IPv6 Address Design

Practical Considerations

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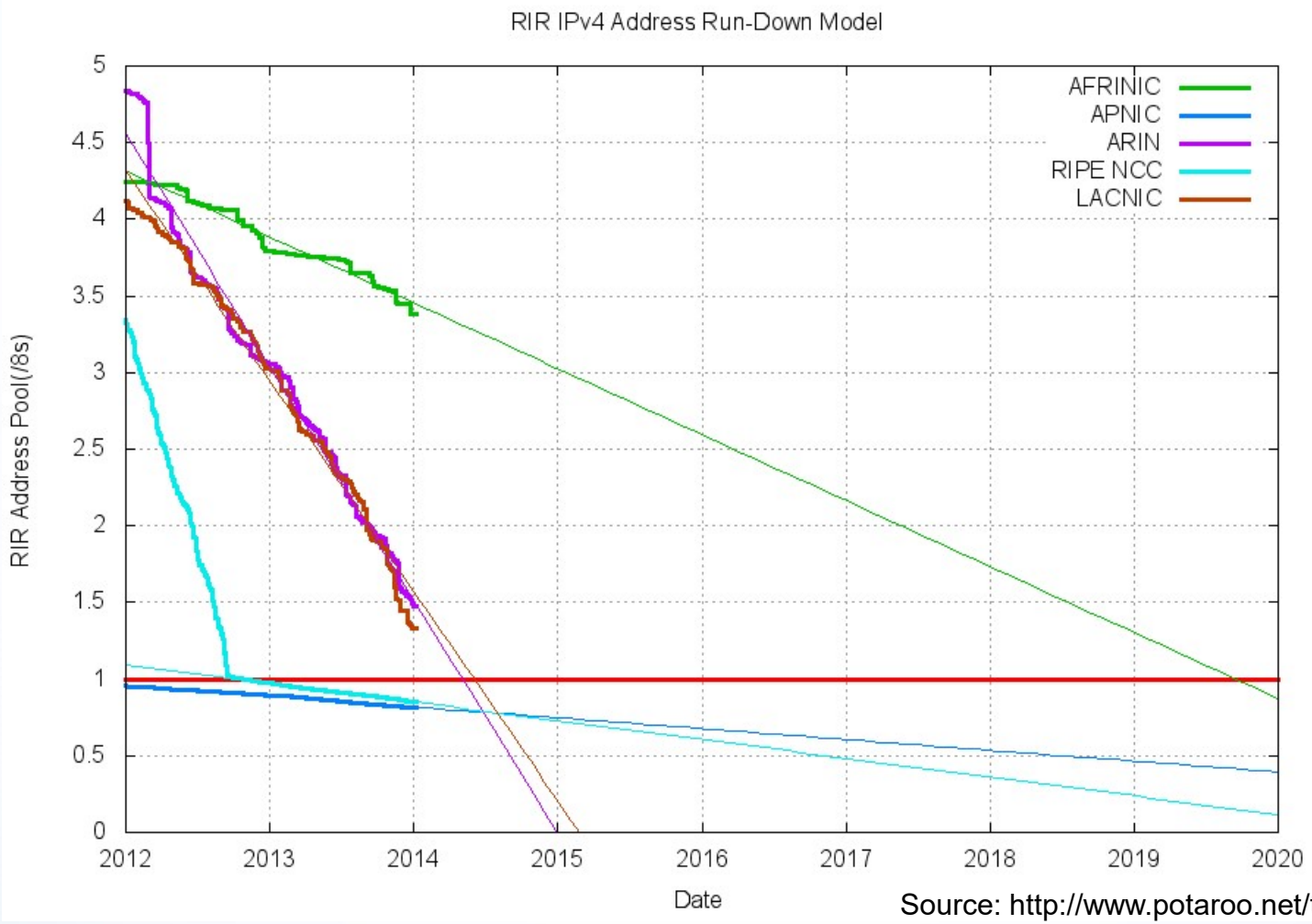
Obligatory IPv4 Depletion Slide



Source: http://www.potaroo.net/tools/ipv4/

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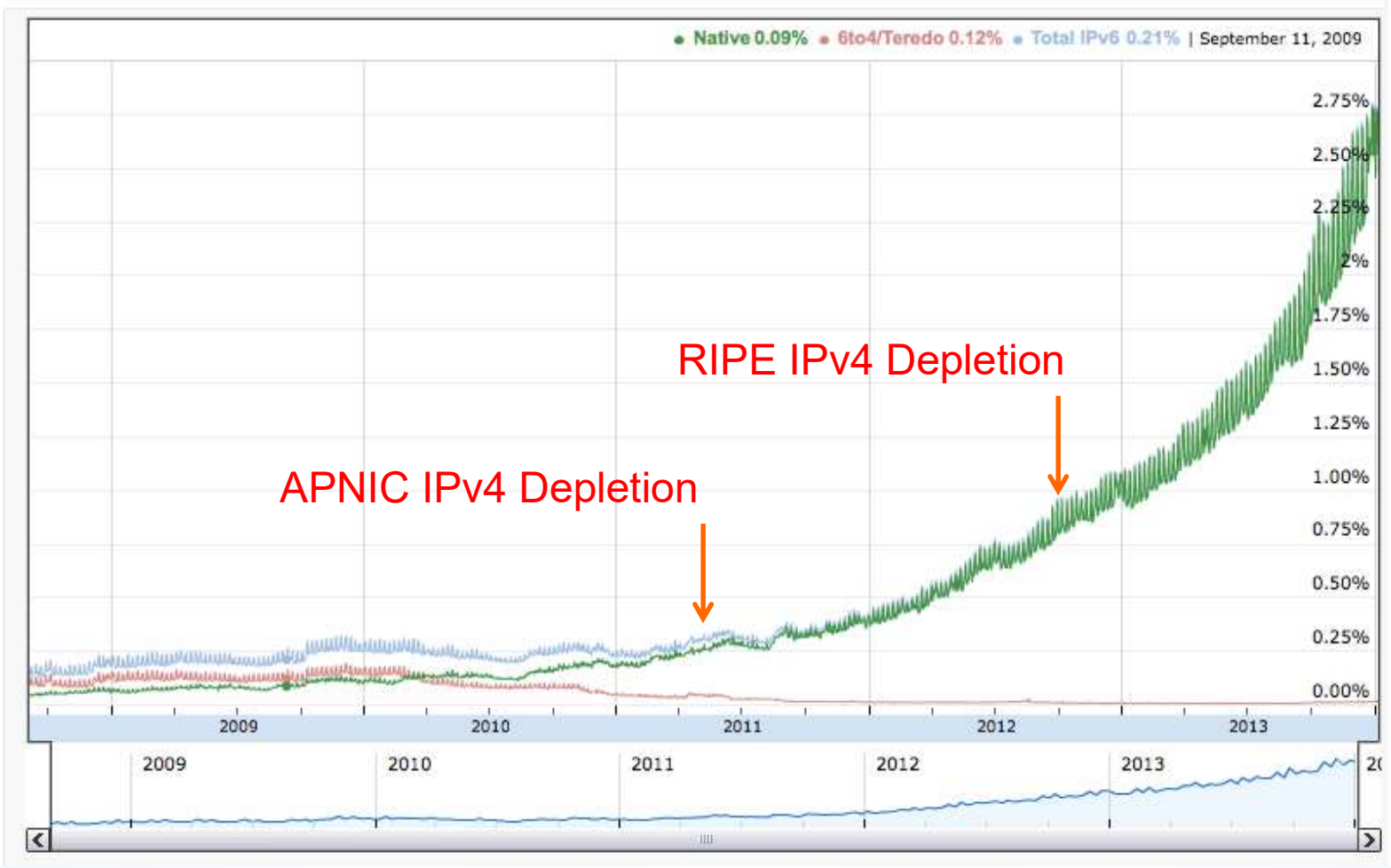
Public IPv6 Traffic



Source: http://www.google.com/ipv6/statistics.html

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It's All About the Address Space

Some Perspective:

1 picometer = 10^{-12} (one trillionth) meter

2^{32} picometers = 4.29 millimeters
- length of a small ant

2^{128} picometers = 3.4 x 10^{23} kilometers
- 34 billion light years
- Furthest visible object in universe: 13.2B LYs

iverse

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Abandon IPv4 Thinking!

Foremost IPv4 design consideration: Conservation

Balancing act between:

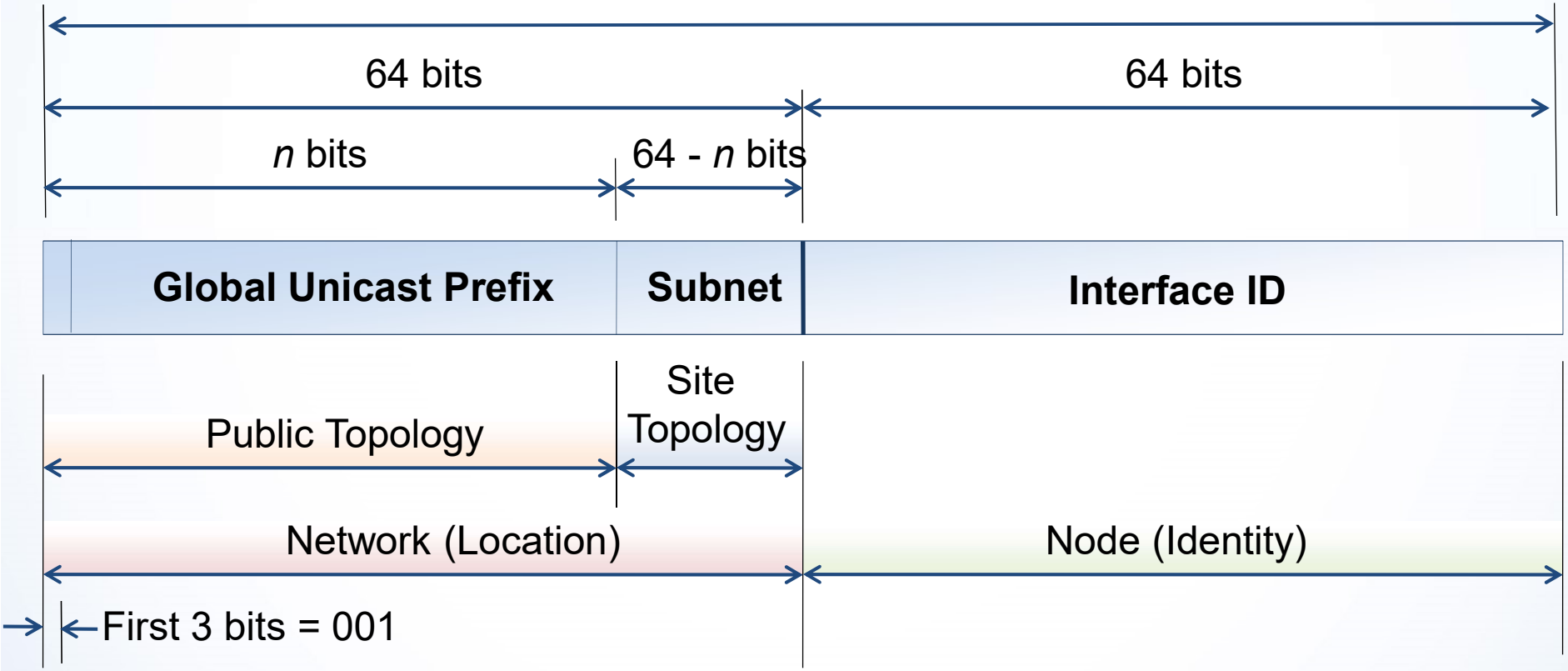
- Number of available subnets
- Number of hosts per subnet

Result: VLSM

- Complex
- Difficult to manage

2001:0db8:1234:abcd:5401:473c:0015:ea85/64

Global IPv6 Unicast Address Structure



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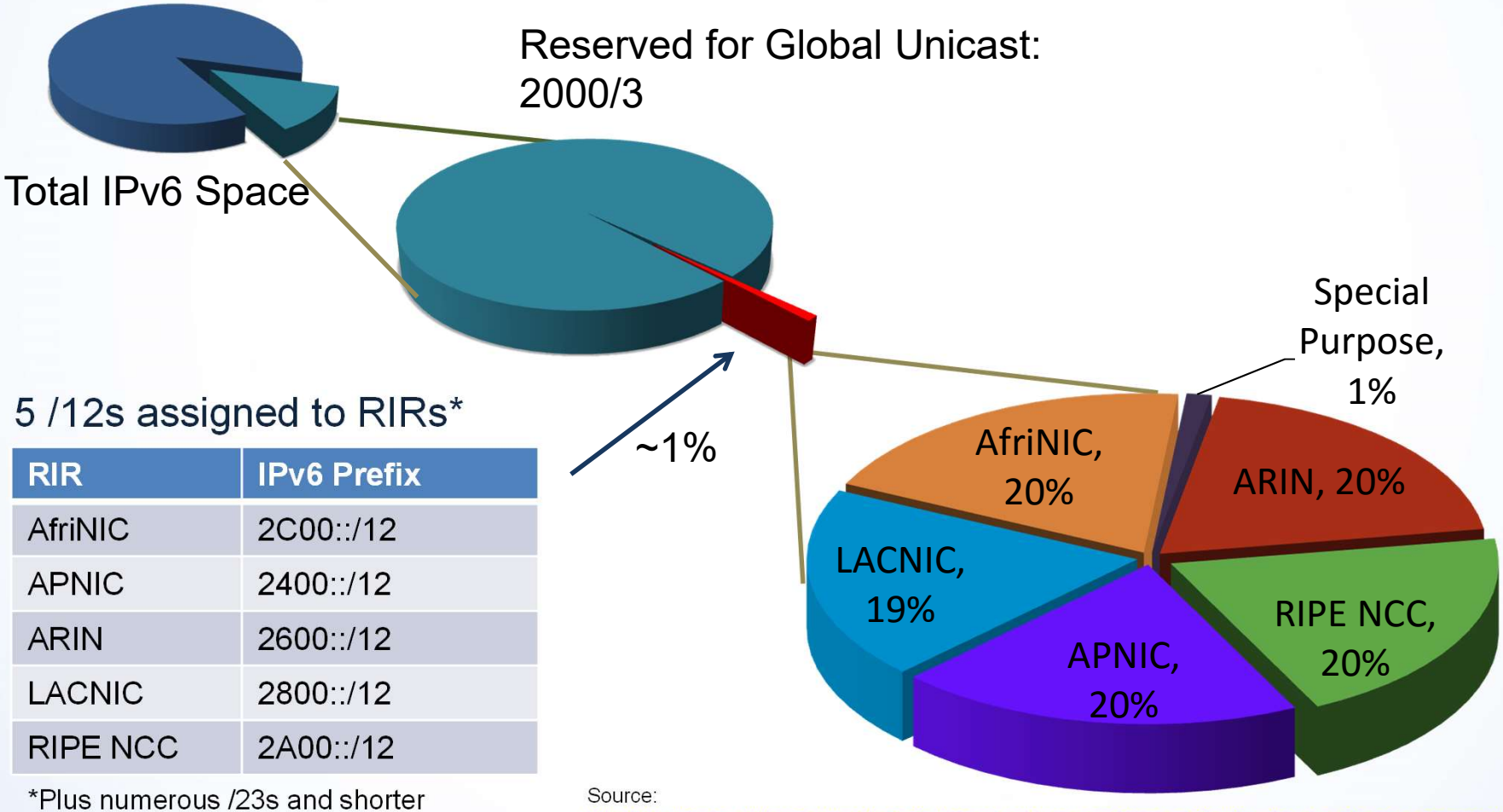
Global IPv6 Prefix Allocations



5 /12s assigned to RIRs*

RIR	IPv6 Prefix
AfriNIC	2C00::/12
APNIC	2400::/12
ARIN	2600::/12
LACNIC	2800::/12
RIPE NCC	2A00::/12

*Plus numerous /23s and shorter

Source: http://www.iana.org/assignments/ipv6-unicast-address-assignments/ipv6-unicast-address-assignments.xml

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IPv6 Prefix Assignments

Typical IPv6 prefix assignments:

- Service provider (LIR): /32 ➔ 2^{32} /64 subnets
- Large end user: /48 ➔ 65,536 /64 subnets
- Medium end user: /56 ➔ 256 /64 subnets
- Small/ Home/ SOHO: /64 or /60 ➔ 1 or 16 /64 subnets

Address r ration

- Is th
- Yes!

If you dc have the right pre

Is this really practical?

What Prefix Size is Right for You?

ARIN Number Resource Policy Manual:

2.10. End Site

"The term End Site shall mean a single structure or service delivery address, or, in the case of a multi-tenant structure, a single tenant within said structure (a single customer location)."

6.5.8.2.1.Standard Sites

"An organization may request up to a /48 for each site in its network, and any sites that will be operational within 12 months."

or

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Are You Ready for IPv7?

All current IPv6 global unicast prefixes start with 001

This is 1/8 of the entire IPv6 address space

2^{45} = 35 trillion /48 prefixes

UN projections for 2100 world population:

Median figure 10 billion

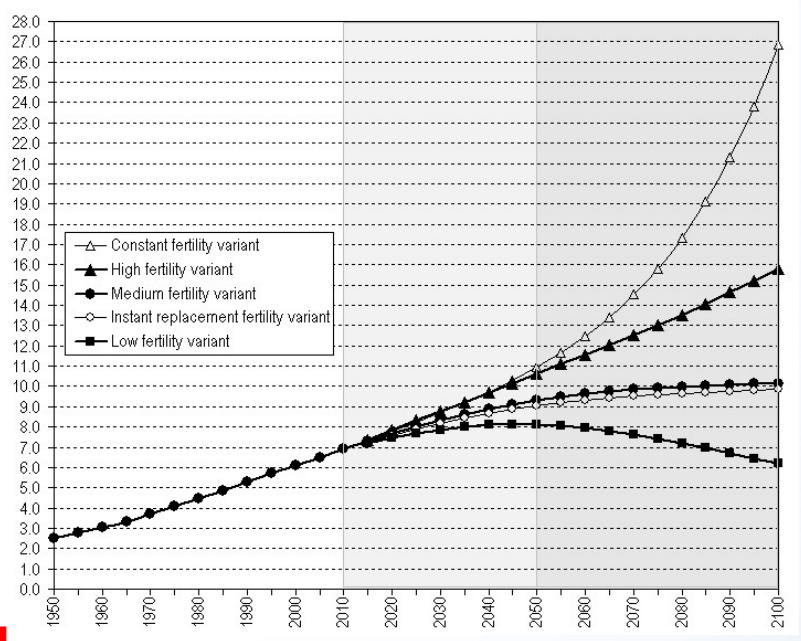
High end: 16 billion

2^{45} / 16 billion = 2199 /48s *per person*

And, we still have 85% of the IPv6 space held in reserve

Opinion:

IP will become obsolete before IPv6 is depleted



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What About Subnet Assignments?

RFC 4291 specifies that Interface-IDs are 64 bits

- Several IPv6 functions depend on this

All subnets should be /64

- Including point-to-point links
- Simplifies address management
- Random addressing improves security

Trend is to use stateful (DHCPv6) addressing

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What About Point-to-Point Links?

18 million trillion addresses in a /64 link

- And I will only *ever* use 2 of them?
- Are you kidding???

People have a very hard time accepting this

- Again: This is not IPv4!
- What else are you going to do with those addresses?

It's a matter of comprehending the scale

- 5000 out of 2^{64} is not really any bigger than 2 out of 2^{64}

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Point-to-Point Subnets (Battling RFCs)

Reasons for using /64

- RFC 3627
- RFC 5375 => /64 usage endorsed and encouraged
- Design consistency
- Anycast problems are not significant on PtP links
  - Subnet-Router Anycast
  - MIPv6 Home Agent Anycast

Reasons for using /127

- RFC 6164
- Ping-pong vulnerability
  - This is an issue with older version of ICMPv6 (RFC 2463)
  - Issue is corrected in newer version of ICMPv6 (RFC 4443)
  - Vendors: Upgrade your code!
- Neighbor cache exhaustion vulnerability

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Point-to-Point Subnets (cont.)

Insist that your vendors use current ICMPv6!

Don't use /126

- This is IPv4 thinking
- "Subnet number" is meaningless in IPv6
- IPv6 does not use broadcast addresses

Potential compromise:

- Assign /64 per PtP subnet
- Address /127 out of the /64

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What Do I Get in Exchange for "Waste"?

Simplicity

- One-size-fits-all subnets

Manageability

- Hex is much easier to interpret (binary) than decimal

Scalability

- Room to grow

Flexibility

- Room to change

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Designing for Simplicity

Start by mapping "working" bits

Generally the bits between assigned prefix and Interface-ID

Group by hex digit (nibble)

4 bits per hex digit

Define "meanings" you need to operate

Geographic area? Logical topology? Type designation? User ID?

Try to keep "meanings" on hex boundaries

Defined meanings will then be some multiple of 2^{4n}

Ex: 16, 256, 4096, 65536…

Don't get carried away with meanings

No need for 10 layers of address hierarchy if 4 will do

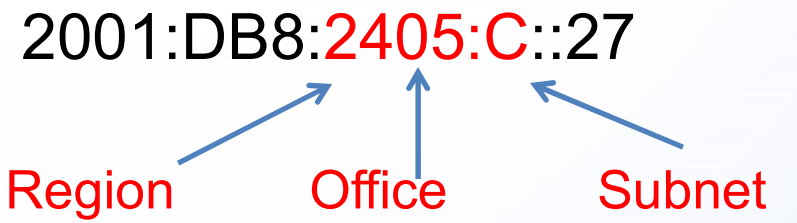
Designing for Simplicity (cont.)

Use zero space as much as possible

- Which address is easier to read?
  - 2001:DB8:2405:83FC:72A6:3452:19ED:4727
  - 2001:DB8:2405:C::27

Benefit: Operations quickly learns to focus on meaningful bits

- Ignore public prefix (usually)
- Ignore Interface-ID (usually)
- A few hex digits tell operations most of what they need to know



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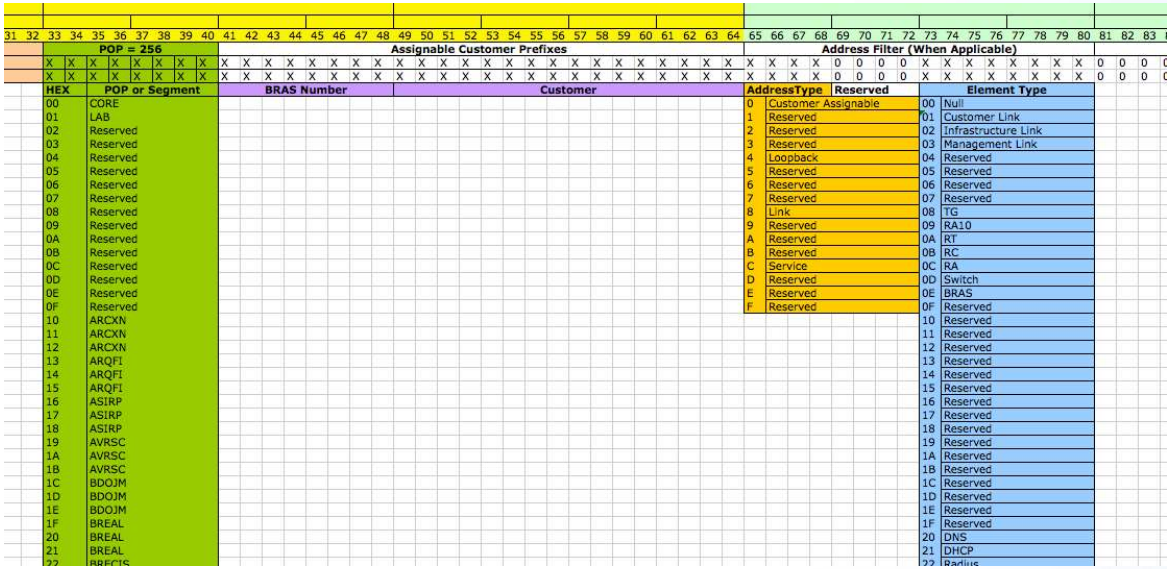
Designing for Scale

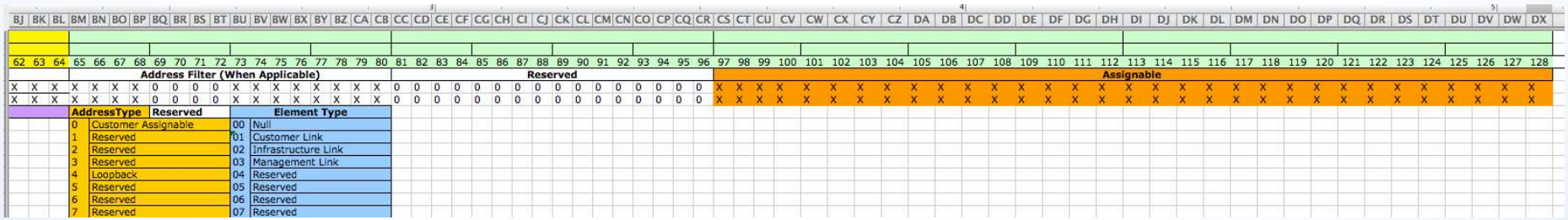
Leave "zero" space whenever possible

- Designate as Reserved
- Both vertical and horizontal

Insert between "meaningful" digits or bits

- Allows future expansion in two directions





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Designing for the Future

Do not integrate IPv4 into an IPv6 design!

- Reading IPv4 in hex is (almost) meaningless
- IPv4 will (eventually) go away

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Other Issues

DNS design and management is critical

DNS issues are well documented

IP Address Management is critical

IPv6 design is not easy to manage via spreadsheets

IPAM deployment tends to be a part of IPv6 deployments

Abandon IPv4 thinking!

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www.FishNetSecurity.com

Thank You

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