Using DHCP-PD to Allocate /64 per Host

draft-collink-v6ops-ent64pd

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IPv6 Hosts Have Multiple Addresses

Just any "ordinary" host:

A single-prefix network: link-local + stable +privacy + 464XLAT = 4

Two-prefixes (multihoming or renumbering): 7

ChromeOS: the current requirement is 7-9 addresses per device

Future Use Cases: SIGCOMM CCR Paper (see PANRG talk)

RFC7934: *"it is RECOMMENDED that IPv6 network deployments provide multiple IPv6 addresses from each prefix to general-purpose hosts. To support future use cases, it is NOT RECOMMENDED to impose a hard limit on the size of the address pool assigned to a host."*

Implications

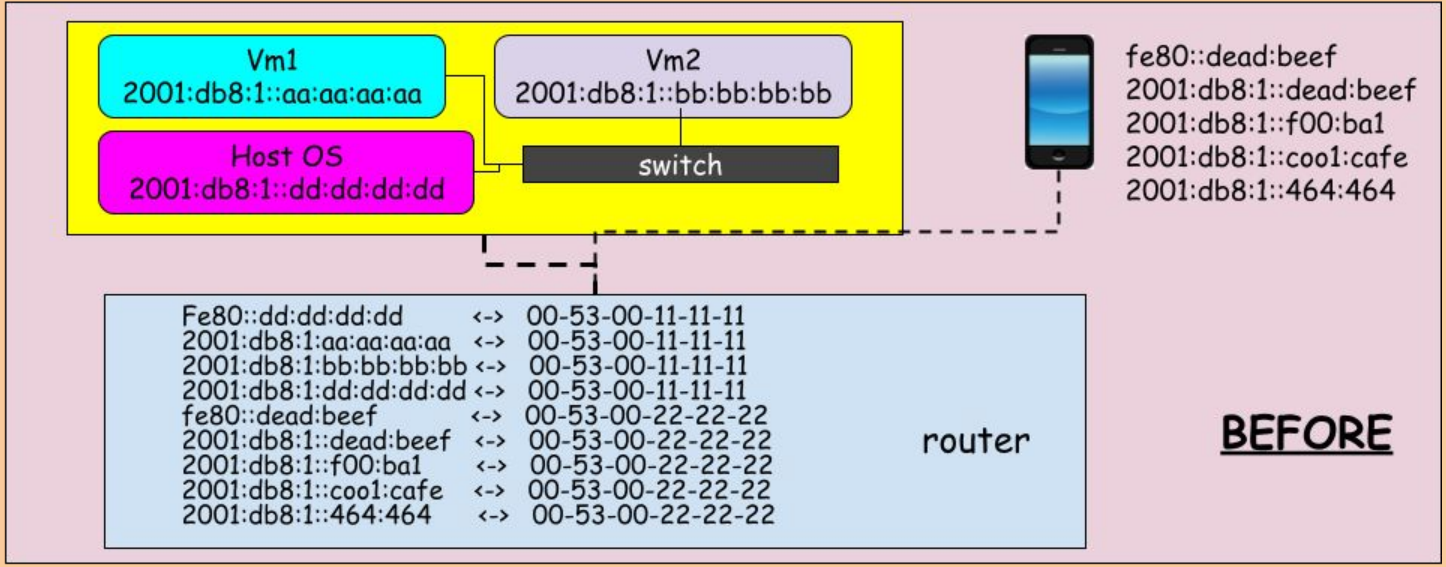
- Scalability
  - ND and ND proxy caches on routers, switches and APs
  - EVPN Type 2 Routes
- Accountabilty
  - What device was using the given address?
- Unpredictable failure mode
  - When an address is blocked: how to know? What to do?

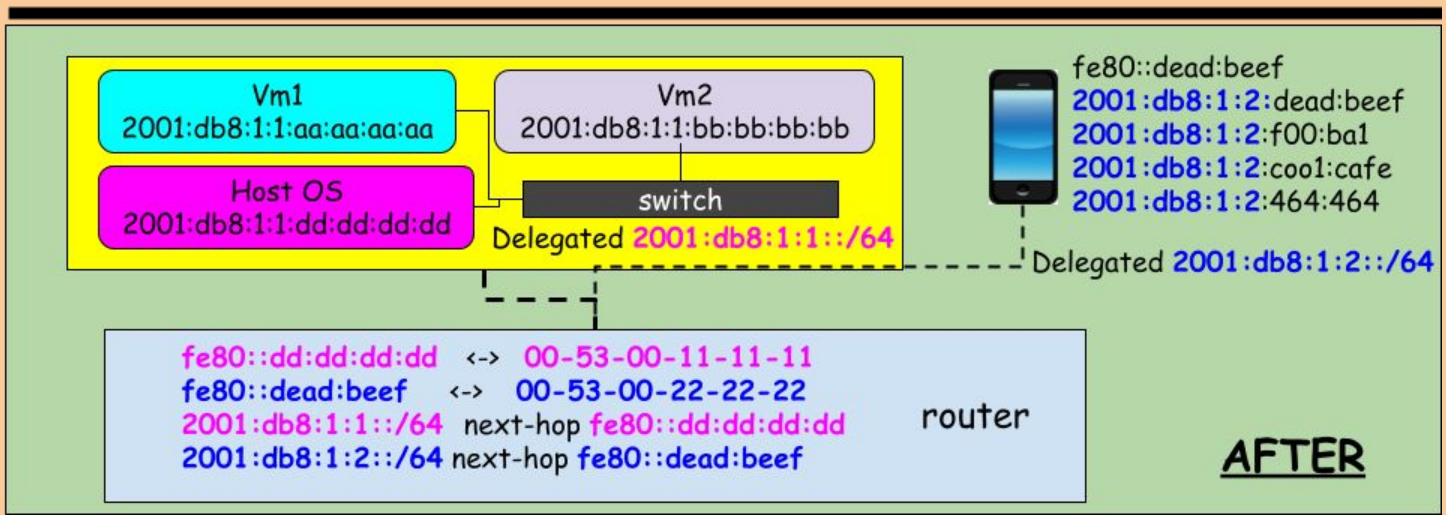

Host's needs
Operator's requirements
JAKE-CLARK.TUMBLR
imgflip.com


CONSENSUS AHEAD
buckle up
rough road
Source: Knight Foundation

Proposed Solution

- Network provides DHCP-PD service
- The host requests a prefix (/64)
- The host uses deleaged prefix to assign addresses to its interfaces and/or expand the network downstream
  - Just like in IPv4… but no need to use NAT!


Vm1
2001:db8:1::aa:aa:aa:aa
Vm2
2001:db8:1::bb:bb:bb:bb
Host OS
2001:db8:1::dd:dd:dd:dd
switch
fe80::dead:beef
2001:db8:1::dead:beef
2001:db8:1::f00:ba1
2001:db8:1::coo1:cafe
2001:db8:1::464:464
Fe80::dd:dd:dd:dd <-> 00-53-00-11-11-11
2001:db8:1:aa:aa:aa:aa <-> 00-53-00-11-11-11
2001:db8:1:bb:bb:bb:bb <-> 00-53-00-11-11-11
2001:db8:1:dd:dd:dd:dd <-> 00-53-00-11-11-11
fe80::dead:beef <-> 00-53-00-22-22-22
2001:db8:1::dead:beef <-> 00-53-00-22-22-22
2001:db8:1::f00:ba1 <-> 00-53-00-22-22-22
2001:db8:1::coo1:cafe <-> 00-53-00-22-22-22
2001:db8:1::464:464 <-> 00-53-00-22-22-22
router
BEFORE


Vm1
2001:db8:1:1:aa:aa:aa:aa
Vm2
2001:db8:1:1:bb:bb:bb:bb
Host OS
2001:db8:1:1:dd:dd:dd:dd
switch
Delegated 2001:db8:1:1::/64
fe80::dead:beef
2001:db8:1:2:dead:beef
2001:db8:1:2:f00:ba1
2001:db8:1:2:coo1:cafe
2001:db8:1:2:464:464
Delegated 2001:db8:1:2::/64
fe80::dd:dd:dd:dd <-> 00-53-00-11-11-11
fe80::dead:beef <-> 00-53-00-22-22-22
2001:db8:1:1::/64 next-hop fe80::dd:dd:dd:dd
2001:db8:1:2::/64 next-hop fe80::dead:beef
router
AFTER

Benefits: Scalability

Before

network has to scale to number of ***addresses***

After

network has to scale to number of ***endpoints***

Benefits: Security

Potential to Eliminate ND Cache Exhaustion Attack

Before

scanning connected /64 can exhaust ND cache

After

Directly connected /64 can be removed(*) from the interface

(*) when all hosts on the segment supports PD

Benefits: Accountability

DHCPv6-PD provides information of subnets used by hosts

- … in the same way as DHCPv4

Benefits: Fate Sharing

Before

if number of IPv6 addresses/MAC is exceeded, some addresses lose connectivity

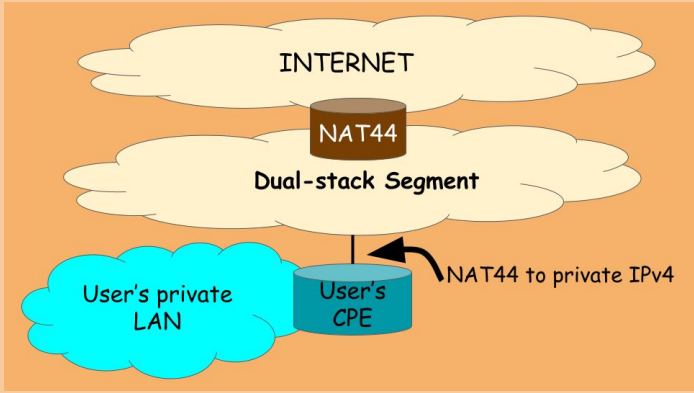
After

all host's addresses share the same fate

Benefits: Network Extensibility

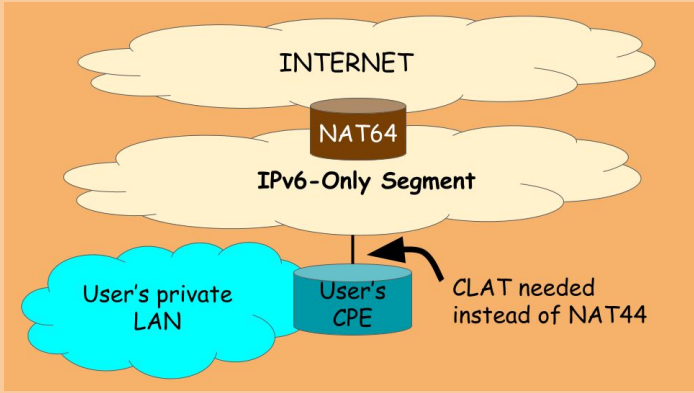
Before

Hosts can extend the network for IPv4 but not for IPv6



After

IPv6 network can be extended



Why /64?

All devices support SLAAC

SLAAC requires /64

Delegating /64 allows to extend the network

Applicability and Limitations

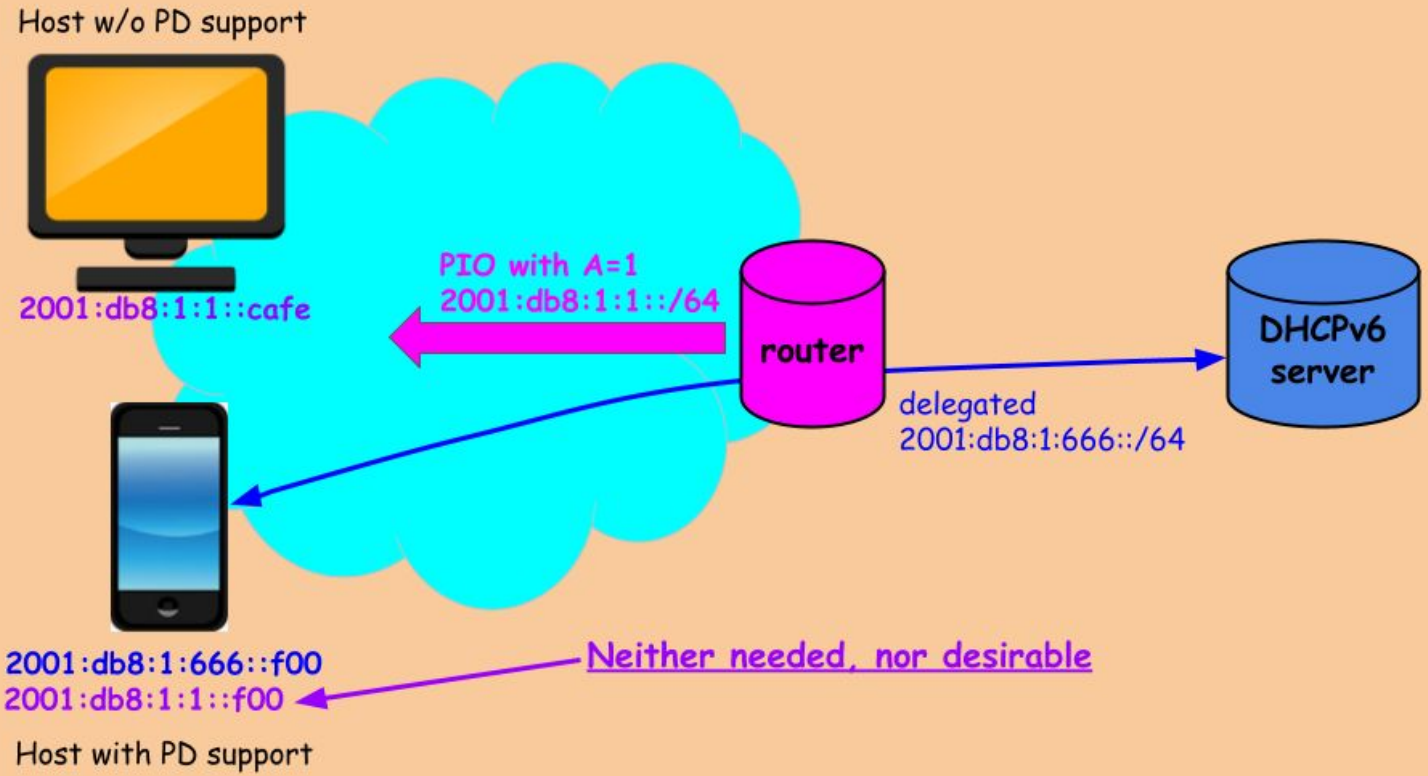
The solution provide benefits to large-scale networks, e.g.

- Large hotspots
- Enterprise networks
- Virtualization

Not so much for home networks

- If ISP provides a /60, that only supports 16 devices!
- But in home networks, SLAAC works fine

Coexistence with PIO and A-flag



Desired Behaviour

- Only use DHCP-PD in “large” networks
  - To prevent exhausting home network pools
- If both DHCP-PD and PIO with A=1 available:
  - Do not configure addresses from the PIO

Proposed solution

Add a new “P” flag in PIO

If P flag is set:

- Ignore A flag
- Start DHCPv6-PD, request a prefix, use it instead of PIO

Next Steps

Android implementation in progress

Adoption Call?