Workgroup: LPWAN
Updates: 5172 (if approved)
Published: 21 April 2021
Intended Status: Standards Track
Expires: 23 October 2021
Authors: P. Thubert, Ed.
Cisco Systems

SCHC over PPP

Abstract

This document extends RFC 5172 to signal the use of SCHC as the compression method between a pair of nodes over PPP. Combined with RFC 2516, this enables the use of SCHC over Ethernet and Wi-Fi.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on 23 October 2021.

Table of Contents

1. Introduction

The Point-to-Point Protocol (PPP) [RFC5172] provides a standard method of encapsulating network-layer protocol information over serial (point-to-point and bus) links. "A Method for Transmitting PPP Over Ethernet (PPPoE)" [RFC2516] transports PPP over Ethernet between a pair of nodes. It is compatible with a translating bridge to Wi-Fi, and therefore enables PPP over Wi-Fi as well.

PPP also proposes an extensible Link Control Protocol and a family of Network Control Protocols (NCPs) for establishing and configuring different network-layer protocols. "IP Version 6 over PPP" [RFC5072] specifies the IPv6 Control Protocol (IPV6CP), which is an NCP for a PPP link, and allows for the negotiation of desirable parameters for an IPv6 interface over PPP. "Negotiation for IPv6 Datagram Compression Using IPv6 Control Protocol" [RFC5172] defines the IPv6 datagram compression option that can be negotiated by a node on the link through the IPV6CP.

PPP is not commonly used in Low-Power Wide Area Networks (LPWAN) but the extreme compression techniques that are defined for use in LPWAN may be applicabel to more traditional links where PPP applies.

The "Static Context Header Compression (SCHC) and fragmentation for LPWAN, application to UDP/IPv6" [SCHC] is a new technology that can provide an extreme compression performance but requires a same state to be provisionned on both ends before it can be operated.

The "SCHC Architecture" [I-D.pelov-lpwan-architecture] enables a peer to peer SCHC operation in addition to the classical device to network LPWAN paradigm, e.g., over a PPP connection. To enable SCHC over PPP and therefore Ethernet and Wi-Fi, this specification

extends [RFC5172] to signal SCHC as an additional compression method for use over PPP.

An example use case for SCHC over PPP over Ethernet (SCHCoPPPoE) is to apply SCHC to periodic flows and maintain them at a protocol-independant size and rate. The constant size may be too small for a particular flow or protocol. The SCHC fragmentation can then be used to transport a protocol data unit (PDU) as N compressed SCHC fragments, in which case the effective PDU rate is the TSN frame rate divided by N.

This can be useful to streamline the frames and simplifies the scheduling of Deterministic Networking [DetNet] and Operational Technology (OT) control flows over IEEE Std 802.1 Time-Sensitive Networking (TSN) [IEEE802.1TSNTG] or one of the RAW Technologies [RAW Technologies].

2. BCP 14

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Extending RFC 5172

With this specification, a PPP session defines a vitual link where a SCHC context is established with a particular set of Rules, which is indicated at the set up of the PPP session as follows:

[RFC5172] defines an IPV6CP option called the IPv6-Compression-Protocol Configuration option with a type of 2. The option contains an IPv6-Compression-Protocol field value that indicates a compression protocol and an optional data field as shown in Figure 1:

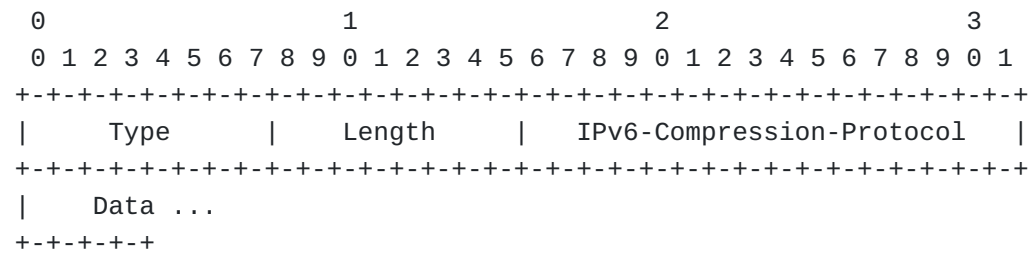

Figure 1: The IPv6-Compression-Protocol Configuration Option

This specification indicates a new IPv6-Compression-Protocol field value for [SCHC] (see Section 5), and enables to transport a Uniform Resource Identifier (URI) [RFC3986] of the set of rules in the optional data. The default format for the set of rules is YANG using the "Data Model for SCHC" [SCHC_DATA_MODEL] encoded in JSON as specified in [RFC7951]. The size of the URL is computed based on the Length of the option as Length-4. If the encoding is asymetrical, the initiator of the session is considered downstream, playing the role of the device in an LPWAN network.

4. Profiling SCHC for high speed links

Appendix D of [SCHC] specifies the profile information that technology specifications such as this must provide. The following section address this requirement.

4.1. Mapping the SCHC Architecture

This specification leverages SCHC between an end point that is an IP Host and possibly a serial DTE (Data Terminal Equipment), and another that is an IP Node (either another IP Host or a Router) and possibly a serial DCE (Data Control Equipment), or a more modern physical or emulated endpoint, e.g., Ethernet devices that echange IP packets over PPPoE.

Both endpoints MUST support the function of SCHC Compressor/ Decompressor (C/D) as shown in Figure 2.

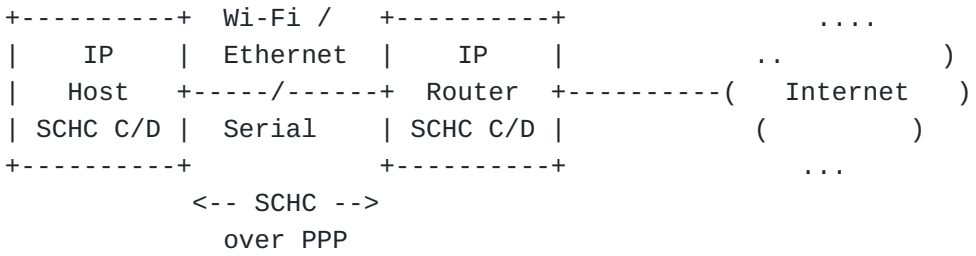

Figure 2: Typical Deployment

The SCHC Fragmenter/Reassembler (F/R) is generally not needed, because the maximum transmission unit (MTU) is expected to be large enough and SCHC only reduces the frame size vs. native IP. But it may be used to obtain a small protocol-independant frame size for the compressed packets, possibly way smaller than MTU.

A context may be generated for a particular upper layer application, such as a control loop using an industrial automation protocol, to protect the particular flow with a DetNet service. The context can

be asymetric, e.g., when connecting a primary and a secondary endpoints, a client and a server, or a programmable logic controller with a sensor or an actuator.

4.2. SCHC Parameters

Compared to typical LPWANs, most serial links and emulations such as PPPoE are very fast and most of the constraints can be alleviated. For this reason, the SCHC profile for PPP is defined as follows:

RuleID numbering scheme: The RuleID for a compression rule is expressed as 2 bytes. The first (leftmost) 2 bits of that RuleId MUST be set to 0 This leaves 14 bits to index the rule. A SCHC compressed packet is always in the form:

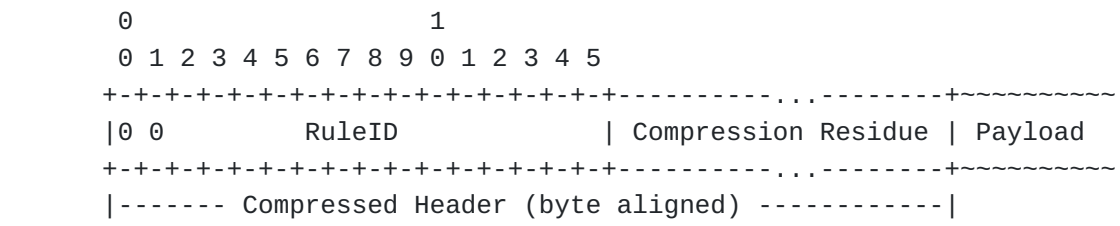

Figure 3: SCHC Compressed Packet

This specification only supports the No-ACK Mode of SCHC fragmentation as specified in section 8.4.1 of [SCHC]. The SCHC Fragment Header is 2 bytes long.

The RuleID for a fragmentation rule is expressed as 4 bits. The bits MUST all set to 1 for a fragmentation rule in No-ACK Mode. The DTag field is 11 bits long (T=11) and the FCN field is one bit (N=1), which is set to 1 on the last fragment as illustrated in Appendix B of [SCHC] and to 0 otherwise. There is no W field (M=0).

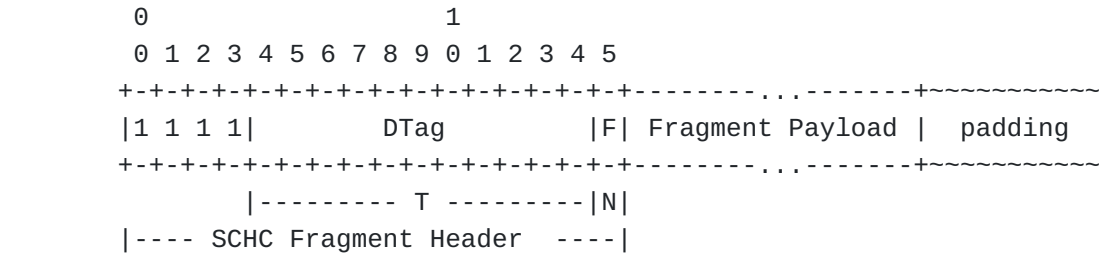

Figure 4: SCHC Fragment

The No-ACK mode has been designed under the assumption that data unit out-of-sequence delivery does not occur between the entity performing fragmentation and the entity performing reassembly and a DetNet PREOF function might be needed to reorder the fragments.

Maximum packet size: MAX_PACKET_SIZE is aligned to the PPP Link MTU.

Padding: The Compression Residue MUST be aligned to the L2 word. For Ethernet, the L2 word is one byte, so padding is needed up to the next byte boundary. If a compression rule produces a residue that is not byte aligned, then it is implicitly terminated with a statement that indicates padding till the next byte boundary. The padding bit is 0.

4.2.1. Resulting Packet Format

In the case of PPPoE, the sequence of compression and encapsulation is as follows:

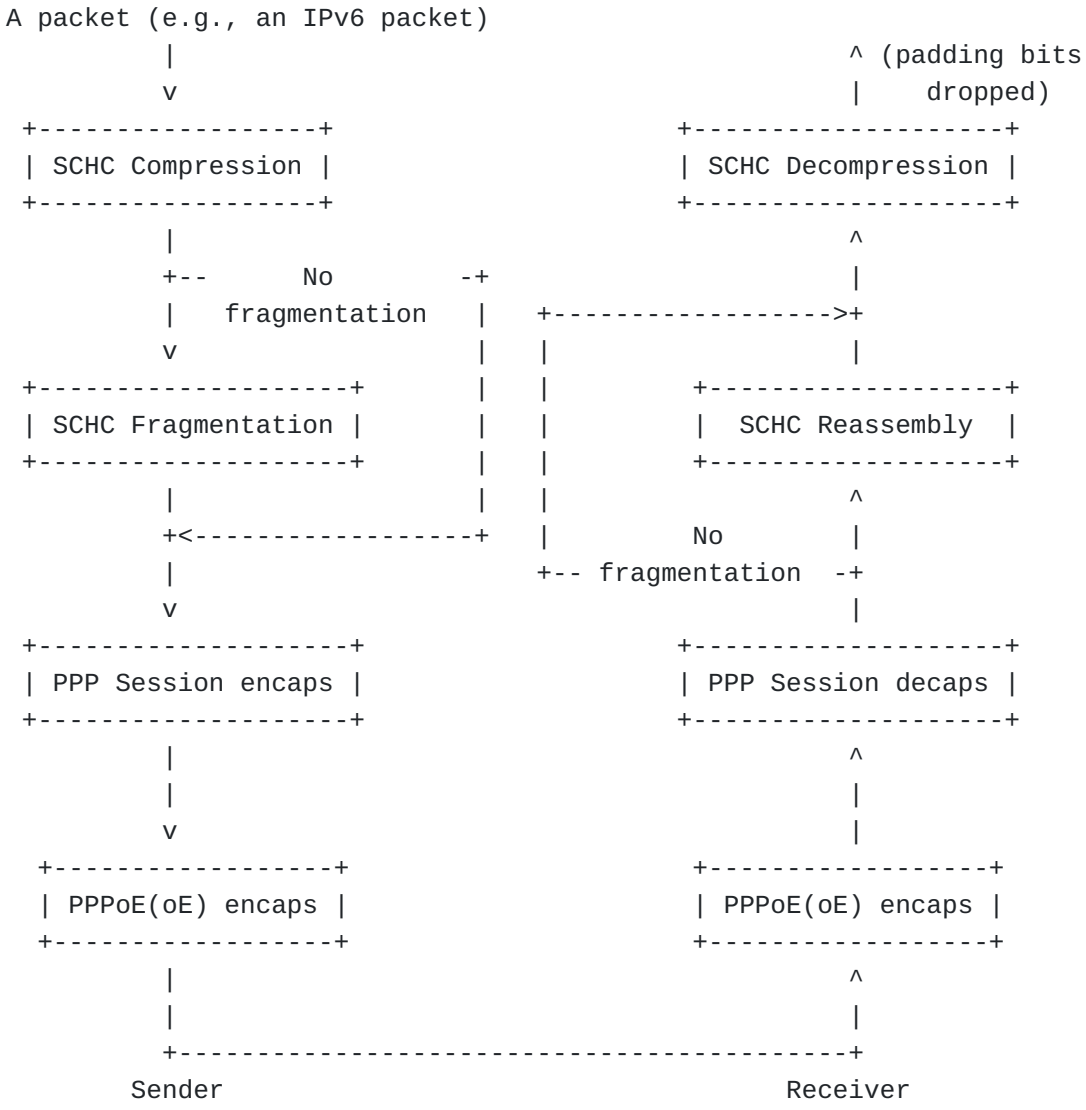

Figure 5: Stack Operation (no fragment)

In the case of PPPoE, a frame that transports an IPv6 packet compressed with SCHC with no fragmentation shows as follows:

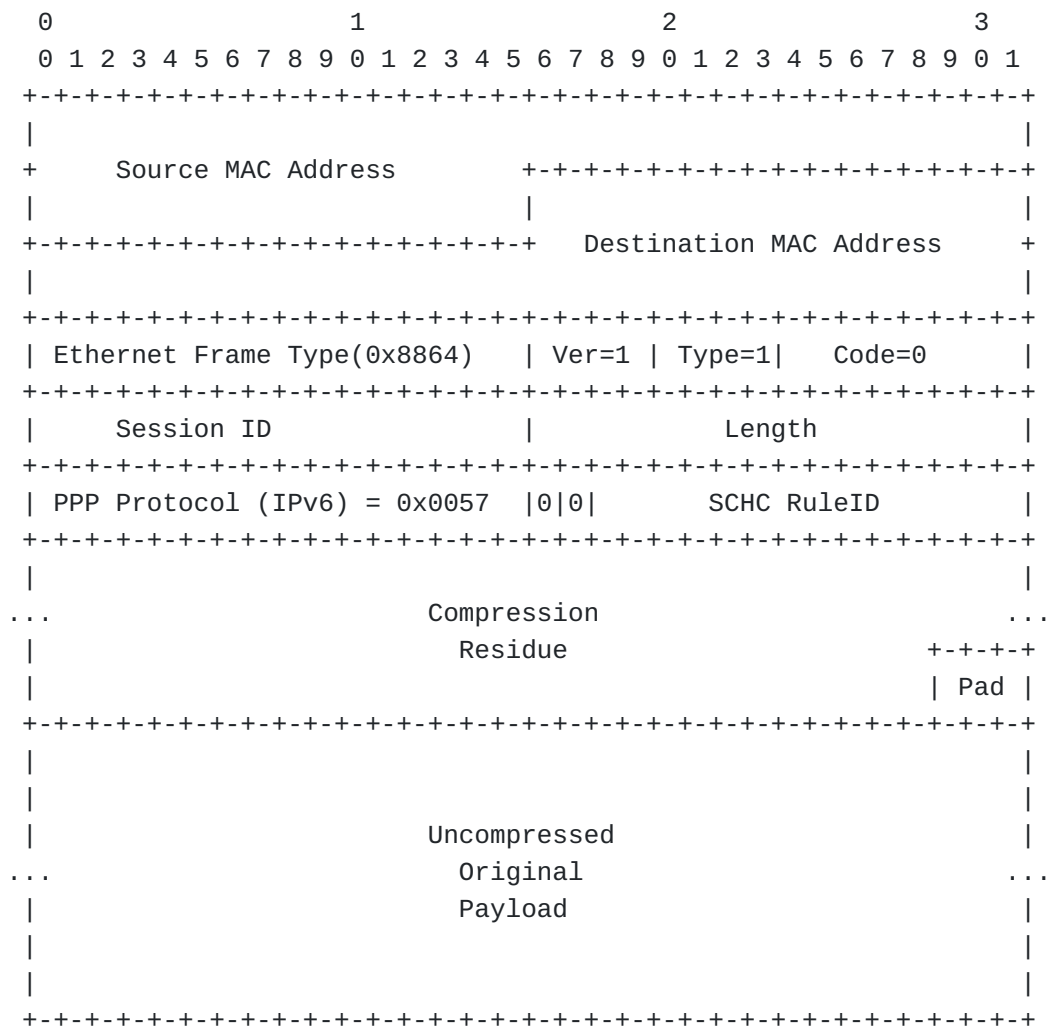

Figure 6: SCHC over PPP over Ethernet Format

4.3. Security Considerations

This draft enables to use the SCHC compression and fragmentation over PPP and therefore Ethernet and Wi-Fi with PPPoE. It inherits the possible threats against SCHC listed in the "Security considerations" section of [SCHC].

5. IANA Considerations

This document requests the allocation of a new value in the registry "IPv6-Compression-Protocol Types" for "SCHC". A suggested value is proposed in Table 1:

Value	Description	Reference
4	Static Context Header Compression (SCHC)	This document

Table 1: IP Header Compression Configuration Option Suboption Types

6. Acknowledgments

7. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC2516] Mamakos, L., Lidl, K., Evarts, J., Carrel, D., Simone, D., and R. Wheeler, "A Method for Transmitting PPP Over Ethernet (PPPoE)", RFC 2516, DOI 10.17487/RFC2516, February 1999, <https://www.rfc-editor.org/info/rfc2516>.

[RFC5072] Varada, S., Ed., Haskins, D., and E. Allen, "IP Version 6 over PPP", RFC 5072, DOI 10.17487/RFC5072, September 2007, <https://www.rfc-editor.org/info/rfc5072>.

[RFC5172] Varada, S., Ed., "Negotiation for IPv6 Datagram Compression Using IPv6 Control Protocol", RFC 5172, DOI 10.17487/RFC5172, March 2008, <https://www.rfc-editor.org/info/rfc5172>.

[RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, RFC 3986, DOI 10.17487/RFC3986, January 2005, <https://www.rfc-editor.org/info/rfc3986>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[SCHC] Minaburo, A., Toutain, L., Gomez, C., Barthel, D., and JC. Zúñiga, "SCHC: Generic Framework for Static Context Header Compression and Fragmentation", RFC 8724, DOI 10.17487/RFC8724, April 2020, <https://www.rfc-editor.org/info/rfc8724>.

8. Informative References

[I-D.pelov-lpwan-architecture] Pelov, A., Thubert, P., and A. Minaburo, "Static Context Header Compression (SCHC) Architecture", Work in Progress, Internet-Draft, draft-pelov-lpwan-architecture-00, 19 January 2021, <https://tools.ietf.org/html/draft-pelov-lpwan-architecture-00>.

[SCHC_DATA_MODEL] Minaburo, A. and L. Toutain, "Data Model for Static Context Header Compression (SCHC)", Work in Progress, Internet-Draft, draft-ietf-lpwan-schc-yang-

data-model-03, 10 July 2020, <https://tools.ietf.org/html/draft-ietf-lpwan-schc-yang-data-model-03>.

[RAW Technologies] Thubert, P., Cavalcanti, D., Vilajosana, X., Schmitt, C., and J. Farkas, "Reliable and Available Wireless Technologies", Work in Progress, Internet-Draft, draft-thubert-raw-technologies-05, 18 May 2020, <https://tools.ietf.org/html/draft-thubert-raw-technologies-05>.

[RFC7951] Lhotka, L., "JSON Encoding of Data Modeled with YANG", RFC 7951, DOI 10.17487/RFC7951, August 2016, <https://www.rfc-editor.org/info/rfc7951>.

[DetNet] Finn, N., Thubert, P., Varga, B., and J. Farkas, "Deterministic Networking Architecture", RFC 8655, DOI 10.17487/RFC8655, October 2019, <https://www.rfc-editor.org/info/rfc8655>.

[IEEE802.1TSNTG] IEEE, "Time-Sensitive Networking (TSN) Task Group", <https://1.ieee802.org/tsn/>.

Author's Address

Pascal Thubert (editor)
Cisco Systems, Inc
Building D
45 Allee des Ormes - BP1200
06254 Mougins - Sophia Antipolis
France

Phone: +33 497 23 26 34
Email: pthubert@cisco.com