            Zero-byte Support for Bidirectional Reliable Mode (R-mode)
             in Extended Link-Layer Assisted RObust Header Compression
                              (ROHC) Profile

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Abstract

   This document defines an additional mode of the link-layer assisted
   RObust Header Compression (ROHC) profile, also known as the zero-byte
   profile, beyond the two defined in RFC 3242. Zero-byte header
   compression exists in order to prevent the single-octet ROHC header
   from pushing a packet voice stream into the next higher fixed packet
   size for the radio. It is usable in certain widely deployed older
   air interfaces. This document adds the zero-byte operation for ROHC
   Bidirectional Reliable mode (R-mode) to the ones specified for
   Unidirectional (U-mode) and Bidirectional Optimistic (O-mode) modes
   of header compression in RFC 3242.

1. Introduction

   [RFC3242] defines a zero-byte solution for compression of IP/UDP/RTP
   packets only for Unidirectional (U-) and Bidirectional Optimistic
   (O-) modes [RFC3095]. The present specification extends the profile
   defined in [RFC3242] to provide zero-byte support for Bidirectional
   Reliable (R-) mode. This specification and [RFC3242] allow a
   header-free packet format to be used in all modes to replace the
   majority of the 1-octet headers of ROHC RTP packets sent during
   normal operation. Specifically, the compressor operating in R-mode
   is allowed to deliver a No-Header Packet (NHP) when [RFC3242] would
   have required it to deliver a ROHC Reliable Packet Type Zero (R-0)
   packet [RFC3095].

For simplification, this profile is defined in the form of the
additions and exceptions to [RFC3242] that are required to extend the
RFC 3242 profile with zero-byte support for R-mode. All terminology
used in this document is the same as in [RFC3242].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in BCP 14, RFC 2119
[RFC2119].

2. Extensions to the assisting layer (AL) interface

   This section describes additions (some are optional) to the assisting
   layer interface as defined in [RFC3242, section 4.2].

2.1. Additional parameters to the compressor to AL interface

   - Mode, indicating the mode in which the compressor is operating.
      The AL has slightly different logic depending on the mode value.

   - SN_ACKed, indicating the latest RTP SN that has been acknowledged.
      It is used only when Mode value = R-mode.

   Note that these two parameters MUST always be attached to every
   packet delivered to the AL.

2.2. Additional interface, assisting layer to compressor

   To improve the compression efficiency of this profile in some
   specific cases, e.g., when the AL operates in such a way that it
   often becomes unsafe to send NHPs, it is RECOMMENDED to implement
   this additional interface. Here, the word "unsafe" means that the
   compressor allows the AL to send NHP but the AL cannot guarantee that
   the RTP SN of the NHP will be correctly decompressed at the receiving
   side. The interface is used to carry update_request as described in
   section 3. Note that this interface is not required in the sense
   that the impossibility of implementing such an interface should not
   be an obstacle to implement this profile over a specific link.

3. R-mode operation

   For the R-mode, this profile extends ROHC RTP by performing a mapping
   of the R-0 packet to the NHP packet. Note that R-0 is the only type
   of packets in R-mode that can be replaced with NHP.

   On the receiving side, the RTP SN of an NHP is determined by the
   decompressor as = SN_Ref_D + Offset_D, where SN_Ref_D is the RTP SN
   of the last update packet received by the decompressor, and Offset_D

the sequence number offset between the NHP and the last update
packet. How to derive Offset_D depends on the implementation of this
profile over a specific link technology and must be specified in the
implementation document(s). For example, it can be calculated by
counting the total number of non-context-updating packets (including
NHPs) and packet loss indications received since the last successful
context update. Alternatively, it can be derived using the link
timing in the case where the linear mapping between RTP SN and link
timing is maintained.

On the transmitting side, the AL follows the same rule defined in
section 4.1.1 of [RFC3242] to determine whether it can send NHP or
not, with one modification. That is, when the AL determines that it
has become unsafe (see section 2.2) to send NHPs, the AL records the
corresponding RTP SN as SN_break. Then it waits until the rule is
satisfied again and SN_ACKed > SN_break before it resumes sending
NHPs. The latter condition is essentially the counterpart of
optimistic approach agreement [RFC3242, section 4.3] of U/O-mode
which states that when the AL in U/O-mode determines it is unsafe to
send NHP, it must send headers in the subsequent X packets, where X
is some agreed number. There are two reasons for the difference: a)
R-mode relies on acknowledgements to synchronize contexts, instead of
optimistic approach principle as in U/O-mode; and b) R-0 packets do
not update decompressor context while UO-0 packets do. To meet the
condition SN_ACKed > SN_break, the AL can either wait passively for
the compressor to send a context update packet (e.g., R-0-CRC
triggered by 6-bit SN wrap-around), or send an update_request via the
interface from AL to the compressor (section 2.2) to request the
compressor to send a context updating packet. The update_request
carries the last SN_break. Upon receiving an update_request, the
compressor SHOULD use a context updating packet (e.g. R-0-CRC) when
sending the next packet. Context updating packets are handled as in
[RFC3095].

Note: the passive waiting as described above might take a long time
in the worst case, during which NHPs cannot be sent. Therefore,
sending update_request via the optional AL to compressor interface is
RECOMMENDED to improve the worst case performance.

Note: the update_request may be lost if the AL and compressor are at
different locations and the channel between them is unreliable, but
such a loss only delays the AL from resuming sending NHP. Therefore,
how frequent the AL sends update_request is an implementation issue.
For example, the AL may send one update_request for each packet it
receives from the compressor until the conditions to send NHP are
met.

Note: as no CRC field is present in R-0 packets, only the function
related to RTP SN and packet type identifier needs to be replaced.
In addition, NHP packets and packet loss indications in R-mode do not
update either the compressor or the decompressor context (as opposed
to U/O-mode). Consequently, the secure reference principle [RFC3095,
section 5.5] is not affected in any way and there is no loss of
robustness in this profile compared to ROHC RTP.

4. Differences between R-mode and U/O-mode

   This section clarifies some differences between R-mode and U/O-mode
   in this profile.

   a) CRC replacement
      Unlike U/O-mode, CRC replacement [RFC3242, section 3.3] is not an
      issue for R-mode since R-0 packets do not carry CRC field.

   b) Periodic context verification
      For U/O-mode, periodic context verification [RFC3242, section 4.6]
      is RECOMMENDED to provide additional protection against damage
      propagation after CRC is replaced. For R-mode, since there is no
      CRC replacement (see above), no change to ROHC RTP is needed in
      this regard. In particular, R-mode has this feature naturally
      built-in, since the sending of R-0-CRC when 6-bit SN wraps around
      implicitly provides periodic context verification for R-mode.

   c) CV-REQUEST option
      For the same reasons as above, the decompressor operating in R-
      mode SHOULD NOT send CV-REQUEST [RFC3242, section 4.5] to
      compressor. This is to avoid unnecessary overhead on the feedback
      channel.

   d) Context Check Packet (CCP)
      When CCP [RFC3242, section 4.1.3] is used, compressor operating in
      R-mode SHOULD set C-bit to 0 (zero) and not generate 7-bit CRC if
      computation cost at compressor and decompressor causes concern.
      The use of the CRC field in CCP to perform decompressor context
      verification is not critical in R-mode (see last note of section 3
      and item b) above).

   e) Handling of Acknowledgements (ACKs)
      Special care in the realization of ACKs should be taken for R-mode
      implementations. It is RECOMMENDED to avoid the use of
      interspersed feedback packets [RFC3095, section 5.2.1] to carry
      ACK information. The reason is that interspersed feedback packets
      will interrupt the RTP SN sequencing and thus temporarily disable
      the sending of NHPs.

5. IANA Considerations

   A ROHC profile identifier has been reserved by the IANA for the
   profile defined in this document (0x0105), where 0x0005 is the
   profile identifier assigned for LLA [RFC3242].

6. Security Considerations

   The security considerations of ROHC RTP [RFC3095, section 7] apply
   also to this document with one addition: in the case of a denial-of-
   service attack scenario where an intruder injects bogus CCP packets
   onto the link using random CRC values, the CRC check will fail for
   incorrect reasons at the decompressor side. This would obviously
   greatly reduce the advantages of ROHC and any extra efficiency
   provided by this profile due to unnecessary context invalidation,
   feedback messages and refresh packets. However, the same remarks
   related to the presence of such an intruder apply.

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8. References

   [RFC3242]   Jonsson, L. and G. Pelletier, "RObust Header Compression
               (ROHC): A Link-Layer Assisted Profile for IP/UDP/RTP",
               RFC 3242, April 2002.

   [RFC3095]   Bormann, C., Burmeister, C., Degermark, M., Fukushima,
               H., Hannu, H., Jonsson, L., Hakenberg, R., Koren, T., Le,
               K., Liu, Z., Martensson, A., Miyazaki, A., Svanbro, K.,
               Wiebke, T., Yoshimura, T. and H. Zheng, "RObust Header
               Compression (ROHC): Framework and four profiles: RTP,
               UDP, ESP, and uncompressed", RFC 3095, July 2001.

   [RFC2119]   Bradner, S., "Key words for use in RFCs to indicate
               requirement levels", BCP 14, RFC 2119, March 1997.

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