LPWAN WG

WG Chairs:
Alexander Pelov a@ackl.io
Pascal Thubert pthubert@cisco.com

AD: Eric Vyncke
<evyncke@cisco.com>

LPWAN@IETF112

IETF 112, Virtual, November 9th, 2021
Note Well

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- **BCP 9** (Internet Standards Process)
- **BCP 25** (Working Group processes)
- **BCP 25** (Anti-Harassment Procedures)
- **BCP 54** (Code of Conduct)
- **BCP 78** (Copyright)
- **BCP 79** (Patents, Participation)

Reminder:

Minutes are taken *
This meeting is recorded **
Presence is logged ***

* All: Please contribute online to the minutes at: https://codimd.iertf.org/notes-iertf-112-lpwan
** Recordings and Minutes are public and may be subject to discovery in the event of litigation
*** Based on Meetecho Attendance Record. You can log once and only once to each session.
Minute takers, jabber scribes

• Minutes
  – CodiMD: https://codimd.ietf.org/notes-ietf-112-lpwan
  – Minute takers volunteers?

• Remote participation
  – Meetecho: https://meetings.conf.meetecho.com/ietf112/?group=lpwan&short=&item=1

• Mailing list: lp-wan@ietf.org
  – To subscribe: https://www.ietf.org/mailman/listinfo/lp-wan

• Meeting materials: https://datatracker.ietf.org/meeting/112/agenda/lpwan-drafts.pdf
# Agenda bashing

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Duration</th>
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<tbody>
<tr>
<td>14:30</td>
<td>Opening, agenda bashing (Chairs)</td>
<td>5mn</td>
</tr>
<tr>
<td></td>
<td>• Note-Well, Scribes, Agenda Bashing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Status of drafts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Presenters: The Chairs</td>
<td></td>
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<tr>
<td>14:35</td>
<td>LPWAN Architecture and general newcomer presentation</td>
<td>5mn</td>
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<tr>
<td></td>
<td>• Presenter: Alexander Pelov</td>
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<td></td>
<td>• Associated drafts: draft-ietf-lpwan-architecture</td>
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<td>14:40</td>
<td>Yang Data Model for SCHC</td>
<td>15mn</td>
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<td>• Presenter: Laurent Toutain</td>
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<tr>
<td></td>
<td>• Associated drafts: draft-ietf-lpwan-schc-yang-data-model</td>
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<tr>
<td>14:55</td>
<td>SCHC-over-SigFox</td>
<td>15mn</td>
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<tr>
<td></td>
<td>• Presenters: Juan Carlos Zuniga / Sergio Aguilar</td>
<td></td>
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<tr>
<td></td>
<td>• Associated drafts: draft-ietf-lpwan-schc-over-Sigfox</td>
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<td>• draft-ietf-lpwan-schc-compound-ack</td>
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## Agenda bashing (cont.)

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<tr>
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<tr>
<td>15:10</td>
<td>SCHC-over-NBIOT</td>
<td>Ana Minaburo</td>
<td>10mn</td>
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<td>15:20</td>
<td>SCHC adoption within the LoRa Alliance</td>
<td>Dominique Barthel</td>
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<td>15:25</td>
<td>Future of SCHC-over-PPP</td>
<td>Pascal Thubert</td>
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<td>Meetecho ends</td>
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## Milestones

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<tr>
<th>Date</th>
<th>Milestone</th>
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<tr>
<td>Feb 2022</td>
<td>Produce a Standards Track document for SCHC over NBIOT</td>
<td>draft-ietf-lpwan-schc-over-nbiot</td>
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<td></td>
<td>Produce a Standards Track document to enable operations, administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and maintenance (OAM) to the LPWAN device, including support for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>delayed or proxied liveness verification (Ping)</td>
<td></td>
</tr>
<tr>
<td>Oct 2021</td>
<td>Produce a Standards Track document for SCHC over SigFox</td>
<td>draft-ietf-lpwan-schc-over-sigfox</td>
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<tr>
<td>Feb 2021</td>
<td>Produce a Standards Track document to define the generic data models to</td>
<td></td>
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<tr>
<td></td>
<td>formalize the compression and fragmentation contexts for LPWANs</td>
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<tr>
<td>Dec 2020</td>
<td>Produce Standard Track documents to apply SCHC IPv6/UDP over the baseline</td>
<td></td>
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<tr>
<td></td>
<td>technologies</td>
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<td>May 2020</td>
<td>Perform SCHC Maintenance, including enabling SCHC mechanisms for Upper</td>
<td></td>
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<tr>
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<td>layer Protocols</td>
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### Document's advancement

<table>
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<th>Document</th>
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<th>Status</th>
<th>IPR</th>
<th>AD / Shepherd</th>
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<tr>
<td>draft-ietf-lpwan-architecture-00</td>
<td>2021-05-18</td>
<td>I-D Exists</td>
<td></td>
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<tr>
<td>LPWAN Static Context Header Compression (SCHC) Architecture</td>
<td>10 pages</td>
<td>WG Document: Informational</td>
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<td>draft-ietf-lpwan-schc-compound-ack-01</td>
<td>2021-10-18</td>
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<td>SCHC Compound ACK</td>
<td>9 pages</td>
<td>WG Document</td>
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<td>draft-ietf-lpwan-schc-over-nbiot-06</td>
<td>2021-10-25</td>
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<td>SCHC over NB-IoT</td>
<td>21 pages</td>
<td>WG Document Feb 2022</td>
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<td>draft-ietf-lpwan-schc-over-sigfox-08</td>
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<td>Éric Vyncke</td>
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<tr>
<td>SCHC over Sigfox LPWAN</td>
<td>33 pages</td>
<td>WG Document Oct 2021</td>
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<td>draft-ietf-lpwan-schc-yang-data-model-05</td>
<td>2021-09-09</td>
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<tr>
<td>Data Model for Static Context Header Compression (SCHC)</td>
<td>51 pages</td>
<td>WG Document Reviews: yangdoctors</td>
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</tbody>
</table>

LPWAN@IETF112 Agenda / Status: SCHC over PPP work stalled @ intarea WG
LPWAN Architecture and general newcomer presentation

Alexander Pelov (a@ackl.io)
Pascal Thubert (pthubert@cisco.com)
Ana Minaburo (ana@ackl.io)
Low-Power Wide-Area Networks
RFC 8376: LPWAN Architecture
<table>
<thead>
<tr>
<th>Function/Technology</th>
<th>LoRaWAN</th>
<th>NB-IoT</th>
<th>Sigfox</th>
<th>Wi-SUN</th>
<th>IETF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor, Actuator, device, object</td>
<td>End Device</td>
<td>User Equipment</td>
<td>End Point</td>
<td>Leaf Node</td>
<td>Device (DEV)</td>
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<tr>
<td>Transceiver Antenna</td>
<td>Gateway</td>
<td>Evolved Node B</td>
<td>Base Station</td>
<td>Router Node</td>
<td>Radio Gateway</td>
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<tr>
<td>Server</td>
<td>Network Server</td>
<td>PDN GW/ SCEF*</td>
<td>Service Center</td>
<td>Border Router</td>
<td>Network Gateway (NGW)</td>
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<td>Security Server</td>
<td>Join Server</td>
<td>Home Subscriber Server</td>
<td>Registration Authority</td>
<td>Authent. Server</td>
<td>LPWAN- AAA Server</td>
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<tr>
<td>Application</td>
<td>Application Server</td>
<td>Application Server</td>
<td>Network Application</td>
<td>Application (App)</td>
<td></td>
</tr>
</tbody>
</table>
Low-Power Wide-Area Networks

License free
In licensed spectrum

25 mW transmission power
15-50 km rural outdoor
20 years on simple battery
2-3 km urban indoor

Data-over-NAS
Guard-bands
In-band

Duty cycling
Collisions
Acknowledgements

No scheduling
Star topology
ALOHA

Device-initiated com
Huge densities
Asymmetric links
Low throughput

Throughput:
Hundreds bps

Payload Size:
Tens of Bytes

Uplink:
Few Messages

Downlink:
Even fewer messages
SCHC Architecture

• Provide the reference architecture
  – Modes:
    • SCHC Device/SCHC Gateway
    • SCHC Peers

• RFC 8724 and Rules
  – Introduces Yang Data Model
  – Discusses rule creation and update
  – Discusses rule installation and discovery
SCHC Architecture

Device
Application

End-Device

Network
Application

Application
Server
SCHC Architecture

SCHC Device

NGW IP/UDP/CoAP

SCHC Gateway

Application Server

AAA Perf Mgmt

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SCHC Architecture

- SCHC Device
- CORECON
- SCHC Gateway
- Rule Manager
- Rules
- SCHC CD-FR
- AAA
- Perf
- Mgmt

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SCHC Architecture

CORECONF

Rule Manager

Rules

SCHC CD-FR

SCHC Gateway

IP/UDP/CoAP

IP

SCHC Device

AAA

Perf

Mgmt
SCHC Architecture

SCHC Device

- Rule Manager
- Rules
- SCHC CD-FR

SCHC Gateway

- Rule Manager
- Rules
- SCHC CD-FR

CORECONF

IP/UDP/CoAP

IP

SCHC

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21
SCHC Architecture

![SCHC Architecture Diagram](image-url)

- Rule Manager
- Rules
- SCHC CD-FR

Protocol

SCHC Peer

CORECONF

SCHC Peer

Protocol

Rule Manager

Rules

SCHC CD-FR

SCHC Peer

Protocol

Rule Manager

Rules

SCHC CD-FR

SCHC Peer
Next Steps in Architecture

• Steps to Provision and Install a SCHC Device
• Steps to Generate and Publish Rules
• Steps to Provision Network for Device Type
• Steps to Identify Device Type and get Rule Set
• State maintenance in the Network
• Steps to Deprecate (forget) a Device Type
draft-ietf-lpwan-schc-yang-data-model
Version 20210817

Authors:
Laurent Toutain (laurent.toutain@imt-atlantique.fr)
Ana Minaburo (ana@ackl.io)
Cosmetic

Add a « - »

```cpp
leaf dtag-size {
  type uint8;
  default "0";
  description
  "Size in bit of the DTag field";
}

leaf w-size {
  when "not(derived-from(../fragmentation-mode, 'fragmentation-mode-no-ack'))";
  type uint8;
  description
  "Size in bit of the window field";
}

leaf fcn-size {
  type uint8;
  mandatory true;
  description
  "Size in bit of the FCN field";
}
```
Cosmetic

Rename types be use RFC8724 terminology and shorter IDs

```
leaf field-id {
  type schc:field-id-type;
  mandatory true;
  description "Field ID, identify a field in the header with a YANG reference."
}

leaf field-length {
  type schc:field-length-type;
  mandatory true;
  description "Field Length in bit or through a function defined as a YANG
      type."
}

leaf field-position {
  type uint8;
  mandatory true;
  description "Field position in the header is a integer. If the field in
      the header the value is 1, and incremented for each repetition of the
      field. 0 means that the position is not important and order may change when
deployment happens."
}

leaf direction-indicator {
  type schc:direction-indicator-type;
  mandatory true;
  description "Direction Indicator, a YANG reference to say if the packet
      is a downlink or uplink."
}
```
Compression

- Simplify TV (remove union)
Compression

- Rename target-value

```c
841+ list target-value {
842+   key "position";
843+   uses tv-struct;
844+   description
845+     "A list of value to compare with the header field value. If target value
846+     is a singleton, position must be 0. For matching-list, should be consecutive
847+     values starting from 1."
848+
849+ }
```

- « rule » and « entry » are singular
No-Compression

- Add a new type of rule for no-compression
- Remove version field (not in RFC8724)
Fragmentation

• Add l2-word-size

```
    grouping fragmentation-content {
        description
        "This grouping defines the fragmentation parameters for all the modes (No Ack, Ack Always and Ack on Error) specified in RFC 8724."

        leaf l2-word-size {
            type uint8;
            default "8";
            description
            "Size in bit of the layer 2 word";
        }
    }
```
Added Compound Ack

- See draft
Added Compound Ack

```
1002+    leaf bitmap-format {
1003+        type schc:bitmap-format-type;
1004+        when "derived-from(../fragmentation-mode, 'fragmentation-mode-ack-on-error')";
1005+        default "schc:bitmap-RFC8724";
1006+        description
1007+            "How the bitmaps are included in the Ack message."
1008+    }
```
Is it usefull?

- Has disappear from RFC 8724

```plaintext
812  leaf maximum-window-size {
813    type uint16;
814    description "by default \(2^{wsize} - 1\);"
815  }
```
relations between values

- add MUST statement in compression rules

```plaintext
leaf matching-operator {
  type schc:mo-type;
  must ".\target-value or derived-from-or-self(., 'mo-ignore')" {
    error-message "mo-equal, mo-msb and mo-match-mapping require target-value";
    description
    "target-value is not required for mo-ignore";
  }
  must "not (derived-from-or-self(., 'mo-msb')) or .../matching-operator-value" {
    error-message "mo-msb requires length value";
  }
  mandatory true;
  description
  "MO: Matching Operator";
}
```

- derived-from-or-self to match identityref
relations between values

• add WHEN statement in fragmentation rules
Other relations between values?

- Test if MSB arg is shorter than field-length?
  - How to deal with length functions?
- Test is LSB/Map-send CDA with MSB/M-M MO?
  - Not in the spec
- Any other???
Conclusion

• New version is on github lp-wan repository
  – Check against RFC 8724 for fragmentation

• Used yangson to check rules
  – Done during Hackathon
    • Transform a openSCHC JSON file to a JSON following YANG DM
      – For Compression, Fragmentation To Be Done
      – CORECONF TBD
  – OpenSchc version will be released soon.
Example openSCHC

<table>
<thead>
<tr>
<th>Rule 6/3</th>
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<tbody>
<tr>
<td>IPV6.VER</td>
<td>4</td>
</tr>
<tr>
<td>IPV6.TC</td>
<td>8</td>
</tr>
<tr>
<td>IPV6.FL</td>
<td>20</td>
</tr>
<tr>
<td>IPV6.LEN</td>
<td>16</td>
</tr>
<tr>
<td>IPV6.NXT</td>
<td>8</td>
</tr>
<tr>
<td>IPV6.HOP_LMT</td>
<td>8</td>
</tr>
<tr>
<td>IPV6.DEV_PREFIX</td>
<td>64</td>
</tr>
<tr>
<td>IPV6.DEV_IID</td>
<td>64</td>
</tr>
<tr>
<td>IPV6.APP_PREFIX</td>
<td>64</td>
</tr>
<tr>
<td>IPV6.APP_IID</td>
<td>64</td>
</tr>
<tr>
<td>ICMPV6.TYPE</td>
<td>8</td>
</tr>
<tr>
<td>ICMPV6.CODE</td>
<td>8</td>
</tr>
<tr>
<td>ICMPV6.CKSUM</td>
<td>16</td>
</tr>
<tr>
<td>ICMPV6.IDENT</td>
<td>16</td>
</tr>
<tr>
<td>ICMPV6.SEQNO</td>
<td>var</td>
</tr>
</tbody>
</table>
Example openSCHC

```
{ "ietf-schc:schc": { "rule": [{ "comp-decomp-action": 'cda-not-sent',
    "direction-indicator": 'di-bidirectional',
    "field-id": 'fid-ipv6-version',
    "field-length": '4',
    "field-position": 1,
    "matching-operator": 'mo-equal',
    "target-value": [{ "position": 0,
        "value": 'AAY=' }],

    { "comp-decomp-action": 'cda-not-sent',
    "direction-indicator": 'di-bidirectional',
    "field-id": 'fid-ipv6-trafficclass',
    "field-length": '8',
    "field-position": 1,
    "matching-operator": 'mo-equal',
    "target-value": [{ "position": 0,
        "value": 'AA="' }],

    { "comp-decomp-action": 'cda-not-sent',
    "direction-indicator": 'di-bidirectional',
    "field-id": 'fid-ipv6-trafficclass',
    "field-length": '8',
    "field-position": 1,
    "matching-operator": 'mo-equal',
    "target-value": [{ "position": 0,
        "value": 'AA="' }]
    }]
}
```
Dependancies

- RFC 8724: Rule format & IPv6 UDP fields
- RFC 8824: CoAP OSCORE field-id
- OAM: ICMPv6 field-id

- YANG DM: Compound Ack
- Frag Rule format
Tree

```plaintext
module: ietf-schc
  +--rw schc
     +--rw version?  uint64
     +--rw rule* [rule-id-value rule-id-length]
       +--rw rule-id-value  uint32
       +--rw rule-id-length  uint8
       +--rw (nature)?
          +--rw 12-word-size?  uint8
          +--rw direction  schc:direction-indicator-type
          +--rw dtag-size?  uint8
          +--rw w-size?  uint8
          +--rw fcn-size  uint8
          +--rw RCS-algorithm?  RCS-algorithm-type
          +--rw maximum-window-size?  uint16
          +--rw retransmission-timer?  uint64
          +--rw inactivity-timer?  uint64
          +--rw max-ack-requests?  uint8
          +--rw maximum-packet-size?  uint16
          +--rw fragmentation-mode  schc:fragmentation-mode-type
          +--rw (mode)?
             +--rw (no-ack)
             +--rw (ack-always)
             +--rw (ack-on-error)
                +--rw tile-size?  uint8
                +--rw tile-in-All?  schc:all1-data-type
                +--rw ack-behavior?  schc:ack-behavior-type
                +--rw bitmap-format?  schc:bitmap-format-type
          +--rw (compression)
             +--rw entry* [field-id field-position direction-indicator]
                +--rw field-id  schc:field-id-type
                +--rw field-length  schc:field-length-type
                +--rw field-position  uint8
                +--rw direction-indicator  schc:direction-indicator-type
                +--rw target-value* [position]
                   +--rw value?  binary
                   +--rw position  uint16
                +--rw matching-operator  schc:matching-operator-type
                   +--rw matching-operator-value* [position]
                      +--rw value?  binary
                      +--rw position  uint16
                   +--rw comp-decomp-action  schc:comp-decomp-action-type
                   +--rw comp-decomp-action-value* [position]
                      +--rw value?  binary
                      +--rw position  uint16
```
draft-ietf-lpwan-schc-over-sigfox-08

Juan Carlos Zúñiga (Sigfox), Carles Gómez, Sergio Aguilar (UPC),
Laurent Toutain (IMT-Atlantique),
Sandra Cáspedes, Diego Wistuba (U Chile)
Draft updates since IETF 111

• rev 05 -> 06
  • SCHC Compound ACK mechanism added
• rev 06 -> 07
  • SCHC Compound ACK split as generic mechanism for all LPWANs
  • Yang model description added to SCHC Compound ACK
• rev 07 -> 08
  • Added normative reference to SCHC Compound ACK usage for SCHC/Sigfox, together with signaling examples
  • SCHC-Abort definitions added
Hackathon – SCHC/Sigfox

• Objectives:
  • Use SCHC over Sigfox draft in a ”real case” scenario
  • Mini weather station: Measure temperature and humidity
  • Send JSON file with measured data from Sigfox Device

• Equipment:
  • LoPy4
  • Pysense

• Codebase
  • SCHC over Sigfox Project in github
  • url: https://github.com/schc-over-sigfox
Implementation and Results

- LoPy4 + Pysense
  - Two threads
  - One thread in charge of sensing
  - Second thread handles SCHC over Sigfox (i.e., fragmentation, transmissions, etc.)
  - Both threads are connected using a list
- JSON file format:
  1- `{"temp": XXX, "hum": YYY, "bat_vol": ZZZ, "light": ABC}
  2- `{"temp": XXX, "hum": YYY}
- SCHC Fragments per JSON
  - 1- 7 SCHC Fragments (1 window)
  - 2- 4 SCHC Fragments

Results

**Case 1**

- W: 0
- 001 - , "light": 58.64736
- 010 - , "hum": 61903
- 100 - "temp": 21.
- 101 - 4.872366,
- 110 - {"bat_vol": [4, 5]}

**Case 2**

- W: 0
- 100 - p": 21.8871
- 101 - 54949, "tem
- 110 - {"hum": 57,
- 111 - 5}

**Payload**

1. {"hum": 63.08279, "temp": 15.84892)
2. {"hum": 53.7601, "temp": 19.52763}
3. {"hum": 45.95958, "temp": 21.59757}
4. {"hum": 48.65317, "temp": 21.55467}

**Temperature**

**Humidity**
Next steps

• Verify latest details on implementation

• Test one more use case (e.g. asset tracking)
Thanks!
draft-ietf-lpwan-schc-compound-ack-01

Juan Carlos Zúñiga (Sigfox), Carles Gómez, Sergio Aguilar (UPC),
Laurent Toutain (IMT-Atlantique),
Sandra Céspedes, Diego Wistuba (U Chile)
Draft history

• SCHC Compound ACK message definition and examples added to draft-ietf-schc-over-Sigfox rev 06

• WG decision to make compound ACK mechanism generic for all LPWAN technologies on a standalone draft

• Implementation of SCHC Compound ACK tested over Sigfox

• draft-ietf-lpwan-schc-compound-ack-00 posted in July’21, and revised in Oct’21

• WG Last Call held in October-November 2021
Backup slides

• SCHC Compound ACK Definition

• Message format

• Message sequence examples
SCHC Compound ACK – Definition

• The SCHC Compound ACK:
  • Only reports windows with fragment losses
  • Includes W field for each bitmap
  • May not fit all bitmaps of all windows for a SCHC packet
  • Has variable size
  • Is compatible with the SCHC Receiver Abort and ACK Failure message formats (RFC8724)

• ACK messages reduction when using SCHC Compound ACK:
  • SCHC Compound ACK messages = Regular SCHC ACKs – (# of windows – 1)

Example

```
SCHC Packet: 14 tiles
Window size: 7 tiles

2 SCHC ACK Messages
```

```
Sender
|------W=0, FCN=6------|
|------W=0, FCN=5------|
|------W=0, FCN=4------|
|------W=0, FCN=3------|
|------W=0, FCN=2-X-----|
|------W=0, FCN=1------|
|------W=0, FCN=0------|  Bitmap: 111011
(no ACK - no DL Enable)
|------W=1, FCN=6------|
|------W=1, FCN=5------|
|------W=1, FCN=4------|
|------W=1, FCN=3------|
|------W=1, FCN=2------|
|------W=1, FCN=1-X-----|

Receiver

[<- SCHC Compound ACK]  W=0,111011 - W=1,111101

[-----W=0, FCN=2------] W=0 completed
[-----W=1, FCN=1------] W=1 completed

DL Enable

[-----W=1, FCN=7------]  Bitmap: 111101

[<- ACK, C=1, W=1 --]
(End)
```
SCHC Compound ACK – Message Format

- When ACK-on-Error mode is used for UL fragmentation, SCHC Compound ACKs MUST be used the in the downlink responses
- W + Bitmap groups MUST be ordered from the smallest window number to the largest
Example – SCHC Packet 28 tiles – Normal SCHC ACK

5 SCHC ACK Messages

W = 00

 Sender          Receiver
|----- W=0, FCN=6------>
|----- W=0, FCN=5------>
|----- W=0, FCN=4------>
|----- W=0, FCN=3------>
|----- W=0, FCN=2------>
|----- W=0, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=0, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=1, FCN=6------>
|----- W=1, FCN=5------>
|----- W=1, FCN=4------>
|----- W=1, FCN=3------>
|----- W=1, FCN=2------>
|----- W=1, FCN=1------>

W = 01

 Sender          Receiver
|----- W=0, FCN=2------>

 DL Enable

 <--- ACK, W=1, C=0 --- Bitmap: 111101

 (no ACK)

|----- W=1, FCN=6------>
|----- W=1, FCN=5------>
|----- W=1, FCN=4------>
|----- W=1, FCN=3------>
|----- W=1, FCN=2------>
|----- W=1, FCN=1------>

W = 11

 Sender          Receiver
|----- W=1, FCN=6------>
|----- W=1, FCN=5------>

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>

W = 10

 DL Enable

 <--- ACK, W=2, C=0 --- Bitmap: 1101111

 (no ACK)

|----- W=2, FCN=6------>
|----- W=2, FCN=5------>
|----- W=2, FCN=4------>
|----- W=2, FCN=3------>
|----- W=2, FCN=2------>
|----- W=2, FCN=1------>

W = 11

 DL Enable

 <--- ACK, W=3, C=0 --- Bitmap: 1110111

 (no ACK)

|----- W=3, FCN=6------>
|----- W=3, FCN=5------>
|----- W=3, FCN=4------>
|----- W=3, FCN=3------>
|----- W=3, FCN=2------>
|----- W=3, FCN=1------>
Example – SCHC Packet 28 tiles – Compound ACK

2 SCHC ACK Messages

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=0</td>
<td>FCN=6</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=5</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=4</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=3</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=2</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=1</td>
</tr>
</tbody>
</table>
| W=0    | FCN=0    | Bitmap: 111011

(no ACK – no DL Enable)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=1</td>
<td>FCN=6</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=5</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=4</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=3</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=2</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=1</td>
</tr>
</tbody>
</table>
| W=1    | FCN=0    | Bitmap: 111101

(no ACK – no DL Enable)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=2</td>
<td>FCN=6</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=5</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=4</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=3</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=2</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=1</td>
</tr>
</tbody>
</table>
| W=2    | FCN=0    | Bitmap: 110111

(Bitmap: 110111)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=3</td>
<td>FCN=6</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=5</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=4</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=3</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=2</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=1</td>
</tr>
</tbody>
</table>
| W=3    | FCN=0    | Bitmap: 111011

(Bitmap: 111011)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=0</td>
<td>W=1, W=2, W=3</td>
</tr>
<tr>
<td>W=0</td>
<td>FCN=2</td>
</tr>
<tr>
<td>W=1</td>
<td>FCN=1</td>
</tr>
<tr>
<td>W=2</td>
<td>FCN=4</td>
</tr>
<tr>
<td>W=3</td>
<td>FCN=2</td>
</tr>
</tbody>
</table>

(Bitmap: 111011)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=3</td>
<td>FCN=7</td>
</tr>
</tbody>
</table>

(Bitmap: 111011)

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>W=3</td>
<td>C=1</td>
</tr>
</tbody>
</table>

(Bitmap: 111101)

Retransmission
Thanks!
draft-ietf-lpwan-schc-over-nbiot-06

Authors:
Edgar Ramos
Ana Minaburo
Reviews

• Reviews from ML
  • Thanks to Ivaylo Petrov & Laurent Toutain for your inputs
Principal changements

• Nits

• Terminology
  • Device
  • RGW-eNB
  • NGW-MME
  • NGW-SGSN
  • NGW-PGW
  • NGW-SCEF
NB-IoT Architecture
Thank you

• Last Call?
RFC 8724, 9011 adoption at LoRa Alliance

Authors:
Dominique Barthel <dominique.barthel@orange.com>
Olivier Gimenez <ogimenez@semtech.com>
IPv6 support at LoRa Alliance

• First use case is DLMS over LoRaWAN
  – DLMS is mainly energy metering application protocol
  – Reuse of existing DLMS/UDP/IPv6 stack, with SCHC/LoRAWAN underneath

• IPv6_over_LoRaWAN Technical Specification being completed
  – Editors: Acklio, Semtech, IMT Atlantique
  – Contributors: 10 companies/institutions
  – Mandates compliance with RFC8724, 9011 and
  – Recommends to pick compression rule with min. Compression Residue
  – Recommends shorter Inactivity and Retransmission Timers than RFC9011 defaults, based on application
Next

• Vote at the Technical Committee meeting Nov 16\textsuperscript{th}
• Write DLMS/UDP/IPv6/LoRaWAN certification document
• Discussions with CSA (formerly Zigbee Alliance) on LoRaWAN in Connected Home over IP (Matter)
draft-thubert-intarea-schc-over-ppp

Authors:
Pascal Thubert <pthubert@cisco.com>
• SCHC over PPP (and then PPP over foo)
• Enables SCHC over
  – Serial, 3GPP
  – Ethernet with PPPoE, Wi-Fi with Ethernet
• Signals
  – A new compression for PPP (Updates RFC 5172)
  – The URL of the data model for the compression
  – Dependency on draft-ietf-lpwan-schc-yang-data-model
Draft status: Stable

- 03 expired
- No discussion at INT AREA
- Co Authors?
- Add applicability statement?
- Possible extensions?