IPv6 Deployment Made Simple

Marc Blanchet

Viagénie

mailto:marc.blanchet@viagenie.ca

http://www.viagenie.ca

Presented at ClueCon, Chicago, August 2009

Viagénie Team Credentials

- Consulting and R&D in IP networking

    – Customers such as providers, enterprises, manufacturers for IPv6/VoIP/Routing deployment, application porting, ...

- 20+ years in IP networking and Unix

- 14 years on IPv6

- Team wrote IETF drafts and RFCs. Co-chair of IETF WGs (idn, vcarddav)

- Wrote the "Migrating to IPv6" book, published by Wiley

- Gave IPv6 tutorials at many conferences. Authored and delivered the Cisco IPv6 course.

- Co-founder and member of the board, IPv6Forum

- Member of steering group of North American IPv6 Task Force

- VoIP developers, ported Asterisk and Freeswitch to IPv6. (Also ported NTP, Quake, … to IPv6)

- Implemented NAT traversal server software (STUN/TURN): http://numb.viagenie.ca

Plan

- Why?

- Key Operational Concepts

- IPv6 configs in hosts, routers and PBX

- Deployment considerations

    - addressing

    - routing/switching

    - ...

- Conclusion

- Talk is not about:

    - developing applications with IPv6 (see cluecon 2008 presentation)

    - Trying to convince you about IPv6...

Why IPv6?

- Initially designed for 2 main reasons: IPv4 address space depletion and global routing table scalability.

- Opportunity to enhance IP: mobility, security, simpler address configuration, enhanced multicast, … IPv6 is a better IP compared to IPv4.

- But these improvements have not yet been sufficient to drive the general deployment of IPv6, except for some specific markets.

- Now, drive is the need for more IP address space, because of IPv4 address space depletion and large private networks:

    - Current estimate: IANA pool empty by Q2 2011. RIR pool empty by Q1 2012. Estimate will change.

- Some large scale networks are planning IPv6-only deployments because of lack of IPv4 address space already.

- Momentum: ipv6.google.com, ipv6.netflix.com, ...

IPv6 Key Operational Concepts

- IPv6 addresses:
    - Ex: 2001:1:2:3:a:b:c:d ; 128bits, 8 hex parts separated by ":"
    - Compressed forms: "::" means all zeros
    - With port number: [2001:1:2:3:a:b:c:d]:80

- Active interfaces automatically configure link-local addresses (fe80::...): link-local only used for communications on the directly connected link.

- Interfaces have multiple addresses

- Usual (and easiest) deployment: dual stack
    - Each interface has both an IPv4 address and IPv6 address.

IPv6 Key Operational Concepts (cont.)
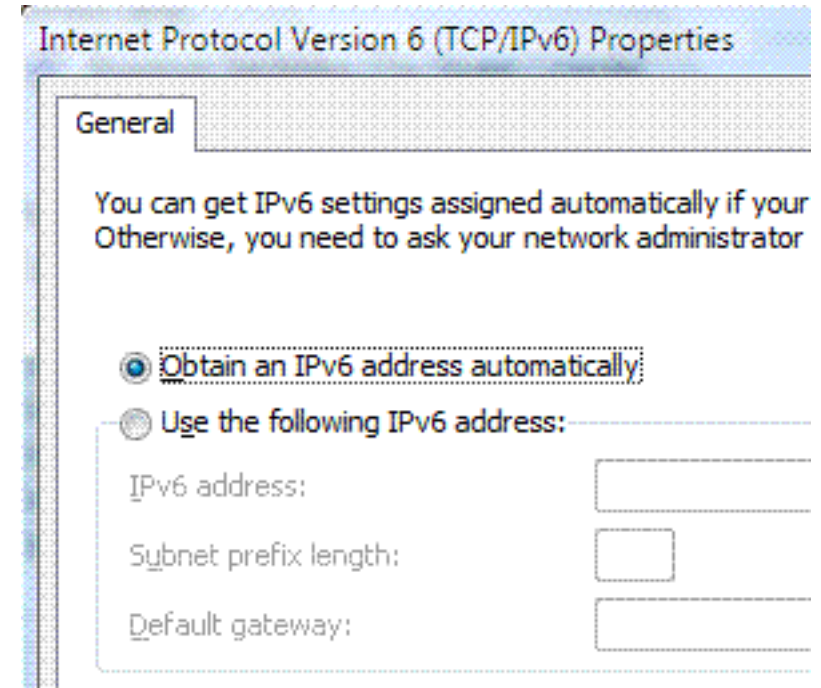
- Address autoconfig
    - known as SLAAC: stateless Address Autoconfiguration
    - supplemental config mechanism (dhcpv6, manual also)
    - Router sends router advertisements that includes prefix, default router and other info. Host uses its mac address as host part.

- Prefix assignments:
    - Subnets/links are /64; no need for VLSM or else.
    - Enterprises receive /48 (65K subnets)
    - Homes receive either /64 (1 subnet) or /56 (256 subnets).
    - Providers receive /32 (65K enterprise customers) to start

OS and PBX IPv6 Configurations

N.B. Using 2001:db8:: as documentation prefix in examples. Do not use it on your network.
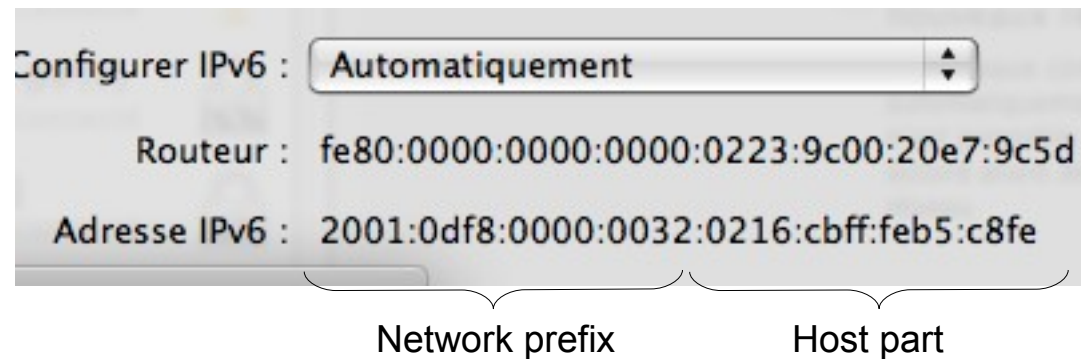
Windows

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- Enabling IPv6:

    - XP: netsh interface ipv6 install (code is there, just enable it)

    - Vista: enabled by default

- By default, uses SLAAC

    - (and creates interfaces for Teredo and ISATAP: tunneling technologies)

- Network Connections->Interface->Properties->Networking->IPv6

- ipconfig; netsh interface ipv6

- Reference: http://www.microsoft.com/ipv6

Internet Protocol Version 6 (TCP/IPv6) Properties

General

You can get IPv6 settings assigned automatically if your
Otherwise, you need to ask your network administrator

- Obtain an IPv6 address automatically
- Use the following IPv6 address:

IPv6 address:

Subnet prefix length:

Default gateway:

MacOSX

- Network Preferences->Advanced
- Supports: manual or SLAAC

Configurer IPv6 :	Automatiquement
Routeur :	fe80:0000:0000:0000:0223:9c00:20e7:9c5d
Adresse IPv6 :	2001:0df8:0000:0032:0216:cbff:feb5:c8fe

Network prefix   Host part

```
# ifconfig en1
  inet6 fe80::216:cbff:feb5:c8fe%en1 prefixlen 64 scopeid 0x6
  inet6 2001:df8::32:216:cbff:feb5:c8fe prefixlen 64 autoconf
  ether 00:16:cb:b5:c8:fe
```

Linux

- Fedora as example
- /etc/sysconfig/network
  - NETWORKING_IPV6=yes
- /etc/sysconfig/network-scripts/ifcfg-eth0
  - IPV6INIT=yes
    - activate IPv6 on interface
    - listen to RA (i.e. SLAAC)
  - Manual address:
    - IPV6ADDR=2001:db8:1:1::1/64
    - IPV6_DEFAULTGW=2001:db8:1:1::2/64

FreeBSD (and *BSD)

- /etc/rc.local

    - ipv6_enable=yes

        - # enables ipv6 on all interfaces
        - #listens to RA (ie. SLAAC)

    - Manual address config:

        - ipv6_ifconfig_fxp0="2001:db8:1:1::1/64"
        - ipv6_defaultrouter="fe80::2"

Cisco IOS

- **ipv6 unicast-routing**

    - enables ipv6 forwarding.

- **ipv6 cef/dcef**

    - Enables Cisco express forwarding for IPv6

- **interface gigabitethernet0**

    - ipv6 address 2001:db8:1:1::1/64
    - ipv6 nd prefix-advertisement 2001:db8:1:1::/64

        - (not needed. By default, sends RA when interface has ipv6 address)

- **ipv6 route ::/0 gigabitethernet0 (::/0 = default route)**

- **ipv6 access-list ...**

Juniper JunOS

interfaces fe-0/0/1 { unit 0 {

  family inet6 { address 2001:db8:1:1::1/64; } } }

  # enables IPv6 on the FE interface

protocols { router-advertisement {

  interface fe-0/0/1 { prefix 3ffe:b00:0:1::/64; } } }

  # configures RA on FE interface

Asterisk IPv6

- IPv6 feature not yet in trunk.

- Get code from http://www.asteriskv6.org

- Only SIPv6 available (no IAXv6)

- sip.conf

  - Bindaddr:

    - If none specified, asteriskv6 binds to both v4 and v6 wildcards
    - Or specify v4 or v6 address with/without ports
    - bindaddr=2001:db8:1::1
    - bindaddr=[2001:db8:1::1]:5061
    - Can specify many bindaddr lines as needed

Freeswitch IPv6

- Since 1.0.1
  - (announced at Cluecon 2008. see presentation)
- Only SIP is IPv6 capable. (not yet IAX,...). IPv6 ACL mostly coded, not yet committed.
- Conf:
  - $$\{local_ip_v6\}$ refers to the binded IPv6 address
  - <param name=""> may be set to IPv6 addresses:
    - rtp_ip
    - sip_ip

Phones

- Many available as alpha-beta-or-soon-to-be-productized versions: Counterpath, Snom, Dlink, Polycom, ...

- Ask your preferred vendor...

Deployment Considerations

Addressing

- As enterprise, get IPv6 prefix (/48) from upstream, unless multihomed where you can get PI from RIR

- As provider, get IPv6 prefix (/32) from RIR

- Internal network:
    - Each subnet has /64
    - Only consideration for subnet assignments is IGP route prefix aggregation

- Efficient address plan method: RFC3531

-

- RIR = (ARIN, RIPE, APNIC, LACNIC, AFRINIC)

IPv6 Private Address Space

- Known as ULA (Unique Local Address)
- fd<40 bits random number>::/48
- (Shall be) non-overlapping private space.
- In addition to global address space:
    - ie. A link may have a global prefix and ULA prefix.
- May be used to number your network before you have an IPv6 upstream provider
- RFC4193

Routing/Switching

- OSPFv3:
  - different process/database/... than OSPFv2.
- ISIS:
  - same process; integrated topology. Be careful if v4 and v6 topologies are different: extension exists.
- BGP
  - Same process, new address family
- MPLS:
  - 6PE: PE are IPv6-enabled. P are unaware of IPv6.
  - 6VPE: for IPv6 VPN across MPLS core.

IPv4 and IPv6

- Dual-stack:
  - all links, hosts, routers run IPv4 and IPv6.
  - usual recommended approach for deployment

- IPv6-only:
  - Some starting to plan IPv6-only networks because depletion of IPv4 address space coming soon.
    - Ex: Large cable operators in North America
  - Easier for network operation: only one IP network to manage.
  - However, for application/service perspective, it is more difficult: need proxy or "smart" translators between the two address families. Scaling considerations.
  - IPv4 legacy nodes and applications.

Provisioning

- Infrastructure devices (servers, routers, vpn, switches, ...) shall have fixed (ie. manual) IPv6 addresses.

- Endpoints may use SLAAC. DHCPv6 is used when more control is needed.

- DNS IPv6 server addresses are sent either:
  - Through RA [RFC5006] (not implemented by all yet)
  - Through DHCPv6
  - Not so much a concern if you still run IPv4 DNS servers and dual-stack network

- While IPv6 stack supports multiple addresses per interface, try to provision the least number; makes operations simpler (logs, ACL, ...)

Upstream Provider

- If your upstream is not providing IPv6, you may use:

    - Tunnel brokers:

        - NAT traversal
        - Provides real IPv6 address and prefix
        - see: http://freenet6.net

    - 6to4: (v4 address embedded in v6 with automatic tunnelling). Be careful about:

        - RTT
        - dependency on your IPv4 external address
        - No NAT traversal

    - Teredo: for single hosts. NAT traversal.

Sample LAN

- Link: 2001:db8:1:1::/64

- Router: 2001:db8:1:1::1

- PBX: 2001:db8:1:1::2

- Phone1: 2001:db8:1:1::3 (or SLAAC or dhcpv6)

- Phone2: 2001:db8:1:1::4

- NB. 2001:db8::/32 is a documentation prefix. Don't use it on your network. Use ULA or assigned prefix.

VoIP IPv4 - IPv6 Interoperability

- IPv4 and IPv6 UAs can communicate via a relay.

- Usually relay is a B2BUA (e.g. FreeSWITCH)

- Consider using a cross-protocol TURN server.

- SIP Protocol/Deployment considerations:

    - Three protocols: SIP, SDP, RTP. Different states. Sometimes on different boxes.

    - Negociating different address families when not all pieces are at the same implementation levels may have "interesting" side effects.

    - Might want to consider single address family VoIP deployments for operational simplicity.

    - Not many people can claim to have good experience in mixed VoIP deployments. Be careful...

Conclusion

- Discussed:
  - IPv6 key operational concepts
  - Configurations for hosts, routers, PBXs
  - Deployment considerations
- Try IPv6 now!
  - http://www.freeswitch.org
  - http://www.asteriskv6.org
  - http://freenet6.net

Questions?

Contact info:

    Marc.Blanchet@viagenie.ca

This presentation is available at http://www.viagenie.ca/publications/

References

- http://www.asteriskv6.org, http://www.freeswitch.org, http://freenet6.net

- IPv4 address depletion estimate: http://ipv4.potaroo.net

- [RFC3531] Blanchet, M., "A Flexible Method for Managing the Assignment of Bits of an IPv6 Address Block", RFC 3531, April 2003.

- [RFC4193] Hinden, R. and B. Haberman, "Unique Local IPv6 Unicast Addresses", RFC 4193, October 2005.

- Migrating to IPv6, Marc Blanchet, Wiley, 2006, ISBN 0-471-49892-0, http://www.ipv6book.ca

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