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Z. Liu
K. Le
Nokia

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.

7. Acknowledgements

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8. References

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9. Authors' Addresses

Zhigang Liu
Nokia Research Center
6000 Connection Drive
Irving, TX 75039
USA

Phone: +1 972 894-5935
Fax: +1 972 894-4589
EMail zhigang.c.liu@nokia.com

Khiem Le
Nokia Research Center
6000 Connection Drive
Irving, TX 75039
USA

Phone: +1 972 894-4882
Fax: +1 972 894-4589
EMail: khiem.le@nokia.com

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