FOSDEM 2020

HashDNS and FQDNDHCP
IPv6 DNS configuration made easy

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All what you need is:

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

This configures:

- IPv6 address
- IPv6 name resolution
- IPv6 reverse name resolution

Why?

- IPv6 adoption is urgent:

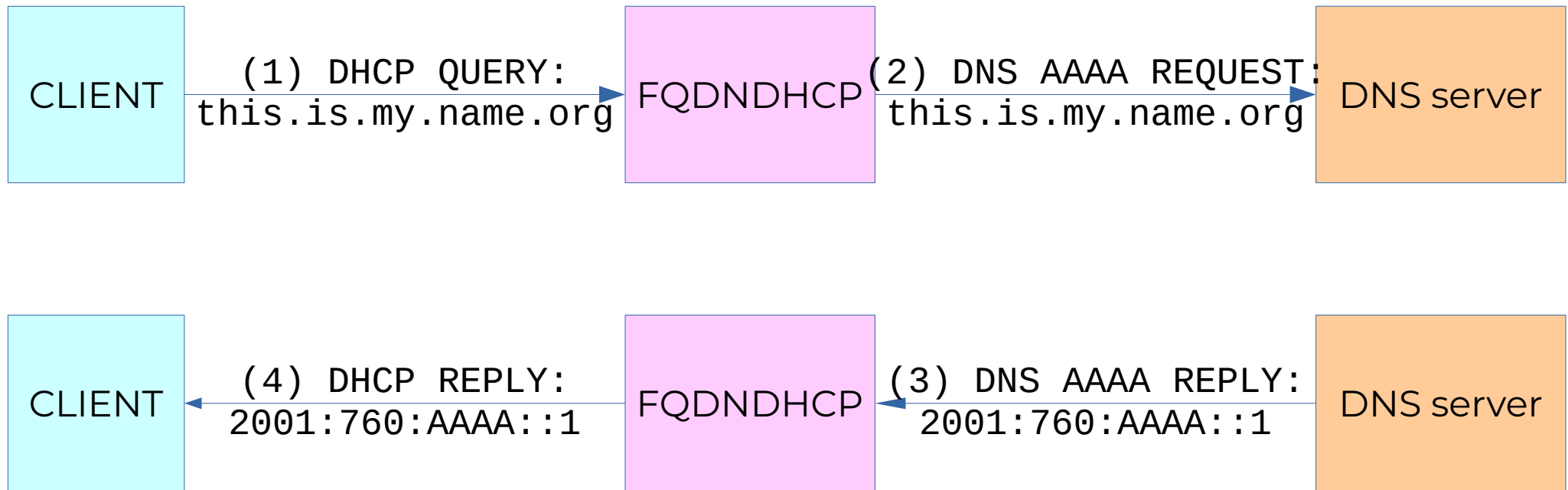*The RIPE NCC has run out of IPv4 Addresses*

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.
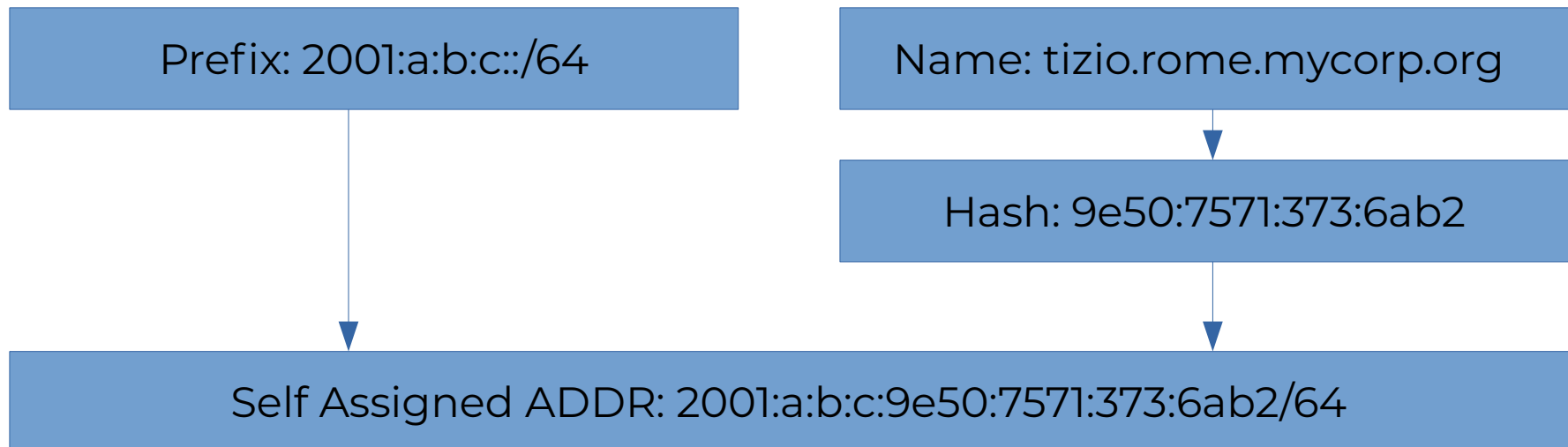
Idea #1: FQDN DHCP

- 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

CLIENT → (1) DHCP QUERY: this.is.my.name.org → FQDNDHCP → (2) DNS AAAA REQUEST: this.is.my.name.org → DNS server

CLIENT ← (4) DHCP REPLY: 2001:760:AAAA::1 ← FQDNDHCP ← (3) DNS AAAA REPLY: 2001:760:AAAA::1 ← DNS server

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!
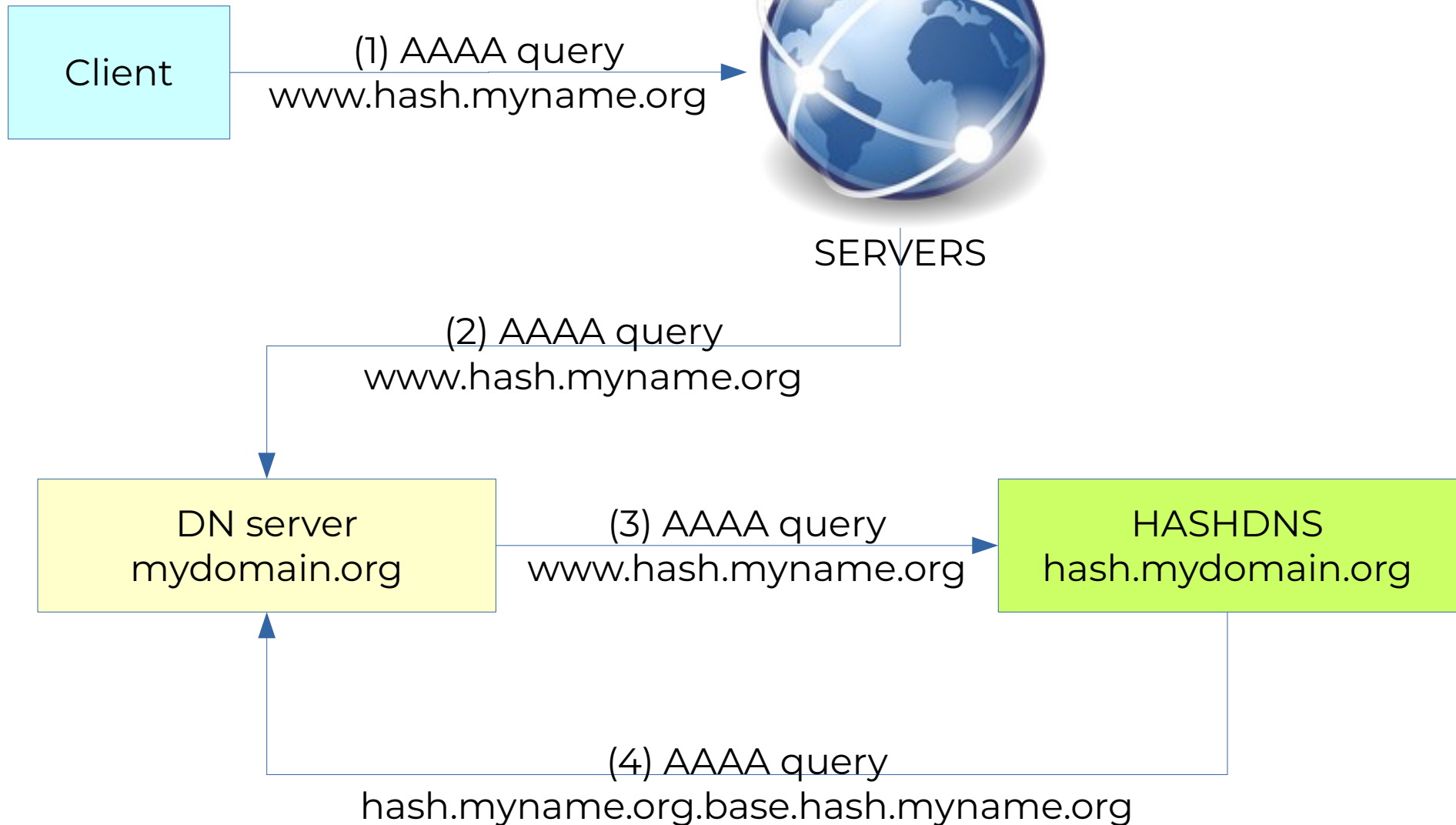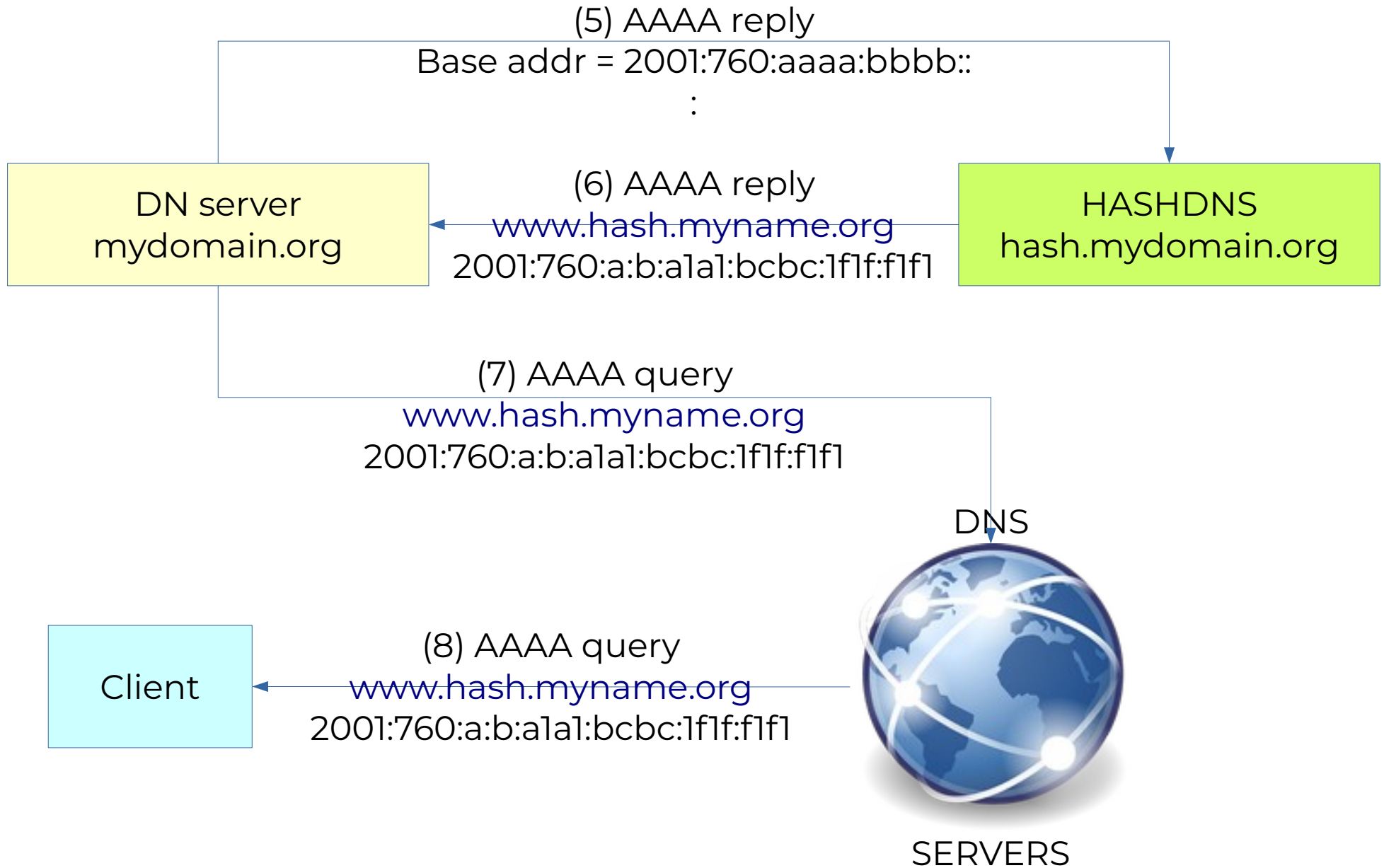
- Self configuration of Hosts and DNS servers

Prefix: 2001:a:b:c::/64		Name: tizio.rome.mycorp.org

Hash: 9e50:7571:373:6ab2

Self Assigned ADDR: 2001:a:b:c:9e50:7571:373:6ab2/64

DNSHASH

DNS

SERVERS

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.mydomain.org

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

DNSHASH

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

DN server
mydomain.org

HASHDNS
hash.mydomain.org

(6) AAAA reply
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:f1f1

(7) AAAA query
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:f1f1

DNS

Client

(8) AAAA query
www.hash.myname.org
2001:760:a:b:a1a1:bcbc:1f1f:f1f1

SERVERS

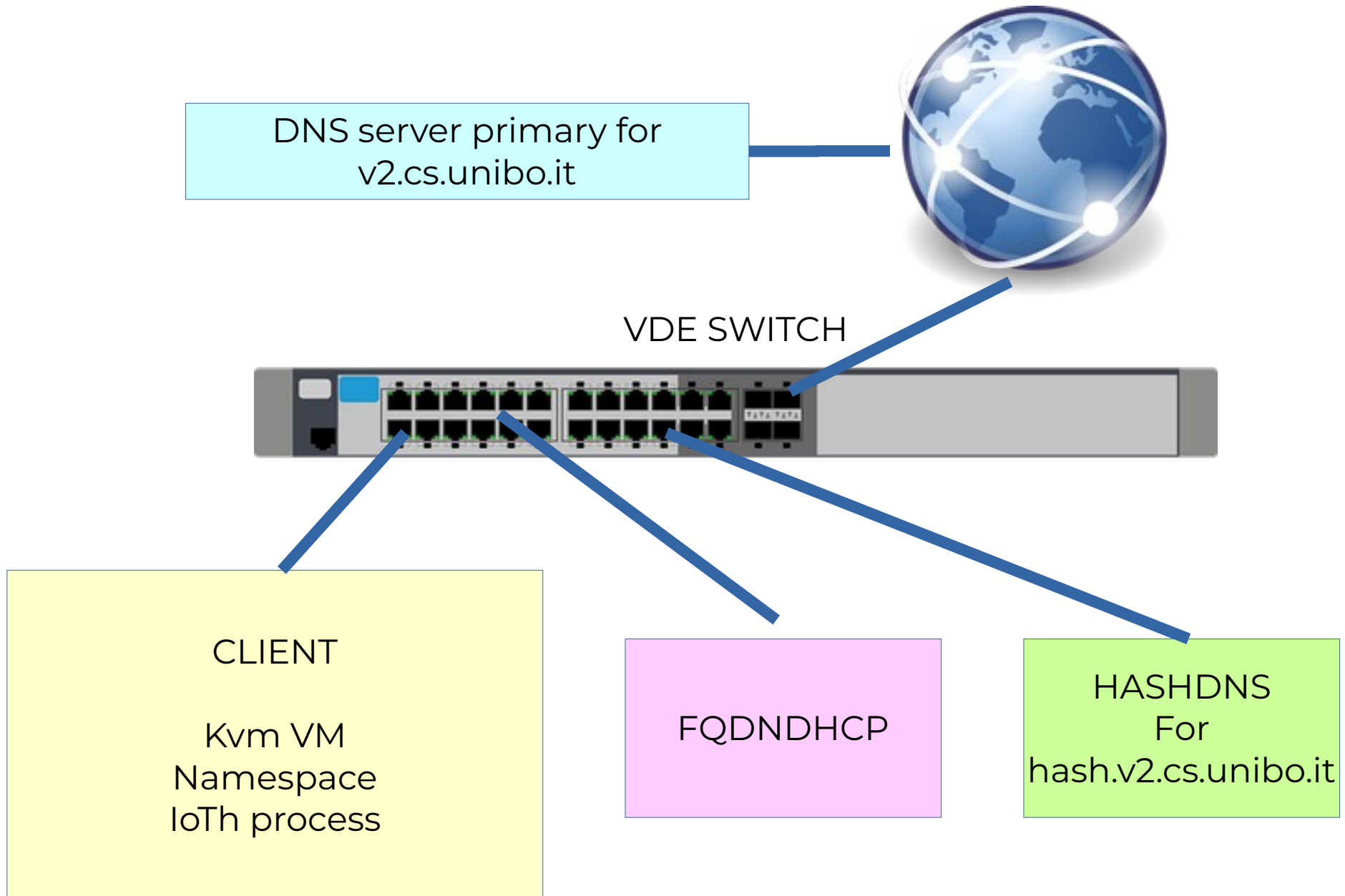# Idea#3 = use FQDNDHCP and HASHDNS together

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::
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 \
-device 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
        fqdndhcp "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
case "$METHOD" in
  manual) : ;;
  *) exit 0 ;;
esac
case "$ADDRFAM" in
  inet6) : ;;
  *) exit 0 ;;
esac
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
        /sbin/dhclient -6 -pf /run/dhclient6.$IFACE.pid -lf /var/lib/dhcp/dhclient6.$IFACE.leases \
                -cf /var/lib/dhcp/dhclient6.$IFACE.conf $IFACE
Fi
$ cat /mnt/aux-files/ifupdown/if-down.d/fqdndhcp
case "$METHOD" in
  manual) : ;;
  *) exit 0 ;;
esac
case "$ADDRFAM" in
  inet6) : ;;
  *) exit 0 ;;
esac
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
```
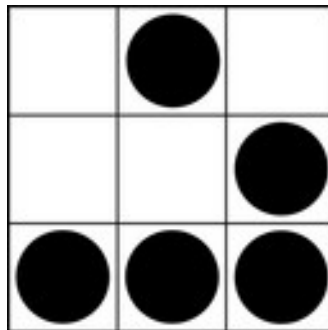
Further info

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...

renzo, rd235, iz4dje