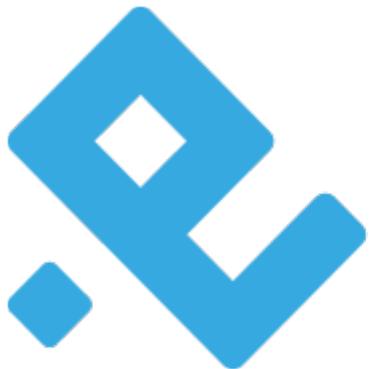


IPv6 in Basic Networking



apachecloudstack[™]
open source cloud computing



pcextreme

Who am I?

- Wido den Hollander (1986)
- Co-owner and CTO @ PCextreme B.V.
 - Dutch hosting company
- CloudStack VP
 - Integrated Ceph into CloudStack
 - Work on the KVM Hypervisor code
 - Integrated IPv6 in Basic Networking



Who is PCextreme B.V.?

- Dutch hosting company since 2004
- 25 employees
- 50.000 customers
- >100.000 shared hosting packages
- Running a *public cloud* on Apache CloudStack with IPv6 and Ceph storage
- CloudStack zones in Amsterdam, Barcelona, Miami, Tokyo and Los Angeles



Hello IPv6!

Did you dare to touch it yet?



IPv6

```
if (ipv4addresses.length < 5%) {  
    System.out.println("IPv4 is almost exhausted");  
}
```



IPv4 vs IPv6

IPv4	IPv6
32-bit (4.294.967.296 addresses)	128-bit (3.402823669×10 ³⁸ addresses)
/24 (255 addresses)	/64 (1.844674407×10 ¹⁹ addresses)
Broadcast	Multicast
ARP	Neighbor Discovery
DHCP	StateLess Address AutoConfiguration
NAT	Routed Addresses
iptables	ip6tables
ICMP is a nice to have	ICMP(v6) is mandatory
Virtual Routers (VRRP)	Router Advertisements
169.254.0.0/16	fe80::/10
0.0.0.0/0	::/0



2001:db8::/32

Reserved for example and documentation use in
RFC3849



No more NAT

With IPv6 each host on the Internet will get a publicly routed address

This means that there is no more need for NAT

Routers will become true **routers** again instead of *packet translators*



Firewalling

NAT != Firewall

With IPv6 you can still use stateful firewalling

ip6tables with *ESTABLISHED,RELATED*



Link-Local

fe80::/10

Mandatory for each IPv6 host and is used for communication in that (Layer 2) network segment

Router Advertisements, Gateways, Neighbor Discovery, Duplicate Address Detection all work over Link-Local



Link-Local

```
root@ubuntu1604:~# ip -6 addr show dev ens3
2: ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 state UP qlen 1000
    inet6 2001:db8:100:0:45b:2cff:fe00:bb/64 scope global
        valid_lft 86391sec preferred_lft 14391sec
    inet6 fe80::45b:2cff:fe00:bb/64 scope link
        valid_lft forever preferred_lft forever
root@ubuntu1604:~#
```



Link-Local

```
root@ubuntu1604:~# ip -6 route show
2001:db8:100::/64 dev ens3 proto kernel metric 256 expires 86385sec
fe80::/64 dev ens3 proto kernel metric 256 pref medium
default via fe80::5054:ff:fe59:c2b3 dev ens3 proto ra metric 1024
expires 165sec hoplimit 64 pref medium
root@ubuntu1604:~#
```



Link-Local

```
root@ubuntu1604:~# ping6 -c 3 fe80::5054:ff:fe59:c2b3%ens3
PING fe80::5054:ff:fe59:c2b3%ens3(fe80::5054:ff:fe59:c2b3) 56 data bytes
64 bytes from fe80::5054:ff:fe59:c2b3: icmp_seq=1 ttl=64 time=0.719 ms
64 bytes from fe80::5054:ff:fe59:c2b3: icmp_seq=2 ttl=64 time=0.644 ms
64 bytes from fe80::5054:ff:fe59:c2b3: icmp_seq=3 ttl=64 time=0.942 ms

--- fe80::5054:ff:fe59:c2b3%ens3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 0.644/0.768/0.942/0.128 ms
root@ubuntu1604:~#
```



Router Advertisements

Using multicast routers advertise themselves on the network

They advertise the prefix/subnet and their *Link-Local Address*

(And lifetime, priority, DNS servers, DNS domain)



Router Advertisements

Hello! I am a router in this network

My address is fe80::5054:ff:fe59:c2b3

The subnet in this network is 2001:db8:100::/64

*Oh, if you wanted to know, the DNS servers you can use are
2001:db8:200:1::53 and 2001:db8:200:2::53*



StateLess Address AutoConfiguration

Routers advertise the subnet for a network

Using a combination of the subnet and it's MAC
the host generates a address

This is *Autoconfiguration* **without** a database



StateLess Address AutoConfiguration

```
root@ubuntu1604:~# ip addr show dev ens3
2: ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
pfifo_fast state UP group default qlen 1000
    link/ether 06:5b:2c:00:00:bb brd ff:ff:ff:ff:ff:ff
    inet6 2001:db8:100:0:45b:2cff:fe00:bb/64 scope global
        valid_lft 86368sec preferred_lft 14368sec
    inet6 fe80::45b:2cff:fe00:bb/64 scope link
        valid_lft forever preferred_lft forever
root@ubuntu1604:~#
```



Linux and BSD

Make sure Privacy Extensions are disabled

```
net.ipv6.conf.all.use_tempaddr = 0  
net.ipv6.conf.default.use_tempaddr = 0
```



Windows

Use MAC as identifier

```
netsh interface ipv6 set privacy state=disabled store=persistent  
netsh interface ipv6 set global randomizeidentifiers=disabled store=persistent
```



Basic Networking

Directly connected to the network/internet



Address selection

We know the subnet and MAC!



Obtaining the address

The Management Server calculates the IPv6 Address the Instance will obtain using the subnet and MAC address



Obtaining the address

```
mysql> select * from vlan \G
***** 1. row *****
      id: 1
      uuid: 5e8b1050-ab7c-4fcc-8c67-cac1528cdfd5
      vlan_id: vlan://untagged
      vlan_gateway: 192.168.200.1
      vlan_netmask: 255.255.255.0
      description: 192.168.200.10-192.168.200.250
      vlan_type: DirectAttached
      data_center_id: 1
      network_id: 204
      physical_network_id: 200
      ip6_gateway: 2001:db8:100::1
      ip6_cidr: 2001:db8:100::/64
      ip6_range: NULL
      removed: NULL
      created: 2017-04-11 05:58:55
1 row in set (0.00 sec)

mysql>
```



Obtaining the address

NIC 1 (Default)	
ID	fc7d4024-4af4-418a-baba-6545494f39a4
Network Name	defaultGuestNetwork
Type	Shared
IP Address	192.168.200.95
Secondary IPs	
Gateway	192.168.200.1
Netmask	255.255.255.0
IPv6 IP Address	2001:db8:100:0:45b:2cff:fe00:bb
IPv6 Gateway	2001:db8:100::1
IPv6 CIDR	2001:db8:100::/64



Security Grouping

Works just like with IPv4



Security Grouping

Details Ingress Rule Egress rule

Add by:
 CIDR Account

Protocol	Start Port	End Port	CIDR	Add
TCP	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="Add"/>
TCP	22	22	0.0.0.0/0	<input type="button" value="tag"/> <input type="button" value="x"/>
ICMP	-1	-1	0.0.0.0/0	<input type="button" value="tag"/> <input type="button" value="x"/>
TCP	80	80	0.0.0.0/0	<input type="button" value="tag"/> <input type="button" value="x"/>
TCP	22	22	:::0	<input type="button" value="tag"/> <input type="button" value="x"/>
ICMP	-1	-1	:::0	<input type="button" value="tag"/> <input type="button" value="x"/>
TCP	80	80	:::0	<input type="button" value="tag"/> <input type="button" value="x"/>



DEMO

Live demos are dangerous. They always fail..



TODO

- System VMs should get IPv6
- Cloud-init doesn't work over IPv6 (config drive?)
- Prefix Delegation
 - Route a subnet to a Instance
- Advanced Networking (?)



When

Apache CloudStack 4.10



Thank you!



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