IPv6

Dispelling the Magic

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Why the Title?

"96 more bits. No Magic"

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Agenda

- RIPE NCC
- Background to IPv6
- History of IPv6
- Why Deploy Ipv6?
- Where are we
- Conclusions

RIPE NCC

- Allocate internet resources in Europe and Middle East
- Membership association
- Amsterdam
- 106 FTE
- Also
  - Training
  - Government Cooperation
  - Outreach

RIPE NCC (2)

- Membership
- Elected Board
  - 3 year terms
- Policy made by RIPE community
  - Policy Development Process
  - Consensus based

RIPE NCC (3)

- Members can request
  - Ipv4 addresses
  - Ipv6 addresses
  - AS numbers
- Subject to “assessment of need”
- Rules and procedures for allocation derive from policy set by the community

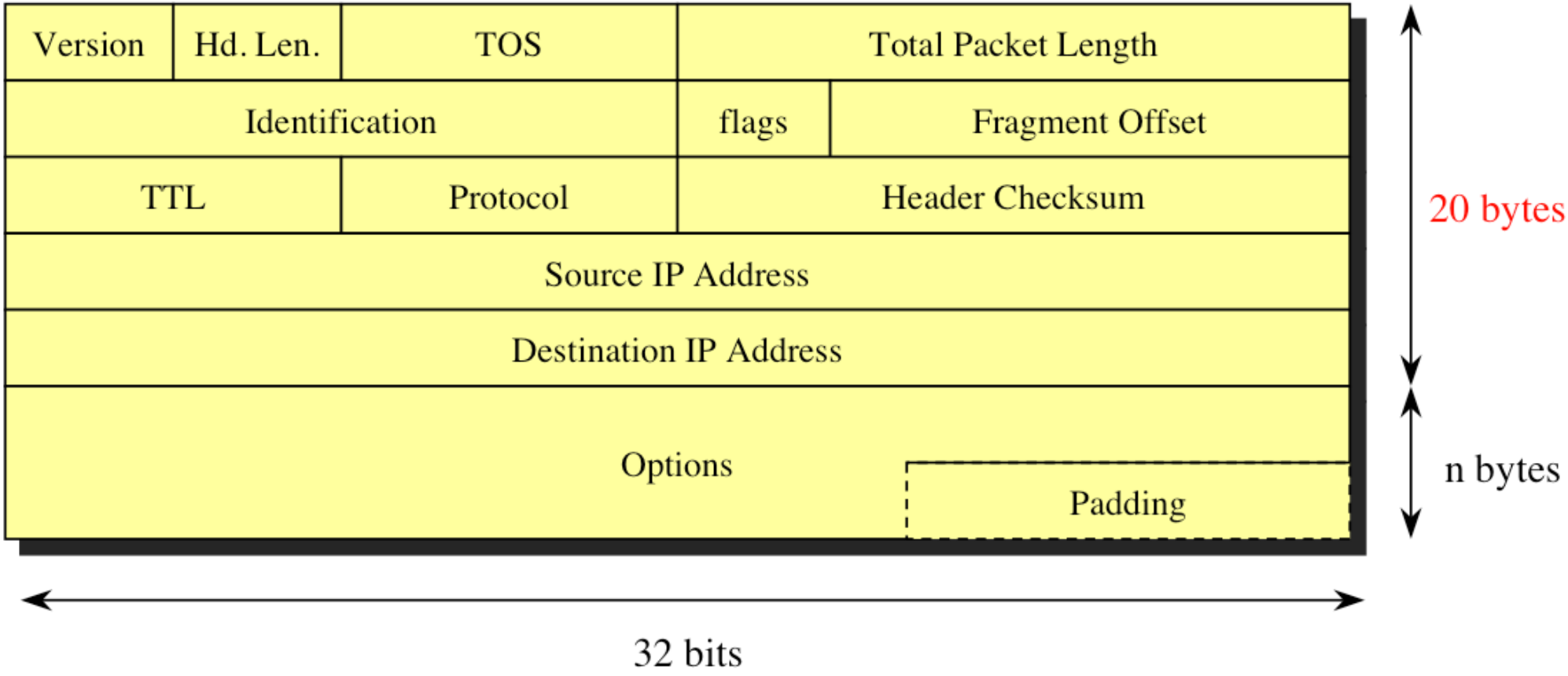
Background to IPv6

- Current internet protocol is Ipv4
- Four principles set down by Cerf and Kahn in 1974
  - independence from underlying network technology and from the architecture of the host
  - universal connectivity throughout the network
  - end-to-end acknowledgements
  - standardized application protocols
- Standardised in 1981
  - 16 bit address space
  - “More space than anyone could ever need”

Ipv4 continued

- Ipv4 wildly successful
- Mainly due to the four principles
- Gradually being undermined
  - Address space depletion
  - NAT
  - Loss of end-to-end principle (throttling, Phorm etc)
- IPv6 may be the answer

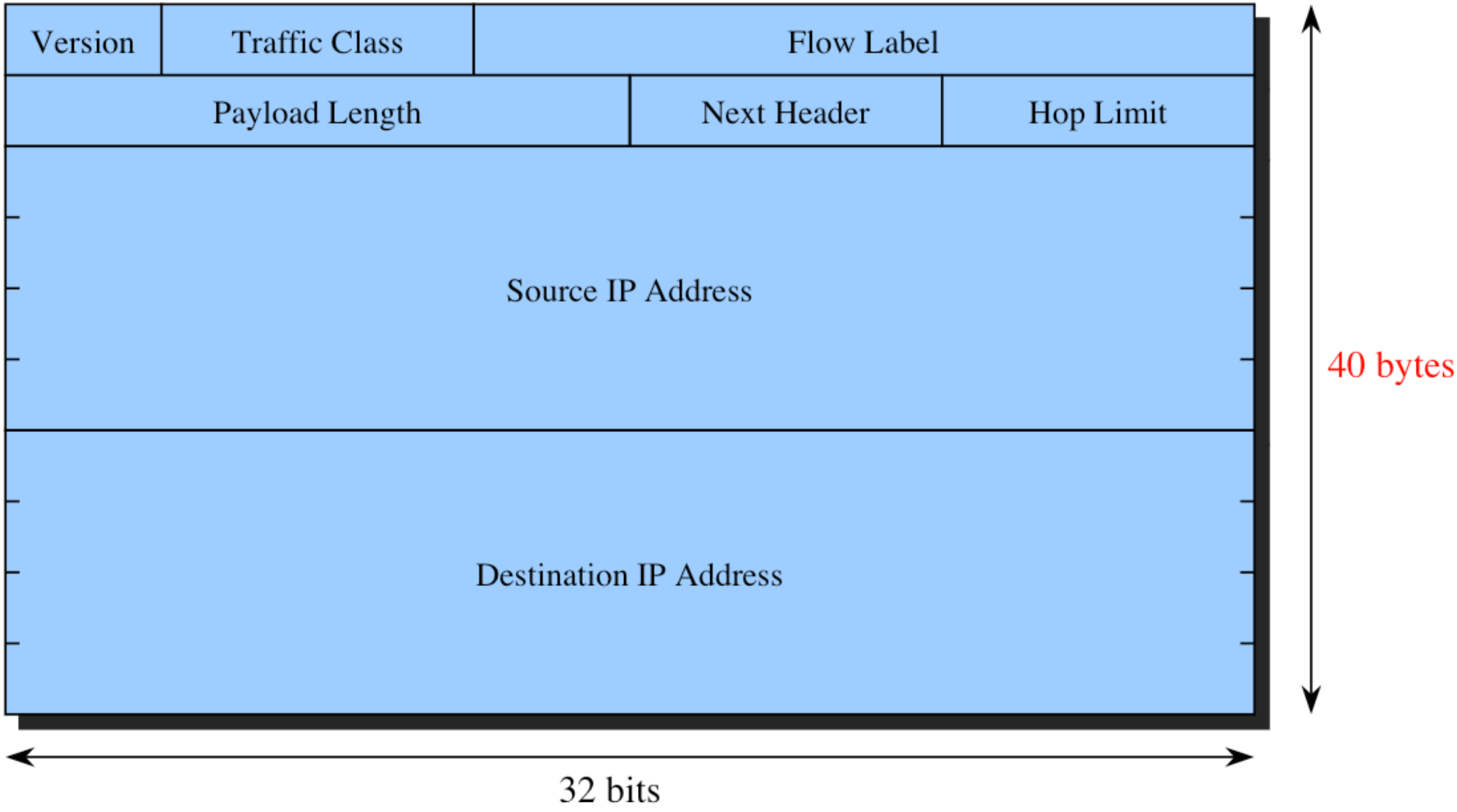
Ipv4 headers



Things missing in IPv4

- Security
- Autoconfiguration
- Traffic engineering (QoS)
- Multicast

Ipv6 headers



Ipv6 header fields

- Version: IP version 6
- Traffic Class: used in congestion control
- Flow Label: QoS management
- Payload length: payload length in bytes
- Next header: specifies the next encapsulated protocol
- Hop Limit: replaces the ttl field of IPv4
- Source and Destination addresses: 128 bits each

Header Format Simplification

- Fixed length of header
  - Length field eliminated by no options
- No fragmentation on router
  - Fragmentation field and option field moved to extension header
  - Hosts should use the path MTU discovery
- No header checksum
  - Reduce cost of header processing, no checksum updates at each router

Improvement of routing speed

However

The only real immediate benefit in the **Header** is the increased address length

IPv6/IPv4 addresses

- Ipv4 address written as four decimal octets
  - Example: 192.168.1.65
- Netmask indicated using a “/”
  - Example: 192.168.1.65/24

IPv6/IPv4 addresses

- Ipv6 address written as eight hexadecimal groups
  - Example: fe80::20c:29ff:fec2:52ff
- Netmask indicated using a “/”
  - Example: fe80::20c:29ff:fec2:52ff/48

Auto configuration

- Useful extension to IPv6
- DHCP has performed this function in Ipv4
- Not suitable in the “Internet of Things”
- Ipv6 has auto configuration defined as part of the implementation

Auto configuration example

- Addresses are link/local scope and global scope
  - Typically an interface will have one of each
  - Global is unique on the internet
  - Link/local is only unique on the local link
- Process
  - Build local (supposedly unique) identifier
  - Build tentative address
  - Test if unique locally
  - If unique then use

Ethernet Example

- Take MAC address
  - 00-0C-29-C2-52-FF
- Pad MAC address
  - 00-0C-29-FF-FE-C2-52-FF
- Invert universal/local bit
  - 02-0C-29-FF-FE-C2-52-FF
- Prepend well known prefix (fe80::/64)
  - fe80::20c:29ff:fec2:52ff
- Test for uniqueness

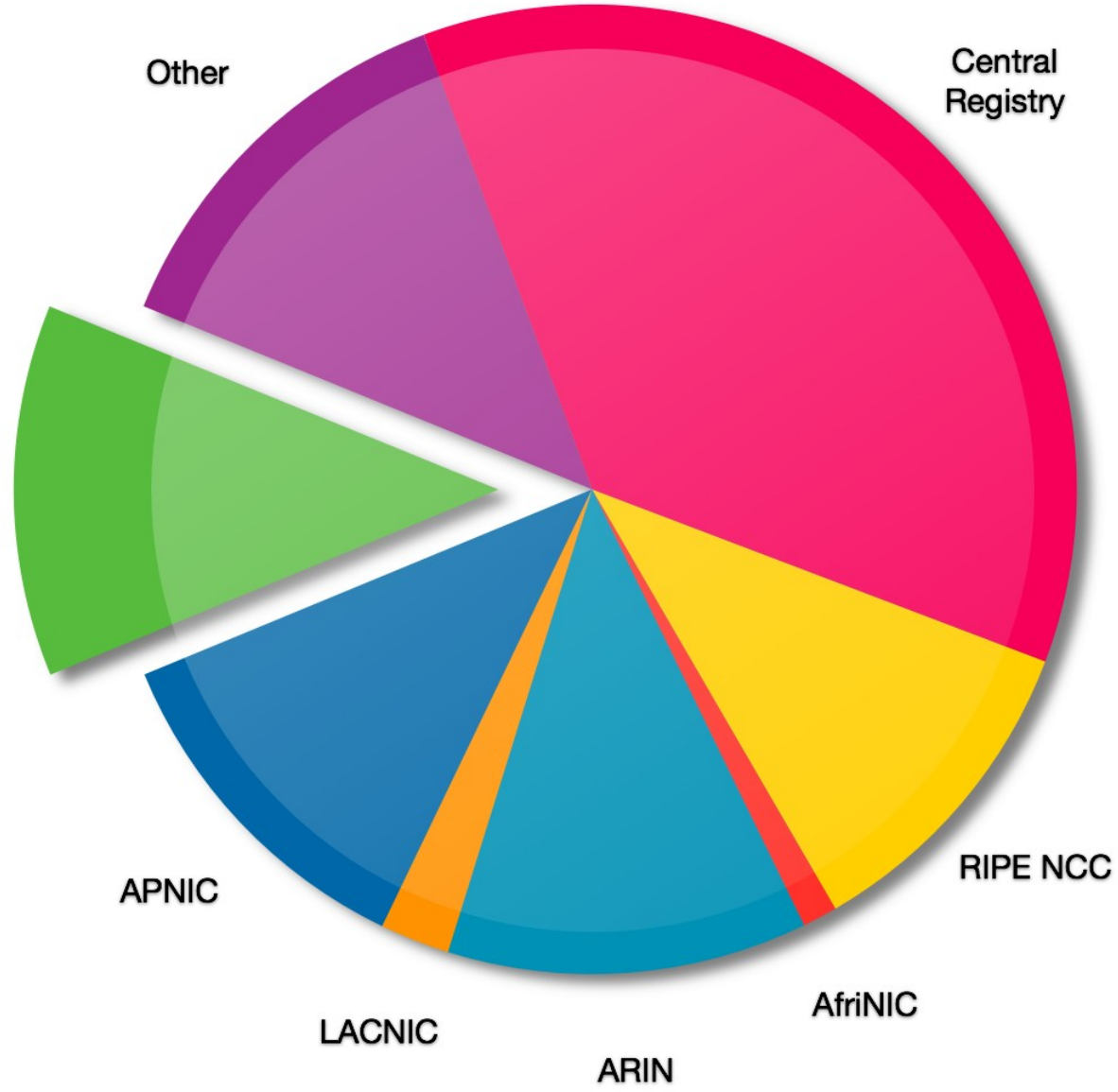
Other Improvements

- Security (IPSEC) but this has been back ported to IPv4
- Traffic Engineering (but will this actually be used)
- Multicast

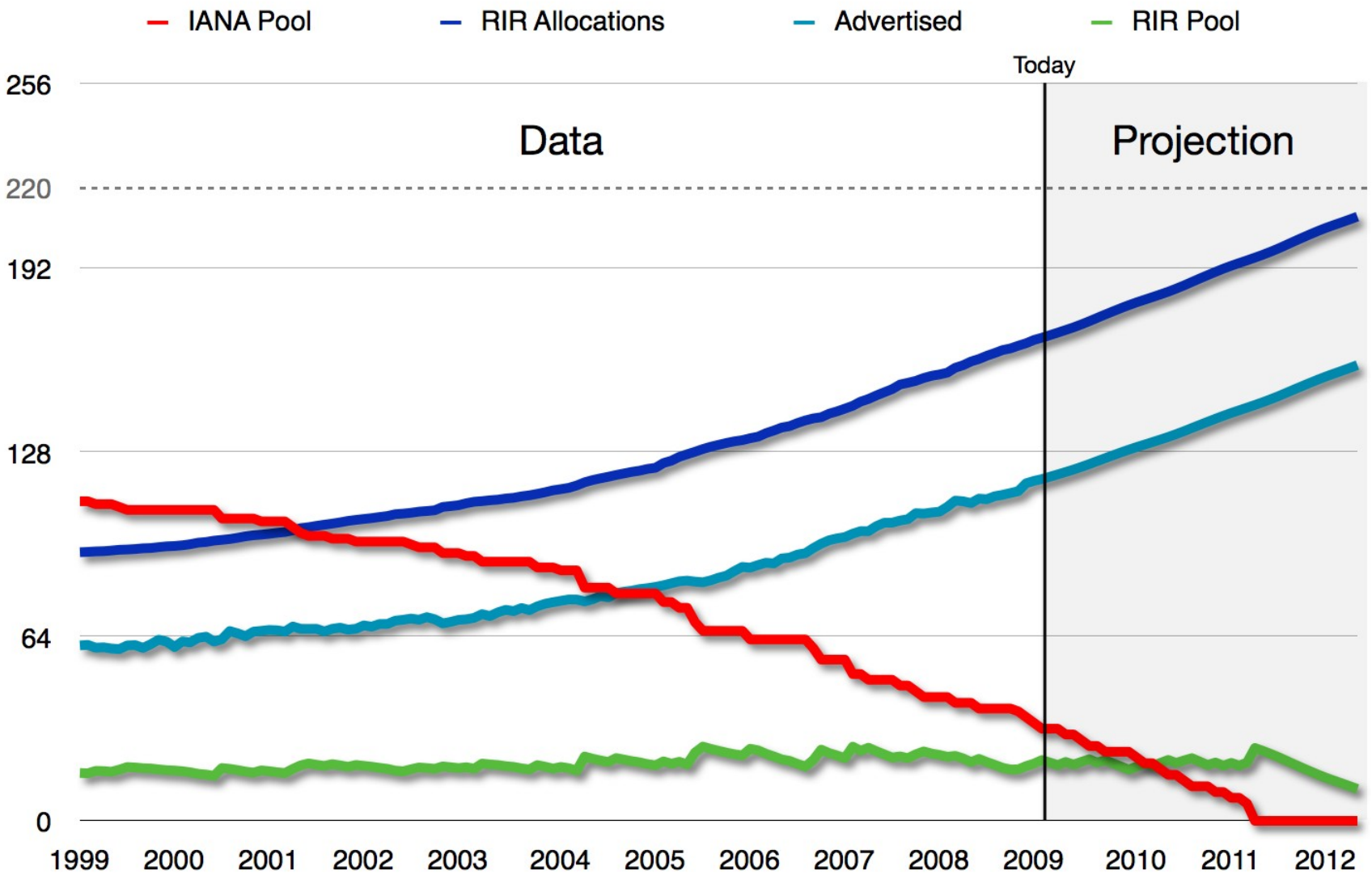
IP address pool now

12%

available



IP address pool - projection



IPv4 remaining free pool Policies (1/2)

- Global Policy for the Allocation of the Remaining IPv4 Address Space (2008-03)
  - Accepted by all regions and documented
  - Distribute the last 5 /8s evenly among RIRs (N=1)

- Use of last /8 (2008-06)
  - New LIRs and Existing LIRs
    - Must qualify for an allocation
    - Will receive only one block in min size regardless of their real needs
  - A /16 will be reserved for unforeseen circumstances
  - Addition of IPv6 deployment requirement suggested

IPv4 remaining free pool Policies (2/2)

- Ensuring efficient use of historical IPv4 resources (2008-07)
  - Currently legacy allocations are exempt from 80% usage policy
  - Proposal requires documentation of usage of legacy space

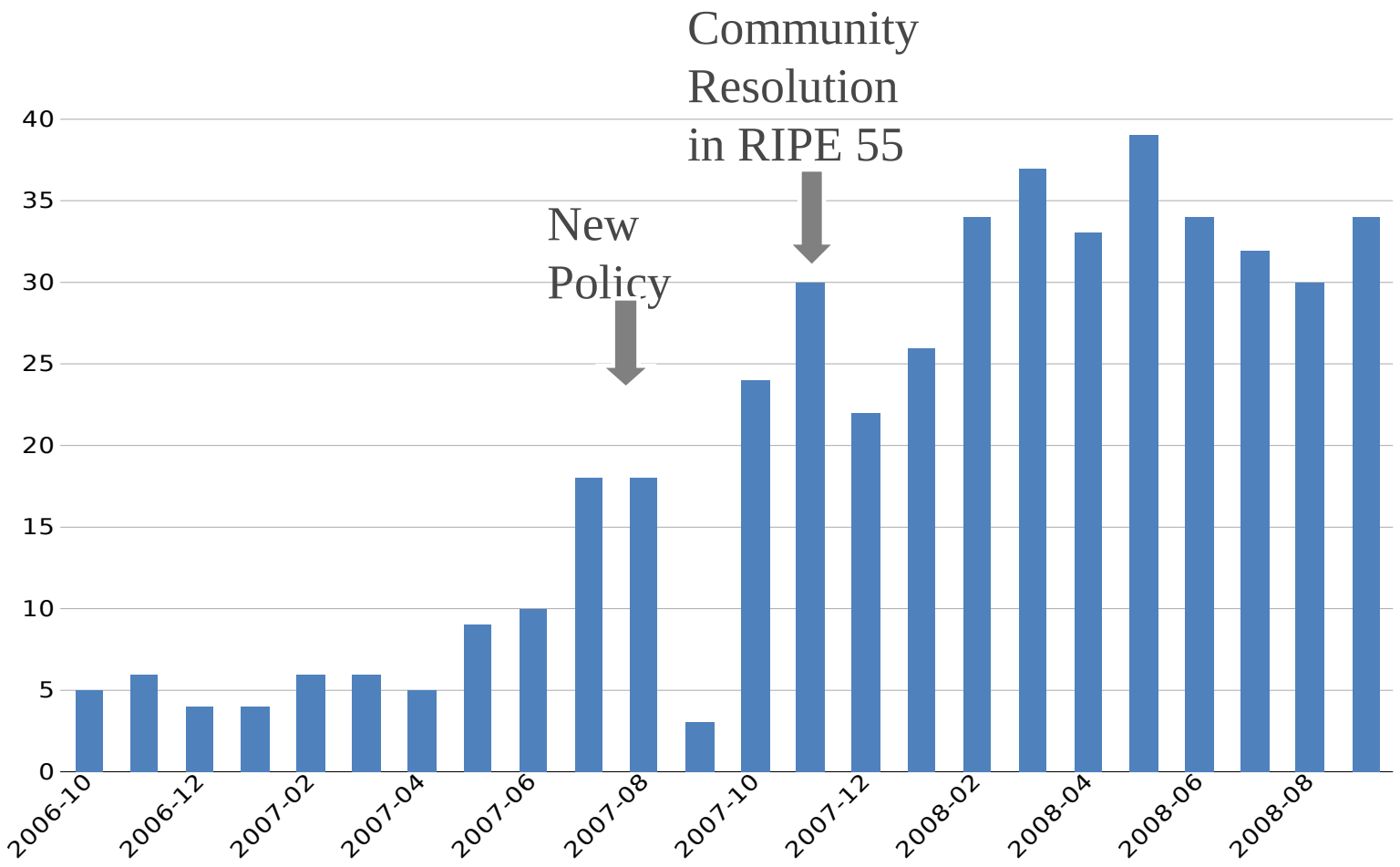
- Enabling Methods for Reallocation of IPv4 Resources (2007-08)
  - IPv4 depletion
  - Applies only to IPv4 PA allocations

Main IPv6 Proposals

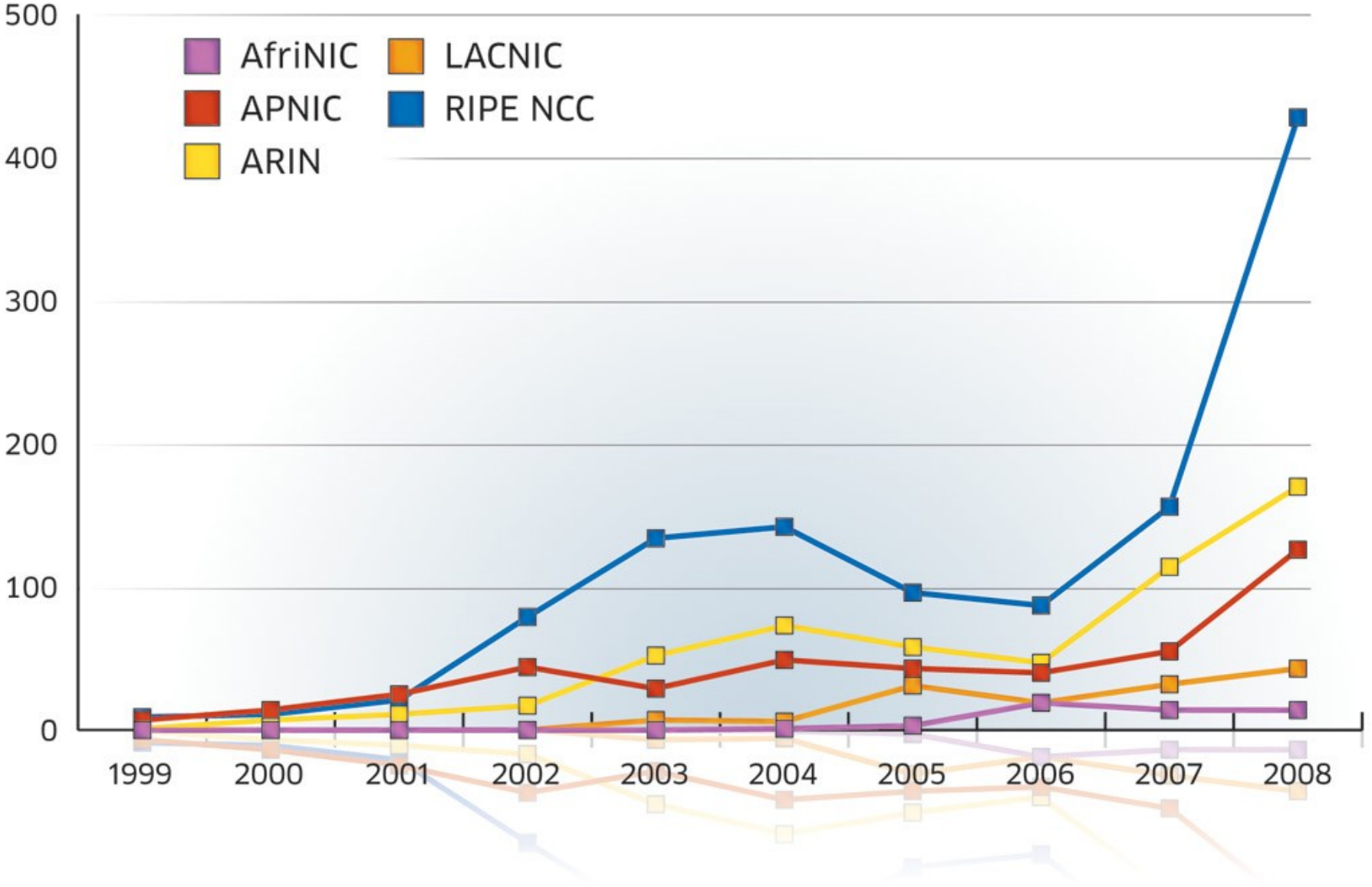
- Proposal 2006-02
  - IPv6 Allocation criteria altered
    - No more requirement for assignments to *others*
    - No more requirement for 200 customers
  - New End Site definition
    - LIRs internal assignments count as End Site
  - LIRs: Plan to make sub-allocations to others or assignments to End Sites

- Proposal 2006-01: IPv6 for End Users

IPv6 Allocations - Last 24 months



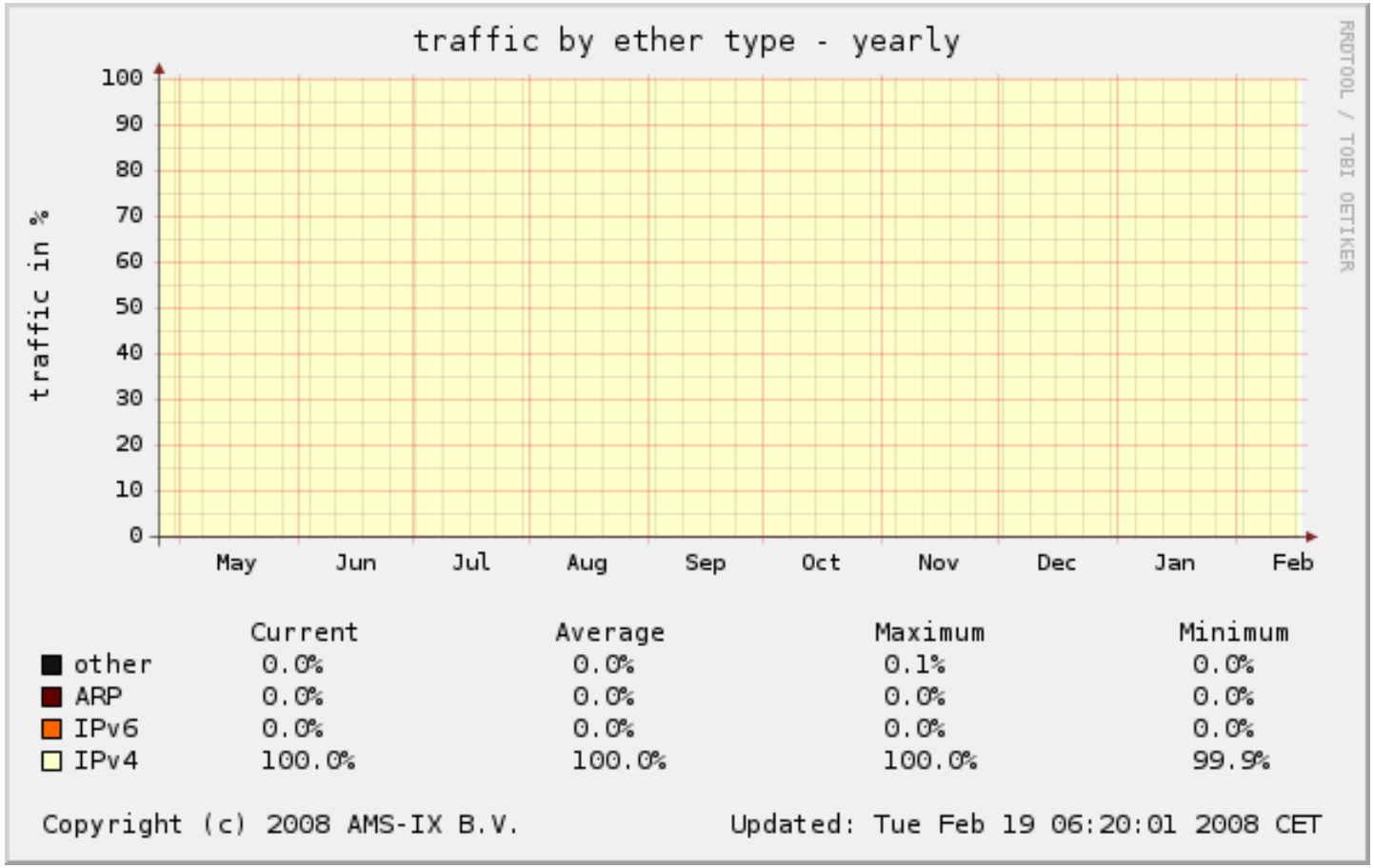
Ipv6 allocations worldwide



IPv6 deployment

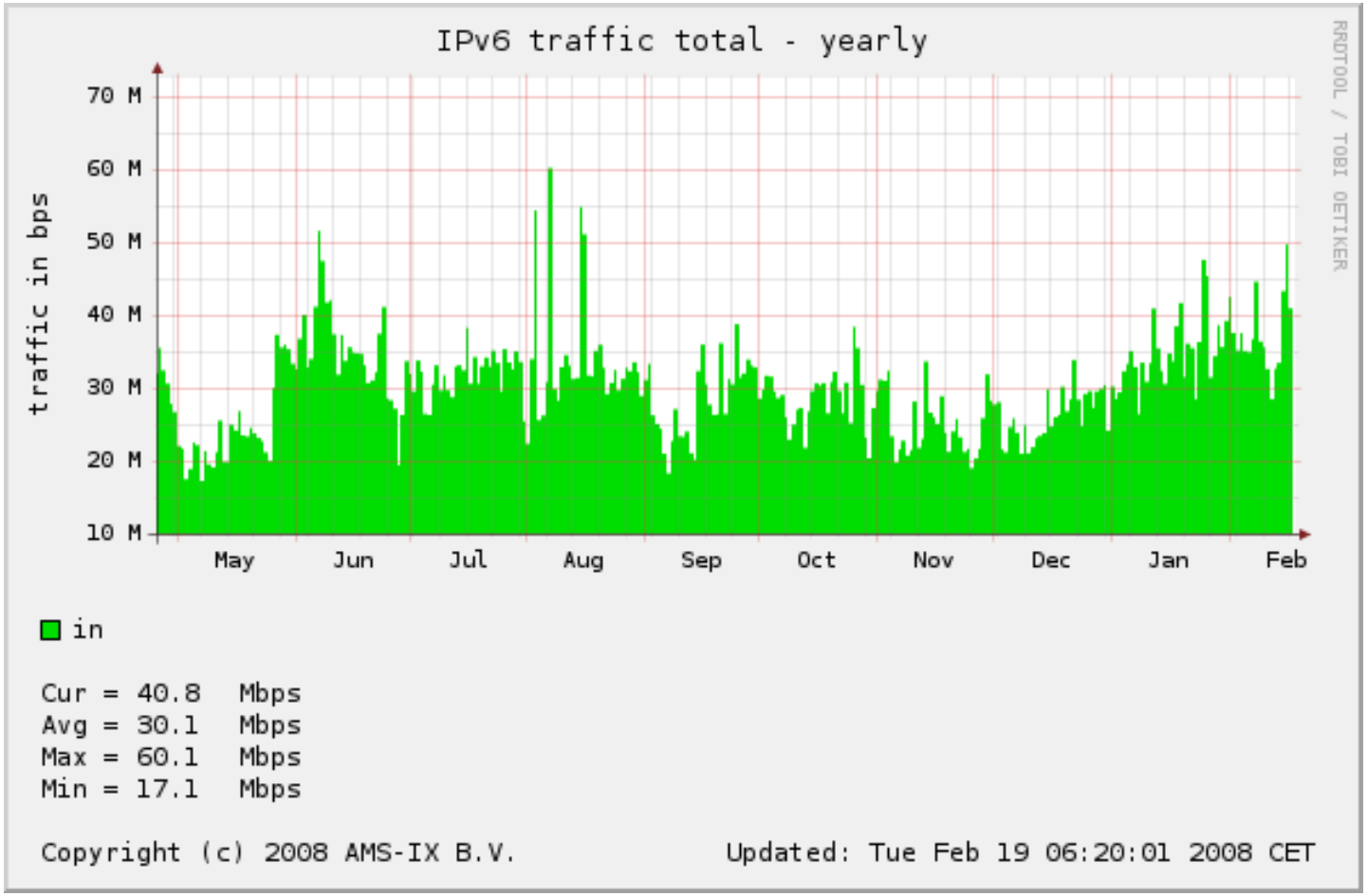
So, is IPv6 being deployed?
And if not, why not?

On the Amsterdam Internet Exchange



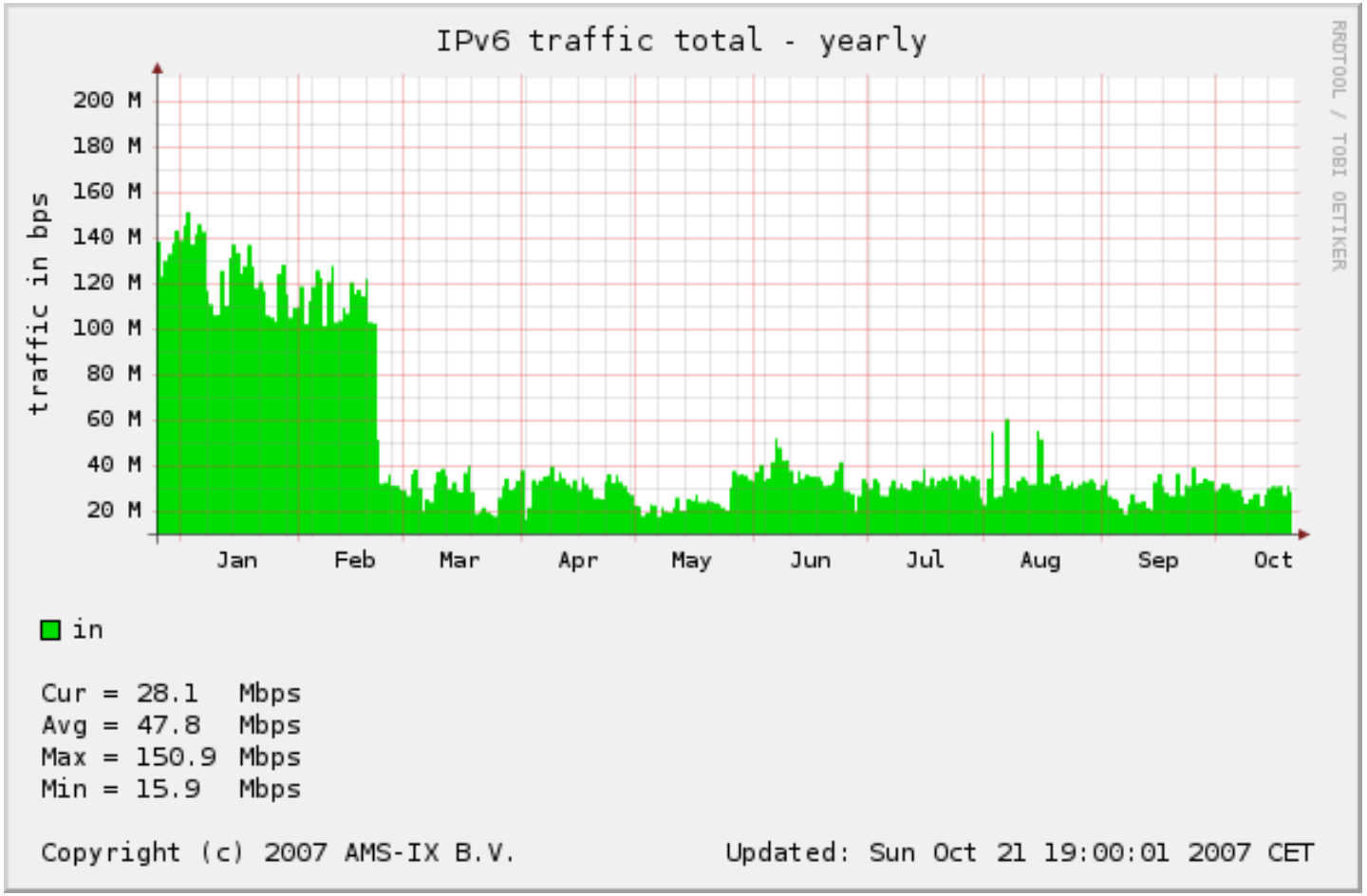
- IPv6 Invisible on the Chart, < 0.1% of all packets on average

On the Amsterdam Internet Exchange



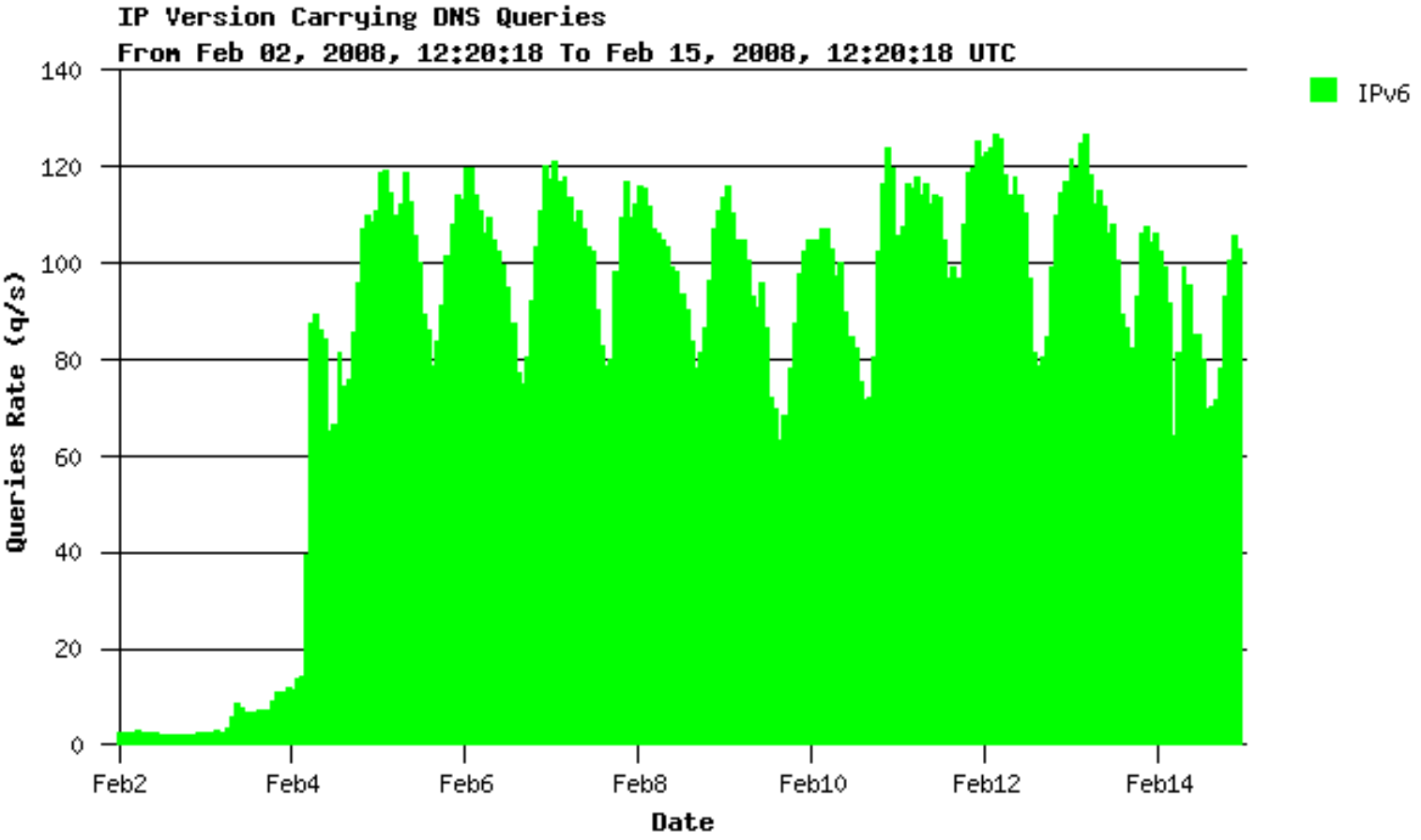
- ***Peak*** IPv6 traffic ~ 8 high speed DSL connections
- Does not include private peerings

On the Amsterdam Internet Exchange



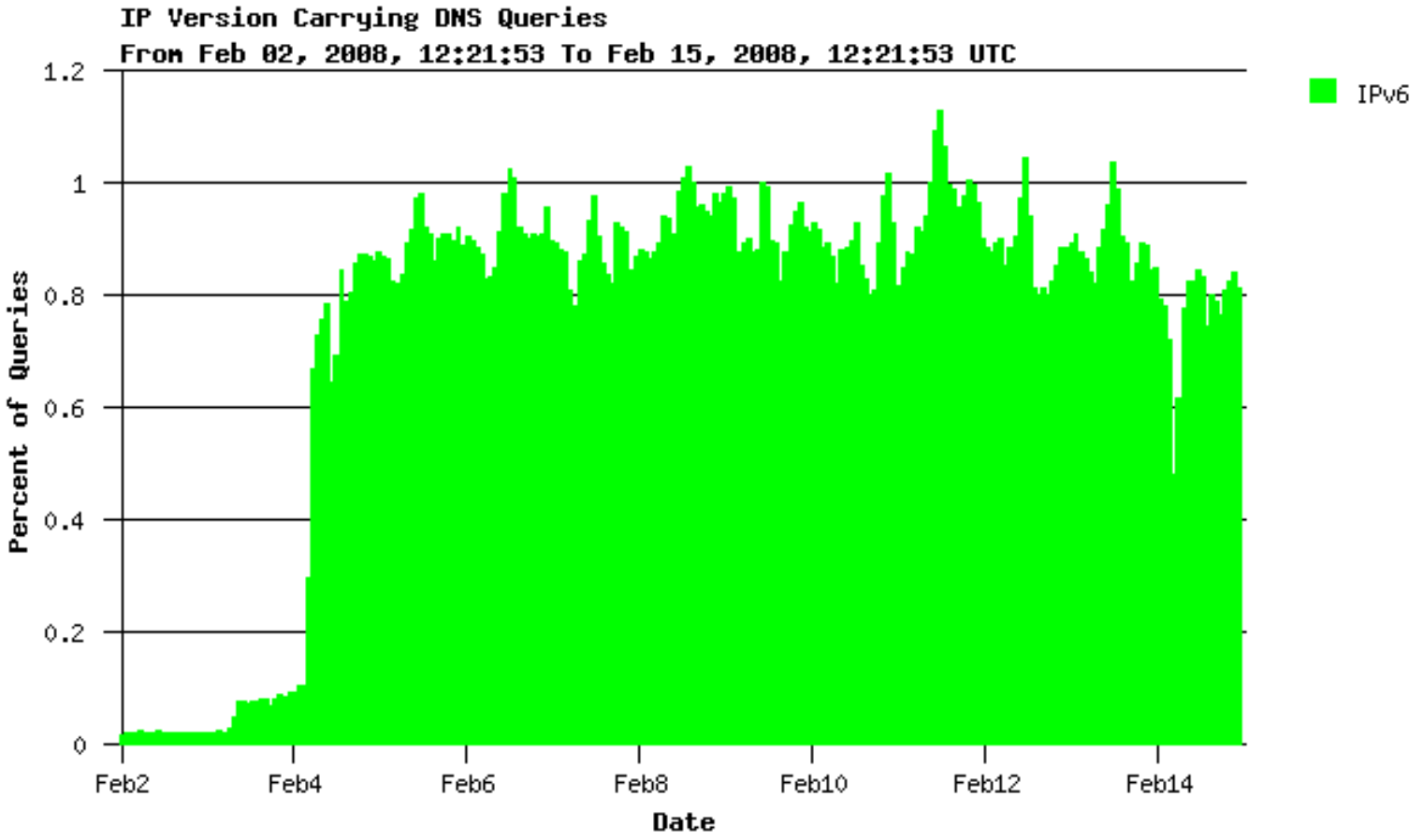
- It went down, not up !

Recently on K.root-servers.net



- IPv6 service addresses of 6 DNS root name servers published on February 4th

Recently on K.root-servers.net



- 0.8-1% of all queries to K come in over IPv6 now

IPv4 and IPv6

- IPv6 and IPv4 are two different protocols
  - Resources available over IPv6 are not reachable from an IPv4 node and vice versa
- Luckily the layers in the Internet Architecture are independent of each other
  - Same transmission, IPv4 and IPv6 can be run in parallel, on the same network
  - Several protocols we have used during the years have died, new have arrived

No customer demand?

- If customers do not ask for IPv6, there is no ability for providers to charge (extra) for IPv6
  - This implies they do not get the extra money needed for investments in new hard- and software
  - Not having any customer demand is not a problem because deployment of IPv6 happens anyway
- Customers ask for content and services (Google, Spotify, Skype) and do not care what protocol is used
  - IPv6 does not enable new services

What do providers do?

- Upgrade of hard- and software happens all the time in a continuous upgrade cycle
  - Remember, no customer demand, no extra revenue, no ability to invest specifically for IPv6
- At least in the short term building a special IPv6 business case just does not make any sense

Core Network

- Core network can already handle Ipv6
- Operational experience is missing
- “Debugging” soft- and hardware is needed
- Management systems are IPv4 only
- “We are with IPv6 where we where with Ipv4 in 1995”
- Vendors have charged extra for IPv6

Ipv6 co-existing with IPv4

- IPv6 in core, but IPv4 only to customers require various gateways
  - IETF is working on solutions
- Often IPv6 works at home, and in core, but not over the connecting link
- Bridging IPv4 to/from IPv6 will be needed for a long time
  - Dual stack services extremely important

Most pressing need today

- “Small gateways” for private homes do not support IPv6
- No large deployment possible
- No interest from enterprises to get IPv6 as their customers and employees can not use IPv6
- Some vendors now start including IPv6, and same for backend systems

What is the cost

- Because IPv6 deployment happens as part of the normal upgrade cycle, it is impossible to separate the costs of IPv6 from upgrade costs
- For homes, the upgrade cycle is slower than the core, in some cases hardware is never changed
  - Translation technologies will be needed

Do we have deployment?

- FreeTelecom in France
  - 3 million subscribers
  - Have their own CPE with IPv6
- IPv6 available for their triple-play users
  - 250k users have asked for it
  - Might look small, but is significant

Measurement in Sweden

- 0.5% users used IPv6 for content available over both IPv6 and IPv4
- 6% users managed to fetch content only available over IPv6
  - 89% over 6to4
  - 9% Toredo
  - 2% “other” IPv6 space

Thanks to Mikael Abrahamsson, Tele2

Conclusions

- Ipv6 is gradually starting to appear
- More and more content is becoming available
- We have a long way to go
- But, there is hope, and the pace of change is accelerating
- The ones who are ready in X-day will survive

Free Advice

Think, prepare and plan now !

To change and deploy in panic mode is ***expensive*** !

Think, prepare and plan now !

Questions?

Answers !