

**Best Current Operational Practice for operators:**

**IPv6 Prefix Assignment for  
end-customers – persistent vs  
non-persistent and what size  
to choose**

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# Draft v2 meeting:



# RIPE BCOP TF

- Work in Progress:
  - <https://www.sinog.si/docs/draft-IPv6pd-BCOP-v2.pdf>
  - <https://www.ripe.net/ripe/mail/archives/bcop/2017-March/000159.html>

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# Executive Summary

- Making wrong choices when designing your IPv6 network will sooner or later have negative implications ...
  - **IPv6 is not the same as IPv4.** In IPv6 you assign a short prefix to each end-customer site, so they are able to have as many subnets (/64s) as they need.
  - It is **strongly discouraged** to assign prefixes longer than /56. If you want a simple addressing plan, /48 for each end-customer.
  - In order to facilitate troubleshooting and have a future proof network, you should consider **numbering the WAN links using GUAs.**
  - Non-persistent prefixes are considered harmful in IPv6 as you can't avoid issues that may be caused by simple end-customer power outages, so assigning **persistent prefixes is a safer and simpler approach.**

# BCOP and Why?

- Describe best **actual** practices
- Target: ISPs deploying IPv6
- Lack of experience or following IPv4 practices bring unexpected or unwanted results
  - IPv6 “brokenness” = Content providers rejection of your AS
  - Lack of compliance with new standards such as Homenet
    - Complete **production** network renumbering, etc.

# Size of end-customer prefix

- /48, /56 or something else?
- Change your mind, this is not IPv4!
- IPv6 has been designed to assign prefixes not addresses
- Tony Hain “maths”:
  - IPv6 lifetime over 480 years, and keep doing that several times
  - Scarcity of addresses is not going to be our next problem



# /64 ?

- **DO NOT DO THAT!**

# /64 ?

- **DO NOT DO THAT!**  
**–NEVER!**

# /64 ?

- **DO NOT DO THAT!**
  - **NEVER!**
    - **NO WAY!**

# /64 ?

- **DO NOT DO THAT!**
  - **NEVER!**
    - **NO WAY!**
      - **BROKEN!**

# /64 ?

- **DO NOT DO THAT!**
  - **NEVER!**
    - **NO WAY!**
      - **BROKEN!**
        - » **VERY BAD FOR YOU**

# /64 ?

- **DO NOT DO THAT!**
  - **NEVER!**
    - **NO WAY!**
      - **BROKEN!**
        - » **VERY BAD FOR YOU**
        - » **BAD FOR YOUR CUSTOMER**

# Numbering the WAN link

1. /64 out of the end-customer prefix
2. /64 out of a dedicated pool
3. Unnumbered
4. ULA

# /64 from customer prefix

- Use the 1<sup>st</sup> /64 from the customer prefix
  - <https://tools.ietf.org/html/draft-palet-v6ops-point2point>
  - Simplifies routing and provisioning
- Some CPEs may not support RFC6603
  - Prefix exclude option for DHCPv6-PD
- Even being required by RFC7084
  - Basic Requirements for IPv6 CPEs



# /64 from dedicated pool

- Most common scenario
  - Dedicated pool for WAN links
- CPE performs router discovery
  - If it is a host (PPPoE), setup is completed
  - If it is a router, will request a prefix (DHCPv6-PD)
- /126, /127, /112 or /64?
  - RFC6164 suggest /127
    - Not all hardware supports it
    - /64 is future proof
    - Hardware limitations for longer than /64 prefixes
    - Allocate /64, use /127 to prevent ND attacks
- If there is *\*always\** a CPE, you can apply security policies w/o harming customers

# Unnumbered

- Don't use GUAs
  - Instead use Link-Local
- Doesn't work for all the devices, which can't request DHCPv6-PD
  - No GUAs means no traffic ...
- Complicate troubleshooting
  - Not able to traceroute the point of failure
- Not suitable for unknown CPEs or non-CPEs attached to the WAN link
- End-host will stay unnumbered
- Some hardware may consume additional resources for numbered links

# ULA

- Strongly discouraged
- ICMPv6 from the CPE to outside ISP
  - ULA source address will not traverse filters
  - PMTUD will break
  - IPv6 connection will break if Path MTU is not the same

# WAN link summary

- /64 GUA is the recommended choice
  - From the customer prefix if RFC6603 is supported
- It may be even required when more than 2 endpoints
  - Managed bridges
  - Repeaters
  - Redundancy (VRRP, multiple routers)
  - Monitoring/troubleshooting devices

# Prefix assignment options

- Align the size of the delegated prefix with a nibble boundary (multiples of 4 bits), so it match DNS reverse zone delegations
- A single customer network is /64
  - A single /64 is plain wrong
  - IETF work allows a single /64 for an interface
- Multiple /64 must be the rule
  - RIR policies allow /48

# /48 for business, /56 residential

- Some operators do this
  - Rationale -> Marketing/Sales differentiation
- Advanced home users may have problems with this
  - You're not able to use all the 4 digits (/48-/56)
- Some may have already an addressing plan with /48 (ULA, TB, transition, etc.)
  - /56 forces to redo it + renumbering
  - /48 just means changing the prefix
- Alternatively, reserve /48, assign /56
- Are you considering SMEs?

# /48 for everybody

- Most practical and pragmatic
- Less call-centre time to sort out problems
- Single “flat” provisioning system
- Same prefix size as ULAs, transition, etc.
  - Direct mapping of existing addressing plans

# Less than /56

- Not recommended
  - Technically no reason for that, enough addresses, this is not IPv4!
    - Over 134 million /56 in a /29
    - Over 16 million /56 in a /32
- Ask for more space to your RIR if required
- Never assign a single /64
  - Except for cellular phones (1 /64 for each PDP)
- LTE modems still require /56 or /48



# Persistent or non-persistent

- Persistent typically by means of AAA or custom provisioning system
  - At customer connection they always get the same prefix
- Non-persistent by means of a big pool in each termination point
  - At customer connection they get a random prefix
  - If persistent, the lease time may provide days, weeks or even months

# Non-persistent is easier?

- Less effort to deploy
  - Issues come later
  - It comes from IPv4 practices, DHCP
    - But we have NAT!
  - Looks easier for aggregation
  - Not looking for “customer” portability
    - May be an extra service
- Commonly using DHCPv6-PD
  - Each end-customer device has a GUA

# However ... non-persistent is harmful

- In case of power failure, CPE hang-up, ...
  - Common even in highly-developed countries
- CPE doesn't send prefix valid lifetime = 0
  - End-customer devices keep the old prefix
  - Will try to use it, will fail
    - Customers claims to the call-centre
- Content providers measure IPv6 brokenness
  - Will ignore your IPv6 traffic
- Power outage often happen several consecutive times ...
- Non-persistent prefixes force a logging system

# Best choice: Persistent or non-persistent

- Allow broadband services provided by the customer and the ISP
  - Allow stable DNS names
    - camera1.username.ispname.com
  - New business/apps/services, new incomes
- Key for non-residential customers
- Avoid having a logging system
- The WAN link still can be non-persistent

# Questions?

## Thanks!