LPWAN WG

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

AD: Eric Vyncke
<evyncke@cisco.com>
Note Well

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Definitive information is in the documents listed below and other IETF BCPs. For advice, please talk to WG chairs or ADs:

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)

https://www.ietf.org/privacy-policy/ (Privacy Policy)
Reminder:

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

* All: Please contribute online to the minutes at: https://codimd.ietf.org/notes-ietf-110-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-110-lpwan
  – Minute takers volunteers?

• Remote participation
  – Meetecho: https://meetings.conf.meetecho.com/ietf110/?group=lpwan&short=&item=1
  – Jabber: lpwan@jabber.ietf.org
    • Jabber scribe volunteers?

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

• Meeting materials: https://datatracker.ietf.org/meeting/110/session/lpwan
Agenda bashing

15:30 Opening, agenda bashing (Chairs)  5mn
  • Note-Well, Scribes, Agenda Bashing
  • Status of drafts
  • Presenters: The Chairs

15:35 LPWAN Architecture and general newcomer presentation  15mn
  • Presenter: Alexander Pelov
  • Associated drafts: draft-pelov-lpwan-architecture

15:50 Yang Data Model for SCHC  10mn
  • Presenter: Laurent Toutain
  • Associated drafts: draft-ietf-lpwan-schc-yang-data-model

16:00 New ideas for SCHC-over-SigFox  15mn
  • Presenters: Juan Carlos Zuniga / Sergio Aguilar
  • Associated drafts: draft-ietf-lpwan-schc-over-sigfox
Agenda bashing (cont.)

16:15  CoAP-over-SCHC
  • Presenter: Ana Minaburo
  • Associated drafts: draft-ietf-lpwan-coap-static-context-hc

16:20  SCHC-over-PPP
  • Presenters: Pascal Thubert
  • Associated drafts: draft-thubert-intarea-schc-over-ppp

16:25  AOB

16:30  Meetecho ends
<table>
<thead>
<tr>
<th>Date</th>
<th>Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 2022</td>
<td>Produce a Standards Track document for SCHC over NBIOT</td>
</tr>
<tr>
<td></td>
<td>draft-ietf-lpwan-schc-over-nbiolet</td>
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<td>Oct 2021</td>
<td>Produce a Standards Track document for SCHC over SigFox</td>
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<td>draft-ietf-lpwan-schc-over-sigfox</td>
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<td>Jul 2021</td>
<td>Produce a Standards Track document to enable operations, administration</td>
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<td>and maintenance (OAM) to the LPWAN device, including support for delayed</td>
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<td>or proxied liveness verification (Ping)</td>
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<td>Feb 2021</td>
<td>Produce a Standards Track document to define the generic data models</td>
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<td>to formalize the compression and fragmentation contexts for LPWANs</td>
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<td>Dec 2020</td>
<td>Produce Standard Track documents to apply SCHC IPv6/UDP over the baseline</td>
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<tr>
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<td>technologies</td>
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<td>May 2020</td>
<td>Perform SCHC Maintenance, including enabling SCHC mechanisms for Upper</td>
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<td>layer Protocols</td>
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### Document's advancement

<table>
<thead>
<tr>
<th>Draft</th>
<th>Title</th>
<th>Date</th>
<th>Status</th>
<th>IPR</th>
<th>AD / Shepherd</th>
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<tr>
<td>draft-ietf-lpwanschc-00</td>
<td>&quot;OAM for LPWAN using Static Context Header Compression (SCHC)&quot;</td>
<td>2020-11-02</td>
<td>I-D Exists</td>
<td>14 pages</td>
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<td>draft-bethel-lpwanschc-00</td>
<td>&quot;Static Context Header Compression (SCHC) Architecture&quot;</td>
<td>2021-01-19</td>
<td>I-D Exists</td>
<td>6 pages</td>
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### Related Internet-Drafts (2 hits)

<table>
<thead>
<tr>
<th>RFCs (2 hits)</th>
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<tr>
<td>RFC 8576 (was draft-ietf-lpwanschc)</td>
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<tr>
<td>Informational RFC</td>
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<tr>
<td>Suresh Krishnan</td>
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<tr>
<td>Alexander Pelov</td>
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</table>

### SCHC over PPP work transferred to intarea WG

**EDIT = Awaiting editing or being edited**

**RFC-EDITOR = Undergoing final internal review before AUTH48**
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
Low-Power Wide-Area Networks

25 mW transmission power

20 years on simple battery
Low-Power Wide-Area Networks

15-50 km rural outdoor
2-3 km urban indoor
Low-Power Wide-Area Networks

- No scheduling
- Star topology
- ALOHA
- Device-initiated com
- Huge densities
- Asymmetric links
- Low throughput
Low-Power Wide-Area Networks

License free

In licensed spectrum

Duty cycling

Collisions

Acknowledgements

Data-over-NAS

Guard-bands

In-band
Collisions

License free

Duty cycling

In licensed spectrum

Acknowledgements

Guard-bands

Star topology

Data-over-NAS

ALOHA

25 mW transmission power

20 years on simple battery

15-50 km rural outdoor

2-3 km urban indoor

Device-initiated com

Huge densities

Asymmetric links

Low throughput

100 bps

(50 kbps max)

12 byte payload

(typically 50 bytes)

140 messages

uplink

4 messages

downlink

X 1%
RFCC 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>
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<td>Sensor, Actuator, device, object</td>
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<tr>
<td>End Device</td>
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<td>User Equipment</td>
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<td>End Point</td>
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<td>Leaf Node</td>
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<td>Device (DEV)</td>
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<td>Gateway</td>
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<td>Radio Gateway</td>
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<td>Server</td>
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<td>Service Center</td>
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<td>Border Router</td>
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<td>Join Server</td>
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<td>Home Subscriber Server</td>
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<td>Application (App)</td>
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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

LPWAN
Radio Gateways (RGW)
SCHC Architecture

Network Gateway (NGW)
SCHC Architecture

- SCHC Device
- SCHC Gateway
- NGW (Network Gateway)
- IP (Internet Protocol)
- IP/UDP/CoAP

AAA, Perf, Mgmt
SCHC Architecture

SCHC Device

CORECONE

SCHC Gateway

Rule Manager

Rules

SCHC CD-FR

IP

AAA

Perf

Mgmt
SCHC Architecture

SCHC Device

SCHC Gateway

Rule Manager

Rules

SCHC CD-FR

IP

IP/UDP/CoAP

CORECONF

AAA

Perf

Mgmt
SCHC Architecture

SCHC Device

- Rule Manager
- Rules
- SCHC CD-FR

SCHC Gateway

- Rule Manager
- Rules
- SCHC CD-FR

IP/UDP/CoAP

CORECONF
SCHC Architecture

Protocol

SCHC Peer

Rule Manager
Rules
SCHC CD-FR

CORECONF

Rule Manager
Rules
SCHC CD-FR

Protocol

SCHC Peer
Example of Network-level SCHC
Example of Network-level SCHC

IP Stack

Rule Manager

Rules

SCHC CD-FR

CORECONF/OSCORE

CRUD

Compressed Packets

SCHC Peer / SCHC Device

LPWAN@IETF110

SCHC Peer / SCHC Gateway
Example of Network-level SCHC

- Rule Manager
- Rules
- SCHC CD-FR
- IP Stack
- Application

CORECONF/OSCORE

CRUD

Compressed Packets

SCHC Peer / SCHC Device

SCHC Peer / SCHC Gateway
What’s new from -03

• Clarifications

• Goal :
  – Define a way to uniquely refers to an ID
    • Field ID
    • MO, CDA
    • Fragmentation parameter

  – Define a structure for rules
    • Inter exchange (see architecture draft)
    • Not internal representation

• Don’t focus on size, this is an abstract representation:
  – CORECONF will help to reduce this size
Identifiers
// -- RCS algorithm types

identity RCS-algorithm-base-type {
  description "identify which algorithm is used to compute RSC. The algorithm defines also the size of the RSC field."
}

identity RFC8724-RCS {
  description "CRC 32 defined as default RCS in RFC8724."
  base RCS-algorithm-base-type;
}

typedef RCS-algorithm-type {
  type identityref {
    base RCS-algorithm-base-type;
  }
}
Id types:

- **field-id-type**: IPv6, UDP, CoAP, OSCORE, ICMPv6 (56 values)
- **field-length-type**: union int64 and identityref (2 values)
- **direction-indicator-type**: 3 values
- **matching-operator-type**: 4 values
- **comp-decomp-action-type**: 8 values
- **RCS-algorithm-type**: 1 value
- **fragmentation-mode-type**: 3 values
- **ack-behavior-type**: 3 values
- **all1-data-type**: 3 values
Field id

identity /field-id-base-type/fid-icmpv6-checksum
identity /field-id-base-type/fid-icmpv6-code
identity /field-id-base-type/fid-icmpv6-identifier
identity /field-id-base-type/fid-icmpv6-sequence
identity /field-id-base-type/fid-icmpv6-type
identity /field-id-base-type/fid-ipv6-applid
identity /field-id-base-type/fid-ipv6-appprefix
identity /field-id-base-type/fid-ipv6-deviid
identity /field-id-base-type/fid-ipv6-devprefix
identity /field-id-base-type/fid-ipv6-flowlabel
identity /field-id-base-type/fid-ipv6-hoplimit
identity /field-id-base-type/fid-ipv6-nextheader
identity /field-id-base-type/fid-ipv6-payloadlength
identity /field-id-base-type/fid-ipv6-trafficclass
identity /field-id-base-type/fid-ipv6-trafficclass-ds
identity /field-id-base-type/fid-ipv6-trafficclass-ecn
identity /field-id-base-type/fid-ipv6-version
identity /field-id-base-type/fid-udp-app-port
identity /field-id-base-type/fid-udp-checksum
identity /field-id-base-type/fid-udp-dev-port
identity /field-id-base-type/fid-udp-length
Field id: coap

- Removed « payload marker »
- Added OSCORE
- Added ICMPv6
Structures
SCHC Data Model - Frag

module: schc
  ++-rw schc
     ++-rw version?  uint64
     ++-rw rule* [rule-id rule-length]
        ++-rw rule-id    uint32
        ++-rw rule-length uint8
        ++-rw (nature)?
     ++-(fragmentation)
        ++-rw direction   schc:direction-indicator-type
        ++-rw dtagsize?   uint8
        ++-rw wsize?      uint8
        ++-rw fnsize
     ++-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)?
        ++-:(no-ack)
        ++-:(ack-always)
        ++-:(ack-on-error)
        ++-rw tile-size?  uint8
     ++-rw tile-in-All1? schc:all1-data-type
     ++-rw ack-behavior? schc:ack-behavior-type

Not in RFC 8724
Up or down, bi forbiden
Frag header, only FCN is mandatory
Mandatory: 1..max
Optional : 0..max
noAck, AA, AoE
No, Yes, Sender Choice
All0, All1, Always
SCHC Data Model - Compression

Optional?
What’s next

• Draft is stable and has been discussed in interim meetings.

• Ready for Working Group Last Call
draft-ietf-lpwan-schc-over-sigfox-05 &
PySCHC Implementation

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

• Hackathon: Off-line coding between UChile and UPC
  • ACK-on-Error and No-ACK SCHC/Sigfox parameter optimizations
  • Error conditions tested

• Last draft updates (rev 05)
  • Added message sequence examples to explain different ACK-on-Error and No-ACK SCHC/Sigfox scenarios
  • Update co-authors’ list

• Compound SCHC ACK message proposal (see next slides)
Compound SCHC ACK - Introduction

• ACK-on-Error over Sigfox:
  • Errors in intermediate windows “may” generate at least one ACK
  • Errors in the last window generate at least 2 ACKs
  • Sigfox DL payload is fixed to 64 bits
• When errors occur over multiple windows, the number of ACKs can be reduced by reporting losses from several windows with a single ACK
Compound SCHC ACK – Principles and Advantages

• The 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
  • Compatible with SCHC Receiver Abort message format and ACK Failure message format (RFC8724)

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

Example

SCHC Packet: 14 tiles
Window size: 7 tiles
2 SCHC ACK Messages
Compound SCHC ACK – Message Format

• Compound ACK message format (only for ACK Failure messages) with SCHC Fragment losses in all windows:

W = 1

SCHC Packet 14 tiles
Window size: 7 tiles

Fixed, same as RFC8724

W + bitmap groups as windows with losses (that can be fitted)
Compound ACK – Message Format

- W + Bitmap groups are ordered from the smallest window number to the largest.
- The window numbered 00 (if present) must always be between the Rule ID and C bit to avoid confusion with padding bits.

```
[ Rule ID | W | C-0 | Bitmap | W | Bitmap | (P-0) ]
000 00 0 111101 01 111011 42 padding bits
```

W = 0

W = 1

SCHC Packet: 14 tiles
Window size: 7 tiles
Thanks!
Questions? Comments?
Backup slides
Example – SCHC Packet 28 tiles

Window size: 7 tiles
5 SCHC ACK Messages

Sender   Receiver
|-----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-----|

W = 00

<-- ACK, W=0, C=0 -- Bitmap: 111011

(no ACK)

W = 01

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

(no ACK)

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

W = 10

3

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

(no ACK)

W = 11

2

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

(no ACK)

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

W = 12

4

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

(Sender)

<-- ACK, W=3, C=1 --

(End)
### ACK Reduction:

- From 5 ACKs to 2 ACKs

### SCHC Packet 28 tiles

#### Window size: 7 tiles

**2 SCHC ACK Messages**

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="" /></td>
<td><img src="image" alt="" /></td>
</tr>
</tbody>
</table>

*Example – SCHC Packet 28 tiles*

- **W = 00**
  - *From 5 ACKs to 2 ACKs*
  - "Compound ACK"
  - "W = 3, C = 1"

- **W = 01**
  - *From 5 ACKs to 2 ACKs*
  - "Compound ACK"
  - "W = 3, C = 1"

---

*Retransmission*
Compound ACK – SCHC Packet 28 tiles

- $W = 0$
- $W = 1$
- $W = 2$
- $W = 3$

- $W$ + Bitmap groups for all windows with losses
- ACK Reduction
  - Number of windows of the SCHC packet: 4
  - ACK reduction: 3 ACKs

SCHC Packet 28 tiles
Window size: 7 tiles
Example – SCHC Packet: 14 tiles

Window size: 7 tiles
3 SCHC ACK Messages

W = 00
 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------|

Receiver
 |-----W=0, FCN=0------|

Window size: 7 tiles
2 SCHC ACK Messages

W = 01
 Sender
 |-----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------|
 |-----W=1, FCN=1------|

Receiver
 |-----W=1, FCN=7------|

All fragments received

(End)

Retransmission

(End)
Testing Network Architecture

- PySCHC SW
- Pycom (LoPy4)
- Sigfox Network
- Google Cloud *

* [https://cloud.google.com/community/tutorials/sigfox-gw](https://cloud.google.com/community/tutorials/sigfox-gw)
draft-ietf-lpwan-coap-static-context-hc-19

Ana Minaburo (ana@ackl.io)
Laurent Toutain (laurent@imt-atlantique.fr)
Ricardo Andreasen (randreasen@fi.uba.ar)
Status

• New Ballot Position Update: RFC Ed Queue
  • Status: EDIT

• Thanks to Benjamin Kaduk
From version 17 to version 19

• V-16
  • New Section 2, Uses Cases
  • New Section 6, CoAP extensions
  • New Section 4, CoAP header fields Compression
  • New Section 5, CoAP Options

• V-17 & V-18
  • New Section CoAP Options
    • Uri-Path and Uri-Query variable length unit in bytes

• V-19
  • New Security Section
  • Update the Examples for the variable length

• Many Editorial Nits
Next steps

• AUTH48... (RFC9024)?

• Questions?
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
Resulting Packet (no Frag example)
Draft status: Stable

• Need refresh – expires March 26th
• The RuleID for a compression rule is expressed as 2 bytes.
• The first (leftmost) 2 bits of that RuleId MUST be set to 0
• Frag: Only No-Ack mode => no out-of-order packet
  – If used with DetNet => may require PREOF reordering
• The RuleID for a fragmentation rule is expressed as 4 bits
  – Reserved 1111 for NO ACK
• Review from LPWAN cc INT AREA ?
Impact on SCHC Architecture

- PPP creates a peerwise relationship as opposed to device/gateway
- None of the end points own the compression rules
- Both fetch them from the same place through URL
Discussion

- Co Authors?
- Add applicability statement?
- Possible extensions?
AOB ?