Extensibility Needs & Motivations

• Why PCP should be extensible?
  – The base PCP should be **simple**
    • Only core functions should be specified in the base PCP document
  – We **don’t understand yet all the use cases** and the requirements (e.g., firewall scenario, stateless NAT, etc.)
  – **Frozen** PCP message format may not be adapted for advanced usages of PCP, and therefore a version change would be required each time a new need appears!
  – Trade-off between **flexible format vs. minimizing implementation complexity**
    • (Mandatory) Fixed field + (Optional) Variable objects
Extensibility Mechanism in PCP

• Two means are proposed so far
  – Allow to define new OpCodes in the future
    • Examples
      – **PCP LIST MAPPING**: Retrieve a list of active mappings
      – **PCP GET EXTERNAL IP ADDRESS**: Get the external address assigned by the NAT; mainly useful for stateless NATs
      – **PCP GET PERCEIVED IP ADDRESS**: Get the perceived IP Address and port as seen by the PCP Server
      – **PCP PING/PONG**: Check the availability of the PCP Server (both the PCP service and IP reachability)
  – Informational Elements
    • TLV objects
    • Optional
IE as a TLV object

<table>
<thead>
<tr>
<th>Code</th>
<th>Reserved</th>
<th>Length</th>
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</thead>
<tbody>
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</tbody>
</table>

- IE codes to be maintained by IANA
- IEs can be enclosed in PCP Request and PCP Responses
- PCP Server does not generate PCP Error messages if they failed to parse an IE
Open Issues #1

• How to notify the PCP Client that an IE is not supported by the PCP Server
  – Implicit
    • Every IE in the request needs to be present in the response if supported by the PCP Server?
  – Explicit
    • Define a dedicated IE which will copy the list of unsupported IEs when issuing the response?
    • Define a dedicated IE which lists only the codes of unsupported IEs?
Open Issues #2

• In some scenarios, a PCP Server might send an unsolicited IE to the PCP Client
  – Examples:
    • Capability IE: provides the capabilities of the PCP Server
    • Report IE: includes various reports from the PCP Server such as Count of mapping, Epoch, errors, port quotas, etc.
    • Error-Sub Code IE
    • Perceived IP Address/Port IE
  – Do we allow this or should we define a dedicated OpCode?
Open Issues #3

• Do we need a flag to indicate a mandatory-to-be-honored IE?
  – E.g., DSCP marking policy for instance
  – Having the M bit may be seen as a contradiction with the IEs being optional
  – Check the conflict with the use of mandatory-to-be-honored-request flag if defined
Appendix
IE Examples

• Extensions to PCP will be defined in separate document(s)
  – The procedure to define new IEs is (to be) described in the base PCP document

• The following slides show a list of examples
  – These examples are not for discussion per se
  – …but are here for illustration purposes
The PCP Server limits the length of the description text. It returns the stored description data to the PCP Client in the PCP Response.

**Examples of Informational Elements**

<table>
<thead>
<tr>
<th>Description IE Code</th>
<th>Reserved</th>
<th>Variable (Max 16bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Data</td>
</tr>
</tbody>
</table>

Excerpt of the mapping table:

<table>
<thead>
<tr>
<th>Internal IP Address</th>
<th>Internal Port</th>
<th>External IP address</th>
<th>External Port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.2.3</td>
<td>5060</td>
<td>1.2.3.4</td>
<td>16597</td>
<td>To access my WebCam from outside</td>
</tr>
</tbody>
</table>

**Associate a free description text with a mapping**

The PCP Server limits the length of the description text. It returns the stored description data to the PCP Client in the PCP Response.
Examples of Informational Elements

Apply a DSCP marking policy

<table>
<thead>
<tr>
<th>DSCP IE Code</th>
<th>Reserved</th>
<th>0x04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dir</td>
<td>DSCP In</td>
<td>DSCP out</td>
</tr>
</tbody>
</table>

DSCP1 <= DSCP2

The mapping is applied by the CGN
Port Reservation Option: Preserve parity, preserve contiguity

Other options can be supported such as RTP/RTCP port set
Examples of Informational Elements

Excerpt of the mapping table

<table>
<thead>
<tr>
<th>Client-ID</th>
<th>Internal IP Address</th>
<th>Internal Port</th>
<th>External IP address</th>
<th>External Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>45767321397231</td>
<td>10.1.2.3</td>
<td>5060</td>
<td>1.2.3.4</td>
<td>16597</td>
</tr>
</tbody>
</table>

Persistent PCP Identifier during CP reboot or IP address change

Avoid stale mapping entries in the PCP Server
Allows to refresh the mapping when a new IP prefix/address is assigned
Examples of Informational Elements

The CGN tags the address to not enforce NAT on them (e.g., IPsec)

<table>
<thead>
<tr>
<th>NAT BYPASS IE Code</th>
<th>Reserved</th>
<th>0x00</th>
</tr>
</thead>
</table>

Transparent NAT traversal