IPv6
Deployment Planning:
"12 Steps to Enable IPv6 in an ISP Network"

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1. Prefix request

- How many customers do you have?
  - Home
  - Corporate
  - Mobile
- What is the expected growth?
  - Short/medium term
- Each customer:
  - /48 for broadband
  - /64 for smartphones
- Overall figures:
  - /32 -> 50.000 customers
  - /31 -> 100.000 customers
  - /30 -> 200.000 customers
  - ...

2. Audit your network

- Has your equipment the right IPv6 support?
  - What needs to be updated (firmware/software)
  - Upgraded (hardware)
  - Replaced
  - New

- Make a detailed inventory
  - From CPEs to upstreams

- Make sure your actual vendors can match your needs
  - Or replace them!

3. Training

- This is one of the main keys
  - IPv6 is not more difficult than IPv4
  - They are different, the difficulty is to "change your mindset"
    - Need to "unlearn" IPv4 to correctly understand IPv6

- Look for demonstrated experience for the training

- Possibly together with a consultancy service

- You will save a lot of time and money
  - The transition will become more urgent and important
  - Losses because you're not ready or did it wrong

4. Upstreams

- Confirm IPv6 support with your upstream providers
  - Look for alternative ones if not
  - If is not possible, look for a tunnel to another IPv6 upstream

- Enable IPv6 BGP peering with them
  - Same AS as IPv4

- Ideally native
  - Alternatively, can use a tunnel (6in4, GRE)

- Same for CDNs, caches, IXs, etc.

5. Security policies

- Equivalent to what you have with IPv4

- Exceptions:
  - Don't filter ICMPv6
  - Double check PMTUD is working

- BGP filtering specific for IPv6

- If you've dual-stack for your management and enterprise networks
  - Make sure to secure unwanted transition mechanisms

6. Monitoring systems

- Again, at a minimum, equivalent to what you have with IPv4
    - With the same conditions or better ones

- Must have systems that check in both stacks, from inside and outside your network, parameters such as:
    - Quality
    - Quantity
    - Stability
    - Prefix visibility
    - …

7. Detailed addressing plan

- Probably got already an overall plan if you contracted a consultancy
    - Once everything is clear needs to be refined

- This is a masterpiece for a correct IPv6 deployment

- Is not related at all to what you're used to with IPv4

- You MUST have an IPAM (IP Address Management)
    - Open Source or commercial product (appliance)
    - It may be tied to your DHCP/DNS
    - Avoid using a word processor or spread sheet for millions of addresses!

8. Deploy you core

- This is the easier part, core and distribution

- You probably have MPLS, which make it even much simpler

- Possibly keep dual-stack here
  - In the future you may consider IPv6-only
    - So, reusing the IPv4 addresses for customers that still need dual-stack, etc.

9. Trials

- Corporate network
- Corporate customers
- Residential customers
  - Employees and others

- LAN/VLAN rules:
  - /64
  - Keep dual-stack (even with private IPv4)

- SLAAC with RDDNS
  - DHCPv6 is just an option

- Manual provisioning is fine at this stage

10. Access network

- Typically one of the most complex steps
- Choose the right transition mechanism
  - My recommendation is 464XLAT
    - It works for residential and cellular
  - For corporate customers probably keep dual-stack
    - Unless they only use the network for "browsing", the 464XLAT as well
  - For Data Centers, SIIT-DC
- Do you've good support on the existing CPEs?
  - You may need to look into alternative suppliers
- For (non-cellular networks) provisioning
  - DHCPv6-PD
- For the customers numbering
  - Follow RIPE BCOP "**Best Current Operational Practice for operators: IPv6 prefix assignment for end-users - persistent vs non-persistent, and what size to choose**"

11. Transition config

- Configure PLAT (NAT64+DNS64) instead of CGN
  - Remember logging systems

- This works for both cellular and non-cellular networks

- In case of cellular, use a single APN
  - See details in my talk about this

12. Update CPEs

- This is the final and most critical step
  - Verifies everything

- Keep the trial
  - Employees
  - Customers

- Once well tested, start massive IPv6 activation
  - Maybe in phases, by regions, etc.

- Don't forget to take advantage of press
  - Commercial announcement

Take advantage of IPv6

- New apps/services

- IoT

- A lot to discover …

Comparing ...

	6RD	Softwires v2	NAT444	DS-Lite	Lw4o6	NAT64	464XLAT	MAP-E	MAP-T
Tunel/Translation (X)	T 6in4	T 6in4	X	T 4in6	T 4in6	X	X	T 4in6	X
Dual-stack LAN	YES	YES	optional	YES	YES	YES	YES	YES	YES
IPv4 Multicast	YES	YES	YES	NO	NO	NO	NO	NO	NO
Access Network	IPv4	IPv4	IPv4 /dual	IPv6	IPv6	IPv6	IPv6	IPv6	IPv6
Overhead	20 bytes	40 bytes	-	40 bytes	40 bytes	20 bytes	20 bytes	40 bytes	20 bytes
Impact in IPv6 addressing plan	YES	NO	NO	NO	NO	NO	NO	YES	YES
CPE Update	YES	YES	optional	YES	YES	YES	YES	YES	YES
NAT44/NAPT	CPE	CPE	CPE + CGN	CGN	CPE	CPE	CPE	CPE	CPE
46/64 Translation	-	-	-	-	-	ISP	ISP +/or CPE	-	CPE + ISP
Translation at ISP with or w/o state	-	-	with	-	-	with	with	w/o	w/o
Scalability	High	Medium	Medium	Medium	High	High	High	High	High
Performance	High	Low	Low	Low	High	Medium	High	High	High
ALGs	NO	NO	YES	YES	NO	YES	YES	YES	YES
Any Protocol or only-TCP/UDP/ICMP	YES	YES	YES	YES	YES	NO	NO	NO	NO
Sharing IPv4 Ports	NO	NO	YES	YES	YES	NO	NO	YES	YES
IPv6 Aggregation	NO	NO	optional	YES	YES	YES	YES	YES	YES
IPv4 Mesh	YES	YES	YES	NO	NO	NO	NO	YES	YES
IPv6 Mesh	YES	NO	optional	YES	YES	YES	YES	YES	YES
Impacts on logging	NO	NO	YES	YES	NO	YES	YES	NO	NO
HA simplicity	High	Low	Low	Low	High	Medium	High	High	High
DPI simplicity	Low	Low	High	Low	Low	High	High	Low	High
Support in cellular	NO	NO	YES	NO	NO	YES	YES	NO	NO
Support in CPEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
	15.5	12.5	10.5	9.5	15	12.5	14	13	13.5

Thanks !

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