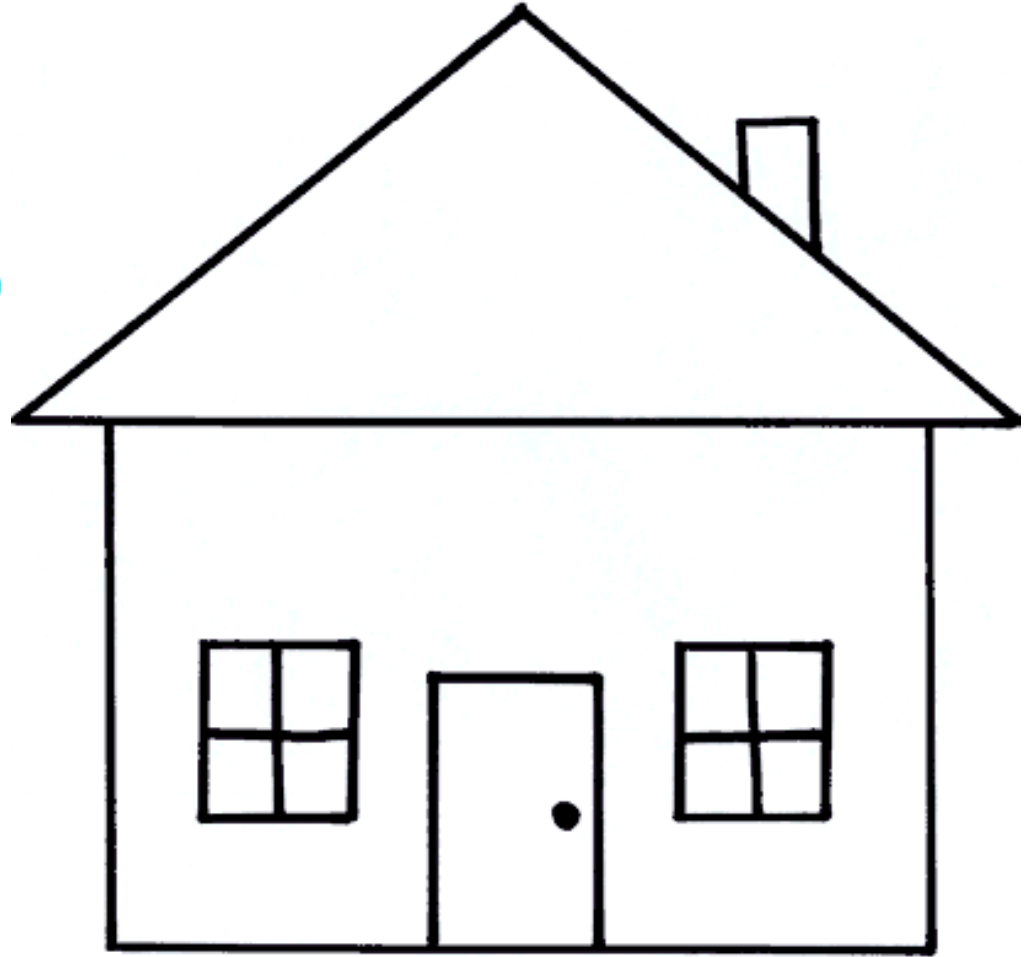# Routing IPv6 in the Homenet

Mark Townsley
Cisco Fellow and Co-Chair of the IETF Homenet Working Group
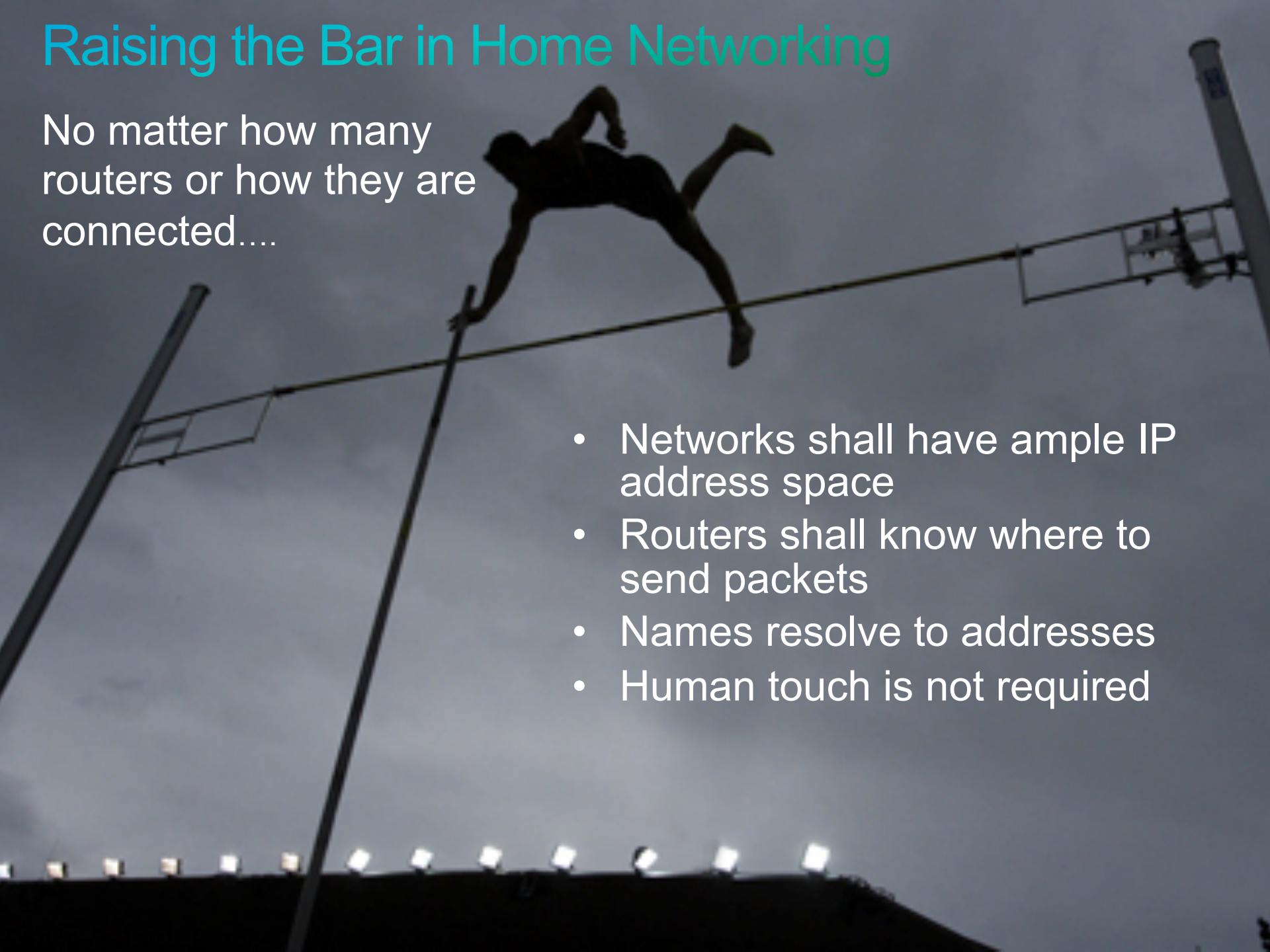
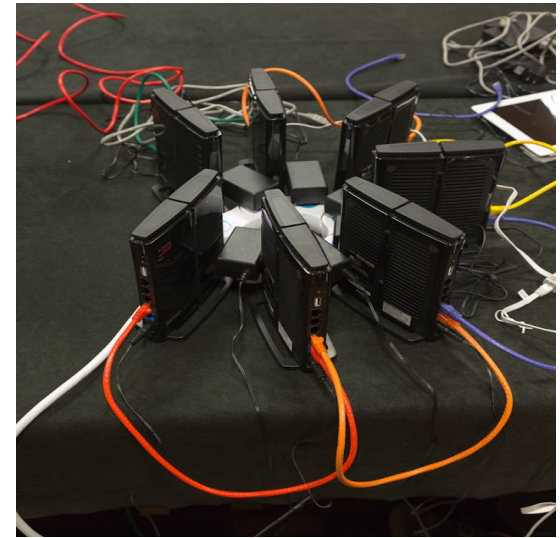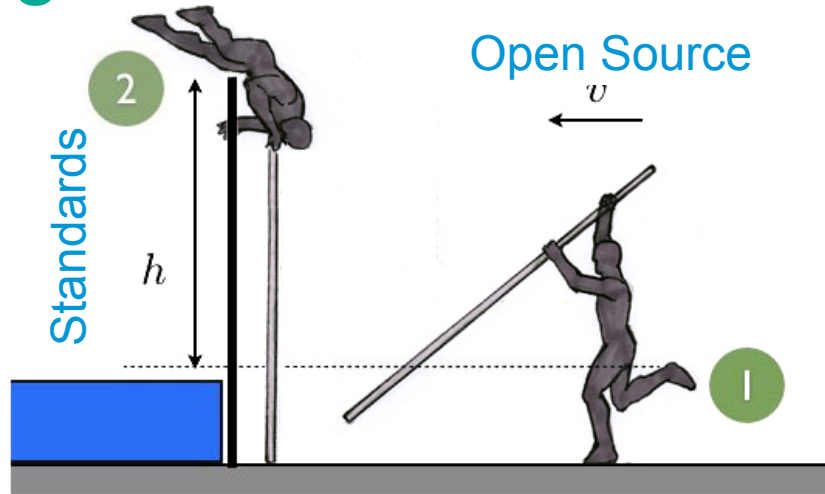RIPE 67, Athens, Greece, October 15, 2013

Raising the Bar in Home Networking

No matter how many routers or how they are connected....

- Networks shall have ample IP address space
- Routers shall know where to send packets
- Names resolve to addresses
- Human touch is not required

Reaching the bar

Standards

Open Source

h

- IETF Homenet Working Group (established July 2011)
  Interim kickoff meeting at Comcast in PA
  Of 120+ IETF WGs, homenet is currently in the top 3 most well attended
  http://tools.ietf.org/wg/homenet/

- Cisco Homenet Tech Fund (established June 2012)
  Funding for open source development, prototyping, etc.
  Please contribute! The idea is to make this a community effort.
  irc #homenet   https://github.com/fingon/hnet-openwrt-openwrt-feed
  https://github.com/fingon/bird-ext-lsa   https://github.com/fingon/hnet-core

Homenet and Hipnet

- Homenet is an IETF Working group, Hipnet is a Cablelabs project

- Homenet and Hipnet are targeting the same overall problem space with similar goals – to make IPv6 routing work within the home

- Hipnet goes as far as it can without introducing a routing protocol

- Homenet has been basing much of its work with a mindset that a home routing protocol will be necessary

- Hipnet and Homenet are incompatible with one another.

- At the last IETF in Berlin, a design team was formed to identify a migration strategy for existing IPv6 capable home routers and potential hipnet CPE to IETF Homenet routers.
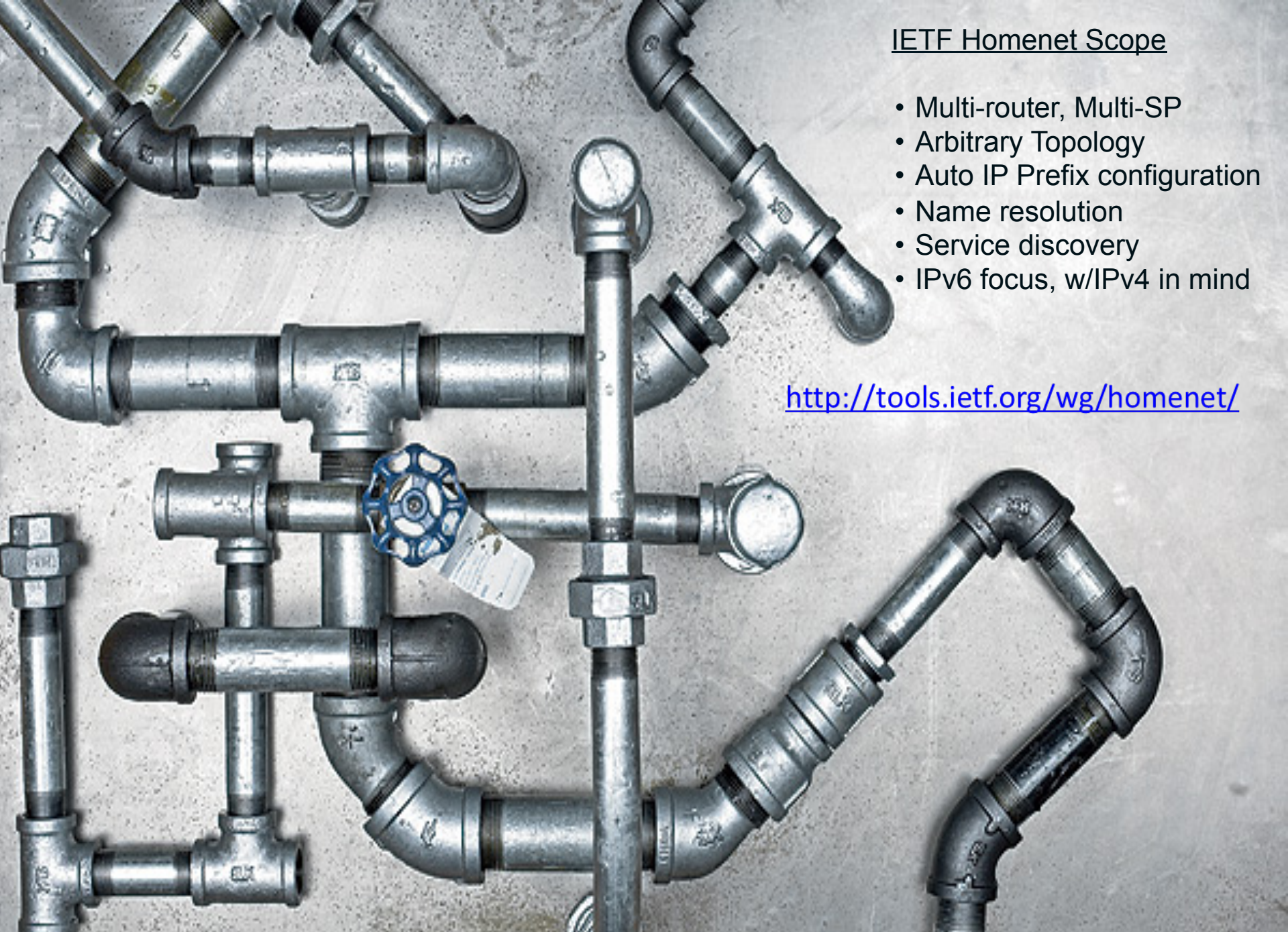
IETF Homenet Scope

- Multi-router, Multi-SP
- Arbitrary Topology
- Auto IP Prefix configuration
- Name resolution
- Service discovery
- IPv6 focus, w/IPv4 in mind

http://tools.ietf.org/wg/homenet/

Evolution of an IPv4 home network

2001:db8::/64

10.0.0 Home Routers

192.168.1/24

192.168.4/24

192.168.100/24

128.66.12.34/32

192.168.3/24

10.2.2.3/24

10.1.2.3/24

COMPANY VPN

THE FUTURE OF HI-FI
State-of-the-art solutions for the digital generation

HOME AUTOMATION

… … …

6
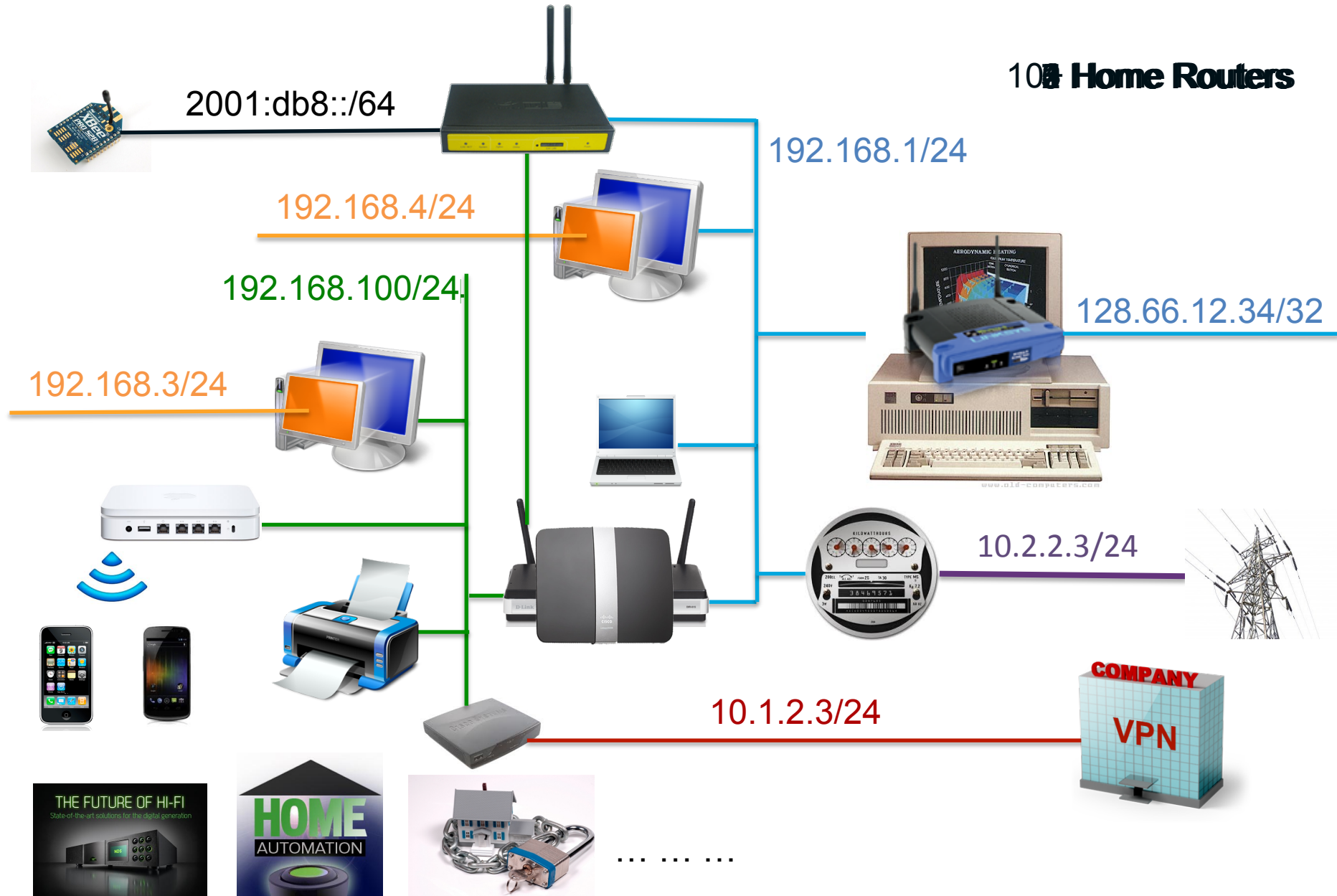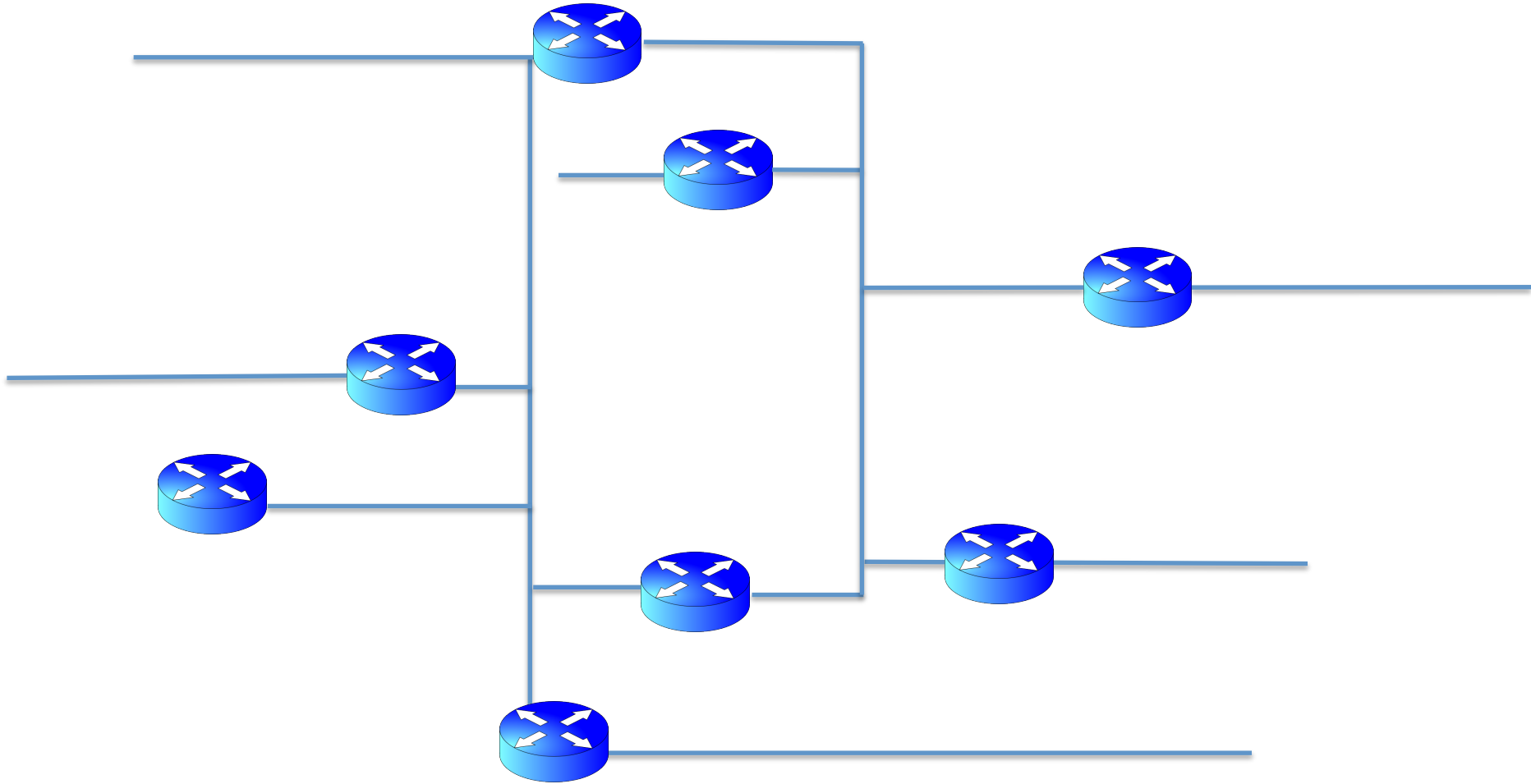
IETF Homenet

IETF Homenet

1. Identify Border Routers

2. Eliminate loops and advertise "Usable Prefixes"

A,B,C

A,B,C

A,B,C

A (/56)

A,B,C

A,B,C

A,B,C

B (/48)

A,B,C

C (/60)

A,B,C

zIGP*
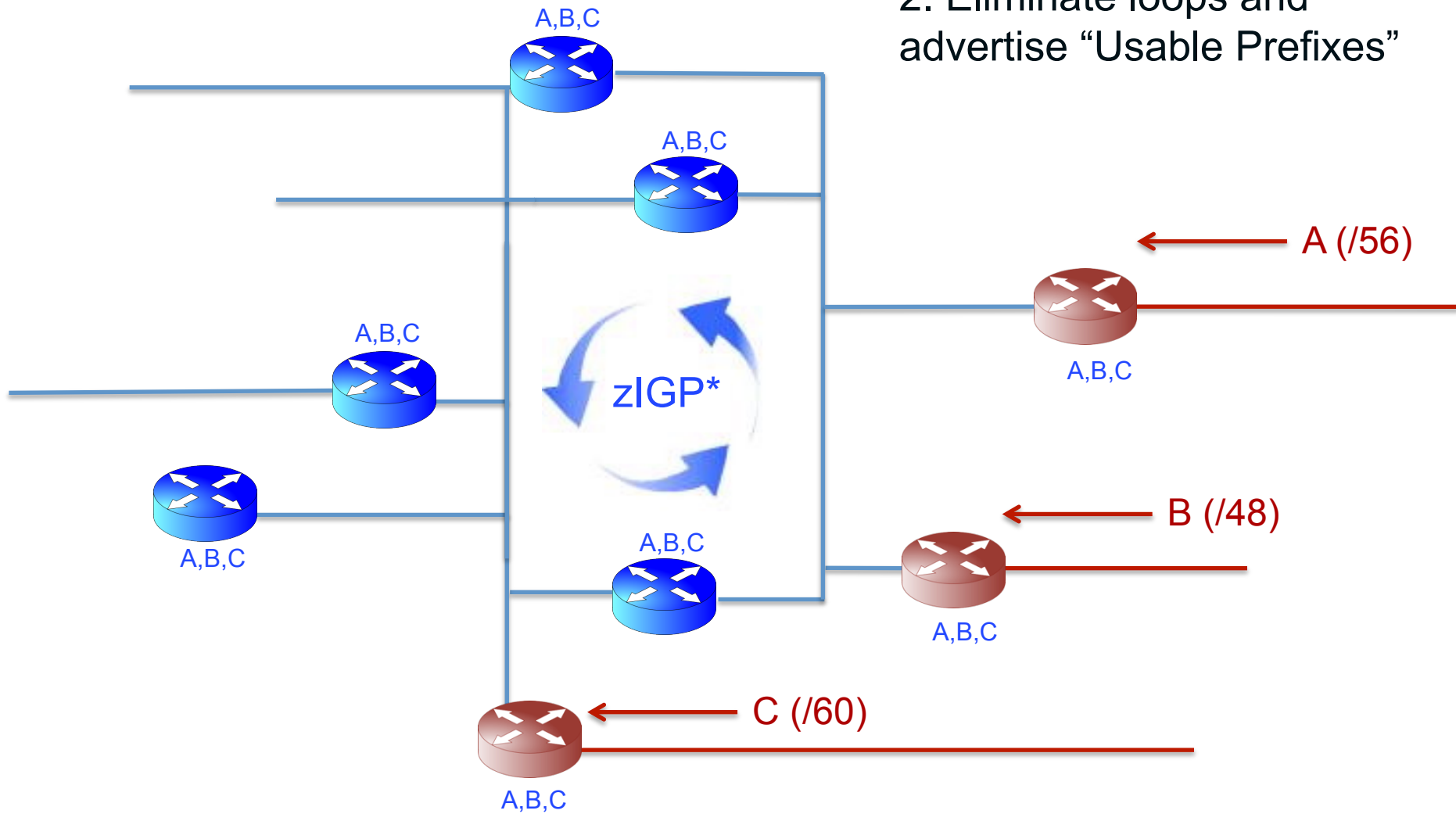
*IGP = Could be OSPF, ISIS, etc…
Current implementation based on:

draft-ietf-ospf-ospfv3-autoconfig and
draft-arkko-homenet-prefix-assignment-01

8

3. Carve up Usable Prefixes into /64s and assign to links
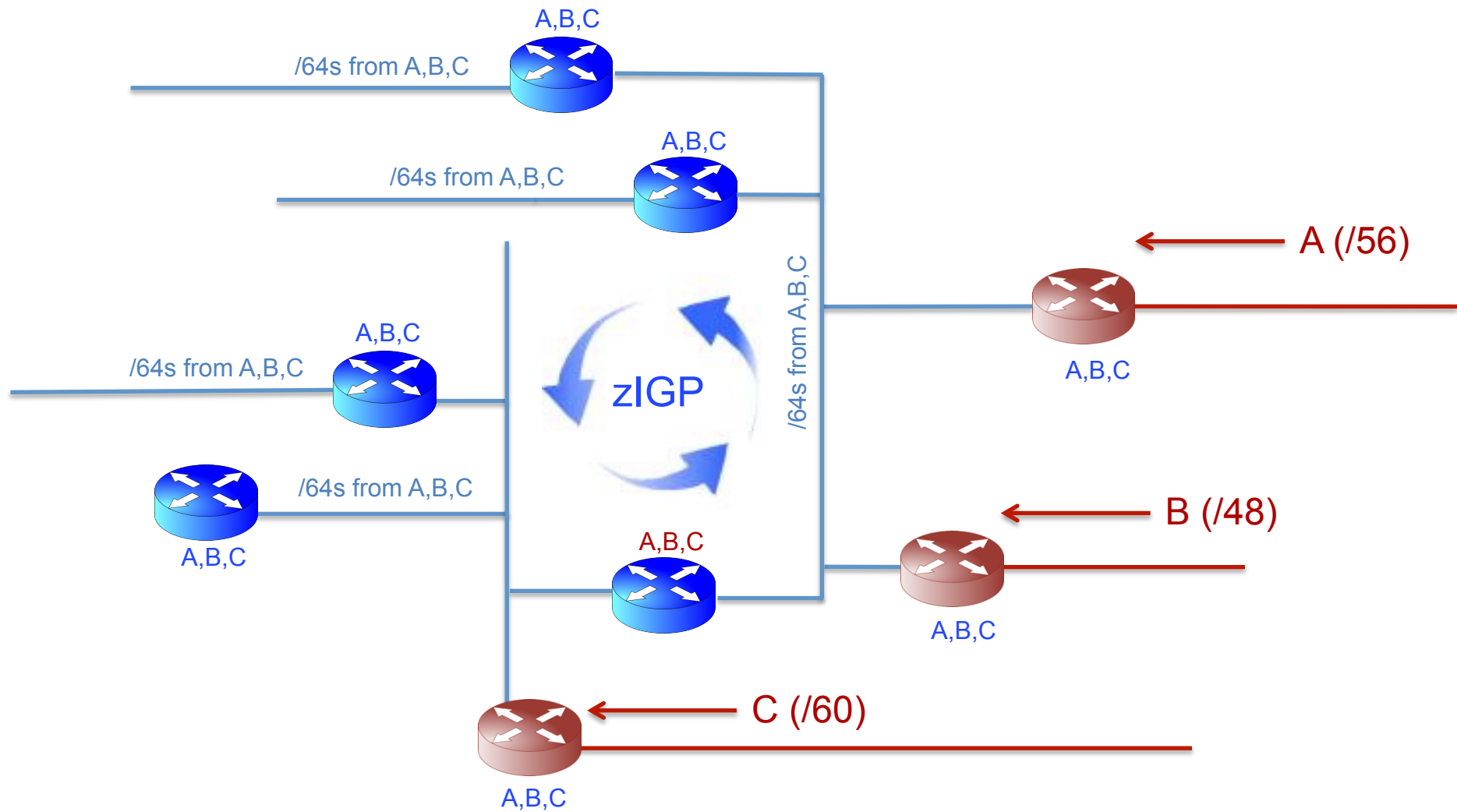
4. Route packets based on <u>Source and Destination</u>

Hosts get multiple IPv6 Addresses!

A (/56)

B (/48)

C (/60)
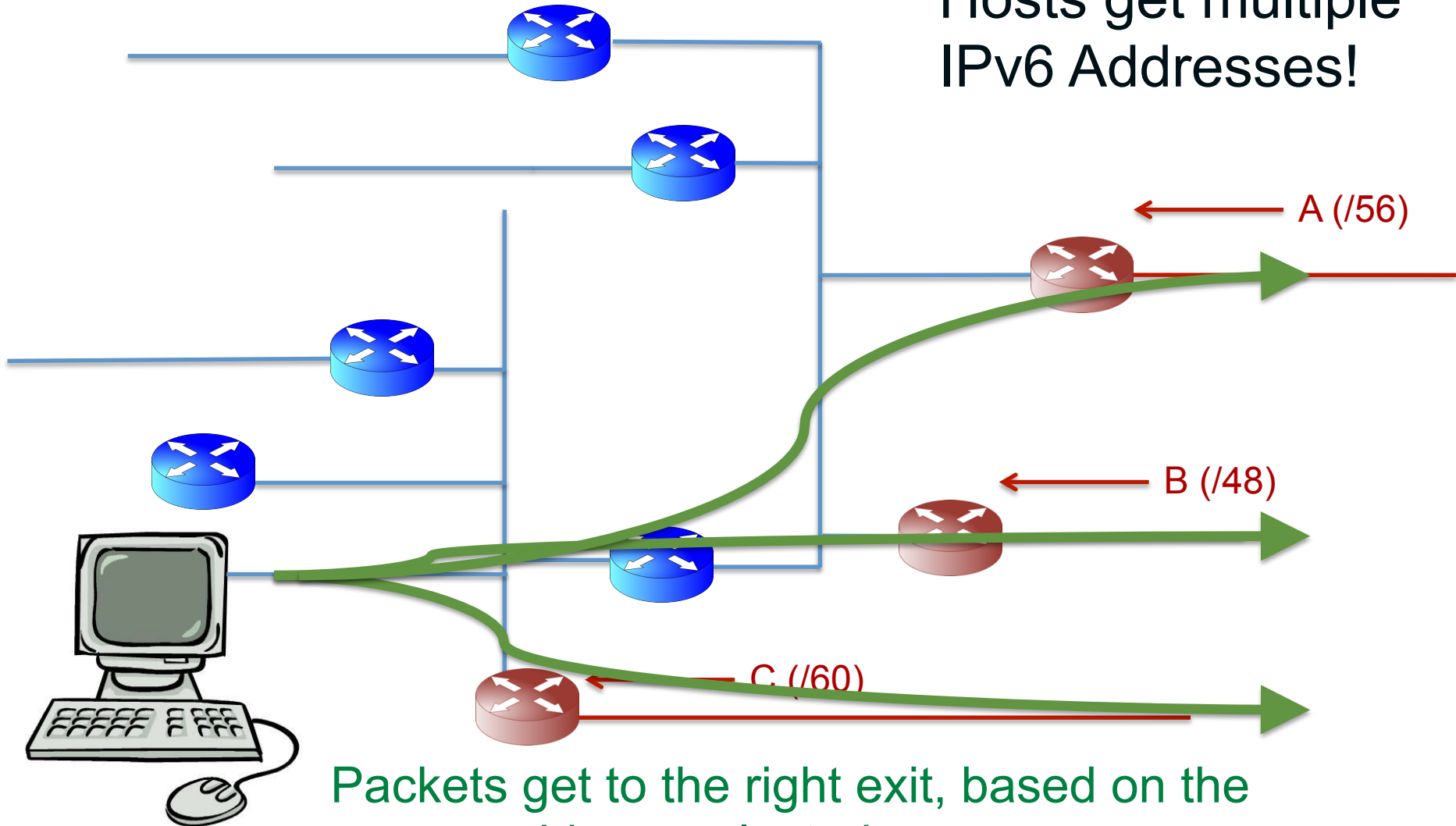
Packets get to the right exit, based on the source address selected

Layer 3 prefix properties information flow

draft-bhandari-dhc-class-based-prefix-05

A,B

A "3G"

zIGP

B "Fiber"

A,B,C

properties   properties   properties

RA or DHCPv6   zOSPF   DHCPv6-PD

Link Information
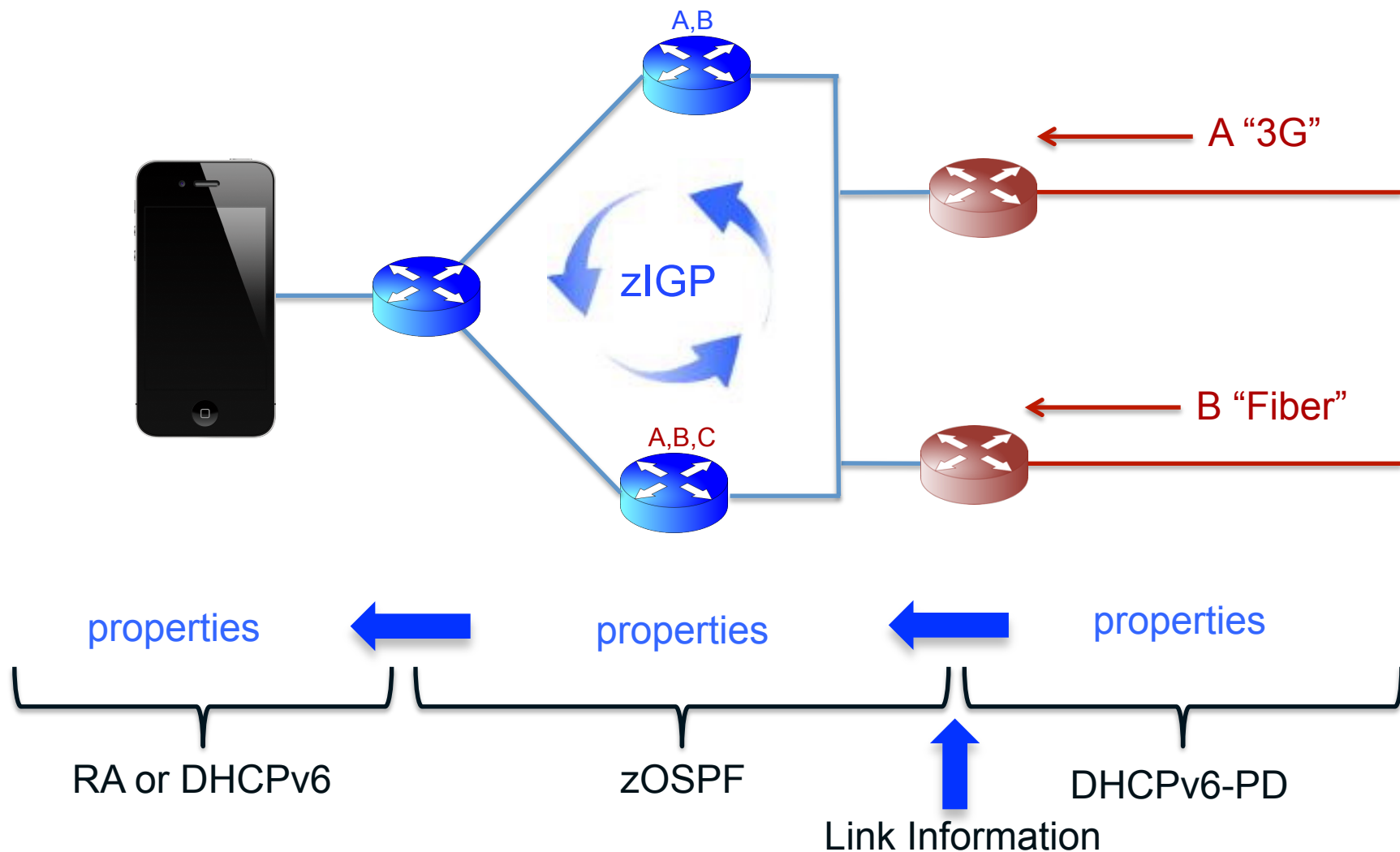
IPv6 prefix colouring

`draft-lepape-6man-prefix-metadata`

Color/Metadata Policy

ISP A

ISP B

OSPFv3

IPv6 Prefixes and Colors

Network Connectivity Information

Homenet Working Group

CISCO™

ÉCOLE POLYTECHNIQUE ParisTech
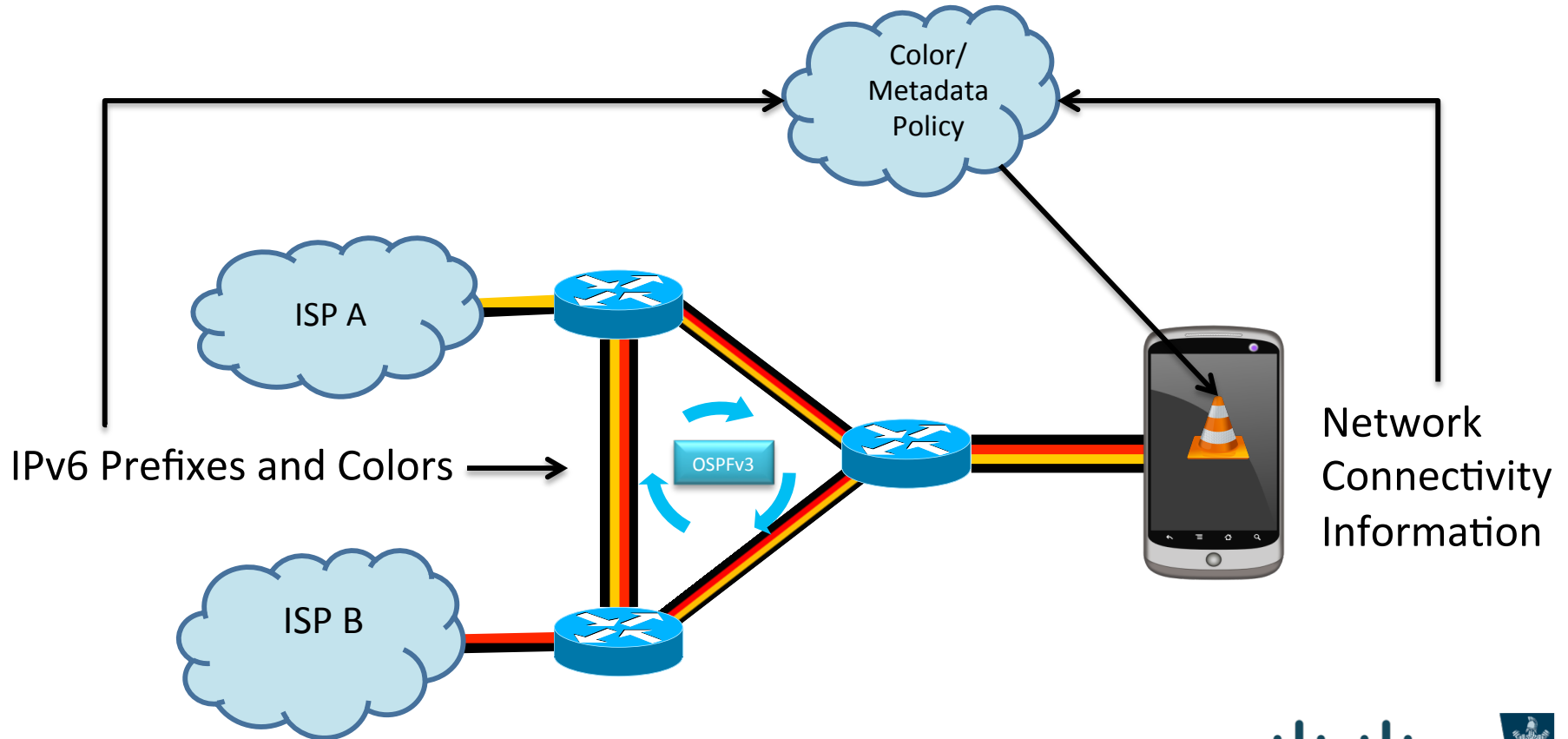
5. Multilink DNS-based service discovery

MDNS

MDNS

zIGP

A (/56)

B (/48)

DNS-SD

C (/60)
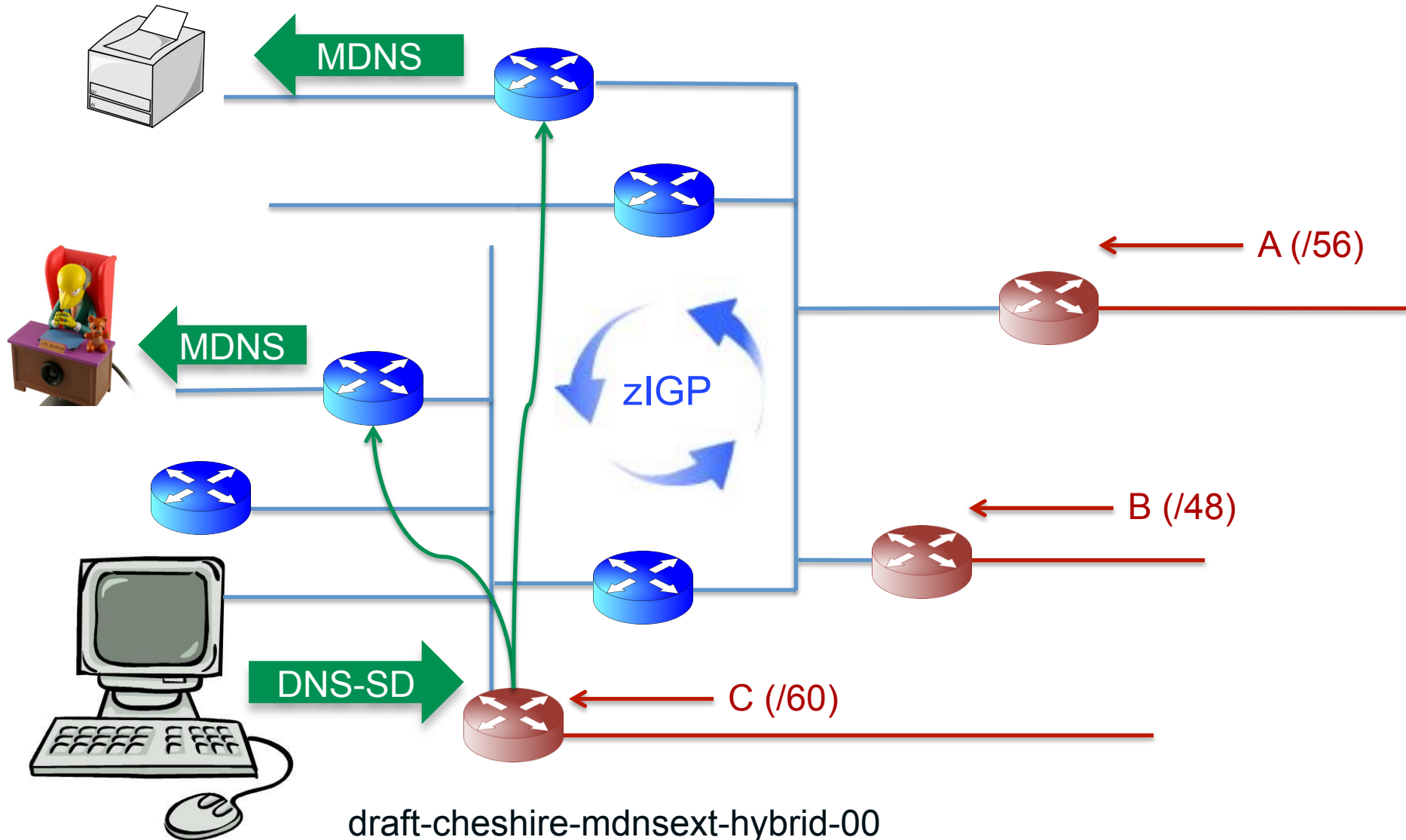
draft-cheshire-mdnsext-hybrid-00

draft-stenberg-homenet-dnssdext-hybrid-proxy-ospf-00
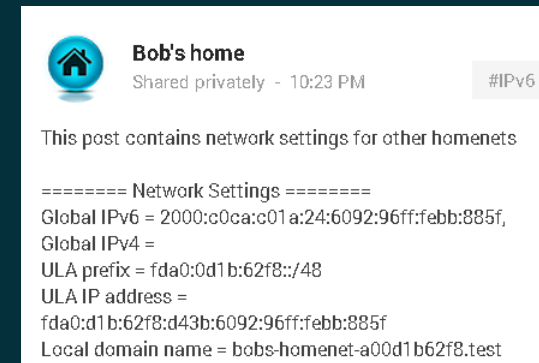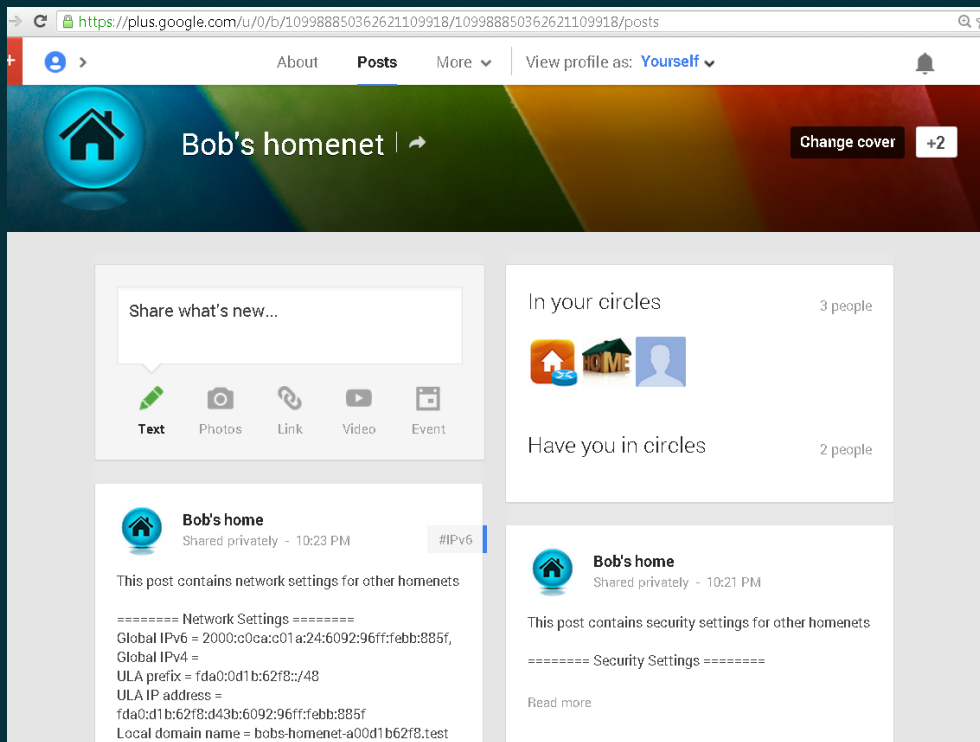
Posts
- config directory
- communication channel

Google+ Page
Represents a home

Circles
≈ ACLs
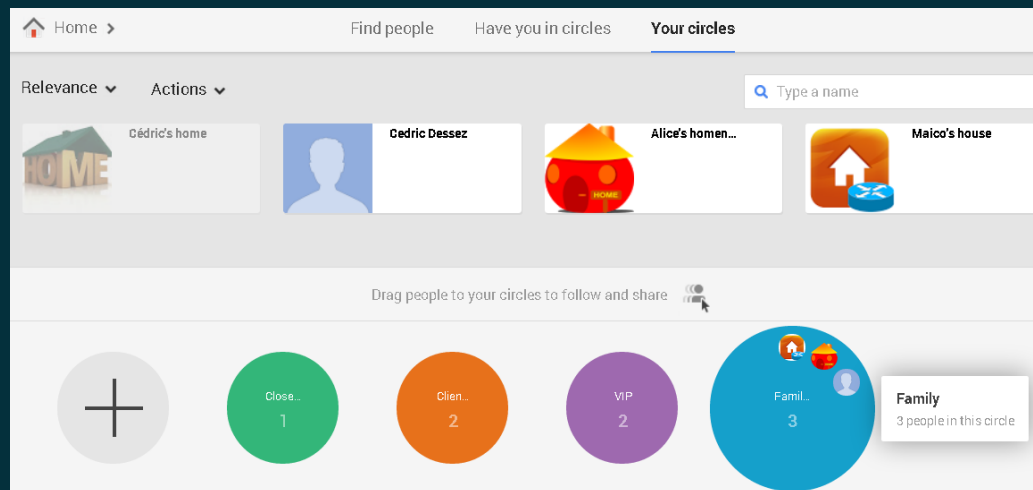
Tunnel Management via G+

- Exchange information to bootstrap encrypted tunnels
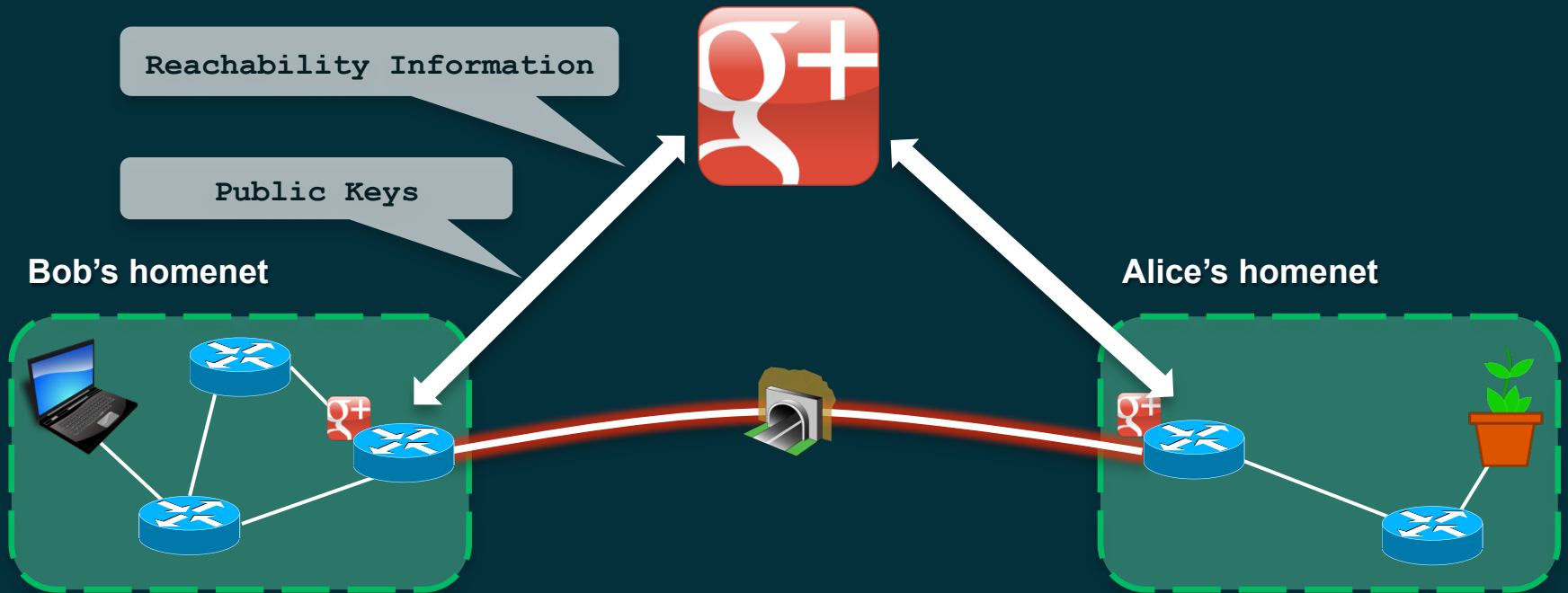
Add routes to the other homenets
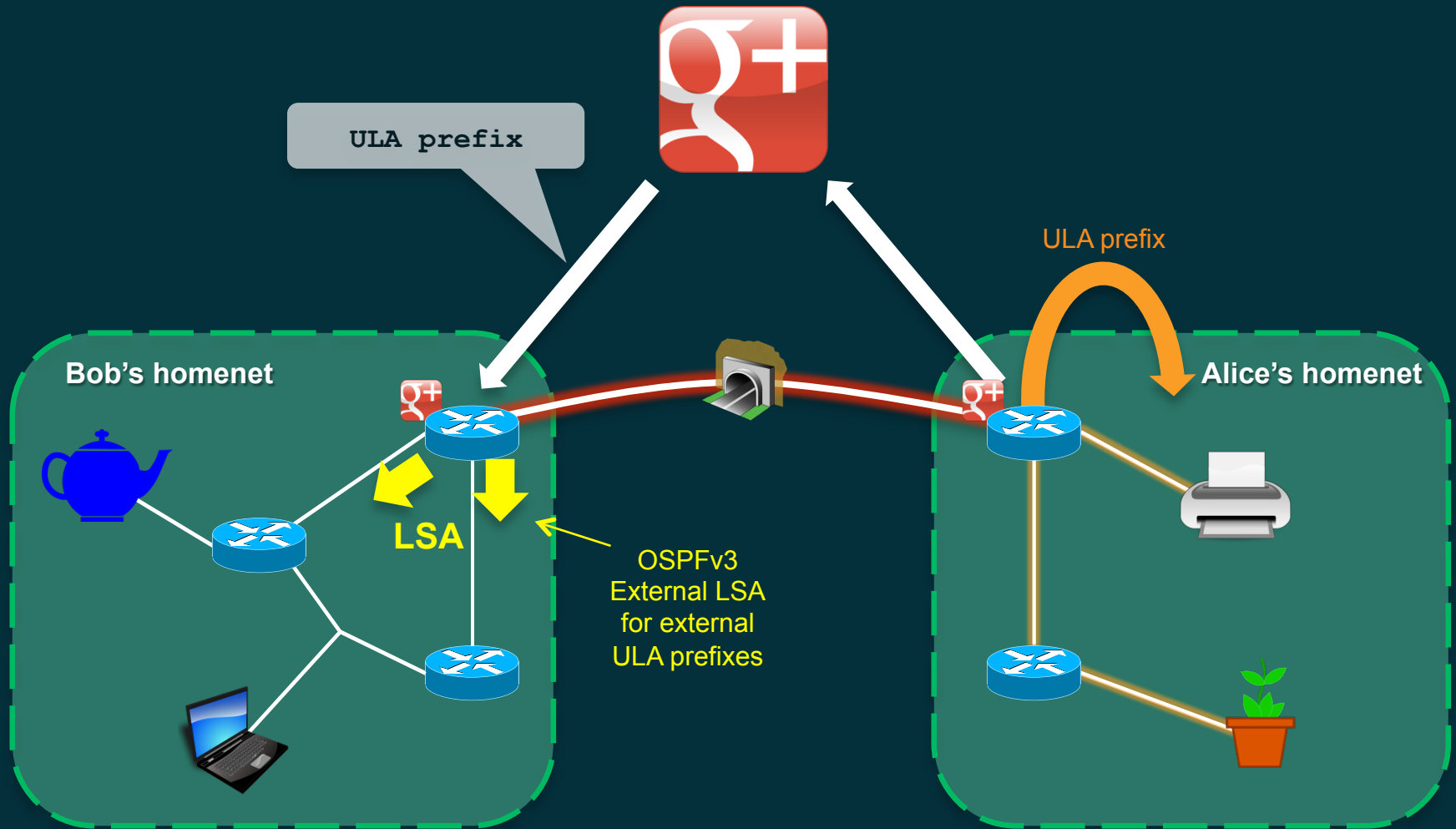
Enable service discovery (DNS-SD)

Using: draft-stenberg-homenet-dnssdext-hybrid-proxy-ospf-00

Domain name
DNS ULA IPv6 address

Recursive DNS server
responsible for the zone
alices-home-76d12fe45a.test

Filter

TLV

Zeroconf browser

OSPFv3 AC
DNS Delegated
Zone TLV
≈ NS record

Search
domain added via
DHCP or SLAAC

bobs-home-fe5ab90c6f.test

alices-home-76d12fe45a.test
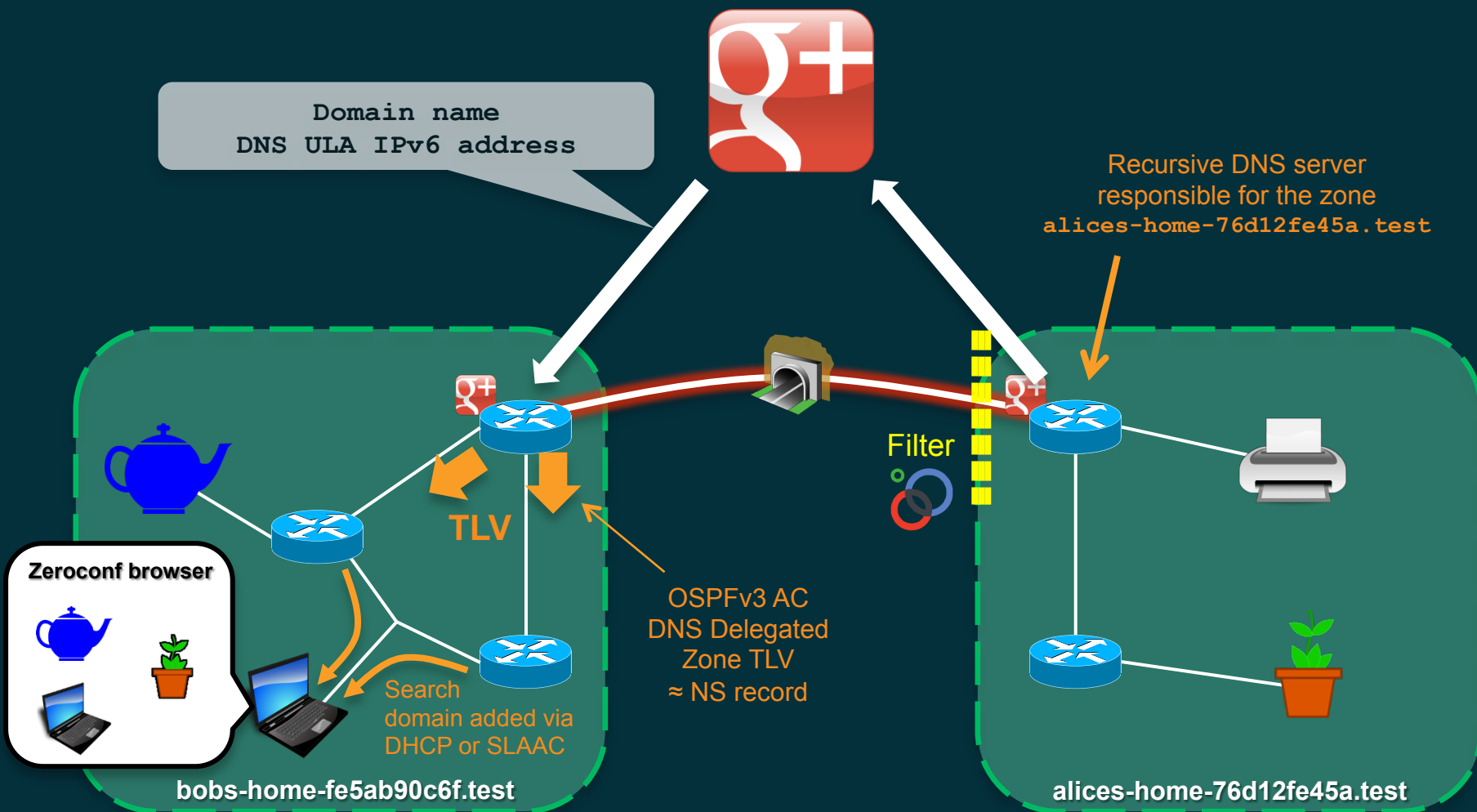
Don't let "Home" in the title fool you…

- Homenet is about much more than just the Home
  (shhh… it's a secret)

  - Automatic prefix distribution and assignment in some of your favorite routing protocols (OSPF, ISIS, etc…)
  - IPv6 site multihoming without NAT, Tunneling, or PI
  - Putting the multi-prefix, multi-address architecture of IPv6 to the test
  - Exposing previously hidden network information to applications for them to use intelligently

Homenet Summary

- IPv6 is increasingly available from ISPs to the home edge

- Homenet is taking IPv6 from the edge, into the home

- The goal is to "raise the bar" for home networking in the process

- RFCs and Open Source code are being developed – please contribute, this is *your* home we are working on!

Thank you.

Messages: Usable Prefix TLV

New OSPF LSA: Auto-Configuration LSA
Made up of TLVs: Type-Length-Value

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      TBD-BY-IANA-1            |            Length              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| PrefixLength     |                 Reserved                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                                                               |
|                          Prefix                               |
|                       (4-16 bytes)                            |
|                                                               |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                   Usable Prefix TLV Format
```
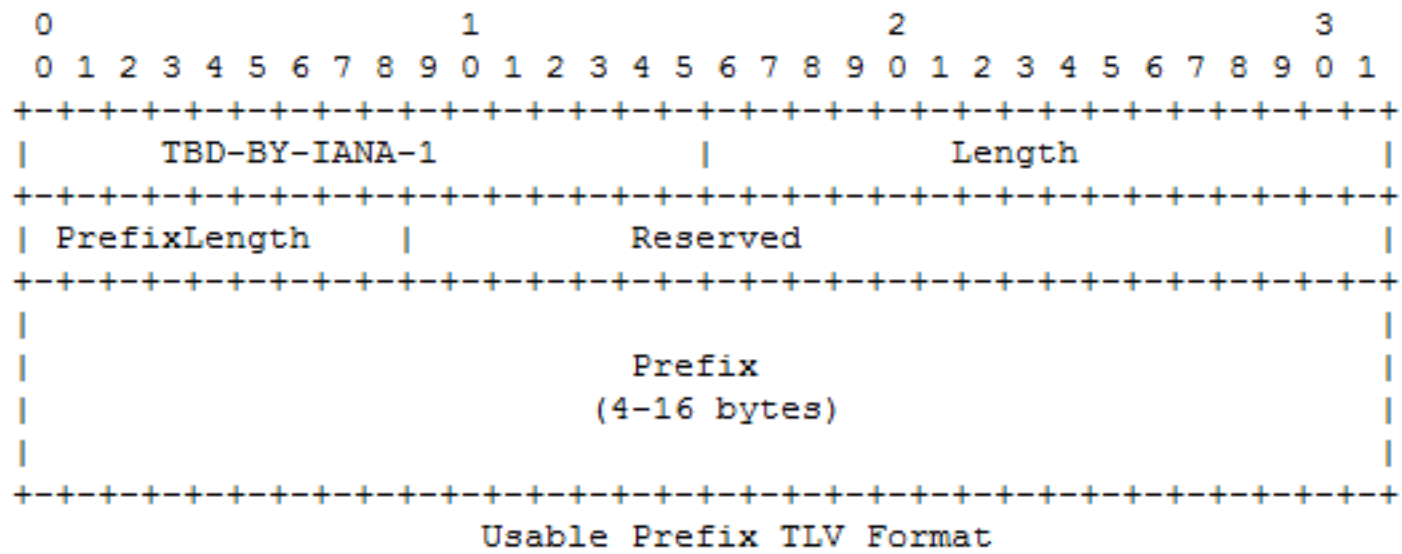
Advertised in the LSA of the router that learned of the prefix via DHCPv6 PD

Messages: Assigned Prefix TLV

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        TBD-BY-IANA-2           |              Length           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Interface ID                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| PrefixLength  |                 Reserved                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                           Prefix                              |
|                         (4-16 bytes)                          |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
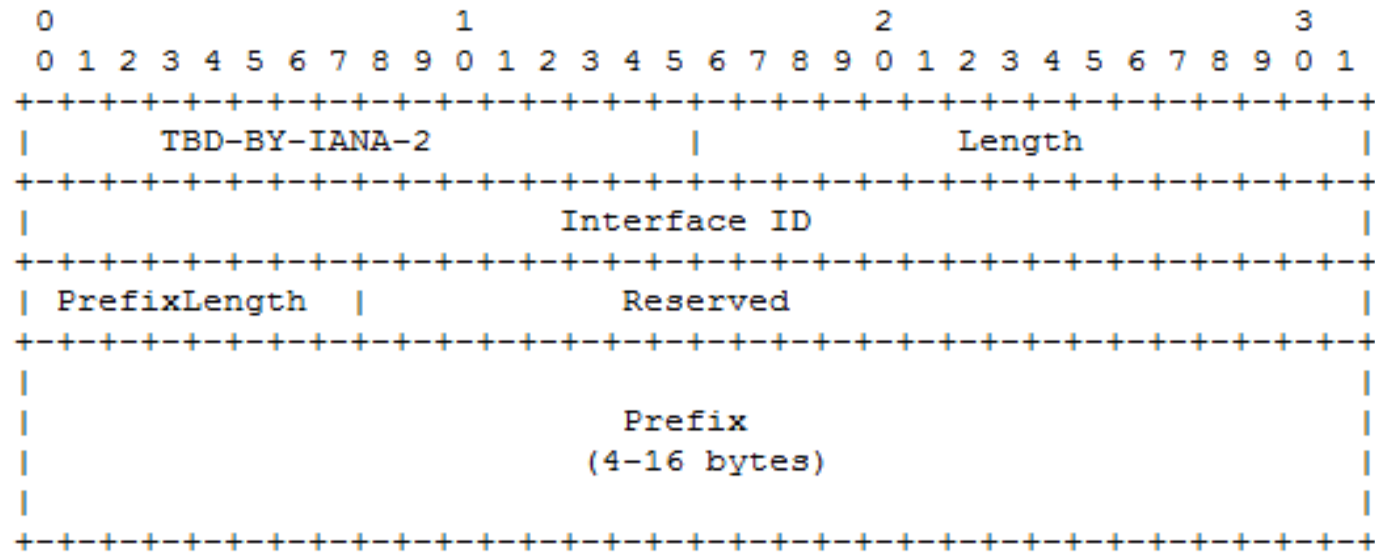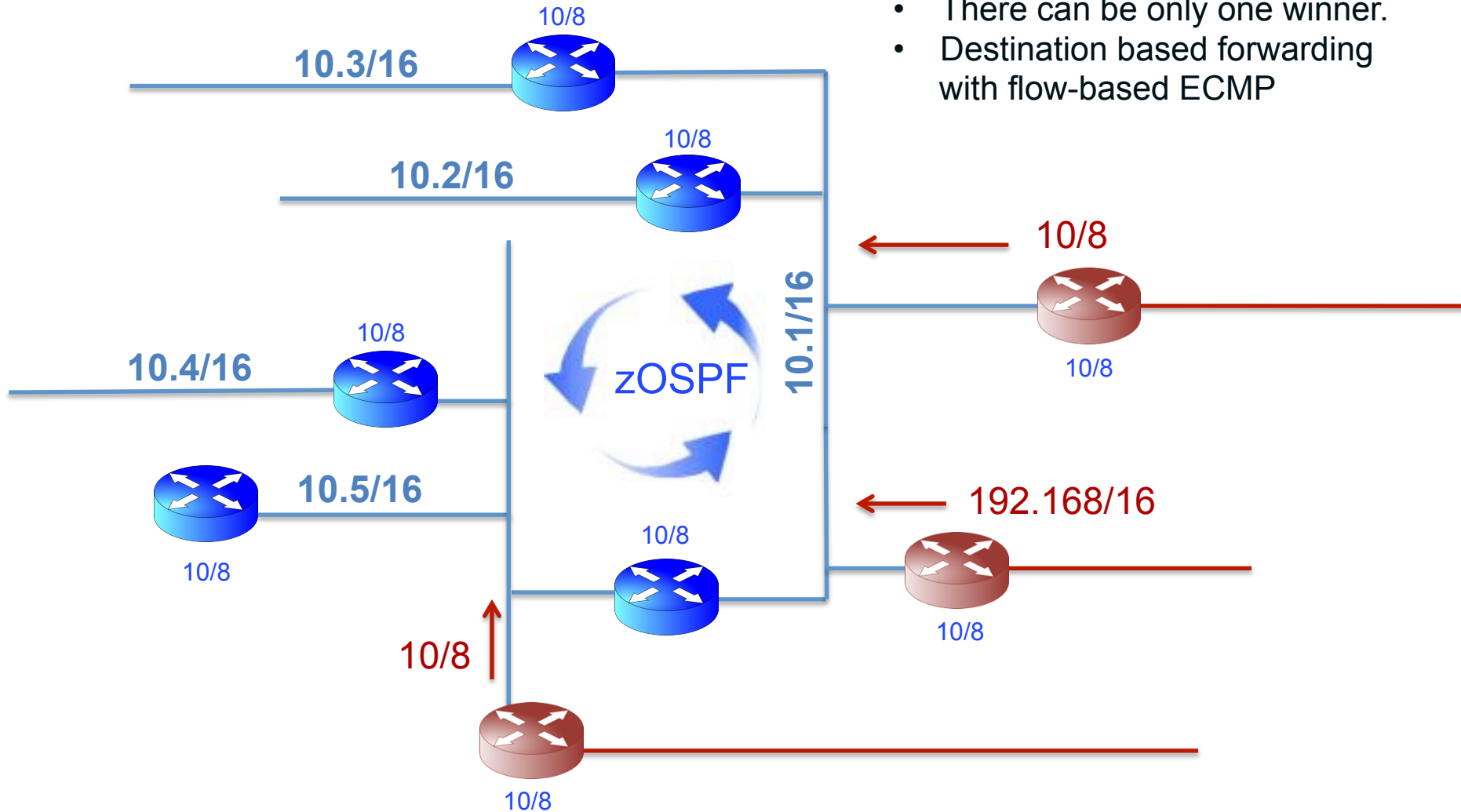
Assigned Prefix TLV Format

Advertised in the LSA of the router that is **responsible** for the assignment

IETF Homenet for IPv4

- Each edge router vies to announce its private IPv4 space.
- There can be only one winner.
- Destination based forwarding with flow-based ECMP

10/8

10.3/16

10/8

10.2/16

10/8

10/8 ←

10.4/16

zOSPF

10.1/16

10/8

10/8

10.5/16

192.168/16 ←

10/8

10/8

10/8 ↑

10/8

Evolution of an IPv4 home network

2001:db8::/64

10+ Home Routers

192.168.1/24

192.168.4/24

192.168.100/24

128.66.12.34/32

192.168.3/24

10.2.2.3/24

10.1.2.3/24

… … …