SwitchWare

Active Network Encapsulation Protocol (ANEP)

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*NB: Not an RFC author! (I was in Cambridge…)

The Problem(s)

- SwitchWare, ANTS, NetScript, etc.
- Variety of Independent and Important Research Goals
- But, no “ABONE” until they interoperate
- So….let’s make it happen!
- Alexander, Braden, Gunter, Jackson, Keromytis, Minden and Wetherall
Solution: Encapsulation

- Encapsulating Active Network Frames
  - Over Link Layers, IPv6 and IP
- Why header?
  - Find environment for eval.
  - Default processing for missing environ.
  - Non-program information
    - e.g., security headers
What’s it look like?

Format of ANEP Header:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>8</th>
<th>16</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flags</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ANEP Header Length
- ANEP Packet Length

Options

Payload
Details: Fields

- **Version**: now 1; change w/ANEP header; discard if unknown value
- **Flags**: for V1, only MSB used
  - MSB=0, try to forward w/default
  - MSB=1, discard if TypeID not recognized
- **ANEP Header Length**: in 32 bit words
  - includes options; 2 if no options
Details: More fields...

- **TypeID**: evaluation environment for message; 16 bits; values by ANANA
  - ANANA is currently Bob Braden
  - Unrecognized value? Check Flags MSB

- **ANEP Packet Length**: Length of entire packet in octets (including payloads)

- **Options length** (variable) computed from Packet and Header length difference
Terminology, FYI:

- **Packet**: ANEP Header + Payload
- **Active Node**: Network Element that can evaluate active packets
- **TLV**: Type/Length/Value triple
- **Basic Header**: First two words (8 octets) of the ANEP Header
Options

- Zero or more Type/Length/Value (TLV) constructs
- Follow the basic header. Format:

<table>
<thead>
<tr>
<th>FLG</th>
<th>Option Type</th>
<th>Option Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

Option Payload (Option Value)
Option Fields

- **Option Type**: 14 bits, used to interpret Option Payload.
- Values assigned by ANANA; private when MSB of FLG is set.
- Unrecognized value? LSB of FLG 0, continue; 1 discard packet. Should log.
- **Option Length**: 16 bits; TLV length in 32 bit words; >= 1.
Option Type Values

- **Reserved:**
  - 1 - Source ID
  - 2 - Destination ID
  - 3 - Integrity Checksum
  - 4 - Non-Negotiated Authentication

- **Format for Source, Destination, N-N:**

```
<table>
<thead>
<tr>
<th>Scheme Identifier</th>
<th>Option Payload</th>
</tr>
</thead>
</table>
```

Source Identifier

- Uniquely identifies sender
- Scheme Identifier is 32 bits; identifies addressing scheme to interpret the variable size Option Payload

- Reserved:
  - 1 - IPv4 Address (32 bits)
  - 2 - IPv6 Address (128 bits)
  - 3 - 802.3 Address (48 bits) (last two octets 0)
Destination Identifier

- Uniquely identifies destination in the active network
- Same payload option format as Source Identifier
Integrity Checksum

- Detect some packet integrity losses
- 16 bit 1’s-complement of 1’s-complement sum of the ANEP packet from the ANEP Version field
- Payload zero for computing checksum
- Option length field is 2.
Non-Negotiated Authentication

- Provides 1-way authentication
- No prior negotiation assumed
- Option payload: 32 bit authentication scheme, followed by scheme’s data.
- Option length field >2.
- Reserved:
  - 1 SPKI self-signed certificate
  - 2 X.509 self-signed certificate
Example: PLANet ANEP

- Well-known UDP/IP Port for ANEP

![Diagram showing ANTS, PLAN, Netscript pointing to ANEP Port, UDP Protocol, and IP over subnets.]
ANEP is not the end, a way to get going
SwitchWare, ANTS, Netscript operate ANEP
Interoperability using existing infrastructure