Path-Aware Semantic Addressing (PASA) for Low power and Lossy Networks

draft-ietf-6lo-path-aware-semantic-addressing-00
draft-ietf-6lo-path-aware-semantic-addressing-01
draft-ietf-6lo-path-aware-semantic-addressing-02

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Path-Aware Semantic Addressing (PASA) for Low power and Lossy Networks
draft-ietf-6lo-path-aware-semantic-addressing-02

draft-ietf-6lo-path-aware-semantic-address-01.txt
May 2023
Main changes: Security Considerations

draft-ietf-6lo-path-aware-semantic-address-02.txt
July 2023
Main changes: Solving bits conflict in EARO option
Updates since -00 revision in a nutshell

- Restructure the section for more logical flow
- Update on the EARO format
- Added a *real* security considerations section
- Added Privacy Considerations Section
- Some text refinement
  - Including explicit text about updating RFC 8505
PASA Address Allocation

OLD
5. PASA Allocation ........................................... 12
   5.1. PASA Addresses and IPv6 Addresses ............... 15
   5.2. Limitation of Number of Child Nodes ............. 16

NEW
5. PASA Address Allocation ................................. 13
   5.1. Tree Allocation Function (TAF) ..................... 13
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   5.3. PASA TAF Addresses and IPv6 Addresses .......... 17
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• Better highlight the Tree Allocation Function
  • Including renaming so to point out the “tree” approach
• Grouped together and improved text about limitation of TAF
• Renamed section “PASA TAF Addresses and IPv6 Addresses”
  • Different AF have different address structure hence a different way go from PASA addresses to full IPv6 addresses and vice-versa
• Grouped and reworked text about alternative allocation functions
Security Considerations

• Derived Security Considerations

  • RFC4944, RFC6282, RFC3818, RFC 6775, RFC8505
    • Link layer security SHOULD be applied
    • Recommendations Section 7 RFC8505 SHOULD be applied

• Depending on the Allocation Function the number of available addresses may be limited
  • Cf. Section 5.2

• A rouge node may leverage on this knowledge to carry out address exhaustion attacks
  • Impersonating different nodes performing multiple registrations
Privacy Considerations

• Algorithmically built addresses may reveal topology information outside the PASA domain.

• Tree Allocation Function (TAF) reveals the path between the root and a node.

• For instance:
  • 2001:db8::2B/64
  • 0x2B in binary form is 101011
  • Trailing bit 1 => PASA Host
  • Parent’s address 1010
  • Parent of 1010 is 10
  • 10 is directly connected to the root

• To avoid this kind of exposure solutions like NAT66 [RFC6296] can be used.
Extended Address Registration Option Prefix/Multicast Registration

draft-ietf-6lo-multicast-registration-15:

**P**: 2-bit P-Field can take the following values:

<table>
<thead>
<tr>
<th>P-Field Value</th>
<th>Registered Address Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Registration for a Unicast Address</td>
</tr>
<tr>
<td>1</td>
<td>Registration for a Multicast Address</td>
</tr>
<tr>
<td>2</td>
<td>Registration for an Anycast Address</td>
</tr>
<tr>
<td>3</td>
<td>Reserved, MUST be ignored by the receiver</td>
</tr>
</tbody>
</table>

draft-thubert-6lo-prefix-registration-03:

**F**: 1-bit flag; set to 1 to indicate that the sender expects other routers to forward packets to self when the packets are sourced with the registered prefix.
PASA Extended Address Registration Option in -00

PASA bit: If set the message is requesting/delivering a PASA address

Host bit: If set the node is acting as PASA Host
### Extended Address Registration Option Conflict -00

```
| P | P | I | R | T | TID | Registration Lifetime |
```

**Registration Ownership Verifier**

```
| Type | Length | Status | Opaque |
```

```
| Rsc | P | H | I | R | T | TID | Registration Lifetime |
```

**Registration Ownership Verifier (ROVR)**

Even names conflict ...

PASA EARO Format -00 revision
PASA Extended Address Registration Option from -00 to -01

- **Old:**

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---------------------------------------------+
| Type | Length | Status | Opaque |
+---------------------------------------------+
| Rsd | P | H | I | R | T | TID | Registration Lifetime |
+---------------------------------------------+
\[...
Registration Ownership Verifier (ROVR) ...
+---------------------------------------------+
```

- **New:**

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---------------------------------------------+
| Type | Length | Status | Opaque |
+---------------------------------------------+
| P | H | Rsd | I | R | T | TID | Registration Lifetime |
+---------------------------------------------+
\[...
Registration Ownership Verifier (ROVR) ...
+---------------------------------------------+
```
Extended Address Registration Option Conflict in -01

PASA EARO Format -01 revision

Still one bit conflict
Updates since -01 revision in a nutshell

- Added definition of terms
- Some renaming to better indicate that it is about “addresses”
- Some changes in the structure to group all operations first and message format afterwards
- New PASA support signaling
Definition of Terms

3. Definition of Terms

PASA Root: The PASA root node is the router responsible for the management of the whole PASA network and routing/forwarding both internal and external traffic. It uses the Address Allocation Function (AAF) and performs the address assignment for its children. The root node functions as gateway between the PASA domain and the Internet, acting as what [RFC8505] names 6LBR (6LowPAN Border Router).

PASA Router: A PASA Router is an internal node, different from the PASA Root, acting as a router, hence as what [RFC8505] names 6LR (6LowPAN Router). Similar to the PASA Root, it uses the address Allocation Function (AF) and performs the address assignment for its children.

PASA Host: A PASA Host is a node with no children (i.e., a leaf), it is what [RFC8505] names 6LN (6LowPAN Node). This node does not perform the address Allocation Function. It merely request an address to its selected parent.

Address Allocation Function (AAF): The Address Allocation Function (AAF) is an implementation of the algorithm used by PASA Root and PASA Routers to assign an address to their children.

• Main terms where defined in the “Architectural Overview” section
• For clarity they have been put in a separate section and text in “Architectural Overview” section revised accordingly

• Allocation Function now renamed “Address Allocation Function” to better express what it does
• Text throughout the document updated accordingly
New Structure

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- PASA operations description
- Format of the different pieces
  - 6LoRH/EARO/6CIO
Signaling PASA Capability

- Using existing machinery..

- 6LoWPAN Capability Indication Option (6CIO)
  - B-bit: Border Router
  - L-bit: Router

- Use new bit to indicate if the node supports PASA
  - A-bit: Nodes support PASA
    - “A” as for Algorithmically Assigned Addresses
      - (P-bit was already gone…)
  - If A is set:
    - B-bit set to indicate node is a PASA Root
    - L-bit set to indicate node is a PASA Router
    - B-bit and L-bit reset => PASA Node
  - H bit in the EARO message not needed anymore
• At PASA node Bootstrap:

1. Node sends Multicast Router Solicitation
2. Node selects as parent one of the nodes responding with a Router Advertisement
   • FCFS may be sufficient...
3. Node sends Neighbor Solicitation with EARO option to register Link-Local Address
   • P-bit set to indicate it is requesting a PASA address as well
4. Selected Parent to send back Neighbor Advertisement with EARO option
   • Status=0 success
   • P-bit returned unchanged
   • PASA address appended to returning the EARO option
5. Finalizing: child MUST register PASA address (without using P-bit)
   • Necessary to be inline with Sec. 5.6 RFC 8505
   • Also signaling that child node accepted the address

• One single bit used for PASA address configuration
  • Bits conflict solved!
    • (We still need a new name ... may be A-bit?)
Next Steps

• Core stable
  • Any feedback welcome

• Multicast Considerations
  • To be done for next revision

• DAD Considerations
  • With TAAF no duplicate addresses by construction

THANKS!