IPv6 Deployment Architecture for Broadband Access Networks

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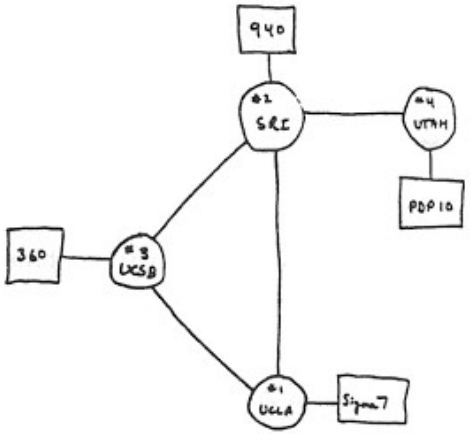
Issue Date: [Date]
Revision: [xx]

APNIC

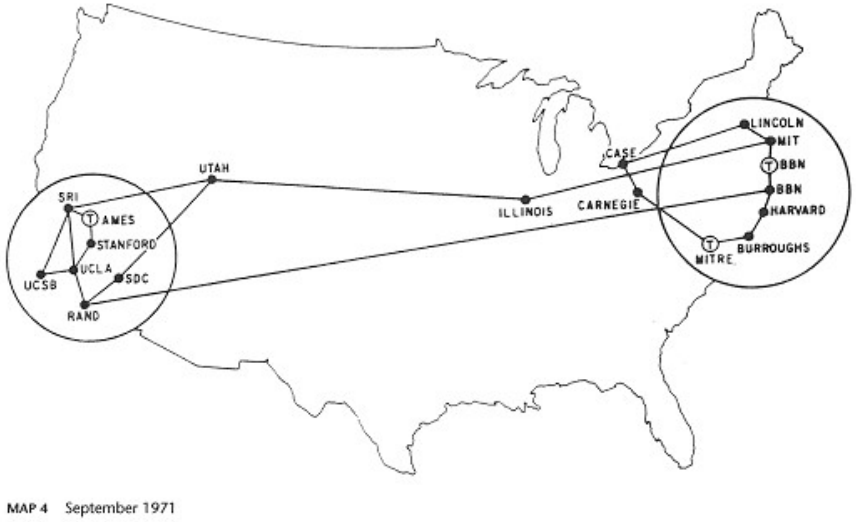
Flashback: Internet Architecture

- 1st generation Internet: **What was the architecture?**



THE ARPA NETWORK

DEC 1969



MAP 4 September 1971

4 Nodes in 1969 (ARPANET)

19 Nodes in 1971

Flashback: Internet Architecture

- 1st generation Internet: **Peer-to-peer model**
  - End devices have content to share
  - A computer (PC/mainframe/terminal) is connected to the Internet
  - Scope of Internet usage was limited to academic research and US defense network
  - Processing power and capacity was an important issue
  - Applications were processed using CPU-based machines
    - Needs stable and considerable power to run this
  - End-to-end visibility was a requirement

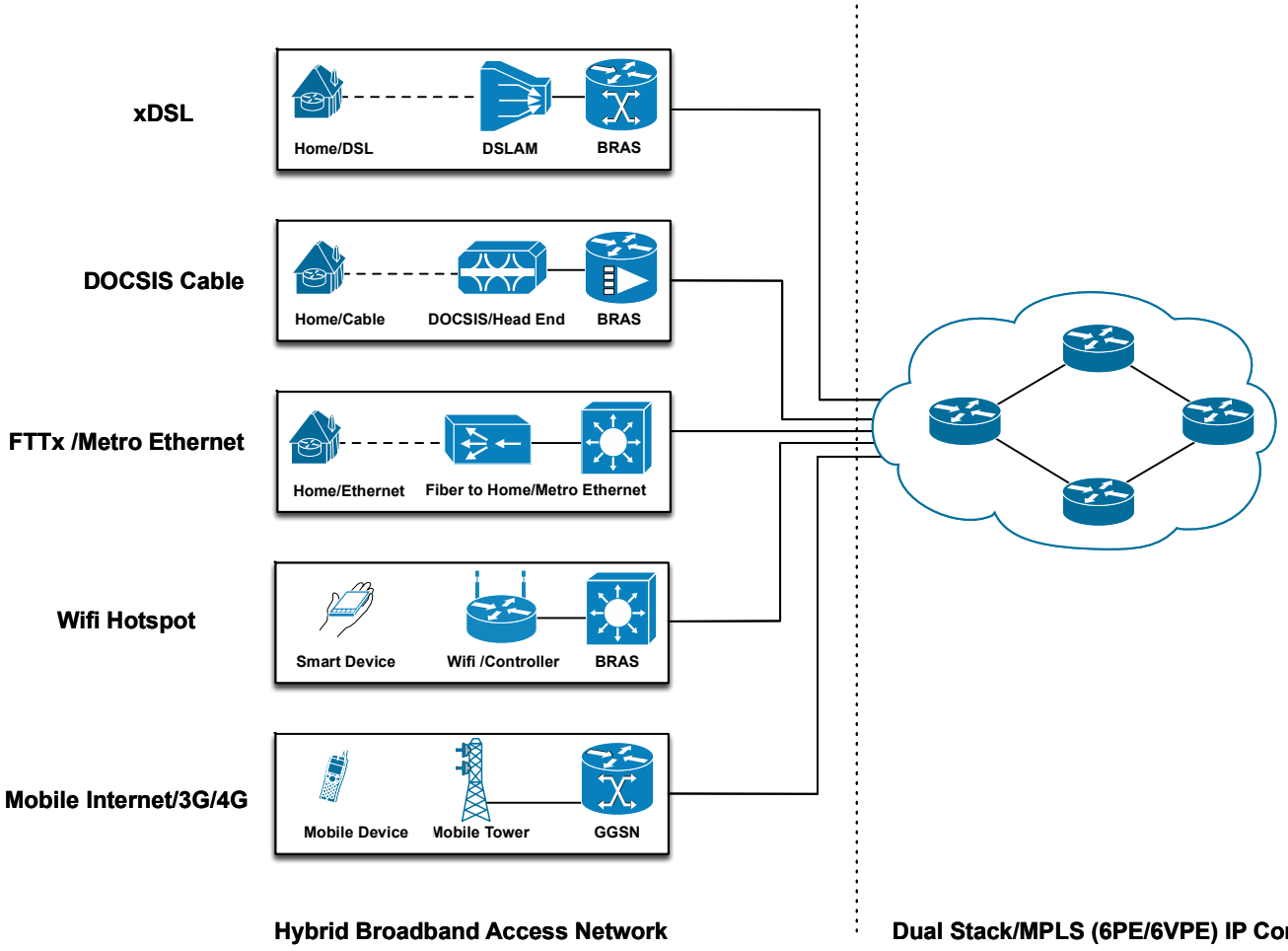
Flashback: Internet Architecture

- 2nd generation Internet: **Client server model**
  - WWW, email etc services were invented
  - Majority of Internet content stored on the server
  - Client machines used to access content from the server
  - Exponential growth of Internet started
  - IETF realized IPv4 protocol address space was insufficient
    - (1990 IETF Meeting by Solensky)
  - IPv4 protocol has outlived its design life
  - NAT/CIDR introduced to expand the lifetime of IPv4
  - End-to-end visibility has disappeared

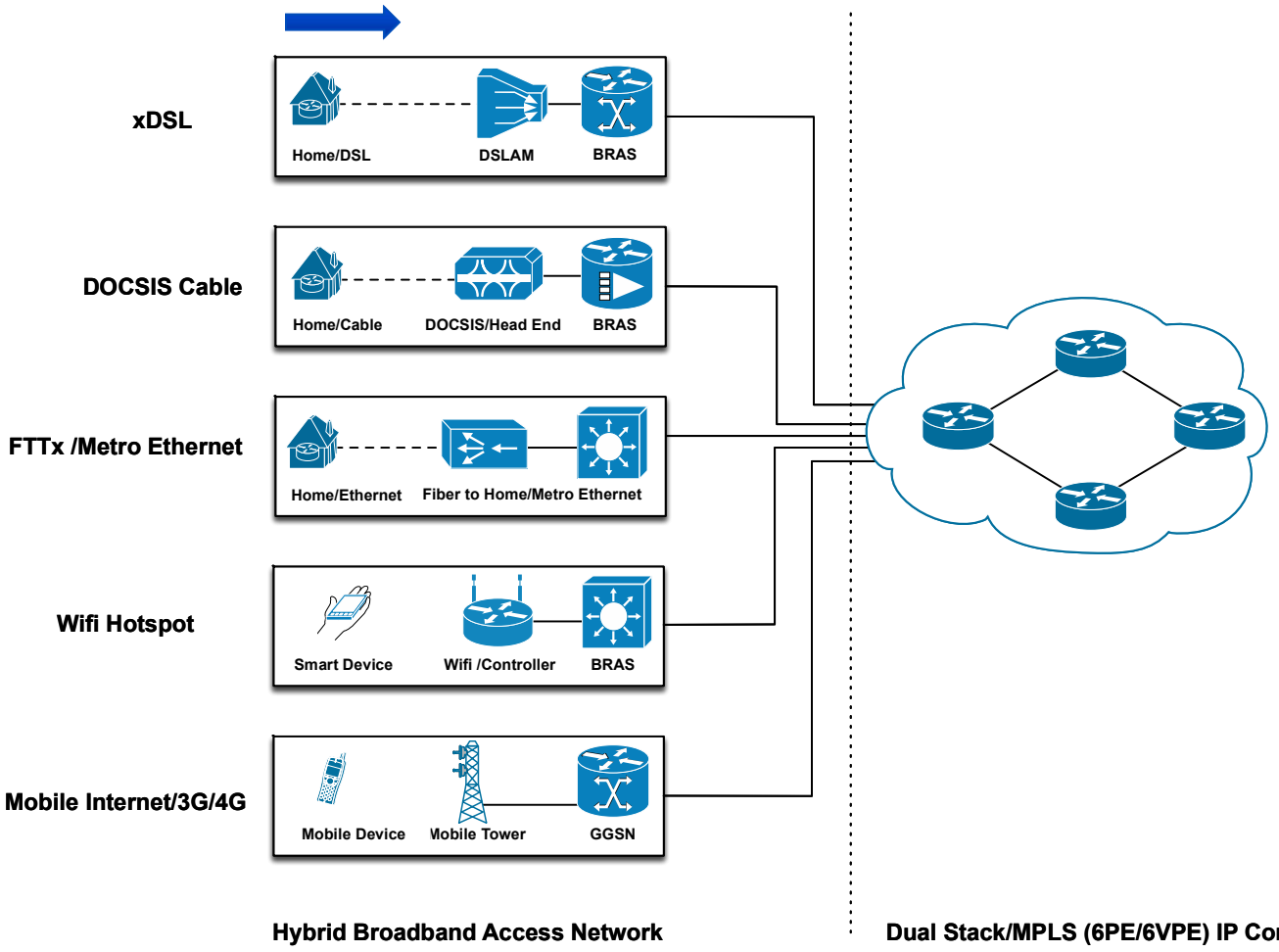
Flashback: Internet Architecture

- 3rd generation Internet : **Peer-to-peer and client server**
  - End devices will have information to exchange
  - Low cost, low power, wireless, embedded computing devices
    - Exchange control information both ways with central server
    - Hardware-based embedded processing VS CPU-based computer processing
  - Scope of Internet usage will expand beyond traditional client server application
    - Hybrid client server and peer-to-peer
  - End-to-end communication will be very important
- Restriction-free growth of architecture will be key design consideration

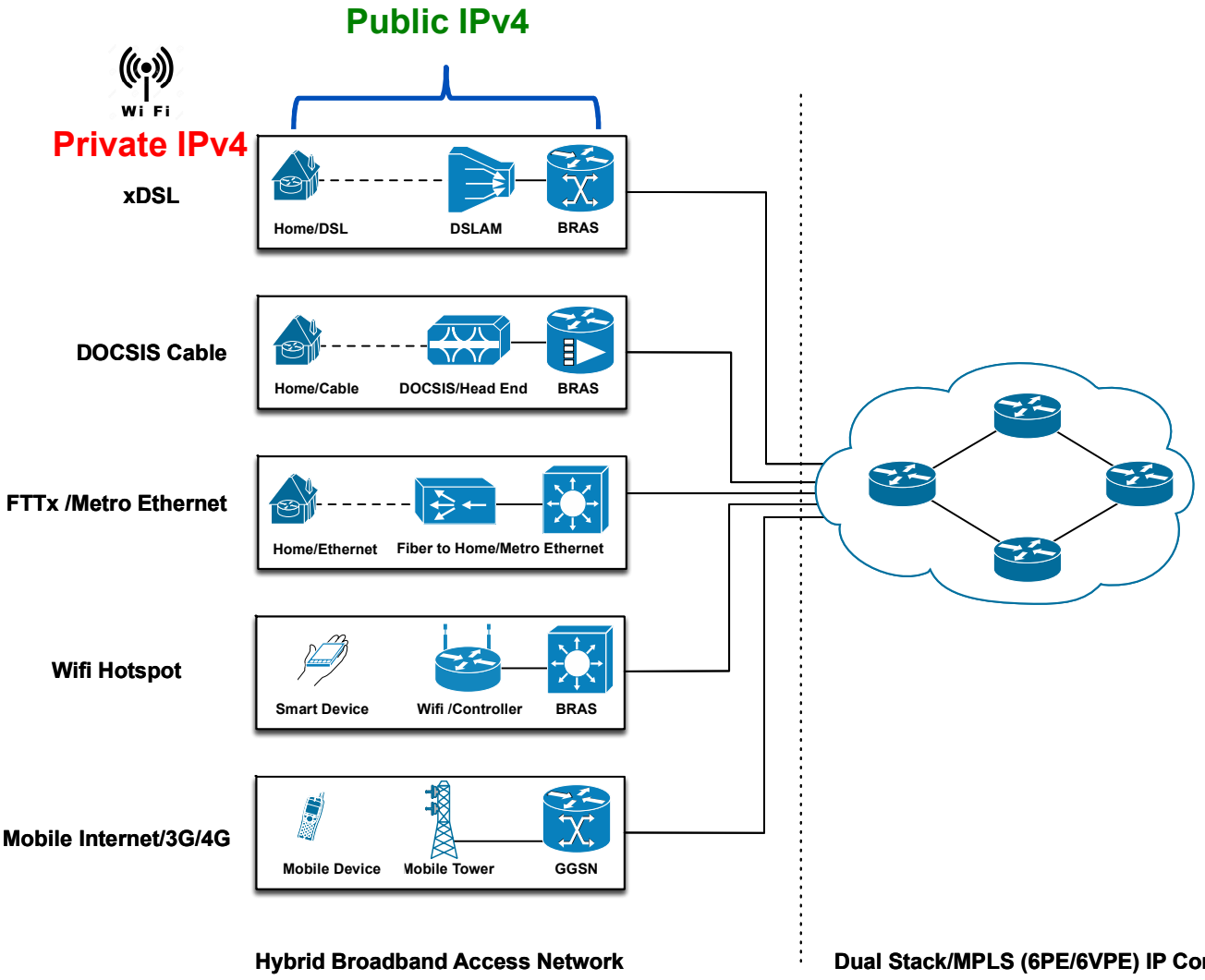
IPv4 for Broadband Access Network



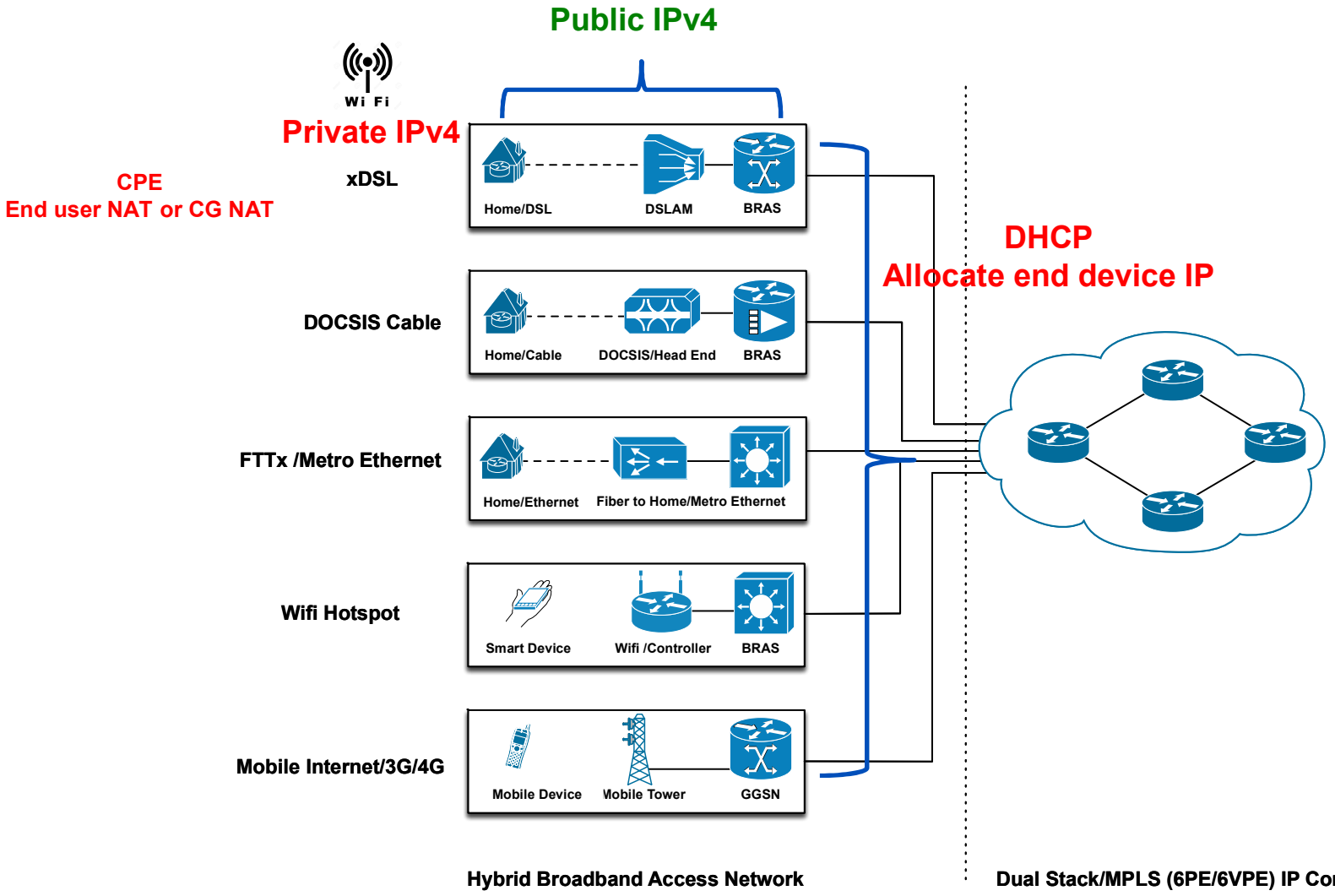
IPv4 for Broadband Access Network



IPv4 for Broadband Access Network



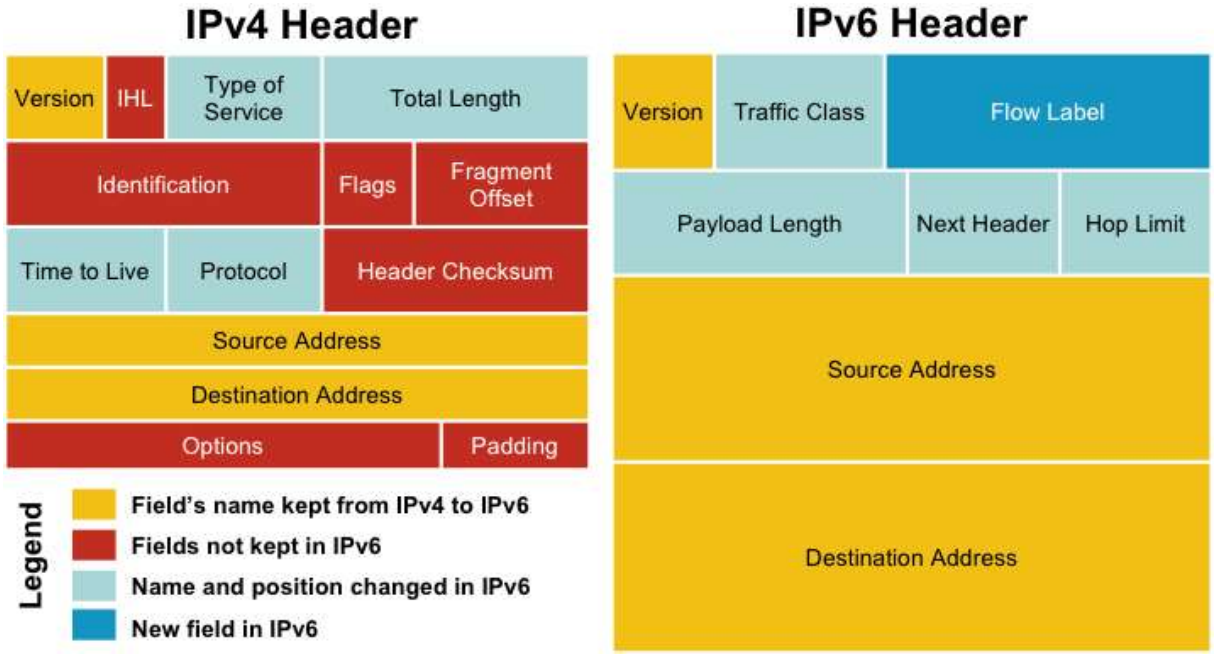
IPv4 for Broadband Access Network



IPv4 for Broadband Access Network

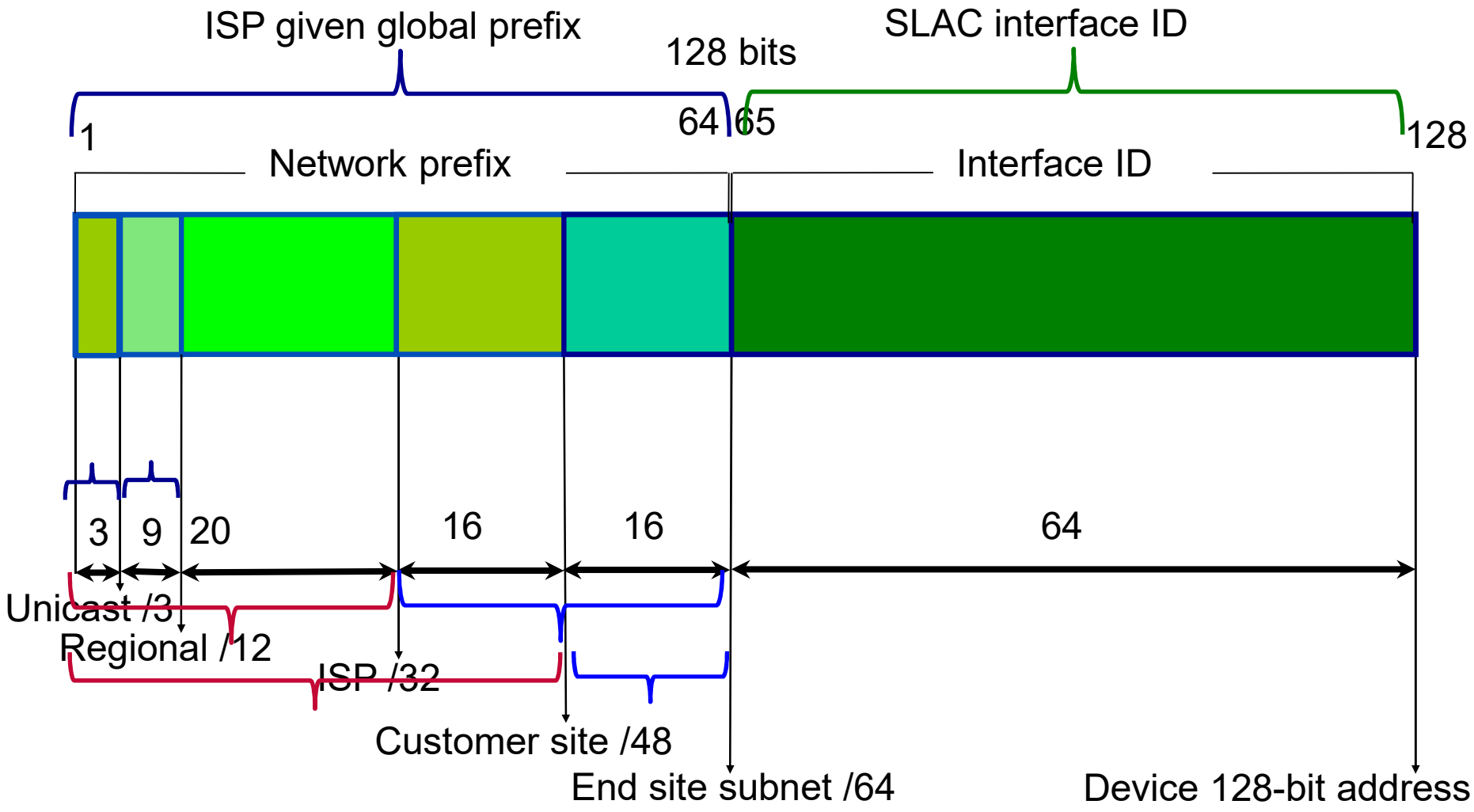
- This architecture will scale if:
  - End user devices are limited
  - End-to-end communication is NOT required
  - Internet remains in “Client Server” Architecture
- This architecture may not scale if:
  - IoT growth sky rockets on end site
  - It needs a control process to keep track of individual devices
    - DHCP, BRAS, PPPoE etc.
  - It needs end-to-end communication
    - Internet changes back to “Peer-to-peer” model

IPv4/IPv6 Header Comparison

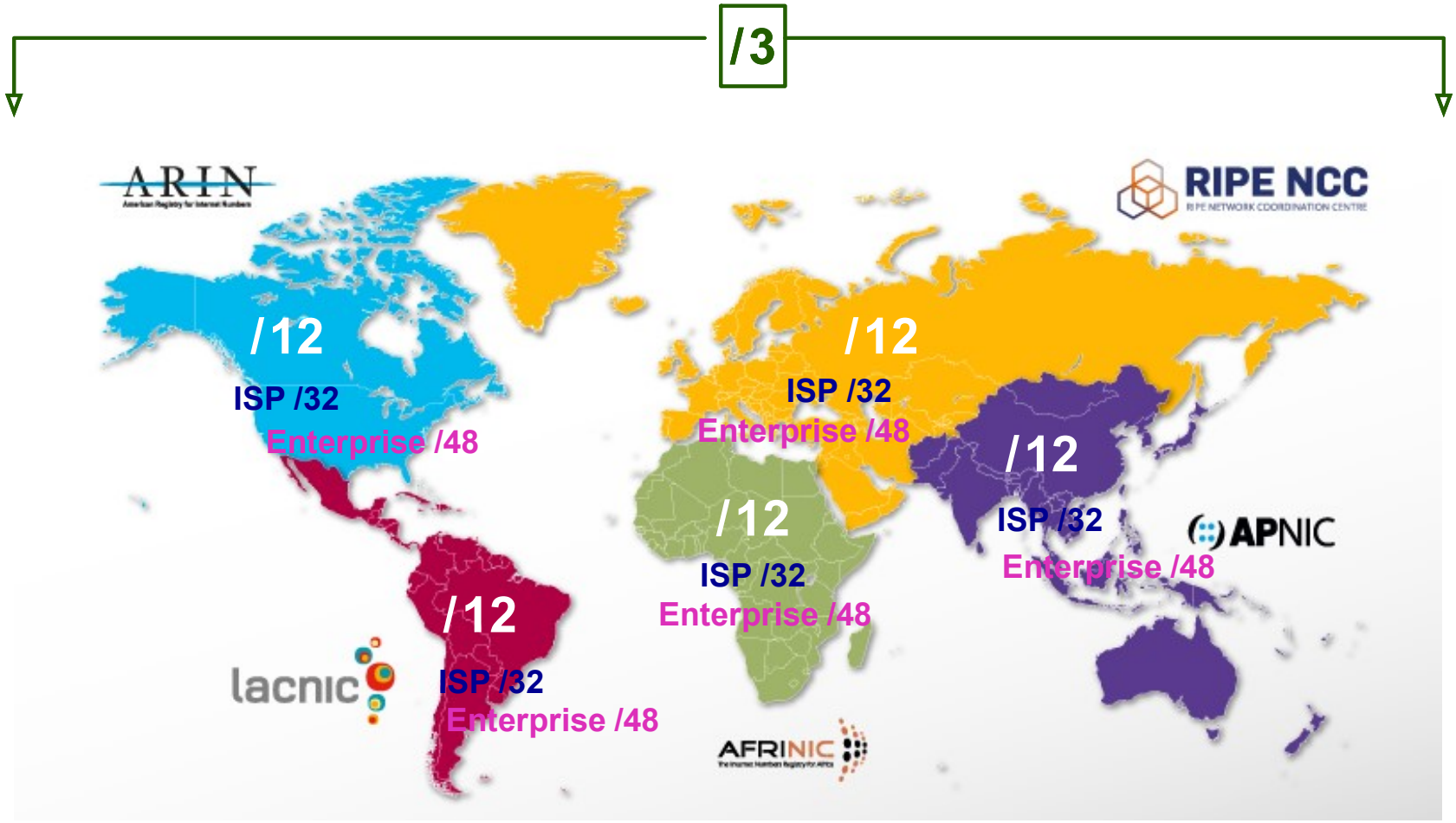


- IPv4 contains 10 basic header fields
- IPv6 contains 6 basic header fields
- IPv6 header comprises 40 octets (fixed) in contrast to 20 octets (variable) in IPv4
- So a smaller number of header fields and the header is 64-bit aligned to enable fast processing by current processors

IPv6 Addressing Structure



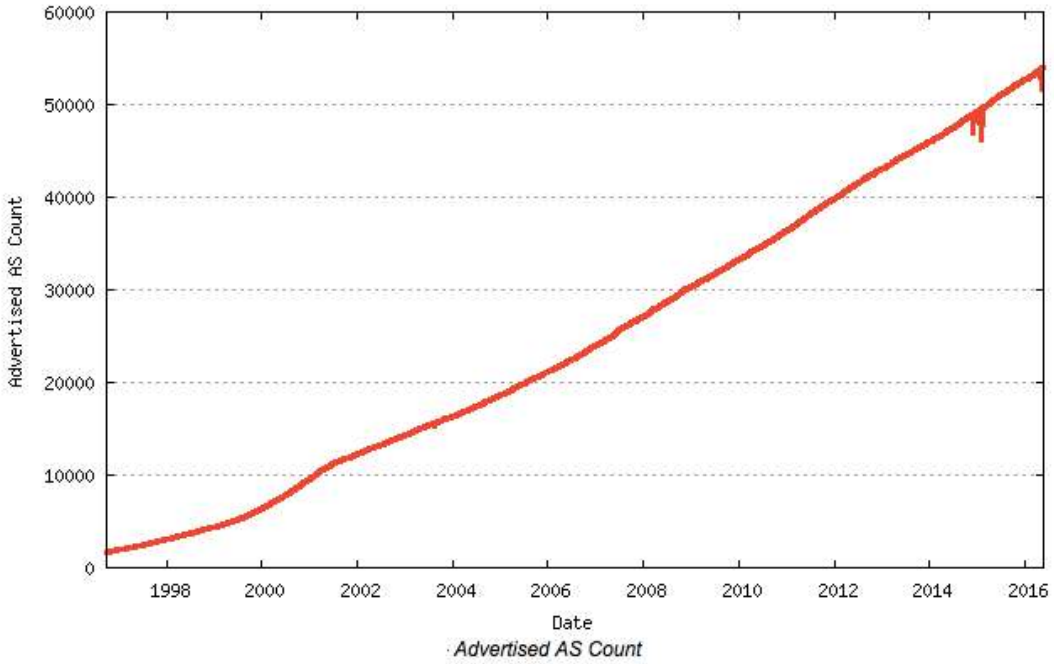
Network Prefix - Global Routing Table



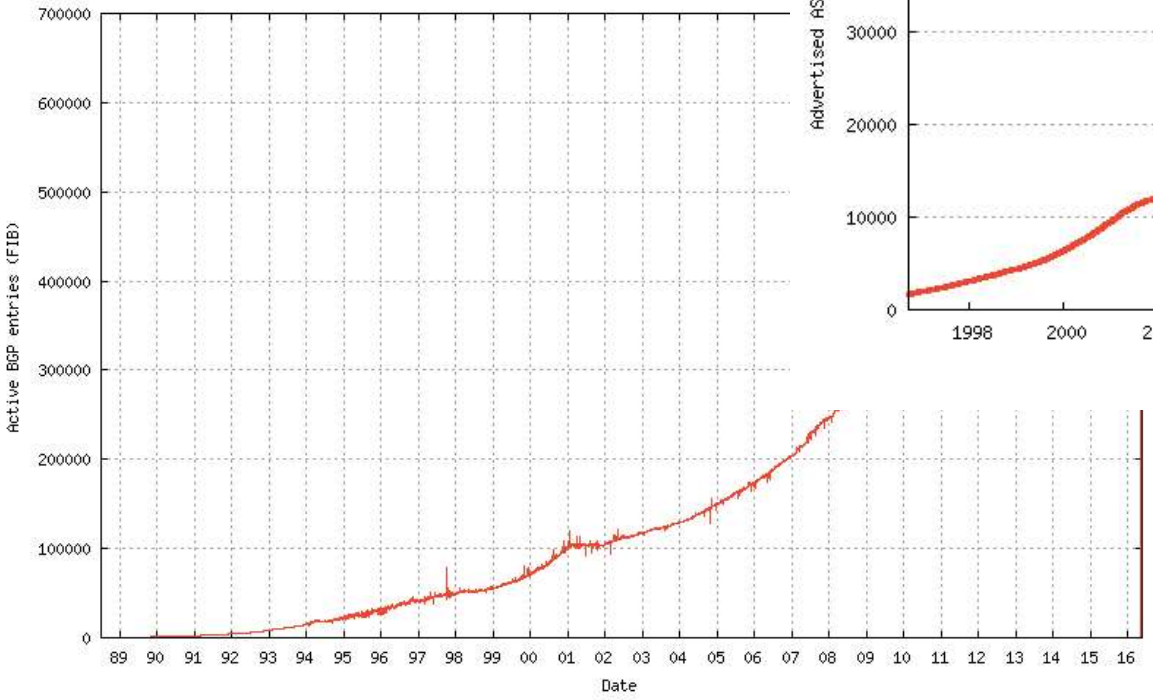
Network Prefix - Global Routing Table

(IPv4)

Active AS



Active BGP entries (FIB)



De-aggregation: 610038/54062

= 11.28 Prefix/ASN

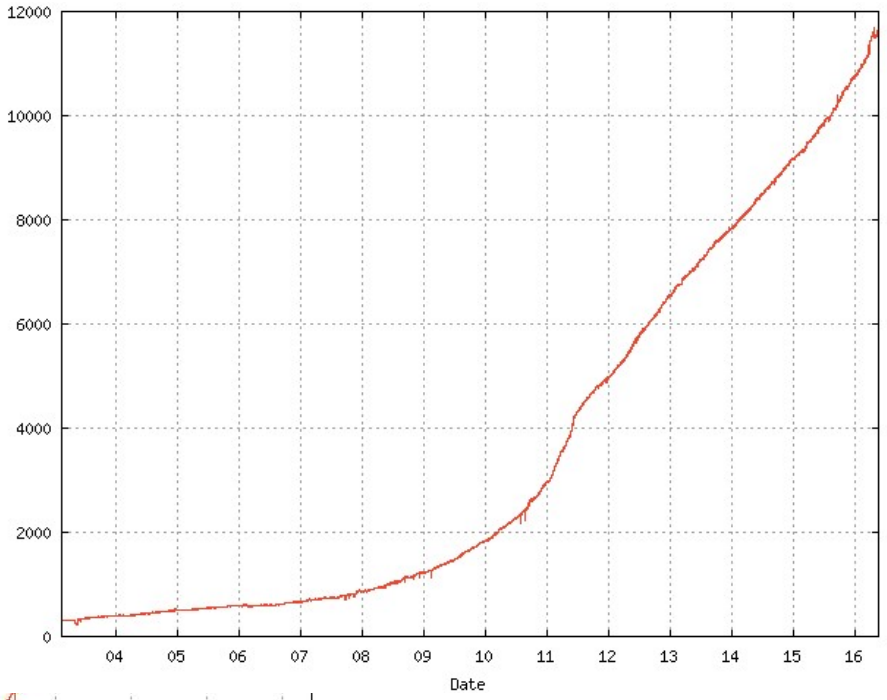
(as of May 22, 2016)

Stat source: http://bgp.potaroo.net/v6/as2.0/index.html

Network Prefix - Global Routing Table

(IPv6)

Active AS



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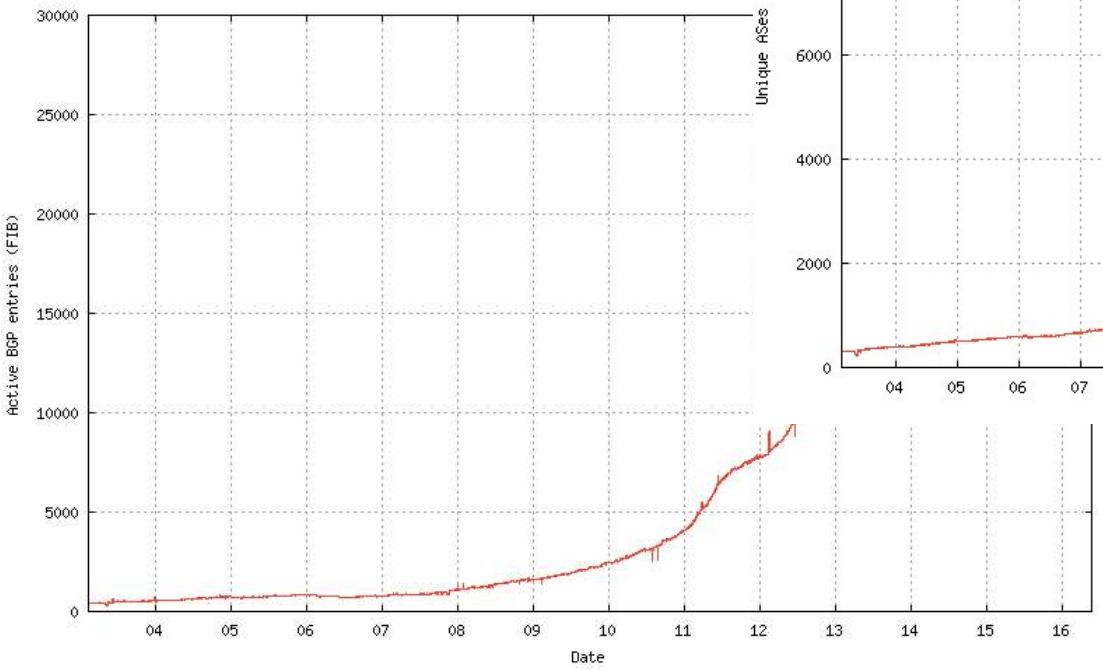


De-aggregation: 29336/11631

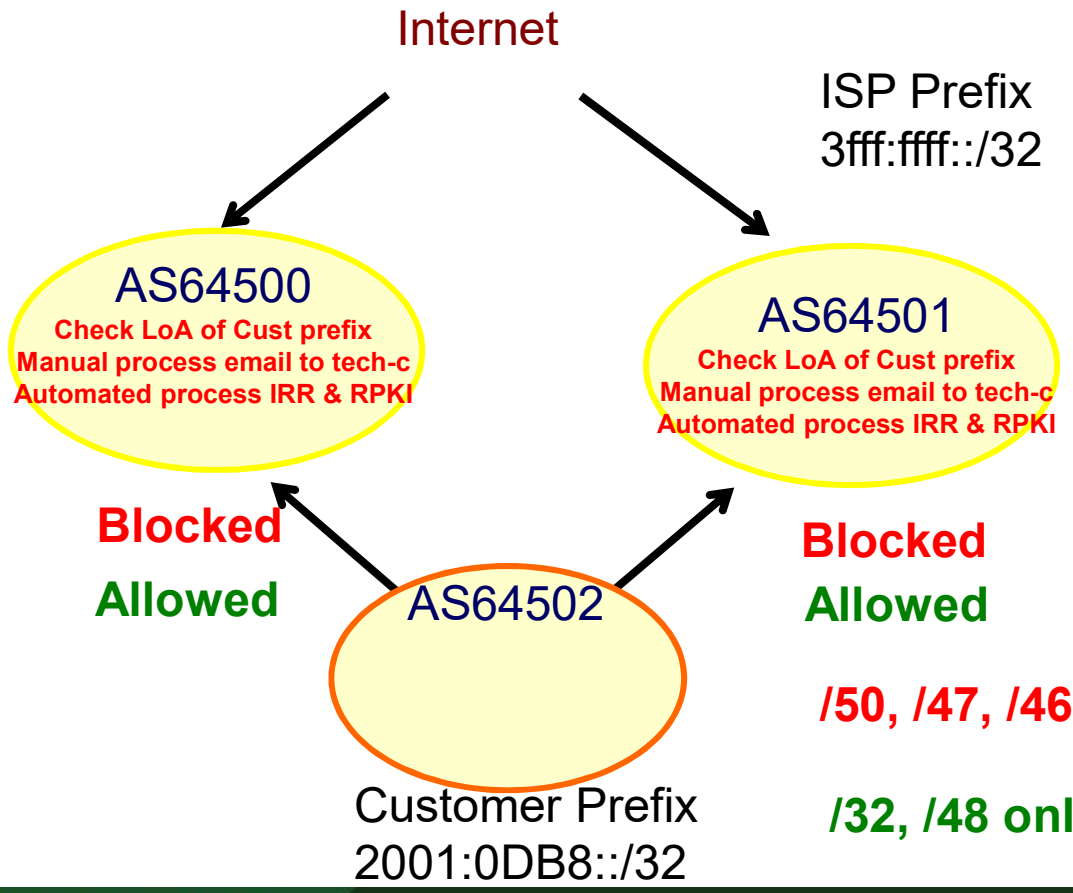
= 2.52 Prefix/ASN

(as of May 22, 2016)

Stat source: http://bgp.potaroo.net/v6/as2.0/index.html

Legitimate Prefix Global Routing

- **Multihome and portable prefix**



Filter requirement for Transit ISP

Route filter permit /48 & /32 in/out

or

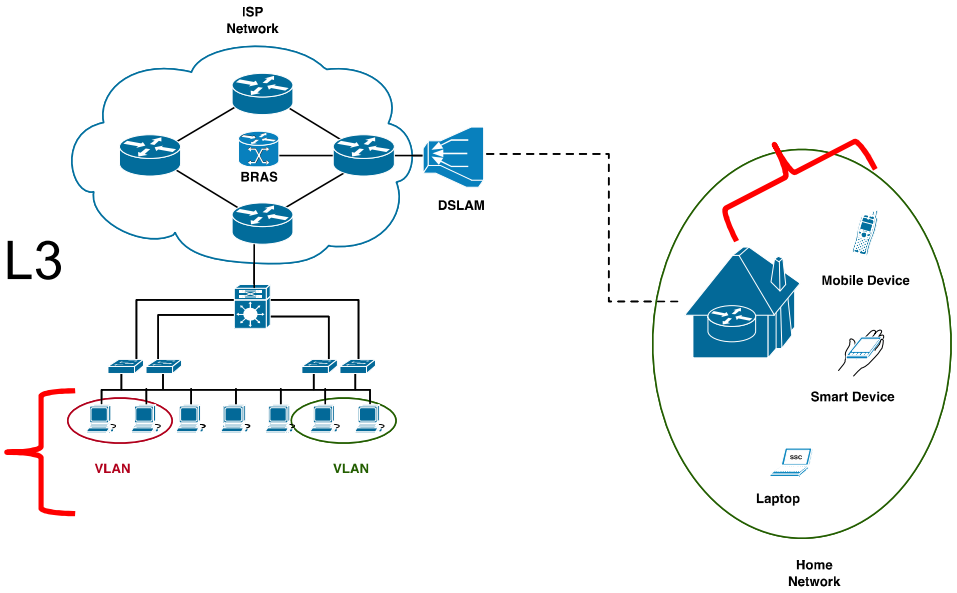
Route filter permit ::/0 only in/out

/50, /47, /46 etc most specific

/32, /48 only most specific

IPv6 End Site Subnet

- What is an IPv6 “end site”?
  - Last part of the network
  - Not further extended to another L3 network
  - Future Internet growth on “end site”
  - Internet of Things (IoT)
  - Internet of Everything
  - Possibly growth area on “end site”
- How far can it grow?
  - 2^{64} possible devices



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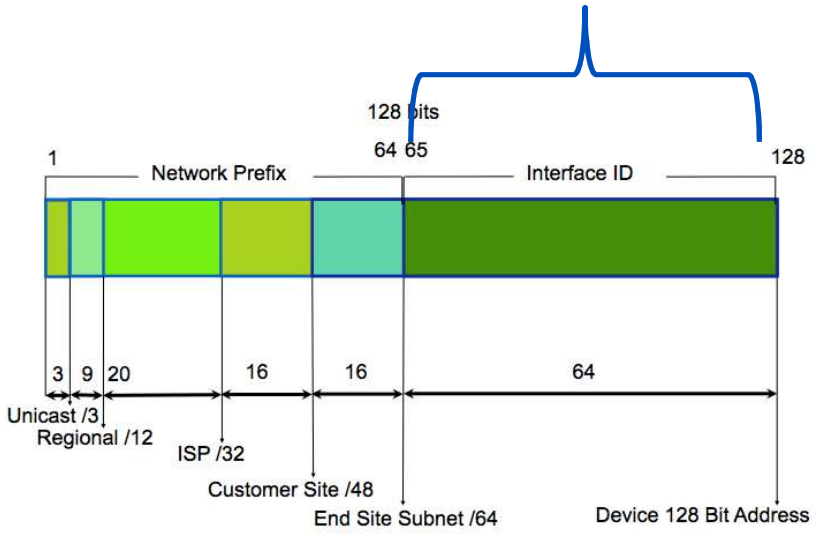
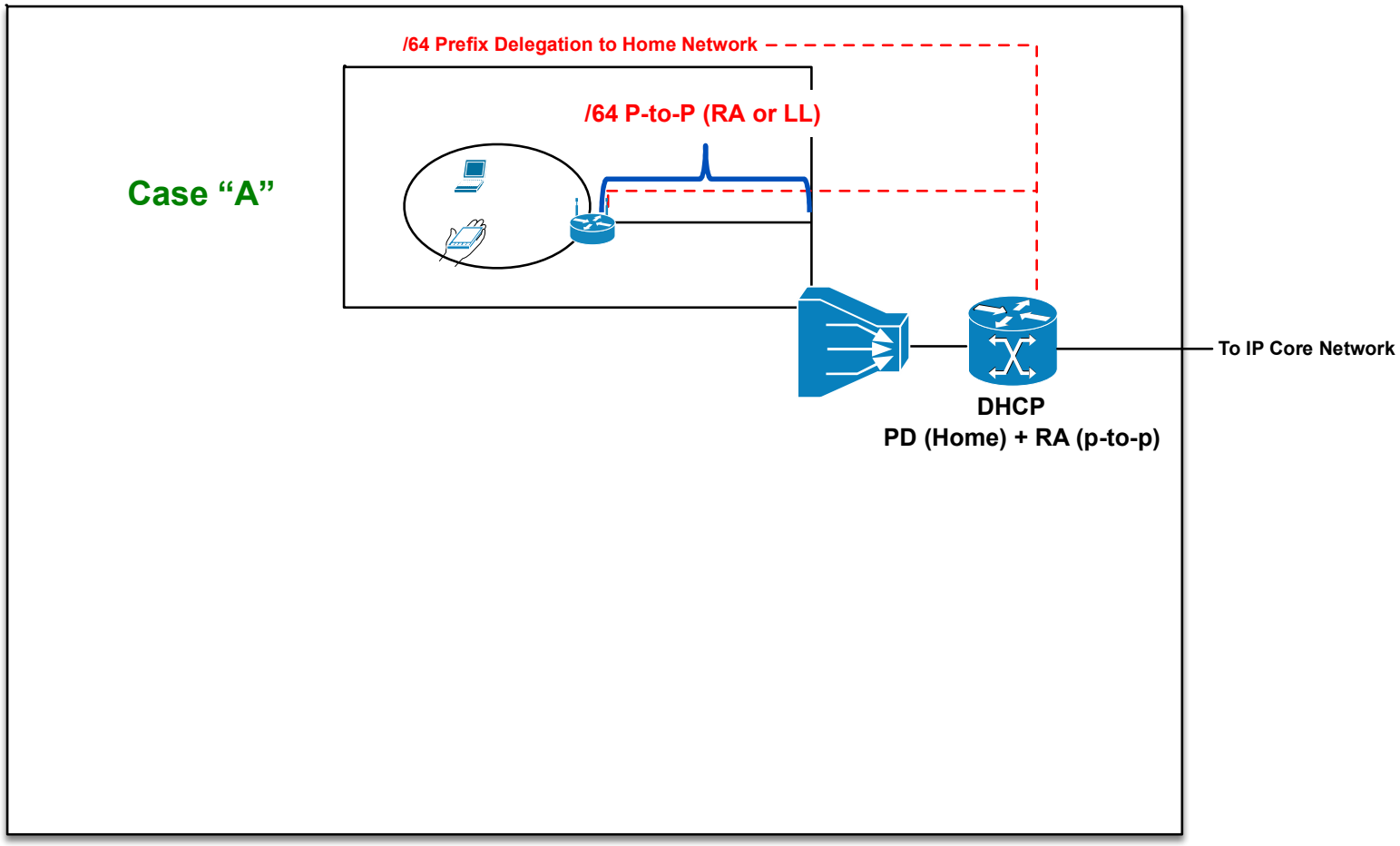


IPv6 Broadband Access Network



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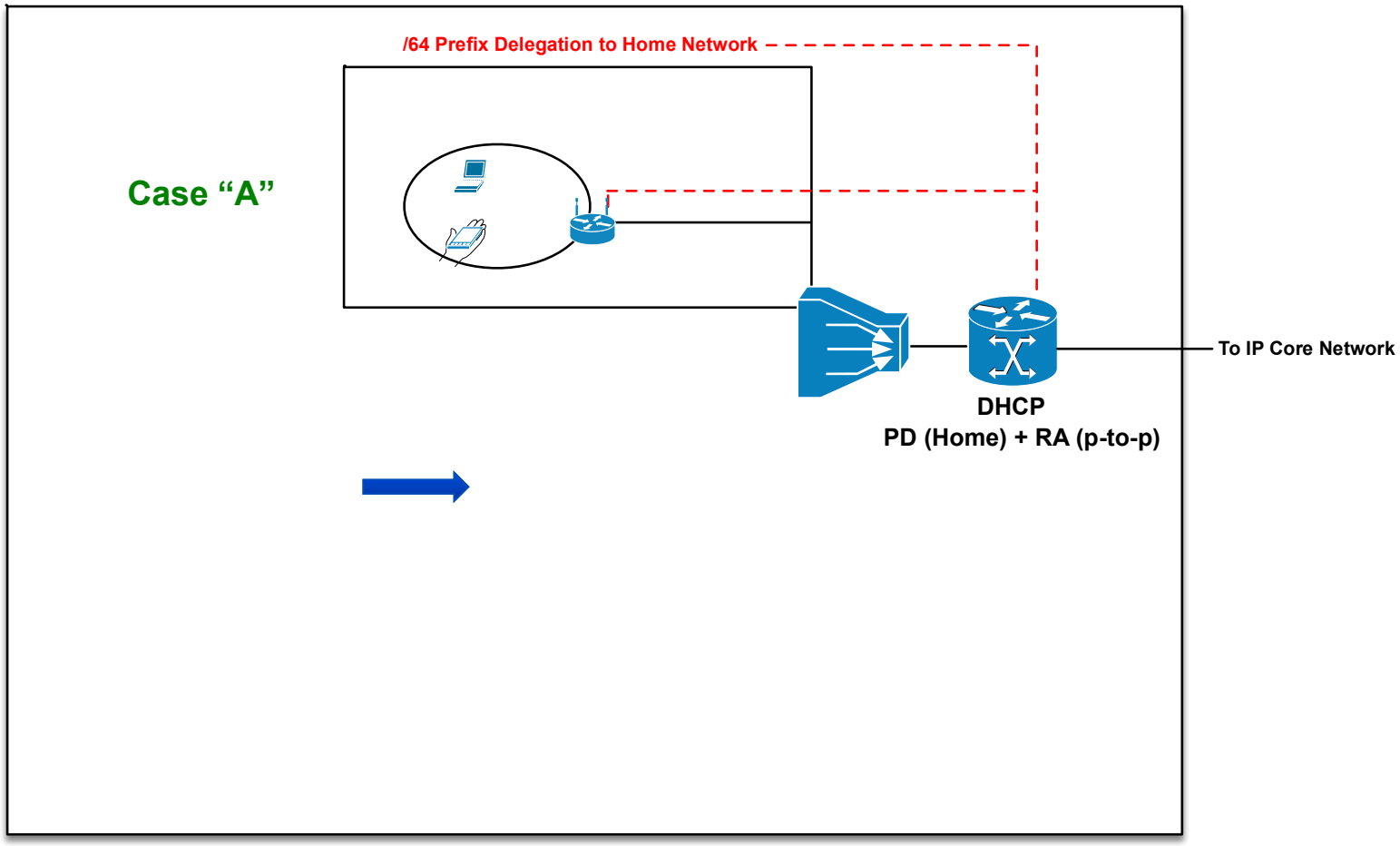

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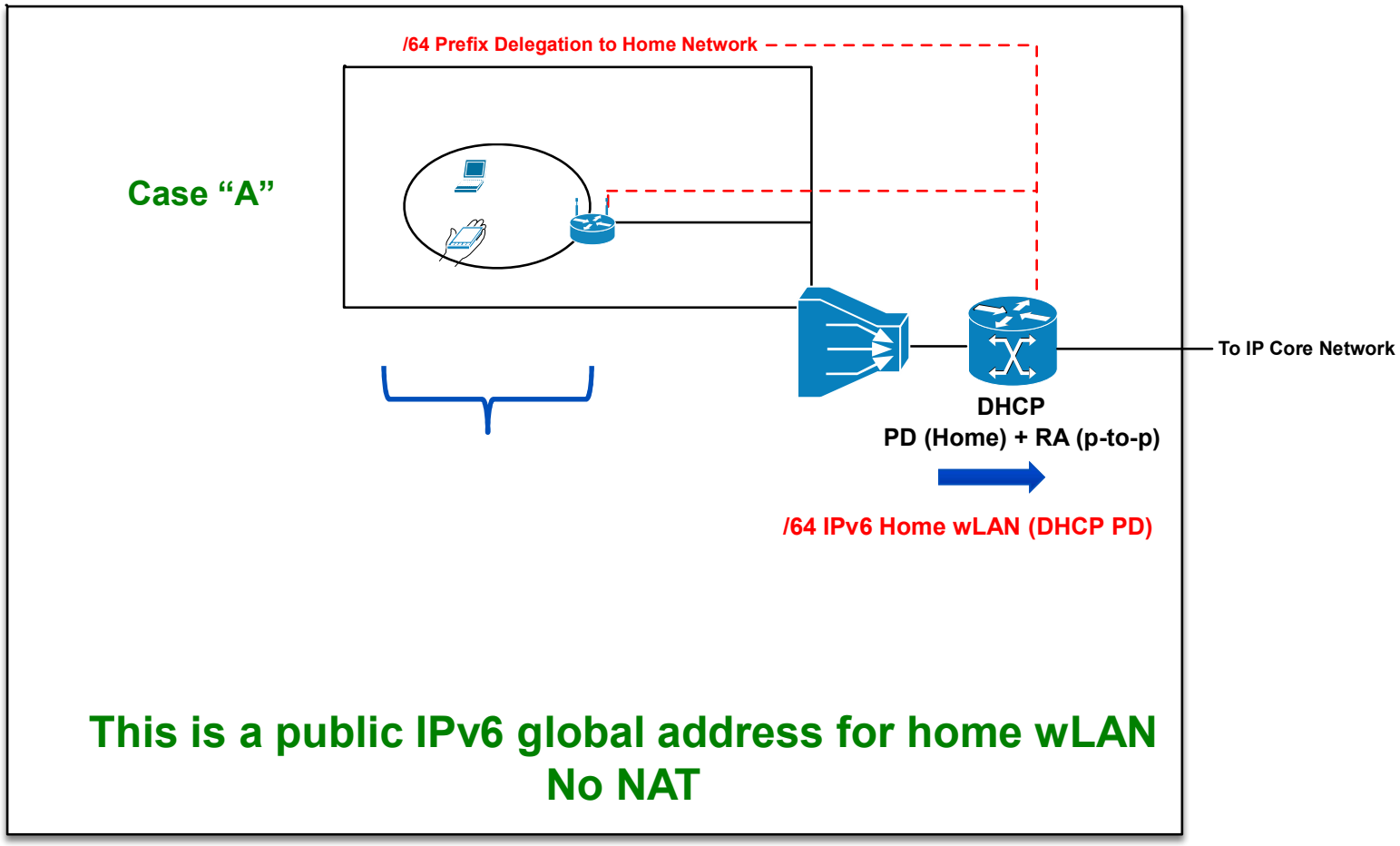
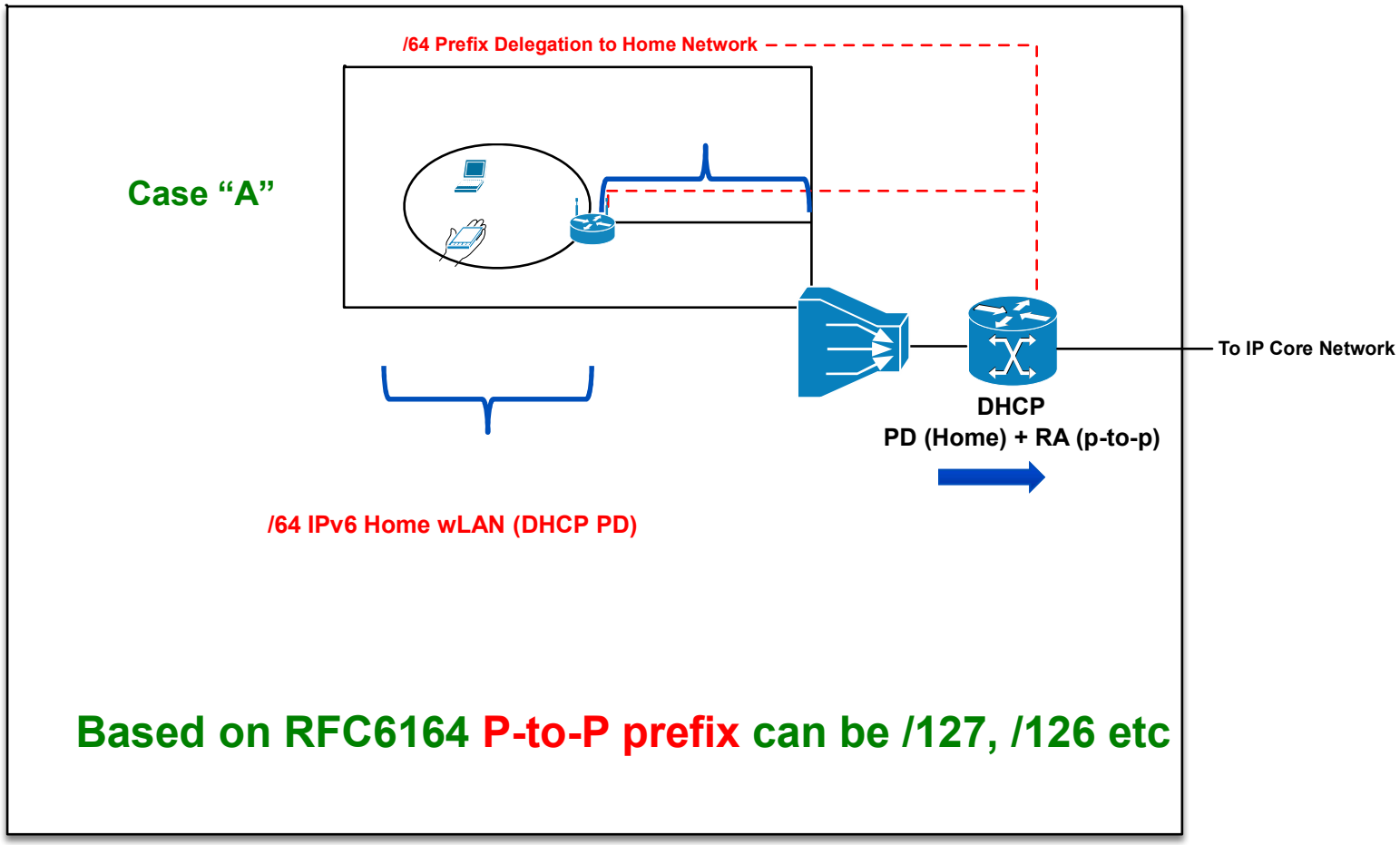


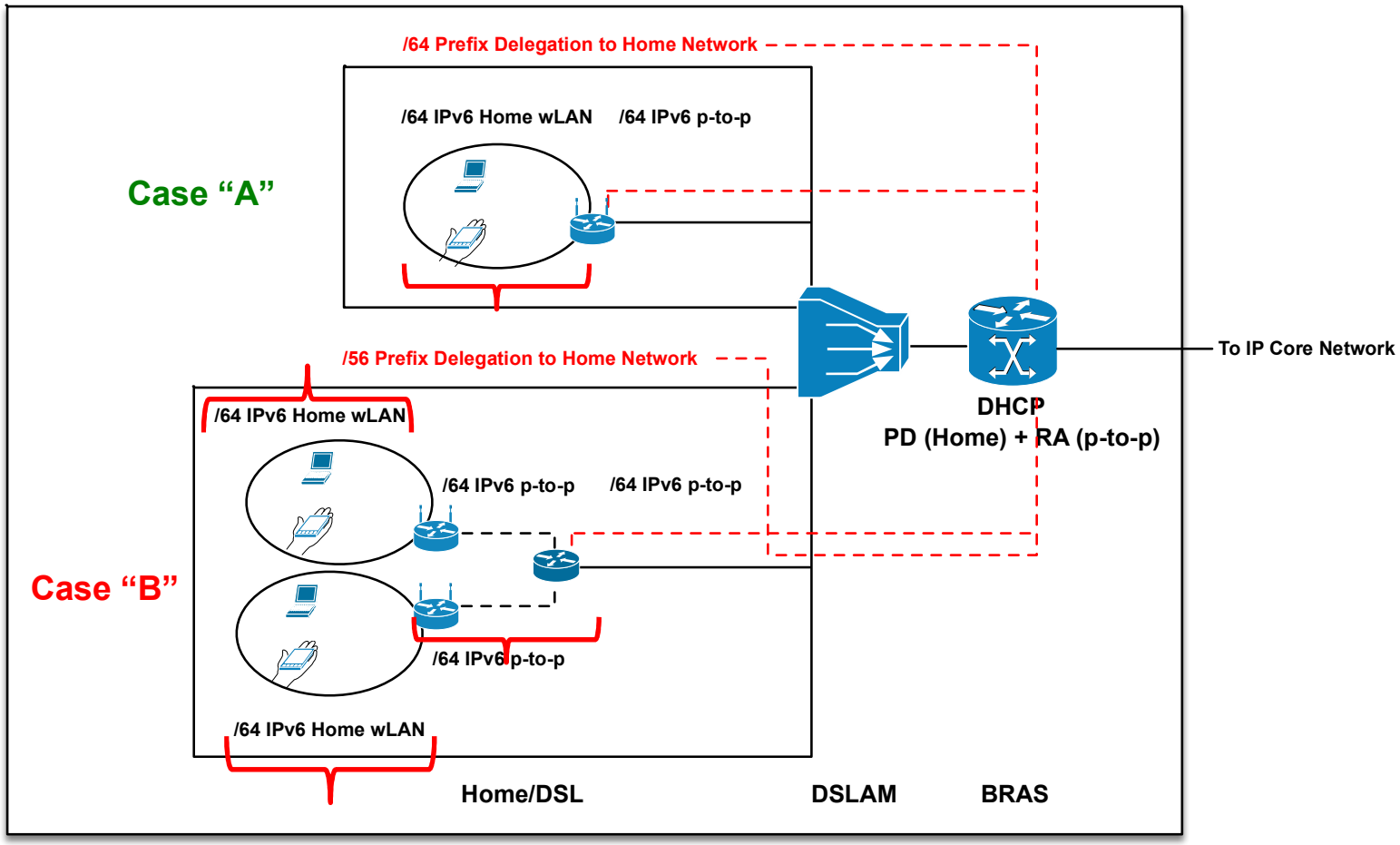
This is a public IPv6 global address for home wLAN
No NAT

IPv6 Broadband Access Network



Based on RFC6164 P-to-P prefix can be /127, /126 etc

IPv6 Broadband Access Network



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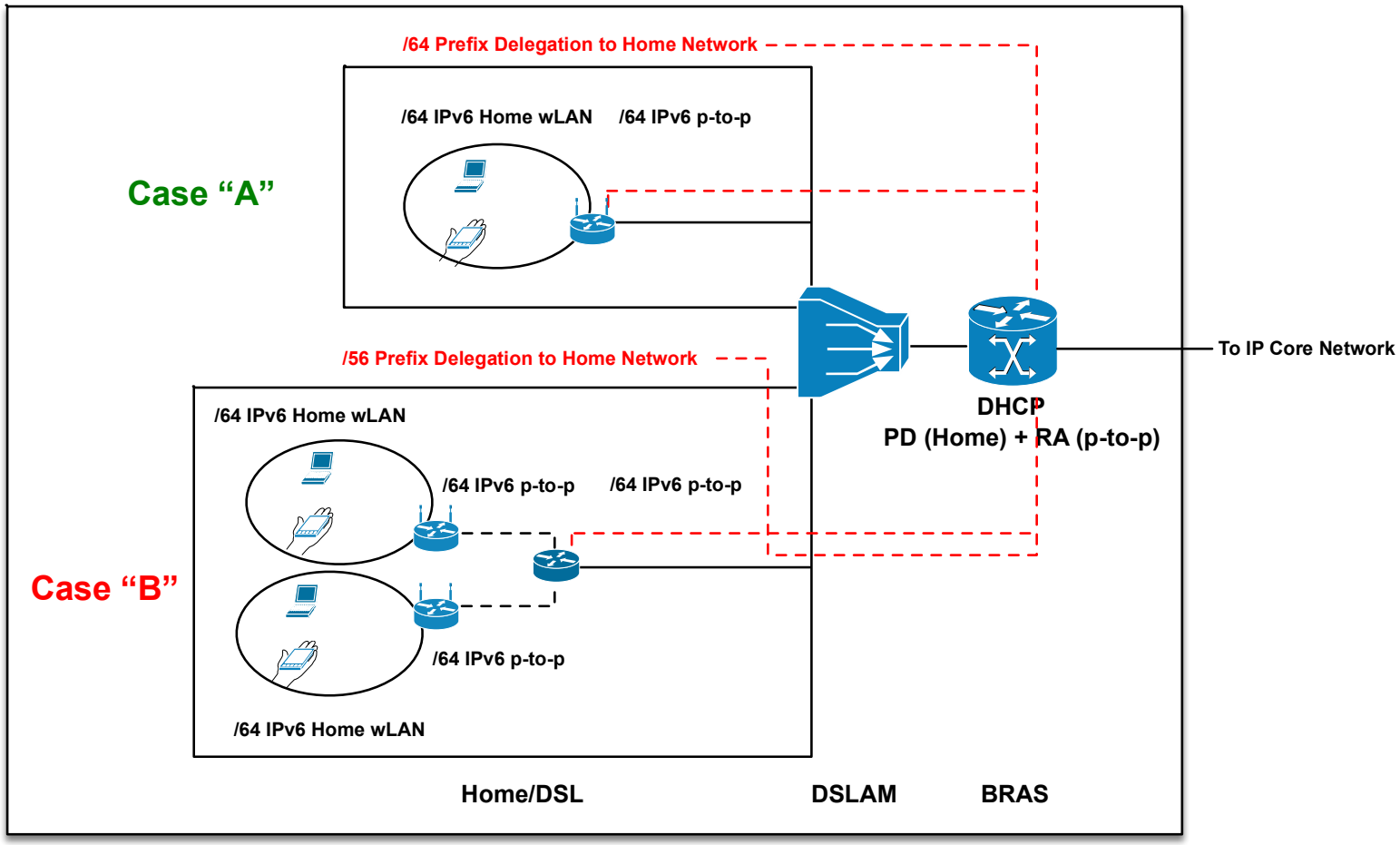

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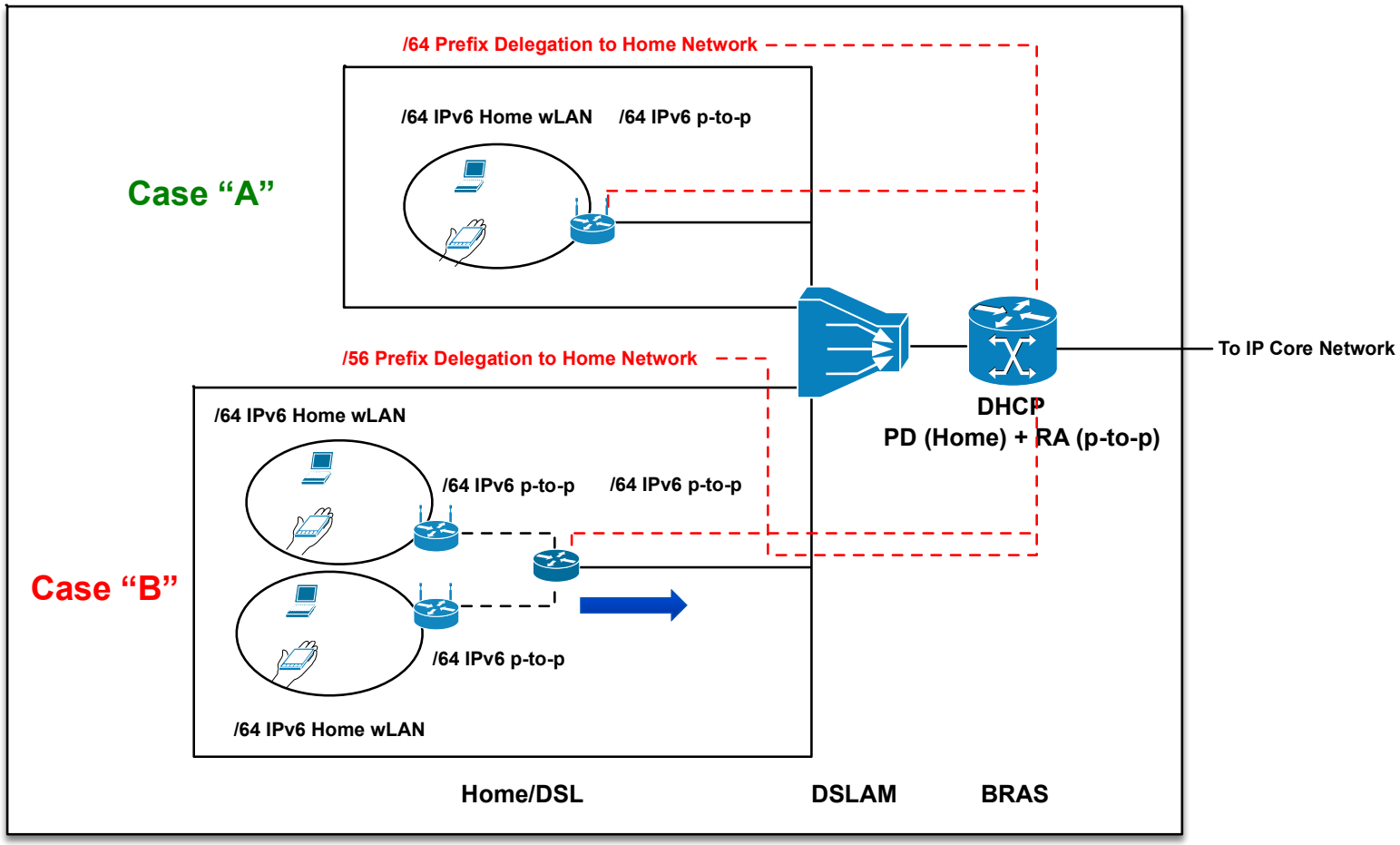

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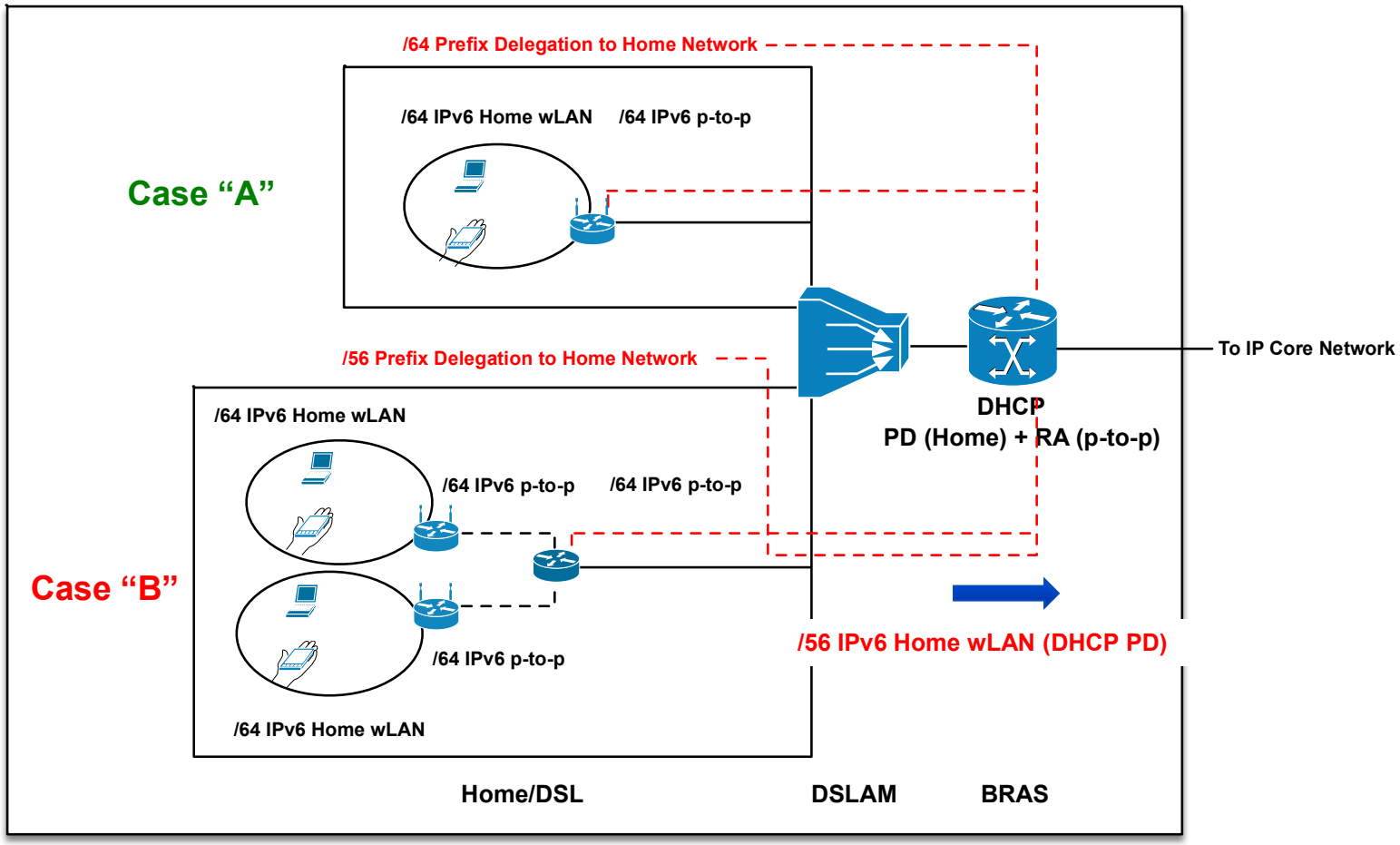

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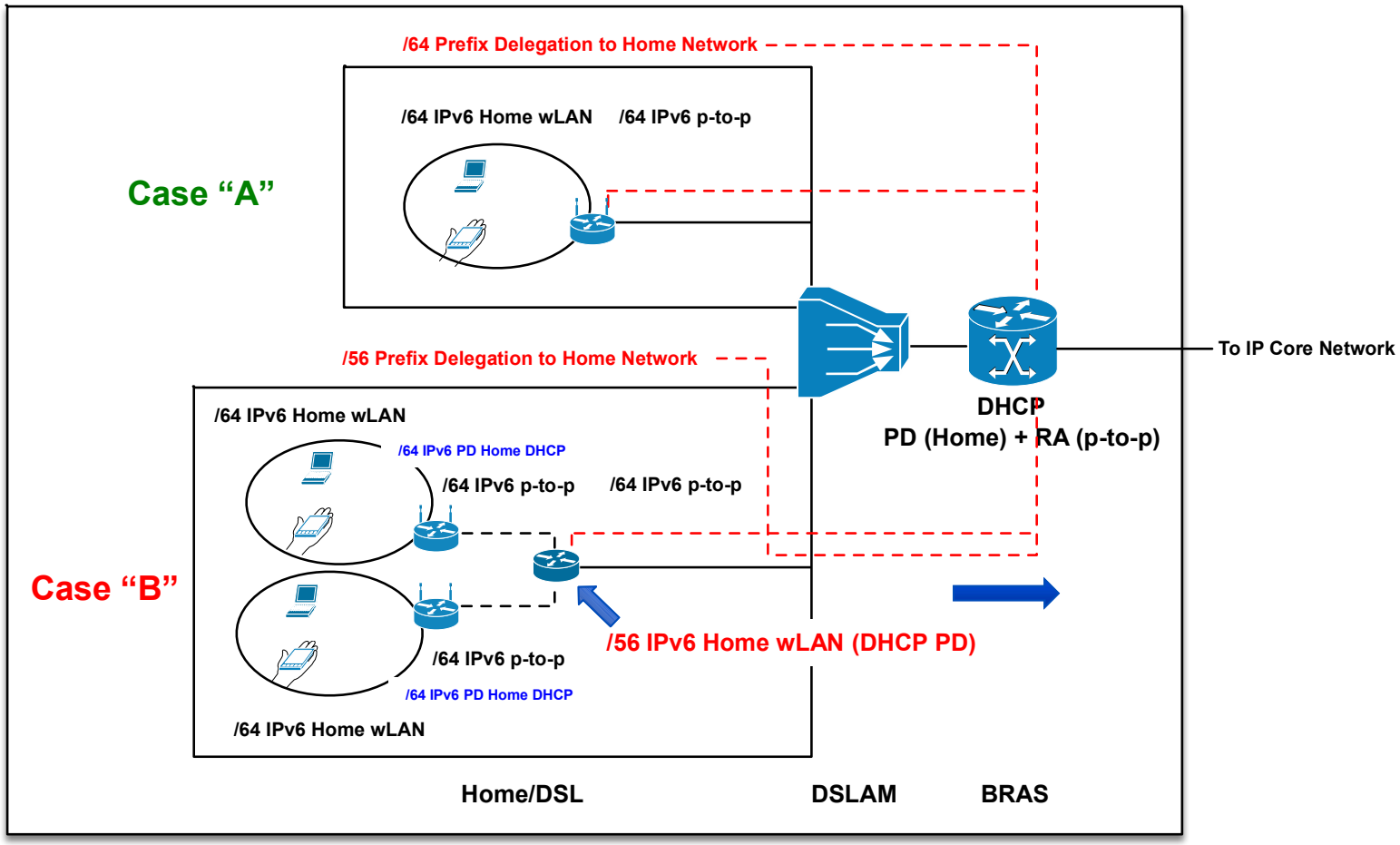

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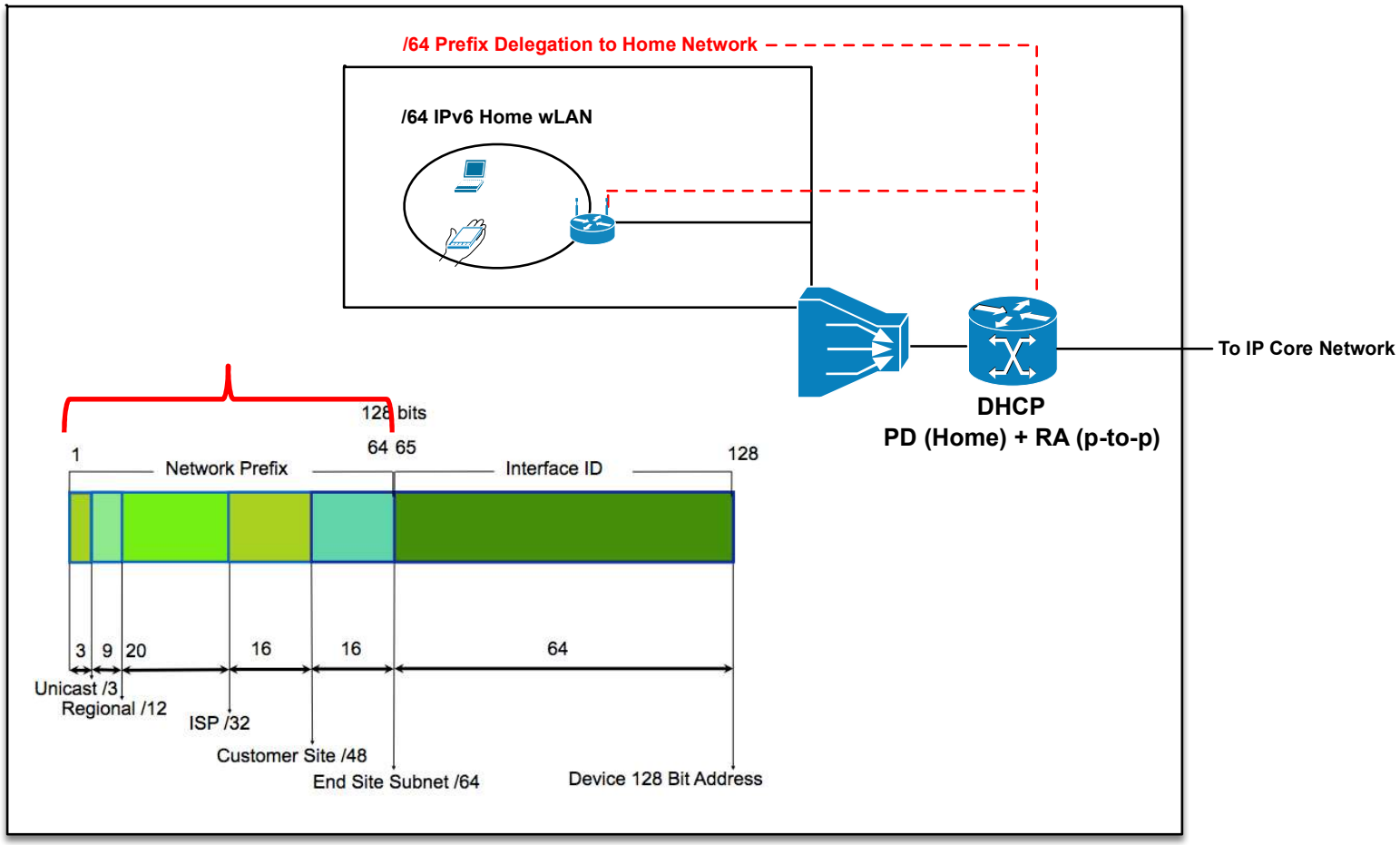

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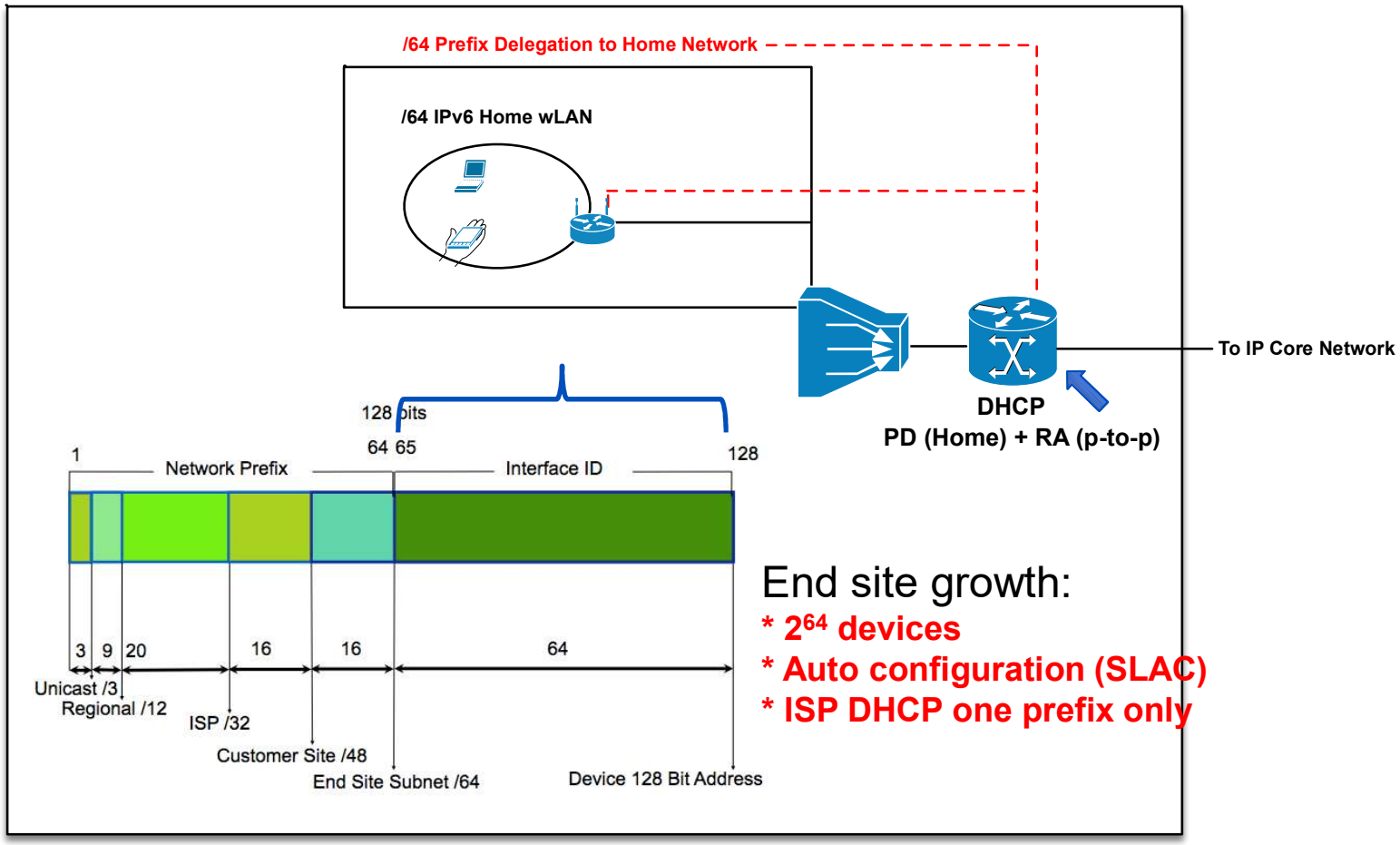

End site growth:

* 2^{64} devices
* Auto configuration (SLAC)
* ISP DHCP one prefix only

Policy Guideline on IPv6 Delegation

APNIC IPv6 Address Delegation Guideline

10. Delegations by LIRs

10.1. LIR assignments to end sites

An LIR can assign a /64 to /48 to an end site customer network based on their requirements.

The following guidelines may be useful:

- /64 where it is known that only one subnet is required.
- /56 for small sites where it is expected only a few subnets will be required within the next two years. Subscribers can receive a /56 when connecting through on-demand or always-on connections such as small office and home office enterprises.
- /48 for larger sites, or if an end site is expected to grow into a large network.

An LIR must submit a second opinion request to APNIC if it plans to assign more than a /48 to a single end site (see Section 10.1.2 below).

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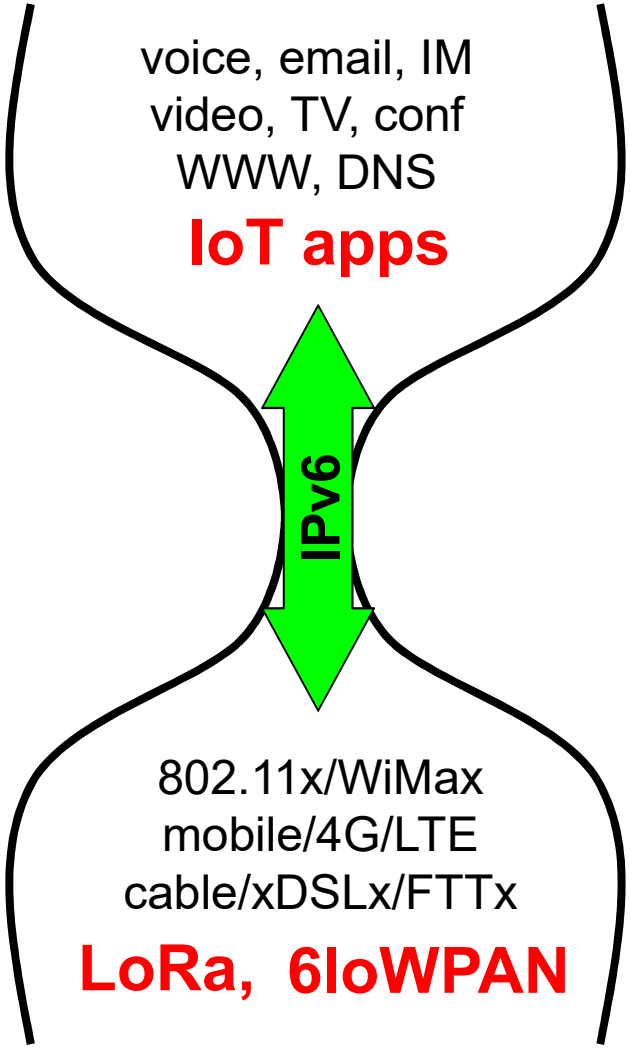
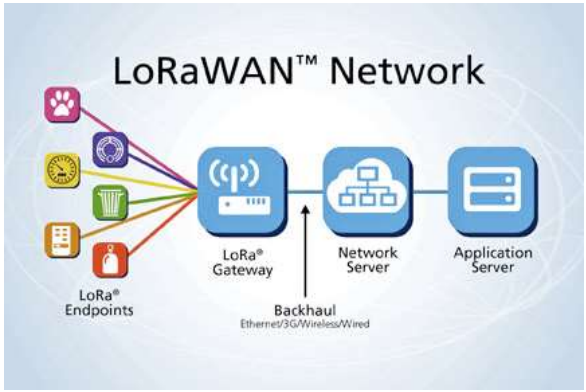
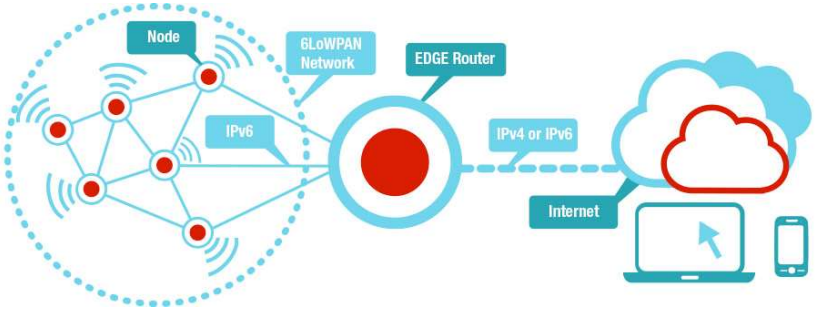
Future IoT Layer 2 & 3 Standard !!







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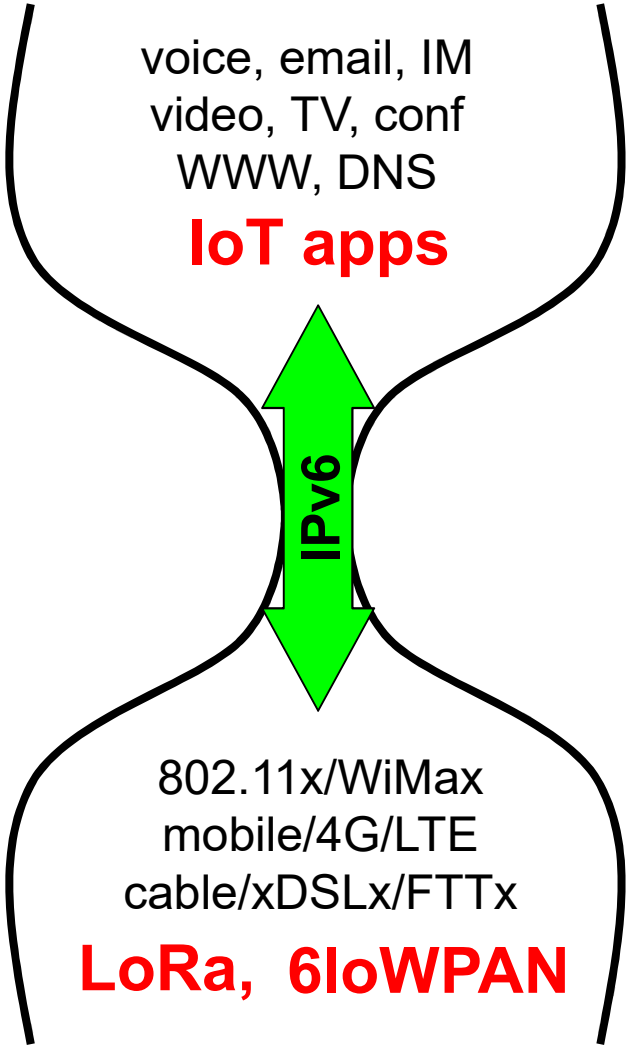

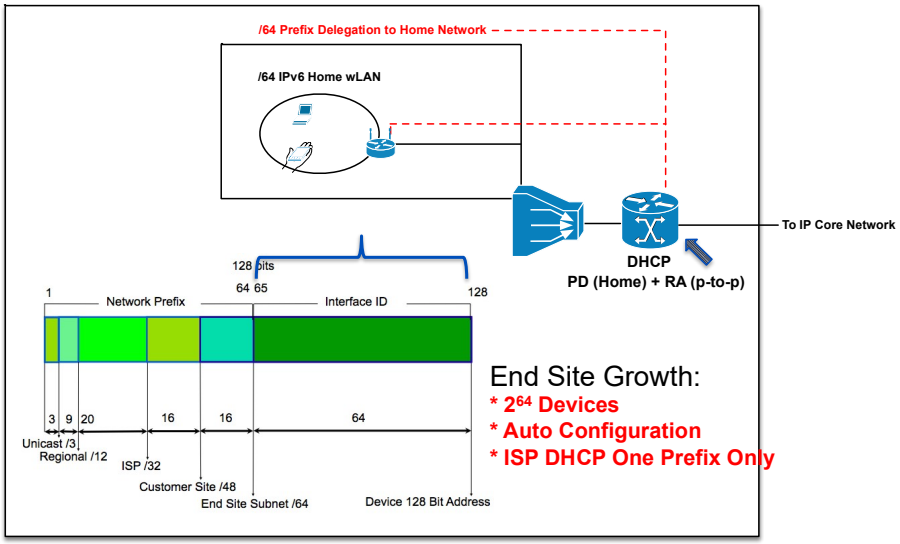

Future “End Side” Growth

Thank you

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More info: http://blog.apnic.net/author/roman/

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