FOSDEM 2020

HashDNS and FQDN DHCP
IPv6 DNS configuration made easy

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All what you need is:

$ cat /etc/network/interfaces.d/eth0
iface tap0 inet6 manual
    fqdn dhcp "this.is.my.name.org"

This configures:
• IPv6 address
• IPv6 name resolution
• IPv6 reverse name resolution
Why?

- IPv6 adoption is urgent:
  
  *The RIPE NCC has run out of IPv4 Addresses*

  Today, at 15:35 (UTC+1) on 25 November 2019, we made our final /22 IPv4 allocation from the last remaining addresses in our available pool. We have now run out of IPv4 addresses. ...

- Internet of things and Internet of threads nodes are servers: they need name resolution.
Idea #1: FQDN DHCP

- Use your fully qualified domain name in your dhcp request
- The dhcp server can ask a DNS which is the IP address of your FQDN and forward the answer as the reply for the stateful address autoconfiguration
- (extensive interpretation of RFC4702)
FQDN DHCP

1. DHCP QUERY: this.is.my.name.org
2. DNS AAAA REQUEST: this.is.my.name.org
3. DNS AAAA REPLY: 2001:760:AAAA::1
4. DHCP REPLY: 2001:760:AAAA::1
Idea #2: Hash based IPv6 addresses

- The host suffix of addresses can be computed by a hash function.
- No more 128 bit address to type!
- Self configuration of Hosts and DNS servers

Prefix: 2001:a:b:c::/64
Name: tizio.rome.mycorp.org
Hash: 9e50:7571:373:6ab2
DNSHASH

Client

(1) AAAA query
www.hash.myname.org

(2) AAAA query
www.hash.myname.org

DN server
mydomain.org

(3) AAAA query
www.hash.myname.org

HASHDNS
hash.myname.org

(4) AAAA query
hash.myname.org.base.hash.myname.org
DNSHASH

(5) AAAA reply
Base addr = 2001:760:aaaa:bbbb::

(6) AAAA reply
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:1f1f

(7) AAAA query
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:1f1f

(8) AAAA query
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:1f1f
Idea#3 = use FQDNDHCP and HASHDNS together

The DNS server/domain used by FQDNDHCP can be provided by HASHDNS:

• The client adds its name in the dhcp request.
• The DHCP server sends a DNS query for the client’s name.
• The DNS systems recursively forwards the query to the hash-dns server
• HashDNS returns the hash generated address.
• (the answer passes through the previous steps backwards up to the client, dhcp sets the address).
Hash Collisions?

- Hash Collisions are theoretically possible:
- Two FQDN may generate the same address
- The probability can be computed as an application of the Birthday paradox problem
- For networks connecting up to 1000 nodes the probability is $< 10^{-14}$
- In this unlikely situation.... I suggest to change the hostname.
- (if it happens again, maybe a pilgrimage to a statistics department may help)
DEMO scenario

DNS server primary for v2.cs.unibo.it

VDE SWITCH

CLIENT
Kvm VM
Namespace
IoTh process

FQDNDHCP

HASHDNS
For hash.v2.cs.unibo.it
### bind9 delegation

(server DNS)
```
# cat /etc/bind/primary/db.v2.cs.unibo.it
...
hash-dns  300     A       130.136.31.253
hash-dns  300     AAAA    2001:760:2e00::ff00::fd
hash      IN      NS      hash-dns
hash.v2.cs.unibo.it.map IN      AAAA    2001:760:2e00::ff00::fd
renzo     IN      CNAME   renzo.hash
...
```

### the vde cable to the Internet
```
$ vde_plug vde:// cmd://'ssh vde vde_plug'
```

### hashdns server
```
$ hashdns -s vde:// -D map.v2.cs.unibo.it 130.136.31.253/24,130.136.31.1
   2001:760:2e00::ff00::fd,2001:760:2e00::ff00::1
```

### fqdndhcp server
```
$ ./fqdndhcp -s vde://
```

### namespace client:

$ vdens vde://
$$ echo 'send fqdn.fqdn "foo.hash.v2.cs.unibo.it";' > /tmp/dhclient.cf

### start the dhcp client (add -i -d for debug)
$$ /sbin/dhclient -6 -i vde0 -cf /tmp/dhclient.cf -lf /tmp/dhclient.lease

### kvm machine:
$ kvm -cdrom finnix-110.iso -monitor stdio \  
edevice e1000,netdev=vde0,mac=52:54:00:00:00:02 \  
-netdev vde,id=vde0,sock=vde:// -hda /tmp/dhcpdisk

#### in the kvm vm
# cat > /etc/network/interfaces.d/eth0
iface eth0 inet6 manual
   fqdn dhcp "finnix.hash.v2.cs.unibo.it"
# mount /dev/sda /mnt
# sh /mnt/script
# ifup eth0
$ cat script
cp /mnt/aux-files/ifupdown/if-up.d/fqdndhcp /etc/network/if-up.d/
cp /mnt/aux-files/ifupdown/if-down.d/fqdndhcp /etc/network/if-down.d/
$ cat /mnt/aux-files/ifupdown/if-up.d/fqdndhcp

```bash
case "$METHOD" in
  manual) : ;;
  *) exit 0 ;;
esac
```

```bash
case "$ADDRFAM" in
  inet6) : ;;
  *) exit 0 ;;
esac
```

```bash
if [ "$IF_FQDNDHCP" ] ; then
  cp /etc/dhcp/dhclient.conf /var/lib/dhcp/dhclient6.$IFACE.conf
  echo send fqdn.fqdn $IF_FQDNDHCP\; >>/var/lib/dhcp/dhclient6.$IFACE.conf
  sleep 2
fi
```

$ cat /mnt/aux-files/ifupdown/if-down.d/fqdndhcp

```bash
case "$METHOD" in
  manual) : ;;
  *) exit 0 ;;
esac
```

```bash
case "$ADDRFAM" in
  inet6) : ;;
  *) exit 0 ;;
esac
```

```bash
if [ "$IF_FQDNDHCP" ] ; then
  /sbin/dhclient -6 -x -pf /run/dhclient6.$IFACE.pid -lf /var/lib/dhcp/dhclient6.$IFACE.leases $IFACE
  rm -f /run/dhclient6.$IFACE.pid /var/lib/dhcp/dhclient6.$IFACE.conf
fi
Further info

wiki.virtualsquare.org

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We are still creating art and beauty on a computer:

the art and beauty of revolutionary ideas translated into (libre) code...

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