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IP Header Compression over PPP

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Abstract

This document describes an option for negotiating the use of header compression on IP datagrams transmitted over the Point-to-Point Protocol [RFC1661]. It defines extensions to the PPP Control Protocols for IPv4 and IPv6 [RFC1332, RFC2023]. Header compression may be applied to IPv4 and IPv6 datagrams in combination with TCP, UDP and RTP transport protocols as specified in [IPHC] and [CRTP].

1. Introduction

The IP Header Compression (IPHC) defined in [IPHC] may be used for compression of both IPv4 and IPv6 datagrams or packets encapsulated with multiple IP headers. IPHC is also capable of compressing both TCP and UDP transport protocol headers. The IP/UDP/RTP header compression defined in [CRTP] fits within the framework defined by IPHC so that it may also be applied to both IPv4 and IPv6 packets.

In order to establish compression of IP datagrams sent over a PPP link each end of the link must agree on a set of configuration parameters for the compression. The process of negotiating link parameters for network layer protocols is handled in PPP by a family of network control protocols (NCPs). Since there are separate NCPs for IPv4 and IPv6, this document defines configuration options to be

used in both NCPs to negotiate parameters for the compression scheme.

IPHC relies on the link layer's ability to indicate the types of datagrams carried in the link layer frames. In this document nine new types for the PPP Data Link Layer Protocol Field are defined along with their meaning.

In general, header compression schemes that use delta encoding of compressed packets require that the lower layer does not reorder packets between compressor and decompressor. IPHC uses delta encoding of compressed packets for TCP and RTP. The IPHC specification [IPHC] includes methods that allow link layers that may reorder packets to be used with IPHC. Since PPP does not reorder packets these mechanisms are disabled by default. When using reordering mechanisms such as multiclass multilink PPP [MCML], care must be taken so that packets that share the same compression context are not reordered.

2. Configuration Option

This document specifies a new compression protocol value for the IPCP IP-Compression-Protocol option as specified in [RFC1332]. The new value and the associated option format are described in section 2.1.

The option format is structured to allow future extensions to the IPHC scheme.

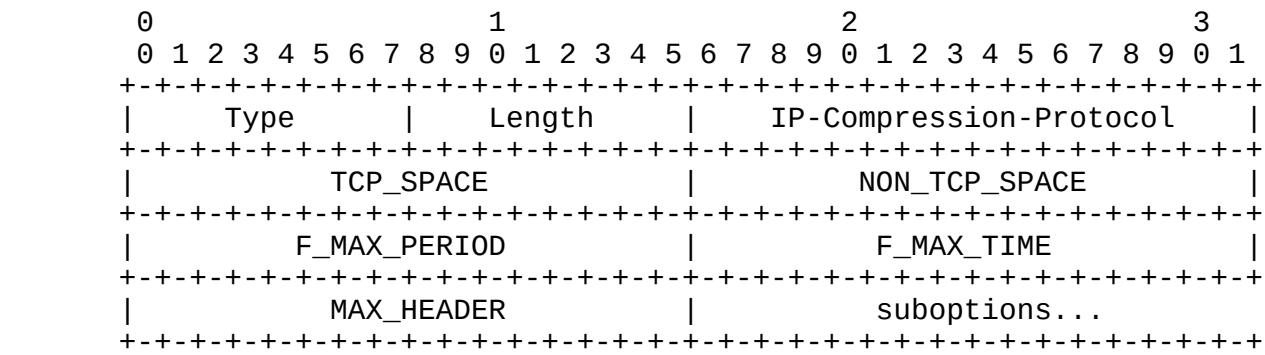
> NOTE: The specification of link and network layer parameter negotiation for PPP [RFC1661], [RFC1331], [RFC1332] does not prohibit multiple instances of one configuration option but states that the specification of a configuration option must explicitly allow multiple instances. From the current specification of the IPCP IP-Compression-Protocol configuration option [RFC1332, p 6] it follows that it can only be used to select a single compression protocol at any time.
>
> NOTE: [RFC1332] is not explicit about whether the option negotiates the capabilities of the receiver or of the sender. In keeping with current practice, we assume that the option describes the capabilities of the decompressor (receiving side) of the peer that sends the Config-Req.

2.1. Configuration Option Format

Both the network control protocol for IPv4, IPCP [RFC1332] and the IPv6 NCP, IPV6CP [RFC2023] may be used to negotiate IP Header Compression parameters for their respective protocols. The format of the configuration option is the same for both IPCP and IPV6CP.

Description

This NCP configuration option is used to negotiate parameters for IP Header Compression. The option format is summarized below. The fields are transmitted from left to right.



Type
2

Length
>= 14

The length may be increased if the presence of additional parameters is indicated by additional suboptions.

IP-Compression-Protocol
0061 (hex)

TCP_SPACE
The TCP_SPACE field is two octets and indicates the maximum value of a context identifier in the space of context identifiers allocated for TCP.

Suggested value: 15

TCP_SPACE must be at least 0 and at most 255 (The value 0 implies having one context).

NON_TCP_SPACE
The NON_TCP_SPACE field is two octets and indicates the maximum value of a context identifier in the space of context identifiers allocated for non-TCP. These context identifiers are carried in COMPRESSED_NON_TCP, COMPRESSED_UDP and COMPRESSED_RTP packet headers.

Suggested value: 15

NON_TCP_SPACE must be at least 0 and at most 65535 (The value 0 implies having one context).

F_MAX_PERIOD
Maximum interval between full headers. No more than F_MAX_PERIOD COMPRESSED_NON_TCP headers may be sent between FULL_HEADER headers.

Suggested value: 256

A value of zero implies infinity, i.e. there is no limit to the number of consecutive COMPRESSED_NON_TCP headers.

F_MAX_TIME
Maximum time interval between full headers. COMPRESSED_NON_TCP headers may not be sent more than F_MAX_TIME seconds after sending the last FULL_HEADER header.

Suggested value: 5 seconds

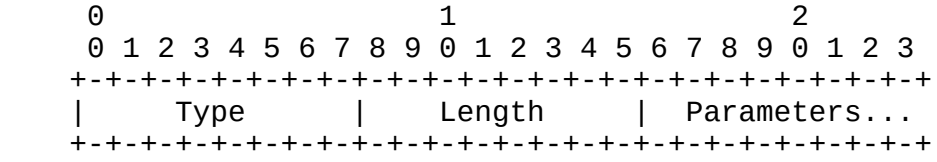
A value of zero implies infinity.

MAX_HEADER
The largest header size in octets that may be compressed.

Suggested value: 168 octets

The value of MAX_HEADER should be large enough so that at least the outer network layer header can be compressed. To increase compression efficiency MAX_HEADER should be set to a value large enough to cover common combinations of network and transport layer headers.

suboptions
The suboptions field consists of zero or more suboptions. Each suboption consists of a type field, a length field and zero or more parameter octets, as defined by the suboption type. The value of the length field indicates the length of the suboption in its entirety, including the lengths of the type and length fields.



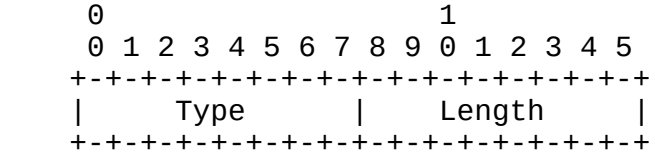
2.2 RTP-Compression Suboption

The RTP-Compression suboption is included in the NCP IP-Compression-Protocol option for IPHC if IP/UDP/RTP compression is to be enabled.

After successful negotiation of parameters for IP Header Compression the use of Protocol Identifiers FULL_HEADER, COMPRESSED_TCP, COMPRESSED_TCP_NODELTA and COMPRESSED_NON_TCP is enabled, regardless of the prescence of an RTP-Compression suboption.

Description

Enable use of Protocol Identifiers COMPRESSED_RTP, COMPRESSED_UDP and CONTEXT_STATE as specified in [CRTP].



Type
1

Length
2

3. Multiple Network Control Protocols

The IPHC protocol is able to compress both IPv6 and IPv4 datagrams. Both IPCP and IPV6CP are able to negotiate option parameter values for IPHC. These values apply to the compression of packets where the outer header is an IPv4 header and an IPv6 header, respectively.

3.1. Sharing Context Identifier Space

For the compression and decompression of IPv4 and IPv6 datagram headers the context identifier space is shared. While the parameter values are independently negotiated, sharing the context identifier spaces becomes more complex when the parameter values differ. Since

the compressed packets share context identifier space, the compression engine must allocate context identifiers out of a common pool; for compressed packets, the decompressor has to examine the context state to determine what parameters to use for decompression.

Context identifier spaces are not shared between TCP and non-TCP/UDP/RTP. Doing so would require additional mechanisms to ensure that no error can occur when switching from using a context identifier for TCP to non-TCP.

4. Demultiplexing of Datagrams

The IPHC specification [IPHC] defines four header formats for different types of compressed headers. They are compressed TCP, compressed TCP with no delta encoding, compressed non-TCP with 8 bit CID and compressed non-TCP with 16 bit CID. The two non-TCP formats may be distinguished by their contents so both may use the same link-level identifier. A fifth header format, the full header is distinct from a regular header in that it carries additional information to establish shared context between the compressor and decompressor.

The specification of IP/UDP/RTP Header Compression [CRTP] defines four additional formats of compressed headers. They are for compressed UDP and compressed RTP (on top of UDP), both with either 8- or 16-bit CIDs. In addition, there is an explicit error message from the decompressor to the compressor.

The link layer must be able to indicate these header formats with distinct values. Nine PPP Data Link Layer Protocol Field values are specified below.

FULL_HEADER
The frame contains a full header as specified in [CRTP] Section 3.3.1. This is the same as the FULL_HEADER specified in [IPHC] Section 5.3.
Value: 0061 (hex)

COMPRESSED_TCP
The frame contains a datagram with a compressed header with the format as specified in [IPHC] Section 6a.
Value: 0063 (hex)

COMPRESSED_TCP_NODELTA
The frame contains a datagram with a compressed header with the format as specified in [IPHC] Section 6b.
Value: 2063 (hex)

COMPRESSED_NON_TCP
The frame contains a datagram with a compressed header with the format as specified in either Section 6c or Section 6d of [IPHC].
Value: 0065 (hex)

COMPRESSED_RTP_8
The frame contains a datagram with a compressed header with the format as specified in [CRTP] Section 3.3.2, using 8-bit CIDs.
Value: 0069 (hex)

COMPRESSED_RTP_16
The frame contains a datagram with a compressed header with the format as specified in [CRTP] Section 3.3.2, using 16-bit CIDs.
Value: 2069 (hex)

COMPRESSED_UDP_8
The frame contains a datagram with a compressed header with the format as specified in [CRTP] Section 3.3.3, using 8-bit CIDs.
Value: 0067 (hex)

COMPRESSED_UDP_16
The frame contains a datagram with a compressed header with the format as specified in [CRTP] Section 3.3.3, using 16-bit CIDs.
Value: 2067 (hex)

CONTEXT_STATE
The frame is a link-level message sent from the decompressor to the compressor as specified in [CRTP] Section 3.3.5.
Value: 2065 (hex)

5. References

[CRTP] Casner, S. and V. Jacobson, "Compressing IP/UDP/RTP Headers for Low-Speed Serial Links", RFC 2508, February 1999.

[IPHC] Degermark, M., Nordgren, B. and S. Pink, "Header Compression for IP", RFC 2507, February 1999.

[RFC2023] Haskin, E. and E. Allan, "IP Version 6 over PPP", RFC 2023, October 1996.

[RFC1144] Jacobson, V., "Compressing TCP/IP Headers for Low- Speed Serial Links", RFC 1144, February 1990.

[RFC1332] McGregor, G., "The PPP Internet Protocol Control Protocol (IPCP)", RFC 1332, May 1992.

[RFC1889] Schulzrinne, H., Casner, S., Frederick, R. and V. Jacobson, "RTP: A Transport Protocol for real-time applications", RFC 1889, January 1996.

[RFC1661] Simpson, W., Ed., "The Point-To-Point Protocol (PPP)", STD 51, RFC 1661, July 1994.

[MCML] Bormann, C., "The Multi-Class Extension to Multi-Link PPP", Work in Progress.

6. Security Considerations

Negotiation of the option defined here imposes no additional security considerations beyond those that otherwise apply to PPP [RFC1661].

The use of header compression can, in rare cases, cause the misdelivery of packets. If necessary, confidentiality of packet contents should be assured by encryption.

Encryption applied at the IP layer (e.g., using IPSEC mechanisms) precludes header compression of the encrypted headers, though compression of the outer IP header and authentication/security headers is still possible as described in [IPHC]. For RTP packets, full header compression is possible if the RTP payload is encrypted by itself without encrypting the UDP or RTP headers, as described in [RFC1889]. This method is appropriate when the UDP and RTP header information need not be kept confidential.

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