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Protocol Numbers for SCHC
draft-ietf-schc-protocol-numbers-04

Abstract

This document requests an Internet Protocol Number, an Ethertype assignment, a CCSDS Encapsulation Number, and well known ports for SCHC. The SCHC architecture, the SCHC instance establishment, and the SCHC compression/decompression processes are simplified when SCHC is easily recognised. Well-known protocol and port numbers are needed. The Internet Protocol Number request is so that SCHC can be used for IP independent of other transports such as UDP and ESP. The Ethertype and the CCSDS Encapsulation Number are to support generic use of native SCHC over any IEEE 802 technology and CCSDS link layer technology, respectively, for IP and non-IP protocols.

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1. Introduction

The Static Context Header Compression (SCHC) Architecture [schc-architecture] originally envisioned SCHC used at the Network layer to enable IPv6 over selected Low-Power Wide Area Networking (LPWAN) radio technologies, encompassing IP and Transport, by the network provider. Then SCHC would be used by the application; this would include any security envelope.

In the evolution of SCHC, compression and fragmentation are available at any layer. After applying SCHC, the protocol information is reduced to a RuleID and the compression residue (if any). We need to identify SCHC to recognise when a protocol header has been compressed by SCHC.

The identifier to be used depends on the protocol/layer in the stack where SCHC is applied. It MUST be unambiguous to transform SCHC into an application. And this identifier could be a protocol number and port numbers.

This approach brakes down when dealing with Diet ESP [diet-esp]. When Next Header is ESP, it is challenging for the ESP process to determine if an incoming ESP payload is regular ESP [RFC4303] or a diet ESP payload. Careful allocation of the incoming SPI [ikev2-diet-esp] can mitigate this and have an implicit SCHC header, but it is not sound protocol design. If the Next Header in the IP header were SCHC, not ESP, a clear segregation of incoming traffic is directly supportable.

Additionally, SCHC can then be the Next Header within the ESP header with 'regular' SCHC rules for processing this content. This approach will greatly simplify [diet-esp].

DTLS 1.3 [RFC9147] adds further complications. DTLS 1.3 headers themselves are typically already very compressed and SCHC would not provide much value. But the UDP header in front of DTLS would benefit of a separate compression from the IP Header compression. Where it is possible with ESP's SPI to mitigate inbound packet processing challenges implicit SCHC would generate, DTLS header does not safely even provide this and a SCHC IP number is necessary to separate traffic.

New IETF work has started with the SCHC WG that is chartered to:

> provide specifications for the application of SCHC over underlying layers, where underlying layers include but are not limited to UDP tunnels, IP, PPP, and Ethernet, as well as the use of SCHC by upper-layer protocols.

To achieve its charter, the SCHC working group needs the allocations that are requested in this document.

These issues carry over to IP Header compression if SCHC were available as an Ethertype (for 802 networking) and if SCHC were available as a TCP/UDP port number (for the application layer). At each layer, SCHC solves a problem that protocol designers, using constrained networks, currently have to design around.

1.1. Basic use case for SCHC as an Internet Protocol Number

A mobile node, or network, may use different links over a period of time. In some cases the node has the multiple interfaces and, in theory, could tune the compression to each interface. In other cases, it is the whole network that is mobile and individual nodes have no "knowledge" of which link with what characteristics is actively handling the traffic. In either case, the node administrator is aware that some links are constrained and use of SCHC compression is highly recommended.

One example is an Uncrewed Aircraft (UA) that uses different links over the duration of an operation (i.e. flight).

* Operation starts using a veriport’s WiFi service.

* On gaining altitude, UA transitions to a Cellular service.

* On gaining more altitude, UA transitions to a constrained 700MHz UHF service.

* On approach to destination vertiport, link transition is reversed.

The UA could use SCHC compression only on the UHF link, but this may complicate the implementation.

A more complex example is an Uncrewed Cargo Aircraft that has multiple avionics systems, all Ethernet connected to an onboard router that has the multiple interfaces. Here the nodes each manage their own secure path to their ground-based server, but have no knowledge of which link is in use to intelligently use compression.

1.2. Basic use case for SCHC as an Ethertype

In the case of a classical LPWAN link such as LoRa [RFC9011], the use of SCHC to compress the transported protocol, as well as the SCHC session (called instance) to use, are implicit. The MAC-Layer endpoints are preconfigured so there can be only one session, and there can be only SCHC. When extended to Ethernet and more powerful endpoint, this model is way too restrictive, and it is necessary to signal both the use of SCHC and the SCHC session to be used. While the SCHC WG is charterd to produce the latter, the Ethertype defined in this document will be used to signal SCHC as the upper-layer protocol.

As an example that will leverage this, Aircraft-to-anything (A2X) [drip-a2x-adhoc-session] and Aircraft-to-Ground [drip-efficient-a2g-comm] protocols are specific cases that can benefit from SCHC as an Ethertype. These can use IEEE 802 wireless technology and lessen spectrum contention in high traffic or long-range situations by minimizing the datagram size via SCHC.

In the above uses, SCHC compresses the IPv6 header completely (all 40 bytes), leaving only destination address (32 bytes, source address calcuated from content), or only 8 bytes (needs both addresses) at the cost of a 1-byte SCHC RuleID. The 2-byte payload length may be needed in some cases (as in Section 4).

Since the whole point of SCHC is to reduce payload size, SCHC directly over an 802 technology cannot be addressed via the Ethernet Protocol Assignment under the IANA OUI. A distinct Ethertype is needed by SCHC to actually reduce payload overhead.

1.3. Basic use case for SCHC as a UDP port

There is a need to allow carrying SCHC-compressed data units (i.e., SCHC datagrams [draft-ietf-schc-architecture]) atop UDP. For example, SCHC-based header compression for Constrained Application Protocol (CoAP) has been specified [RFC8824]. The document entitled 'Transmission of SCHC-compressed packets over IEEE 802.15.4 networks' [6lo-15dot4-schc] aims to exploit the opportunity of carrying SCHC-compressed CoAP messages on top of UDP. To support this functionality, there is a need for UDP port numbers known by both endpoints (sender and receiver) that identifies the presence of a SCHC Stratum atop UDP, i.e., that the UDP payload is a SCHC datagram (in this case, a SCHC-compressed CoAP message).

In addition, note that it is possible to use traditional 6LoWPAN header compression [RFC6282] to compress IPv6 and UDP headers, but not to compress CoAP headers. Therefore, the only way to support CoAP header compression on devices running 6LoWPAN is by means of SCHC, which again requires to place a SCHC Stratum on top of UDP.

SCHC header compression is also being developed for further protocols carried by UDP (e.g., QUIC [schc-quic-compression]). In the future, SCHC may be applied to any protocol at any layer, such as DTLS and TCP.

1.4. Basic Use case for SCHC over connection-oriented communication

In a connection-oriented communication, two endpoints establish a session to transfer data reliably, with error detection and reordering of received data. During the connection establishment (3-way handshake), both hosts must identify SCHC with the layer-4 port number and exchange and agree on the SoR. Through the data transfer, the management of the SoR uses the Yang data model as described in the [draft-toutain-schc-coreconf-management]. Both endpoints must make the same changes to keep the integrity of the flow control.

The SoR may contain dedicated Rules for Acknowledgements and connection termination.

This approach is essential for critical business applications where data loss or corruption could have serious financial or legal consequences.

1.5. Basic use case for SCHC over Space Links

Space communications is a very bandwidth constraint environment. Space links are typically point-to-point links. The deployment of IP in deep space is described in the TIPTOP use case [I-D.ietf-tiptop-usecase] and architecture [I-D.many-tiptop-ip-architecture] documents. It specifies the use of SCHC on space link layers as defined by the Consultative Committee for Space Data Systems (CCSDS).

1.6. SCHC Port Numbers and protocol number as identifiers

In the current SCHC architecture, the SCHC Stratum Header adds signalling information to the SCHC packet. It may be fully compressed, and it does not add any overhead in that case. The SCHC Stratum Header helps to identify the use of SCHC and selects the correct instance and SoR in the SCHC process. The SCHC Stratum Header format includes an identifier that depends on the compressed stack layer. These identifiers are the protocol number at layer three and port numbers at layer four.

2. Terms and Definitions

2.1. Requirements Terminology

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. Internet Protocol Number for SCHC

SCHC as the IP payload SHOULD be indicated in the IPv4 "Protocol" field or the IPv6 "Next Header" field with a value of TBD1 (recommended: 145) as shown below:

Decimal	Keyword	Protocol	IPv6 Extension Header	Reference
TBD1 (145)	SCHC	Static Context Header Compression		This RFC

Table 1: Internet Protocol Numbers

The SCHC compressed header with payload is shown below. The size of the SCHC RuleID is variable as described in [RFC8724]. An implementation should have a table of source IP address and RuleID size. The addresses should be represented in prefix format to allow for groups of addresses having the same RuleID size.

```
|------- Compressed Header -------|
+---------------------------------+--------------------+
|  RuleID  |  Compression Residue |      Payload       |
+---------------------------------+--------------------+
```

Figure 1: SCHC Packet

The RuleID may be statically configured per [RFC8724], or may be negotiated within a protocol as in IKE [ikev2-diet-esp].

4. Ethertype for SCHC

The use of SCHC as an Ethertype is similar to that as in Section 3, above. Immediately after the SCHC Ethertype is the RuleID as in Figure 1. If the rules for the RuleID does not provide the datagram length, the datagram length MUST be explicit in the Compression Residue, as the 802 header may not provide the needed length information to properly process the datagram.

5. Transport Port Numbers for SCHC

SCHC’s first function is to compress the header; with this action, the protocol ports are hidden from the application. To identify SCHC in the upper layers, the protocols do not have a next header field. The port numbers are necessary to be aware that the protocol’s header has been compressed.

6. CCSDS Encapsulation Number for SCHC

The CCSDS link layers have a common encapsulation named Internet Protocol Extension (IPE)[IPoverCCSDSSpaceLinks]. The codepoints are managed by the Space Assigned Numbers Authority(SANA) under the IPE registry [SANAIPEHeaderRegistry]. This registry already specifies the encapsulation of previous IP header compression techniques. This document requests SANA through CCSDS to allocate a codepoint for SCHC in the IPE registry.

7. IANA Considerations

7.1. IANA Internet Protocol Number Registry Update

This document requests IANA to make the following change to the "Assigned Internet Protocol Numbers" [IANA-IPN] registry:

Internet Protocol Number:
: This document defines the new Internet Protocol Number value TBD1 (suggested: 145) (Section 3) in the "Assigned Internet Protocol Numbers" registry.

Decimal	Keyword	Protocol	IPv6 Extension Header	Reference
TBD1 (145)	SCHC	Static Context Header Compression		This RFC

Table 2

7.2. IANA Ethertype Request

IANA is requested using the process in Section 5.5 of [intarea-rfc7042bis], to request the Ethertype for SCHC.

7.3. IANA SCHC Ethertype Registry

A registry of SCHC RuleIDs for SCHC as an Ethertype may be needed. More discussion is needed to resolve this. For example, split a 1-byte RuleID in half. The top half of 1-14 assigned to different domains of use, like for aviation. A value of 15 designates that a 2-byte RuleID is used.

8. Security Considerations

TBD

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