Transmission of SCHC-compressed packets over IEEE 802.15.4 networks

draft-ietf-6lo-schc-15dot4-02

Carles Gomez  
Universitat Politècnica de Catalunya (UPC)  
carles.gomez@upc.edu

Ana Minaburo  
Consultant  
anaminaburo@gmail.com

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Introduction

This document

Traditional
CoAP, other
UDP, other
IPv6
6LoWPAN HC
6LoWPAN Frag
802.15.4

Main goal
CoAP, other
UDP, other
IPv6
SCHC HC
6LoWPAN Frag
802.15.4

Transition
CoAP
UDP
SCHC HC
IPv6
6LoWPAN HC
6LoWPAN Frag
802.15.4

SCHC exploits a priori knowledge of header field values
Status

• WG adoption
  • draft-ietf-6lo-schc-15dot4-00
    – Same content as draft-gomez-6lo-schc-15dot4-05
  • In January 2023

• Version -02
  • Several additions and updates
  • One coauthor, now a contributor
    – Flavien Moullec (had joined in -01)
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4.3. Pointer-based, R.O. frame format

- SCHC Pointer Dispatch

- Additional 6LoWPAN Dispatch Type (page 0):
  - Bit pattern 01000101 (to be confirmed by IANA)
  - Indicate that this dispatch is followed by the SCHC Pointer
    - Allows all RuleIDs (starting by 1 or by 0) after the SCHC Dispatch
4.3. Pointer-based, R.O. frame format

- SCHC Pointer format:
  - OLD:
  - NEW:
    - Byte-aligned
    - Allows to represent a full 128-bit IPv6 destination address (if needed)
Appendix A. Header compr. examples (I/II)

• A.1. Single-hop or Straightforward Route-Over
  – IPv6/UDP uplink packet

• A.2. Tunneled, RPL-based Route-Over
  – TO-DO

• A.3. Pointer-based Route-Over
  – IPv6/UDP uplink packet

• A.4. Mesh-Under
  – TO-DO

• A.5. Enabling the transition protocol stack
  – IPv6/UDP/CoAP uplink packet
Appendix A. Header compr. examples (II/II)

- A.1. Single-hop or Straightforward Route-Over

Uncompressed IPv6/UDP packet:

```
60 00 00 00 00 17 00 40
FD 00 00 00 00 00 00 00
02 02 02 02 02 02 02 02
20 01 00 00 00 00 00 00
00 00 00 00 00 00 00 01
22 3D 16 2E 00 OF 33 68
68 65 6C 6C 6F 20 31
```

55 bytes

Compression (RuleID 0x20)

SCHC Dispatch

SCHC-compressed packet:

```
44 20 02 02 00 02 00 02
00 02 58 65 6C 6C 6F 20
31
```

17 bytes
Appendix B. Analysis of RO multihop approaches (I/III)

• Straightforward RO approach:
  – Header overhead: 1 byte
  – All nodes (incl. intermediate nodes) must store all the Rules in use in the whole network
  – Suitable for rather small and static networks

• Tunneled, RPL-based RO approach:
  – Header overhead: 2 bytes + variable part
    • Variable part: ≥ 6 bytes (uplink); 12 bytes, 16 bytes... (downlink)
  – A node only stores the Rules for the communications it is involved in as an endpoint
    • Reduces memory requirements and the impact of context updates (if any)
  – Scalable with network size
  – Requires RPL non-storing mode
  – Intranetwork communication requires traversing the root node (might not be necessarily optimal)
Appendix B. Analysis of RO multihop approaches (II/III)

• Pointer-based RO approach:
  – Header overhead: 3 bytes + variable part
  – Variable part is the IPv6 destination address compression residue:
    • Could be 0 bytes in special cases (full address known beforehand)
    • Could be 2-8 bytes in intranetwork communications (prefix known)
    • Could be 16 bytes in communications with external nodes (if several possible destination prefixes)
  – A node only stores the Rules for the communications it is involved in as an endpoint
    • Reduces memory requirements and the impact of context updates (if any)
  – Scalable with network size
  – Does not require RPL
  – Intranetwork communication: not constrained to traversing a root node
Appendix B. Analysis of RO multihop approaches (III/III)

• Best fit:
  – Small networks
    • Straightforward
  – Larger networks
    • Tunneled, RPL-based
      – Communication with (several) external networks
    • Pointer-based
      – Intranetwork communication + special cases of external comm.
Question 1

• Keep or reduce the number of multihop RO approaches?
  • Currently, 3 existing approaches

• Authors’ opinion:
  • Enable all of them:
    – Relatively complementary
    – The most suitable one can be chosen for each deployment

• Thoughts?
Question 2

• **IEEE 802.15.4-specific document or generic document?**
  • Currently, IEEE 802.15.4-specific

• **Authors’ opinion:**
  • IEEE 802.15.4-specific is more straightforward
    – Well defined scope

• **Observations:**
  • IEEE 802.15.4-specific doc may be the basis for other similar documents focusing on other similar technologies
  • If generic approach, then one technology-specific document is needed for each technology of interest
    – In addition to the base document

• **Thoughts?**
Comments/Questions?

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Universitat Politècnica de Catalunya (UPC)
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Consultant
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Introduction

• IPv6/UDP/CoAP header size

<table>
<thead>
<tr>
<th></th>
<th>IPv6/UDP (bytes)</th>
<th>CoAP (bytes)</th>
<th>TOTAL (bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a)</td>
<td>b)</td>
<td>a)</td>
</tr>
<tr>
<td>No compression</td>
<td>48</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>6Lo(WPAN) - RFC 6282</td>
<td>7</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>SCHC - RFC 8724, 8824</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Assumptions:
- Best case, global addr.
- CoAP
  a) No header options
  b) Table 6, RFC 8824

• SCHC: static context, a priori knowledge of header field values

• Theoretical battery lifetime improvement over IEEE 802.15.4 by a factor up to >2
  • Actual improvement will be lower, depending on device HW, MAC/adaptation/application layer settings, payload size, network topology, etc.
Introduction (II)

- Maximum battery lifetime improvement factor
  - Short MAC addresses, intra-PAN
  - E.g. a battery-operated sensor that periodically sends a message over IEEE 802.15.4

![Graph showing maximum improvement factor vs. CoAP payload size](chart)

*NOTE: actual improvement will be lower*