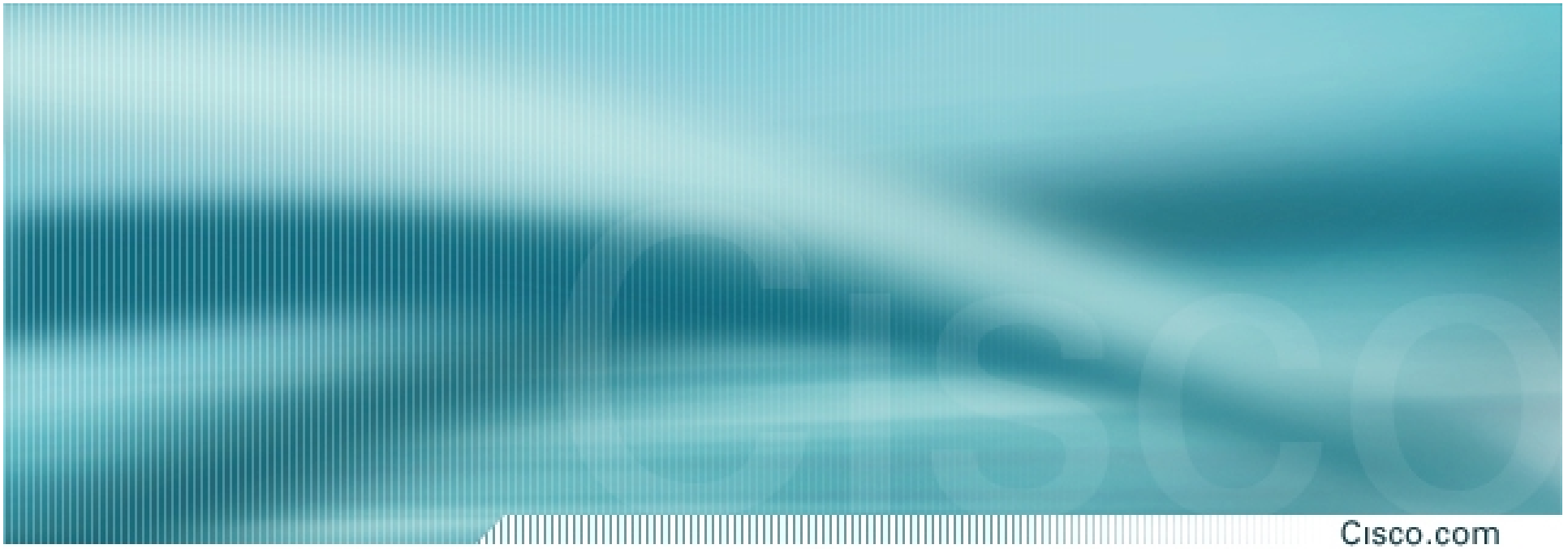

Cisco IOS IPv6 Solutions for Broadband Deployment

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IPv6 Business Model

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- **Integration of IPv6 brings benefits but it has also a cost**

  ROI not – yet - easy to evaluate

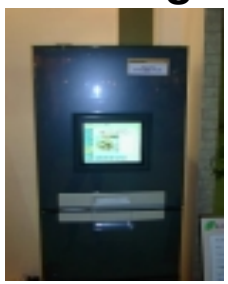
- **Additional business models needs to be created and demonstrated**

  Create a Win-Win situation where IPv6 services are beneficial for the overall community (ISP, End-Users and channels)

  Nobody accept to pay more just to do what is available today through IPv4 and NAT, but add new services/capabilities and the potential is there.

- **Examples**

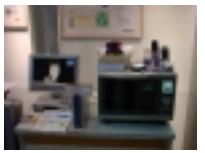
  Adding IPv6 to End-Sites – eg. Home/SOHO/Schools - with a single IPv4 global address



  Can add IPv6 to implement Server's applications (eg. Web), Peer-to-Peer (Video conferencing, Instant Messenger, ….

  Enable deployment of new generation of devices that require global addressing



- **Let's go through a case study**

A Today's Network Infrastructure

- **MPLS technology selected as existing core infrastructure**

  Current services are MPLS/VPN, L2 services over MPLS, Circuit over MPLS

- **IP services portfolio**

  Enterprise: Lease Lines

  Home Users/SOHO: ADSL, ETTH, Dial

  Data Center: Web hosting, servers,…

IPv6 Integration Goals

- **Add IPv6 services to current portfolio by focusing on Home/SOHO users**
  - **Where NAT restrictions are the most perceptible**
  - **Enable Innovation**
- **Cost control & Investment protection**
  - **Must adapt to the current economic environment**
- **Delegate IPv6 prefix from ISP ::/32 prefix**
  - **Really moving to IPv6 production services**
  - **Validating IPv6 auto-configuration mechanisms**
- **Adding new connectivity services**
  - **Ie: 802.11 (WiFi) Hot Spots**

Deployment Activities

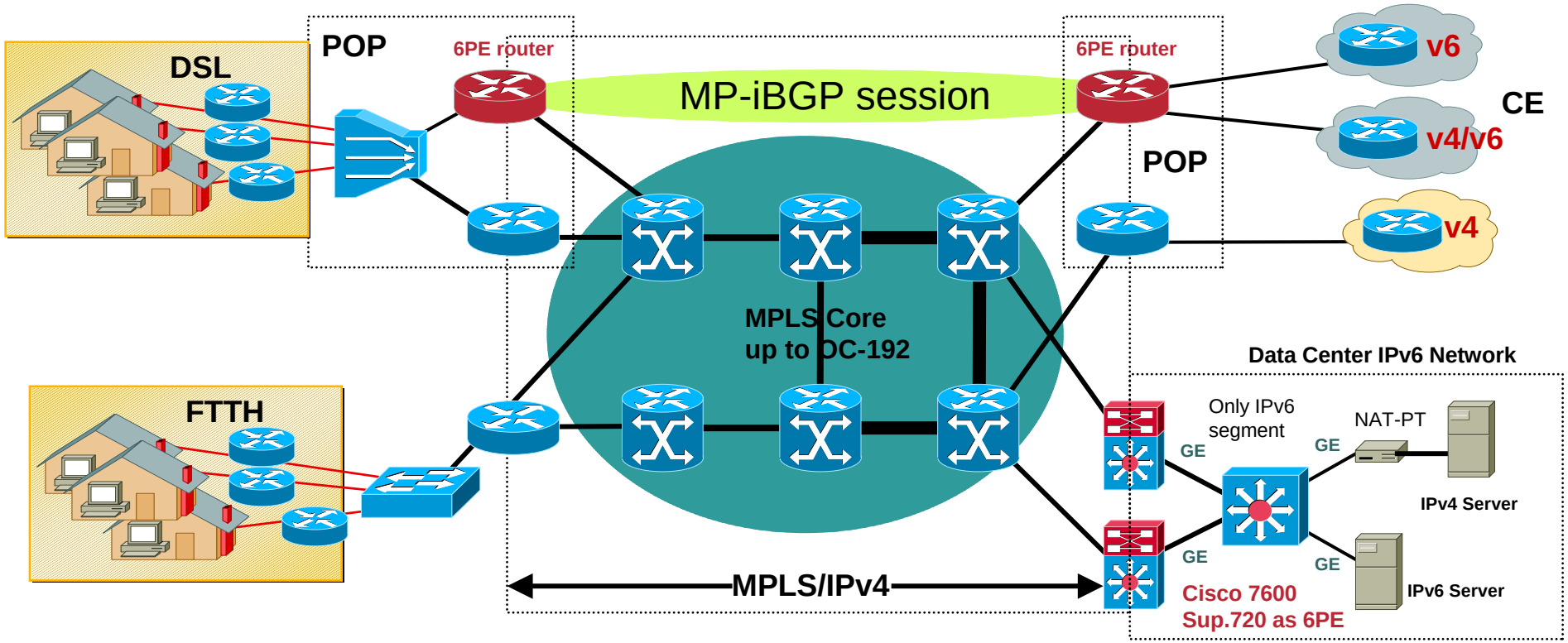
- **IPv6 Core Network Enhancement**
  - **IPv6 Provider Edge Routers (6PE) over MPLS**
- **Broadband Access Networks**
  - **IPv6 over broadband data link layers**
  - **IPv6 address allocation guidelines**
  - **IPv6 AAA Radius**
  - **IPv6 auto-configuration – Prefix Delegation & Stateless DHCP**
- **Data Center**
  - **IPv6 on Layer 3 infrastructure**

Scenario for IPv6 Core infrastructure

- IPv4 and IPv6 services will be there for – at least - the next 5 years
- Dual stack network looks like the best solution to move to production
  - Tunnels were good for trials
- Native IPv4 and IPv6 require a full network upgrade
  - Valid scenario
- In our case study, MPLS being already deployed for IPv4 services, 6PE is the preferred scenario
  - IPv6 POPs can be installed one by one (software upgrade or new PE router) – Cost of deployment is under control
  - IPv6 prefix ::/48 can be assigned from ::/32
  - draft-ietf-ngtrans-bgp-tunnel

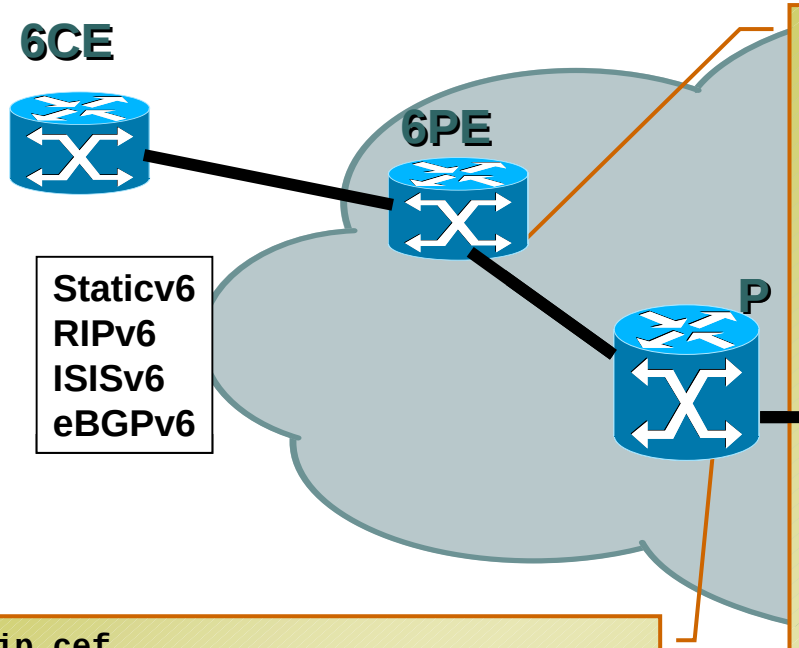
Recommended Cisco 6PE
NPE-G1 – 7200, 7301
NPE-G100 – 7304
7600 – Sup.720
Cisco 12000

Minimum Infrastructure Upgrade for 6PE



- MPLS/IPv4 Core Infrastructure is IPv6-unaware
- PEs are updated to support Dual Stack/6PE
- IPv6 reachability exchanged among 6PEs via iBGP (MP-BGP)
- IPv6 packets transported from 6PE to 6PE inside MPLS

6PE configuration




```
ip cef
mpls label protocol ldp
tag-switching tdp router-id
loopback0
!
interface Serial2/0
 ip address 10.10.10.2
255.255.255.252
 ip router isis
 mpls label protocol ldp
 tag-switching ip
!
```

```
ipv6 cef
mpls label protocol ldp
mpls ipv6 source-interface Loopback0
mpls ldp router-id loopback0
!
interface Loopback0
 ip address 10.10.20.2 255.255.255.255
 ipv6 address 2003::/64 eui-64
!
router bgp 100
 no synchronization
 no bgp default ipv4-unicast
 bgp log-neighbor-changes
 neighbor 10.10.20.1 remote-as 100
 neighbor 10.10.20.1 update-source Loopback0
 !
 address-family ipv6
 neighbor 10.10.20.1 activate
 neighbor 10.10.20.1 send-label
 redistribute connected
 redistribute rip ripv6CE1
exit-address-family
!
```

Deployment Activities

- IPv6 Core Network Enhancement
  - IPv6 Provider Edge Routers (6PE) over MPLS
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- Data Center
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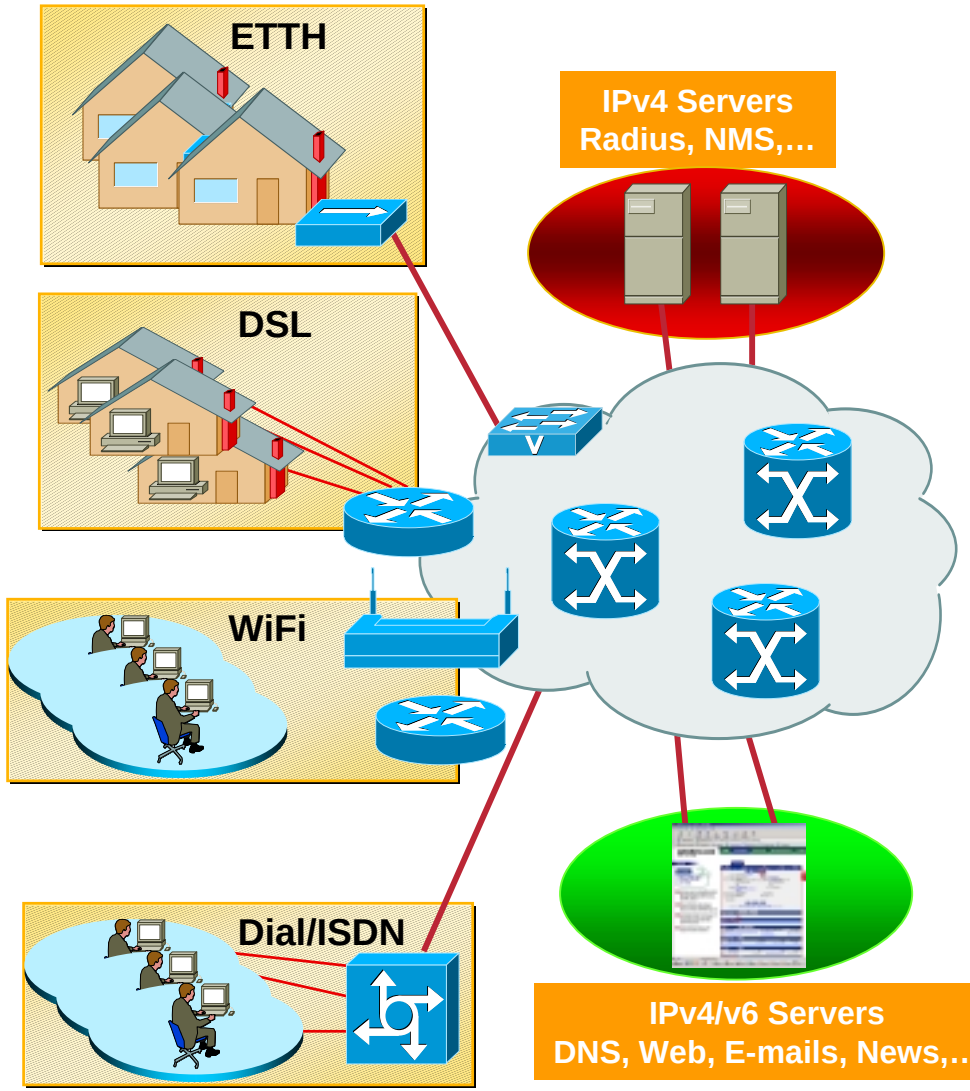
Data Link Layers

- Dial/ISDN
  - PPP
- Ethernet-To-The-Home
  - Ethernet
- 802.11 (WiFi) Hot Spots
  - Ethernet like
- ADSL
  - ATM RFC 1483 Routed
  - ATM RFC 1483 Bridged (RBE)
  - PPPoA
  - PPPoE
- Available from Cisco IOS routers running 12.2T and 12.2B releases



IPv6 Address Allocation Guidelines

“…recommends the assignment of /48 in the general case, /64 when it is known that one and only one subnet is needed…”

RFC3177
IAB/IESG Recommendations on IPv6 Address Allocations to Sites

Policy Example

- Give Home/SOHO a permanent /64 – single link
- Give Home/SOHO a permanent /48
- Short-lived /64 from a prefix-pool

  A Separate /64 is assigned each user/interface. The prefix is advertised in RA's and a route is installed in the RIB.

- Short-lived /128 from a shared prefix-pool

  /64 prefix is shared between all users of the pool. The same /64 prefix is advertised in RA's out all interfaces. The user gets an /128 based on the prefix and his Interface-Identifier. A route in the RIB is installed only for the /128.

- For some users set the Interface-ID explicitly

AAA/RADIUS

- **Cisco Vendor Specific Attributes**

  IPv6 Prefix, IPv6 Route, IPv6 ACL (Input & Output)

- **RADIUS and IPv6 (RFC3162)**

  Framed-IPv6-Prefix
  Framed-IPv6-Route
  Framed-IPv6-Pool
  NAS-IPv6-Address
  (Login-IPv6-Host)
  (Framed-Interface-Id)

- **On Cisco IOS, RADIUS transport is IPv4 as today most Radius server are used for both protocols**

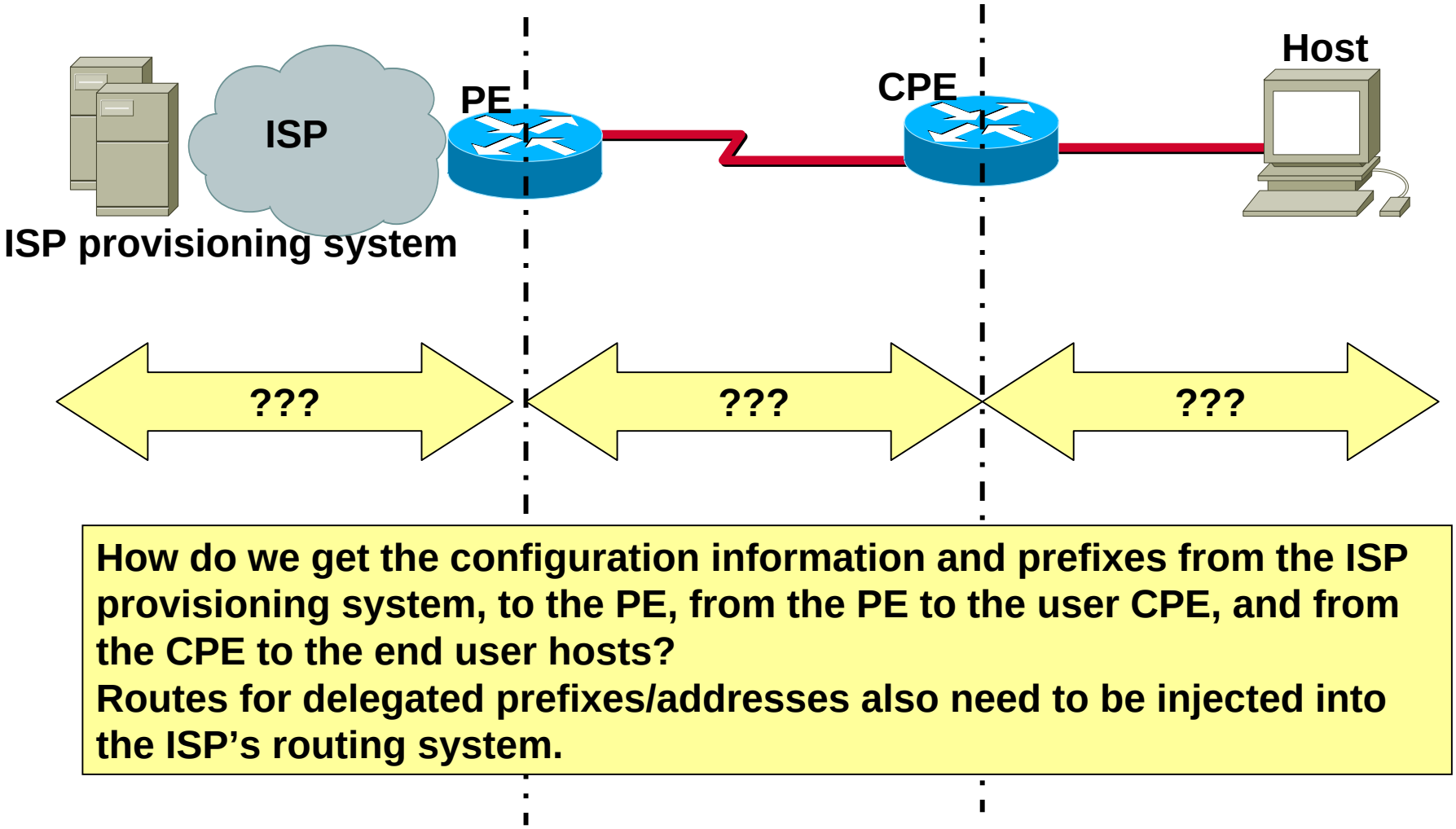
  IPv6 should be added later

- **IPv6 AAA available on Cisco IOS**

  Cisco VSA available now from Cisco IOS 12.2T and 12.2B

  RFC 3162 available from upcoming Cisco IOS 12.3T

Deployment model



How do we get the configuration information and prefixes from the ISP provisioning system, to the PE, from the PE to the user CPE, and from the CPE to the end user hosts?
Routes for delegated prefixes/addresses also need to be injected into the ISP's routing system.

Requirements for Prefix Delegation

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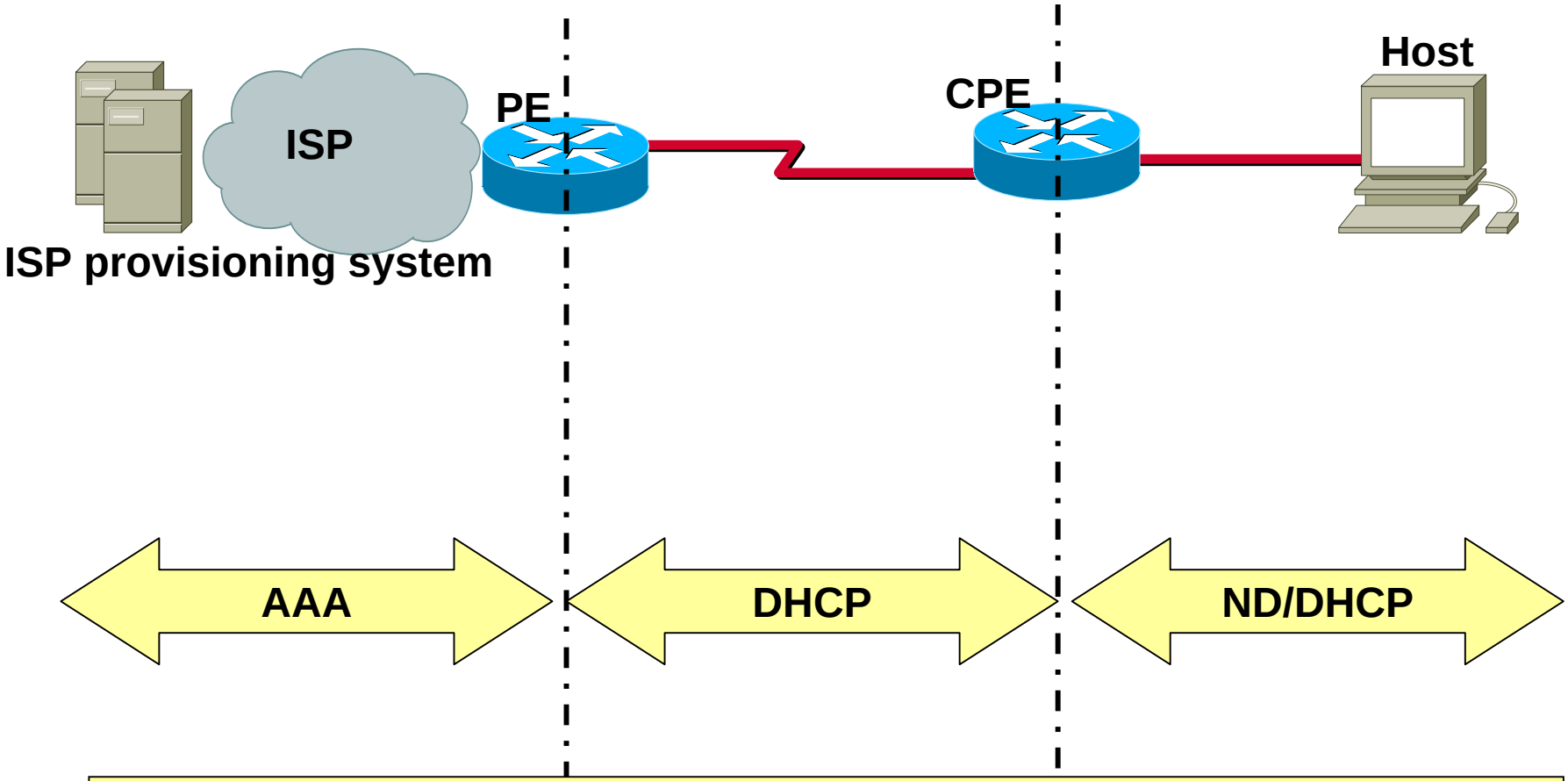
- Assignment of variable length prefixes
- Allow for prefix lifetime expiry, and service provider initiated reconfiguration
- Independent of end user topology
- Media independent

  xDSL, Ethernet-to-the-Home, Cable, Wireless
- Requirements for IPv6 prefix delegation

  draft-ietf-ipv6-prefix-delegation-requirement-01.txt
- Other configuration information:

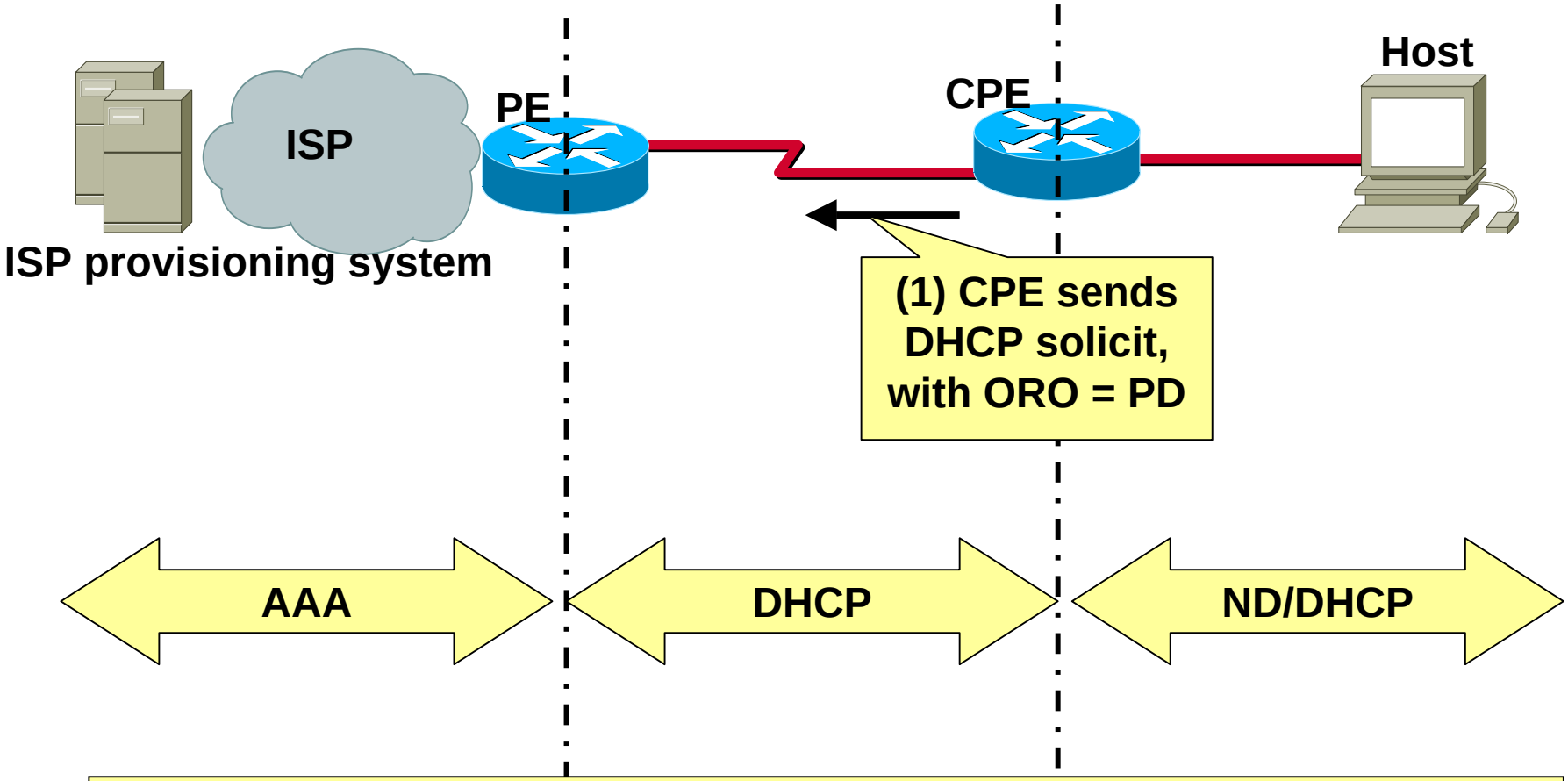
  Pass on other types of information, e.g DNS parameters (DNS servers, domain name), NTP servers, SMTP, POP, etc.

Suggested solution — Provisioning system to PE



The PE can also send RA's on the PE-CPE link, and the CPE can auto-configure an "uplink" address. Prefix should be different from the prefix assigned to the user.

Suggested solution — Provisioning system to PE



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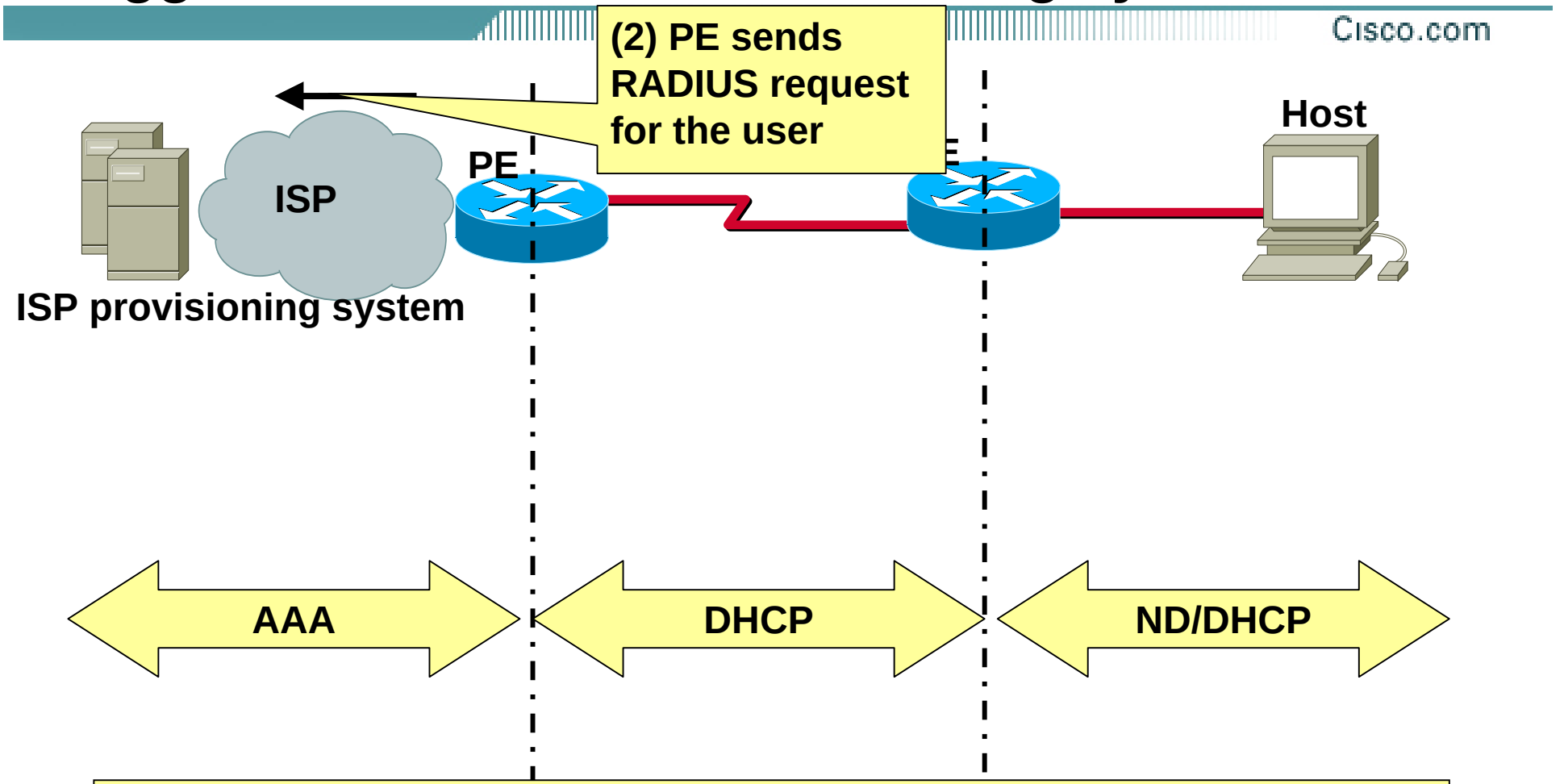

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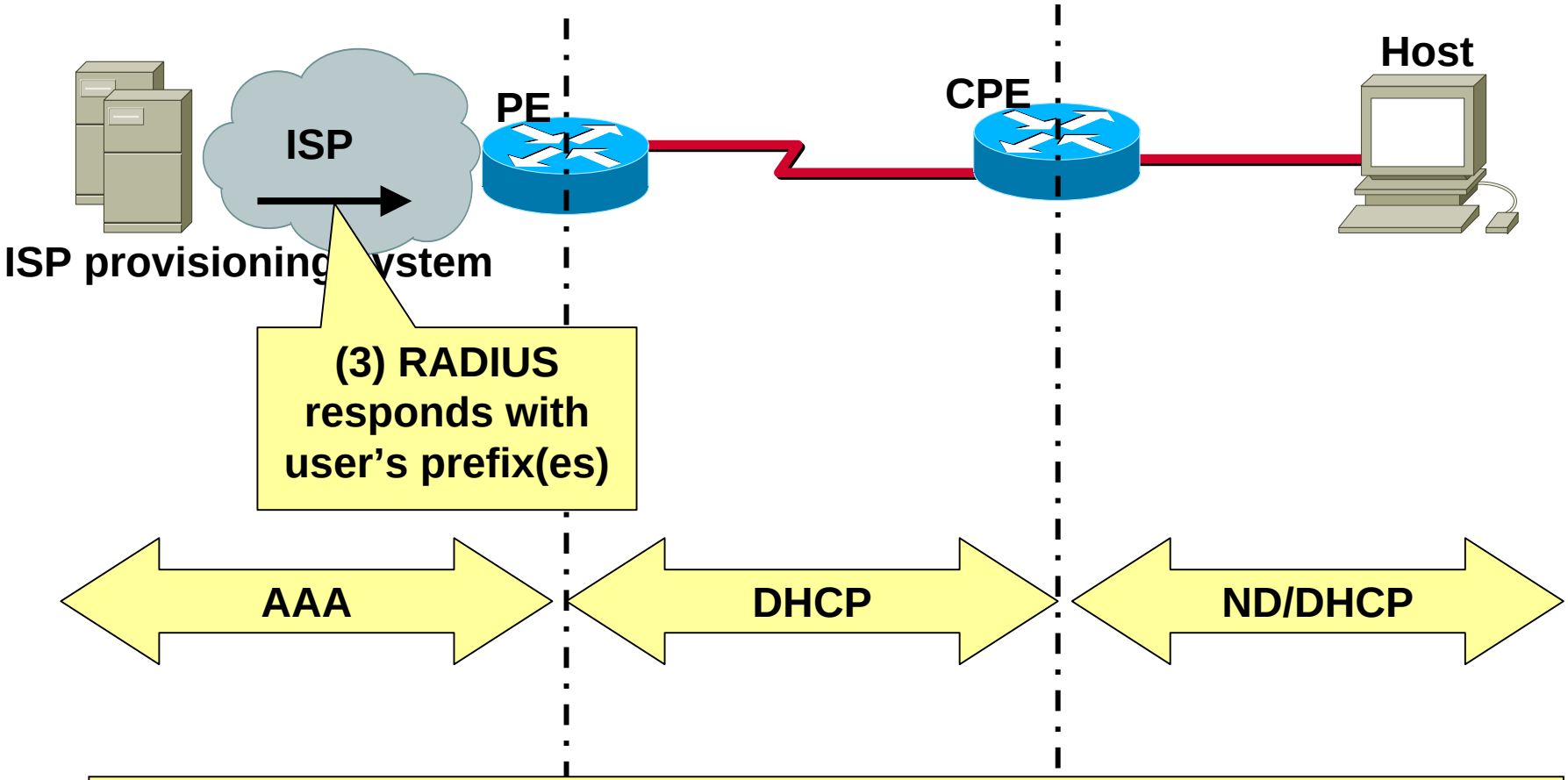

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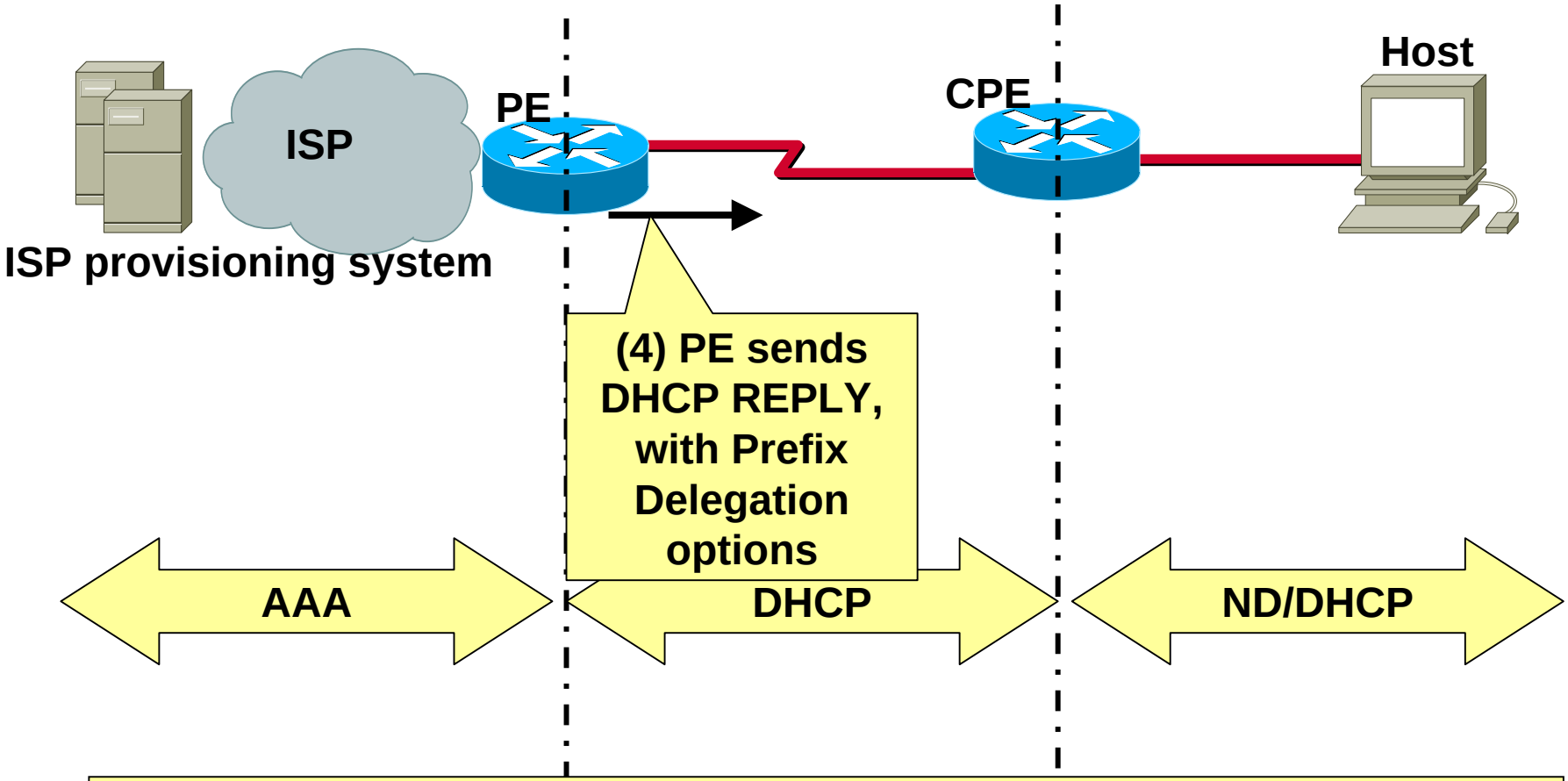

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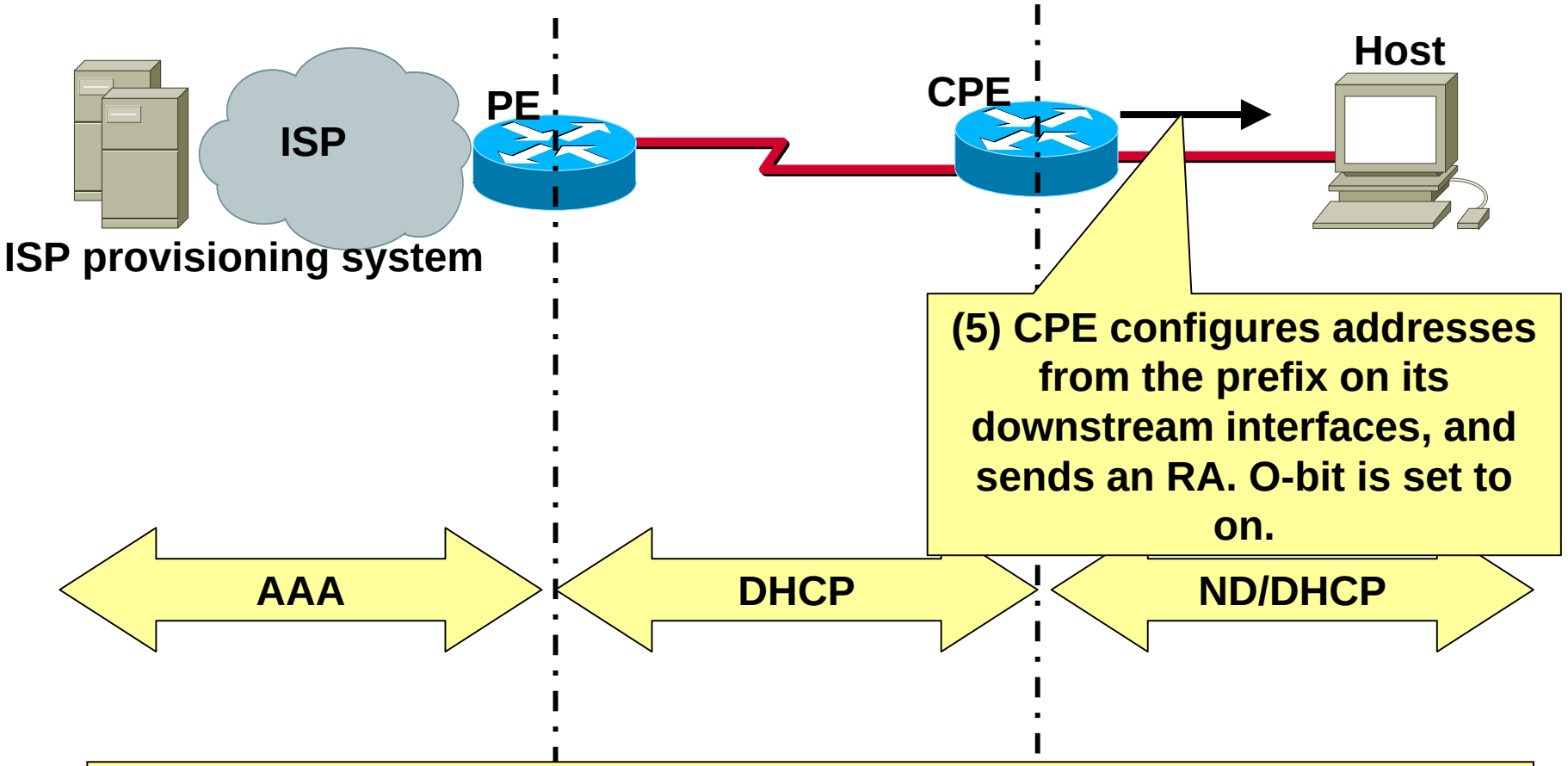

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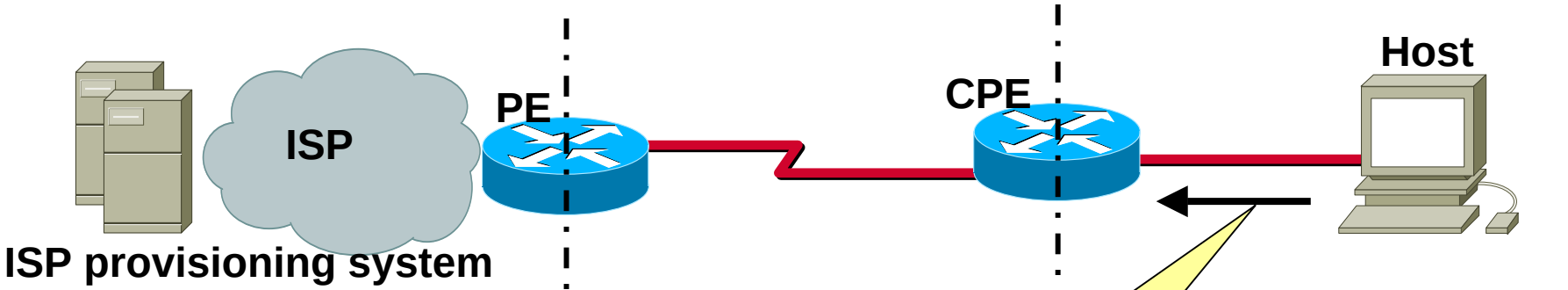


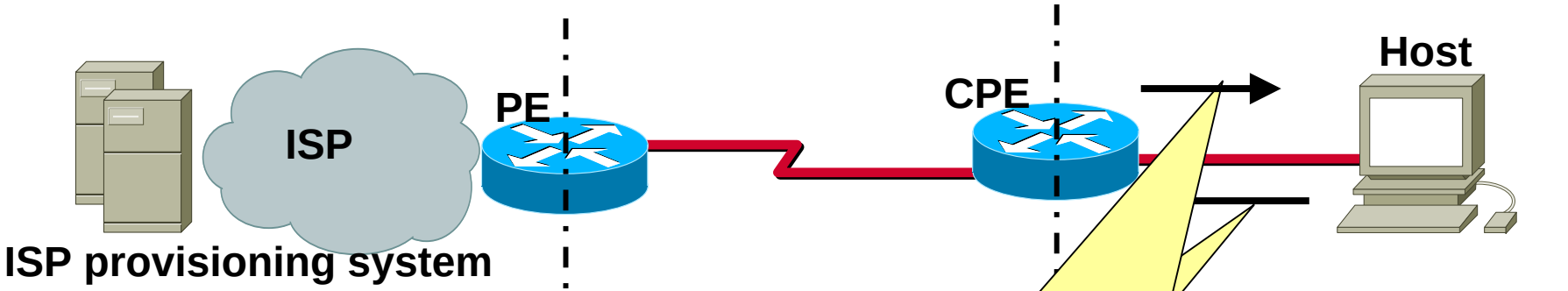
AA

ND/DHCP

(6) Host configures addresses based on the prefixes received in the RA. As the O-bit is on, it send a DHCP INFORMATION-REQUEST message, with an ORO = DNS

The PE ca d the CPE can auto-configure a fferent from the prefix assigned to the user.

Suggested solution — Provisioning system to PE



(7) CPE sends a DHCP REPLY containing request options. Note that the CPE is configured as a DHCP client upstream, and as a DHCP server downstream. The DHCP downstream server acts as a cache, and uses the options received on the upstream interface.

(6) Host
on the p
the O-bi
INFORM
with an

AA /DHCP

The PE car E can auto-configure a fferent from the prefix assigned to the user.

Deployment Activities

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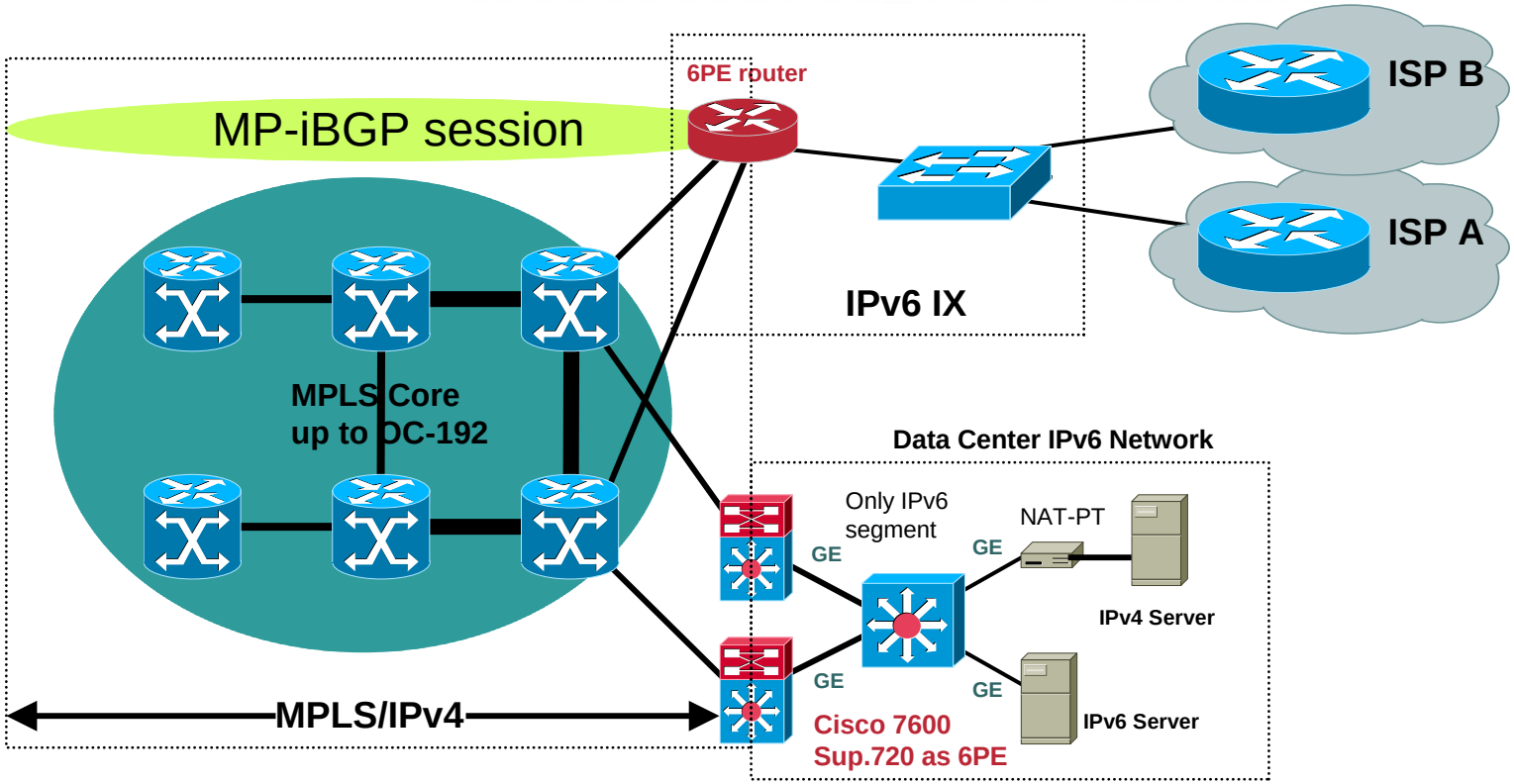
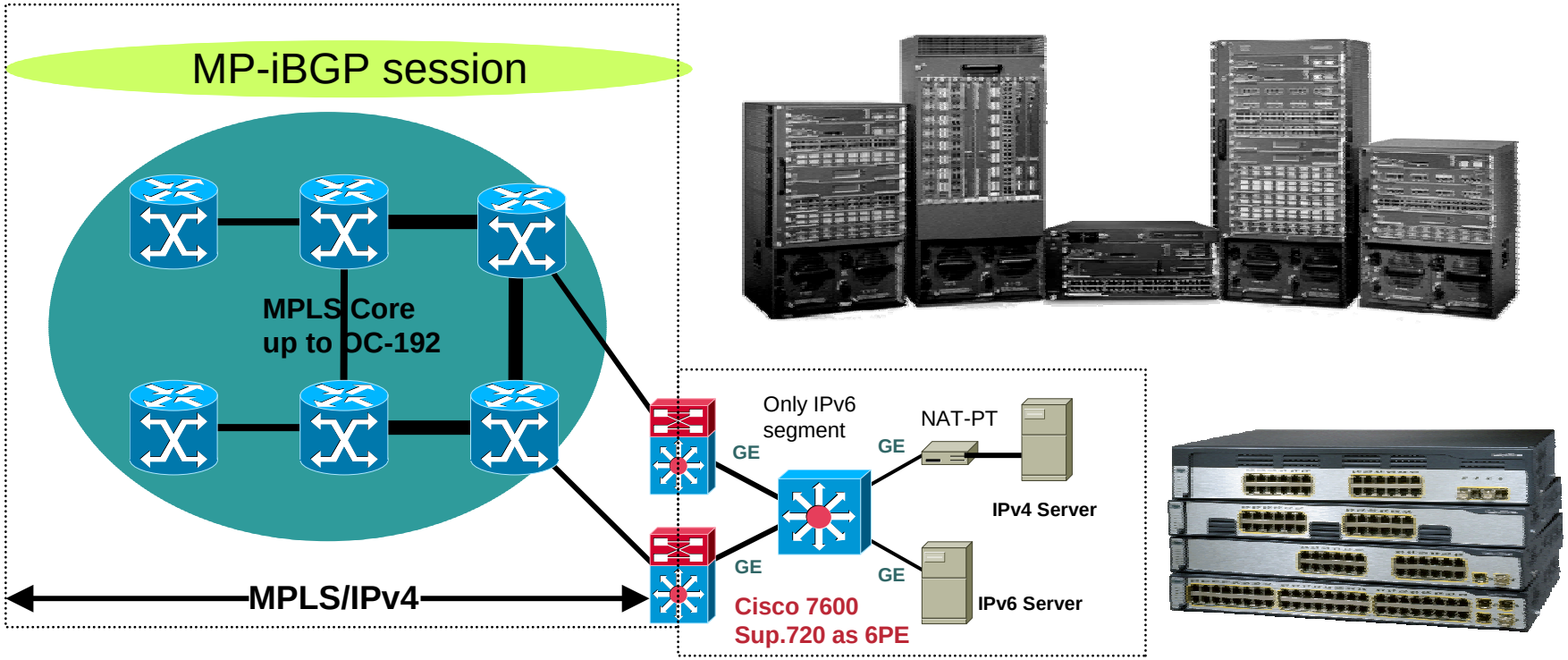
IPv6 Deployment in Data Center



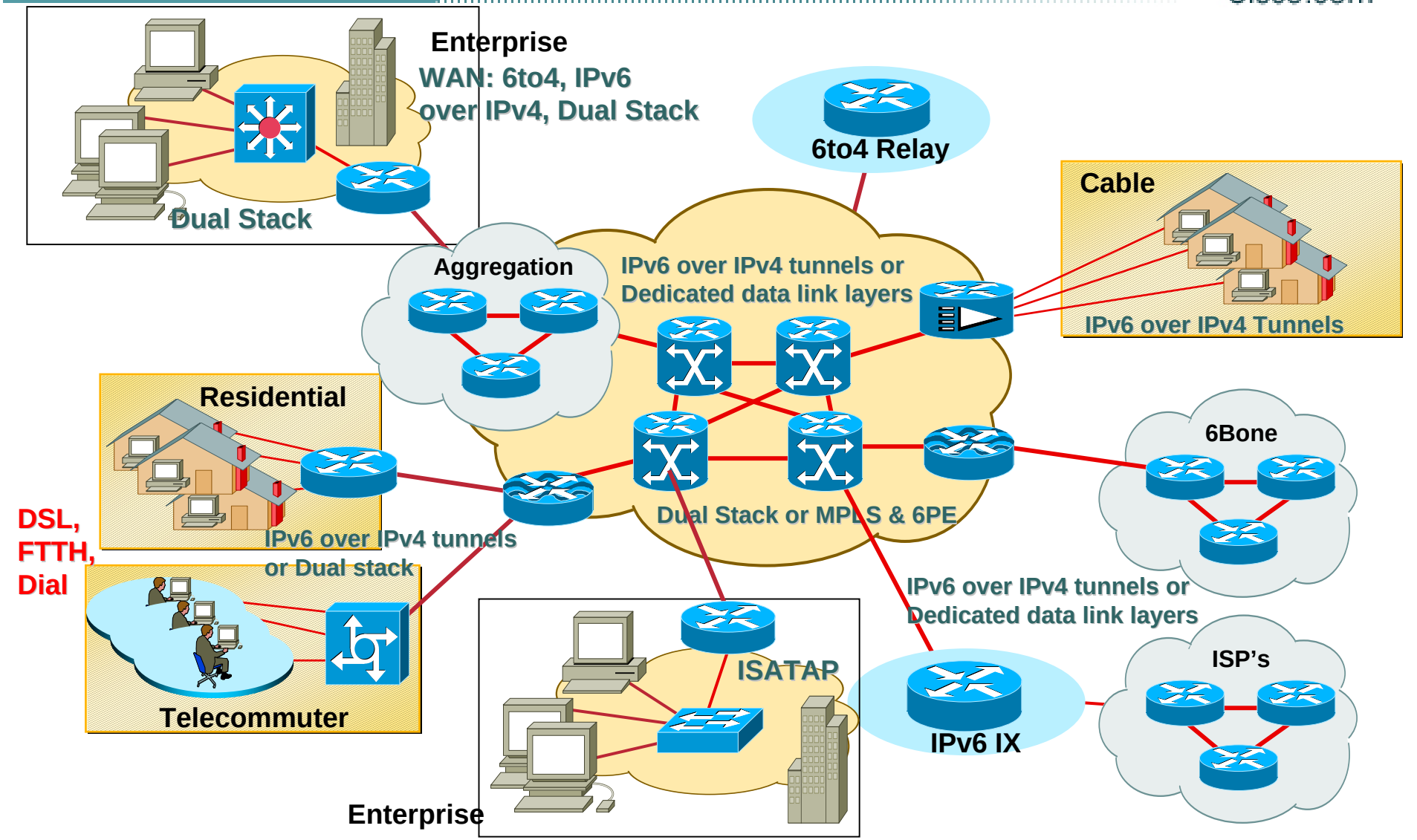
- Configuring MP-BGP to peer with other IPv6 ISP
- Upgrading DNS Server(s) to support AAAA records & IPv6 Xport
- Integrating IPv6 AAA on Radius Server
- NAT-PT as an option to front-end IPv4-only server

IPv6 Deployment in Data Center



- **Best-in-class IPv6 performances on Catalyst series**
  - **Supervisor Engine 720 & distributed PFC3 modules, 10GE HW FW**
    - **IPv6 hardware assistance for IPv6 native and IPv6 over IPv4 tunnels (configured, 6to4, ISATAP) delivering Millions of PPS**
  - **Catalyst 3750 series**

Moving IPv6 to Production, running Cisco IOS



Questions?

EMPOWERING THE
INTERNET GENERATION

More Information

- **CCO IPv6 - http://www.cisco.com/ipv6**
- **The ABC of IPv6**

  http://www.cisco.com/en/US/products/sw/iosswrel/products_abc_ios_overview.html
- **IPv6 e-Learning [requires CCO username/password]**

  http://www.cisco.com/warp/customer/732/Tech/ipv6/elearning/
- **IPv6 Access Services :**

  http://www.cisco.com/warp/public/732/Tech/ipv6/docs/ipv6_access_wp_v2.pdf
- **ICMPv6 Packet Types and Codes TechNote:**

  http://www.cisco.com/warp/customer/105/icmpv6codes.html
- **Cisco IOS IPv6 Product Manager – pgrosset@cisco.com**

References

- RFC3162 - RADIUS and IPv6
- RFC2472 - IPv6 over PPP
- Requirements for IPv6 dialup operation

  draft-itojun-ipv6-dialup-requirement-02.txt
- Requirements for IPv6 prefix delegation

  draft-ietf-ipv6-prefix-delegation-requirement-01.txt
- DHCPv6 Prefix Delegation

  draft-ietf-dhc-dhcpv6-opt-prefix-delegation-01.txt
- draft-ietf-ipv6-dns-discovery-07.txt
- draft-droms-dnsconfig-dhcpv6-01.txt
- draft-droms-dhcpv6-stateless-guide-00.txt