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R. Huang
Q. Wu
Huawei
H. Asaeda
NICT
G. Zorn
Network Zen

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RTP Control Protocol (RTCP) Extended Report (XR) Block for MPEG-2 Transport Stream (TS) Program Specific Information (PSI) Independent Decodability Statistics Metrics Reporting

Abstract

An MPEG-2 Transport Stream (TS) is a standard container format used in the transmission and storage of multimedia data. Unicast/multicast MPEG-2 TS over RTP is widely deployed in IPTV systems. This document defines an RTP Control Protocol (RTCP) Extended Report (XR) block that allows the reporting of MPEG-2 TS decodability statistics metrics related to transmissions of MPEG-2 TS over RTP. The metrics specified in the RTCP XR block are not dependent on Program Specific Information (PSI) carried in MPEG-2 TS.

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1. Introduction

1.1. MPEG-2 Transport Stream Decodability Metrics

The European Telecommunications Standards Institute (ETSI) has defined a set of syntax and information consistency tests and corresponding indicators [ETSI] that are recommended for the monitoring of MPEG-2 Transport Streams [ISO-IEC.13818-1.2013]. The tests and corresponding indicators are grouped according to priority:

- First priority - Necessary for decodability (basic monitoring)
- Second priority - Recommended for continuous or periodic monitoring
- Third priority - Recommended for application-dependent monitoring

This memo is based on information consistency tests and resulting indicators defined by ETSI [ETSI] and defines a new block type to augment those defined in [RFC3611] for use with MPEG-2 Transport Stream (TS) [ISO-IEC.13818-1.2013]. The new block type supports reporting of the number of occurrences of each PSI-independent indicator in the first and second priorities; third priority indicators are not supported.

1.2. RTCP and RTCP Extended Reports

The use of RTCP for reporting is defined in [RFC3550]. [RFC3611] defined an extensible structure for reporting using an RTCP Extended Report (XR). This document defines a new Extended Report block for use with [RFC3550] and [RFC3611].

1.3. Performance Metrics Framework

"Guidelines for Considering New Performance Metric Development" [RFC6390] provides guidance on the definition and specification of performance metrics. "Guidelines for Use of the RTP Monitoring Framework" [RFC6792] provides guidance on the reporting block format using RTCP XR. The new report block described in this memo is in compliance with the monitoring architecture specified in [RFC6792] and the performance metrics framework [RFC6390].

1.4. Applicability

This block type allows a count of MPEG-2 Transport Stream quality metrics that are measured in accordance with ETSI TR 101290 [ETSI] to be reported by an endpoint. These metrics are useful for identifying bitstream packetization and transport stream encoding problems that may affect the user's perception of a video service delivered over RTP.

2. Standards Language

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 RFC 2119 [RFC2119].

3. MPEG-2 TS PSI-Independent Decodability Statistics Metrics Block

ETSI TR 101290 [ETSI] generally defines metrics related to error events while this document contains counts of those metrics defined in [ETSI]. The block defined in this document reports MPEG-2 TS PSI-independent decodability statistics metrics beyond the information carried in the standard RTCP packet format, which are measured at the receiving end of the RTP stream. It contains counts of eight metrics defined in ETSI TR 101290 [ETSI]. Information is reported about basic monitoring parameters necessary to ensure that the TS can be decoded, including:

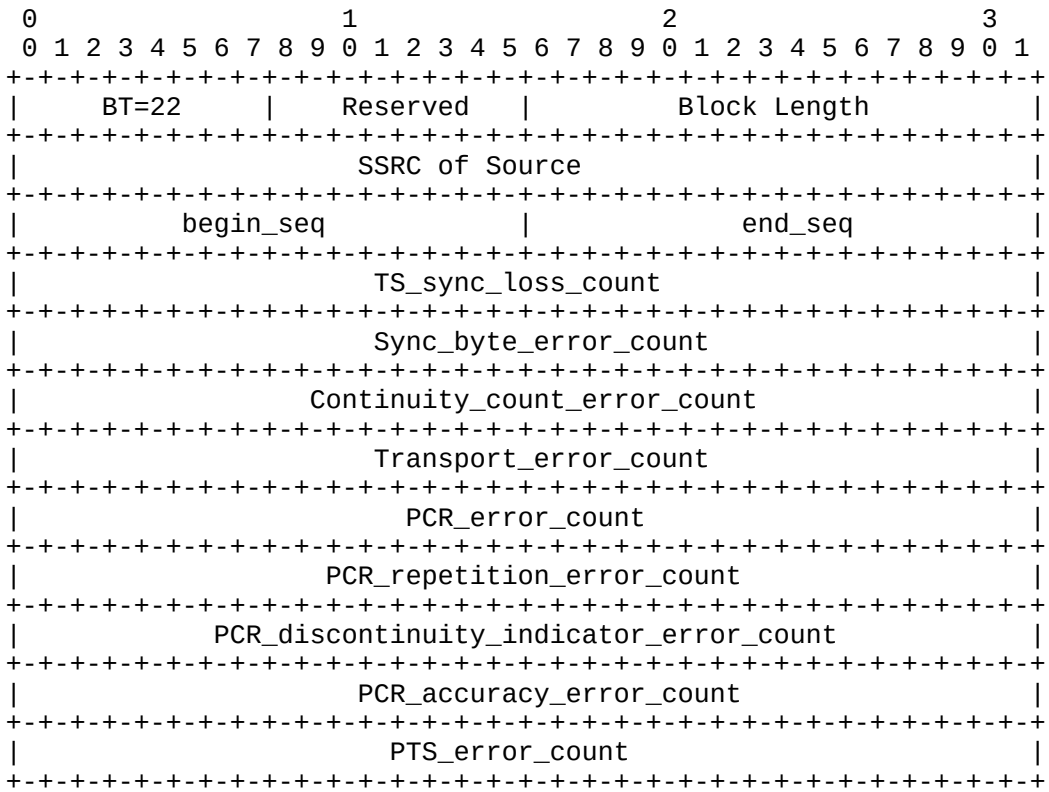
- Transport Stream Synchronization Losses
- Sync byte errors
- Continuity count errors

and continuous monitoring parameters necessary to ensure the continuous decoding, including:

- Transport errors
- Program Clock Reference (PCR) errors
- PCR repetition errors
- PCR discontinuity indicator errors
- PCR accuracy errors
- Presentation Time Stamp (PTS) errors

The other parameters are ignored since they do not apply to all MPEG-2 implementations. For further information on these parameters, see [ETSI]. Note that when the report of this block spans across more than one measurement interval [RFC6776], the count of the metrics (e.g., Sync byte errors and PCR errors) defined in [ETSI] may reflect a problem in the current or previous measurement interval.

The MPEG-2 TS PSI-Independent Decodability Statistics Metrics Block has the following format:



Block Type (BT): 8 bits

The MPEG-2 TS PSI-Independent Decodability Statistics Metrics Block is identified by the constant 22.

Reserved: 8 bits

These bits are reserved. They MUST be set to zero by senders and ignored by receivers (see [RFC6709] Section 4.2).

Block Length: 16 bits

The constant 11, in accordance with the definition of this field in Section 3 of RFC 3611. The block MUST be discarded if the block length is set to a different value.

Synchronization source (SSRC) of Source: 32 bits

As defined in Section 4.1 of RFC 3611.

begin_seq: 16 bits

The RTP sequence number corresponding to the start of the measurement period, as defined in Section 4.1 of RFC 3611.

end_seq: 16 bits

The RTP sequence number corresponding to the end of the measurement period, as defined in Section 4.1 of RFC 3611.

TS_sync_loss_count: 32 bits

A count of the number of TS_sync_loss errors that occurred in the above sequence number interval. A TS_sync_loss error occurs when there are two or more consecutive incorrect sync bytes within the MPEG-2 TS, as defined in Section 5.2.1 of [ETSI].

Sync_byte_error_count: 32 bits

A count of the number of Sync_byte_errors that occurred in the above sequence number interval. A sync byte error occurs when the sync byte is not equal to 0x47 in any TS packet contained in the MPEG-2 TS, as defined in Section 5.2.1 of [ETSI].

Continuity_count_error_count: 32 bits

A count of the number of Continuity_count_errors that occurred in the above sequence number interval. A Continuity_count_error occurs when any of the following faults happen within the MPEG-2 TS -- incorrect packet order, a packet occurs more than twice, or a packet is lost, as defined in Section 5.2.1 of [ETSI].

Transport_error_count: 32 bits

A count of the number of Transport_errors that occurred in the above sequence number interval. A Transport_error occurs when an erroneous TS packet cannot be corrected within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI].

PCR_error_count: 32 bits

A count of the number of PCR_errors that occurred in the above sequence number interval. A PCR_error occurs if the primary clock reference (PCR) is not seen for more than 100 ms within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI]. The time interval between two consecutive PCR values should be no more than 40 ms.

PCR_repetition_error_count: 32 bits

A count of the number of PCR_repetition_errors that occurred in the above sequence number interval. A PCR_repetition_error occurs when the time interval between two consecutive PCR values is more than 40 ms within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI].

PCR_discontinuity_indicator_error_count: 32 bits

A count of the number of PCR_discontinuity_indicator_errors that occurred in the above sequence number interval. A PCR_discontinuity_indicator_error occurs if the time interval between two consecutive PCR values is more than 100 ms within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI].

PCR_accuracy_error_count: 32 bits

A count of the number of PCR_accuracy_errors that occurred in the above sequence number interval. A PCR_accuracy_error occurs when the PCR accuracy of the selected program is outside the range of +/-500 ns within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI].

PTS_error_count: 32 bits

A count of the number of PTS_errors that occurred in the above sequence number interval. A PTS_error occurs when the PTS repetition is more than 700 ms within the MPEG-2 TS, as defined in Section 5.2.2 of [ETSI]. Note that the PTS is contained in the MPEG-2 TS and is used to aid the decoder in presenting the program on time, at the correct speed, and synchronized.

4. SDP Signaling

RFC 3611 defines the use of the Session Description Protocol (SDP) [RFC4566] for signaling the use of RTCP XR blocks. However, XR blocks MAY be used without prior signaling (see Section 5 of RFC 3611).

4.1. SDP rtcp-xr Attribute Extension

This session augments the SDP attribute "rtcp-xr" defined in Section 5.1 of RFC 3611 by providing an additional value of "xr-format" to signal the use of the report block defined in this document. The ABNF [RFC5234] syntax is as follows.

```
xr-format =/  xr-tpid-block

xr-tpid-block = "ts-psi-indep-decodability"
```

4.2. Offer/Answer Usage

When SDP is used in Offer/Answer context, the SDP Offer/Answer usage defined in [RFC3611] for unilateral "rtcp-xr" attribute parameters applies. For detailed usage of Offer/Answer for unilateral parameters, refer to Section 5.2 of [RFC3611].

5. IANA Considerations

New report block types for RTCP XR are subject to IANA registration. For general guidelines on IANA allocations for RTCP XR, refer to Section 6.2 of RFC 3611.

5.1. New RTCP XR Block Type Value

This document assigns the block type value 22 in the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" to the "MPEG-2 Transport Stream PSI-Independent Decodability Statistics Metrics Block".

5.2. New RTCP XR SDP Parameter

This document also registers the new parameter "ts-psi-indep-decodability" in the "RTP Control Protocol Extended Reports (RTCP XR) Session Description Protocol (SDP) Parameters Registry".

5.3. Contact Information for Registrations

The contact information for registrations is:

Qin Wu (sunseawq@huawei.com)
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

6. Security Considerations

There might be some relationship between reported error counters and contractual Service Level Agreements (SLAs); hence, an attack (e.g., RTP endpoints reporting false data, or an attacker in the path modifying the data being reported) might deliberately corrupt these error counters, resulting in financial implications for the network operator (either as a result of unneeded performance metrics, or penalty charges for SLA failure).

A solution to prevent such an attack is to apply an authentication and integrity protection framework for the RTCP XR block. This can be accomplished using the RTP profile that combines Secure RTP [RFC3711] and the Audio-Visual Profile with Feedback (AVPF) into Secure AVPF (SAVPF) [RFC5124].

Besides this, the RTCP XR block in this document introduces no new security considerations beyond those described in [RFC3611].

7. Acknowledgements

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Authors' Addresses

Rachel Huang
Huawei
101 Software Avenue, Yuhua District
Nanjing 210012
China

EMail: rachel.huang@huawei.com

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012
China

EMail: bill.wu@huawei.com

Hitoshi Asaeda
National Institute of Information and Communications Technology
4-2-1 Nukui-Kitamachi
Koganei, Tokyo 184-8795
Japan

EMail: asaeda@nict.go.jp

Glen Zorn
Network Zen
227/358 Thanon Sanphawut
Bang Na, Bangkok 10260
Thailand

Phone: +66 (0) 8-1000-4155
EMail: glenzorn@gmail.com