A+P implementations

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Implementation Overview

- Network Topology

```
public
addresses
realm                 +----------+
                      |   PRR    |
                      |          |
   ===                +----------+
IPv4 ^                  ^  ^
     |                  |  |
     |                  v  v
     |                +-------------+
over |                | PPPoE/DHCPv6 |
     |                |   Server    |
     |      ===       +-------------+
     |   IPv6  ^         |  |
     |   over  |         |  |
IPv6 |  PPPoE  |         |  |
     V         v         |  |
   ===       ===         v  v
              ^        +----------+
              |        |   A+P    |
              |        |   CPE    |
              |        +----------+
Private |              ^  ^
RFC1918 |              |  |
realm   |              v  v
        |            +----------+
        |            |   Host   |
        V            |          |
                     +----------+
```

- CPE Parameters

OpenWrt Wireless Freedom

Model	CPU Speed (MHz)	Flash (MB)	RAM (MB)	Wireless NIC	Wireless Standard	Wired Ports
Linksys WRT54GS	200	8	32	Broadcom (integrated)	11g	5

Two flavor of implementations

- Port Range A+P

```
|31bits|1bit|  32bits|8 bits|16bits|4bits|1bit|1bit|1bit|1bit|32 bits|
+------+----+-------+------+------+-----+----+----+----+----+------+
|AplusP|flag|Public | EUI64| port |Port |flag|flag|flag|flag|Public |
|Prefix| 0  |IPv4   |      | Range|Range| 1  | 2  | 3  | 4  |IPv4   |
|      |    |Address|      |      |Size |    |    |    |    |Address|
+------+----+-------+------+------+-----+----+----+----+----+------+
```

- Scattered Port Sets A+P

```
|31bits|1bit|  32bits|8bits|16bits |4bits|1bit|1bit|1bit|1bit|32bits|
+------+----+-------+------+------+-----+----+----+----+----+-------+
|AplusP|flag|Public | EUI64|SID_  |Reser|flag|flag|flag|flag|Public |
|Prefix| 0  |IPv4   |      |Value |-ved | 1  | 2  | 3  | 4  | IPv4  |
|      |    |Address|      |      |     |    |    |    |    |Address|
+------+----+-------+------+------+-----+----+----+----+----+-------+
```

Scattered ports provisioning

- What's the benefits of provisioning scattered ports?
  - For incoming ports
  - Scattered ports allocation is more likely to satisfy the random incoming port requests from applications
    - such as eMule, uTorrent,sharez, using UPnP 1.0

- A solution
  - to distribute bulks of non-continuous ports among subscribers,
  - also takes port randomization into account

How to provision scattered ports?

- Only two parameters
- Subscribers ID pattern

```
|1st |2nd |3rd |4th |5th |6th |7th | 8th|
+----+----+----+----+----+----+----+----+
| 0  | s  | 0  | 0  | s  | 0  | s  | 0  |
+----+----+----+----+----+----+----+----+
|9th |10th|11th|12th|13th|14th|15th|16th|
+----+----+----+----+----+----+----+----+
| s  | 0  | s  | 0  | 0  | 0  | 0  | 0  |
+----+----+----+----+----+----+----+----+
```

- Subscribers ID value

```
|1st |2nd |3rd |4th |5th |6th |7th | 8th|
+----+----+----+----+----+----+----+----+
| 1  | 0  | 1  | 1  | 0  | 1  | 0  | 1  |
+----+----+----+----+----+----+----+----+
|9th |10th|11th|12th|13th|14th|15th|16th|
+----+----+----+----+----+----+----+----+
| 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
+----+----+----+----+----+----+----+----+
```

Random ephemeral port selection for Scattered Port Sets NAT

- Subscribers ID pattern

- Subscribers ID value
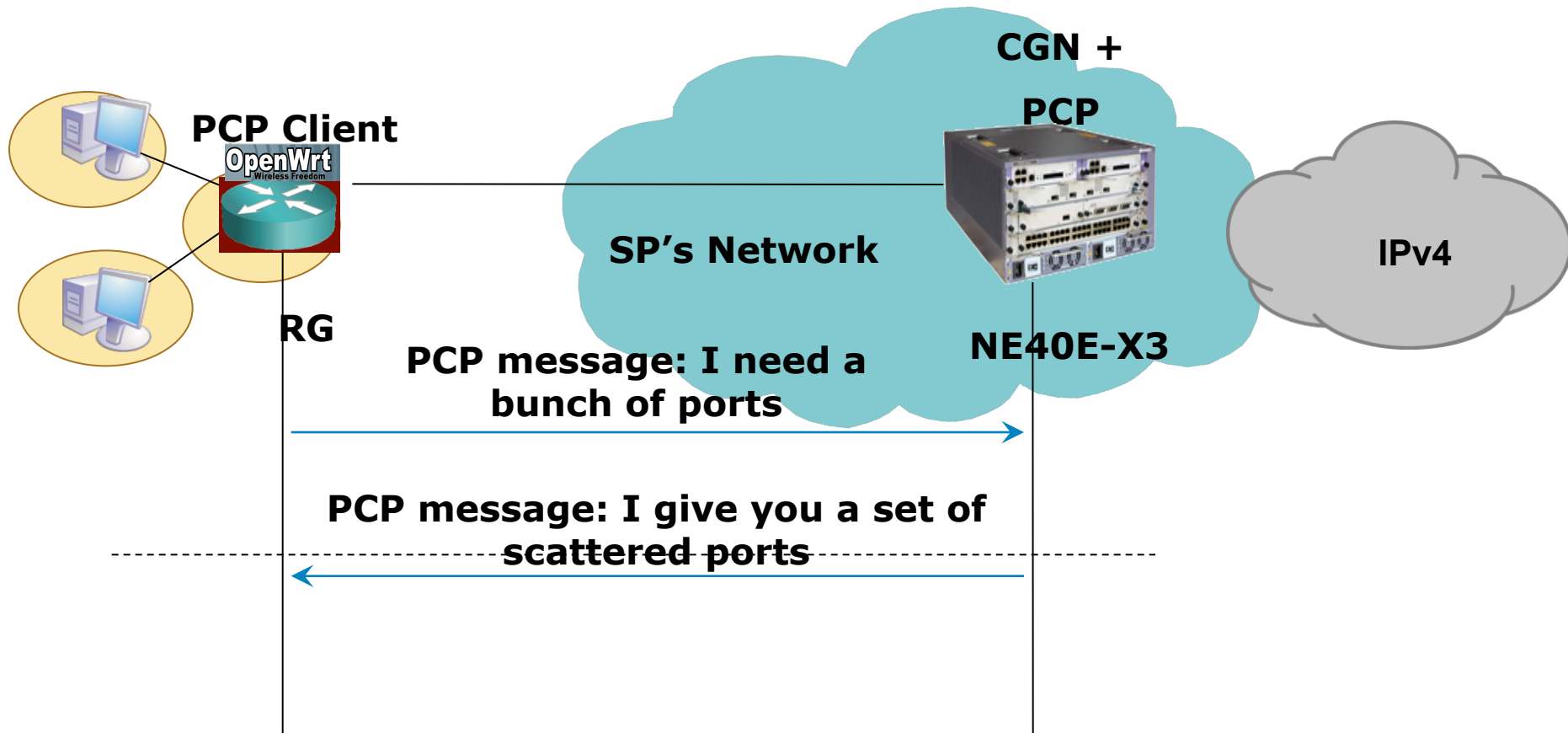
Only one line code needs to be changed!

```
do{

    restricted_next_ephemeral = (random()|subscriber_ID_pattern)

                                 & subscriber_ID_value;

    if(five-tuple is unique)

    return restricted_next_ephemeral;

}
```

An Implementation of Scattered Port Sets (A demo in DS-Lite case)

PCP Client

CGN + PCP

SP's Network

IPv4

RG

NE40E-X3

PCP message: I need a bunch of ports

PCP message: I give you a set of scattered ports

Location: **2000D**

Check out website for this demo: http://130.129.48.23:35328/

What we learnt from it?

- What breaks?
  - UPnP 1.0 clients
- How to fix it?
  - Take care of port allocation mechanisms !
  - Same thing with even/odd ports allocation,which is something matters to RTP/RTCP

```
         _.._..,_,_
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      | ]::   '       [
     '=]):   .)    ([
       | : :       ' |
        ~~----~~
```

- Call for comments on mailing list