IP Transitioning in CE Routers
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Two Choices:

1. **Multihoming**: Multiple active interfaces are allowed, router decides which WAN interface to use for upstream traffic based on IP forwarding metrics.

2. **Forced single-homing**: Router is “allowed” one and only one active WAN interface at any time.
Parallel Dual-Stack IP Config

Boot

Configure native IPv6

OK?

No IPv6 service

Yes

IPv6 service

Configure native IPv4

OK?

No IPv4 service

Yes

IPv4 service
Requirements for IPv6 Multihoming and 6rd Sunsetting

1) The CE router MUST associate delegated prefixes with the WAN interface(s) they were learned from (e.g., DHCPv6-PD, 6rd, etc). Each packet sent out a WAN interface MUST have a source address that corresponds to a delegated prefix associated with the given WAN interface.

2) The IPv6 CE router MUST allow different or identical delegated prefixes on 6rd and native interfaces. By default, a 6rd virtual interface MUST be assigned a higher routing cost than a native IPv6 interface.
DS-Lite

Same Two Choices:
1. Multihoming
2. Forced single-homing
Boot

Configure native IPv6

OK?

Yes

IPv6 service

No

No IPv6 service

Configure native IPv4

OK?

Yes

IPv4 service

No

No IPv4 service

6rd option?

Yes

Initiate IPv6 over 6rd

No
Load Balance Broadband Router
TL-R470T+

TP-Link TL-R470T+ Dual Wan Load Balance Broadband Router

$43 online

TL-R470T+ by TP-LINK (Factory New) The TL-R470T+ Load Balance Broadband Router possesses stronger data transmission capacity and stability, cost-efficient for networks in places such as Internet cafes and small offices. It brings you high return on investment with low overhead. Management: QoS, Web-based Management, Remote Web Management, DHCP.
IPv4 Forwarding w/Multiple Exits (one example)

CPE NAPT Table
Dynamic:
- Flow 1 (5-tuple) – Intf 1
- Flow 2 (5-tuple) – Intf 1
- Flow 3 (5-tuple) – Intf 2
- Flow 4 (5-tuple) – Intf 2
- Flow 5 (5-tuple) – Intf 1
- Flow 6 (5-tuple) – Intf 1
- Flow 7 (5-tuple) – Intf 2
- Flow 8 (5-tuple) – Intf 2
- Flow 9 (5-tuple) – Intf 1
- Flow n (5-tuple)

Static:
- DS-Lite – Intf 3
- Port FWD (UPnP, PCP…)

AFTR NAPT Table
Dynamic:
- Flow 1...
- Flow 2...
- Flow 3...
Static:
- Port FWD (PCP)
- Address C…Z
Example IPv4 Forwarding Policy for Transition

1. IPv4 over IPv6 transport is preferred over others

2. Less address translation occurrences is preferred over more [RFC5864][I-D.donley-nat444-impacts]

3. The closer the state is to the edge, the better. [RFC1958]

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<td>MAP-E</td>
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</tr>
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</table>

Table 1: IPv4 Preference Table
Forcing Single-Homing

Boot

- Configure native IPv6
  - OK? (Yes -> IPv6 service, No -> No IPv6 service)
  - DS-lite option? (Yes -> Initiate IPv4 over DS-lite)

- Configure native IPv4
  - OK? (Yes -> IPv4 service, No -> No IPv4 service)
  - 6rd option? (Yes -> Initiate IPv6 over 6rd)
Forced Singlehoming (2)

1. Boot
   - Configure native IPv6
     - OK? no → Wait (timeout)
       - OK? yes → DS-lite option?
         - yes → Configure native IPv4
         - no → Native IPv6?
           - yes → Native dual stack service
           - no → IPv4 only service
     - yes → DS-lite option?
       - yes → Configure native IPv4
       - no → Initiative IPv4 over DS-lite

2. OK? no → No (IPv4) service
   - OK? yes → Initiative IPv4 over 6rd

3. 6rd option? no → IPv4 only service
   - 6rd option? yes → Initiative IPv4 over 6rd
IPv6
IPv4
6rd
ite
Whack a mole!
CPE
Current text states CE Routers SHOULD implement DS-Lite and 6rd, but avoids how they interact with one another as well as with Native IPv4 and Native IPv6.

Two choices:

1. Specify in the “Transition” section that IP interface configuration operate independently

In order to support Multihoming:
   - **For 6rd:** Include the two requirements in this presentation
   - **For DS-Lite:** Require that IPv4 “dual-wan” functionality be employed. If we want to transition to IPv6, define a default policy for IPv4 mechanisms.

2. Or, move the “Transitioning” solution space to a new document.