PCP NAT64 Experiments

I-D. draft-boucadair-pcp-nat64-experiments
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Objectives of this effort

• Test PCP in IPv6-only environments including WiFi and 3G by:
  – Implement a PCP Server controlling a NAT64 device
  – Implement a PCP Client to be embedded in IPv6-only hosts
  – Update some applications to be PCP-enabled

• Validate the overall PCP chain and assess its impact
Software Modules

• NAT64
  – Based on Viagenie’s Ecdysis implementation (Linux Kernel module).
  – Added a management interface & PCP network interface to be connected via TCP.

• PCP server
  – Based on ISC’s PCP server for DS-Lite.
  – Added an interactive shell to view/add/delete users & mappings.
  – Added Description & RTP/RTCP options.

• PCP packet generator for Android
  – Custom packet creator for MAP & PEER Opcodes.

• Linphone SIP UA integrating PCP Client
  – Ported from Linux C coded implementation.
Implemented Drafts

- draft-ietf-pcp-base
  - MAP and PEER OpCodes
  - THIRD_PARTY option
  - PREFER_FAILURE option
- I-D.boucadair-pcp-description-option
- I-D.boucadair-pcp-nat64-prefix64-option
- I-D.boucadair-pcp-rtp-rtcp
- I-D.boucadair-mmusic-altc
PCP Packet Generator GUI

Choose the request type:
- MAP
- PEER

Client IPv6: 2001:df8:0:112:9a0c:82f
Internal Port: 8080
Suggested External IPv4: Suggested external IPv4
External Port to Ask: External port to ask
Lifetime: 3000
Protocol: TCP
3rd Party
Preferred Fail: RTP n/n+1
Prefix 64
Description: ietf85

Sugg. external addr: 161.105.194.14:8080
Req. Lifetime = 300 Seconds | Proto: TCP
Sending Request sent successfully!!
Waiting for response...Received a 60 bytes response.
================================== Mapping created ===============
Lifetime: 300
Epoch time = 505
assigned external = 161.105.194.14:8080
Description = ietf85
Prefix 64 = /0
PCP commands

PCPSERVER> list user

<========== USERS LISTING ==========>
  External IPv4 = <161.105.194.14>
  Port range:[ 1024 - 64999 ]
  Epoch time value = <2099>
<================== 0 ==================>

PCPSERVER> list map

<========== MAPPING LISTING BY USER ==========>
  External IPv4 = <161.105.194.14>
  Port range: [ 1024 - 64999 ]
  User epoch time= <2102>
---- List of mappings : ----
  protocole= TCP
  Internal port= <8080>
  External port = <8080>
  Expire= <2474>
  Description= "ietf85"
  No 3rd party address

-----------------------------------0-------------------
<================== 0 ================>
Test #1: Hosting a Server behind a NAT64
Test #1: Testbed architecture

- **INTERNET v4**
- **INTERNET v6**
- **My actual demo pc**
  - IP: 161.105.194.10/28
- **PCP server**
  - 161.105.194.14/28
  - 2001:688:1f94:3000::2/64
  - HTTP request
    - Dest: 161.105.194.14:8080
- **PCP client on IPv6 3G + IP Webcam**
  - IP: 20a1:xxxx
- **PCP client on IPv6 WiFi**
- **NAT64+DNS64**

**PCP MAP REQUEST:**
20a1:xxxx.8080 → x.x.x.x:8080

**PCP MAP Response:**
20a1:xxxx.8080 → 161.105.194.14:8080

PCP request
PCP response
Test#2: SIP-based Communications behind NAT64
SIP Testbed Architecture

SIP client "12"
IP: 161.105.194.11/28

SIP server "mysip.fr"
IP: 161.105.194.13/28

NAT64+DNS64
PCP server "mypcp.fr"
IP: 161.105.194.14/28

INTERNET
v6

IPv4
IPv6

SIP client 14 on IPv6 WiFi
IP: 2001:688:1f94:3000::x/64

PCP client 15 on IPv6 WiFi
IP: 2001:688:1f94:3000::x/64

IPv4
IPv6
PCP & SIP Packets

Destination: 2001:688:1f94:3000::2.5351

PCP Request:
Version: 1
R bit: Request (0)
Opcode: MAP (0x01)
Requested Lifetime: 36000 sec
MAP Request Protocol: UDP (17)
Internal Port: 3938
Suggested External Port: 3938
Suggested External IP Address: ::ffff:0.0.0.0
Option Code: Unknown (0x7f) Option Length: 12 bytes Data:
000000000000000000

Source: 2001:688:1f94:3000::2 port:5153

PCP Response:
Version: 1
R bit: Response (1)
Opcode: Unknown (0x81)
Result Code: 0
Lifetime: 36000 sec
Epoch Time: 1
MAP Response Protocol: UDP (17)
Internal Port: 3938
Assigned External Port: 3938
Option Code: PREFIX64 (0x7f) Reserved: 0 Option Length: 12 bytes Data:
200106881f94300a00000000
PCP & SIP Packets

```plaintext
REGISTER sip:mysip.fr SIP/2.0
Via: SIP/2.0/UDP 161.105.194.14:3938;branch=z9hG4bK1572043597
From: <sip:client4@mysip.fr:5070>;tag=893886783
To: <sip:client4@mysip.fr:5070>
Call-ID: 1271173454
CSeq: 2 REGISTER
Contact: <sip:client4@161.105.194.14:3938>;line=b3433a7df33282d>
    Authorization: Digest username="client4", realm="asterisk",
        nonce="09f75e47", uri="sip:mysip.fr",
        response="826fcff4c6e84ee45fbfa52c351e6316", algorithm=MD5
Max-Forwards: 70
User-Agent: Linphone/3.4.0 (eXosip2/unknown)
Expires: 3600
```
PCP & SIP Packets

```
INVITE sip:13@mysip.fr:5070 SIP/2.0
Via: SIP/2.0/UDP 161.105.194.14:35011;branch=z9hG4bK702695557
From: <sip:client4@mysip.fr:5070>;tag=641336337
To: <sip:13@mysip.fr:5070>
Call-ID: 1532307201
CSeq: 20 INVITE
Contact: <sip:client4@161.105.194.14:35011>
Content-Type: application/sdp
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY, MESSAGE, SUBSCRIBE, INFO
Max-Forwards: 70
User-Agent: Linphone/3.4.0 (eXosip2/unknown)
Subject: Phone call
Content-Length: 538
v=0
o=client4 3867 3867 IN IP4 161.105.194.14
s=Talk
c=IN IP4 161.105.194.14
b=AS:256
t=0 0
m=audio 7056 RTP/AVP 111 110 3 101
a=rtpmap:111 speex/16000
a=fmtp:111 vbr=on
a=rtpmap:110 speex/8000
a=fmtp:110 vbr=on
a=rtpmap:3 GSM/8000
a=rtpmap:101 telephone-event/8000
a=fmtp:101 0-11
m=video 9056 RTP/AVP 102 99
a=rtpmap:102 H264/90000
a=fmtp:102 profile-level-id=428014
a=rtpmap:99 MP4V-ES/90000
a=fmtp:99 profile-level-id=3
a=altc: IP4 161.105.194.14 7056
```
Encountered Problems

- Android handset disconnects WiFi when no IPv4 address available (no support of DHCPv6)
  - workaround: configure static IPv4 address, wait for RA then delete IPv4
- Address selection for PCP packets
Encountered Problems

PCP Error

Error number: 12

'ADDRESS_MISMATCH'

inet6 fe80::9a0c:82ff:fed9:c2d0/64 scope link
valid_lft forever preferred_lft forever
app_112@android: # netcfg wlan0 dhcp

1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue
   state UNKNOWN
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
      valid_lft forever preferred_lft forever
   link/sit 0.0.0.0 brd 0.0.0.0
2: sit0: <NOARP> mtu 1480 qdisc noop state DOWN
   link/sit 0.0.0.0 brd 0.0.0.0
3: ip6tnl0: <NOARP> mtu 1452 qdisc noop state DOWN
   link/tunnel6 :: brd ::
4: rmt0: <POINTOPOINT,MULTICAST,NOARP> mtu 1500 qdisc
   noop state DOWN qlen 1000
   link/ppp
5: rmt1: <POINTOPOINT,MULTICAST,NOARP> mtu 1500 qdisc
   noop state DOWN qlen 1000
   link/ppp
6: rmt2: <POINTOPOINT,MULTICAST,NOARP> mtu 1500 qdisc
   noop state DOWN qlen 1000
   link/ppp
7: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500
   qdisc pfifo_fast state UP qlen 1000
   link/ether 98:0c:82:c9:c2:d0 brd ff:ff:ff:ff:ff:ff
   inet6 2001:0112:21bc:8e5b:bc85:ed42/64 scope global temporary dynamic
      valid_lft 598667sec preferred_lft 79667sec
   inet6 2001:0112:9a0c:82ff:fed9:c2d0/64 scope global dynamic
      valid_lft 2591987sec preferred_lft 604787sec
   link/ether 98:0c:82:c9:c2:d0 brd ff:ff:ff:ff:ff:ff
   inet6 fe80::9a0c:82ff:fed9:c2d0/64 scope link
      valid_lft forever preferred_lft forever
   app_112@android: #
Encountered Problems
Encountered Problems

• Address mismatch
  – Implementation issue

• Address Lifetime
  – Network APIs does not provide access to lifetime associated to addresses
    • Problem well documented: see RFC6250 and draft-carpenter-behave-referral-object-01
    – pcp-base discusses already considerations related to the refresh of PCP mapping when privacy addresses are in use (section 8.4)
    – Does the base spec need to cite RFC6250?