The Top 5 Things You need to keep in Mind when preparing your IPv6 Addressing Plan

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Abstract

One of the first steps in an IPv6 deployment project is to obtain an IPv6 prefix for your organisation and **create an IPv6 addressing** plan. Thanks to the growth of IPv6 deployment globally, there is **more experience and new best practices** are created that can assist with such a task.

This session will present the **top 5 major points** you need to consider and focus on when writing your addressing plan. The aim is to provide the attendees with guidance and suggestions.

Agenda

- Obtaining an IPv6 Prefix
- Subnetting your IPv6 allocation and assignments
- Working with standard IPv6 subnet sizes
- “Nibble boundary” rules
- ISP approach to addressing CPEs
- Examples of IPv6 addressing plans

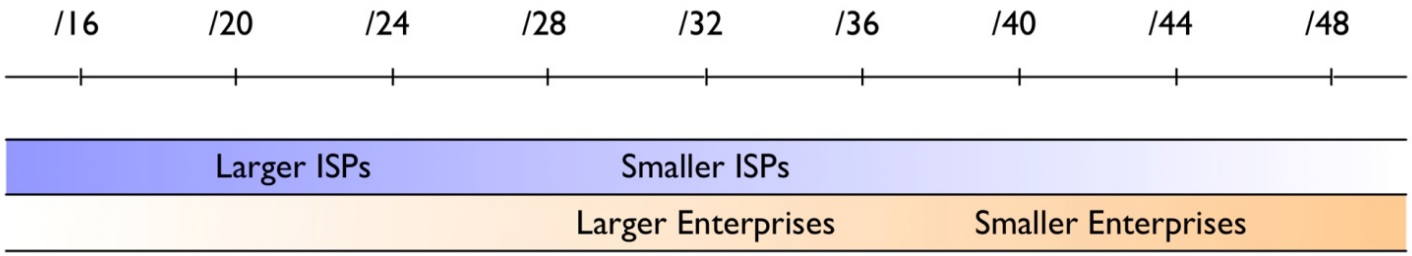
1. OBTAINING AN IPv6 PREFIX

Obtaining an IPv6 Prefix (1)

- ISPs obtain a prefix for:
  - themselves and
  - to sub-allocate it to their customers (as an LIR)
- ISPs request their prefix from the RIR
  1. How large allocation do you need?
     - /29 is now typical (or larger)
  2. What size of prefixes will you hand out to your customers?
     - Typical /48 per customer site
     - For BB subs the current best-practise is /56

Obtaining an IPv6 Prefix (2)

- The Enterprise view
  - Most likely not much experience dealing with RIRs
  - The multihoming requirement (and challenge)
  - Selecting Provider Independent vs. Provider Assigned
- Let go of an unnecessary “conservation” mindset.
  - An enterprise can and should get a “right-sized” allocation



Obtaining an IPv6 Prefix (3)

- Out-of-region announcements
  - No actual RIR policy that prohibits this
  - Some organizations running networks in other regions will want to obtain a regional IPv6 allocation as a precaution
  - Check with upstream ISP the accepted prefix length announcements
    - Usually /48 is ok (for now)

Examples of IPv6 Allocations

- Largest allocations
  - In the RIPE region*:
    - /19 Deustche Telecom, France Telecom, UK MoD
    - /20 Telia Sonera, Telecom Italia
  - In the ARIN region:
    - Service providers:
      - /20 Comcast
    - Enterprises:
      - /24 US Veterans Administration

*Source: RIPE NCC database https://apps.db.ripe.net/search/

2. SUBNETTING YOUR IPv6 ALLOCATION AND ASSIGNMENTS

What to consider when subnetting your IPv6 allocation

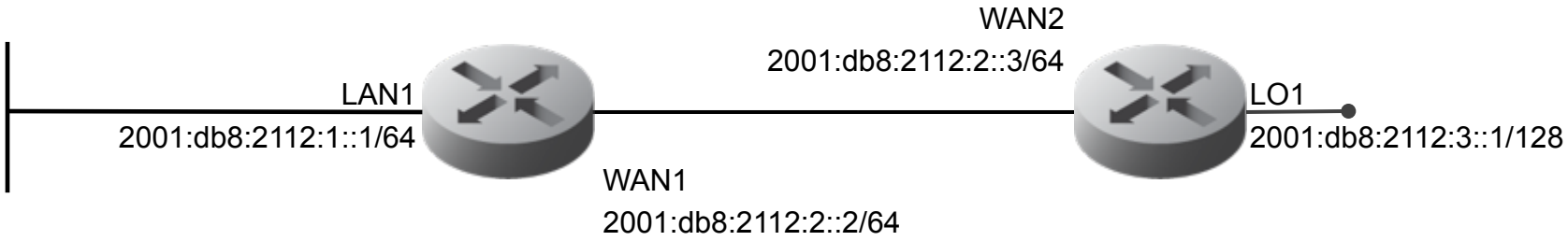
- Be sure to request a large enough allocation at the outset
  - Rule of thumb: /48 per site (for an Enterprise)
    /56 per BB CPE (for an ISP)
- Don’t fall into the IPv4 mindset
  - No subnetting beyond the /64

Prefix	Subnet groups per /32	/48 subnets per group
/32	1	65,536
/36	16	4,096
/40	256	256
/44	4,096	16
/48	65,536	1

3. WORKING WITH STANDARD IPv6 SUBNET SIZES

The “best size” for an IPv6 subnet?

- Enterprise – site allocation size: /48
- Point-to-point links and LAN interfaces: /64 or /127
  - Subnets smaller than /64 have appeared in some deployments for very specific use cases
- Loopbacks
  - One /64 and all loopbacks from it
  - Many /64s and keeping the Interface ID the same
  - In either case, /128 per loopback
    - (equivalent to /32 in IPv4)



4. NIBBLE BOUNDARY RULE

“Nibble boundary” benefits

- 2001:db8:1234:5678::/64
  - Nibble = 4 bits = 1 HEX character
- Keep the addressing plan tidy
- Easy to recognise what portion of prefix is assigned and what we are working with
- Assists hierarchy of the plan, easier summarisation and security policies

Nibble boundaries when subnetting within a site

Prefix	Subnet groups per /48	/64 subnets per group
/48	1	65,536
/52	16	4,096
/56	256	256
/60	4,096	16
/64	65,536	1

Nibbles make IPv6 prefixes more legible

Subnet bits a multiple of 4	
Prefix:	2001:db8:1::/48
Range:	2001:db8:1:0000:0000:0000:0000:0000 2001:db8:1:ffff:ffff:ffff:ffff:ffff

Subnet bits not a multiple of 4	
Prefix:	2001:db8:1::/49
Range:	2001:db8:1:0000:0000:0000:0000:0000 2001:db8:1:7fff:ffff:ffff:ffff:ffff 2001:db8:1:8000:0000:0000:0000:0000 2001:db8:1:ffff:ffff:ffff:ffff:ffff

Mapping locations or functions into IPv6 address prefixes using nibbles

2001:db8:1:LXXX::[/52 - /64]

Location (16 sites)
2001:db8:1:[0-f]nnn::/52

Interface subnets (4096 per location)
2001:db8:1:n[0-f][0-f][0-f]::/64

Prefix	Assignment
2001:db8:1:0000::/52	Reserved
2001:db8:1:1000::/52	Building 1
2001:db8:1:2000::/52	Building 2
…	…
2001:db8:1:f000::/52	[Location 16]

Prefix	Assignment
2001:db8:1:1000::/64	Reserved
2001:db8:1:1001::/64	VLAN1
2001:db8:1:1002::/64	VLAN2
…	…
2001:db8:1:1fff::/64	[Subnet 4096]

- CAUTION! It's possible to overdo this approach…
  - There is a trade-off between the operational benefits of the approach and the flexibility of your addressing plan for growth and extensibility

5. CPE ADDRESSING

ISP approach to CPE addressing

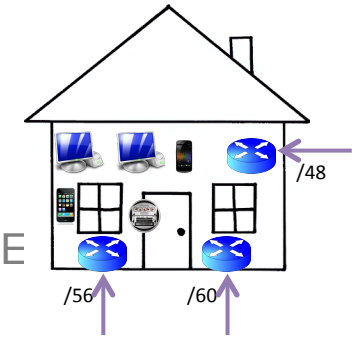
- We started with /48 (RFC 3177)
  - Made obsolete by RFC 6177
- Now /56 per CPE is the best practise
- But the IETF Homenet working group is reconsidering /48
  - Prefix colouring (?)

- What do you think of SP Wi-fi and /64 per host?

For Your Reference

Other Influences in the Industry

- **IETF Homenet & ISP's IPv6 Addressing**
  - This WG focuses on supporting next-generation services on unmanaged home networks
    - In the center of their work is **IPv6**
  - Multiple ISP connections to the home
    - Example: broadband, VPN router, smart meters, home security etc.
    - Terminated at a CPE (6rd, DHCPv6-PD, MAP, static IPv6 etc.)
  - **Not really impacting the ISP IPv6 addressing** as it's behind the CPE
    - Rather realize the potential **of prefix coloring & IPv6 Segment Routing**
  - Homenet presentation @ UKNOF 27 (January 2014)



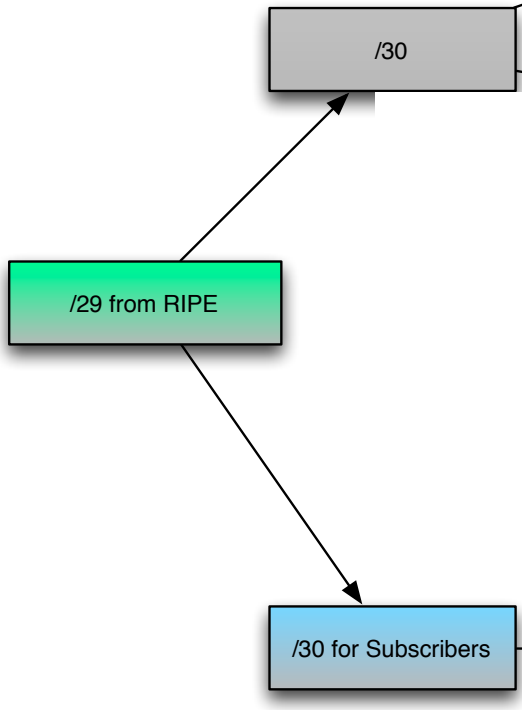
- **IETF v6 Ops & Unique IPv6 Prefix Per Host**
  - Large scale environments with the need to assign IPv6-prefix per host (E.g. SP Wi-Fi)
  - Advantages:
    - Monitoring the prefix instead of IPv6 address
    - Host isolation (prefix has an Off-link flag set), limitation in ND communication
  - Think about it from the perspective of the IPv6 prefix allocation from your RIR/LIR
  - **How many /64 are you going to need?**
    - This will impact the required allocation size
  - presentation @ UKNOF 33 (January 2016)

EXAMPLES OF ADDRESSING PLANS

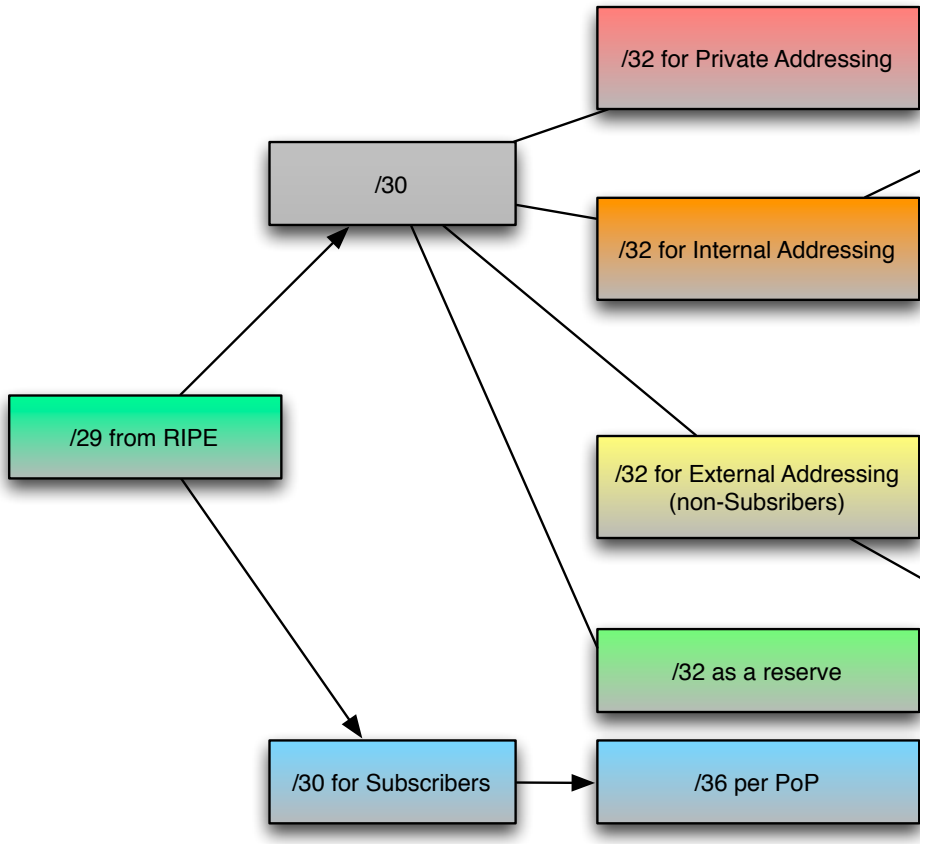
A large enterprise plan summary

- 5 RIRs with IPv6 – 5 /32s (one per RIR)
- Region gets a /36 (15 /36s held in reserve)
- Core has core networks and external DMZs; /40s
- Countries have sites: i.e., grouping of buildings or single buildings at the same location; /40s
- Sites are /56s of /48s for applications; i.e., DHCP client(s), customer/printing/etc. environments
- Applications are /48s and they contain /64s (subnets)

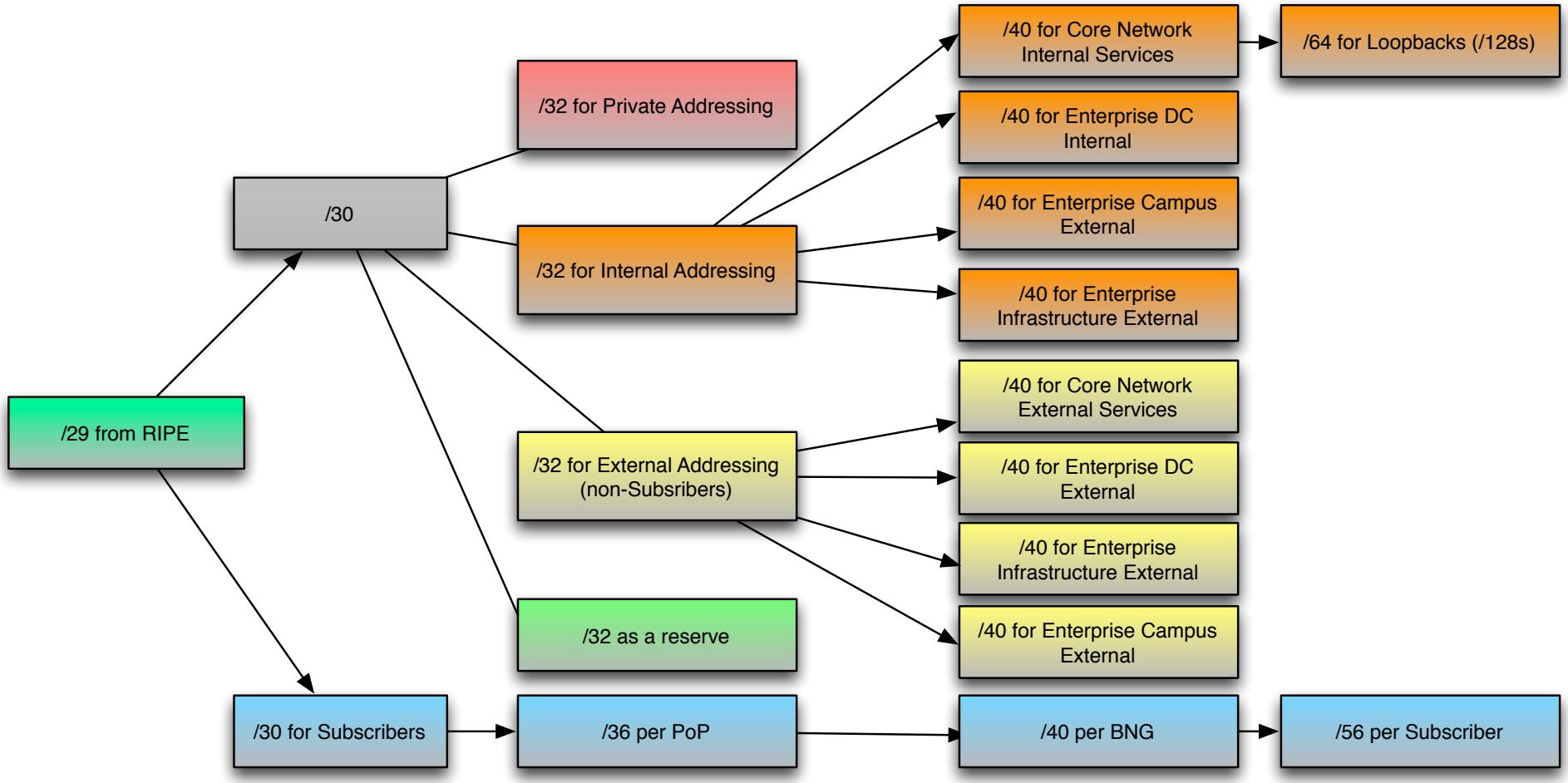
ISP addressing plan (1)



ISP addressing plan (2)



ISP addressing plan (3)



SUMMARY & RESOURCES

Summary

- Obtaining an IPv6 Prefix
  - ISP vs. Enterprise; PI vs. PA
- Subnetting your IPv6 allocation and assignments
  - The right size for your organization's initial allocation
- Working with standard IPv6 subnet sizes
  - /64s, /48s, /128s, (possibly also /127s)
- "Nibble boundary" rules
  - Legibility of unique prefixes
- ISP approach to addressing CPEs
  - /56 vs. /48
- Examples of IPv6 addressing plans
  - Enterprise
  - ISP

Resources

- **IPv6 Address Planning**
  - Tom Coffeen, O'Reilly (http://shop.oreilly.com/product/0636920033622.do)
- **How to write an IPv6 Addressing Plan**
  - Veronika McKillop, Cisco Live breakout session BRKRST-2267
  - Recording: www.ciscolive.com/online (register for free and search for the session code)
- **Create an Addressing Plan**
  - RIPE NCC https://www.ripe.net/publications/ipv6-info-centre/deployment-planning/create-an-addressing-plan