Lightweight 4over6
+ SD-nat (aka stateless DS-Lite)
= Lightweight DS-Lite
(twice as light!)

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(Softwire item, presented here for feedback)
Motivations

• Simple extension to DS-Lite to push NAT function to CPE
• Eliminate per-flow state on AFTR
• Eliminate per-flow logs on AFTR
• Hub & Spoke model:
  No mathematical IPv4 and IPv6 address coupling
Technical Matrix

CGN Port Management

Addr/Port Set Provisioning

Per-flow stateful

DS-Lite

Per-subscriber stateful

Public 4over6 Lightweight DS-Lite

Stateless

MAP-E, MAP-T, 4rd-u, etc.

Address Binding

Algorithmic Mapping
Benefits of allocating independently IPv6 and IPv4 address

- IPv6 addresses do not have to be allocated sequentially.
- Easily define and change IPv4 customer profiles (number of ports).
- IPv4 resources can be re-allocated freely.
Not Tying IPv6 address to IPv4 address plus port range

• In general, removing the mathematical restriction allows the operator to deliver the service he wants to offer, in the way he wants to offer them.

• The price to pay is to provision and manage resources at a finer granularity.

• Introduce per-subscriber state on tunnel concentrator (AFTR)
  – No per flow state!
Classic DS-Lite Architecture

AFTR Per-flow mapping table

DS-Lite CPE implements:
- B4 element

DHCPv6 configures:
- CPE IPv6 address
- CPE IPv6 delegated prefix
- DNS resolver
- AFTR IPv6 address

IPv4

AFTR

DHCPv6

PE

CPE (no NAT)
Lightweight DS-Lite ICMP Architecture Proposal Option

AFTR Per-subscriber mapping table

<table>
<thead>
<tr>
<th>IPv6</th>
<th>IPv4</th>
<th>Port Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001:db8::1</td>
<td>192.1.2.3</td>
<td>1000-1999</td>
</tr>
<tr>
<td>2001:db8::2</td>
<td>192.1.2.3</td>
<td>2000-2999</td>
</tr>
</tbody>
</table>

ICMPv4 “Port Restricted” over IPv6 tunnel

Lightweight DS-Lite CPE implements:
- DHCPv4 Client Relay Agent (over IPv6) to configure B4 element IPv4 address
- ICMP “Port Restricted” to configure its NAT port range

DHCPv6 configures:
- CPE IPv6 address
- CPE IPv6 delegated prefix
- DNS resolver
- AFTR IPv6 address
- IPv6 address of DHCPv4 server

DHCPv4 (over IPv6) configures:
- CPE B4 IPv4 address
ICMP port restricted message as proposed method to communicate port restricted range

• Under discussion in Softwire
  – AFTR must notify the CPE when port is out of assigned range with an ICMP message
  – Can we re-use existing ICMP message:
    • Port exceeded
    • Administratively prohibited
    • Other?
  – Or do we need a new ICMP message?
Current proposal: IPv4 ICMP Packet Format

+---------------------------------+----------------+----------------+---------------+
| Type   |    Code    | Checksum       |
+---------------------------------+----------------+----------------+---------------+
| Min Port | Max Port  |               |
+---------------------------------+----------------+---------------+
| Original Internet Headers + 64 bits of Payload |
+---------------------------------+----------------+---------------+
Security Considerations

• Require ingress filtering on IPv6 access network
• \((\text{MaxPort} - \text{MinPort})\) MUST be \(\geq 64\)
• IPv6 SRC MUST be AFTR’s IPv6 address
  – As configured on CPE (learned from DHCPv6)
• IPv6 DST MUST be CPE’s IPv6 address
• IPv4 SRC MUST be 192.0.0.1
  – AFTR well known address
• IPv4 DST MUST be CPE’s IPv4 address