Flexible IPv6 Migration Scenarios in the Context of IPv4 Address Shortage

I-D.boucadair-behave-ipv6-portrange and
I-D.boucadair-softwire-dslite-v6only
Softwire WG Interim Meeting-BEIJING, September 2011

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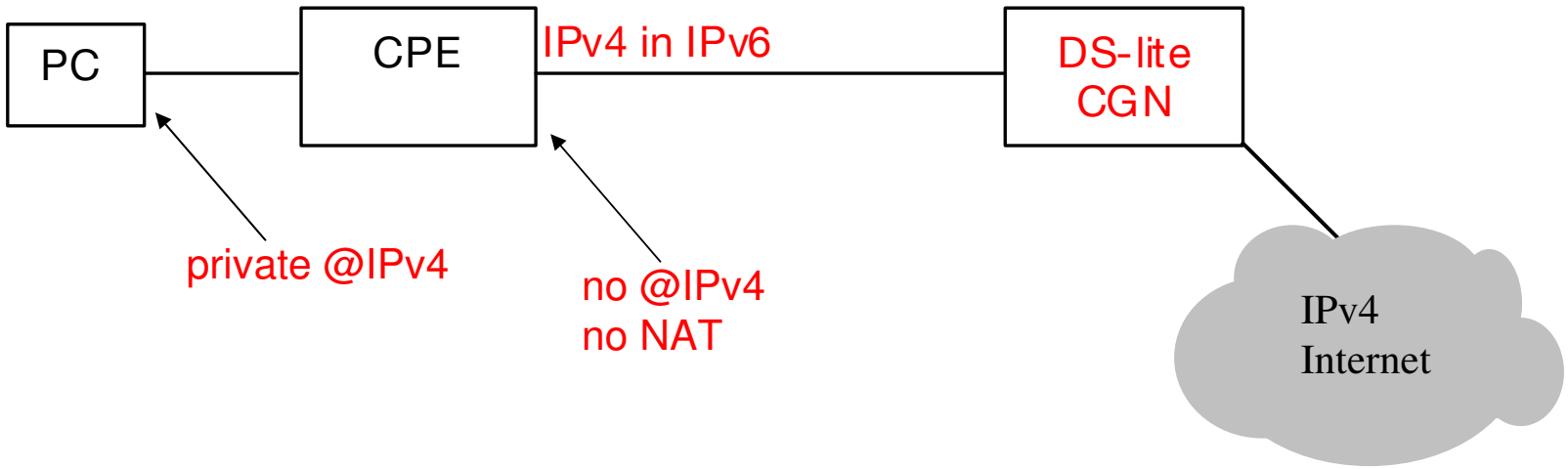
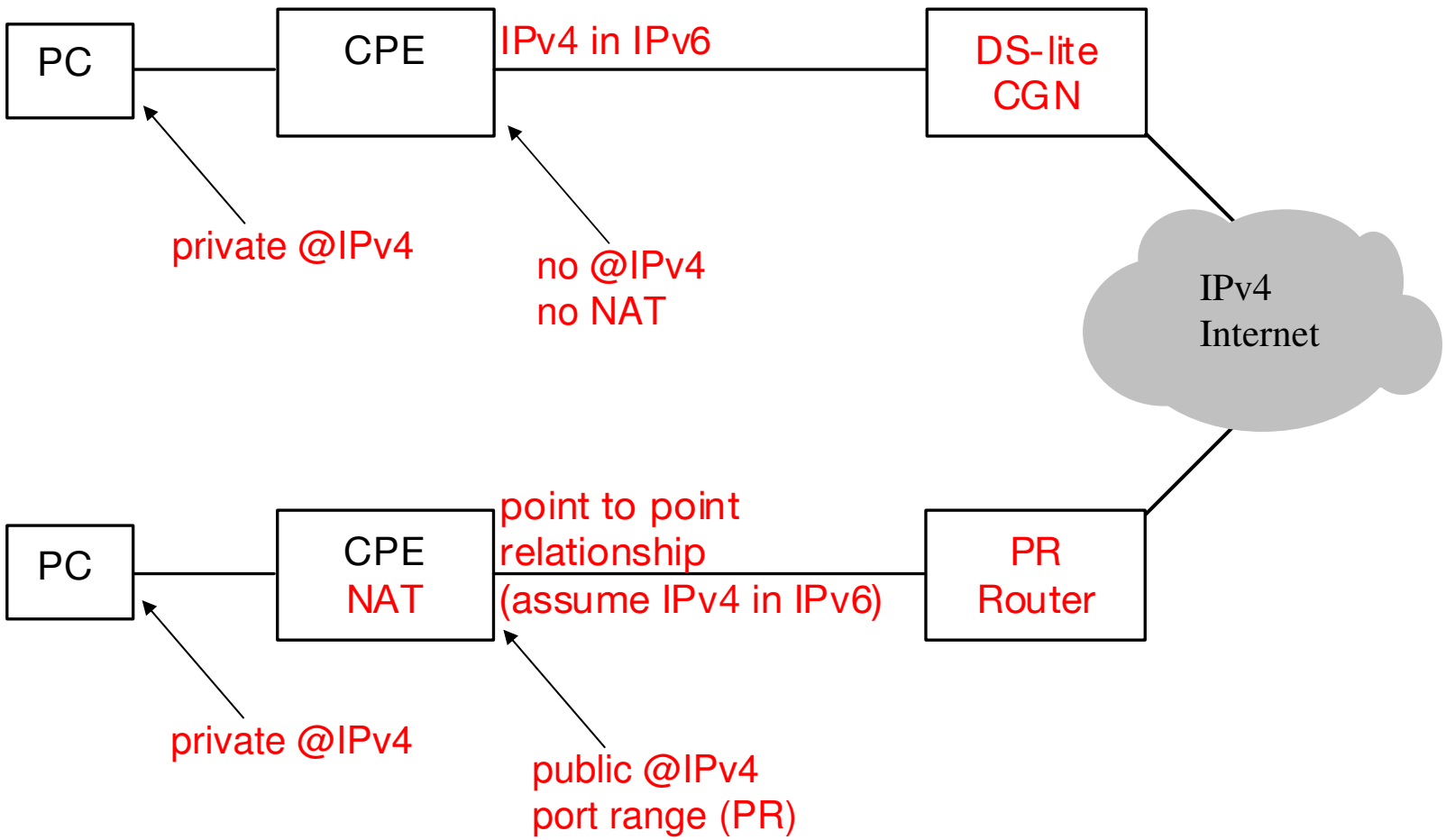
IPv6 context

- ISPs wishing to:
  - Migrate towards an IPv6-only network
  - Offer connectivity to the IPv6
  - Offer connectivity to the IPv4 Internet, saving their public address space
- We present a solution which allows to use IPv6 transfer capabilities and eases removing CGN devices from the network (CGN Exit Strategy)

DS-Lite CGN and PRR

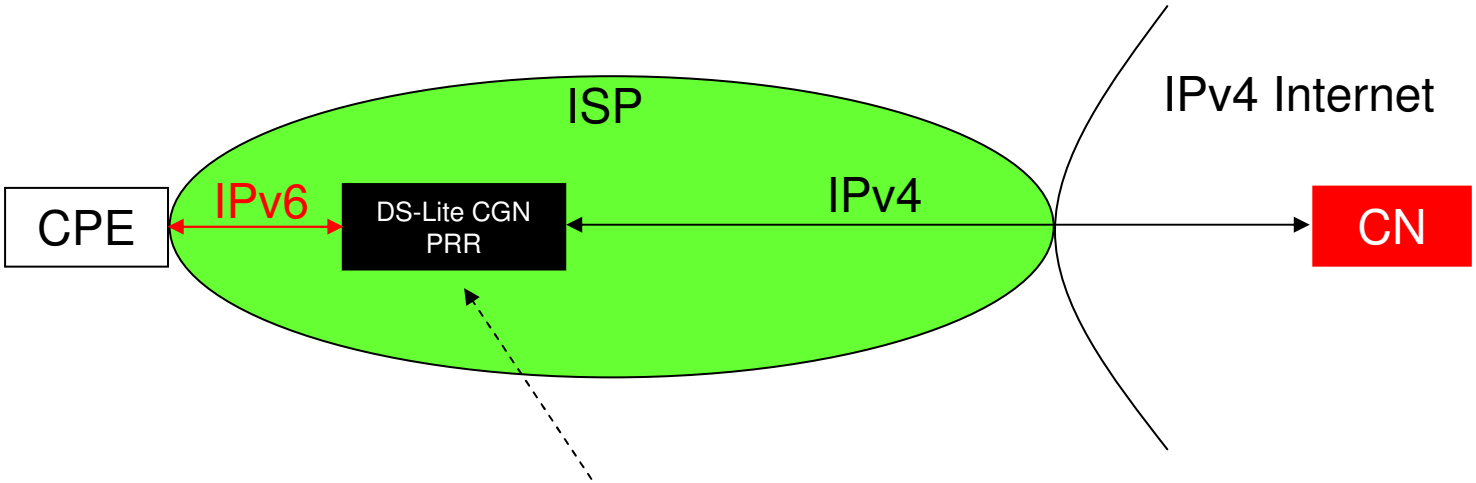


DS-Lite CGN and PRR



PRR: Port Range Router

IPv4 Internet Connectivity
with IPv6 in Access only

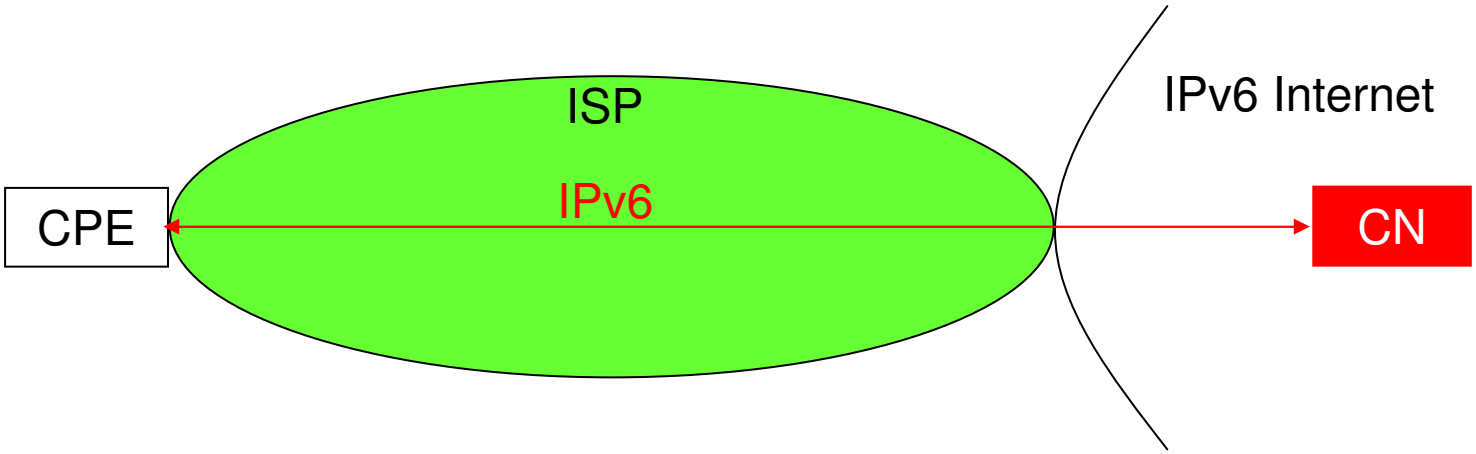


- DS-Lite CGN only
- PRR only
- Or Co-located DS-Lite CGN and PRR

CPE: Customer Premises Equipment

CN: Correspondent Node

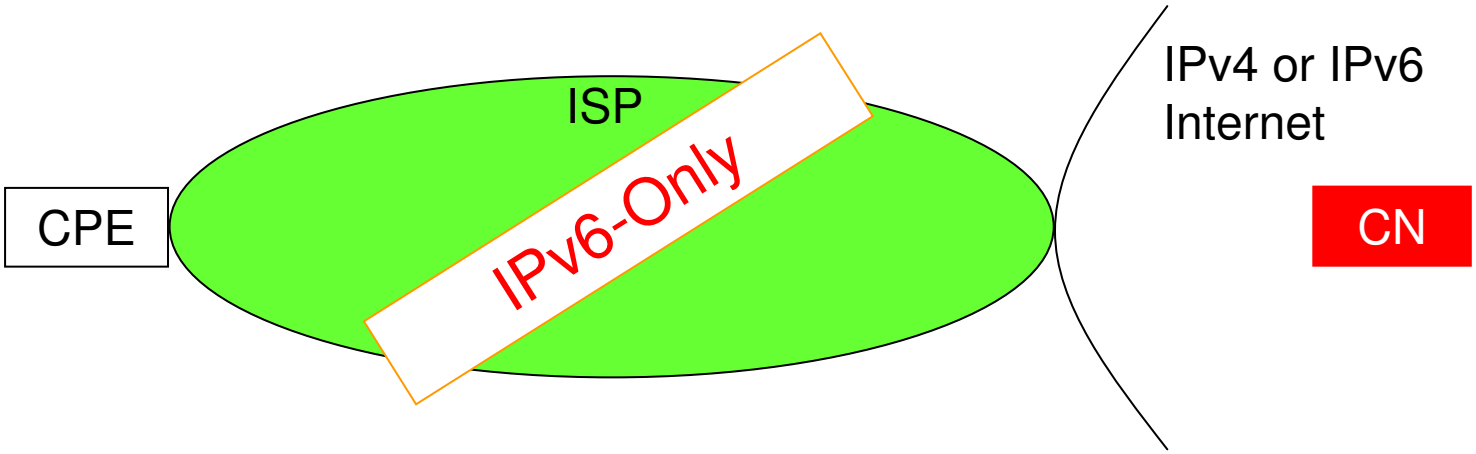
IPv6 Internet Connectivity



CPE: Customer Premises Equipment

CN: Correspondent Node

A voluntary migration towards IPv6



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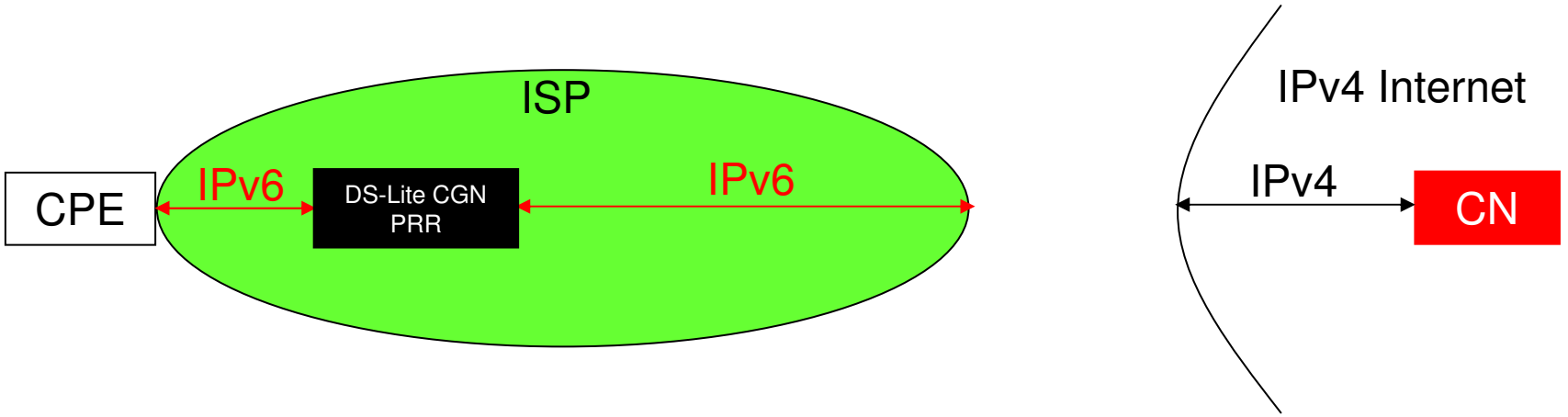
IPv4 Internet Connectivity
with IPv6 in Access and Core



IPv4 Internet Connectivity
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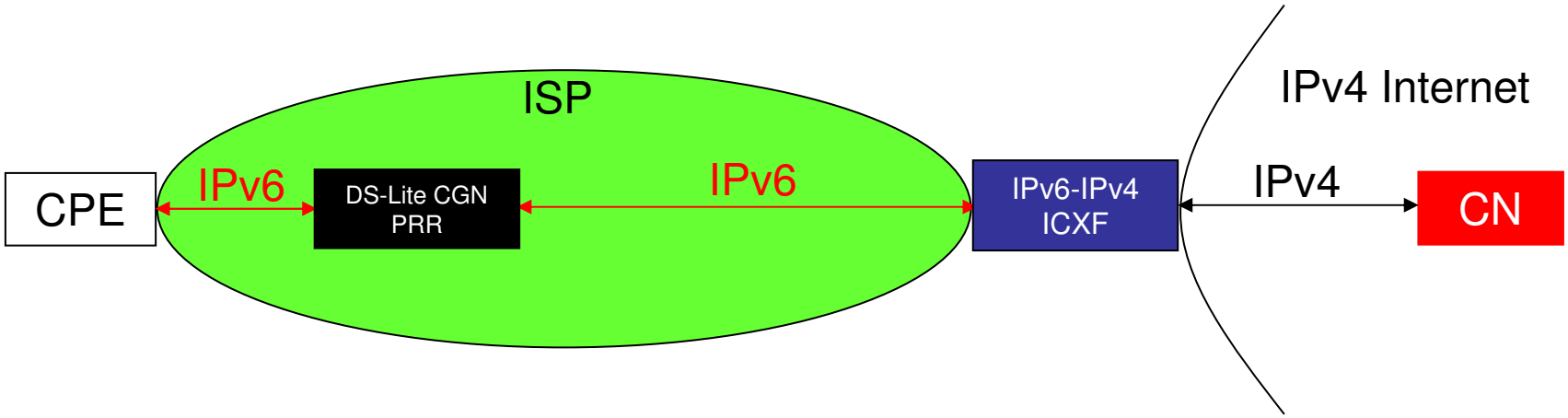
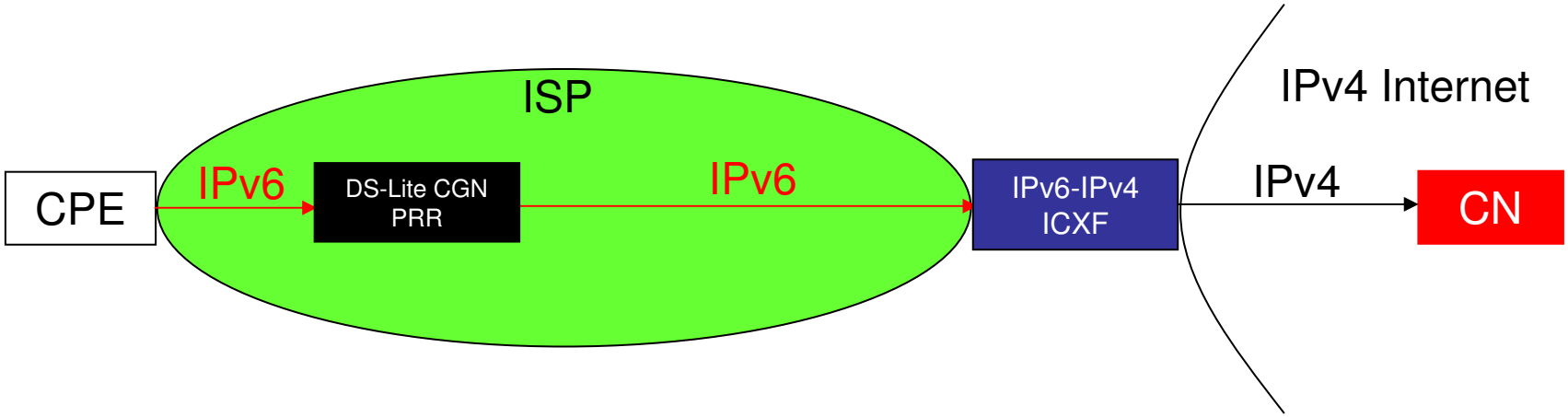


ICXF: Interconnection Function

From CPE to CN



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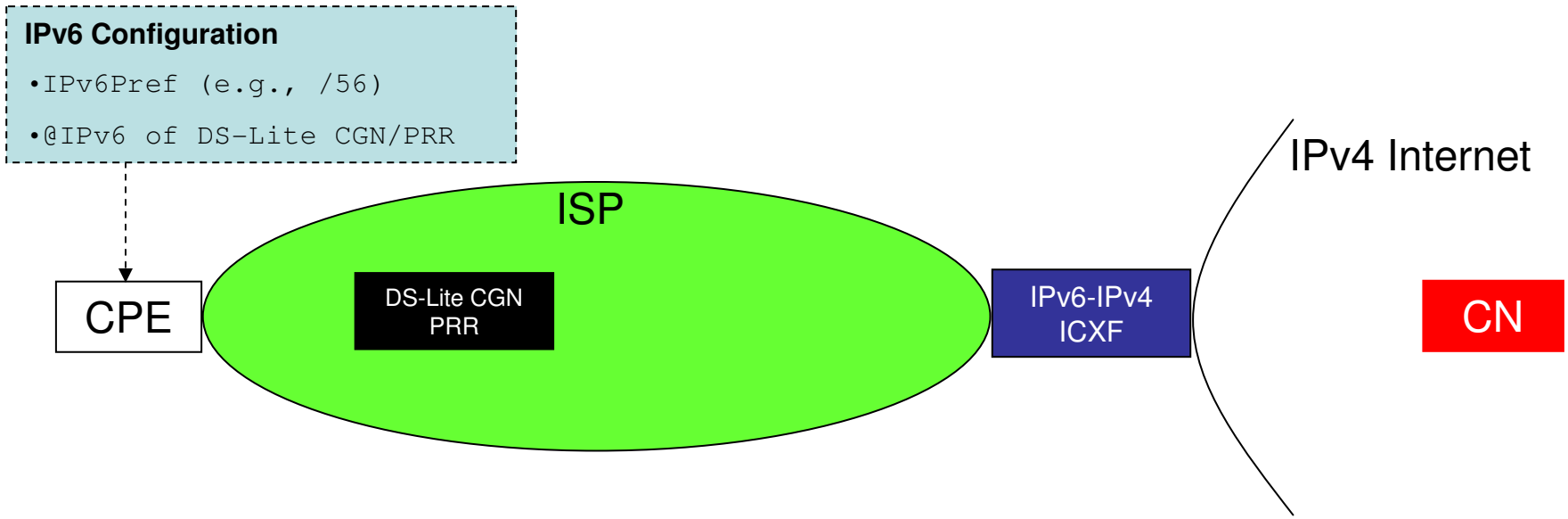

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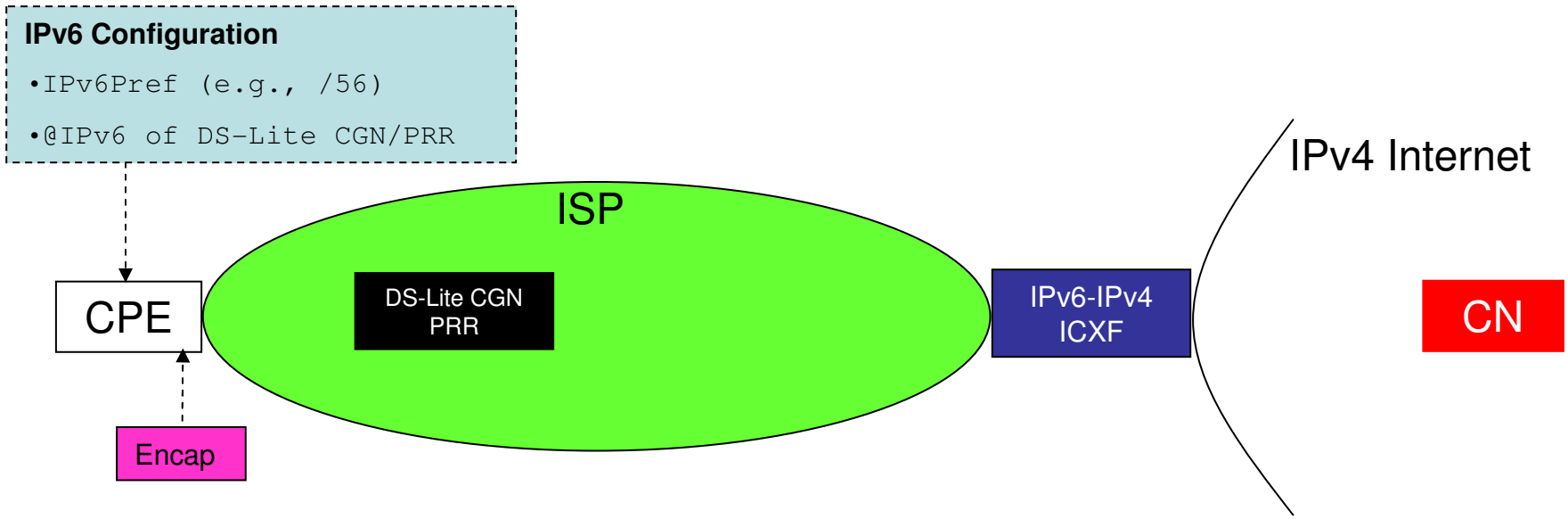

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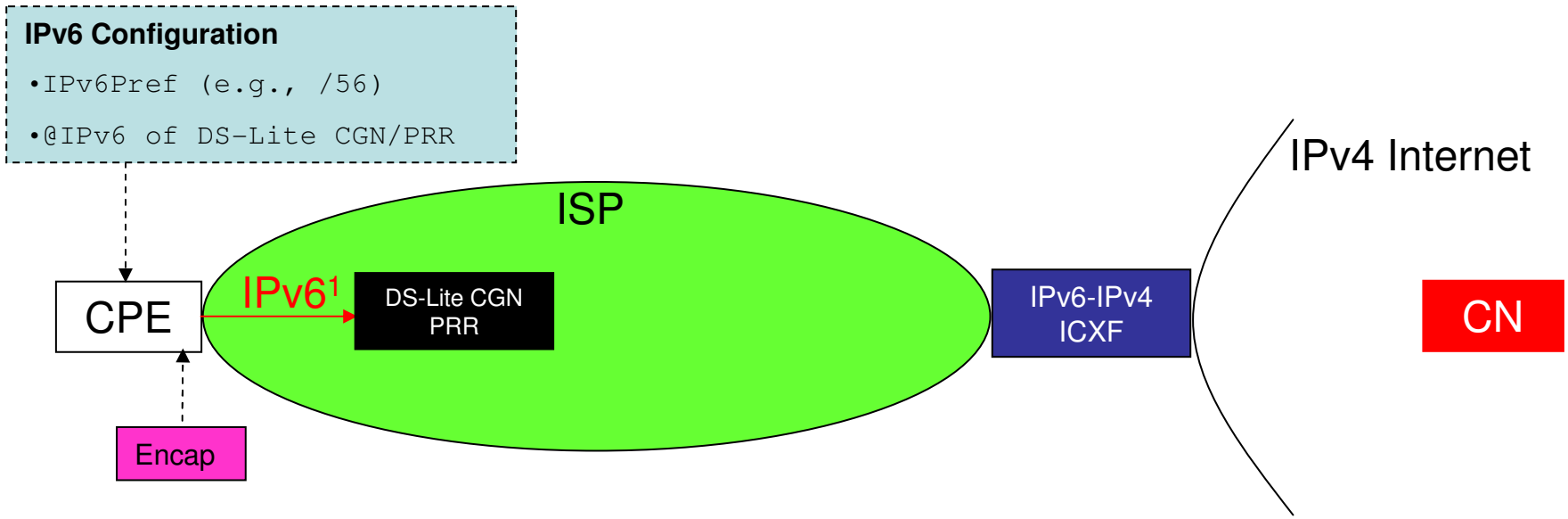
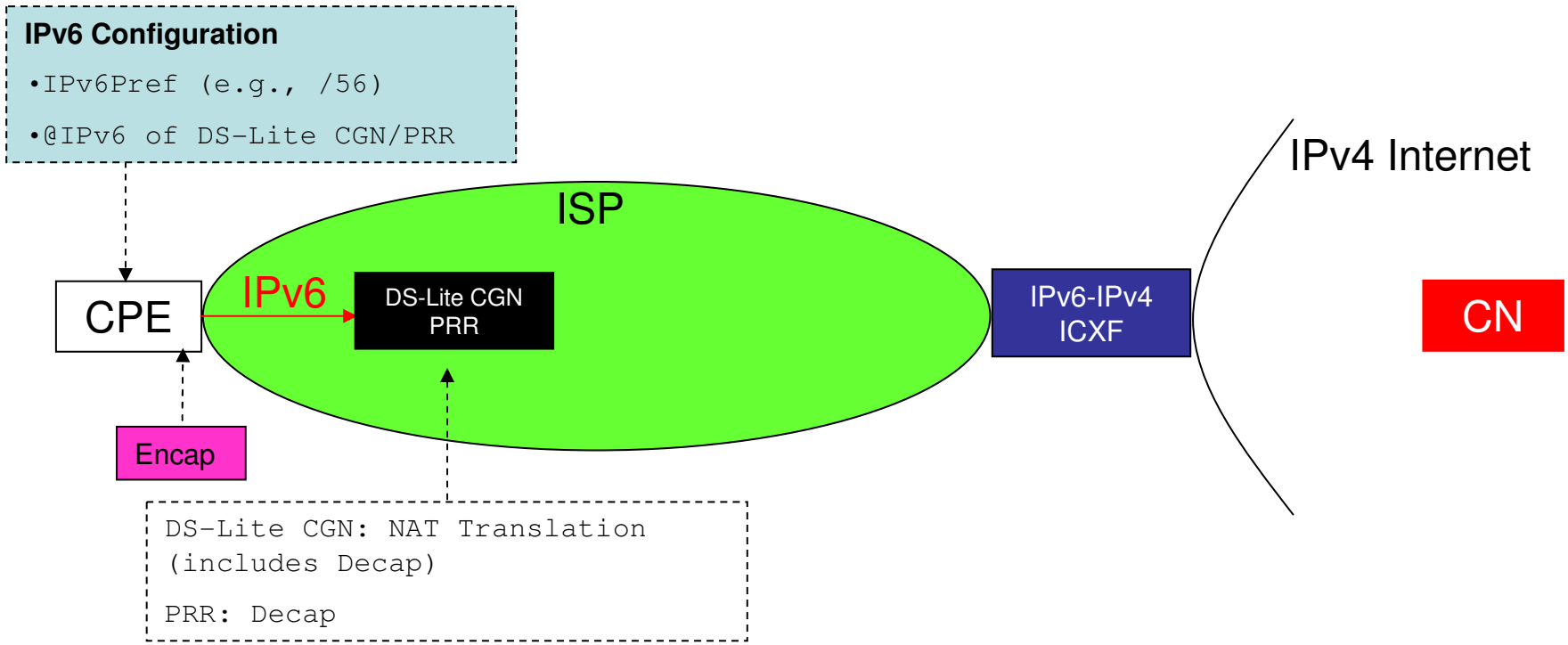


[1]IPv4-in-IPv6
@IPv6 src = @IPv6 in IPv6Pref
@IPv6 dst = @IPv6 of DS-Lite CGN/PRR

From CPE to CN



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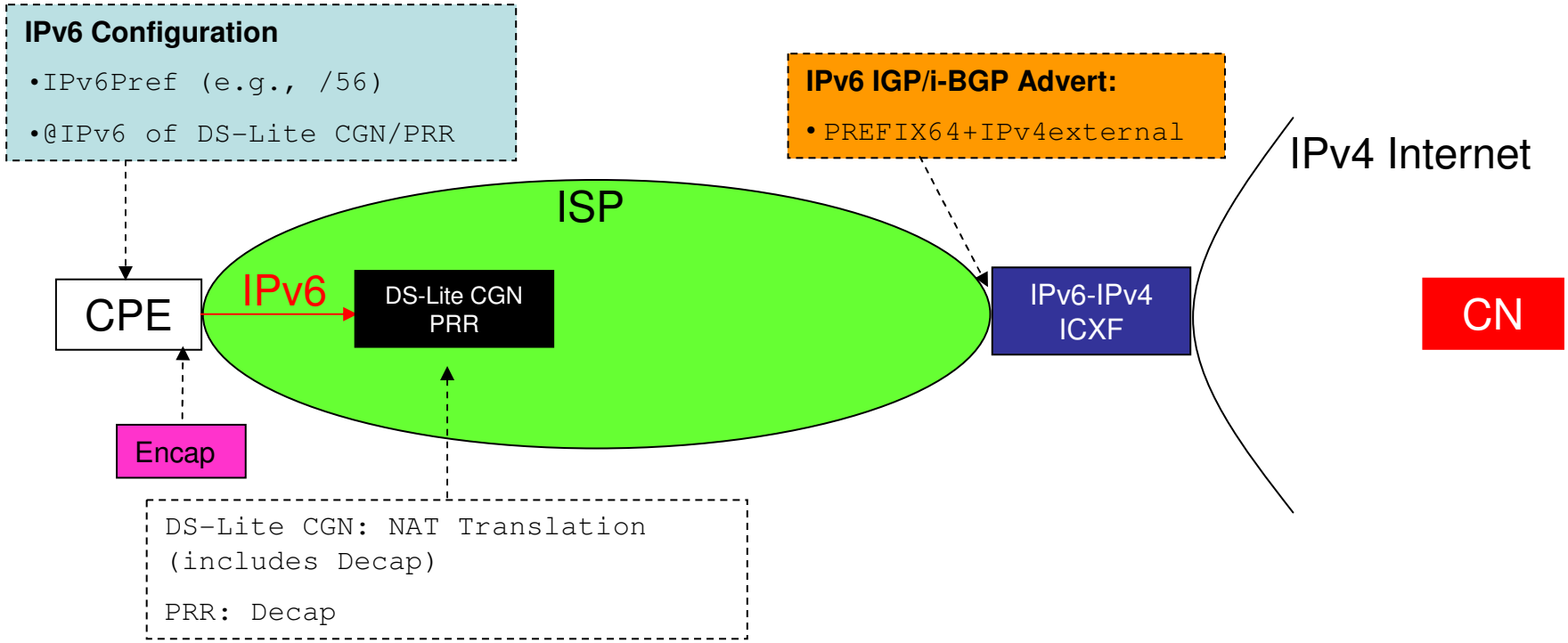
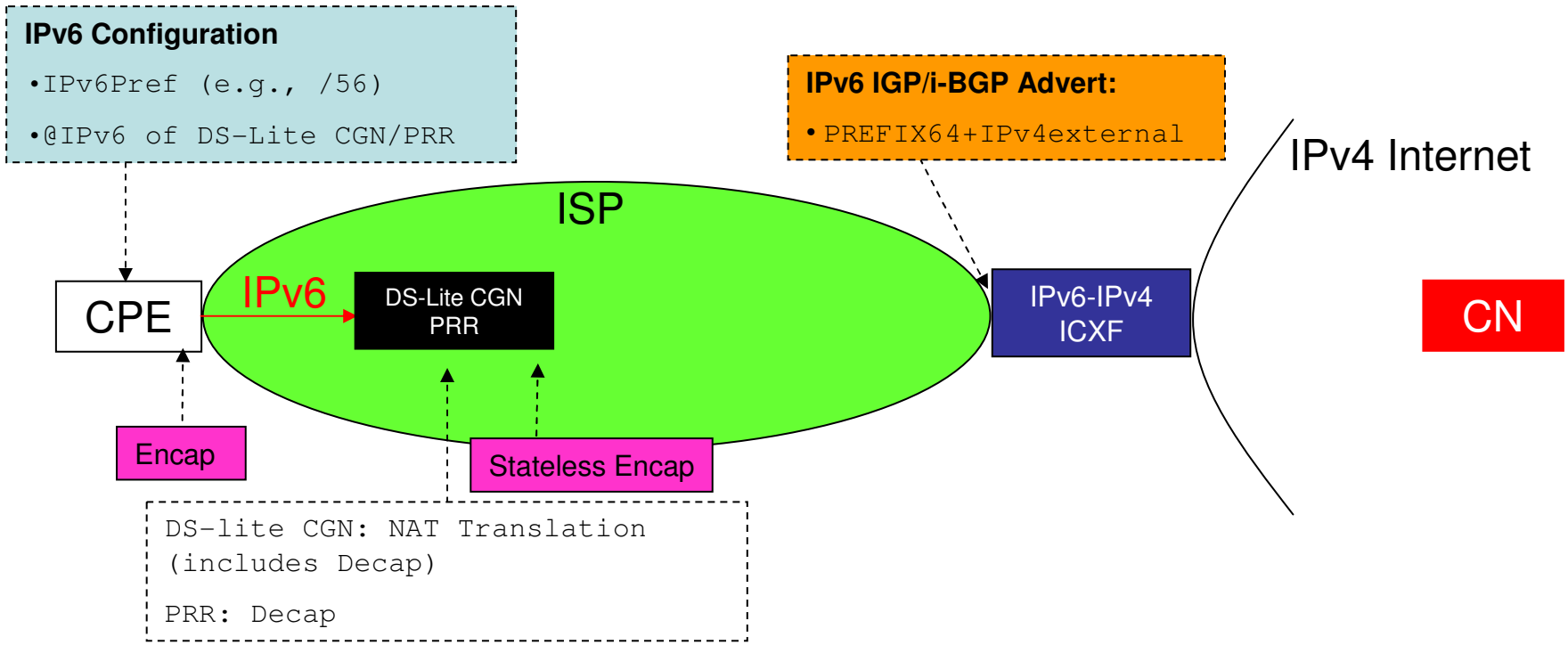


- PREFIX64: NSP or WKP
- **draft-ietf-ospf-ipv4-embedded-ipv6-routing** can be used to advertise IPv4-embedded IPv6 prefixes

From CPE to CN



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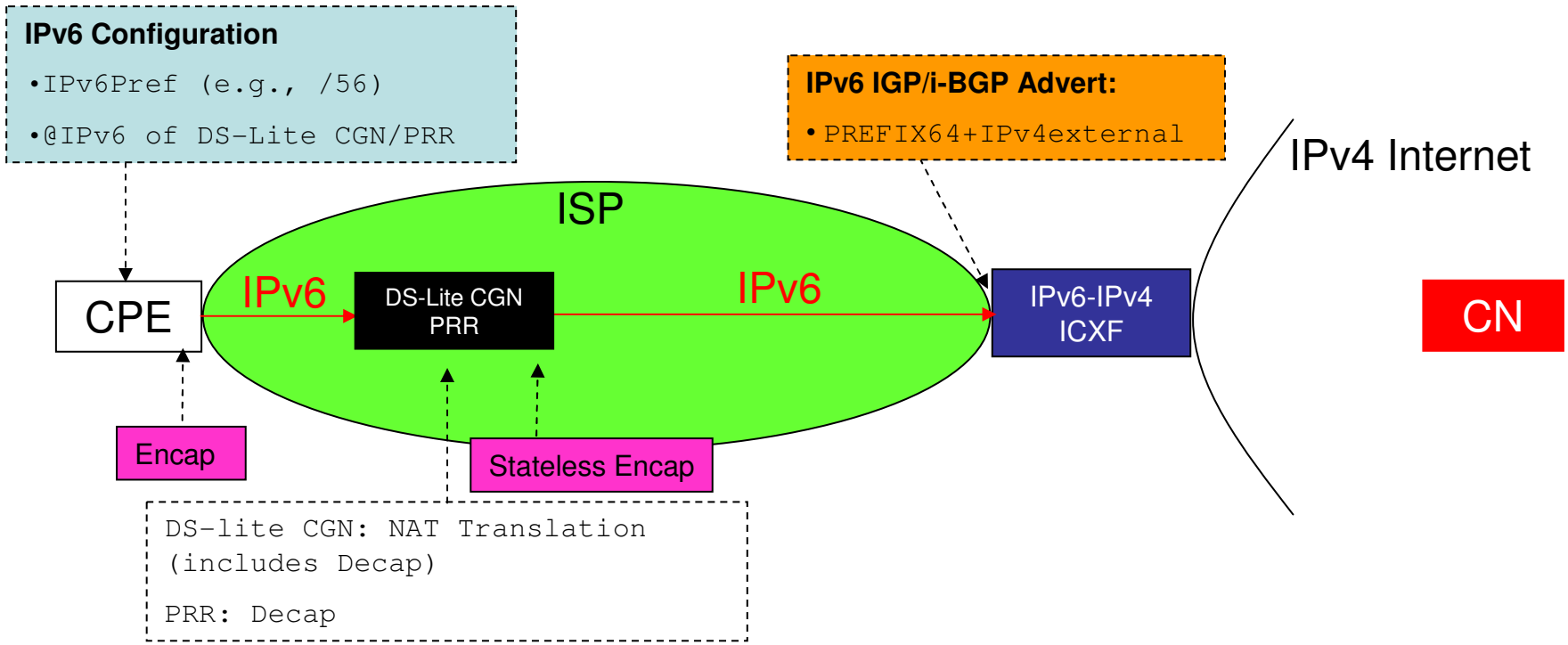

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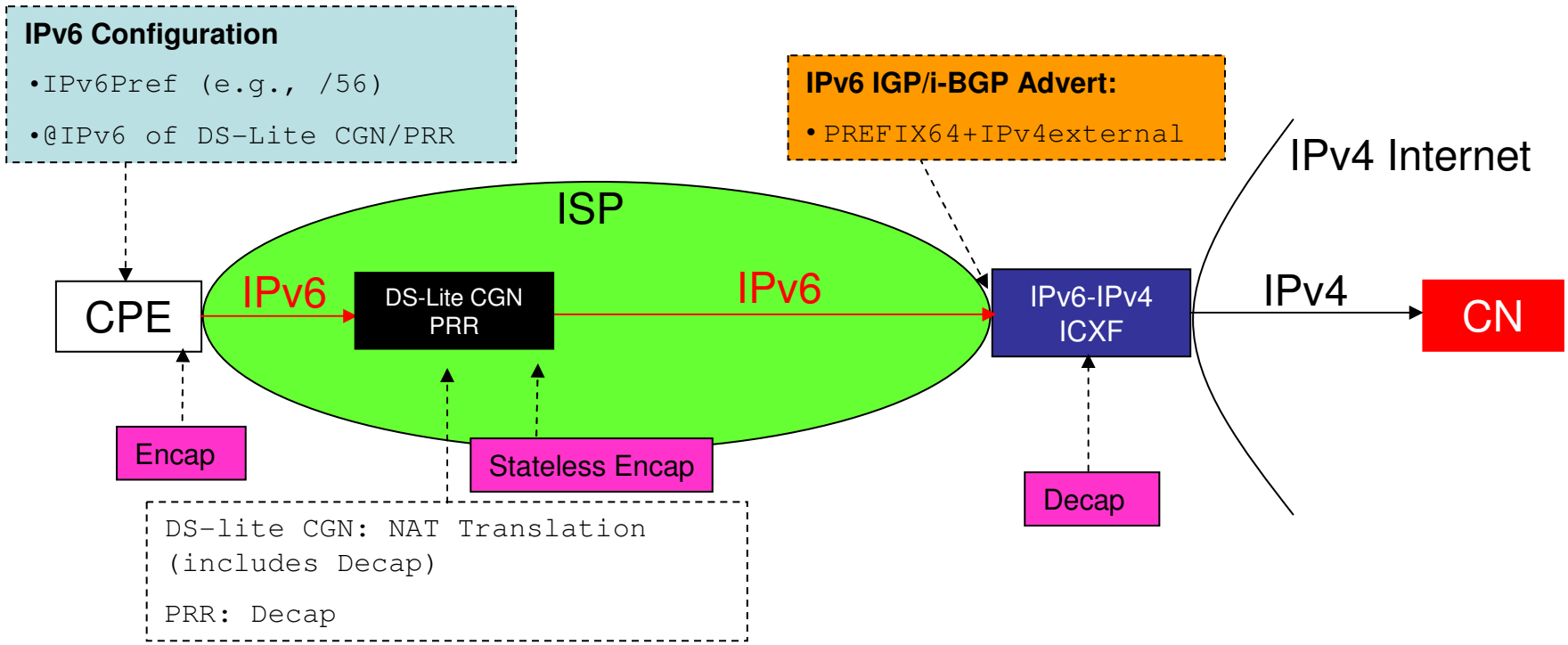

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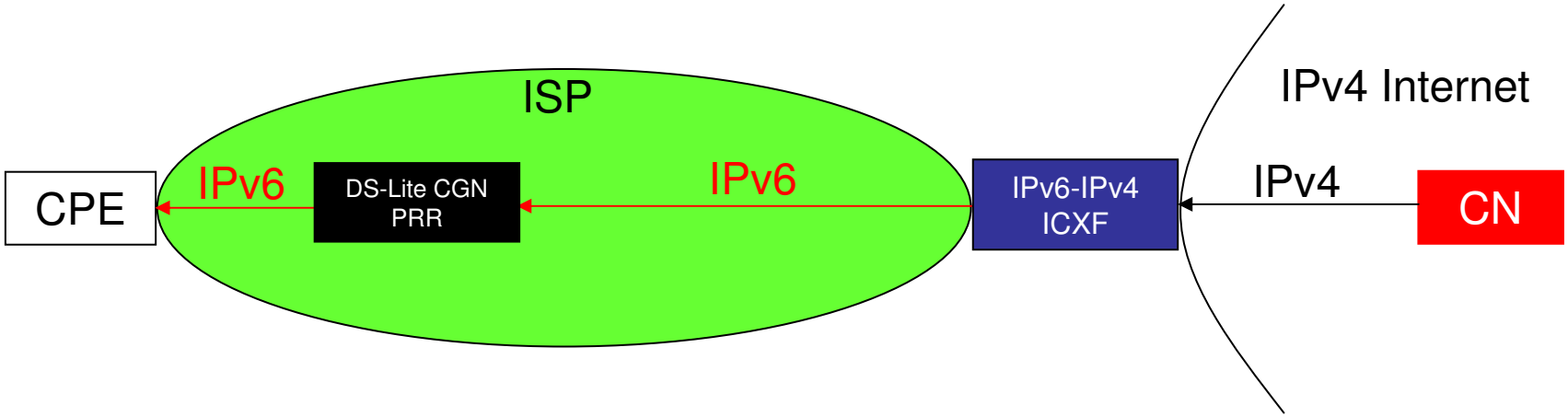

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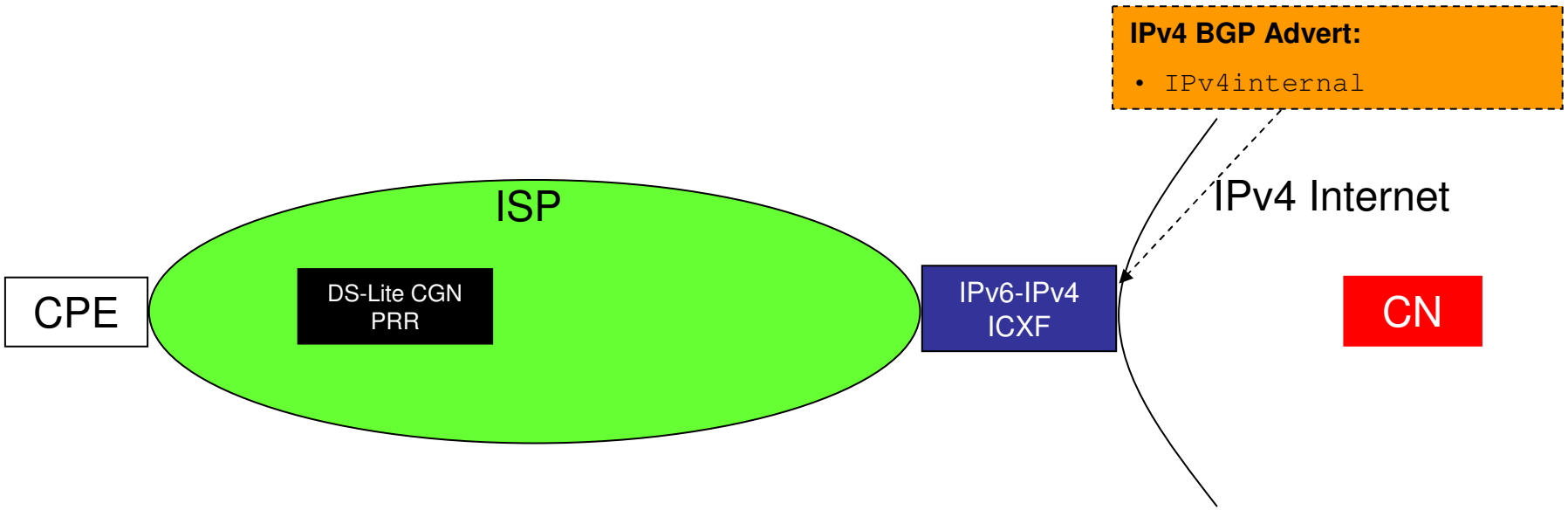

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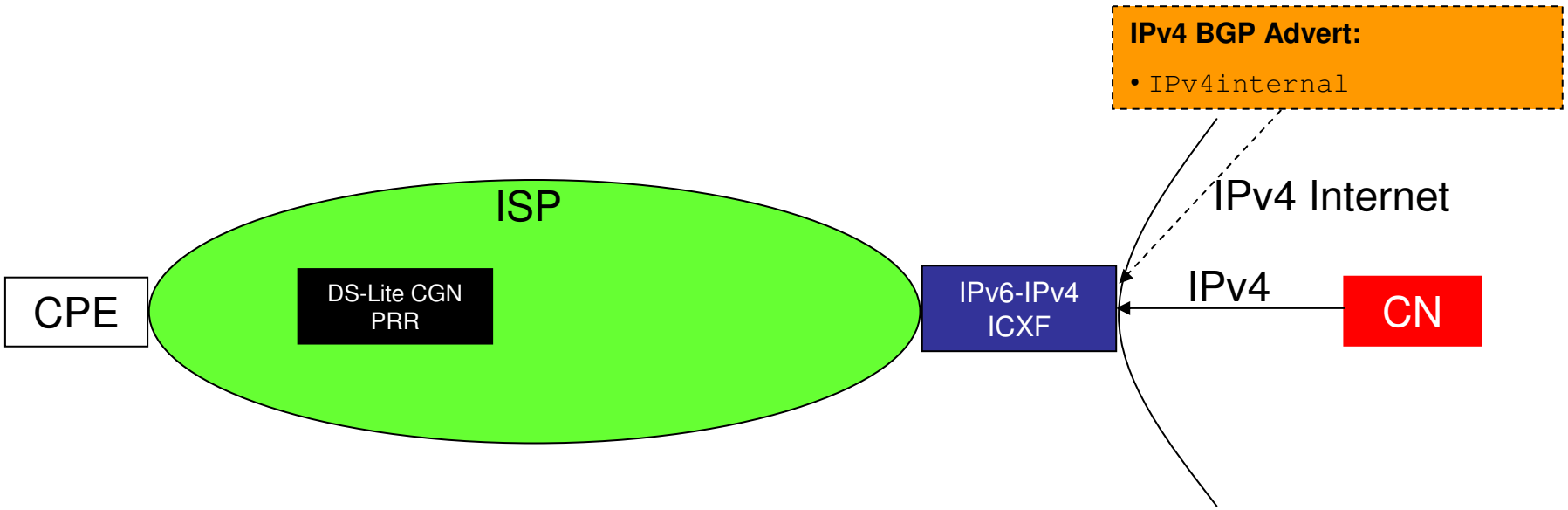

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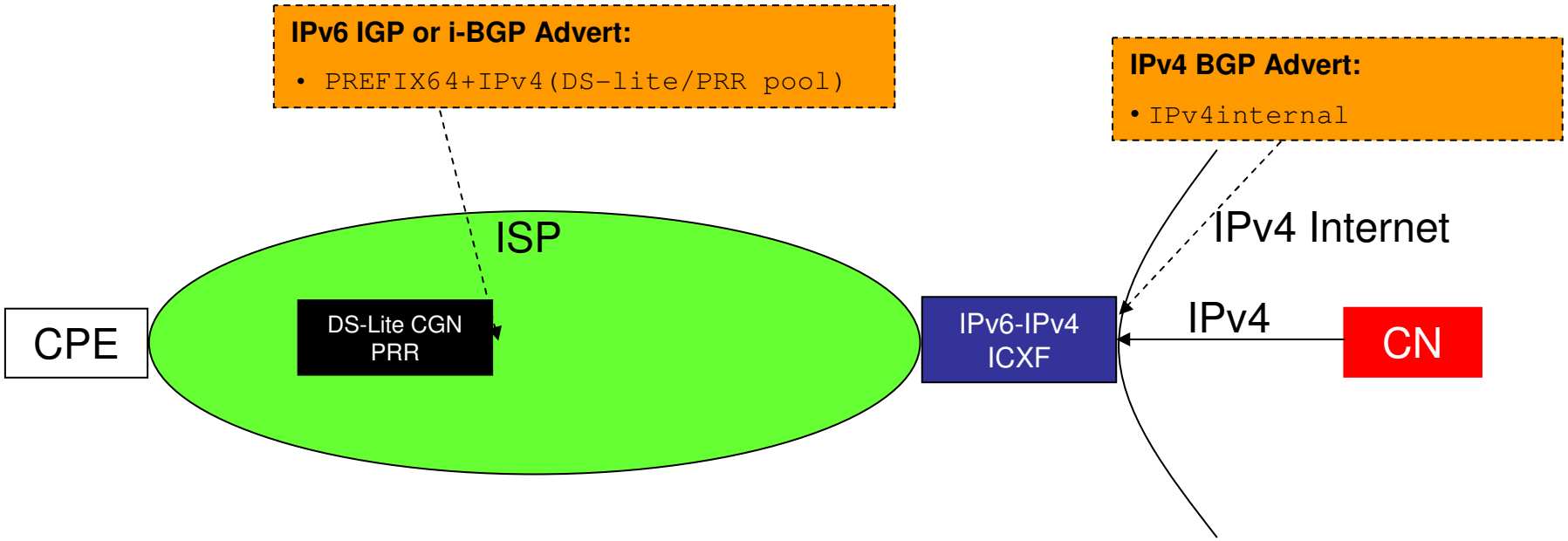

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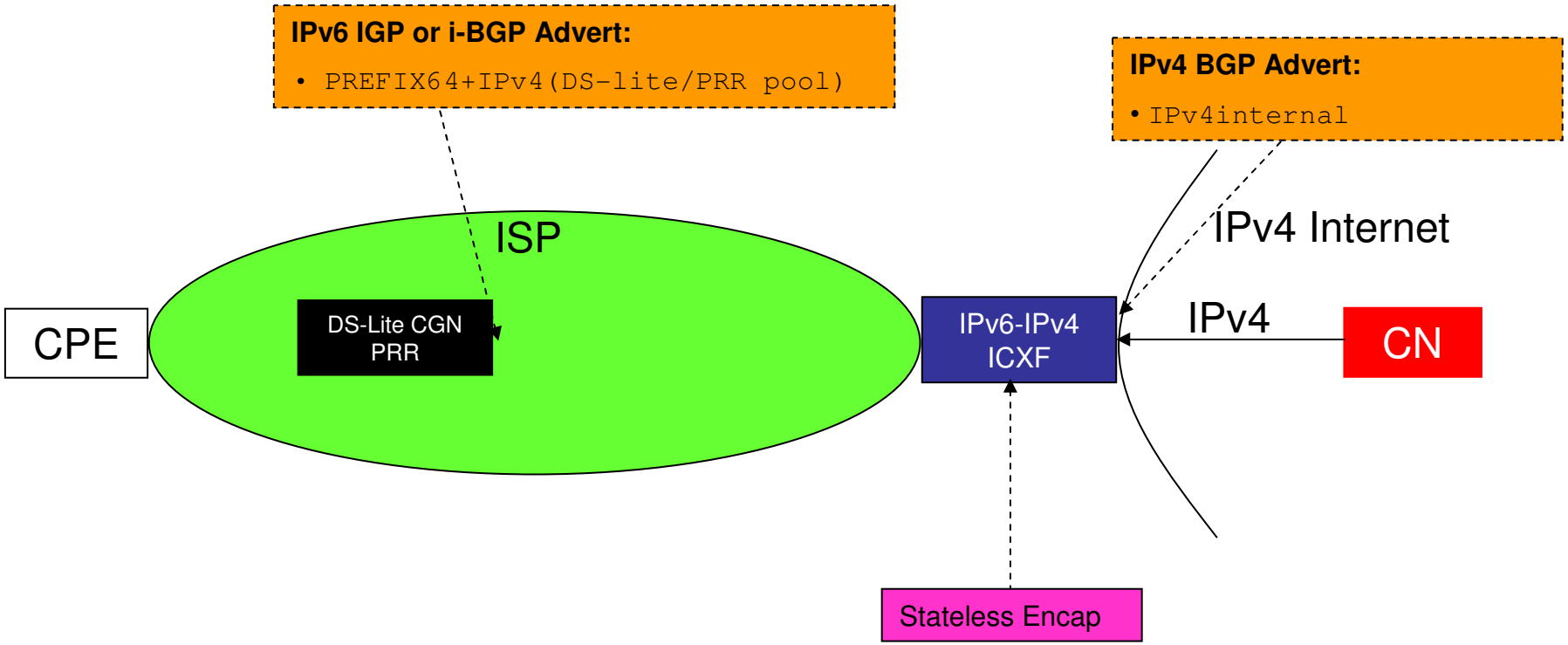

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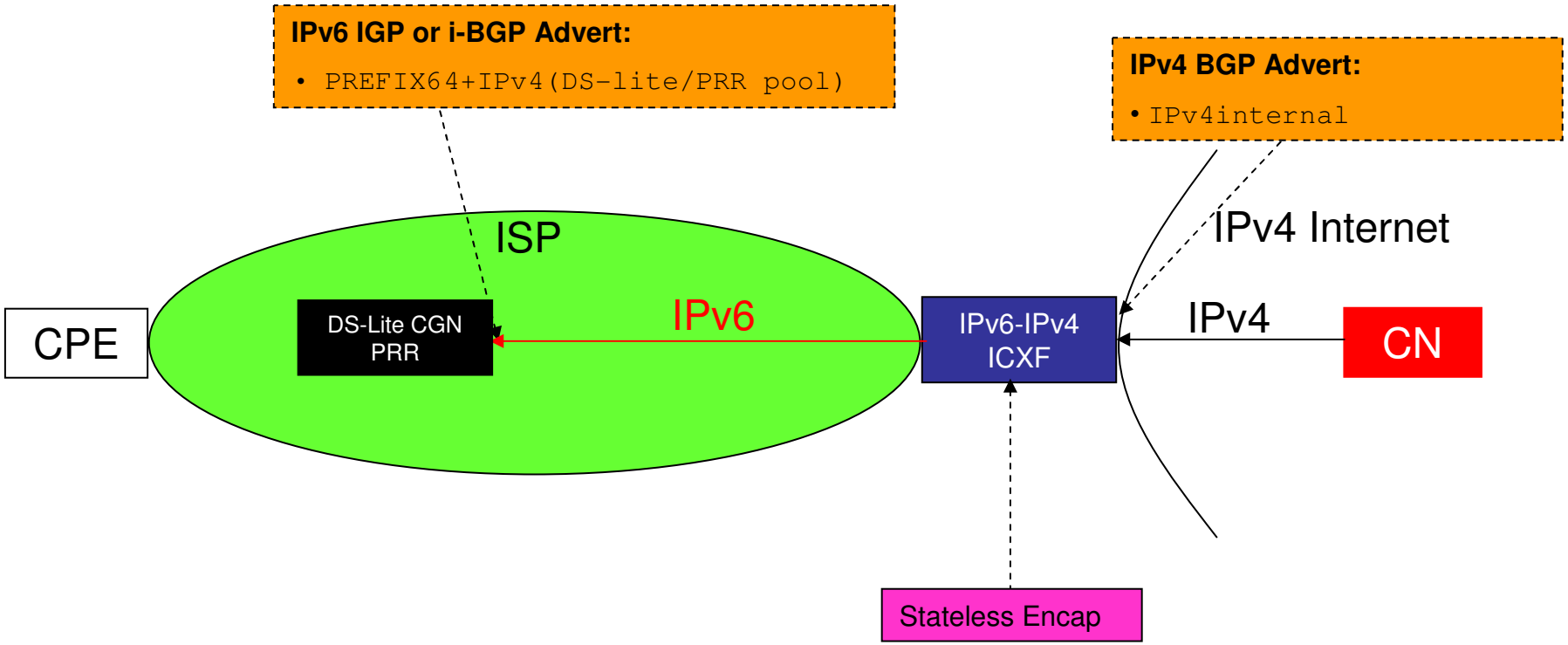

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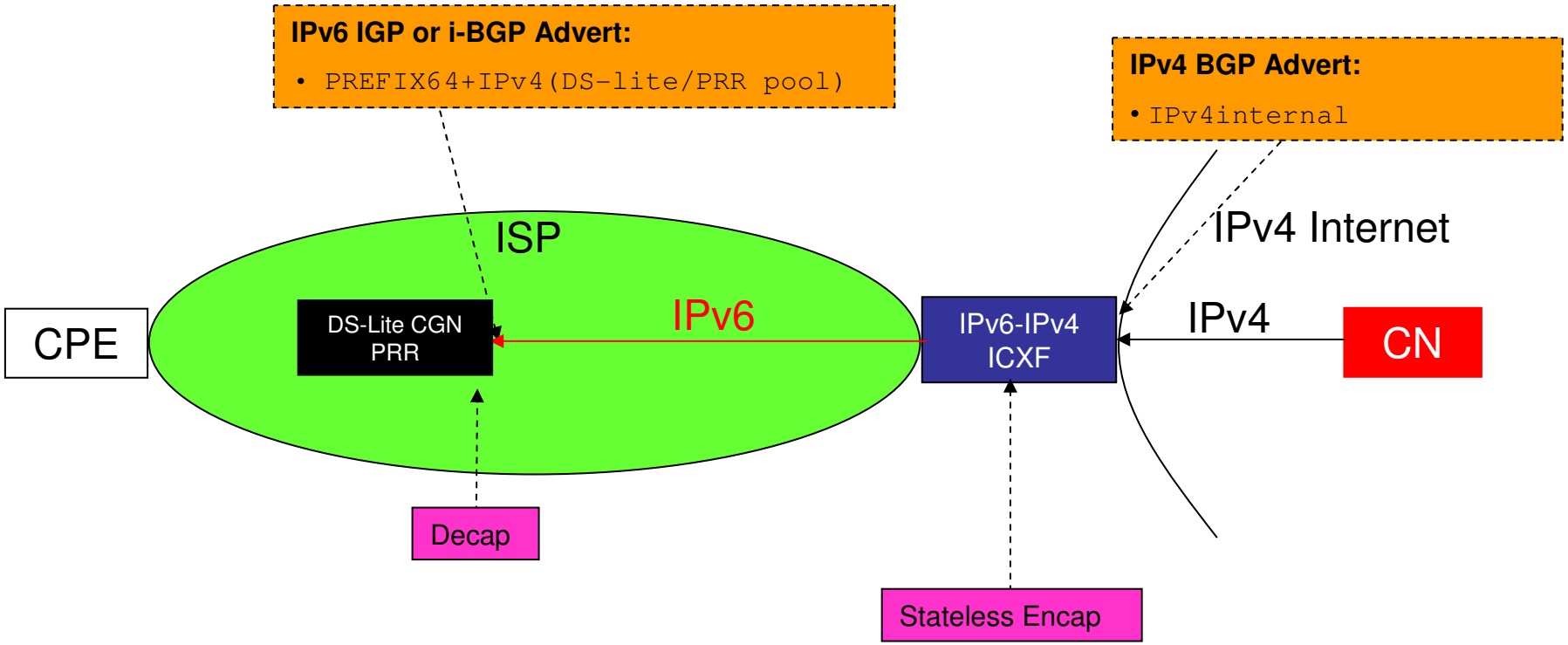

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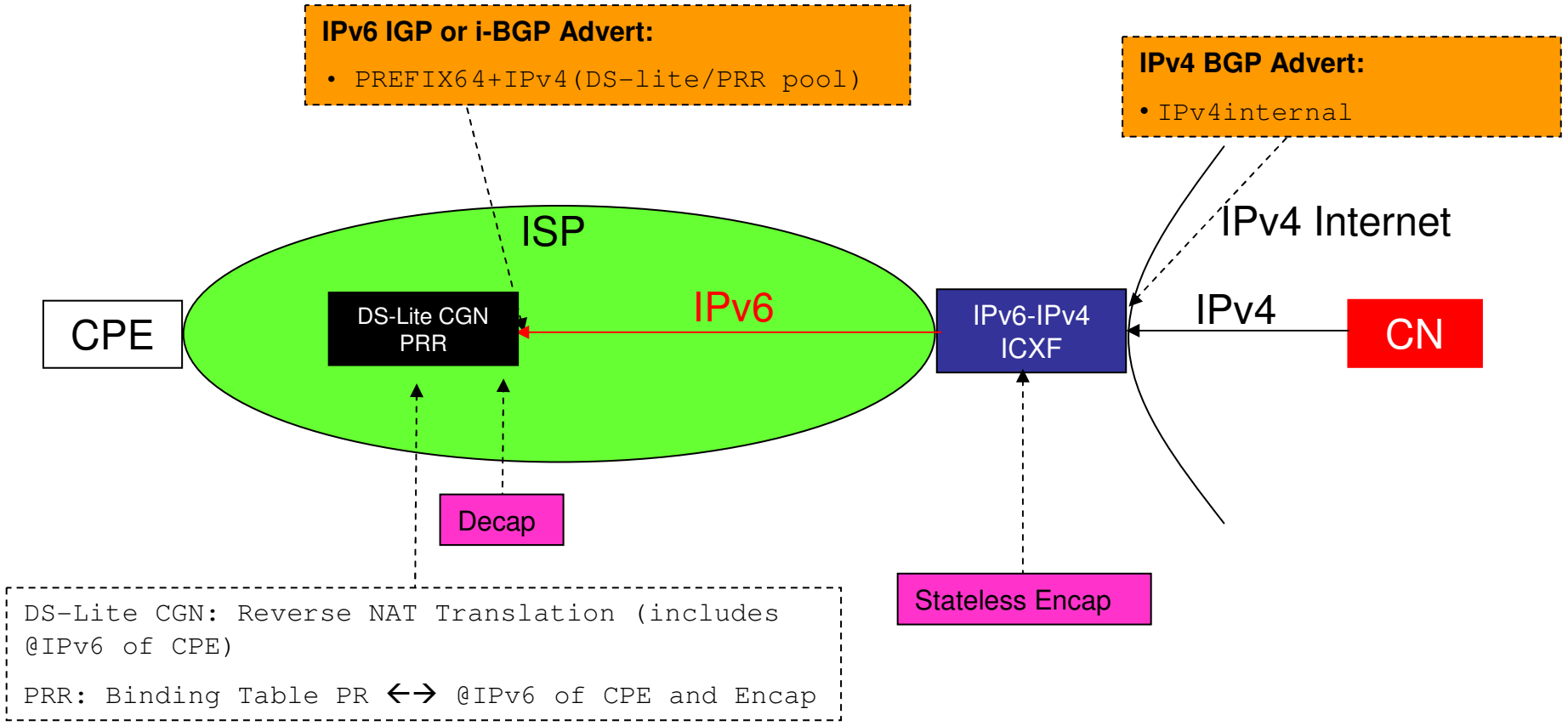

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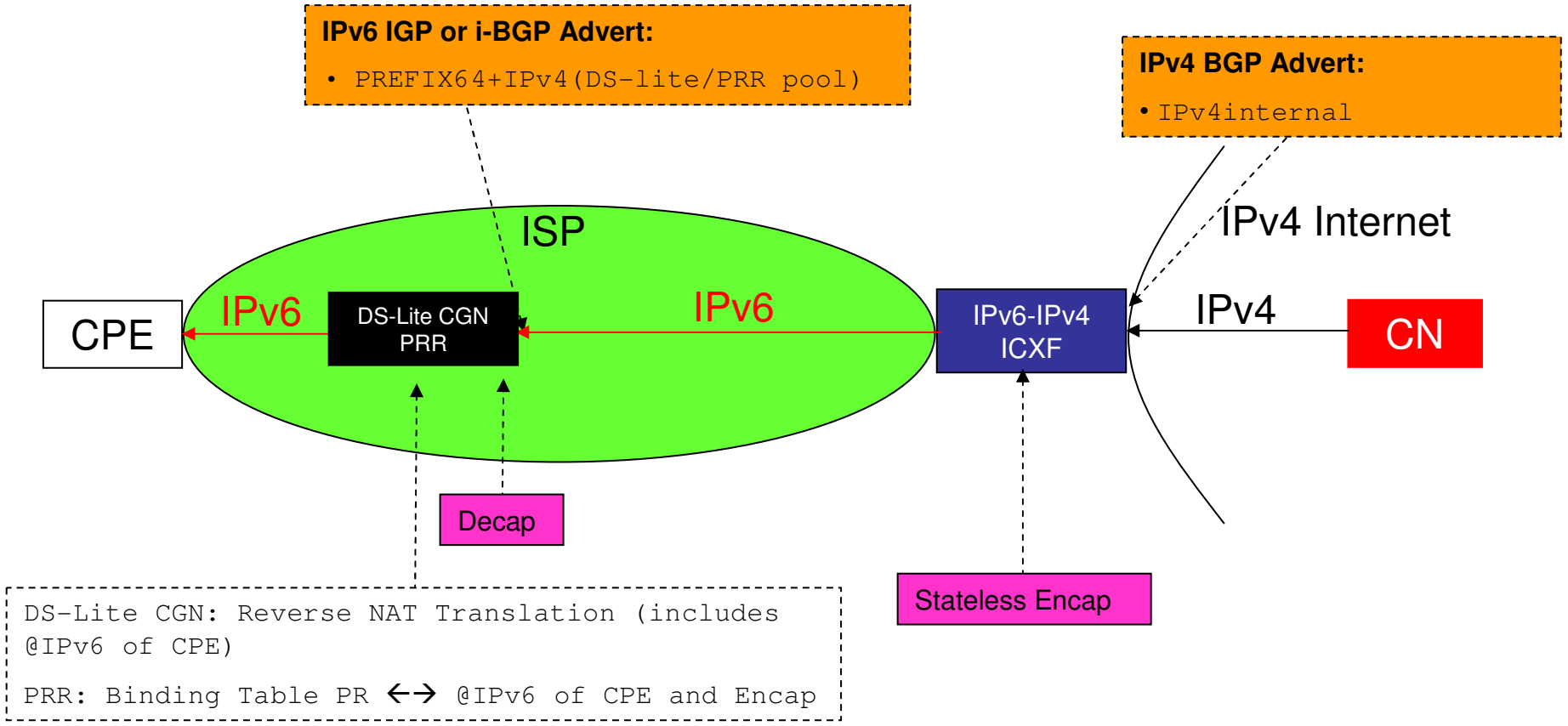
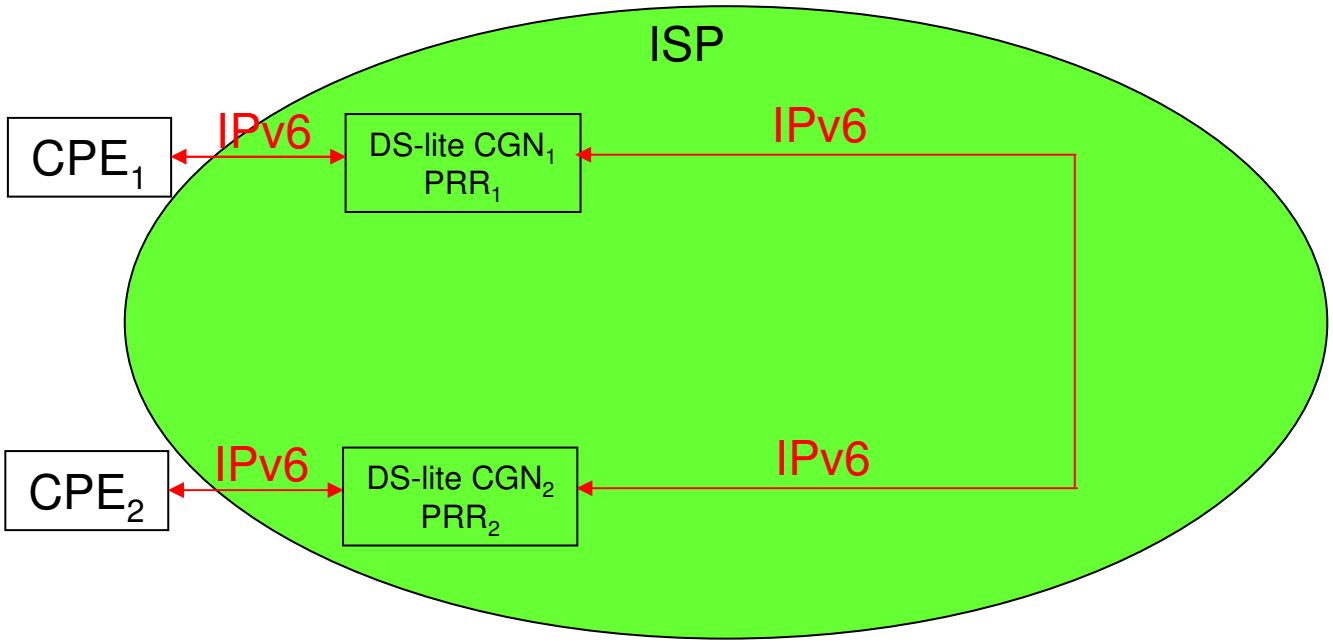
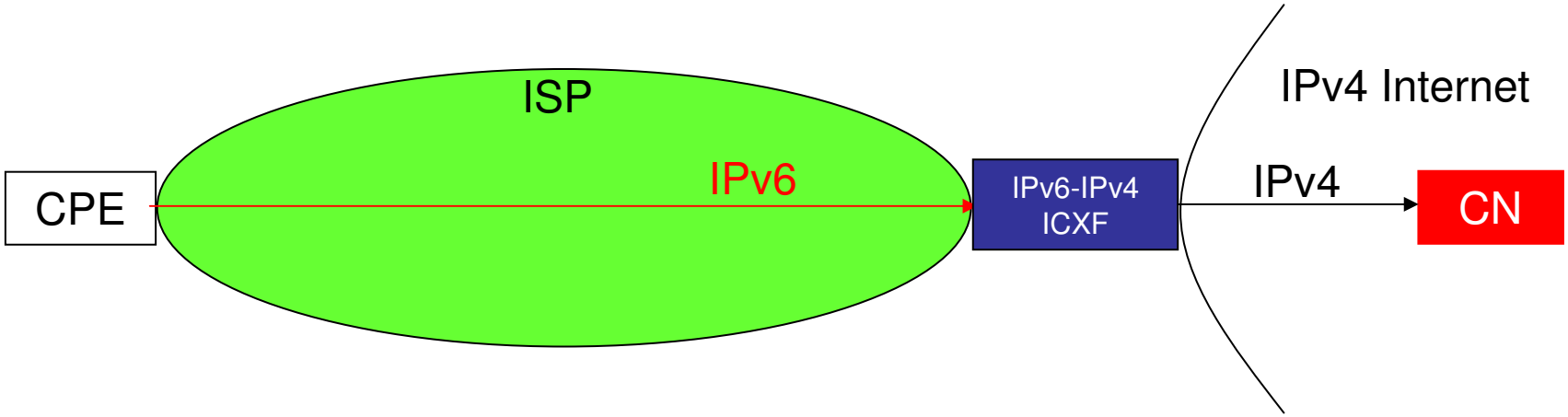


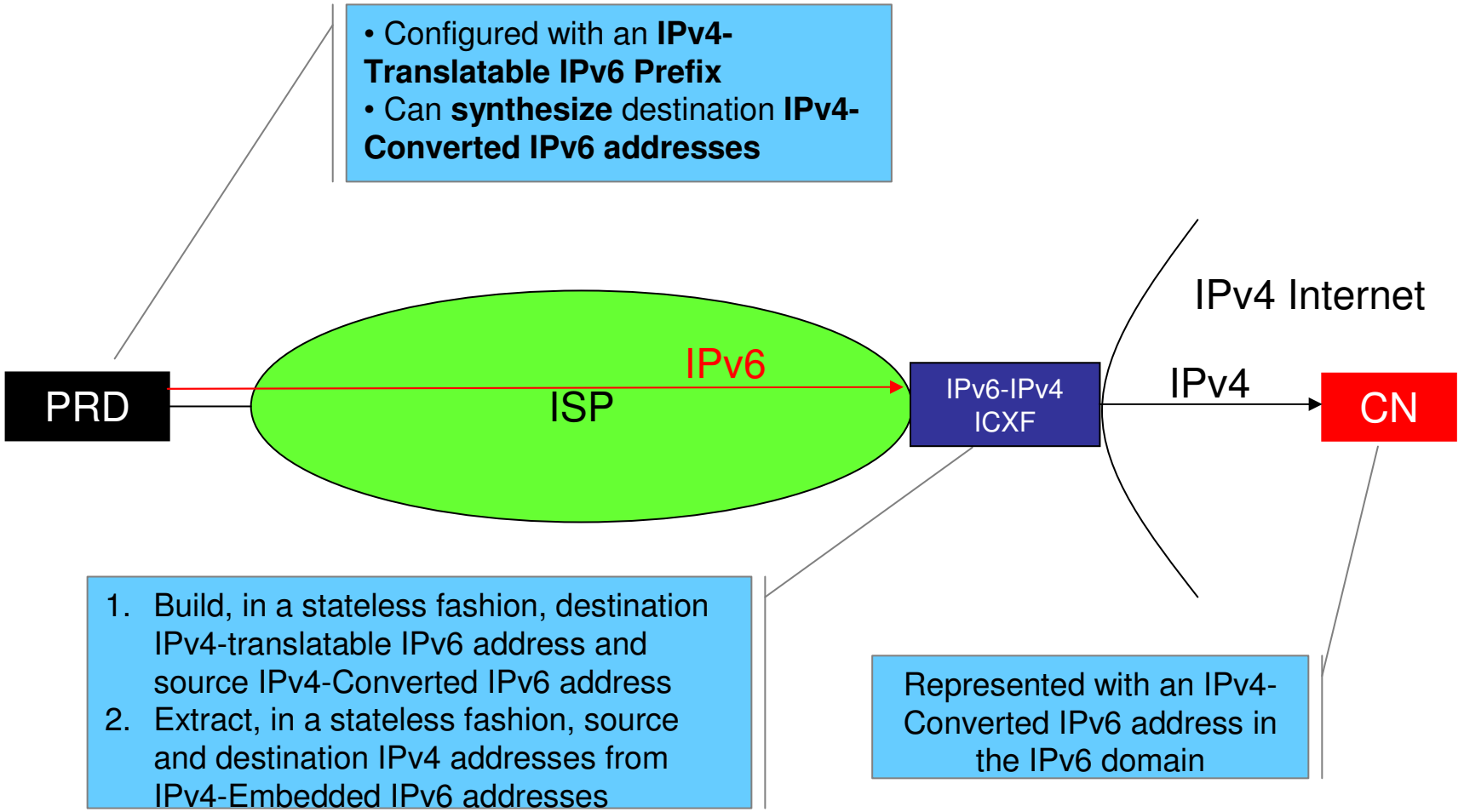
Tromboning Issue



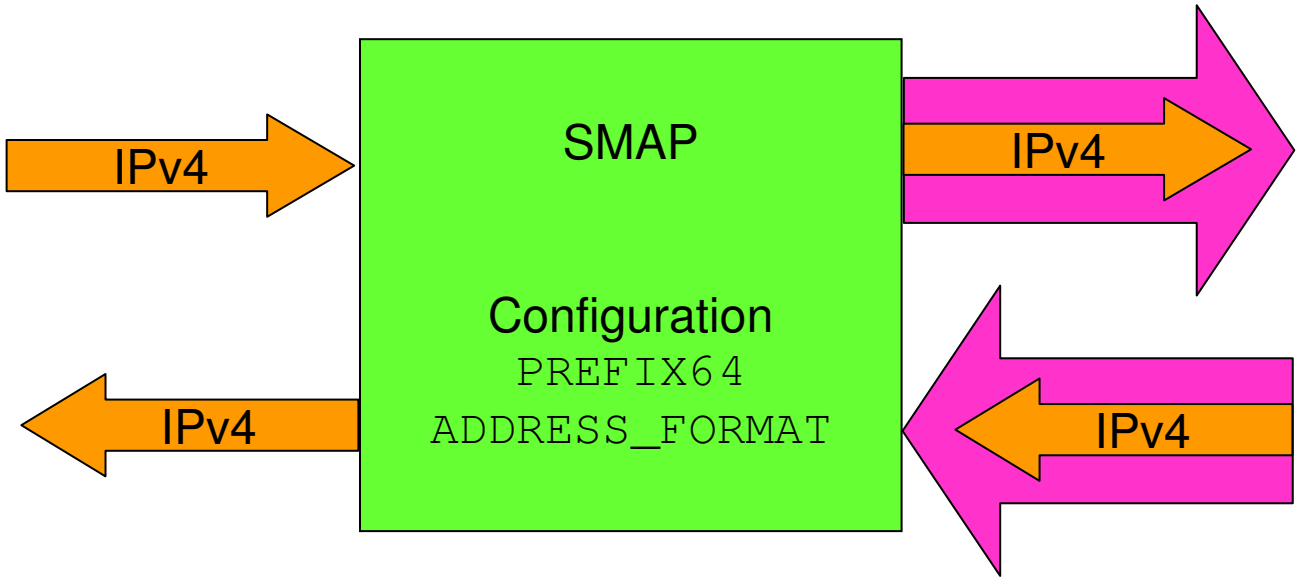
Removing CGN and PRR



Removing CGN and PRR

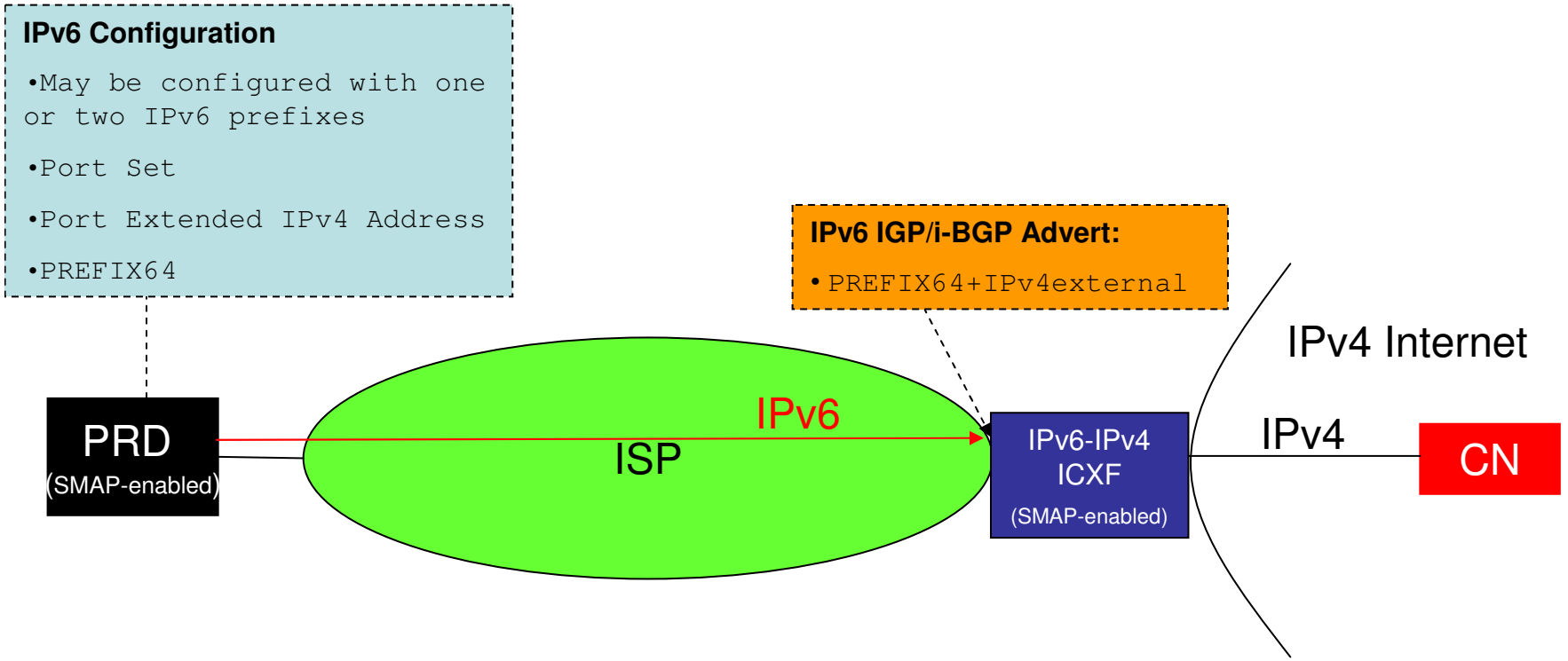


SMAP: Stateless A+P Mapping Function



- SMAP can be embedded in a CPE, ICXF, CGN, PRR
- SMAP prepends the IPv4 address and port number to a pre-configured PREFIX64 and address format
- SMAP proceeds to stateless encapsulation and decapsulation of IPv4 datagrams into IPv6 datagrams

Removing CGN and PRR



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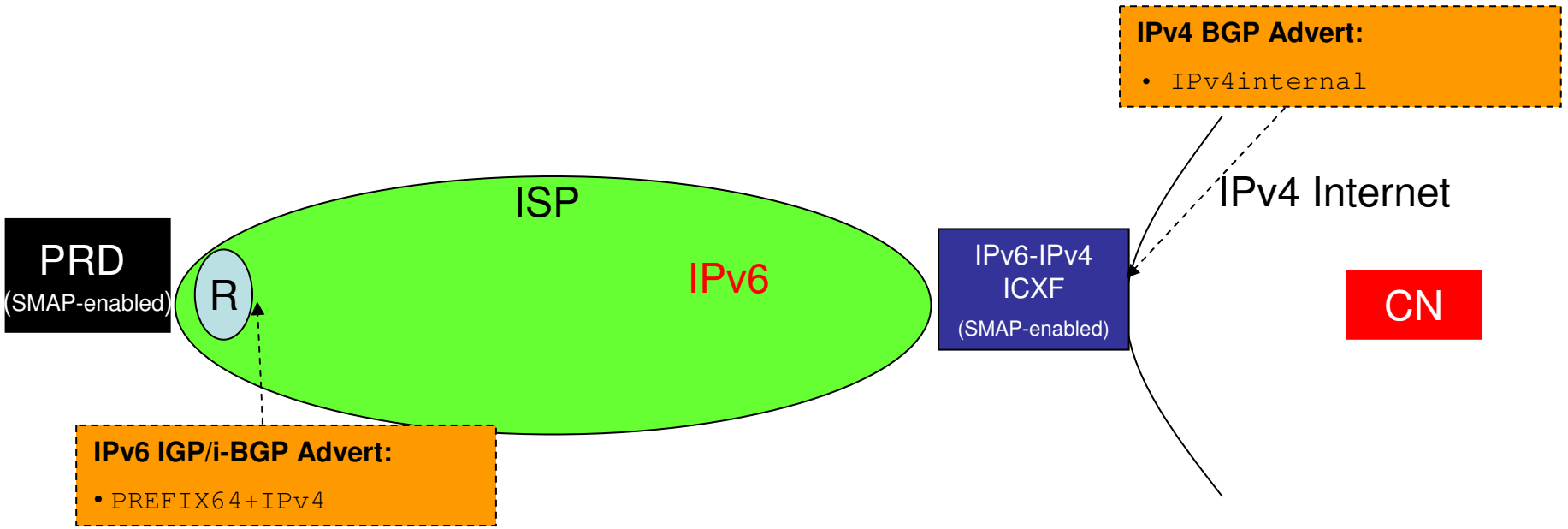

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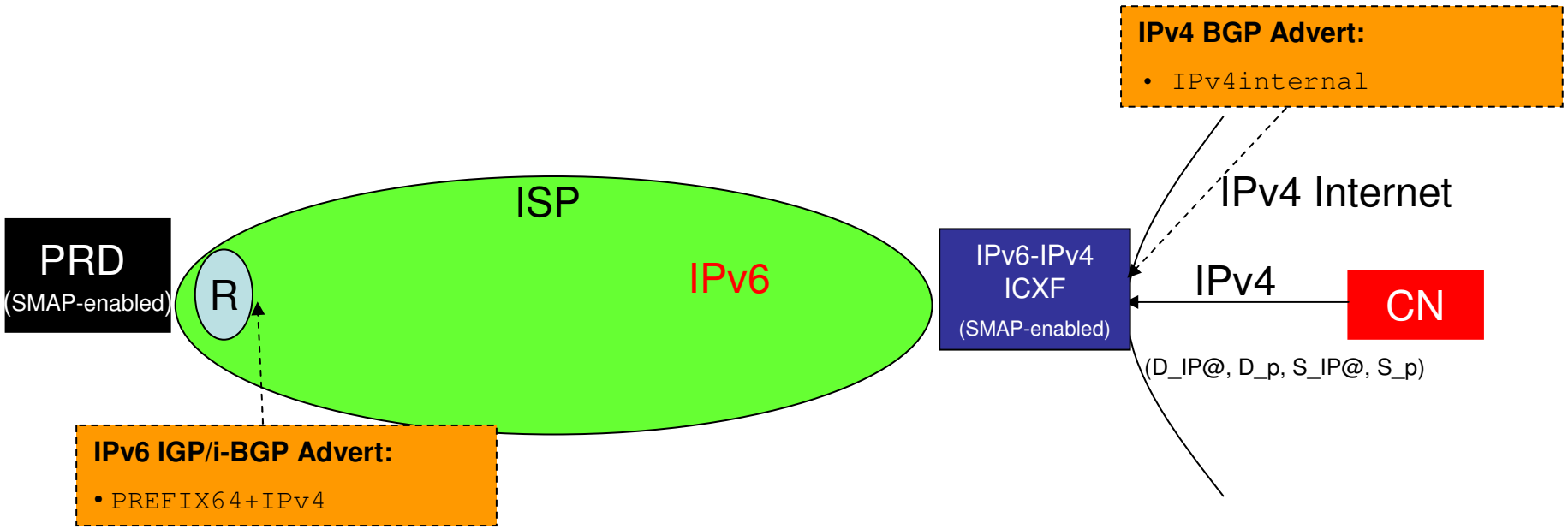

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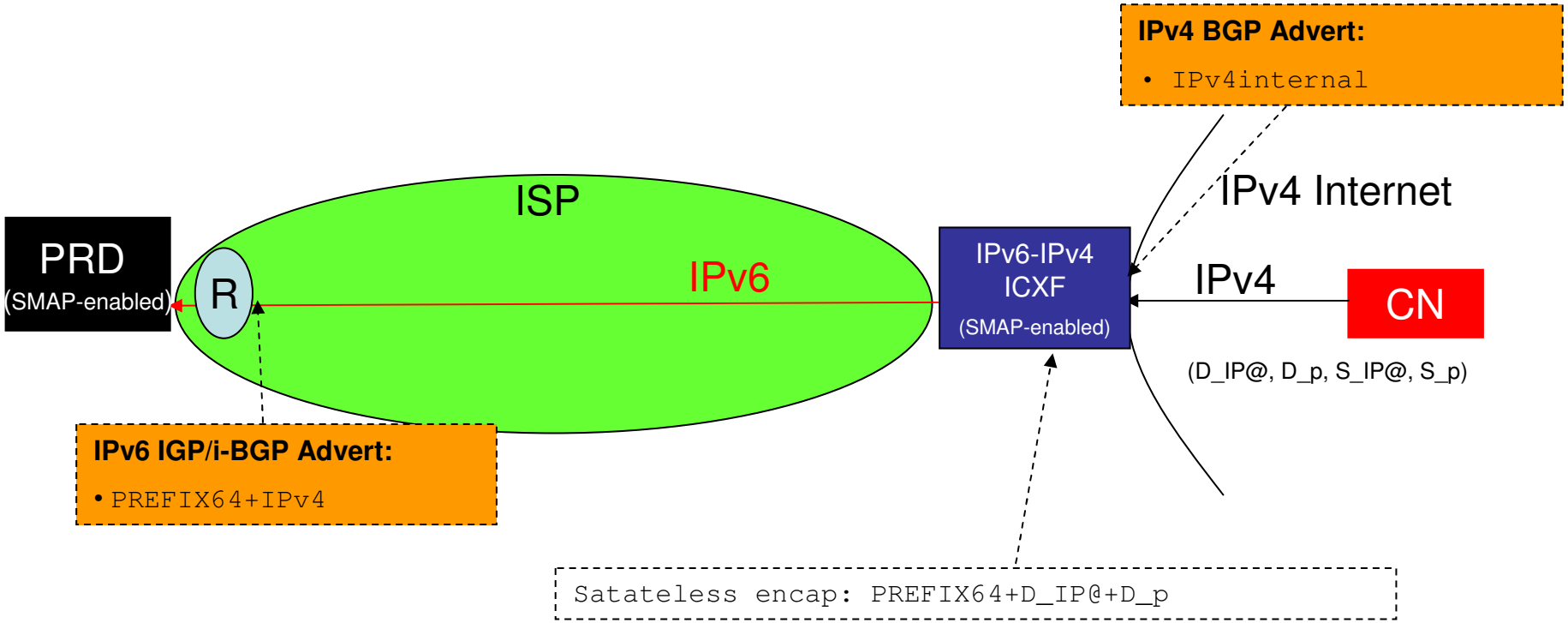

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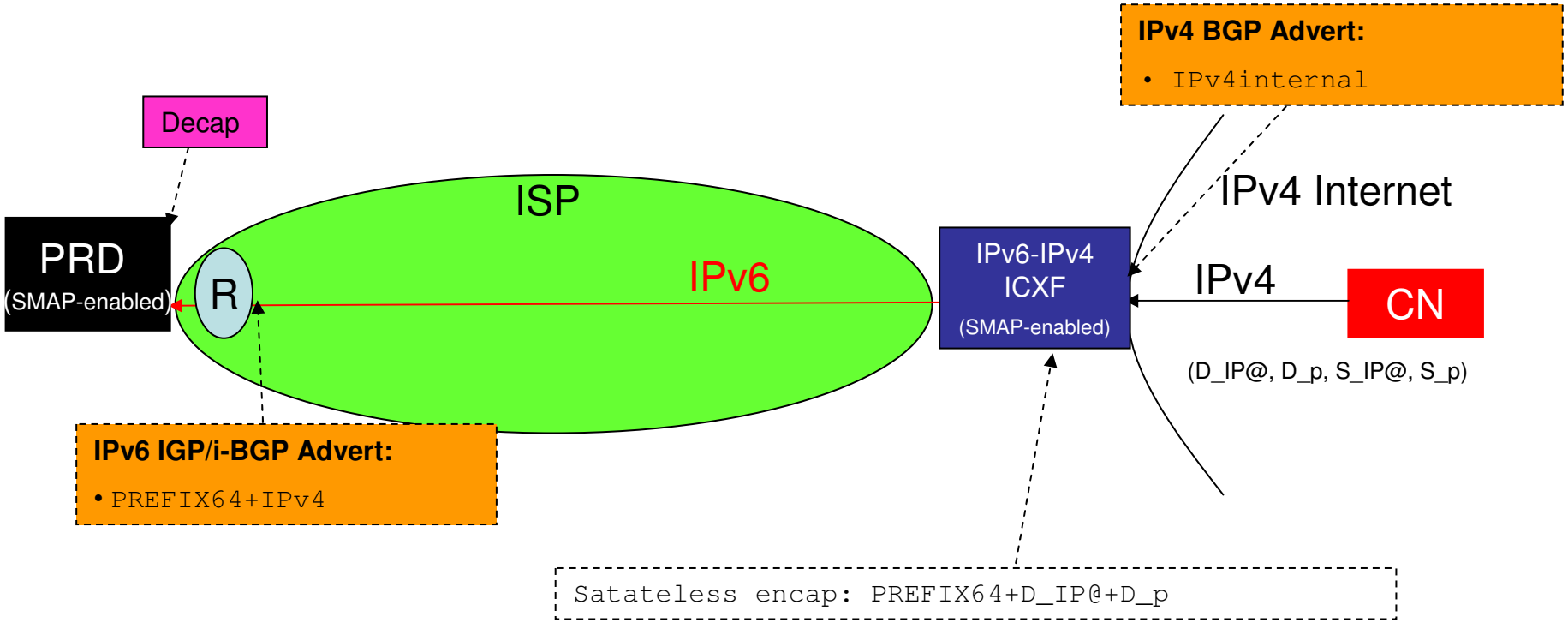
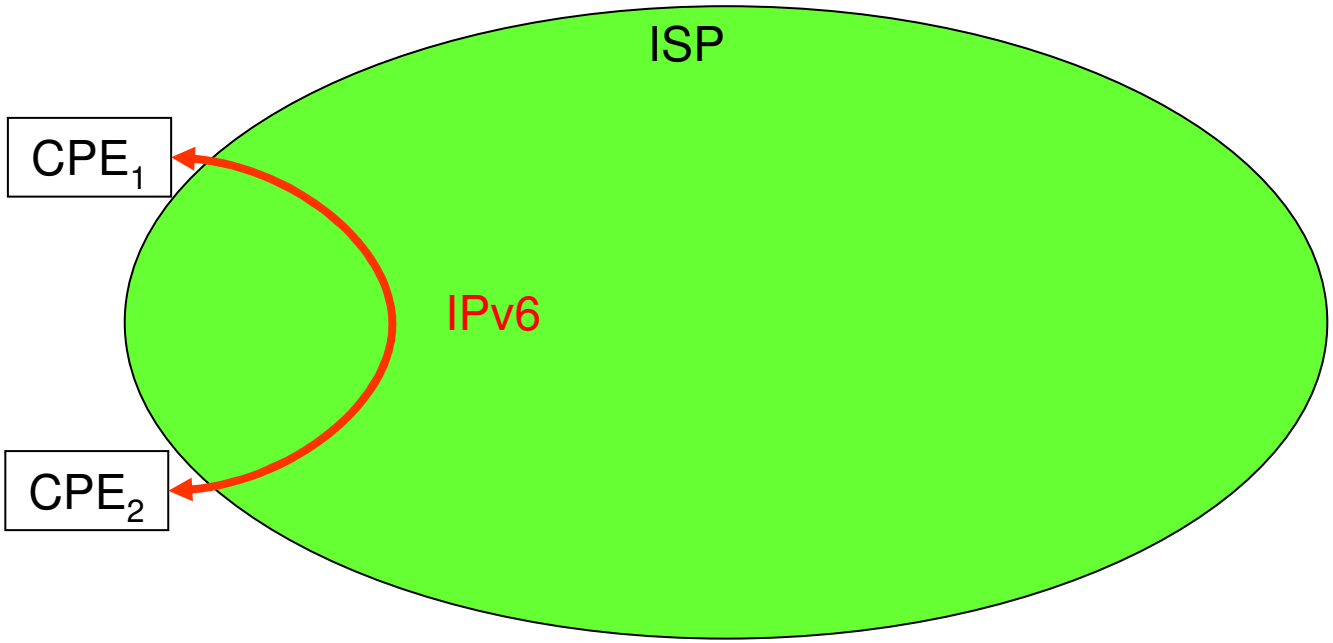
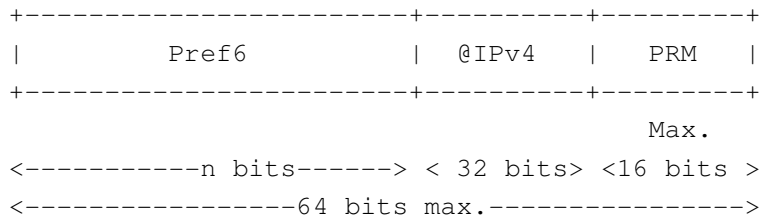


CPE-CPE Communications

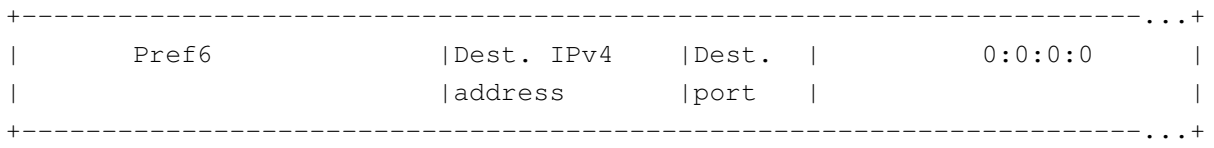


Prefix and Address Formats



PREFIX Format

PRM: refers to the value of the significant bits of the port range mask



Address Format

Port Range Mask

- Simple
  - Similar to Subnet Mask
- Hierarchical structure
- Flexible
  - For stateless schemes the significant bits forming the Port Range Mask must be consecutive
- Allows differentiated port set schemes bound to same shared IPv4 address
- Compliant with RTP/RTCP applications
- Allows to assign 0-1023 range to a user
- SP can be enforce its own policies w.r.t. port ranges to be allocated to requesting users
- Etc.

Port Range Example

- Ex (contiguous):
  - Value **10**0000000000000000
  - Mask **11**0000000000000000
  - Port Range 32768-49151
- Ex (non-contiguous):
  - Value 000000**00**00000000
  - Mask 000000**11**00000000
  - Port Range 0-255, … ,64512-64767 (64 ranges)
- Other examples are given in the draft

Conclusion

- Stateless encap/decap functions
- IPv6 Routing does not take into account Port Range (can be dynamic)
- Provide flexibility for DS-Lite vs. Port Range selection
  - Vendors can implement both DS-Lite CGN and PRR functions in the same device
  - Same IPv6 requirements on the customer devices for both DS-Lite and IPv6 Port Range
    - IPv6 prefix
    - IPv6 address to reach PRR/DS-Lite CGN
- Allows to remove CGN/PRR from the path while continuing to deliver IPv4 services over an IPv6-only ISP network