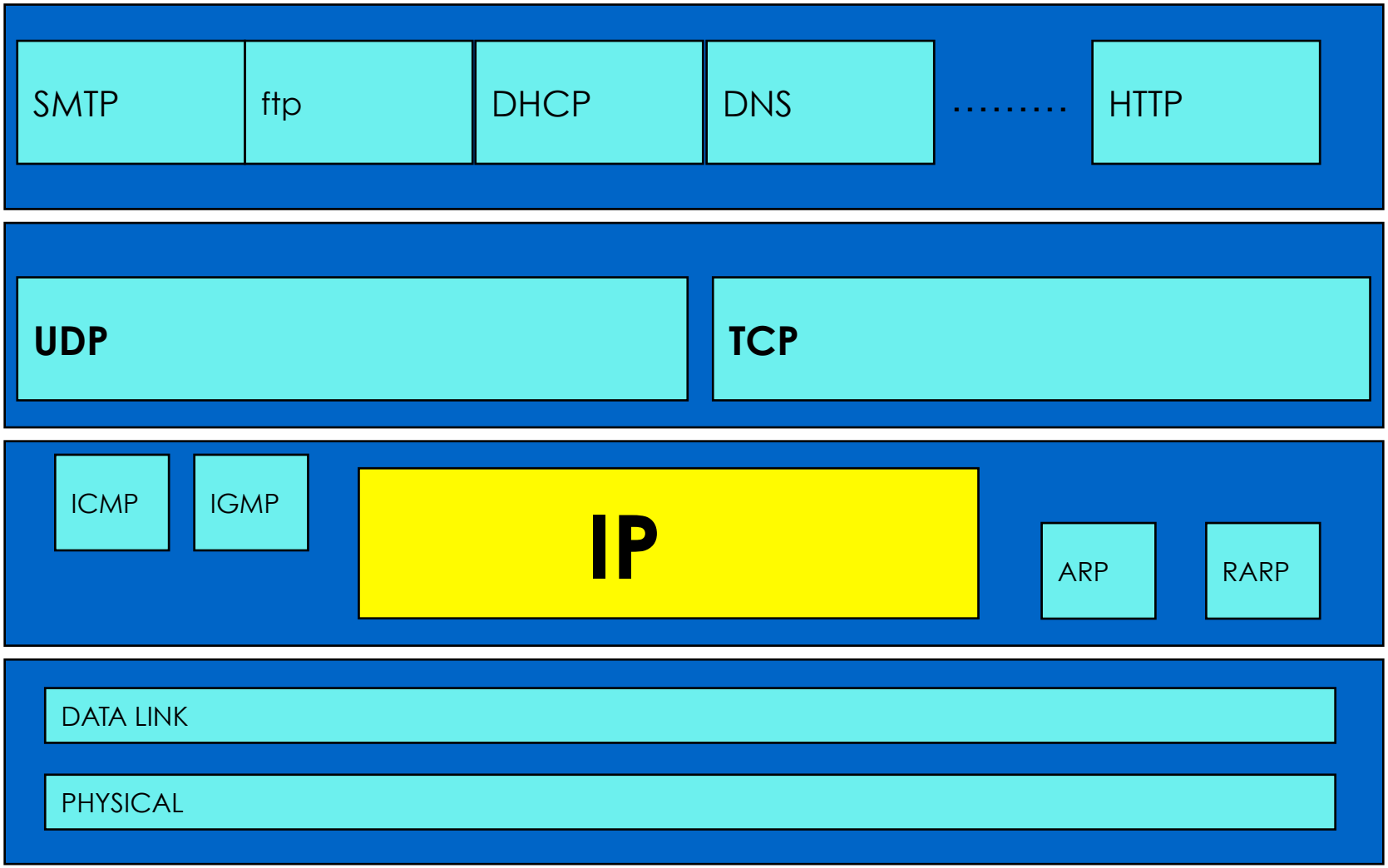
# Overview

- What is IPv6?
- Protocol Background
- New Functional Improvement
- IPv6 Addressing Models
- Protocol Header Comparison
- Interface ID
- Global Network Prefix
- IPv6 Address Distribution

# What Is IPv6?

- IP stands for Internet Protocol which is one of the main pillars that supports the Internet today
- Current version of IP protocol is IPv4
- The new version of IP protocol is IPv6
- There was an IPv5 (Internet Stream Protocol) but it was assigned for experimental use [RFC1190]
- IPv6 was also called IPng in the early days of IPv6 protocol development stage

# TCP/IP Protocol Structure



# Protocol Background

- August 1990
  - First wakeup call by Solensky in IETF on IPv4 address exhaustion
- December 1994
  - IPng area were formed within IETF to manage IPng effort [RFC1719]
  - List of technical criteria was defined to choose IPng [RFC1726]
- January 1995
  - IPng director recommendation to use 128 bit address [RFC1752]
- December 1995
  - First version of IPv6 address specification [RFC1883]
- December 1998
  - Updated version changing header format from 1st version [RFC2460]

# Why IPv6?

- IPv4 address exhaustion due to the decreasing supply of unallocated IPv4 addresses.
- IPv6 provides much larger IP address space than IPv4
  - IPv4 = 32 bits = 4,294,967,296 addressable devices
  - IPv6 = 128 bits = 3.4 x $10^{38}$ possible addressable devices
  - That's ~ 5 x $10^{28}$ addresses per person on the planet
- New functionality and improvement to IPv4

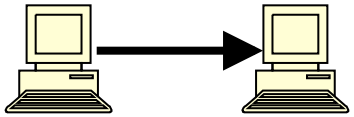
# New Functional Improvement

- Increase from 32-bit to 128-bit address space
- Stateless auto-configuration
- Fixed header size (40 bytes) and 64-bit header alignment mean better router/switch performance
- No hop-by-hop segmentation (Path MTU discovery)
- Built-in features for multicast and anycast groups
- Eliminate triangular routing and simplifies deployment of mobile IP-based systems
- Built-in support for IPSec, VPN, and QoS tagging
- No more broadcast

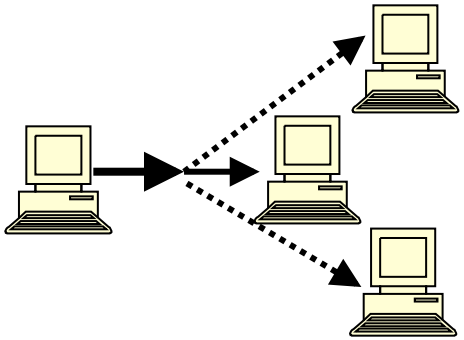
# IPv6 addressing model

RFC 4291

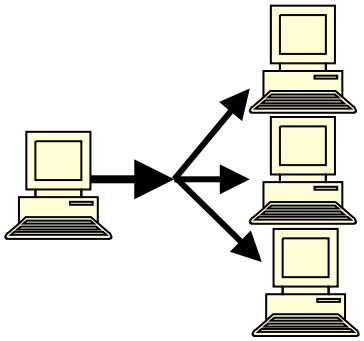
- Unicast
  - Packet is sent to a single interface



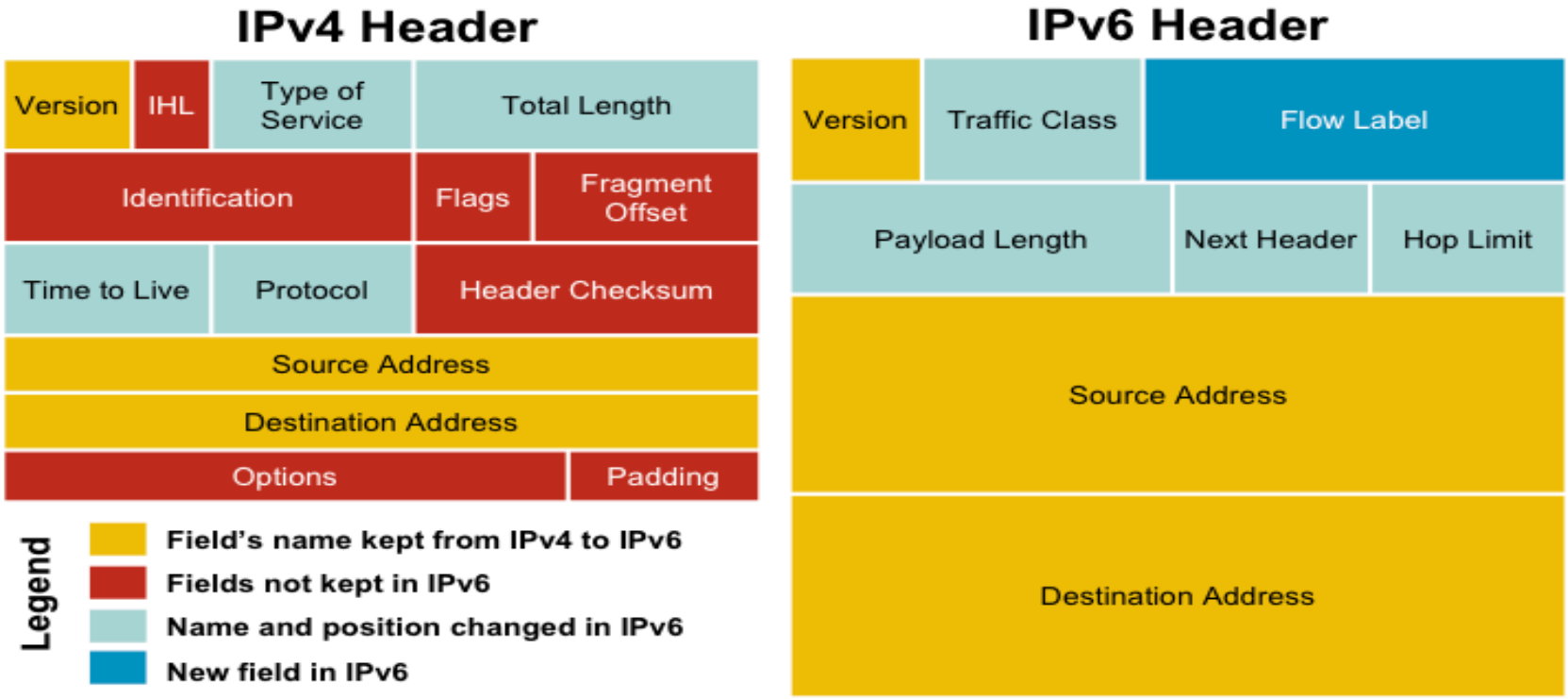
- Anycast
  - Packet is sent to the nearest of
  - group interfaces (in terms of routing distance)



- Multicast
  - Packet is sent to multiple interfaces



# Protocol Header Comparison



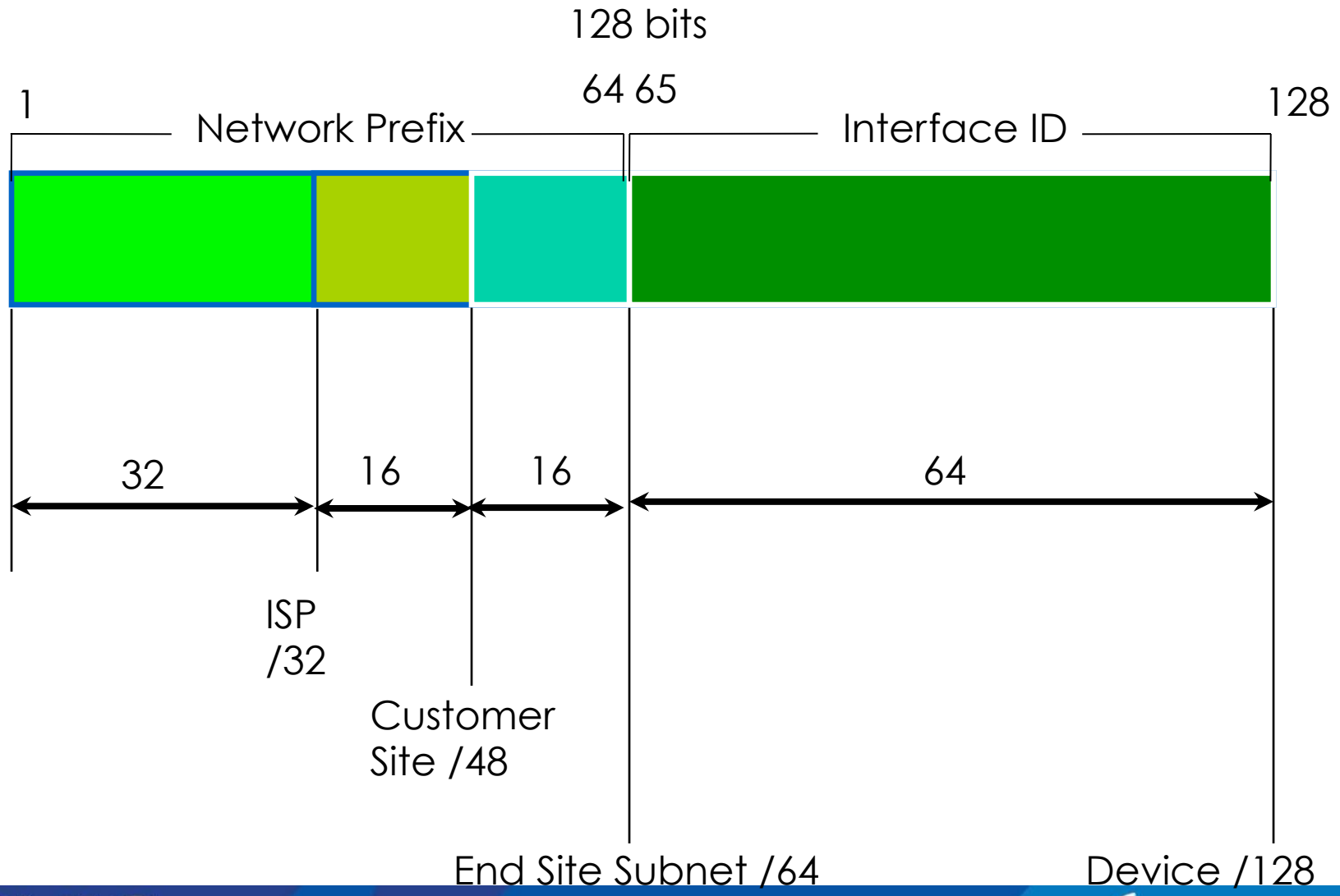

- IPv4 contains 10 basic header fields
- IPv6 contains 6 basic header fields
- IPv6 header has 40 octets in contrast to the 20 octets in IPv4
- So a smaller number of header fields and the header is 64-bit aligned to enable fast processing by current processors

Diagram Source: www.cisco.com

# IPv6 addressing

- 128 bits of address space
- Hexadecimal values of eight 16 bit fields
  - X:X:X:X:X:X:X:X  (X=16 bit number, ex: A2FE)
  - 16 bit number is converted to a 4 digit hexadecimal number
- Example:
  - FE80:DCE3:124C:C1A2:BA03:6735:EF1C:683D
- Abbreviated form of address
  - 2001:0DB8:0000:0000:0000:036E:1250:2B00
  - →2001:DB8:0:0:0:36E:1250:2B00
  - →2001:DB8::36E:1250:2B00  ( :: can only be used once)

# IPv6 Addressing Structure



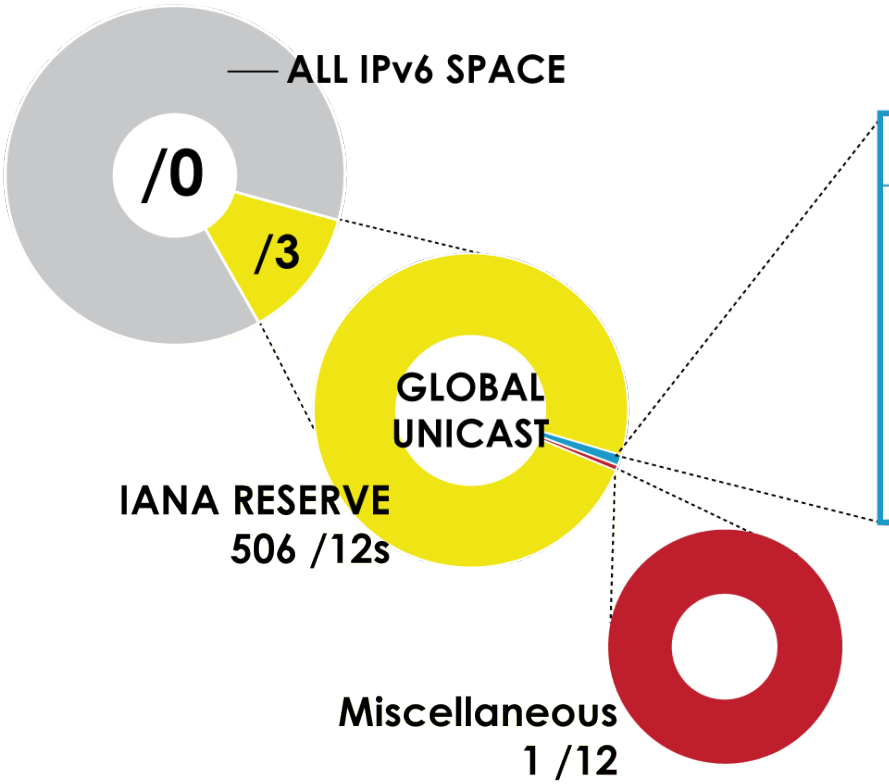
# Interface ID

- The lower-order 64-bit field addresses
- May be assigned in several different ways:
  - auto-configured from a 48-bit  MAC address expanded into a 64-bit EUI-64
  - assigned via DHCPv6
  - manually configured
  - auto-generated pseudo-random number
  - possibly other methods in the future

# Global Network Prefix

- IPV6 Global Unicast Address
  - Global Unicast Range: 001x 2000::/3
    - 1/8 of whole IPv6 address space
    - Last address 3fff:ffff:ffff:ffff:ffff:ffff:ffff:ffff
  - All five RIRs are given a /12 from the /3 to further distribute within the RIR region
    - APNIC 2400:0000::/12
    - ARIN 2600:0000::/12
    - AfriNIC 2C00:0000::/12
    - LACNIC 2800:0000::/12
    - Ripe NCC 2A00:0000::/12

# IPv6 Address Space

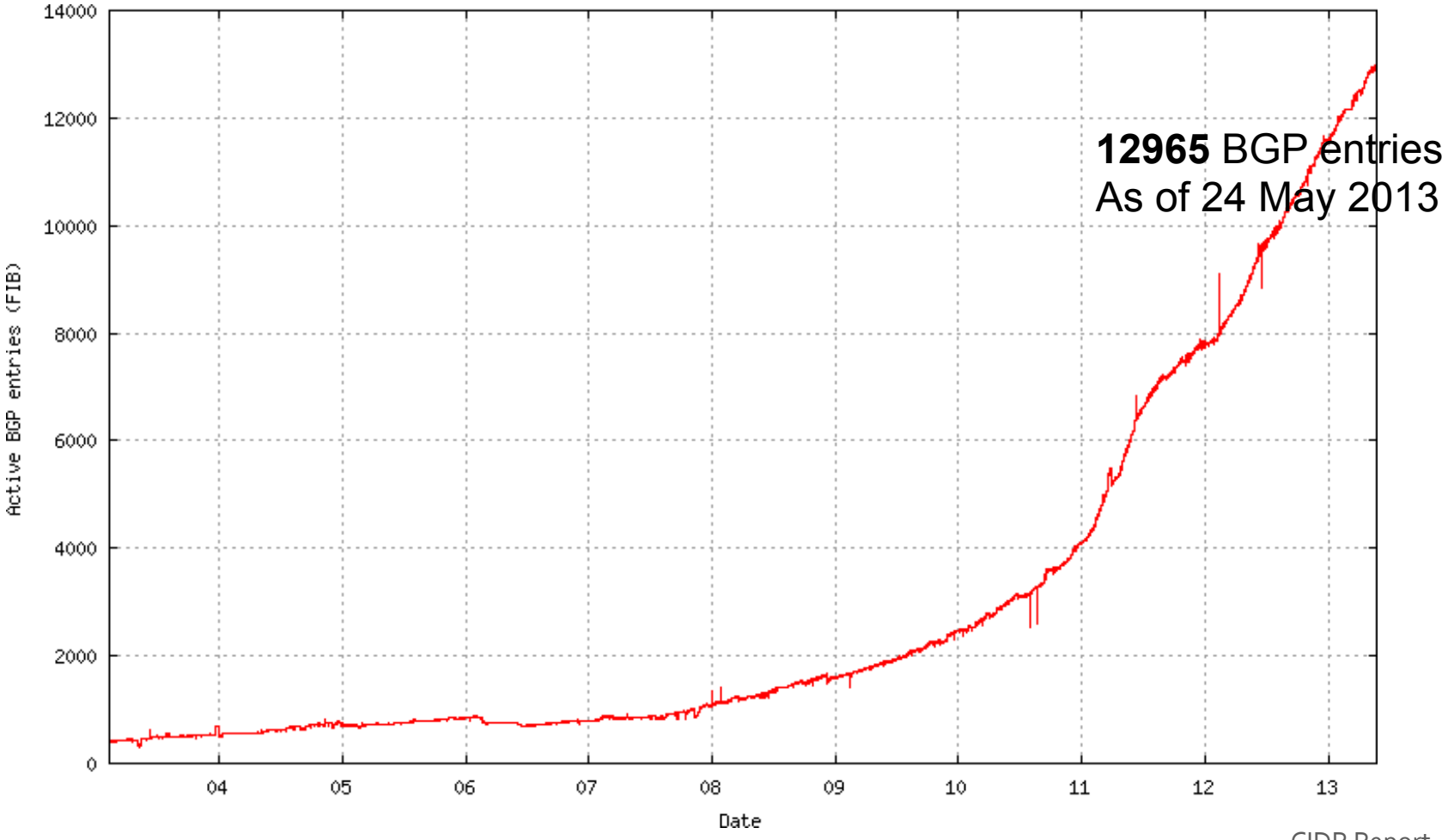



RIRs 5 /12s (October 2006)

| RIR | IPv6 ADDRESS |
|---|---|
| AfriNIC | 2C00:0000::/12 |
| APNIC | 2400:0000::/12 |
| ARIN | 2600:0000::/12 |
| LACNIC | 2800:0000::/12 |
| RIPE NCC | 2A00:0000::/12 |

# IPv6 Address Distribution

# IPv6 BGP Routing Table

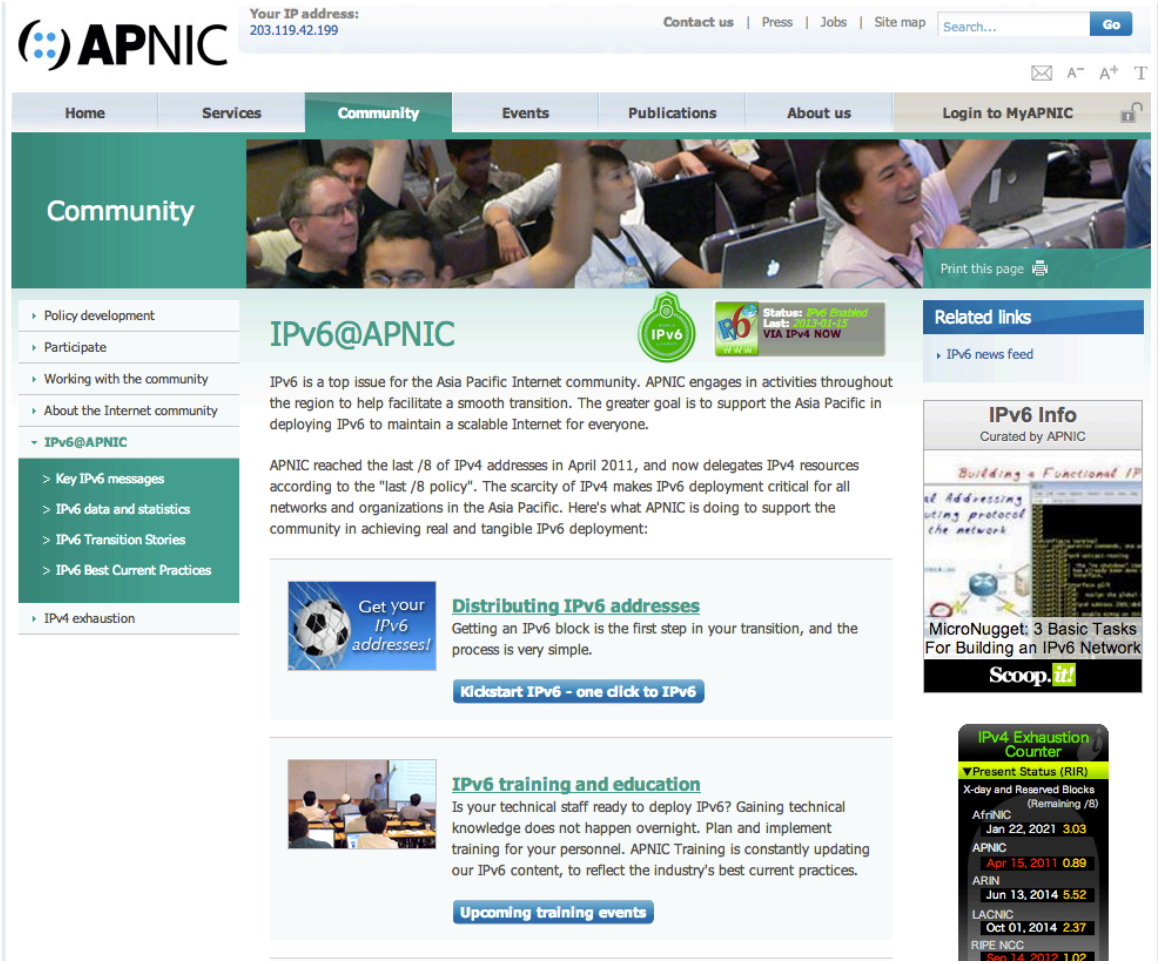



CIDR Report

# Questions

- Please remember to fill out the feedback form
  - <survey-link>
- Slide handouts will be available after completing the survey

# IPv6@APNIC


APNIC
Your IP address:
203.119.42.199
Contact us | Press | Jobs | Site map
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Working with the community
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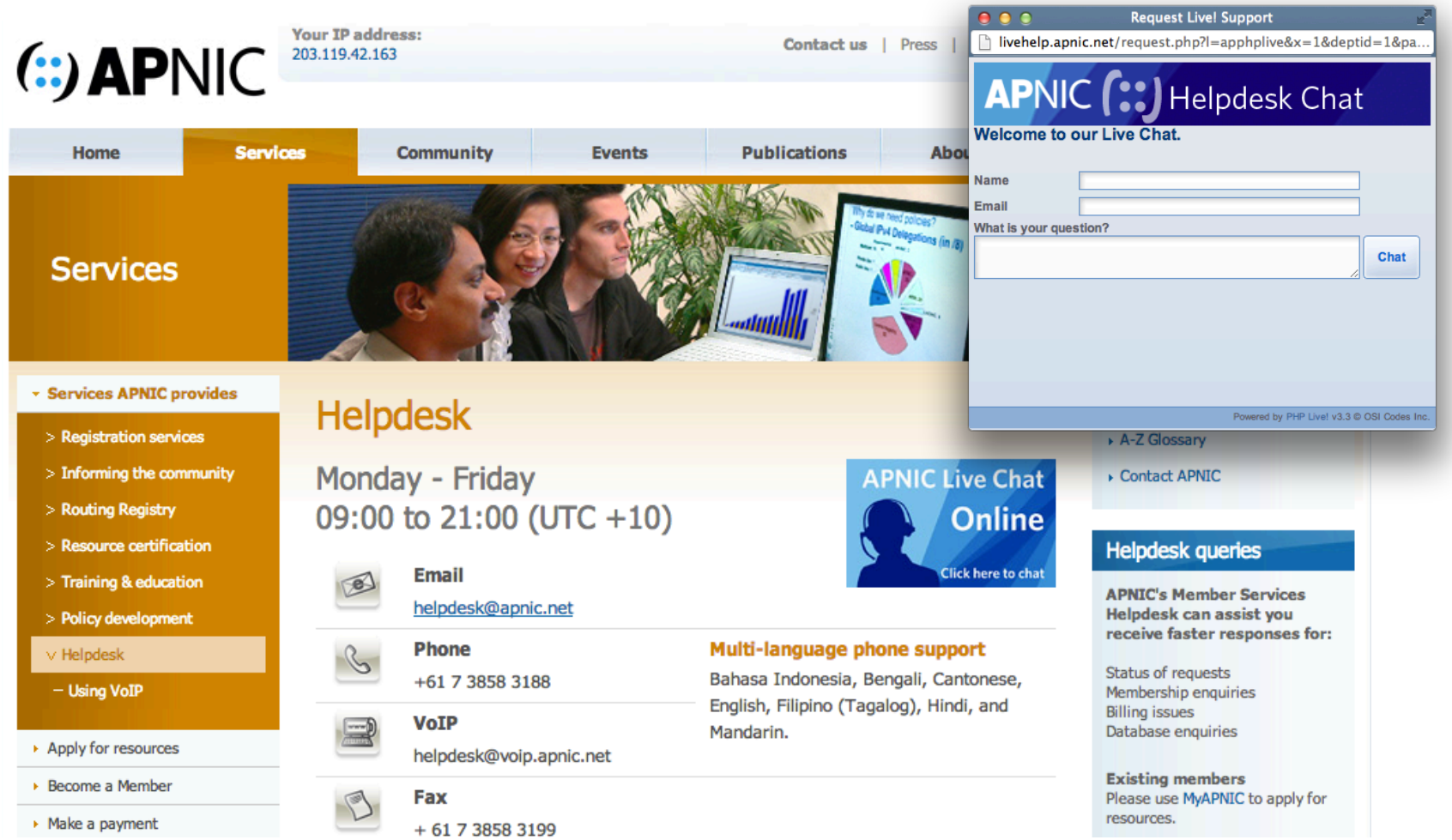
IPv6@APNIC
Key IPv6 messages
IPv6 data and statistics
IPv6 Transition Stories
IPv6 Best Current Practices
IPv4 exhaustion
IPv6@APNIC
IPv6 is a top issue for the Asia Pacific Internet community. APNIC engages in activities throughout the region to help facilitate a smooth transition. The greater goal is to support the Asia Pacific in deploying IPv6 to maintain a scalable Internet for everyone.
APNIC reached the last /8 of IPv4 addresses in April 2011, and now delegates IPv4 resources according to the "last /8 policy". The scarcity of IPv4 makes IPv6 deployment critical for all networks and organizations in the Asia Pacific. Here's what APNIC is doing to support the community in achieving real and tangible IPv6 deployment:
Get your IPv6 addresses!
Distributing IPv6 addresses
Getting an IPv6 block is the first step in your transition, and the process is very simple.
Kickstart IPv6 - one click to IPv6
IPv6 training and education
Is your technical staff ready to deploy IPv6? Gaining technical knowledge does not happen overnight. Plan and implement training for your personnel. APNIC Training is constantly updating our IPv6 content, to reflect the industry's best current practices.
Upcoming training events
Related links
IPv6 news feed
IPv6 Info
Curated by APNIC
MicroNugget: 3 Basic Tasks For Building an IPv6 Network
Scoop.it
IPv4 Exhaustion Counter
Present Status (RIR)
X-day and Reserved Blocks
(Remaining /8)
AfriNIC
Jan 22, 2021 3.03
APNIC
Apr 15, 2011 0.89
ARIN
Jun 13, 2014 5.52
LACNIC
Oct 01, 2014 2.37
RIPE NCC

# APNIC Helpdesk Chat



# Thank you!

End of Session

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