Planning IPv6

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Agenda

- Getting informed.

- Evaluation.

- Planning:

    - Addressing.

    - Routing.

    - Services.

    - Software.

    - Training.

- Implementing.

- Transition scenarios.

Who should be planning for IPv6?

- **Internet Service Providers.**

- **Enterprise Networks.**

- **Content Providers.**

- **Software Development Companies/Units.**

Planning is not only an Engineering task, it also may include sales, marketing and management units.

There is not "one recipe fits them all".

Getting Informed.

- Congratulations you are taking the first step!.

- But, it is only the first step!

- Just need a couple of people understanding the problem and the technology complexity (or lack of).

- Sources of information:

Books, Manuals, vendors materials (and reps?), howto, tutorials, presentations, etc.

Books:

IPv6 Essentials - Silvia Hagen. ISBN: 0596100582.

Deploying IPv6 Networks - Ciprian Popoviciu - ISBN: 1587052105.

Running IPv6 - Iljitsch van Beijnum - ISBN: 1590595270.

IPv6 in Practice - Benedikt Stockebrand - ISBN: 3540245243.

Understanding IPv6 (Microsoft) - Joseph Davies - ISBN: 0735624461.

Global IPv6 Strategies: From Business Analysis to Operational Planning (Network Business) - Patrick Grossetete - ISBN: 1587053438.

Vendors Material:

Are important for two reasons:

• You can find out if their equipments are ipv6 capable or if a software or hardware upgrade is needed (memory!)

• You can learn about configurations complexity.

Be aware, many times you need to educate your vendors about IPv6.

Does it makes sense today to buy equipments that do not support IPv6??

How to / Manuals

Many available, either for Open Source Software, Windows, etc.

Some examples:

- http://tldp.org/HOWTO/Linux+IPv6-HOWTO/

- http://www.bieringer.de/linux/IPv6/IPv6-HOWTO/IPv6-HOWTO.html

- http://wiki.openwrt.org/IPv6_howto

- http://technet.microsoft.com/en-us/network/bb530961.aspx

- http://www.microsoft.com/technet/network/ipv6/ipv6faq.mspx

Mailing Lists:

LACTF: www.lac.ipv6tf.org

http://lists.cluenet.de/pipermail/ipv6-ops/

http://www.ripe.net/mailman/listinfo/ipv6-wg

Traditional Operative Systems and Software Mailing
  Lists.

Meetings:

- IPv6 Tour?

- FLIP-6 @ LACNIC (Videos are Available)

- Global IPv6 Summit.

- IPv6 Summit Nacionales/Regionales.

- Google IPv6 Summit in YouTube.

Many meetings allow remote participation.

Getting informed, Conclusions:

• Do I understand the technology or do I need to look for help?

• Does IPv6 affects me?, my business? my customer?

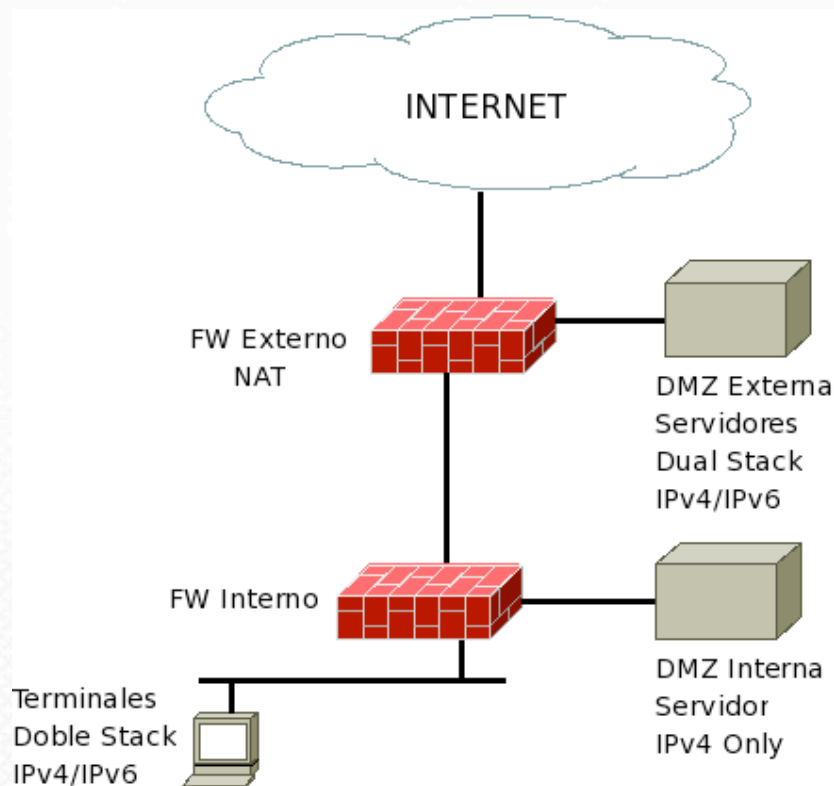• Do I have the resources to go on to the next step? (particularly human resources).

Evaluation

- At this stage I want to answer the following questions:

    - How IPv6 impacts my network or business?
    - How IPv6 impacts my systems?
    - What training and how much will I need?
    - Which are the costs related.

- The objective is come up with a Project Plan to seek to Manager Approval.

- But, first I need an inventory of my equipments, systems and services!

Evaluation (Objectives)

- We need an objective to focus our Project Plan.
- The objective can be:
  - Enterprise network: IPv6 support terminals to access IPv6 only content and external DNS/email IPv6 only servers.
  - ISP: Internet Connection with IPv6 Support, IPv6 support on VPNs.
  - Hosting Companies: Content to be available for IPv6 only hosts natively.
- Contact your marketing and sales teams and check if they have any idea.

Evaluation (Objectives): Example

INTERNET

FW Externo
NAT

DMZ Externa
Servidores
Dual Stack
IPv4/IPv6

FW Interno

DMZ Interna
Servidor
IPv4 Only

Terminales
Doble Stack
IPv4/IPv6

- The objective is to give IPv6 access to terminals and external access to external servers.

- Internal communications can still happen using RFC1918 space.

- Internal servers can still be IPv4 only.

Evaluation: Connectivity

• **Finding Connectivity could be the bottleneck for your IPv6 deployment.**

• **First step: Talk to your upstream providers. They may offer you native or tunnel connections. Normally there are not extra costs.**

• **There are free tunnel options (6in4).**

• **Try to avoid 6to4 or Teredo (if you can).**

• **Consider your internal infrastructure, are you a L3 VPN?**

• **Domain names: Does your Registry/Registrar supports IPv6?**

• **Addressing: Are you going to use PI or PA addressing? Will you qualify under current policies?**

Evaluation: Training.

- We can divide it in two areas:

    - Training on IPv6.

    - Training on specific platforms.

- At this stage, please check the local training opportunities and also the possibility of internal training.

Evaluation: First Experience.

- **Normally a reduced environment.**

- **Can be a lab, but please try to be a place that you have easy access.**

- **Many times Tunnels are a good option. Please remember that fragmentation normally happens in software.**

- **Some free available:**

  - **http://www.tunnelbroker.net - Good connectivity from Miami.**

  - **http://go6.net**

- **TIP: Please choose a close location to avoid long RTT.**

- **You can use addresses from the provider or ask LACNIC for addresses.**

Evaluation: First Experience at home.

- **Equipment options:**

  - Router CPE, example Cisco 827.

  - Apple Airport implements 6to4.

  - "Server" with Windows, linux,Xbsd.

  - Open-WRT for CPEs.

- **Túnels: 6to4 or Tunnel Broker (6in4).**

- **Security: Do not forgot your firewall rules.**

Getting internal Support:

- At this stage you should be able to write an internal document (business plan) to seek internal support. In that case to need to evaluate the cost associated with implemented IPv6. Marketing and sales inputs could be important.

- You need to consider your strategic opportunities and the timeline for the implementation. Why now? What are my competitors doing?

- Stick to your objectives.

- Support can be only partial.

Planning:

- Planning Plan:

  - Addressing.

  - Routing.

  - Services.

  - Software.

  - Training.

- We use as a base the document generated in the previous sessions.
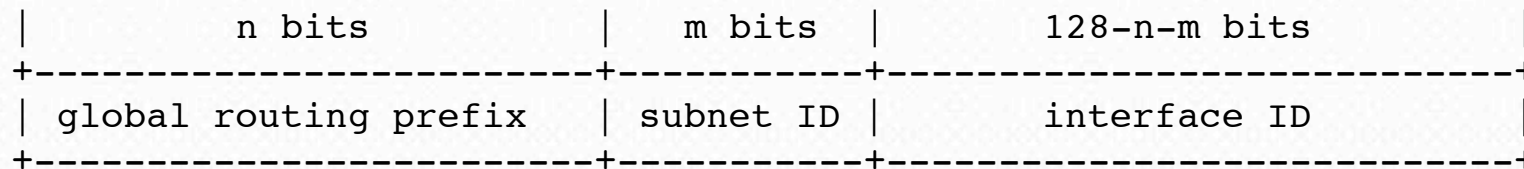
IPv6 Addresses… 6deploy Doc.

Tools:

• **Randomly ULA address generator based on MAC addresses:** http://www.sixxs.net/tools/grh/ula/

• **Tool: ipv6calc. (apt-get install ipv6calc).**

• **Tool: sipcalc -r for reverse DNS.**

• **6to4 Address Calculator: http://www.ip-calc.com/**

• **Subnetting tool: www.ipv6book.ca/allocation.html**

Subnetting IPv6:

Just like in IPv4.

No Subnet mask but only prefix length notation.

Default Route: ::/0

```
|            n bits            |   m bits  |        128-n-m bits          |
+-----------------------------+-----------+------------------------------+
| global routing prefix       | subnet ID |         interface ID         |
+-----------------------------+-----------+------------------------------+
```

Example: Sub-net: 2001:db8:31:1::/64, Global Prefix: 2001:db8::/32, Sub-net ID: 31:1.

Addressing IPv6 LAN:

Generally we will use Interface ID length = 64 bits.

As we have seen we use 64 bits modified IEEE EUI-64 format.

Each LAN will have then: 2^{64}-1 hosts.

There is no "broadcast".

There is no "network address" but:

"Subnet-Router anycast address", RFC 2373.

There is no justification for a shorter then 64 bit prefix in one broadcast domain.

Longer prefixes are possible, ex: /96, etc using DHCPv6.

Addressing IPv6 WAN:

Please read RFC 3627.

Several Options:

> **Use /64 subnets.**
>
> **Use /126 subnets (just like /30 in IPv4).**
>
> **Even /127 could be possible.**
>
> **Other lengths: /112 or /120.**

The most common options: /64 and /126.

Addressing IPv6 Loopbacks:

Again we can use /64 subnets.

Another option is to use /128 (just like /32 in IPv4).

Any other alternative is possible.

Addressing ISP Customers:

Only one receipe: each customer should receive a prefix shorter than /64.

Most common prefixes: /48 or /56 per customer (business and residential).

Fixed IP addresses is expected, but will depend on the business plans.

Please remember two objectives:

    - internal summarizations.

    - always think in 300% growing at least.

Addressing Servers:

Two tendencies:

Addresses that are easy to remember:

ns.lacnic.net.uy - 200.7.84.224 <--> 2001:13c7:7001:4224::224

Addresses "hard to scan".

Consensus that if addresses are in the DNS, no need to chose a random address.

Routing Plan:

You basically repeat what you already do in IPv4. Much better for troubleshooting is to use the same topologies.

Options:

- **IGP:**
  - **STATIC**
  - **OSPFv3**
  - **ISIS**
  - **RIP-NG**
  - **Other: CISCO EIGRP (with IPv6 support).**
- **EGP:**
  - **Multi-protocol BGP with Address Family IPv6, IPv6 Multicast, IPv6 VPN.**

Routing Plan:

BGP: Normally separate sessions for IPv4 and IPv6 (conservative approach). Same config.

Please use same ASN! (same routers).

OSPF: With OSPFv3, you can turn OSPFv2 off.

ISIS: Be careful with Routing Black-Hole.

MPLS: Check 6PE and 6VPE architectures.

Routing Plan: Default Route.

- **ICMPv6 ND (RFC 2461): Can take seconds or cause a lot of traffic in the network.**

- **VRRPv3: It is a draft, adds IPv6 support, some implementations (Juniper, Nokia, etc.).**

- **CARP: Available for OpenBSD, FreeBSD or NetBSD.**

- **Cisco Protocols: HSRP and GLBP.**
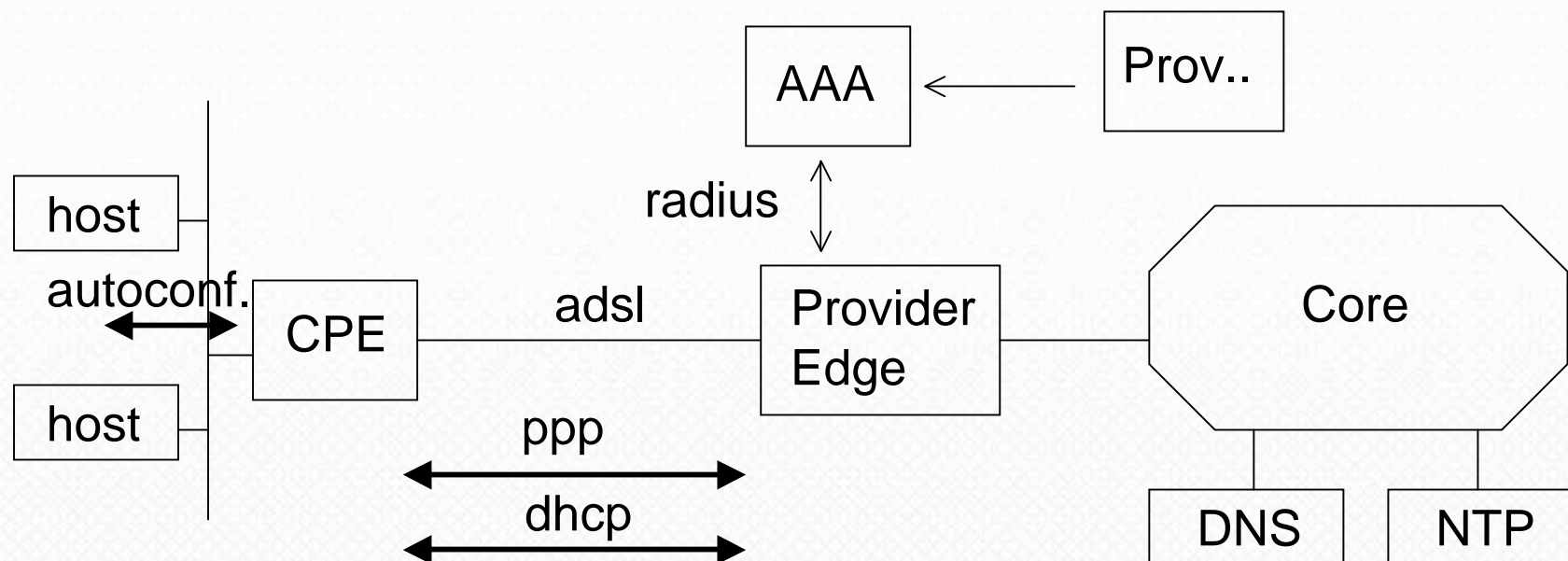
Services:

Key of the IPv6 implementation.

You need to consider services and software that run on top of IP or that manages or use IPv6.

Sometimes is only needed a command as simple as (Listen ::).

Examples: mail, web, dns, jabber, ftp, voip, etc.

Service Delivery for ISPs:

Training Plan:

People: Planning, operations, engineering, call center, marketing and sales.

Not easy to find training options.

Do you need to train your customers? Does your customer know about IPv4?

Implementation Plan:

The idea is to set how to go from the current situation to the goal of the objectives.

Try not the do "satellite" implementations.

Please have the user experience as a center of you implementation plan.

The NOC needs to be "IPv6 enable".

Do not turn IPv6 off at the first problem.

Be careful when turning IPv6 on in a LAN without knowledge from the users.

Be careful when adding AAAA records to the DNS (think that Google uses ipv6.google.com).

Transition Scenarios

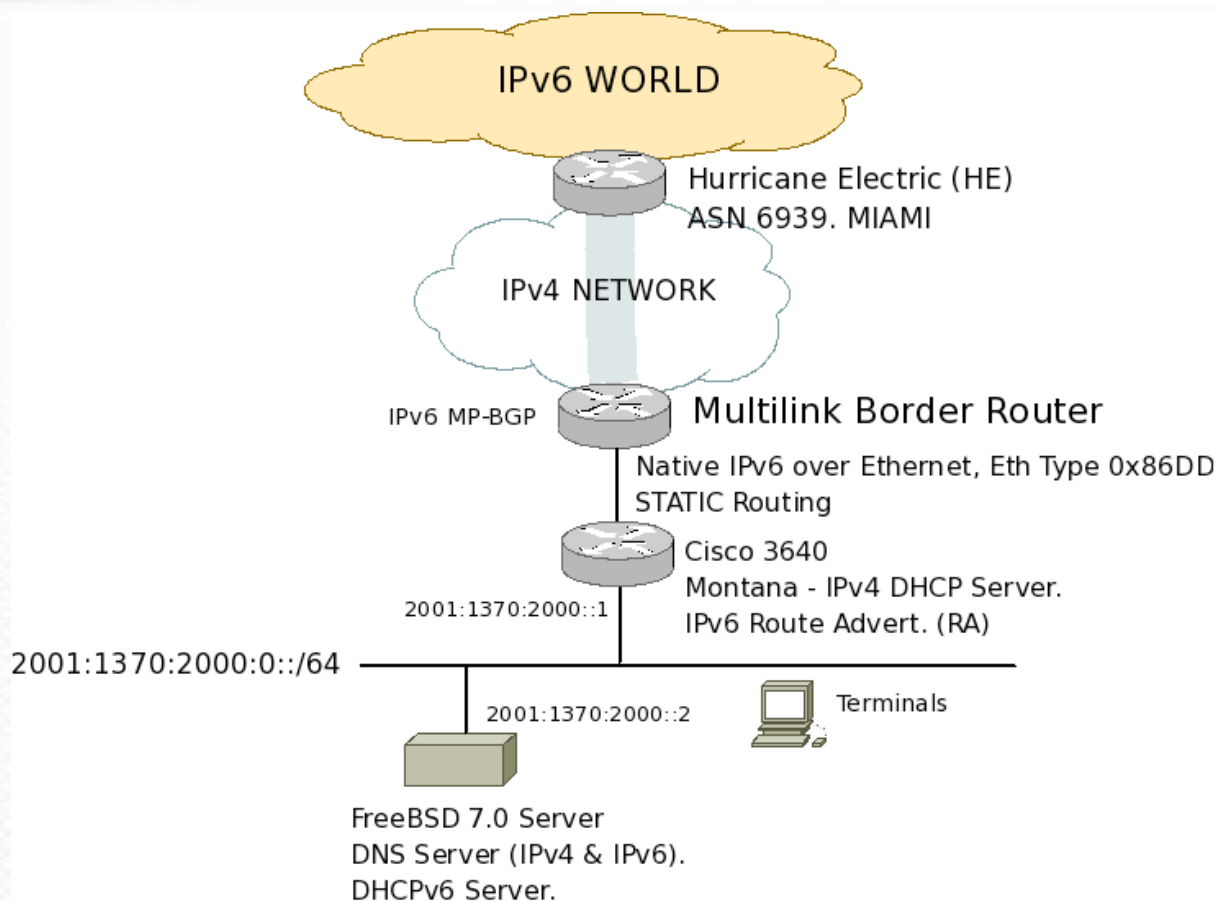The question is: How does an IPv6 only host can access IPv4 content?

You need NAT, a special NAT.

Two options under the table:

NAT-PT: Deprecated and loosing steam. It changes DNS responses.

Softwires: Uses L2TP Tunnels. Gaining steam, wanted by major ISP.

You can always use Proxys or Application layer ALG.

LAB Network:

IPv6 in LACNIC Network Montevideo.

Current Situation:

- **Running Native IPv6 through local provider (ANTEL) and Tunnel to Research Network (SECIU).**

- **Using MP-BGP with own IPv6 addresses.**

- **ASN 28000.**

- **Prefix: 2001:13c7:7001::/48.**

IPv6 in LACNIC Network Montevideo.

Services:

- Wired and Wireless network connection to terminale.

- DNS (recursive and auth).

- NTP over IPv6

- Internal Web Servers.

- Mail

- Jabber (chat).

IPv6 in LACNIC Network Montevideo.

Addressing:

- **/64 for LAN.**
  - **200.7.84.0/27 <--> 2001:13c7:7001:4000::/64**
  - **200.7.85.128/26 <--> 2001:13c7:7001:5128::/64**
- **/128 for Loopbacks.**
- **/126 for Wans.**
- **Servers: Ej: Mail:**
  - **200.7.84.3 <--> 2001:13c7:7001:4000::3**

IPv6 in LACNIC Network Montevideo.

Routing: FreeBSD + Quagga.

🔵 **OSPFv3:**

router ospf6

 router-id 200.7.84.225

redistribute connected

redistribute static route-map static-ospf6

 interface em0 area 0.0.0.0

🔵 **VTY:**

line vty

access-class access4

 exec-timeout 0 0

ipv6 access-class acces

IPv6 in LACNIC Network Montevideo.

Routing FreeBSD + Quagga.

🌑 **BGP:**

address-family ipv6

network 2001:13c7:7001::/48

neighbor ANTELV6 activate

neighbor ANTELV6 next-hop-self

neighbor ANTELV6 soft-reconfiguration inbound

neighbor ANTELV6 maximum-prefix 2000

neighbor ANTELV6 prefix-list TODO in

neighbor ANTELV6 prefix-list NUESTRAS-REDES out

neighbor ANTELV6 route-map ANTEL-IPV6-IN in

neighbor ANTELV6 route-map ANTEL-IPV6-OUT out

neighbor 2800:a0:2:a0:c828:1104:c828:a006 peer-group ANTELV6

exit-address-family

IPv6 in LACNIC Network Montevideo.

Route Adv: FreeBSD + radvd.

DNS: For each A an AAAA.

   mail   A   200.7.84.3

   mail   AAAA   2001:13c7:7001:4000::3

DNS Reverse: we use the tool: sipcalc -r

3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.4.1.0.0.7.7.c.3.1.1.0.0.2.ip6.arpa. IN   PTR   mail.lacnic.net.uy.

Merci beaucoup !