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AVT WG
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RTP Profile for TCP Friendly Rate Control

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Abstract

This memo specifies a profile called "RTP/AVPCC" for the use of the real-time transport protocol (RTP) and its associated control protocol, RTCP, with the TCP Friendly Rate Control (TFRC). TFRC is a

equation based congestion control scheme for unicast flows operating in a best effort Internet environment.

1. Introduction

[Note to RFC Editor: All references to RFC XXXX are to be replaced with the RFC number of this memo, when published]

This memo defines a profile called "RTP/AVPCC" for the use of the real-time transport protocol (RTP) [[RTP](#)] and its associated control protocol, RTCP, with the TCP Friendly Rate Control (TFRC) [[TFRC](#)]. TFRC is a equation based congestion control scheme for unicast flows operating in a best effort Internet environment and competing with TCP traffic.

Due to a number of inherent TFRC characteristics, the AVPCC profile differs from other RTP profiles in the following ways:

- o TFRC is a unicast congestion control scheme, therefore by extension the AVPCC profile can only be used by unicast RTP flows.
- o A TFRC sender relies on receiving feedback from the receiver roughly once per round-trip time (RTT) in order to adjust its send rate. For certain flows (depending on RTTs and data rates) this TFRC requirement can result in control traffic that exceeds RTP's bandwidth recommendations for control traffic.

RTP restricts control traffic to a fixed fraction of session bandwidth, so as to prevent RTCP feedback implosion in multicast scenarios. As AVPCC can only be used by unicast flows, TFRCs increased use of traffic does not effect scalability or cause traffic implosion.

- o TFRC is highly sensitive and dependent on accurate and current computations of the RTT. The sender uses the RTT to compute a TCP-friendly send rate, while the receiver uses the RTT or an estimate of the RTT to compute the loss event rate.

This memo primarily addresses the means of supporting TFRC's exchange of information between senders and receivers via the following modifications to RTP and RTCP: (1) RTP data header additions; (2) extensions to the RTCP Receiver Reports; and (3) relaxation of the recommended RTCP timing intervals. For details on TFRC congestion control readers are referred to [[TFRC](#)].

The current TFRC standard, [RFC3448](#), only targets applications with

fixed packet size. TFRC-PS is a variant of TFRC for applications with varying packet sizes. The AVPCC profile is applicable to both congestion control schemes.

2. Relation to the Datagram Congestion Control Protocol

The Datagram Congestion Control Protocol (DCCP) is a minimal general purpose transport-layer protocol with unreliable yet congestion-controlled packet delivery semantics and reliable connection setup and teardown. DCCP currently supports both TFRC and TCP-like congestion control. In addition DCCP supports a host of other features, such as: use of Explicit Congestion Notification (ECN) and the ECN Nonce, reliable option negotiation and Path Maximum Transfer Unit (PMTU) to name a few. Naturally an application using RTP/DCCP as its transport protocol will benefit from the protocol features supported by DCCP.

In contrast the RTP Profile for TFRC only provides RTP applications a standardized means for using the TFRC congestion control scheme, without any of the protocol features of DCCP. However there are a number of benefits to be gained by the development and standardization of a RTP Profile for TFRC:

- o Media applications lacking congestion control can incorporate congestion controlled transport without delay by using the AVPCC profile. The DCCP protocol is currently in its early stages of development and widespread deployment is not yet in place.
- o Use of the AVPCC profile is not contingent on any OS level changes and can be quickly deployed, as the AVPCC profile is implemented at the application layer.
- o AVPCC/RTP/UDP flows can traverse firewalls as they are essentially UDP flows and therefore do not require any special changes to NATs and firewalls.
- o Use of the AVPCC profile with various media applications will give researchers, implementors and developers a better understanding of the intricate relationship between media quality and equation based congestion control. Hopefully this

experience with congestion control and TFRC will ease the migration of media applications to DCCP once DCCP is deployed.

In short, the AVPCC profile provides an immediate means for congestion control in media streams, in the time being until DCCP is deployed.

3. Conventions Used in this Document

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](#) [[2119](#)].

4. RTP and RTCP Packet Forms and Protocol Behavior

The section "RTP Profiles and Payload Format Specifications" of [RFC 3550](#) enumerates a number of items that can be specified or modified in a profile. This section addresses each of these items and states which item is modified by the AVPCC profile:

RTP data header: The standard format of the fixed RTP data header is used (one marker bit).

Payload types: This profile does not define new payload types, and has no payload type restrictions.

RTP data header additions: A 16 bit fixed field is added to the RTP data header for the transport of the quad RTT counter to the TFRC receiver.

RTP data header extensions: No RTP header extensions are defined, but applications operating under this profile MAY use such extensions. Thus, applications SHOULD NOT assume that the RTP header X bit is always zero and SHOULD be prepared to ignore the header extension. If a header extension is defined in the future, that definition MUST specify the contents of the first 16 bits in such a way that multiple different extensions can be identified.

RTCP packet types: No additional RTCP packet types are defined by this profile specification.

RTCP report interval: This profile is restricted to unicast flows, therefore at all times there is only one active sender and one receiver. Sessions operating under this profile MAY specify a separate parameter for the RTCP traffic bandwidth rather than using the default fraction of the session

bandwidth. In particular this may be necessary for data flows where the the RTCP recommended reduced minimum interval is still greater than the RTT.

SR/RR extension: A 12 octet RR extension is defined for the RTCP RR packet.

SDES use: Applications MAY use any of the SDES items described

in the RTP specification.

Security: The RTP default security services are also the default under this profile.

String-to-key mapping: No mapping is specified by this profile.

Congestion: This profile specifies how to use RTP/RTCP with TFRC congestion control.

Underlying protocol: The profile specifies the use of RTP over unicast UDP flows only.

Transport mapping: The standard mapping of RTP and RTCP to transport-level addresses is used.

Encapsulation: This profile leaves to applications the specification of RTP encapsulation in protocols other than UDP.

5. The TFRC Feedback Loop

TFRC depends on the exchange of information between a sender and receiver. In this section we reiterate which items are exchanged between a TFRC sender and receiver as discussed in [\[TFRC\]](#). We note how the AVPCC profile accommodates these exchanges.

5.1. Data Packets

As stated in [\[TFRC\]](#) a TFRC sender transmits the following information in each data packet to the receiver:

- o A sequence number, incremented by one for each data packet transmitted.
- o A timestamp indicating the packet send time and the sender's current estimate of the round-trip time, RTT. This information is then used by the receiver to compute the TFRC loss intervals.

- or -

A course-grained timestamp incrementing every quarter of a round trip time, which is then used to determine the TFRC loss intervals.

The standard RTP sequence number suffices for TFRCs functionality. For the computation of the loss intervals the AVPCC profile extends the RTP data header by 16 bit field in order to accommodate the transmission of a quad RTT counter (see [Section 5](#)).

5.2. Feedback Packets

As stated in [[TFRC](#)] a TFRC receiver provides the following feedback to the sender at least once per RTT:

- o The amount of time elapsed between the receipt of the last data packet at the receiver, and the generation of this feedback report. This is used by the sender for RTT computations.
- o The rate at which the receiver estimates that data was received since the last feedback report was sent.
- o The receiver's current estimate of the loss event rate, p .

To accommodate the feedback of these values the AVPCC profile defines a 12 octet extension to the RTCP Receiver Reports (see [Section 6](#)).

6. RTP Data Header Additions

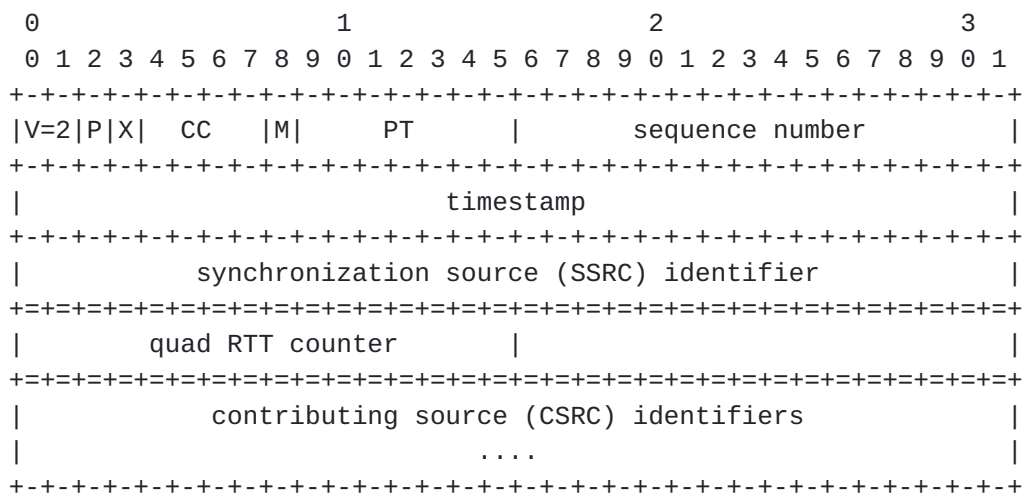


Figure 1:

7. Receiver Report Extensions

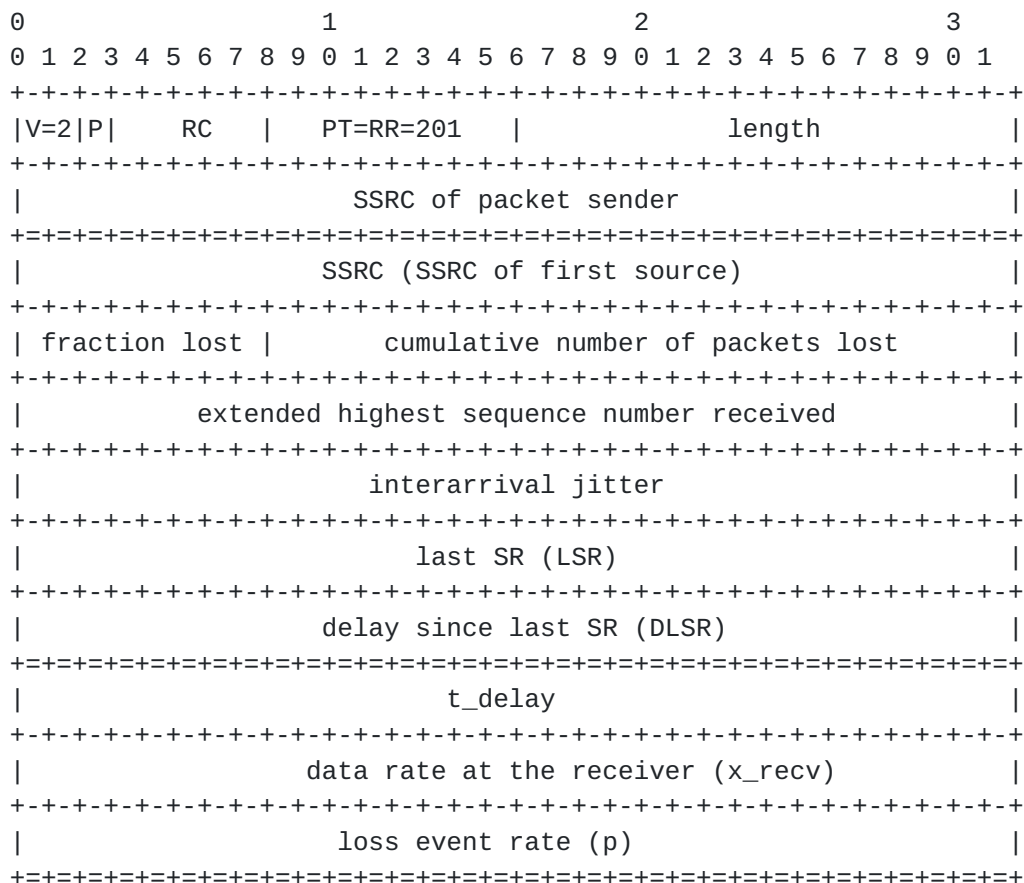


Figure 2:

8. RTCP Timing Intervals

[RFC3550](#) recommends that control traffic be limited to a small and known fraction of the session bandwidth. Specifically it recommends that the fraction of session bandwidth be added for RTCP be fixed at 5%. Based on this fixed bandwidth allotment and the number of senders and receivers the interval between RTCP feedback packets is calculated.

In addition to recommended restrictions on control traffic bandwidth, [RFC3550](#) also recommends an average minimum interval of 5 seconds between sending RTCP packets, however this minimum interval can be scaled to a reduced minimum. Computed in seconds of 360 divided by session bandwidth in kilobits/second.

These restrictions on the fraction of control traffic bandwidth and

the frequency of feedback is to ensure scalability to large multicast groups and prevent control traffic implosion.

The TFRC algorithm requires feedback from receivers at least once per

RTT. For data rates less than 5Mbps (depending on the RTT) this may require transmitting RTCP packets at higher frequency than recommended by the scaled minimum interval. This increased frequency may or may not results in a control traffic in excess of 5% of the session bandwidth.

The AVPCC profile defines the control traffic bandwidth as a separate parameter of the session to accommodate TFRCs feedback requirements.

+-----+-----+-----+-----+					
Session Bandwidth (B)	10 kbps	72 kbps	5000 kbps	10000 kbps	
Minimum Interval (360/B)	36 sec	5 sec	72 msec	36 msec	
RTCP Bandwidth	-	-	~7 kpbs	~14 kpbs	
+-----+-----+-----+-----+					

Figure 3: Session bandwidth and RTCP minimum intervals. RTCP bandwidth is computed assuming compound packet sizes of 60bytes.

9. IANA Considerations

<TBC>

10. Security Considerations

<TBC>

11. Acknowledgments

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Informative References

[13.](#) IPR Notice

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